KARNATAKA NEERAVARI NIGAM LIMITED

(A Government of Karnataka Enterprise)
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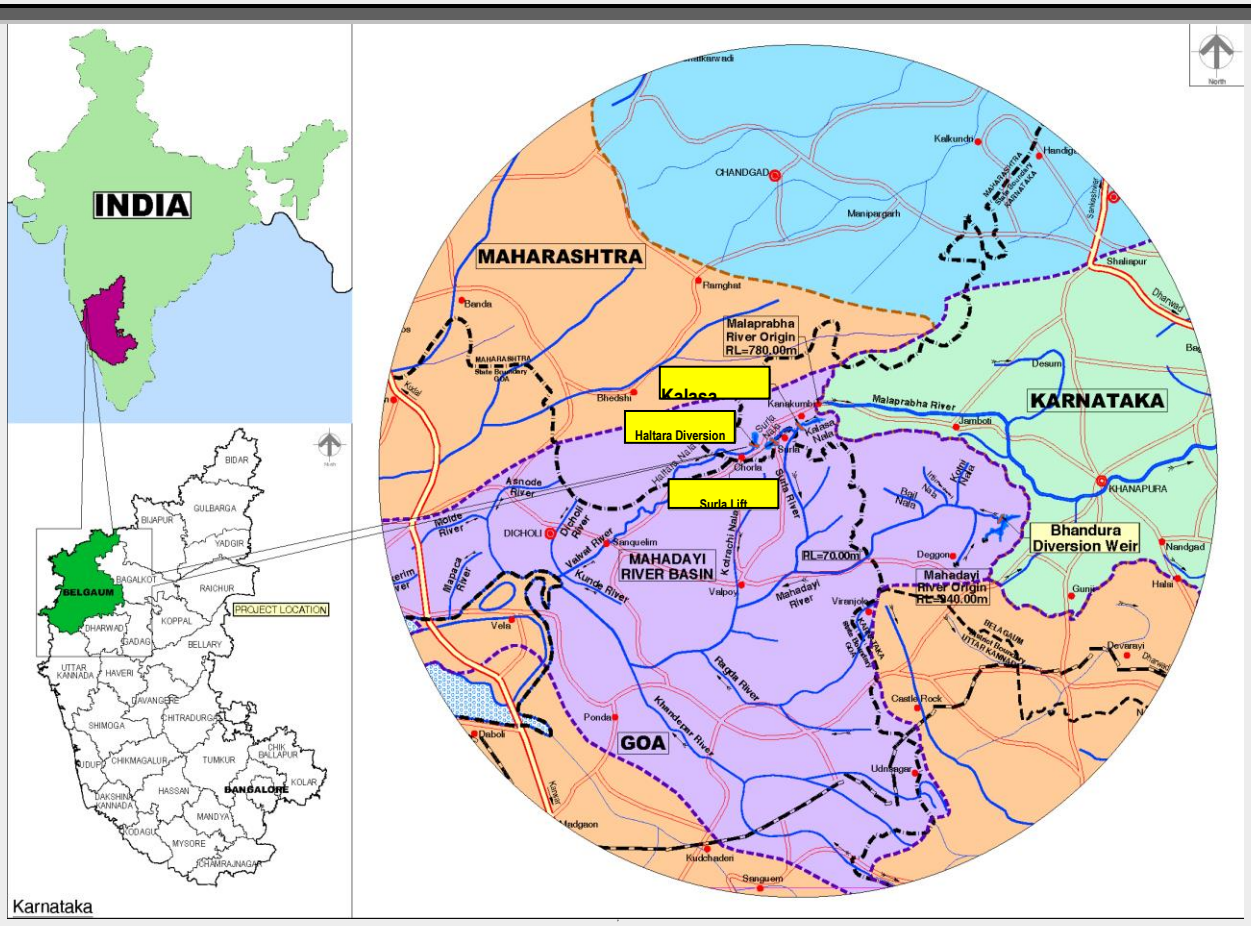
Infantry Road, Bengaluru, Karnataka 560001.

KALASA NALA DIVERSION SCHEME (LIFT SCHEME)



DETAILED PROJECT REPORT

Volume I – Report
Estimated Cost - Rs.995.30 Crores (At 2021-22 Price Level)
November 2022

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Document Control

Title:	KALASA NALA DIVERSION SCHEME
Subject:	DETAILED PROJECT REPORT
Type:	Report
Classification:	Client use
Control:	Controlled
Copyright:	EIT
Digital filename:	EIT-1460X-WRE-XX-DPR-A001-R0C1-All Chapter
Document No.:	EIT-1460X-WRE-XX-DPR-A001-R0C1-All Chapter
Related documents reference	

Rev.	Description	Issue Date	Author		Checked		Approved	
			Initials	Sign.	Initials	Sign.	Initials	Sign.
00	Document created and submitted to GoK	17/08/2020	HGN		SN		NR	
01	Submitted to CWC	04/09/2021	HGN		SN		NR	
02	Attending to CWC Observations	05/03/2022	HGN		SN		NR	
03	Submission of DPR	22/11/2022	HGN		SN		NR	

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Annexure No.	Details	Remarks
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Annexure No.	Details	Remarks
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Abbreviation

CA	Catchment Area
CBIP	Central Board of Irrigation and Power
CEA	Central Electricity Authority
KNNL	Karnataka Neeravari Nigam Limited
CWC	Central Water Commission
KWDT	Krishna Water Disputes Tribunal
DGPS	Differential Global Positioning System
DPR	Detailed Project Report
EIA & EMP	Environmental Impact Assessment and Environmental Management Plan
EL	Elevation
FRL	Full Reservoir Level
GOI	Government of India
GOK	Government of Karnataka
GTS	Geometric Trigonometric Survey
IS	Indian Standards
KPCL	Karnataka Power Corporation Limited
KPTCL	Karnataka Power Transmission Corporation Limited
NA	Not Applicable
PWD	Public Works Department
R & R	Resettlement and Rehabilitation
SIA	Social Impact Assessment
TMC	Thousand Million Cubic Feet
USBR	United States Bureau of Raclamation
REIA	Rapid Environmental Impact Assessment
EMP	Environment Management Plan
mbgl	Meters below ground level
lpm	Litres per minute
lps	Litres per second
MLD	Million litres per day
OSHA	Occupational Safety and Health Administration
PERT	Program Evaluation and Review Technique

CPM	Critical Path Method
BC Ratio	Benefit Cost Ratio
MWL	Maximum water level
MOE&F	Ministry of Environment and Forest

CERTIFICATES

Appendix - A

Certificates

Certificate on Preparation of DPR

This is to certify that Detailed Project Report (DPR) of Kalasa Nala Diversion Scheme (Lift Scheme) Project, Karnataka has been prepared in a consultative mode with the specialized directorates of CWC i.e. Hydrology, Irrigation Planning, Inter-State Matters and Project Planning from concerned unit under Design & Research Wing.

Chief Engineer,
KNNL, Malaprabha Project Zone
Dharwad

Appendix –H

Certificate on status of action taken for Statutory Clearances

This is to certify that necessary actions have been taken for obtaining Statutory clearances for the Kalasa Nala Diversion Scheme (Lift Scheme) Project located in the State of Karnataka and status of the action taken is as follows:

a. Environment Clearance from MoEF&CC :

i. EIA - Exempted
ii. EMP in process
iii. Others in process

b. Forest Clearance from MoEF&CC :

In process

c. Clearance in respect of R&R of Tribal population from MoTA:

NA

Chief Engineer,
KNNL, Malaprabha Project Zone
Dharwad

Appendix –I

Certificate on mode of construction

This is to certify that the Kalasa Nala Diversion Scheme (Lift Scheme) Project located in the State of Karnataka is going to be constructed through contract / Department and special team has been planned for timely construction of project as per the MoWR, RD&GR "Guidelines for Preparation of Detailed Project Reports of irrigation and multipurpose projects. The constitution of the special team is as follows:

No.	Designation of officers of the team
	Will be confirmed

Signed by

Chief Engineer,
KNNL, Malaprabha Project Zone
Dharwad

Appendix – J

To

The Chief Engineer,
Project appraisal Organization, Central
Water Commission Sewa Bhavan,
R.K. Puram, New Delhi – 110066

Subject: DPR Clearance for the Kalasa Nala Diversion Scheme (Lift Scheme) Project.

1. The above project has been examined in the centralized design team (KNNL) to review all the designs pertaining to the project and accord approval based on which the designs were presented to an independent Expert Committee – Estimate Review Committee (ERC). The review of planning, design and estimates are reviewed and scrutiny at three levels and the Administrative Sanction by GoK is accorded.

   (i) All necessary surveys and investigations for planning of the project and establishing its techno-economic feasibility have been carried out as per the aforementioned guidelines.

   (ii) 10%/5000 ha. of the command area of the project (whichever is minimum) has been investigated in full details in three patches representing terrain conditions in the command for estimation of the conveyance system upto the last farm gates **– Not applicable.**

   (iii) 100% of Main Canal and 10% of the remaining Canal structures (Branch canals, Distributaries, Minors etc.) have been investigated in full detail **– Not applicable.**

   (iv) Detailed Hydrological, geological, construction material investigations, have been carried out for all major structures i.e. dams, weirs, main canal, branch canal up-to distributaries carrying a discharge of 10 cumecs.

   (v) Soil survey of the command has been carried out in detail as per IS 5510- 1969 **– Not applicable.**

   (vi) Necessary designs for the various components of the project has been done in accordance with the guidelines and relevant Indian Standards for Planning & Design/Safety aspects including design flood estimation etc., of the project which are enclosed. List of Codes is enclosed.

   (vii) Necessary studies for utilization of ground water have been done with special regard to problem of water logging and suitable provisions have been made for conjunctive use of ground water & drainage arrangements **– Not applicable.**

   (viii) The cropping pattern has been adopted in consultation with the State Agriculture Department and are based on soil surveys of the command keeping in view the national policy in respect of encouraging crops for producing oil seeds and pulses. Availability of

water as per Inter-State agreements, awards and consent of co-basin States are also considered **– Not applicable.**

(ix) The cost estimates and economic evaluations are carried out as per guidelines issued by the Central Water Commission.

2. The project has also been examined by the State level Project appraisal / Technical Advisory Committee comprising representative of Irrigation, Agriculture, Fisheries, Forests, Soil Conservation, Ground Water, Revenue and Finance Dept. and State level Environmental Committee etc. and techno-economic feasibility of the project has been established.

3. The project is recommended for acceptance by Central Water Commission and Ministry of Water Resources, River Development & Ganga Rejuvenation.

Chief Engineer,
KNNL, Malaprabha Project Zone
Dharwad

Appendix –K

Certificate on Survey and Investigation

This is to certify that the Kalasa Nala Diversion Scheme (Lift Scheme) Project located in the State of Karnataka for which 100% survey has been carried out. Pertinent data and information is incorporated in the report.

Signed by

(Signature, Name with seal)

Chief Engineer,
KNNL, Malaprabha Project Zone
Dharwad

Appendix – L

Certificate on Cadastral Survey

This is to certify that proper Cadastral Survey has been carried out for all the property coming under submergence, for reservoir and for the Kalasa Nala Diversion Scheme (Lift Scheme) Project located in the State of Karnataka. The list of properties coming under submergence are as follows:

No.	Name of Properties	
1	**Land in ha (including Roads Bridges Colony etc)** *Forest land:*	33.0507 Ha
	Revenue land:	96.6975 Ha
	Others:	-
	Total	**129.7482 Ha**
2	**Houses and Buildings (in Nos.)**	-
3	**Other structures such as road bridges, Railway bridges etc. (in Nos.)**	-
4	**Others**	-

Signed by

Chief Engineer,
KNNL, Malaprabha Project Zone
Dharwad

SECTION – 1
CHECKLIST

Section - 1
Checklist
(As per CWC Guidelines 2010)

No.	Particulars	Details
I.	**GENERAL DATA**	
1)	Name of the project	Kalasa Nala Diversion Scheme (Lift Scheme)
2)	**Location**	
a)	State(s)	Karnataka
b)	District(s)	Belagavi
c)	Taluka (s) / Tehsil (s)	Khanapur
d)	Longitude/Latitude	15°40'52.54"N 74°11'22.98"E – Kalasa Diversion 15°39'49.21"N 74° 8'44.62"E – Haltara Diversion 15°14'57.24"N 74° 10'50.41"E – Surla Lift Dam
e)	Survey of India Topographical Map reference No.	48 I/2 & 48 I/6
f)	Earthquake Zone number	Zone III
g)	Complete address for correspondence along with pin code /e-rnail	Executive Engineer, KNNL Kalasa Project Division Khanapur-591302 eekpdkhanapur@gmail.com
3)	**Category of the project**	Drinking water supply
a)	Irrigation/Multipurpose	Drinking water supply to Hubli and Dharwad towns, Kundagol Town and en route villages
b)	Storage/diversion	Diversion
II.	**PLANNING**	
4)	Has the Master plan for overall development of the river basin been prepared and stages of basin development discussed?	Not Applicable
5)	Have the alternative proposals (including set of smaller developments vis-a-vis a single large development) been studied and their merits and demerits discussed?	Alternative proposals have been discussed in the report.

No.	Particulars	Details
6)	Does the scheme fit in the overall development of the river basin and has its priority in the overall development of the basin been discussed?	Not Applicable
7)	Have the other Departments concerned with the development been informed?	All the concerned departments have been informed.
8)	Is the present scheme proposed to be executed in stages? If so, are various stages of execution and development discussed in the report?	The present scheme is proposed to be executed as a single project comprising of construction of diversion Dams across Kalasa Nala and Haltara Nala for diverting the required quantum of water through water conducting system.
9)	Are the effects of the scheme on the riparian rights & existing Upstream and downstream projects etc. discussed?	There are no projects envisaged either u/s of the present scheme or on the d/s within the state of Karnataka. The present scheme envisages providing drinking water supply to Hubli – Dharwad twin cities along with Kundagol Town and en route villages. The scheme proposes to divert 1.72TMC of water from Kalasa Project, as providing drinking water takes precedence over supply for irrigation and other uses. As such, effects on the upstream & downstream projects do not arise.
10)	Has the provision for municipal and industrial water supply been made?	The present proposal is to divert the Water to Malaprabha River for augmenting the storage of Malaprabha reservoir, this augmentation will in turn cater the drinking water supply needs of Hubli-Dharwad twin cities along with Kundagol Town and en route villages.
III.	**INTERSTATE AND INTERNATIONAL ASPECTS**	
11)	Are there any International/Interstate issues involved? If so have these issues been identified and present status of agreement or tribunal decision indicated specially in respect of	
a)	Sharing of water	Discussed in detailed at chapter 3
b)	Sharing of cost	Not Applicable
c)	Sharing of benefits (irrigation, flood control. Power etc.)	Not Applicable
d)	Acceptance of the submergence by the upstream state(s)	Not Applicable
e)	Acceptance by the upstream state(s) of compensation of land coming under submergence	Not Applicable

No.	Particulars	Details
f)	Settlement of oustees	Not Applicable
g)	Any other	Not Applicable
NOTE:-If there is no agreement, state the present position against each of the above item		
IV.	**SURVEYS**	
12)	Have the detailed topographical surveys been carried out for the following items and maps prepared as per prescribed scales	
a)	River surveys	Carried out
b)	Reservoir surveys	Carried out
c)	Head work surveys (dam(s), dyke(s), barrage(s).weir(s) etc. and auxiliary components)	Carried out
d)	Plant and Colonies sites	Not Carried out
e)	Canal(s),branch canal(s) and water distribution system	Carried out
f)	Major canal structures	Carried out
g)	Power house, switch-yard, surge shafts, tailrace	Not Applicable
h)	Tunnel(s), adit(s),penstocks etc.	Not Applicable
i)	Surveys (detailed and sample) of areas of the command for OFD and Drainage work	Not Applicable
j)	Soil surveys	Carried out
k)	Surveys for soil conservation	Not Applicable
l)	Any other surveys i.e. archeological right of way. communication etc.	Not Applicable
V.	**GEOLOGICAL INVESTIGATIONS**	
13)	Have the geological surveys for the following items been carried out and report on geology of the following appended?	
a)	Region as a whole	Carried out
b)	Reservoir	Carried out
c)	Head work and energy dissipation area	Carried out
d)	Power house and appurtenances	Not Applicable
e)	Intakes and regulators	Carried out
f)	Major canal structures	Carried out
g)	Tunnel(s),Pen stock(s),hill(s)etc.	Not Applicable
h)	Communication routes	Carried out
i)	Any other	Not Applicable

No.	Particulars	Details
VI.	**SEISMIC INVESTIGATIONS**	
14)	Has the seismicity of the region been studied and co-efficient of vertical horizontal acceleration for the various structures discussed?	Effect of seismicity of the region is discussed in the Design Report. For details refer Volume-II
15)	Has the approval of the Standing Committee for recommending design of seismic coefficients for River Valley Project been obtained?	NA
16)	Is there possibility of liquefaction of foundations? If so whether liquefaction studies been carried out?	No
VII.	**FOUNDATION INVESTIGATIONS**	
17)	Have the detailed foundation investigations (including in-situ tests and laboratory tests) for the following structures been carried out and detailed report(s) appended?	
a)	Earth and rock fill dam(s)	Not Applicable
b)	Masonry/concrete dam(s)	Not Applicable
c)	Barrage(s) / Weir(s) / head regulators) etc.	Carried out
d)	Canal(s) & Canal Structures	Carried out
e)	Power house (t),tunnel (s), transformer caverns), Desilting chamber(s), surge tank(s) / shaft(s), intake(s)	Not Applicable
f)	Pump House(s)	Carried out
g)	Any other	Nil
18)	Are there any Special features affecting the designs?	No
VIII.	**CONSTRUCTION MATERIAL SURVEYS**	
19)	Have the surveys and laboratory tests for the· following Construction materials been carried out and report(s) appended?	
a)	Soils for impervious, semi-pervious and pervious zones of earth and rock-fill dam(s)	Not Applicable
b)	Sand	Detailed Investigations about the availability and quality of the material have been carried out
c)	Rock and coarse aggregates	Detailed Investigations about the availability and quality of the material have been carried out
d)	Bricks and tiles	Not Applicable
e)	Pozzolona	Carried out
f)	Cement and lime stone	Carried out
g)	Steel	Carried out
h)	Any other	As necessary
20)	Have the sources for each of the above	Sources identified and details collected

No.	Particulars	Details
	material been identified and need etc. indicated?	
21)	Have the proposals for procurement of scarce materials been indicated?	Not Applicable
IX.	**HYDROLOGICAL AND METEOROLOGICAL INVESTIGATIONS**	
22)	(a) Have the hydrological and meteorological investigations been carried out and status of following data discussed in report?	Yes
	i. Rainfall	Yes
	ii. Temperature	Yes
	iii. Sunshine	Yes
	iv. Gauge & Discharge	Yes
	v. Sediment	Carried out
	vi. Water quality	Will be assessed.
	vii. Evaporation	Provided in the Report.
	(b) Has the above data been collected & appended?	Provided in the Report.
X.	**HYDROLOGY**	
23)	Is the Hydrology dealt with in detail in a separate volume? Have its brief details been included in this Report?	Yes
24)	Have an index map and bar chart showing locations of various hydro-metric, climatic and rainfall stations existing / ongoing / planned water resources projects and the data availability at those stations been attached?	Attached
25)	Have required detail note about project-specific-hydro-meteorological data observatories been attached.	Attached
26)	Have required detail in case of Himalayan rivers, if project being planned in upper reaches the satellite imageries of project catchment especially one during snow melt period (March-May) and one during monsoon (June-September) period been attached?	Not Applicable
27)	Are detail notes about quality, Consistency? Processing and gap filling of the data included.	Not Applicable
28)	**Have hydrological studies been carried out for the following:**	
a)	To establish the availability of water for the benefits envisaged?	Yes

No.	Particulars	Details
b)	To determine design flood for the various structures (spillway, weir ,barrage etc.)	Yes.
c)	Sediments storage	Not Applicable
d)	Design flood for diversion during construction	Will be carried out during construction stage
e)	Tail water rating curve	Yes
f)	Evaporation rates from reservoirs/concerned area	Yes.
g)	Command area rainfall	Not Applicable
29)	Has the Ground Water Potential (existing use and additional availability) been indicated?	Not considered.
30)	Have the studies regarding reservoir sedimentation been carried out and revised elevation-area capacity curves been used in the simulation studies (Working Table)?	NA
31)	Have the ecological requirements of water such as low flow augmentation and water quality control etc. and water requirement for domestic, industrial use and power generation (thermal, Hydel, nuclear) been considered and included in the Project Report and incorporated in the simulation studies?	No.
32)	Have the details of the simulation studies. (Working Tables) and conclusions arrived, from the various alternatives explaining the factors and assumptions been included and discussed?	Yes
33)	Has the number of failures for different aspects been indicated?	No
34)	Have the likely desirable and, undesirable changes in the hydrologic regime due to-.the project been brought out in the report?	No changes
35)	Is the criteria adopted for selection of the construction diversion flood discussed?	NA
36)	Has the basis for determining the storage capacity been discussed?	Yes
37)	Have integrated working tables (for more than one reservoir in the system) been prepared?	Yes
38)	Has carry over storage been provided? If so. Whether studies for most economic carry over storage been done?	Not Applicable
39)	Have the flood routing studies been carried out?	Yes. Ungated spillway is proposed.
40)	Have the back water studies been carried	Not Applicable

No.	Particulars	Details
	out?	
XI.	**LAND ACQUISITION AND RESETTLEMENT OF OUSTEES**	
41)	Have the type and quantum of land proposed to be acquired in the submerged area project area, area coming under canals and distribution system, area required for rehabilitation of the ousters been detailed?	Yes, Refer Vol I, Chapter 18 Under B-lands
42)	Is the basis for provision for land compensation indicated?	Yes, Refer Vol I, Chapter 18 Under B-lands
43)	Have the rehabilitation measures, amenities and facilities to be provided to the Project Affected Persons been discussed and whether their provisions included in the report? Are these in accordance State's policy/project, specific policy/draft national policy for rehabilitation and resettlement	Not Applicable
44)	Are the basis of land acquisition of the submerged area upto FRL/MWL etc. discussed?	Yes, Refer Vol I, Chapter 18 Under B-lands
XII.	**DESIGNS**	
45)	Does the state have established a Central Design Organization and State level multi-disciplinary /Advisory Committee and whether its composition has been indicated in the report?	Yes. KNNL is the nodal agency appointed by GoK for the implementation of the project. KNNL has dedicated centralized design team to review all the designs pertaining to the project and accord approval based on which the designs will be presented to an independent Expert Committee – Estimate Review Committee (ERC). In other words, the review of planning, design and estimates will undergo review and scrutiny at three levels before the Administrative Sanction is accorded.
46)	Has the selection of final location of the head works and, appurtenances, in preference to the other sites investigated been discussed?	Yes. Refer Vol –I, Chapter 1
47)	Have the layout of the project viz location of head work workshop sheds, offices, Colonies. etc. been finalized and discussed?	Yes
48)	Has the layout of the various major components of the head works been discussed in the, light-of site features, geology, foundation characteristics?	Yes, Refer Vol –I, Chapter 4
49)	Have the detailed designs been prepared for the following components & got vetted by	Yes. KNNL is the nodal agency appointed by GoK for the implementation of the project.

No.	Particulars	Details
	CDO?	KNNL has dedicated centralized design team to review all the designs pertaining to the project and accord approval based on which the designs will be presented to an independent Expert Committee – Estimate Review Committee (ERC). In other words, the review of pllanning, design and estimates will undergo review and scrutiny at three levels before the Administrative Sanction is accorded. Yes, all the detailed designs are wetted by CDO which has also been certified under Appendix-J
a)	Earth or rock fill dam. Masonry or concrete dam; spillway, barrage, weir. Etc. and appurtenances.	Yes, Refer Vol –I, Chapter 7
b)	Energy dissipation arrangements, training walls etc.	Yes, Refer Vol –I, Chapter 7
c)	Openings through dams- galleries head regulators, penstocks other outlets, sluices etc.	Yes, Refer Vol –I, Chapter 7
d)	Regulators	NA
e)	Canal and water conductor system	Yes, Refer Vol –I, Chapter 7
f)	Canal structures	NA
g)	Pump house, Intake structures	Yes, Refer Vol –I, Chapter 7
h)	Power House, tunnels, surge shaft	NA
i)	Instrumentation	NA
j)	Power evacuation arrangement	NA
k)	Design of Hydro Mechanical equipment's	Yes.
50)	Have the salient features of the above components ·and the assumptions made in the design of above components of the project been indicated and their basis discussed?	Yes,
51)	Have any model studies been carried out for location of the-dam, spillway and other appurtenances & checking the design profile. of the spillway. Energy dissipation arrangements. Location of outlets/regulators etc.?	Will be carried out before execution.
52)	Has the final alignment of canal(s), and branch canal(s) been discussed in the light of various alignments studied?	NA
a)	Does the canal design provide for meeting requirement to rush irrigation?	NA
b)	Have any intermediate storages and tail tanks	NA

No.	Particulars	Details
	been considered to reduce the canal capacities?	
53)	Are the canals and distribution system being lined and If so what is the minimum capacity of the channel proposed to be lined?	NA
54)	Is the location of canal structure on main and branch canals fixed after detailed surveys of the final alignments?	NA
55)	Are the regulation arrangements of the. Off taking channel both. Near and away from the cross regulators discussed?	NA
56)	Are sufficient escapes including terminal escapes provided on the main/branch canal distributaries/minors?	NA
57)	Have the basis for adopting water way for the cross-drainage works been discussed?	NA
58)	Have the proposals for rating the canal section by providing standing wave flumes. Rating of the falls, broad crested weirs. V - notches etc. been discussed for the canal and distribution system?	NA
59)	Have any model studies for major canal structure(s) been carried out and if so are the results discussed and incorporated in the design?	NA
XIII.	**IRRIGATION AND COMMAND AREA DEVELOPMENT**	
60)	Have the conveyance and field irrigation efficiencies for paddy and upland crops during kharif, rabi etc. been indicated, discussed, and justified?	Not Applicable
61)	Have the 10-daily/monthly crop water requirements at the canal head been worked out?	Not Applicable
62)	Are there any proposals for introducing Warabandi and if so, have these proposals been discussed in the report and sample calculations for a typical distributary / minor / sub- minor furnished?	Not Applicable
63)	Has the present position of irrigation in the command through existing canals, tanks, and lift schemes. Wells etc. been brought out·in the report?	Not Applicable

No.	Particulars	Details
64)	Are the particulars of all irrigation projects (including minors schemes) existing / proposed in the command been indicated?	Not Applicable
65)	Are there any potential areas, where ground water is available? If so, has the quantity & quality of the ground water been indicated?	Not Applicable
66)	Has the quantum of available ground water been assessed and plan for its conjunctive use with surface water been prepared and incorporated in the report?	Not Applicable
67)	Have the semi-detailed soil surveys been carried out for the entire command? If not the extent of area surveyed may be indicated.	Not Applicable
68)	Have soil and land irrigability classifications brought out in the report?	Not Applicable
69)	Is the method used for determining the crop water requirements discussed?	Not Applicable
70)	Has the pre-project cropping pattern and the proposed cropping pattern along with justification been furnished?	Not Applicable
71)	Has the proposed cropping pattern been certified by Centre/State Agricultural: Authorities giving the statement of having considered the soil characteristics and land irrigability characteristics of the command area in-deciding the percentage of the command area falling under respective crops as suggested in DPR.	Not Applicable
72)	Whether drinking water needs of the population projected for the 25-30 years after construction of the project on enroute and that in the command of the project considered.	Yes, discussed in detailed under chapter-1
73)	Whether the proposed G.W utilization is certified by CGWB and a statement furnished.	Not Applicable
74)	Are the areas and percentages of the CCA that will be irrigated during kharif, rabi, two seasonal, summer and perennial been indicated?	Not Applicable
75)	Is justification furnished for irrigating perennials and summer crops from the reservoir?	Not Applicable

No.	Particulars	Details
76)	Have the monthly reservoir operation studies been carried out at least for 20 years and summary on annual basis attached?	Not Applicable
77)	Have the number of blocks selected for detailed surveys for On Farm Development (OFD) works including drainage and total area covered by such blocks been indicated?	Not Applicable
78)	Have the existing locations of the Trial cum Demonstration Farm, input centers (seeds, fertilizer and insecticides) in the command been indicated and proposal to strengthen the same discussed?	Not Applicable
79)	Have the arrangements for financing the OFD works and proposals, if any, for strengthening, the same been discussed?	Not Applicable
80)	Have the agencies responsible for execution of OFD Works been identified and simultaneous planning of execution of OFD works along with engineering works discussed?	Not Applicable
81)	Has-the year wise phasing of irrigation development as a result of the project been discussed?	Not Applicable
82)	Is the existing communication system telephone. Wireless and roads within command are a sufficient to meet the requirement after full development to irrigation? If not, have the new proposals been planned and discussed?	Not Applicable
83)	Is the adequacy of the marketing centers in the Command Area and new proposals to meet the requirements after full development of irrigation been discussed?	Not Applicable
84)	Is there any stabilization of existing irrigation proposed?	Not Applicable
XIV.	**FLOOD CONTROL AND DRAINAGE**	
85)	Have the various flood control components of the multipurpose project been indicated?	Not Applicable
86)	Have the damage areas in pre-project & post project situations been identified and flood intensities worked out at each of the damage center(s) which gets affected?	Not Applicable
87)	**Have the following flood aspects been discussed?**	

No.	Particulars	Details
a)	Flood cushion in the reservoir.	Not Applicable
b)	Maximum moderated flood outflows over the spillway etc. and its frequency	Not Applicable
c)	Existing and proposed safe carrying capacities of the channel below the dam after construction of flood embankment, channel improvement, river diversion etc.	Not Applicable
d)	Synchronized moderated peak floods due to releaser(s) from the dam upstream and un-intercepted catchment up to the damage centers.	Not Applicable
e)	Average annual expenditure incurred on flood relief works.	Not Applicable
f)	Area and population affected/likely to be affected before/after the project.	Not Applicable
g)	Estimated saving in annual loss of life, property, cattle, crops etc. (evaluated in terms of money) due to flood control.	Not Applicable
88)	**Have the following drainage aspects of command area been discussed?**	
a)	Existing Surface and sub-surface drainage network and problems of the drainage congestion, water logging, alkalinity/salinity if any.	Not Applicable
b)	Studies on sub soil water table (pre-monsoon, post monsoon etc.).	Not Applicable
c)	Maximum intensity of 1, 2. and 3 day rainfall.	Not Applicable
d)	Deficiencies in farm drains.	Not Applicable
e)	Deficiencies in existing natural drains	Not Applicable
f)	Proposal for improvement of drainage water logging /alkalinity/salinity of the area along with justification thereof.	Not Applicable
g)	Identification of the area in Command which will get benefited due to execution of drainage net-work and benefits thereof in terms of relief from crop damage, increased yields etc.	Not Applicable
XV.	**NAVIGATION**	
89)	Is the present scheme for remodeling of the existing facilities and/ or extension of the navigable reach or establishing new navigable	NA

No.	Particulars	Details
	reach?	
90)	Is the existing inland transport system being fully utilised? If not, have the bottlenecks in its full utilisation been identified and discussed?	NA
91)	Have the surveys for goods and passenger traffic been carried out and discussed?	NA
92)	Is the extent of modification required in the existing system discussed and justified?	NA
93)	Do design for the canal section and structures take into account the navigation requirements?	NA
94)	Have the proposals to develop the new scheme and phases of development in the different reaches been discussed?	NA
95)	If the area is being served by inland water transport, have the following been discussed:	NA
a)	The existing toll rates and registration fees for the crafts (size-wise)	NA
b)	Proposals for revision of tollage rates and fees, if any.	NA
c)	Concurrence of the competent authorities for revision of rates and fees.	NA
d)	Proposal to subsidies the tariff, tollage, craft registration fee, passenger fare etc. to attract traffic.	NA
96)	Has the State Inland Water Authority been consulted while finalising the scheme and its view point discussed?	NA
97)	Has economic justification and viability of the, navigation component of the multipurpose project been discussed?	NA
XVI.	**POWER**	
98)	**Have the following points been discussed**	
a)	Availability of the power generating capacity in the state as well as in the region from different sources.	NA
b)	Total energy available and peaking capacity of the system, in the state as well as in the region from different sources.	
c)	Integrated operation of the system and present status of utilization in the state as well	NA

No.	Particulars	Details
	as in the region.	
d)	Surpluses and shortfalls in the system in the state as well as in the region.	Not Applicable
e)	Future plans of power development from different sources in the State/region.	Not Applicable
f)	Fitment of the scheme in planning of power development of the state /region.	
g)	Energy generated from the project Firm power, seasonal power and total power.	Not Applicable
h)	Proposal for transmission lines connecting to the existing system / grid.	Not Applicable
i)	Project. Cost. Per kwh installed and per kwh generated at bus bar as compared to the different hydro-electric: thermal generation and gas projects and different sources.in the State as well as.in the region to justify the power component of the project.	Not Applicable
j)	Whether the proposed addition to the transmission system has been shown-on a geographical map Whether options considered for the proposed addition have been discussed with statement of justification for the selected option after carrying out supporting studies covering load flow studies , short circuit studies (three phase and single phase) and stability studies.	Not Applicable
k)	*Whether sufficient surplus of Peak power is available for pumping of water from lower to upper reservoir.	Yes
l)	*Actual off peak energy requirement of proposed scheme	Total Power Requirement for Scheme is 9 MVA (5.25 MVA for Kalasa lift and 1.15 MVA for Surla lift and 2.60 MVA for Haltara lift)
m)	*Cost of peak-and off peak energy	Not Applicable
	for pumped storage schemes only	
XVII.	**CONSTRUCTION PROGRAMME & PLANT AND, MANPOWER PLANNING**	
99)	Are the major components of work proposed to be done departmentally or through contractor?	The construction works are proposed to be executed through Tendering process by a contractor.
100)	Have the various alternative construction programme been studied and proper justification furnished for the final programing adopted?	Yes, for 2 (24 months including monsoon) Years.

No.	Particulars	Details
101)	Has the proposed Construction programme been prepared and synchronized for timely completion of each of the major component of work including Command Area Development?	Yes, refer Chapter 15. Command area development is not envisaged
102)	**Have the year wise quantities of the following materials of construction been worked out for various components of the project.**	
a)	Excavation separately in -soft and hard strata	Yes, will be considered during execution.
b)	Earth work in filling-impervious, semi-pervious and pervious	Yes, will be considered during execution.
c)	Rock fill-for dam,toe, riprap etc.	NA
d)	Stone for masonry	Yes, will be considered during execution.
e)	Coarse aggregate for concrete	Yes, will be considered during execution.
f)	Sand-for filter, masonry/ concrete.	Yes, will be considered during execution.
g)	Gravel-for filter.	Yes, will be considered during execution.
h)	Yes, will be considered during execution.	Yes, will be considered during execution.
i)	Cement-normal, quick/slow setting with or without Pozzolona, special types	Yes, will be considered during execution.
j)	Lime-surkhi-Pozzolona	NA
k)	Scarce material-special steel	Yes, will be considered during execution.
l)	Other material-fuel, electricity, explosive etc.	Yes, will be considered during execution.
103)	Have the year wise quantities to be executed by machine labour for each of the major component been worked out for each of the above material?	Yes, will be considered during execution.
104)	Have the labour intensive items of the various major components of the project been identified and the quantities of such items worked out?	Yes, will be considered during execution.
105)	Have PERT chart or CPM diagrams for construction programme of various components been made and included in report? Has organizational setup and frequency for project monitoring been indicated in the report?	Yes, will be considered during execution.
XVIII.	**FOREIGN EXCHANGE**	
106)	Have the details of the plant and machinery, spares, instruments and scares material to be imported\ worked out ?	NA
107)	Has the phasing of imports and source(s) of imports been discussed item wise?	NA
108)	Are the imports to be affected under foreign grants/credits or internal resources of the country?	NA
109)	Is the scheme covered under State sector or	Covered under State Sector

No.	Particulars	Details
	Central sector?	
XIX.	**FINANCIAL RESOURCES**	
110)	Has the Concurrence of the State Finance department been obtained?	Yes, the project has been approved by the competant authority.
111)	Is the scheme included in the Five Year/Annual Plan? If not what is the present position regarding its inclusion in the plan?	The project has been covered under state budget further a provision of Rs. 500 Crores is also made in the FY 2022-23
112)	Whether the scheme has already been started? If so, is the present stage of construction indicated?	The part of the project has been completed as per submission before Honorable supreme court under O.S 6 of 2006. The completed project component is water conductive system (i.e., Kalasa Inter connecting canal) in non-forest area within the state of Karnataka
113)	Have the year wise requirement of funds been indicated?	Yes, 1st year – 40% of the project Cost 2nd year – 60% of the project Cost
114)	Is the scheme covered or proposed to be covered under any foreign assistance/aid agreement?	NA
XX.	**ESTIMATE**	
115)	Is the separate volume of estimate attached as appendix?	Yes
116)	Is the year to which the rates adopted in the estimate relates to indicated?	The estimates were prepared based on Common SoR of 2021 – 22
117)	Have the analysis of rates for various major items of the work for the major components of the project been furnished and with basis of analysis described?	Rate analysis sheet is appended with the cost estimates
118)	**Are the provision for the following items made on the basis of sample survey and sub estimates**	
a)	Distributaries: minor and sub-minors	Not Applicable
b)	Watercourses	Not Applicable
c)	Drainage	Not Applicable
d)	CAD works	Not Applicable
XXI.	**REVENUE**	
119)	**Are the basis for the following sources of revenues furnished?**	
a)	Betterment levy and proposal for its recovery	NA
b)	Irrigation cess	NA
c)	Flood protection cess	NA
d)	Crop wise water rates	Not applicable as the present scheme do not envisage any irrigation component

No.	Particulars	Details
e)	Sale of water for Village / City / Industrial / Power / Water supply	Yes, Refer Chapter 20
f)	Miscellaneous	-
120)	Have these rates been compared with the existing rates at the other projects in the State/region?	Yes, rates have been adopted as per the prevailing rates approved by GoK which is in vouge
121)	In case the rates are being enhanced, has the concurrence of the concerned department(s) been obtained?	NA
122)	Have the Organizational set up for the collection of revenue been indicated?	Yes, refer Chapter 15.
XXII.	**B.C.RATIO**	
123)	**Are the allocated cost for the following components of the multipurpose project worked out and basis there in furnished?**	
a)	Irrigation	NA
b)	Power	NA
c)	Flood Control	NA
d)	Navigation	NA
e)	Water supply	YES, Augmentation
f)	Any other	NA
124)	Have the various departments of the State/Centre agreed to the sharing of the above allocated cost?	Yes
125)	Have the crop wise benefits been worked out for irrigated and un irrigated crops being grown before project in consultation with the agriculture department and statement furnished?	NA
126)	Have the crop wise benefits been worked out for proposed cropping pattern after the introduction of irrigation in consultation with the agriculture department and statement furnished?	NA
127)	Is the B.C. Ratio of Irrigation Projects acceptable or otherwise justified?	NA
128)	Is the B.C.Ratio for Flood Control Projects acceptable or otherwise justified?	NA-
129)	Is the B.C.Ratio for power component of the project acceptable or otherwise justified?	NA
130)	Have the financial and economic return statements been furnished keeping in view the phasing of development?	Yes , Refer Chapter 21

No.	Particulars	Details
131)	Are the benefits other than those considered in the B.C. Ratio and financial return statement been identified?	NA
132)	Is the benefit from Gallper land, if proposed, based on lease rates admissible and statement from concerned Central/State authorities furnished?	NA
133)	Are the benefits from fisheries, horticulture, if proposed, based on lease rates admissible and statement from concerned Central/State authorities furnished	No benefits considered at present
XXIII.	**ECOLOGICAL ASPECTS**	
134)	**(a) Is the area likely to have any of the following environmental and ecological problems due to the altered surface water pattern? If yes, whether preventive measures have been discussed?**	
	Excessive sedimentation of the reservoir and the upper reaches of the river and its tributaries tailing into reservoir	
	i. Water logging, salinity/alkalinity	Not Applicable
	ii. Quality of surface and ground water	No
	iii. Ground water recharge	No
	iv. Health hazards-water borne diseases,	Not Applicable
	v. industrial pollution etc.	Not Applicable
	vi. Submergence of important minerals deposits	Not Applicable
	vii. Submergence of monuments/archeological sites	Not Applicable
	viii. Fish culture and aquatic life	Not Applicable
	ix. Plant life (flora)	Not Applicable
	x. Wild Life	Not Applicable
	xi. Migratory birds	Not Applicable
	xii. National parks and sanctuaries	Not Applicable
	xiii. Seismicity due to filling of reservoir	Not Applicable
	xiv. Likely changes in the regime of the river	Not Applicable
	xv. Any other	Not Applicable
	(b) Have the environmental and forest clearances from MOEF&CC been obtained? If not what is status thereof?	EIA is not applicable & proposal of forest clearance is already submitted to MoEF&CC
XXIV.	**COLONIES AND BUILDINGS**	
135)	Has the planning of the colony/building been done keeping in view the ultimate use for optimum utilisation of investment?	Yes
136)	Has an estimate of the extent of higher cost	NA

No.	Particulars	Details
	involved been made and details discussed?	
137)	Are the permanent buildings being constructed required for maintenance of the project only?	Yes
138)	Can the buildings other than required for maintenance of the project being constructed be put to some other use after the completion of the project by the department or any other agencies?	Yes
139)	Have the interested agencies been consulted for planning of the buildings to suit their requirements later on?	Yes
140)	Have the proposals for disposal of temporary buildings been discussed?	NA
XXV.	**PUBLIC PARTICIPATION AND COOPERATION**	
141)	**Are the possibilities of these been discussed in:**	
a)	Planning	Yes
b)	Construction	Yes
c)	Improved agricultural practices	NA
d)	Any other	NA
142)	Have-public debates about utility of projects been held and the response thereof outlined in the Report?	NA
XXVI.	**SOIL CONSERVATION**	
143)	Is the need for soil conservation measures in the catchment-of the project discussed?	NA

Executive Engineer,
KNNL, Kalasa Project Division,
Khanapur.

Superintending Engineer,
KNNL, MLBCC Circle.
Naviluteertha.

Chief Engineer,
KNNL, Malaprabha Project Zone
Dharwad

SECTION - 2
SALIENT FEATURES

Section - 2

Salient Features

No	Particulars		Details		
1	**Name of the Project**		Kalasa Nala Diversion Scheme for drinking water supply		
2	**Type of Project** (Irrigation or Multipurpose)		Single (Drinking water Project)		
3	**Location**		15°40'52.54"N, 74°11'22.98"E – Kalasa Diversion Dam 15°39'49.21"N, 74° 8'44.62"E – Haltara Diversion Dam 15°14'57.24"N, 74° 10'50.41"E – Surla Lift		
3.1	River Basin	a) Name	Malaprabha river basin./Mahadayi river basin		
		b) Located in (i) State(s) (ii)Countries (if international river)	Kankumbi, Chorla Karnataka India		
3.2	River /Tributary		Malaprabha River		
3.3	State(s)/District(s)Taluk(s) or Tehsils in which the following are Located.		**State**	**District(s)**	**Taluka(s)**
	a) Reservoir		Karnataka	Belagavi	Khanapur
	b) Headwork		Karnataka	Belagavi	Khanapur
	c) Command Area		NA	NA	NA
	d) Power House		Karnataka	Belagavi	NA
3.4	Name of the Town/village near the Headwork		Chorla & Kankumbi village Khanapur Taluk, Belagavi District		
3.5	Location of Head Works	a) Longitude	15°40'52.54" N, 15°39'49.21"N, 15°14'57.24"N		
		b) Latitude	74°11'22.98" E, 74° 8'44.62"E, 74° 10'50.41"E		
		c) Lies in Earthquake Zone Number.	Zone No-III		
3.6	Project area Reference to				
	a) Degree Sheets		48I/2 and 48I/6 (Scale: 1:50,000)		
	b) Index Plan		Enclosed		
3.7	**Access to the Project**		**Name**	**Distance from project site**	
	a) Airport		Belagavi Airport	52 km	
	b) Rail head		Khanapura	34 km	
	c) Road head		NH 748 AA		

No	Particulars	Details	
	e) Sea port	Goa (Sea port)	Mormugoa port 55 km
3.8	Rail/Road transportation limit of		
	a) Weights (T)	--	---
	b) Dimensions (LxBxH)	--	---
4	**International/Interstate aspects of the Project**		
	a)Catchment area of the Basin (Mahadayi River)	2032 Sq.km (Karnataka - 375 Sq.km, Maharashtra-77 Sq.km, Goa -1580 Sq.km)	
	b) Catchment area in the State	Karnataka - 375 Sq.km	
	c) Submergence due to project		
	(i) In the State	15.4651 ha	
	(ii) In other States	NA	
	d) Water allocation for the state	MWDT Award – 1.72 TMC (Kalasa nala diversion scheme)	
	e)Water allocation for the other states	Maharashtra-1.33 TMC, Goa -24 TMC (over and above the existing utilization of 9.395 TMC)	
	f) Committed utilization	NA	
	g) Proposed annual utilisation by the project		
	(i) Irrigation	NA	
	Khariff	NA	
	Rabi		
	Hot weather		
	Total		
	(ii) Water supply	1.72 TMC (supply of drinking water to Hubli – Dharwad twin cities, Kundagol town and en route villages).	
	(iii) Hydel (evaporation losses)	NA	
	(iv) Thermal Power	NA	
	(v) Livestock	NA	
	(vi) Industrial	NA	
	(vii) Tank filinling	NA	
	h) Minimum agreed/proposed flow in the river for maintaining ecology	As per Statutory requirements.	
5	**Estimated Life of Project (years)**	100 Years	
6	**Irrigation (Ha.)**	**By Flow**	**By lift**
	a) Gross Command Area (GCA)	NA	NA
	b) Culturable Command Area (CCA)	NA	NA
	c) Area under Irrigation (ICA)	NA	NA
	i) Kharif	NA	NA
	ii) Rabi	NA	NA
	iii) Hot Weather	NA	NA
	iv) Two Seasonal	NA	NA
	v) Perennial	NA	NA
	vi) Gross Irrigated Area (GIA)**	NA	NA

No	Particulars	Details	
	iv) Intensity of Irrigation (GIA/CCA) x100	NA	NA
	v) District Benefited	NA	NA
	** Irrigated Area under Khariff, Rabi, Two seasonal, Hot weather and Perennial shall be indicated		
	d) Cost per hectare of gross irrigated area	NA	NA
	e) Cost per 1000 cum of gross storage (TMC)	NA	NA
	f) Cost per 1000 cum of water delivered at the canal head/outlet (TMC)	NA	NA
	g) Water utilization	NA	NA
7	**Flood Control**	NA	
8	**Navigation**	NA	
9	**Water Supply**	Supply of drinking water to Hubli – Dharwad twin cities, Kundagol town and en route villages belongs to Karnataka state.	
9.1	Domestic		
	a) Names of the towns / villages served	Hubli – Dharwad twin cities, Kundagol town and en route villages belongs to Karnataka state.	
	b) Size of population served	10 lakh (Hubli-Dharwad population)	
	c) Quantum of water made available (TMC)	1.72 TMC	
9.2	Industrial Location(s)	NA	
	a) Name (s) (Location(s))	NA	
	b) Quantum of water made available	NA	
10	**Project Performance**	**Period of simulation**	**No. of failures**
	a) Irrigation	NA	NA
	b) Power	NA	NA
	c) Flood control	NA	NA
	d) Water Supply	NA	NA
	e) Navigation	NA	NA
11	**Hydrology**		
11.1	Catchment		
11.1.1	Catchment Area at Headwork site(Sq.Km)		
	a) Gross	25.50 Sq Km (At Kalasa Dam site)	
	b) Intercepted	15.50 Sq.Km (Kalasa) 6.00 Sq.km (Surla) 4.00 Sq.km (Haltara)	
11.1.2	Catchment area classification according to mode of precipitation		
	a) Rainfed	2032 Sq km (Mahadayi)	
	b) Snow	Nil	
11.2	Precipitation		

No	Particulars	Details			
11.2.1	Catchments				
		Rainfall (weighted mm)			Snowfall (mm)
		Annual	Monsoon (June-Oct)		Annual
	a) Average	3854.63	3750.63		NA
	b) Maximum	6282.90	6200.60		NA
	c) Minimum	1988.30	1874.80		NA
	d) Co-efficient of variation	NA	NA		NA
11.2.2	Command				
		Cropping Season			
		Annual (mm)	Khariff (Jun –Oct) mm	Rabi (Nov- Feb) mm	Hot (Mar-May) mm
	a) Average	NA	NA	NA	NA
	b) 80% dependable	NA	NA	NA	NA
	b) ET_0 (mm)	NA	NA	NA	NA
11.3	Annual yield calculated at the proposed site (Mcum.)				
	Yield at Kalasa, Haltara and Surla dam site (75% Dependable flow)	2.194 TMC (62.13 M cum) as assessed by MWDT			
11.4	Climatic Data(Command)	Moderate tending to hot			
11.4.1	Name of station(s) and period of records				
	No.	Names	Period of Records		
			From	To	
		Belgaum	1973	2013	
11.4.2	Data (average of all stations in command area)				
			Max	Min	
		a) Air Temperature (°C)	31.3	21.4	
		b) Humidity (%)	88	60	
		c) Wind (km/hr)	23.1	9.5	
		d)Water temperature (°C)	27.1	16	
11.5	Seismic coefficients				
	a)Horizontal	The project falls under Zone III as per IS 1893 and corresponds to basic seismic coefficient α_h = 0.04. With the importance factor of I = 3.0 , the α_h = 0.012. Vertical component is half of this i.e, αv = 0.06			
	b)Vertical				
11.6	Utilisation with in the State (TMC)	1.72 TMC			
11.6.1	Water availability(States share in case of interstate River)	Karnataka = 32.11 TMC, Maharashtra-7.21 TMC and Goa -148.74 TMC			
11.6.2	Committed Utilisation(Mcum)				
	a) Up stream projects(completed & ongoing)	NA			
	b) Downstream projects	Nil			

No	Particulars	Details
11.6.3	Proposed utilization by the project	
	a)Irrigation	NA
	i)Khariff	NA
	ii) Rabi	NA
	iii) Hot weather	NA
	iv)Perinneals	NA
	Total	NA
	b) Water supply & other purpose	1.72 TMC for Water supply (Augmentation to Malaprabha reservoir)
11.7	Flood near the Head Work site	--
11.7.1	Historical period of record	--
11.7.2	Observed period of record	--
	Maximum water level	--
	Maximum discharge	--
	Year of occurrence / Date	--
11.7.3	Estimated Flood in cum/sec	
	a) 50 years return period	--
	b) 100 years return period	--
	c) 1000 years return period	--
	d) Standard Project flood	--
	e) Probable Maximum flood	--
11.7.4	Design flood in cum/sec	
	a) Dam	311.27 Cumecs (Kalasa), 125 Cumecs (Haltara), 78.92 Cumecs (Surla)
	b) Weir / Barrage	NA
	c) Construction Diversion	NA
	d) Flood Control works	NA
11.7.5	River flows(minimum observed)	
	a) Water level (El.Mts)	---
	b) Discharge (cumecs)	---
	c)Months of nil flow, if any	Nil
12	**Reservoir**	
12.1	Water levels (EL.m)	Refer Table 8.1
	a) Maximum Water level (MWL)	Refer Table 8.1
	b) Full Reservoir level (FRL)	Refer Table 8.1
	c) Minimum Draw Down Level (MDDL)	Refer Table 8.1
	d) Outlet levels	Nil
	i) Irrigation	Nil
	ii) Power	NA
	iii) Others (Please Specify)	NA
	e) Dead Storage Level	Refer Table 8.1
12.2	Free Board (m)	Refer Table 8.1
12.3	Wave height (m)	Refer Table 8.1

No	Particulars	Details		
12.4	Live Storage (M.cum)	Refer Table 8.1		
12.5	Capacity (M.cum)	Refer Table 8.1		
	a) Maximum Water Level	Refer Table 8.1		
	b) Full Reservoir Level	Refer Table 8.1		
	c) Minimum Draw Down Level	Refer Table 8.1		
	d) Dead Storage Level	Refer Table 8.1		
12.6	Flood absorption capacity (M.cum)	Refer Table 8.1		
	a) Below FRL	NA		
	b) Between FRL & MWL	NA		
12.7	Sedimentation (M.cum) and levels after			
	Total Sediment	**50 years**	**100 years**	
	b) Above MDDL	Nil	Nil	
	c) Below MDDL	Nil	Nil	
	d) Encroachment on Live Storage	Nil	Nil	
	b) New zero elevation	Nil	Nil	
12.8	Average Monthly evaporation losses from reservoir (Mcft)	**Month**	**Evaporation value**	
		Jun		
		Jul		
		Aug		
		Sep		
		Oct		
		Nov		
		Dec		
		Jan		
		Feb		
		Mar		
		Apr		
		May		
		Total=		
12.9	Seepage in the reservoir	NA		
13	**Submergence**			
13.1	Land and Property Submerged-Refer Chapter 8			
13.2	Submergence ratio (with reference to CCA)	Irrigation is not envisaged and as such CCA Is not a part of the proposal		
13.3	Number of families /persons affected			
	a) Total	Nil		
	b) Scheduled castes			
	c) Scheduled tribe			
	d) Other backward castes			
	e) General			
14	**Head Works**			
14.1	Dam	Concrete Gravity Diversion Dam		
14.1.1	Embankment Dam			

No	Particulars		Details	
	(a)	Type of Dam	Refer Table 8.1	
	(b)	Length of Dam at Top	Refer Table 8.1	
	(c)	Top Width	Refer Table 8.1	
	(d)	Maximum Height above GL	Refer Table 8.1	
	(e)	Dyke(s)	Refer Table 8.1	
	(f)	Type of cut off and maximum depth	Refer Table 8.1	
14.1.2	Masonry and Concrete Dam (Non-over flow section)			
			Left side	Right Side
(a)	Type of Dam		Concrete	Concrete
(b)	EL of top		Refer Table 8.1	
(c)	EL of deepest foundation			
(d)	Length at top			
(e)	Width at top			
(f)	Width at deepest bed level			
8	Maximum height above deepest foundation level			
14.1.2	Spillway (Over-flow section)			
(a)	Type of spillway (Ogee/chute/side channel/tunnel/syphon/any other type		Ogee	
(b)	Full Reservoir level		Refer Table 8.1	
(c)	Maximum Water Level			
(d)	Length			
(e)	Maximum height above the deepest foundation			
(f)	Crest level			
(g)	EL of deepest foundation			
(h)	Number of gates			
(i)	Type of gates			
(j)	Size of Gate			
(k)	Maximum Discharge Capacity			
	(i)FRL			
	(ii)MWL			
(l)	Flood lift			
(m)	Tail water level			
	(i)Maximum			
	(ii)Minimum			
(n)	Type of energy dissipation arrangements			
(p)	Type of hoisting arrangement and its capacity			
14.1.4	River sluice(s), Irrigation/Power outlets			
(a)	Purpose			
(b)	Number			
(c)	Size(m)			

No	Particulars	Details
(d)	Sill level	
(e)	Discharge capacity at (m^3/s)	
	(i)Full reservoir level	
	(i)Minimum draw down level	
(f)	Type of gates	
(g)	Size of gate	
(i)	Type of hoist arrangement and its capacity	
14.2	Barrage	
14.3	Weir	
14.4	Head Regulator	
15	**Canal system**	NA
16	**Cropping pattern**	NA
17	**Power**	
17.1	Type –Conventional/Pumped storage	
17.2	Installed capacity (MW)	
17.3	Load Factor	
17.4	Annual Energy	
	(a)Firm	
	(b)Seasonal	
	(c)Total	
17.5	Off peak requirement for pumping	
17.6	Cost per kW installed	
17.7	Cost per kW at the bus bar	
17.8	Head Race Channel /Tunnel	
	(a)Length(m)	
	(b)Shape	
	(c)Size(m)	
	(d)Rock type reach-wise-RMR/Q values	
	(e)Rock cover reach-wise	
	(f)Free/Pressure flow	
	(g)Lining type-PCC/RCC/Steel	
	(h)Reach-wise Design Internal & external pressure	
	(i)Thickness of lining (m)	
	(j)Design Discharge (m^3/s)	
	(k)Invert level at (EI-m)	
	(l)Gate-No. Type & size	
17.9	Reservoir	
	(a) Capacity (TMC)	
	(b) FRL (EL-m)	

No	Particulars	Details
	(c) Max. Reservoir Level	
	(d) Min. Drawdown Level	
	(e) Live Storage	
	(f) Balancing period	
17.10		
	a) Size of forebay	
	b) Sill level of Forebay	
	c) FRL	
	d) Maximum reservoir level	
	e) MDDL	
	f) Duration of storage	
	(g) Number of off-takes	
	(h) Size of off-takes	
	(i) Invert level at off-take(El-m)	
	(j) Capacity of each off-take (m^3/s)	
	(k) Escape arrangement • Location • Length • Discharge capacity (m^3/s)	
17.11	Intakes	
	(a) Upper intake (i) Type & size of intake	NA
	(ii) Energy profile with details of transition	NA
	(iii) Stability of the slope/cut around intake	NA
	(iv) Design velocity through trash rack and bellmouth	NA
	(v) Submergence of the entry below water level	NA
	(vi) Intake gates-Number. Type. Size	
	(vii) Details of anti-vortex arrangements	
	(viii) Type of hoisting arrangement and its capacity	
	(b) Lower Intake (for pumped storage scheme) (i) Type & Size of intake (ii) Entry profile with details of transition	NA

No	Particulars	Details
	(iii) stability of the slope/cuts around intake (iv) Design velocity through trash rack and bellmouth (v) Submergence of the entry below water level (vi) Intake gates-Number. Type. Size (vii) Details of anti-vortex arrangements	
17.12	Surge tank /Shaft	NA
	(a) Nos. & Location (HRT/TRT or both)	NA
	(b) Type height & size	NA
	(c) Orifice-size & position (or any other relevant details)	NA
	(d) Top level (e) Bottom level	NA
	(f) Steady state level	NA
	(g) Capacity	NA
	(h) Lower expansion Chamber-Size and location	NA
	(i) Upper expansion Chamber-Size and location	NA
	(j) Max. Surge Level (El-m)	NA
	(k) Min. Surge level (El-m)	NA
	(l) Size of gates and capacity of hoists	NA
17.13	Penstocks/pressure shafts:	
	(a) Number, diameter, & length	NA
	(b) Inclination	NA
	(c) Liner type	NA
17.14	Power House (a) Type (Surface or Under Ground) (b) Orientation (c) Rock types encountered-RMR/Q Value (d) Major wedge formations, if any (e) Rock ledge dimension between cavities (f) Maximum head(m) (g) Minimum head(m) (h) Average head(m)	NA
	(i) Head loss in water conductor system	NA

No	Particulars	Details
	(j) Design head(m)	NA
	(k) Dimensions (m)	NA
	(l) Unit Capacity	NA
	(m) Installed capacity (MW)	NA
	(n) Type of turbine	NA
	(o) Type of generator	NA
	(p) Type of power house crane	NA
	(q) Number and size of draft tube gates/bulk head capacity of hoists	NA
17.15	Switch Yard (a) Type (b) Voltage level (c) No. of incoming and outgoing bays	NA
17.16	Transformer Cavern (a) Dimension (b) Orientation (c) Rock type encountered – RMR/Q Values (d) Major wedge formations, if any	NA
	(e) Rock ledge-dimension between cavities	NA
17.17	Tail Race Channel (a) Shape & Size (b) Length (c) Recovery Slope (d) Side Slope (e) Max. Tail Water Level (El-m) (f) Min. Tail Water Level (El-m) (g) Average tail water level (El-m) (h) Tail water level corresponding to one unit discharge. (i) Tail water level corresponding to max flood condition / one in thousand year flood. (j) HFL of recipient river channel at outfall (k) Draft tube gate – Number, Type, Size	NA
17.18	Tail Race Tunnel	NA
	(a) Number Shape & Size	NA
	(b) Length	NA
	(c) Reach wise Rock cover	NA

No	Particulars	Details
	(d) Reach wise Rock properties-RMR/Q	NA
	(e) Type of lining	NA
	(f) Max. Tail Water Level	NA
	(g) Min. Tail Water Level	NA
	(h) Avg. Tail Water Level	NA
	(i) Tail water level corresponding to one unit discharge	NA
	(j) Tail water level corresponding to Max. flood condition / one in thousand year flood	NA
	HFL Of recipient river channel at outfall	NA
	(k) Draft tube gate number, type, size	NA
18	**Construction facilities**	
19	**Cost**	
19.1	Cost of the Project (Rs. Lakhs)	**Rs. 99530.00 Lakhs**
	Allocated cost	
	a) Irrigation b) Power c) Flood control d) Navigation e) Water supply & others	Not envisaged in the present project Not envisaged in the present project Not envisaged in the present project Not envisaged in the present project Components pertaining to augmentation is dealt with in this DPR
20	**Benefits / Revenue**	

20.1 Benefits

Item	Benefits		
	Qty	Unit Price	Value in Lakhs
a) Food Production (tonne)			
b) Power(kwh)	---	---	---
c) Flood Protection(ha)	---	---	---
d) Navigation (tonnage)	---	---	---
e) Water supply (Population served)	---	---	---
f) Any other (fisheries)	----	----	---
Total	**---**	**---**	**----**

20.2 Revenue

Item	Revenue		
	Qty	Rate	Amount in lakhs
a) Betterment levy	----	----	---
b) Water Rates			
c) Irrigation Cess	----	----	---
d) Pisiculture rights action	----	----	---
e) Power rates	----	----	---

No	Particulars	Details		
	f) Navigation	----	----	---
	(i)Cargo rates	----	----	---
	(ii)Re Charges	----	----	---
	(iii)Passenger Tax	----	----	---
	(iv) others			
	g) Others	---	---	
	Total			
21	**Benefit Cost Ratio**			
	(a) B.C.Ratio	NA		
	(b) Financial Rate of Return (FRR)	NA		

Executive Engineer,
KNNL, Kalasa Project Division,
Khanapur.

Superintending Engineer,
KNNL, MLBCC Circle.
Naviluteertha.

Chief Engineer,
KNNL, Malaprabha Project Zone
Dharwad

SECTION - 3
EXECUTIVE SUMMARY

Section - 3
Executive Summary

1.0 Introduction

Karnataka State having a geographical area of 1,91,976 sq.km happens to be the eighth largest State in India with a population of 6,10,95,297 as per 2011 census. Karnataka is blessed with major rivers such as Krishna and Cauvery besides 13 West flowing rivers. In spite of having big river systems, many parts of Karnataka are facing drought like situation resulting in acute drinking water shortage. *Hubli-Dharwad towns, Kundgol town is falling Malaprabha Sub Basin of Krishna Basin under Belgavi district is one such area, having major problem regarding drinking water.*

As per National water policy, providing drinking water to the people is of paramount important and it precedes over all the other needs.

Considering the above factors, a Dam has been proposed to build across seasonal ***Mahadayi River***, called as Kalsa Nala Diversion scheme, to meet the Drinking water in the Malaprabha basin.

1.1 Justification for taking up the Project

The present project is one of the several alternatives thought of to augment / supply of drinking water to Hubli – Dharwad twin cities, Kundagol town and en route villages.

This is due to the fact that Malaprabha River in itself is not drained enough by its catchment. The proposal considers diverting water from the tributaries of River Mahadayi like Kalasa nala, Haltara nala and Surla nala etc. which are close by after giving due consideration to:

- Water quality
- Availability of required quantum of water
- Pumping head
- Length of transmission line
- Capital cost
- Requirement of power
- Electricity charges
- Annual O & M cost
- Lastly an approximate water tariff which can be charged during the projected year of 2051

- This project is one of the two projects proposed to be undertaken for diverting about 3.90 TMC of water to meet the drinking water needs of the above areas, Under Kalasa project, it is envisaged to divert 1.72 TMC of water after the following works are completed.

Hence construction of a Dam is inevitable to meet the long term objective of proving drinking water from an assured source.

1.2 Objectives

Kalasa, Haltara, Surla Nala Diversion Scheme project is located within the Karnataka and will have a storage capacity of about 3.90 TMC. The proposed project is envisaged to address the following Objectives:

- To facilitate in creating storage to meet the Drinking water requirements of Hubli-Dharwad towns, Kundgol town in the Malaprabha Basin within Karnataka.

1.3 Drinking Water Needs

The requirement has been assessed considering the growth for the next 40 years and also requirerment for other needs which are essential is assessed details of which are furnished below.

Table.1: Requirement of Water Needs

No	Particulars	Quantity (in TMC)
A	**Drinking water**	
1	Domestic water demand of Hubli – Dharwad twin city	7.70
2	Domestic water demand of en route villages	0.22
3	Domestic water demand of Kundagol town	0.08
4	Domestic water demand of live stock	0.69
	Total demand in the year 2051	**8.69**
	Grand Total	**8.69 Say 9.00**

The yield at the proposed site at 50%, 65% and 75% dependability are 8858 Mcft, 7687 Mcft and 6359 Mcft respectively. It has been estimated in the hydrology report that it is possible to achieve 90 to 91.4% of reliability for supplying the drinking water and as per the standards for drinking water needs reliability should be 90%.

1.4 Water Allocation

The total water demand for Hubli – Dharwad twin cities, Kundagol Town, en route villages etc. works out to 7.56 Tmc and 8.69 TMC respectively for the years 2044 and 2051.

Kalasa Nala Diversion Scheme integrated project is planned to meet ever growing demand for drinking water needs. The most of the utilization comes under consumptive use (20% consumption and 80% as return flow). The allocation of water for Kalasa diversion scheme as per tribunal is 1.72 TMC.

2.0 Mahadayi River

River Mahadayi (Mandovi) is a West flowing interstate river in Western Ghats. The river takes its origin in Karnataka, flows for about 35 Kms in Karnataka State, and enters Goa and joins the Arabian Sea.

The total catchment area of the river Mahadayi is 2032 Sq.km, out of which 375 Sq.km is in Karnataka, 77 Sq.km is in Maharashtra and 1580.00 Sq.km is in Goa.

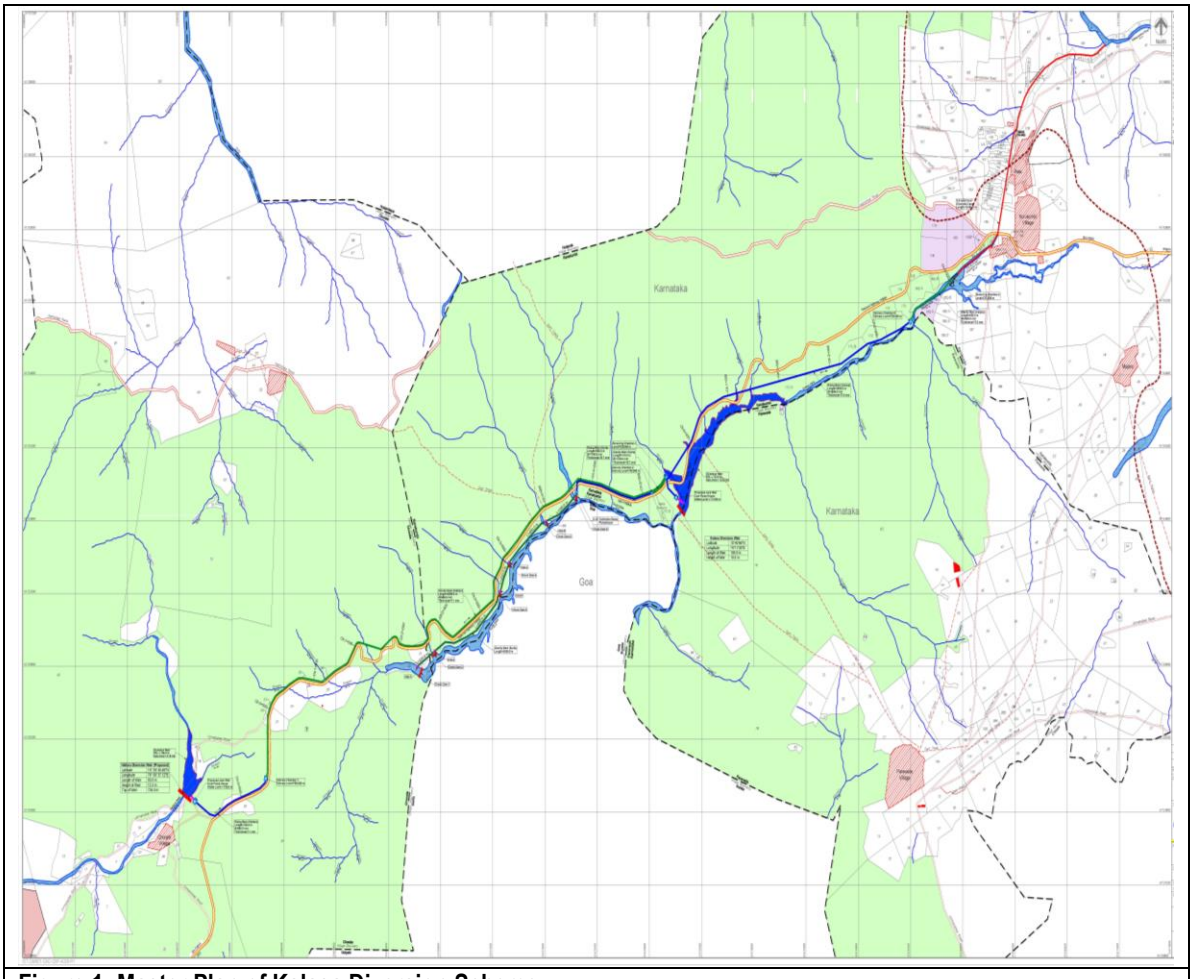

Figure 1: Master Plan of Kalasa Diversion Scheme.

However now the Hon'ble Mahadayi Disputes Tribunal has made an independent study to assess the yield of the Kalasa Nala. The comparative statement of Yield details at 75% dependability and allocation for the proposed scheme are as follows. (vide MWDT award Volume-VII Pg.1441-1443)

2.1 Location of Project Area

Kalasa Nala Diversion Scheme (Lift Scheme) project is located at Latitude 15°40'52.54" N and Longitude 74°11'22.98" E Coordinates near Kankumbi village, Khanapur taluk of Belagavi District, Karnataka State.

3.0 Interlinking of The Scheme with Neighboring Schemes

After diverting water from Kalasa to Malaprabha River as envisaged, arrangements would be made to supply the required quantum of water to the Twin cities of Hubli – Dharwad, Kundagol Town along with en route villages. The total quantum of water proposed to be diverted from Kalasa Nala Dam is 1.72TMC as per the award of the Hon'ble Mahadayi Water Disputes Tribunal.

3.1 Interstate / International Aspects

Details enumerated in a separate Chapter on Interstate / International aspects.

3.2 Fitment of the Scheme in Overall Development of River Basin

This project has been envisaged exclusively as a drinking water supply scheme and as such, overall development of the river basin is not a criteria considered.

3.3 Choice of the Project

3.3.1 Earlier Proposal – Alternate -1

The Mahadayi Project is a combined project for both irrigation and Electricity generation, providing 9 TMC of water for diversion to Malaprabha River (4 TMC from Mahadayi and 5 TMC from neighboring nalas Kalasa, Haltara and Kotni) was approved by the government vide order No. PWD:132:PPC:88:Dated 5-11-1988 as per which the Karnataka Power Corporation has to take action to prepare the project report for diversion of 4 TMC of water in consultation with the Irrigation Department and send this proposal for Central Electricity Authority for clearance.

3.3.2 Earlier proposal – Alternate - 2 (PFR of 2020)

The earlier proposals were modified as the drinking water became priority due to scarcity of drinking water of Hubli-Dharwad Towns, Kundagol town and Enroute villages. Drinking water requirement has been arrived at as 7.56 TMC considering the projected population up to the year 2044. Out of 7.56 TMC, 3.56 TMC is contributed by Kalasa Nala diversion scheme. Now as per the allocation made by MWDT the contribution from Kalasa Nala Diversion will be 1.72 TMC out of 3.90 TMC.

3.4 Modified proposal under Kalasa nala Diversion Scheme (Lift Scheme)

Consequent to the reduction in allocation of water, a diversion dam of 10.5 m at Kalasa Nala, 9.30 m at Haltara nala and 2.35 m at Surla Nala from the Nala bed levels is proposed to divert 1.72 TMC of water to Malaprabha river though a series of Lift schemes.

The extent of storage is now restricted to 522 - minutes, thereby minimizing the forest submergence. The total extent of submergence is 10.2831 Ha at Kalasa, 2.9203 ha at Haltara and 1.491 Ha at Surla.

The forest land required for the conveyance system under Kalasa will be 4.860 Ha and that of Haltara is 11.49 Ha & Surla will be 1.30 Ha.

3.5 Surveys and Investigations

The desktop study has been carried out which includes detailed Survey, Alignment of Head Works consisting of Intake fore bay, Jack Well cum Pump House, Rising Main and Delivery Chamber. It involves establishment of Ground Control points, Temporary Benchmarks with respect to GTS BM and preparation of maps, Geotechnical Investigations, and analysis etc.

4.0 Hydrology (Working Tables, Performance Tables, Flow Tables)

Karnataka Neeravari Nigam Ltd proposes to construct a diversion dam across a Kalasa nala, Haltara Nala and series of check dams across tributaries of surla nala within the state of Karnataka to cater the drinking water demand for Hubli-Dharwad twin cities, Kundgol town and enroute villages.

4.1 Yield Calculations

The annual yield was estimated in the Report prepared in the year 2010 by considering the combined catchment area of Kalasa Nala, Haltara Nala and Surla Nala of 25.50 Sq.km. The annual yield was computed by using various formulae then available for computing the runoff from rainfall for the basin. The formulae adopted were as follows:

a) Rainfall runoff correlation developed by KPCL for Mahadayi basin.

b) Rainfall runoff correlation developed by NWDA for Mahadayi basin.

c) Rainfall runoff correlation developed by Inglis formulae for ghat section.

Table.2: Kalasa Nala Diversion Scheme table of list of Annexures for monsoon yield and diversion

Details of Catchment	Catchment Area in Sq.km	Annual, Monsoon available yield and Diversion works at 75.60% dependability			
		Annual yield in Mcft	Monsoon yield in Mcft	Diversion in Mcft	Remarks
Haltara	4.00	344.16	323.10	270.00	
Surla-1	2.63	226.29	212.44	177.40	
Surla-2 & 2A	0.28	24.09	22.62	18.90	
Surla-3	0.21	18.07	16.96	14.18	
Surla-4 & 4A	0.11	9.46	8.89	7.43	
Surla-5	1.23	105.83	99.35	83.03	
Surla-6	1.54	132.50	124.39	103.95	
Kalasa	15.50	1333.62	1252.01	1042.28	
Total	25.50	2194.02	2059.76	1717.17	

Note: Total diversion= Diversion + Evaporation =1719 Mcft + 1 Mcft = 1720 Mcft

5.0 Hydro Geology

Water table generally follows the topography of the area and is at greater depths in the water divides and topographic highs, but becomes shallower in the valleys and topographic lows and therefore, groundwater moves down and follows the gradient from the higher to lower elevations, that is, from recharge area to discharge area. Therefore, locally direction of flow from higher elevations is towards the rivers. Overall, the general flow direction of ground water in the district is generally towards the east. The district is underlain by gneisses, schist, limestone, sandstone, basalts, alluvium etc. of Archaean to Recent age. Deccan basalts cover an area of 7,650 Sq. Km. in the northern part of the district and have a maximum thickness of around 256 m, which gradually thins out in the southern direction. Exploratory drillings were carried out to study the yield potential of fracture systems. Hard rocks occupy a major part of the district; majority of which are basaltic lava flows. Most of these rocks have poor capacity of storing and transmitting water, except through favorable zones and at favorable locations. Aquifer systems encountered are therefore limited in nature.

6.0 Final Layout of all major components of the scheme

- Construction of diversion dam across Kalasa Nala. Jack well cum pump house on the foreshore. Rising main (MS Pipe) from Jack well to Kalasa Inter connecting diversion canal.

- Construction of diversion dam across Haltara Nala. Jack well cum pump house on the foreshore. Rising main (MS Pipe) from Jack well to Kalasa dam.
- Construction of diversion weirs across tributaries of Surla Nala. Gravity main (MS Pipe) linking all the weirs and leading to collection sump (receiving chamber), Jack well cum pump house including rising main (MS Pipe) from sump to Kalasa dam.
- Transmission line upto project site including substations.

6.1 Stages / Phases of Development of Project

The present Project is proposed to be implemented in a single Stage over a span of 24 months.

7.0 Irrigation, Command area, Flood Control, Drainage, Power and Navigation

This project does not envisage Irrigation, Command area, Flood Control, Drainage, Power and Navigation.

8.0 Construction Program

The construction schedule for the Kalasa Nala Diversion Scheme drinking water Project is considered as **24 months**

8.1 Construction Materials

The sources of the major construction materials required for the project have been anticipated as follows:

- Explosives for blasting will be obtained from suppliers in Belagavi.
- Cement in bulk will be obtained from cement factories/ nearest cement dealers.
- Coarse aggregate which will be produced on site from the excavated materials, selected Rock quarries and River Course
- Fine aggregate which will be processed from the excavated material and other nearest local sources if necessary.
- Reinforcement & Structural steel will be obtained from SAIL/TATA or any other approved dealers.

9.0 Environment, Ecology and Forest aspects of the project

Environmental Impact Assessment (EIA), a systematic process to identify, predict and evaluate the significant environmental effects of proposed actions and projects which is applied prior to major decisions and commitments being made. Under this study the social, cultural and health effects form an integral part in order to prevent, mitigate and offset the significant adverse effects of proposed undertakings.

The EMP will provide information for decision-making on the environmental consequences of proposed actions; and promotes environmentally sound and sustainable development through the identification of appropriate enhancement and mitigation measures.

With the infringement of the site the impacts become more complex and larger in scale thus, in order to reduce the burden of environmental impacts it becomes necessary to undertake EMP study for maintaining the sustainability of the project even after the developmental processes.

9.1 Compensatory Afforestation and Net Present Value

The project involves diversion of 33.0507 Ha of forest land. Further, a total 33.0507 Ha of compensatory afforestation land has been identified in Sy. No. 66 of Halahalli Village, Telasang Hobli, Athani Taluk, Belgaum District. Further, a Net Present Value of Rs. 15,451.76 Lakhs (for 30 years) will be deposited to Forest Department as per the guidelines issued by MoEF&CC keeping in view of Economic Value of loss of eco-system services due to diversion of very dense forest land.

10.0 Estimates

The Project estimates prepared are based on the “Broad guidelines for preparation of Project Estimates for major & multipurpose Projects” issued by central Water commission and its revisions.

10.1 Preparation of Estimates

The estimate for various components of the project work comprises of two parts. Firstly, the estimate of quantities for the identified items for each work and secondly the cost estimate which is based on rates for each item of work.

Further the estimates comprise of three major categories namely estimate for civil works and estimate of hydro mechanical works. There will be other components like project roads, buildings etc.

The estimate for quantities for civil works is based on the drawings prepared based on preliminary designs and assumptions.

In case of hydro mechanical works, the weight of gates & embedded parts and hoist capacities are worked out based on the empirical formulae provided in the schedule of Rates of W.R.D.O of Govt. Of Karnataka.

The rates for hydro mechanical works is based on S.R of W.R.D.O Government of Karnataka.

For each item of work, provision is made for contingency @ 3% and 2% towards work charged establishment.

The cost arrived at for each item is rounded off to the near rupee in Crores Accordingly the total estimated cost of the project SOR 2021-22 .is **995.30 crores.**

11.0 Financial Resources

Government of Karnataka has already earmarked Rs 500 crore in the budget for the current financial year 2022-23.

12.0 Revenues

The present project is envisaged to augment the drinking water needs of Hubli-Dharwad cities, Kundgol town and enroute villages. The project authorities will be responsible in ensuring the bulk supply of water to Malaprabha basin. It will be the mandate for the end user to plan further till the last mile. Hence, the revenue computations are not considered in the present project.

13.0 Conclusion

The present proposal of Kalasa Drinking water Project will help in achieving the following objectives.

- To meet the ever-growing drinking water needs of Hubli & Dharwad cities.
- To meet the ever-growing drinking water needs of Kundagol town and enroute villages.
- Maintain the ecology and environment of the entire project area.

14.0 Recommendation

The DPR of Kalasa Nala Diversion Scheme Drinking water Project, on implementation will meet drinking water needs within the project area and is techno-economically viable. Hence the project is recommended for implementation.

Executive Engineer,
KNNL, Kalasa Project Division,
Khanapur.

Superintending Engineer,
KNNL, MLBCC Circle.
Naviluteertha.

Chief Engineer,
KNNL, Malaprabha Project Zone
Dharwad

REPORT

Chapter 1
Introduction

River Mahadayi (Mandovi) is a West flowing interstate river in Western Ghats. The river takes its origin in Karnataka, flows for about 35 Kms in Karnataka State, and enters Goa and joins the Arabian Sea.

The total catchment area of the river Mahadayi is 2032 Sq.km, out of which 375 Sq.km is in Karnataka, 77 Sq.km is in Maharashtra and 1580.00 Sq.km is in Goa.

However now the Hon'ble Mahadayi Disputes Tribunal has made an independent study to assess the yield of the Kalasa Nala. The comparative statement of Yield details at 75% dependability and allocation for the proposed scheme are as follows. (Vide MWDT award Volume-VII Pg.1441-1443)

Table 1.1: Comparative statement of Yield details at 75% dependability and allocation for the proposed scheme

Sl. No	Name of Project	Yield as per the tribunal	Allocation made by the tribunal
1.	Proposed Kalasa dam site (including Haltara and Surla diversion) with catchment area of 25.50 sq.km.	**2.19 TMC**	**1.72 TMC**

1.1 Aim(s) of the Project and Description of Works

The present project is one of the several alternatives thought of to augment / supply of drinking water to Hubli – Dharwad twin cities, Kundagol town and en route villages.

This is due to the fact that Malaprabha River in itself is not drained enough by its catchment. The proposal considers diverting water from the tributaries of River Mahadayi like Kalasa nala, Haltara nala and Surla nala etc. which are close by after giving due consideration to:

- Water quality
- Availability of required quantum of water
- Pumping head
- Length of transmission line
- Capital cost
- Requirement of power
- Electricity charges
- Annual O & M cost

1.2 Location of Project Area

Kalasa Nala Diversion Scheme (Lift Scheme) project is located at Latitude 15°40'52.54" N and Longitude 74°11'22.98" E Co-ordinates near Kankumbi village, Khanapur taluk of Belagavi District, Karnataka State.

The dam site is located about 33 Km upstream of Mahadayi river and,4 Km D/S of Kanakumbi region.

Location of the Kalasa Nala dam site along with catchment area is shown in **Error! Reference source not found.**.

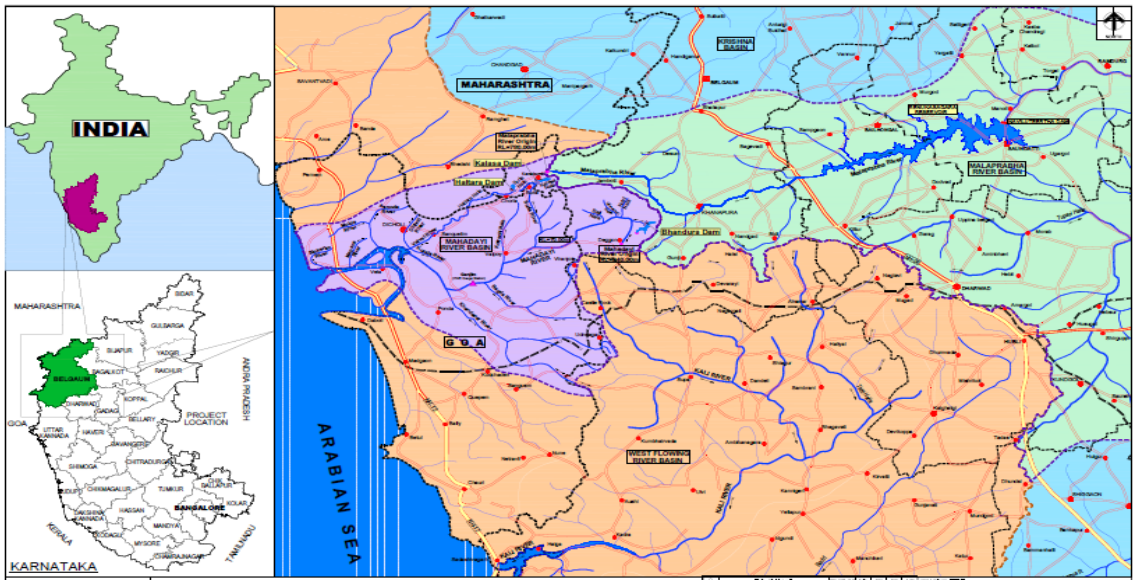

Figure 1: Project Service Area

1.3 Accessibility

1.3.1 By Road

The projects are accessed via NH-748AA connecting Belagavi to Goa.

1.3.2 By Rail

The nearest rail station is Belgaum and Khanapur

1.3.3 By Air

The nearest airport is Belgaum at around 65 Km.

1.3.4 Port Connectivity

The nearest port is Karwar in Karnataka.

1.4 General Climatic Conditions

Three distinct seasons prevailing in the basin:

(i) Summer season - March to May

(ii) Monsoon season - June to November

(iii) Winter season - December to February.

The basin receives substantial rainfall during monsoon period from June to November.

- The normal rainfall varies from 3000 mm to 6000 mm.
- The maximum, minimum and average rainfall of the basin is 5697 mm, 1834 mm, and 3468 mm respectively.
- The annual average maximum and minimum temperature is 31.3º C and 21.4º C
- The average monthly maximum and minimum relative humidity is 88% and 60% respectively.
- The winds are fairly strong during the monsoon period which is westerly throughout the day.
- The average monthly maximum and minimum wind speed is around 23.1 Km/hr and 9.5 Km/hr.
- The average monthly sunshine varies from 92.48% to 31.55%.
- It is seen that the sky is generally clear or lightly clouded except during south-west monsoon season.

1.5 General Description of Topography, Physiography and Geologyof the Basin

1.5.1 Topography

The project as a whole located in the Northern Karnataka Plateau covering the districts of Belgaum, Bagalkot, Dharwad and Gadag. This region largely covers the parts of Malaprabha sub basin in Krishna basin and its tributaries, open out to form undulating plains in Karnataka. On the western side flowing tributary nalas joins Mahadayi River which follows its course in to Goa where it is called as Mandovi River and joins Arabian sea. The general elevation of the region varies between 700m to 800 m. In general, the entire region on the western side, is enclosed by the ranges of Western Ghats with an elevation ranging from 700 m to more than 1000 m with its northern part being an interrupted but clearly identifiable high plateau. On the eastern side towards Malaprabha river course, after the hill region, plain area start which are mostly under cultivation.

1.5.2 Physiography

The project as a whole lies in the Northern Karnataka Plateau covering the districts of Belgaum, Bagalkot, Dharwad and Gadag.This region largely covers the parts of Malaprabha sub basin in Krishna basin lying in Karnataka. In the west, it is enclosed by the ranges of Western Ghats with an elevation ranging from 700 m to more than 1000 m with its northern part being an interrupted but clearly identifiable high plateau.

In the east, the valleys of the Malaprabha followed by that of Krishna and its tributaries open out to form undulating plains. The general elevation of the region varies between 500m to 700 m.

1.5.3 Geology

Regional Geology:

Various geological formations can be observed in Belgaum district where in Bandura and Kalasa Diversion schemes are proposed. The region comprise schist and banded ferruginous quartzite, the Peninsular gneiss by granite and gneissic granites rocks, the Kaladgi formations consisting of sandstone, quartzite, shale and Limestone and Basalt (Deccan Trap) and the Laterite formations are observed in the district. Population.

Kalasa, Surla and Haltara nalas are the tributaries to Mahadayi River. These tributaries originate in the Western Ghats at an elevation of EL 700m to 800 m in the water divide ridge portion hilly region and flows into westerly flowing Mahadayi River. On the eastern side of the summit of this western ghat range belong to catchment of River Malaprabha which is a tributary to Krishna River/basin. The catchment area of these tributaries comprised of thick forest and receives heavy rainfall during south-

west monsoon. The present proposal is to partly divert water from Kalasa, Surla and Haltara nalas to augment storage in the Malaprabha reservoir. It is proposed to be executed as single project comprising "Diversion dams across Kalasa and Haltara nalas and Check dams across five tributary nalas of Surla, for diverting the required quantity of water through Lift scheme and further take it to Malaprabha River augmentation of water for drinking water supply needs of Hubli-Dharwad twin cities along Kundgol town enroute villages. All the sites of these schemes are located almost adjacent to Bleagavi-Gow going high way no 748AA.

The topography, geology of these individual sites of these three nalas are described based on the site visits and previous investigation data made available for preparation of this report.

This geological appraisal report is prepared with respect to Haltara, Surla and Kalsa Nala Diversion dams/check dmas schemes individually, based on the site visit and previous reports/investigation data collected for the alternative studies done earlier for head works and diversion arrangements through canal/s alignments between Mahadayi and Malaprabha catchment area.

1.6 Population

Details of Population forecast:

- Present population of Hubli – Dharwad is 10 lakhs
- Projected population in the year 2051 is 33.41 lakhs
- Projected floating population for the year 2051 is 2.97 lakhs
- Projected population of Kundagol town for the year 2051 is 0.36 lakhs
- Projected population of enroute villages for the year 2051 is 1.94 lakhs
- Provision is also made for drinking water needs of livestock in the area.

Hence the implementation of the proposed scheme is inevitable to meet the long term objective of proving drinking water from an assured source.

Supply of adequate quantity of drinking water from a reliable source by way of diverting from the nearest perineal source will help in allround growth of the area.

Hence, vision and decision of the GoK is in line with overall development of Karnataka and realizing the same the proposed project has been planned.

1.6.1 Identification of beneficiary

The present project aims at providing drinking water supply to Hubli – Dharwad and Kundagol town along with Enroute villages.

The twin cities of Hubli-Dharwad boast of a High Court Bench, three Universities, two medical colleges, eight engineering colleges, an IIT, a very busy Airport and is known to be an educational hub. Under the "Smart City" Challenge of the Government of India, the Hubli-Dharwad twin cities are selected, and it has been proposed to be covered under the smart city scheme and works are being undertaken by the Hubli-Dharwad Smart City Limited.

1.6.2 Process of arriving at the total quantum of water

In order to arrive at the total quantum of water required for drinking water purpose, a scientific method has been adopted involving the following

1 Design period for storage by Dams as per CPHEEO Manual

2 Present population as per 2011 census.

3 Projecting the population upto 2051.

4 Adopting the requirement of water for towns, rural areas, and livestock as per the CPHEEO manual.

5 Calculation of quantum of water as per the above.

As per CPHEEO Manual Clause 2.2.8.1 Table 2.1, a Per capita supply rate of 135 LPCD has been considered for Hubli – Dharwad and Kundagol towns. For en route villages, a Per capita rate of 70 LPCD is considered along with 35 LPCD for livestock for cattle's / buffaloes and 25 LPCD for sheep / poultry and Goat.

The water demand for the project is detailed hereunder.

The total water demand for Hubli – Dharwad twin cities, Kundagol Town, en route villages etc. works out to 7.56 Tmc and 8.69 TMC respectively for the years 2044 and 2051. Abstract of water demand is tabled below:

1.6.3 Projected water requirement

Table 1.2: Abstract of water demand is table

No	Description	Water demand as on 2051 (TMC)
1	Domestic water demand of Hubli – Dharwad twin city	7.70
2	Domestic water demand of en route villages	0.22
3	Domestic water demand of Kundagol town	0.08
4	Domestic water demand of live stock	0.69
	Total demand in the year 2051	**8.69**

1.7 Natural Resources

Since this project is exclusively for drinking water, the details of Master Plan for overall development of water Resources do not arise. (However, Master plan for utilization of Mahadayi water is prepared considering the thrust area of drinking water and in basin developments.)

1.8 Land use and Socio Economic aspects

The main purpose of taking up this project is to supply drinking water to the Hubli – Dharwad twin cities, Kundagol town including en route villages which are facing acute shortage of the potable water.

1.8.1 Land Use

The district is primarily located on the eastern side of the Western Ghats and its topography is predominantly undulating. A “rugged terrain” marks the western part of Khanapur and Belgaum taluks with deep cutting ravines on the foothills of the Western Ghats. The elevation of these hills varies from 796 to 1025 m above MSL. Northern portion of the district is a plateau region formed by basaltic lava flows, which represents “Deccan peneplain”. The central and southern parts exhibit moderate to gently “undulating terrain” having sparsely distributed knolls and tors. In some parts, especially in Ramdurg and Saundatti taluks, hills with elevations between 686 and 783m amsl are present. The famous Yellamma temple in Saundatti taluk is located in one of these isolated hills. The remaining part of the district is in general a “plateau area”. The elevation in the plains varies from 534m in the northeastern part to 820 m above MSL in the southwestern part of the district. This has its bearing on the regional slope which is towards northeast. The differential altitude is significant because, it is likely to cause irregular ground water flow patterns on the micro scale.

1.8.2 Soil Types

The soils of Belgaum district can broadly be classified into red soils and black soils. These soils vary in depth and texture, depending on the parent rock type, physiographic settings and climatic conditions. By and large, black soils predominates the Deccan Trap terrain and the red soils are found in the southwestern and southeastern part of the district in gneissic terrain. These soils in turn can be grouped into seven categories as given below, out of which the first five cover large tracks of land while the last two are local in nature.

1.8.2.1 Shallow Black Soils

These soils occur in the Deccan trap region and to some extent are also developed in schist, shale and limestone terrains. They are greyish to dark greyish-brown in colour, with clayey texture. These soils have poor to moderate infiltration characteristics.

1.8.2.2 Medium Black Soils

These soils are predominantly derived from Deccan traps and occupy large parts of the district. They are dark greyish-brown to very dark greyish-brown with clayey texture. These are derived from the weathered products of basalts and limestone and are darker in valleys than in high lands. Their texture varies from loam to clay, with low to moderate infiltration characteristics.

1.8.2.3 Deep To Very Deep Black Soils

These soils occupy large tracts in Deccan trap terrain along the Krishna River and also in the gneissic terrain. These soils are dark greyish-brown to very dark greyish-brown in colour and have clayey texture. These soils occur on plains or lands having gentle slopes. These soils exhibit wide cracks in summers. These are derived from a wide variety of parent rock types, like traps, schists, gneisses and sedimentary rocks. They are generally transported and therefore occur in valleys and depressions. Accumulation of lime, gypsum and soluble salts at varying depths in the soil profile often pose problems. They have poor infiltration characteristics.

1.8.2.4 Mixed Red and Black Soils

These soils occur in the northern parts of the district. They are dark reddish-brown to dark greyish-brown in colour with silty-clay to clayey-loam textures. These soils are derived from gneisses, schists and sedimentary rocks. Red soils having high infiltration characteristics are confined to uplands, whereas, black soils of poor to medium infiltration characteristics occur in valleys and low lands.

1.8.2.5 Red Loamy Soils

These soils occur as small strips in the valleys adjacent to the Western Ghats. They are generally transported and are loamy to silty-loam in texture. They have moderate to good infiltration characteristics.

1.8.2.6 Lateritic Soils

Lateritic soils are red in colour and occur as pockets. They occur at high-levels as insitu in Deccan Trap terrain and at low-levels as transported in Malnad region. They are derived from Deccan traps as well as sedimentary rocks, Dharwarian Schists and peninsular gneisses. These soils have well to moderate infiltration characteristics.

1.8.2.7 Alluvial Soils

These soils are developed over the alluvium deposited by the Krishna River and its tributaries. They are very limited in extent and thickness and are local in nature. These soils have good infiltration characteristics and are composed of coarse sand, sandy-loam and loams.

Figure 2: Pictorial view of the project site

River Mahadayi (Mandovi) is a West flowing interstate river in Western Ghats. The river takes its origin in Karnataka, flows for about 35 Kms in Karnataka State, and enters Goa and joins the Arabian Sea. The entire river section or the stretch is ideally suited for siting the dam since it is possible to impound the water of high capacity with minimum submergence. Geologically, several sections of the river are most ideally suited for locationg the dam since reasonably good founding strata is likely to be available at shallow depth. Since the river has deep gorge for most of its length habitation is minimum. This

helps in having minimum resettlement and rehabilitation of villages. Hence Mahadayi river appears to be one of the ideal River basin for siting the dam in view of several advantages as mentioned above

Figure 3: Existing Delivery chamber at project site

Figure 4: Valley of the Mahadayi River at Dam site

1.8.3 Socio Economic Aspects

The Concept of water and development has been changing in the recent decade. Water for life, energy, agricultural, industrial and domestic sectors should be widely managed between upstream and downstream sides of the water source. These water managements will mitigate the socio-economic impacts in the local regions. The notion of economic impact refers to the effects, on the local and regional economies, of project construction and subsequent operating activities. These include: direct and secondary demands for labor and services, as well as effects on local resources and thus on the very structure of the local economy. Such economic effects also cause significant social impacts which impinge on economic parameters. Also various impacts stem directly from the project activities and these also have economic implications. Overall, socio-economic impacts endanger a complex dynamic stage which is not easy to predict accurately.

Socio economic factors are of greater interest in the recent years in EIA (Environmental Impact Assessment) as they represent specific aspects of human environment and the changes represent the most critical alterations associated with project implementation.

Further, a detailed study will be conducted which will provide us the understand of how the potential changes could be increase /decrease in population, Disruption of settlement patterns, change in land use, disruption in religious pattern, attitudes and life styles, changes in transportation systems, relocations of highways and rail roads. Detailed studies will be carried out on the Infrastructure and cultural sites located within 10km radius of the project site.

1.9 History

The Hubli – Dharwad twin cities were earlier depending on open wells as is the case with other areas. The piped water supply scheme was first implemented in the year 1912.

1.9.1 Dependency on existing water schemes

There are two important schemes which supplied water to the twin cities

- Water supply from Unkal and Kelageri schemes
- Neersagar reservoir

Out of the two, water supply from Unkal and Kelageri is stopped long ago due to it being unable to meet the growing demand.

Neersagar reservoir is the one which is supplying water to the twin cities. However, due to vagaries of monsoon, the reservoir is unable to supply water even once in 8 to 10 days over last few years. Thus, Neersagar reservoir cannot be considered as a dependable source of supply.

Hence, it has become all the more important that a dependable source need to be identified and actions initiated to mitigate the drinking water supply problem being faced by the twin cities of Hubli – Dharwad.

The twin cities of Hubli – Dharwad are facing lot of hardships due to shortage of supply of drinking water. These towns located strategically and with their easy accessibility have become industrial, educational and commercial hub.

They have witnessed tremendous growth in the recent past with population growing at a very fast rate. It has thus become imperative to have a dependable source for supply of drinking water to the area. As a part of the project, it is necessary to consider the drinking water needs of the Towns and villages en route also.

With this in view, several attempts have been made to study alternate sources

At present, water supply is from Neersagar reservoir which was constructed during the year 1955. However, does not have the capacity to supply water to meet the required demand. Furthermore, there are instances when reservoir got dried up or was left with meager quantity of water which had resulted in supply to the Hubli – Dharwad once in 8 – 10 days. This has made the present source to be considered not dependable.

Thus, getting the water from Malaprabha source was seen as feasible considering all the factors indicated above. The Malaprabha source is proposed to be augmented by diversion.

Kalasa Nala Diversion scheme (Earlier proposed scheme – Gravity Diversion):

Earlier the Government of Karnataka had taken up the work of Kalasa Inter-connecting canal to divert water from Kalasa Reservoir to Malaprabha river ***vide G.O.No:WRD/36/2006, Date: 15/03/2007 in non-forest area***.

Accordingly the Construction of Inter Connecting Canal which is from Kalasa reservoir to Malaprabha River and was taken up by State Govt. in non-forest area. The total length of the interconnecting canal is 5.15 Kms. comprising of 2735m of open canal and 2415m of RCC cut & cover portion.

The work of Inter Connecting Canal is almost completed. The components of ICC and stage of work are as under

No.	Component of Work	Stage
1.	**Open Canal:** i) Reach -1 Ch: 145.00 m to 750.00 m ii) Reach -2 Ch: 3165.00 m to 5005.00 m	Completed.
2.	**Cut and Cover:** i) Reach -1 2 vent box Ch: 750.00 m to 2580.00 m ii) Reach -2 3 vent box Ch: 2580.00 m to 3165.00 m	Completed
3.	**Structures:** i) Cross regulator with transition at ch: 690.00 m to 750.00 m ii) Inlets at Ch: 180.00 m, 630.00 m 2580.00 m 3187.00 m	Completed (Except errection of gates) Balance Completed Completed Completed

For the present project, Power requirement, Electricity charges including O & M costs are not to be considered.

As a result, the present proposal has been prepared by identifying the source, construction of dams of suitable capacity, conveying / diverting the required quantum of water to Malaprabha River and further supplying it to Hubli _ Dharwad towns as well as village en route.

1.10 Choice of the Project

1.10.1 Earlier Proposal – Alternate -1

The Mahadayi Project is a combined project for both irrigation and Electricity generation, providing 9 TMC of water for diversion to Malaprabha River (4 TMC from Mahadayi and 5 TMC from neighboring nalas Kalasa, Haltara and Kotni) was approved by the government vide order No. PWD:132:PPC:88:Dated 5-11-1988 as per which the Karnataka Power Corporation has to take action to prepare the project report for diversion of 4 TMC of water in consultation with the Irrigation Department and send this proposal for Central Electricity Authority for clearance.

However, in the meeting held on 19-04-1991 in the chambers of the Commissioner and Secretary to Government, Department of Energy, and Bangalore it was decided that the project reports for Irrigation and Power components of Mahadayi project are to be prepared separately.

The Karnataka Irrigation Department is entrusted with the execution of Irrigation components of the above project. The diversion scheme contemplates construction of dams, tunnels and open cuts. The total catchment of Mahadayi River is 2032.00 Sq.km. out of which the catchment in Karnataka is 375.00 Sq.km.

The Kalasa Nala and Surla Nala are tributaries of Mahadayi River. The Government of Goa has raised an objection for cutting of trees and bushes in their territory during survey works of Kalasa Dam. Also it has appeared in the Newspaper that Goa Government is objecting for sharing of River water of Mahadayi which is flowing in both the states. In view of the above objection, it is proposed to modify the earlier proposal without affecting much of the technical parameters as mentioned below:

The earlier proposal was modified avoiding submergence in Goa state. The location of Kalasa Dam is shifted by 200Ms upstream from earlier location at confluence of Kalasa and Surla Nalas. The FRL is changed from RL 733.00 M to 735.00M as the location is shifted on upstream side. The proposed dam is earthen dam with side waste Dam

On account of shifting of Kalasa Dam the diversion channel from Haltara to Kalasa reservoir also requires modification to avoid submergence in Goa state. Earlier it was proposed to divert Haltara reservoir water to Surla nala through 1.50 Km length of open channel. As surla nala falls in Goa territory a parallel channel in lieu of surla nala of length 5.42 Kms leading Haltara reservoir to Kalasa reservoir is proposed which also collects yield of Surla nala catchment in Karnataka state.

The project report of “The Mahadayi Diversion Scheme Stage-I “: (Phase – I and Phase – II) was placed before the IVth Technical Committee held at Hidkal Dam on 15-9-1992 and has been cleared

for Rs. 23.93 crores subject to the water planning which is to be cleared by Chief Engineer, WRDO Bangalore vide G.O Letter No: ID:51: NPC:92:Dated 8-10-1992

It is proposed to take up the works as below. :-

Component – 1

- Construction of Kalasa Dam and open channel with cut and cover connecting Kalasa reservoir to Malaprabha River to divert water from Kalasa reservoir.

Component – 2:

- Construction of Haltara dam and open channel to divert water of Haltara nala, Surla Nala water and from Surla catchment to Kalasa reservoir.

Based on above components, of DPR of Kalasa nala diversion scheme was prepared adopting MLBCC Circle, Naviluteertha CSR for 1999-2000 amounting to Rs.44.78 Crores.

For this DPR, administrative approval was accorded by the Govt. vide order No.ID/57/WBT/2000, Bangalore Dated: 22.08.2000, and the project estimate is technically sanctioned by the Chief Engineer, KNNL, Irrigation (North) Belgaum vide Reg No. CIN 270 for March 2002 for Rs.44.78 Crores.

1.10.2 Earlier proposal – Alternate - 2 (PFR of 2020)

The earlier proposals were modified as the drinking water became priority due to scarcity of drinking water of Hubli-Dharwad Towns, Kundagol town and Enroute villages. Drinking water requirement has been arrived at as 7.56 TMC considering the projected population up to the year 2044. Out of 7.56 TMC, 3.56 TMC is contributed by Kalasa Nala diversion scheme. Now as per the allocation made by MWDT the contribution from Kalasa Nala Diversion will be 1.72 TMC out of 3.90 TMC.

Kalasa nala is a tributary to Mahadayi River. It originates in the peaks of Western Ghats near Kankumbi Village of Khanapur Taluk in Belgaum District and flows in the west direction and joins Surla Nala and on to Mahadayi River. The catchment receives very heavy rainfall.

It is proposed to augment the storage in Malaprabha reservoir by diversion of water from Kalasa Nala. The Kalasa reservoir receives water from its independent catchment as well as from Haltara nala and partly from Surla nala basin by an interconnecting canal.

The Kalasa nala Diversion Scheme envisages construction of a dam across Kalasa Nala and Haltara Nala near Kankumbi village in Khanapur taluka of Belgaum District

Earlier the administrative approval for this scheme has been accorded by the Government of Karnataka for Rs 44.78 Crores on 22.08.2000. (Price level of 1999-2000)

- The total catchment area of proposed dams and surla nala diversion is 25.50 Sq Km
- Submergence area is 403 Ha out of which 258 Ha is Forest Land.
- The length of the Kalasa Nala Dam is 441 m with height of dam being 27.00 M
- The length of the Haltara Dam 105 Mts with its height being 15.28 M
- The length of inter connecting canal from Haltara Dam to Kalasa Nala dam is 5.90 Km
- The length of inter connecting canal from Kalasa Nala dam to Malaprabha River is 5.15 Km

However, considering that the said scheme has been proposed to utilize the water for drinking purpose and keeping in view the time which may be required to obtain clearance from the Government of India.

The proposal envisages implementation of

- Construction of Kalasa and Haltara Nala Dams and Conveyance system required quantum of water to divert Malaprabha River.

The cost of the Project is worked out based on detailed designs and drawings. The cost of the project works out to **885.80 Crores (As per 2018-19 SoR)**

1.10.3 Conceptualization of Lift Scheme (Modified Proposal)

The Major findings/comments/observations of the Directors of Central Water Commission for the earlier proposed Kalasa diversion scheme (Gravity Diversion Scheme):

- Height of the dam,
- Over sizing of the inter connecting canals,
- Hydrology.

For the above observations, suitable compliance reports have been submitted justifying the technical feasibility of the project components.

Further, The Government of Karnataka has conceptualized an alternate proposal of ***lift scheme instead of gravity since the diversion is meant for meeting the drinking water requirements,*** this will address all the apprehensions of CWC regarding the diversion. This alternate proposal has thus minimized the storage by reducing the height of the dams, submergence in forest area, etc.,

The proposed lift scheme will now address the,

- Concerns of the downstream riparian states regarding diversion of additional water over and above the allocation by having regulating arrangements at the lift point as well as at delivery point.
- Minimizing the time required for execution of the project from 5 years to 6 months.
- Minimizing the extent of forest land diversion by about 85%
- Avoiding major infrastructure for diverting water in terms of open canal, diversion dam etc. by having piped conveyance system.

1.10.4 Modified proposal under Kalasa nala Diversion Scheme (Lift Scheme)

Consequent to the reduction in allocation of water, a diversion dam of 10.5 m at Kalasa Nala, 9.30 m at Haltara nala and 2 to 6 m high check dams across Surla Nala from the Nala bed levels is proposed to divert 1.72 TMC of water to Malaprabha river though a series of Lift schemes.

The extent of storage is now restricted to 522 - minutes, thereby minimizing the forest submergence. The total extent of submergence is 12.30 Ha at Kalasa, 2.28 ha at Haltara and 1.94 Ha at Surla. The forest land required for the conveyance system under Kalasa will be 10.48 Ha and that of Haltara is 6.95 Ha & Surla will be 3.25 Ha.

1.10.4.1 Conveyance system

Since the additional lift is included from the Surla nala, it is now proposed to pump the water from Halthara and Surla nala and deliver to Kalasa reservoir. The diverted water including Kalasa is pumped to the entry of cut and cover.

A jack well cum pump house is proposed at the fore shore of the Haltara Dam. Water will be lifted and conveyed through MS pipe of 0.96 m dia for a length of 740.0 m to Delivery Chamber (DC-1) and further by gravity to Receiving Chamber (RC-1).

Under Surla nala there are 6 streams which are to be harnessed to achieve combined discharge requirement. Hence, it is proposed to provide a Gravity Pipe from Nala-1 (CD-1) upto Nala-6 (CD-6) by providing a cross country pipeline. Inlets are proposed at every nala which will feed the discharge to Gravity Pipe. Looking to the topography, difference in Nala-1 to Nala-6 is about 7.0 m. Hence, Gravity Pipe can be proposed.

From the end of Gravity Pipe i.e., after crossing Nala-6, a collection sump cum pump house is proposed from which combined water from all the 6 nalas is pumped to a Delivery chamber (DC-2) and further by gravity to Receiving chamber (RC-1). The receiving chamber will receive water from both Halthara and Surla leading to Kalasa reservoir.

A jack well cum pump house is proposed at the fore shore of the Kalasa Dam. Water will be lifted and conveyed through MS pipe of 2.83 m dia for a length of 2880.0 m to Delivery Chamber (DC-3) and further by gravity to Receiving Chamber (RC-2) leading to already constructed cut and cover.

1.10.4.2Project componenets

This project is one of the two projects proposed to be undertaken for diverting about 3.90 TMC of water to meet the drinking water needs of the above areas.

Under Kalasa project, it is envisaged to divert 1.72 TMC of water after the following works are completed.

As per National water policy, providing drinking water to the people is of paramount important and it precedes over all the other needs.

1.6.1 Construction of Diversion Dam across Kalasa nala

Construction of Jack well cum pump house along with rising main for diverting combined water of Kalasa nala, Haltara lift and Surla Lift from Kalasa diversion dam to the existing Kalasa - Interconnecting canal which will in turn join to Malaprabha River at Kankumbi village.

1.6.2 Construction of Diversion Dam across Haltara nala

Construction of Jack well cum pump house along with rising main for diverting water from Haltara diversion dam to the reservoir of Kalasa diversion dam.

1.6.3 Construction of Diversion Dam across Surla nala

In the present proposal water of six Surla sub-nalas contributing from the Catchment of Karnataka will be intercepted by construction of check dams within the Karnataka state, these waters will be intercepted and transferred to a receiving chamber through MS gravity feeder pipeline which will run perpendicular to these six check dams. Further the intercepted water will be received by a receiving chamber located near the confluence of Kalasa and Surla Nalas in the sixth Surla sub-nala. A Retention period of 90 seconds has been provisioned in the receiving chamber; the water will be

diverted by a Jack well cum pump house along with rising main to the reservoir of Kalasa diversion dam

As against the claim of Karnataka for the diversion of 3.56 TMC from the Kalasa nala diversion scheme (Lift scheme), and the tribunal has allotted 1.72 TMC in its award dated 14/08/2018 which has been published in the extraordinary Gazette of India by the Ministry of Water Resources, Government of India on 27/02/2020.

The Government of Karnataka has already filed an SLP seeking increased allocation as per its original claim before the Hon'ble. Supreme Court of India.

The Kalasa lift scheme is planned for diversion during monsoon (i.e., from 1st June to 31st October)

As per the tribunal award the diversion lift scheme shall be regulated by the Mahadayi Monitoring committee which will be constituted by Govt. of India. This shall ensure the diversion of waters as per the allocation by the Tribunal.

1.11 Stages / Phases of Development of Project

The present Project is proposed to be implemented in a single Stage.

1.12 Fitment of the Scheme in Overall Development of River Basin

This project has been envisaged exclusively as a drinking water supply scheme and as such, overall development of the river basin is not a criteria considered.

1.13 Intimation to Other Developmental Authorities

The scope of the project is intimated to other development authorities.

1.14 Public Announcements & Public Hearings

The project is an important scheme involving exclusive drinking water supply to the Hubli – Dharwad twin cities, town along with en route villages, the project would be taken up by giving wide publicity by way of public announcements and conducting public hearings.

1.15 Interlinking of the Scheme With Neighbouring Schemes

After diverting water from Kalasa to Malaprabha River as envisaged, arrangements would be made to supply the required quantum of water to the Twin cities of Hubli – Dharwad, Kundagol Town along with en route villages. The total quantum of water proposed to be diverted from Kalasa Nala Dam is 1.72TMC as per the award of the Hon'ble Mahadayi Water Disputes Tribunal.

1.16 Interstate / International Aspects

Details enumerated in a separate Chapter on Interstate / International aspects.

1.17 Cost & Benefit of the Scheme

The cost of the Project is worked out based on detailed designs and drawings. The cost of the project works out to **995.30 Crores (As per 2021-22 common SR).**

1.18 Public Co-Operation & Participation

The details of the project have been widely publicized and the people in the areas concerned have been made aware of the project. The Government on its part has taken views of the elected representatives and the technical experts on the scheme before giving approval to it. Even after giving administrative approval, the Department has carried out enough alternative studies to address all the issues concerned such as land acquisition, forest etc. Further deliberations on the scheme has lead to finalizing the most economical, viable and implementable alternative.

1.19 Provision for Domestic & Industrial Water Supply

No provision has been made in the project for domestic and industrial power supply.

Chapter 2
Physical Features

2.1 Geographical Disposition

Kalasa Nala Diversion Scheme (Lift Scheme) project is located at Latitude 15°40'52.54" N and Longitude 74°11'22.98" E Coordinates near Kankumbi village, Khanapur taluk of Belagavi District, Karnataka State.

2.2 Topography of the Basin

Malaprabha River originates at an elevation of 793 m near Kankumbi village in the Khanapur taluk of Belgaum district and flows towards east to join River Krishna at an elevation about 488 m after traversing a distance of 306 Km. It is one of the principal tributaries of River Krishna.

The Kalasa Project lies in the hilly terrain of the Western Ghats. The area is highly undulating with hills covered by thick evergreen forests.

The project as a whole lies in the Northern Karnataka Plateau covering the districts of Belgaum, Bagalkot, Dharwad and Gadag.This region largely covers the parts of Malaprabha sub basin in Krishna basin lying in Karnataka. In the west, it is enclosed by the ranges of Western Ghats with an elevation ranging from 700 m to more than 1000 m with its northern part being an interrupted but clearly identifiable high plateau. In the east, the valleys of the Malaprabha followed by that of Krishna and its tributaries open out to form undulating plains. The general elevation of the region varies between 500m to 700 m.

2.3 Geology of the Basin and Reservoir

Regional Geology:

Various geological formations can be observed in Belgaum district where in Bandura and Kalasa Diversion schemes are proposed. The region comprise schist and banded ferruginous quartzite, the Peninsular gneiss by granite and gneissic granites rocks, the Kaladgi formations consisting of sandstone, quartzite, shale and Limestone and Basalt (Deccan Trap) and the Laterite formations are observed in the district.Population

Kalasa, Surla and Haltara nalas are the tributaries to Mahadayi River. These tributaries originate in the Western Ghats at an elevation of EL 700m to 800 m in the water divide ridge portion hilly region and flows into westerly flowing Mahadayi River. On the eastern side of the summit of this western ghat range belong to catchment of River Malaprabha which is a tributary to Krishna River/basin. The

catchment area of these tributaries comprised of thick forest and receives heavy rainfall during south-west monsoon. The present proposal is to partly divert water from Kalasa, Surla and Haltara nalas to augment storage in the Malaprabha reservoir. It is proposed to be executed as single project comprising "Diversion dams across Kalasa and Haltara nalas and Check dams across five tributary nalas of Surla, for diverting the required quantity of water through Lift scheme and further take it to Malaprabha River augmentation of water for drinking water supply needs of Hubli-Dharwad twin cities along Kundgol town enroute villages. All the sites of these schemes are located almost adjacent to Belagavi-Goa going NH-748AA.

The topography, geology of these individual sites of these three nalas are described based on the site visits and previous investigation data made available for preparation of this report.

This geological appraisal report is prepared with respect to Haltara, Surla and Kalsa Nala Diversion dams/check dmas schemes individually, based on the site visit and previous reports/investigation data collected for the alternative studies done earlier for head works and diversion arrangements through canal/s alignments between Mahadayi and Malaprabha catchment area.

Geological Succession of this region.

Major Rock Formation	- Age
Laterite, sand deposits	-Recent
Deccan Basalt	-Tertiary
Sandstone, Dolomite, Limestone	-Kaladagi Series
Schist, Gneiss, Granite	-Archean

As such, the project comprising of dams across Kalasa, Surla and Haltara Nalas and alignments of diversion pipelines fall in the Western Ghats region which is a rich reserve of rock formations. Deccan Basalt, Meta Greywacke, quartzite, quartz sericite schist, phyllite and Dykes are the predominant rock types found in this area. Granites, Leptynites, Charnockite as well as iron ore, dolerites, laterites and bauxite ores are also found in varying proportions in the surrounding areas. Archean complex rocks are the oldest formation and are also found in majority of the surrounding project area. They are un-fossiliferous, crystalline rocks.

The formation of the Deccan Trap along with Inter- trappean bands, belong to tertiary era and it represents one of the largest accumulations of basaltic continental lava covering an area of 500,000 km^2. This landform mostly consists of greyish to black augite-basalt rock which is prevailing at and around these three schemes.

Besides above rock formation in the study area tertiary and recent laterites and alluvial deposits are also found capping the Deccan trap. It is more recent and is found on the coast as well as in several districts of Deccan Plateau. Laterite is a product of sub-ariel weathering and leaching action in different rocks during monsoon, in conditions of excessive wetting followed by dryness. The high-level laterite found in Belgaum, Bellary, Chikamagalur and Hassan districts are of this type.

All the three diversion schemes mentioned under this report fall within Deccan Basalt rock formation along with recent deposits mentioned under this regional geology paragraph.

2.3.1 Kalasa nala diversion scheme.

The scheme envisages construction of diversion dam across Kalasa nala, and Jack well to lift the water to raising mains and to gravity mains pipe line. The water from Haltara, Surla and Kalasa all together will be further joining with the already constructed gravity main to carry waters of three nalas to Malprabha River.

a. **Kalasa Diversion Dam** :

Kalasa nala flows in Western Ghats to join with Surla which in turn joins to Mahadayi River. At the project site, Kalasa nala flows in SW direction. The project envisages construction of 10.5m high diversion dam with its top at EL723.0m at its crest/FRL level from the deepest foundation, across the nala. The site is almost adjacent to Belgaum Goa Highway. Further, it is proposed to lift the water through Jack well located on the right bank (adjacent to highway near existing Delta-resort) of the nala connecting to rising mains through pipe line.

b. Topography:

The proposed dam site is in hilly area of western ghat and Kalasa nala having broad bed width with gentle gradient at the banks on both side. Right bank at the dam axis having terrace like flat ground for considerable length (70m) there onwards, slope gentle at moderate angle towards highway side with thick vegetation growth. The left bank of the nala is relatively sloping at moderate angle. The valley slopes are dissected with sub nalas having dendritic pattern. The nala bed having very gentle gradient from upstream to downstream direction for considerable length at the proposed dam axis.

c. Dam site:

The proposed Kalasa dam is a concrete dam with earthen flanks on both sides and Ogee type diversion structure with central spillway in the river course. The total length and height of the dam is fixed based on the topography and geological conditions and also storage requirement as envisaged for this project.

d. Surface and sub-surface geological Investigations:

Detailed geological field traverses have been carried out for the project site. The diversion dam site remains same one which was considered for the earlier scheme. Some exploration works have been carried out at the dam site involving 6 no of holes varying from 8.30m to 34m depths. All the holes were extended down to hard rock for establishing the rock profile along the dam axis and upstream and downstream portions also. One drill hole is also proposed for the newly selected Jack well location on the right bank hill slope of the dam site. The data of relevant drill holes have been used as indicated in the geological section prepared.

The bed rock consisting of strong basalt is also exposed all along and width of the dam site portion. All these information, have been used to assess the subsurface strata conditions of the dam site. Accordingly, geological sections are prepared along the dam axis (Section A-B) and along cross sections (C-D, E-F and G-H) representing the non over flow, spillway blocks along with under sluice block also.

Figure 5: View of Dam site on Kalasa Nala exposed with basalt rock in the nala bed.

e. Dam Site Geology:

Kalasa nala at the proposed dam site is following straight course along S-W (N240) direction. The river bed gradient is seen to be very gentle both in upstream and downstream directions. The river banks are covered with overburden deposits comprising slope wash and alluvial deposits of the nala at and around the dam site. The Greyish black basalt rock exposure throughout the length of the river bed portion seen to be eroded due to water action leaving some pot holes, openings along some joints etc. The flow joint sin the basalt noted to be dipping at 15^0 degree in the downstream direction. Other set of joints are dipping steeply (75^0-85^0) either along or across the river course.

Overall, from the field traverses and available subsurface geological information as explained above, the basalt bed rock is present from the ground level itself and in the bank portion adjacent to river bank, it may be available at 1.5m to 2m depth along the dam axis for the dam foundation. The top layer of basalt may be weathered and may require its removal, before getting in to fresh and strong rock. As noted at site, pot holes or eroded surface of basalt due to water action as seen in the basalt expose. Such eroded surface to some extent may need striping to get suitable rock at the foundation grade.

Figure 6-Upstream of dam axis view

Figure 7-Downstream of dam axis view

Figure 8: View of right bank terrace covered under overburden deposits.

Hence, it is observed that entire dam area along with Jac well location is occupied by Basalt bed rock. It is generally hard and strong rock. The basalt being strong igneous rock, it provides sound and stable foundation conditions for the dam base and other appurtenant structures at the dam site.

The dam site along with jack well area, rising main and gravity flow pipeline alignment areas comprises of Deccan Basalt as the main bedrock, prevailing in the area. The basalt expected to be having gently dipping flow joints along with other two to three set of impersistent joints.

f. Following geological inferences are drawn about the dam site works.

- Topographically, at the dam site, river has flat gradient and both banks, especially the right bank is flat for quite length before start of moderate slope on the hill side.
- At the dam axis, the nala bed is exposed with basalt rock and are available att he foundation levels of Bay-01 to Bay-09 of the concrete dam. As the bed rock further towards the bank are covered with overburden deposits with thickness varying from 4m to 10m, the key blocks of the dam may have to be located on overburden deposit. Or lese the foundation of these blocks should be lowered at the basalt rock. The overburden deposits comprising lateritic sandy-silt soils along with laterite boulders.
- Basalt being hard rock, suitable for concrete dam with central spillway as proposed.

Geological section based on site observations and subsurface information around the dam site based on drill hole data has been developed mainly indicating the depth of overburden and bed rock contact.

Figure: 1.4- View of dam site across the river flow

Such sections are developed along the dam axis (A-B) and also across the dam body representing non overflow portion and also spill way portion and block having under sluice opening Sections (C-D, E-F and G-H).

Over all it is observed that the proposed dam foundation expected to be on the bed rock profile with embankment portions may fall on the overburden portion. During construction, if required foundation levels can be adjusted suiting to the site conditions.

The provision of rock anchors with grout holes at the foundation of the dam will be quite use full in strengthening the jointed rock and to enhance the stability of the dam.

g. Reservoir area:

The dam height being around 10m, the reservoir will be spreading mainly along the valley portion of Kalasa nala course. The banks are relatively gentle which is almost flat adjacent to rover course. Hence reservoir spreading shall be more along the nala course. The water escaping in to other places also seen to be not possible as the Kalasa is the main drainage flowing in this terrain.

As in the case of dam site, Basalt is the bed rock in the reservoir area also. The ground portion mostly covered with moderately thick overburden deposits. The catchment being highly forested, the surface erosion is also expected to be minimum in this part of the terrain.

Since the bed load will be carried during floods in the nala, under sluice provision in the dam is recommended.

h. Jack well location and Rising main along with Gravity flow pipeline alignment.

i. Topography

Kalasa Diversion Project lie in the hilly terrain having thick forest of western ghat region. The water conductor system comprising Jack well, rising mains and pipe line alignment for gravity flow of the water in to main course of Malprabha River is located on the right bank of Kalasa nala. The area in general is covered with overburden deposits mainly consisting of gravely, sand-silty lateritic soils with some laterite and basalt rock boulders. Availability of hard bed rock at some location along the pipe line alignment is not ruled out. The local drainage system is developed in dendritic to semi dendritic pattern along with redial patterns at places diverging around the summit of the hills.

ii. Jack well Location:

The proposed jack well location is about 50m away from the dam, on the right bank hill slope. The area is moderate to steeply sloping ground towards, thick overburden deposits along with highly weathered basalt rock expected in the side walls of the jack well pit. The fresh bed rock may be expected around EL 727m based on the earlier drill hole data done towards right bank of the Kalasa nala. As the foundation level of Jack well is EL 709m it is predicted to be on fresh and hard basalt rock.

iii. Rising mains and gravity Pipe line alignment:

In general, being hilly area where the alignment run through for rising mains and gravity lines, terrain will be undulatory having varying thickness of overburden deposits. Basalt is expected as bed rock

along the alignment comprising of laterite and basalt boulders. This may require mild blasting locally during excavation. The fresh rocks are generally hard and weathered will be softer rocks.

However, as the major length of the alignment for this structure will be routed through overburden deposits, these deposits may be the foundation material for most of the locations due to non-availability of bed rock at that depth.

Only in case of some deep cut below the ground level more than 5m depth or so, it may pose some stability issues which will be for temporary nature/period, as these pipe lines are proposed to be covered with excavated material once the laying of pipes are over.

2.3.2 Haltara diversion scheme:

I. Haltara diversion Dam :

This is the western most project among the three schemes. Haltara nala flows towards NE direction at the proposed dam site. The project envisages construction of 12m high diversion dam with its top at EL738.5m across the nala near Chorla Village. Further, it is proposed to lift the water through Jack well located on the left bank of the nala connecting to rising mains through pipe line.

II. Topography:

The proposed dam site is in hilly area of western ghat and Haltara nala having broad bed width with gentle gradient at the proposed dam site. Both the banks at the dam axis having terrace like flat ground which further slope up at moderate angle towards the abutment side and under thick vegetation growth. The Jack well is proposed on the left bank and location is on moderately sloping ground. The valley slopes are dissected with sub nalas having dendritic pattern with EL varying around 800m. The nala bed having very gentle gradient from upstream to downstream direction varying from EL731m to 726m in a span of about 770m length.

III. Dam:

The proposed Haltara dam is a concrete dam with earthen flanks on both sides and Ogee type diversion structure with central spillway in the river course. The total length and height of the dam is fixed based on the topography and geological conditions and also storage requirement as envisaged for this project.

IV. Surface and sub surface geological Investigations:

Detailed geological field traverses have been carried out for the project site. One drill hole is completed for the Jack well location on the left bank hill slope of the dam site. One more hole of 6m deep was also reportedly drilled/attempted along the dam axis on the left bank terrace portion which had encountered bed rock around 1.75m depth. Apart from this, there is one big diameter (5m) dug well

quite nearer to dam axis, about 50m downstream on the left bank terrace portion near the foot hill side of the left bank hill range of Hltara nala. This well gives better idea about the subsurface geological information of the dam site area where in bed rock has encountered has encountered around 1.75m depth.

Besides above, the Basalt rock exposers are found on the right bank of the Haltara Nala at about 50m upstream of the dam axis. All these information, have been used to assess the subsurface strata conditions of the dam site.

Figure 9: View of a dug well near dam site nearby on left bank, encountered with Basalt rock .

V. Dam Site Geology:

Haltara nala at the proposed dam site is following straight course towards N20E direction. The river bed gradient is seen to be very gentle both in upstream and downstream directions. The river bed and banks are covered with overburden deposits comprising weathered material and alluvial deposits along the dam axis. The Greyish black basalt rock exposures are mostly observed on the right bank at about 50m upstream of the dam axis. Over all, from the field traverses and available subsurface geological information as explained above , the basalt bed rock is expected around 1.5m to 2m depth for the dam foundation. The top layer of basalt may be weathered before getting in to fresh, strong rock. Hence some selective removal of the softer rock may be required during the foundation excavation at the dam site. On an average 1.0m to 1.5m weathered thickness of basalt is assessed at this site.

Hence, it is observed that entire dam area along with Jack well area is occupied by Basalt rock. It is generally hard and strong rock. The basalt being strong igneous rock, it provides sound and stable foundation conditions for the dam base and other appurtenant structures at the dam site.

Figure 10: View of dam site looking towards downstream direction from dam axis.

Figure 11: Basalt rock exposed on right bank, 50m upstream of dam axis.

In general, the dam site along with jack well area, rising main and gravity flow pipeline alignment areas comprises of Deccan Basalt which is the main bedrock prevailing in the area. The basalt expected to be having gently dipping flow joints along with other two to three set of impersistent joints.

Following geological inferences are drawn about the dam site works.

- Topographically, at the dam site, river has flat gradient and both banks are also flat for quite length before start of moderate slope on the hill side.
- At the dam axis, the ground is covered with overburden deposits for about 1.5m to 2m thick which will be followed by weathered basalt of about a meter thick and fresh and strong basalt rock. The overburden deposits comprising lateritic, sandy-silty soils along with laterite boulders.
- From the available data and field observations, it is inferred that the rock profile runs almost horizontal in the river bed portion and along the banks covering substantial length of dam base.
- Basalt being hard rock, suitable for concrete dam with central spillway as proposed.

Figure 12: View of dam site across the river flow

Geological section based on site observations and subsurface information around the dam site based on drill hole data has been developed mainly indicating the depth of overburden and bed rock contact. Such sections are developed along the dam axis (A-B) and also across the dam body representing

non overflow portion and also spill way portion and block having under sluice opening Sections (C-D, E-F and G-H).

Over all it is observed that the proposed dam foundation expected to be on the bed rock profile with embankment portions may fall on the overburden portion. During construction, if required foundation levels can be adjusted suiting to the site conditions. As such it is recommended to remove highly weathered basalt rock for the dam base especially in case of concrete blocks.

The provision of rock anchors with grout holes at the foundation of the dam will be quite use full in strengthening the jointed rock and to enhance the stability of the dam.

VI. Reservoir area:

The dam height being around 10-12m, the reservoir will be spreading mainly along the valley portion of Saltara nala course. The banks are relatively gentle which is almost flat adjacent to rover course. Hence reservoir spreading shall be more along the nala course covering the bank portions. The Saltara nala valley slopes are at moderate angle, devoid of any unstable zones. Possibility of water escaping in to other places also seen to be not possible as the Saltara is the main drainage flowing in this terrain.

As in the case of dam site, Basalt is the bed rock in the reservoir area also. The ground portion mostly covered with moderately thick overburden deposits. The catchment being highly forested area, the surface erosion is also expected to be minimum in this part of the terrain.

Since the bed load will be carried during floods in the nala, under sluice provision in the dam is recommended.

VII. Jack well location and rising main along with gravity flow pipeline alignment.

i. Topography:

Saltara Nala Diversion Project lie in the hilly terrain having thick forest of western ghat region. The water conductor system comprising Jack well, rising mains and pipe line alignment for gravity flow of the water in to main course of Malprabha River is located on the leftt bank of Saltara nala. The area in general is covered with overburden deposits mainly consisting of gravely, sand-silty lateritic soils with some laterite and basalt rock boulders. Availability of hard bed rock at some location along the pipe line alignment is not ruled out. The local drainage system is developed in dendritic to semi dendritic pattern along with redial patterns at places diverging around the summit of the hills.

ii. Jack well Location:

The proposed jack well location is about 100m away from the dam, on the left bank hill sidehaving moderately sloping ground under forest cover. Ground is covered with overburden deposits. Tone hole is drilled nearer to the Jack well location and following is the findings of the hole done.

BH-01-Hole done at El 758m, Total depth of the hole is **25.5m**

Depth 00.00-18.0 m – Soil

18.0 – 21.0m – Soft rock- weathered Basalt.

21m- 22.5m (EL 737-735.5M) - Multi soft and hard rock-Interpreted to be different varieties of moderately weathered basalt

22.5m- 25.5m (EL 735.5M-732.5m) – Fresh and hard Basalt, with zeolites in between.

Figure 13: View of the core box of drilling done for Jack well foundation

In view of above findings, it is inferred that the Jack well foundation level being at **EL724.5m**, the foundation grade of Jack well structure expected to be on hard and fresh basalt rock. To attain this one, surface pit excavation for the foundation of jack well is required which will negotiate about 18m through overburden deposits followed by weathered rock for about 4m depth followed by fresh basalt rock. As such the jack well, foundation shall have stronger and harder rock formation.

Figure 14: View of Jack well location on left bank hill slope of Saltara nala

VIII. Rising mains and gravity Pipe line alignment.

In general, being hilly terrain, where the alignment run through for rising mains and gravity lines, terrain will be undulatory having varying thickness of overburden deposits. Basalt is expected as bed rock along the alignment comprising of laterite and basalt boulders. This may require mild blasting locally during excavation. The fresh rocks are generally hard and weathered will be softer rocks.

However, as the major length of the alignment for this structure will be routed through overburden deposits, these deposits may be the foundation material for most of the locations due to non - availability of bed rock at that depth.

Figure 15: View of Raising main location

Only in case of some deep cut below the ground level more than 5m depth or so, it may pose some stability issues which will be of temporary nature/period, as these pipe lines are proposed to be covered with excavated material once the laying of pipes are over.

2.3.3 Surla nala diversion scheme

The scheme envisages six pick up dams for the diversion of water from the tributary nalas of Surla. Series of pick dams are proposed across small nalas whose height vary around 1.97m to 2.3m. These check dam are spread along Belgaum-Goa highway, which are connected to Gravity main pipe line that also running parallel to the high way.

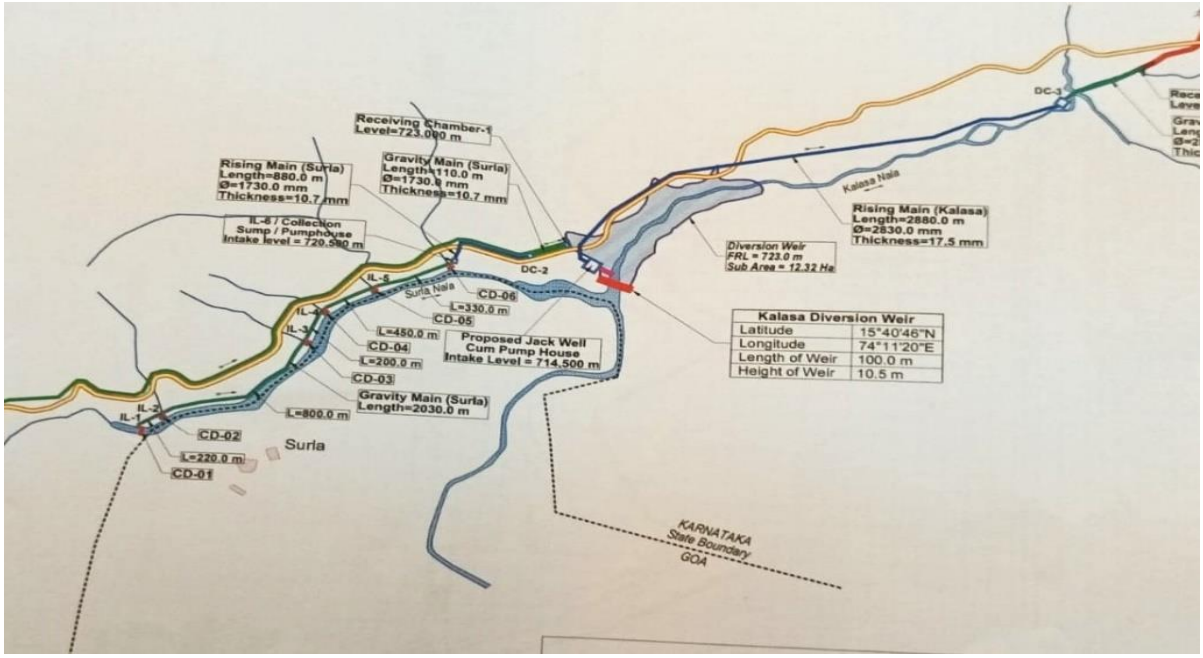

Figure 16: General layout of Surla diversion scheme

A. **Topography and Geology set up of the area**.

This scheme is also located in the western ghat region having abundant growth of trees. The topography comprised of hilly area dissected with various tributary nalas. The tributaries to Surla, are all flowing in the southerly direction on which check/diversion dams are proposed. The nala banks are having thick growth of vegetation and covered with expectedly 2-3m thick overburden deposits.

Basalt is the main bed rock at all the Check dams and along the gravity main alignment. As the proposed check dams no 2 to 6 are of smaller heights of 2m only, probably the foundation grade for these dams will be mainly of overburden deposits which consists of lateritic soil and some boulders of laterite and basalt rocks. As the nalas are having moderate gradient, some erosion control measure in

the downstream of the gravity /check dam structures may be needed. There is possibility of getting the basalt rock also at the foundation grade of these structures.

The Check dam no-01 is proposed in fact on the start of the main Surla nala itself and the height of the diversion structure is 6.8m. In this case the nala at this proposed site is having gentle gradient with flat banks covered with overburden deposits mainly of old alluvium deposits brought by the nala itself.

Figure 17: Downstream side View of Surla nala/diversion site

Figure 18-View of Surla- weir site-01

Figure 19: Weir site-02

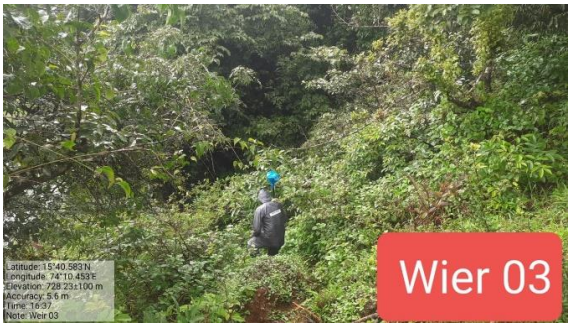

Figure 20: Weir site-03

Figure 21: Weir site-04

Figure 22: Weir site-05

Figure 23: View of Weir site-6

Figure 24: View of Surla Jack well location near Weir-6 site

From the above photographs, it is evident that all the weir sites, Jack well, gravity main alignment etc, are under the cover of thik overburden deposits. The Jack well site is proposed to be explored with one bore hole.

It is also recommended that Weir-01 site being relatively higher structure compared to others, recommended to explore by a drill hole or exploration pits on the banks of the weir site.

2.4 Seismicity:

The proposed project areas fall within **Zone III** of Seismic zonation map of India. Accordingly, the structures of the project should be designed.

2.5 River System and Basin Characteristics

River Mahadayi (Mandovi) is a West flowing interstate river in Western Ghats. The river has a total length of 81 kilometres (50 miles); 35 kilometres (22 miles) in Karnataka, 1 kilometre (0.62 miles) in Maharashtra and 45 kilometres (28 miles) in Goa. It originates from a cluster of 30 springs at Bhimgad in the Western Ghats in the Belagavi District of Karnataka.The River has total 2,032 km^2 catchment area of which 1,580 km^2, 375 km^2 and 77 km^2 catchment area are in Goa, Karnataka and Maharashtra respectively. With its cerulean waters, Dudhsagar Falls and Varapoha Falls, it is also known as the Gomati in a few places. The Mandovi enters Goa from the north via the Sattari Taluka and from Uttara Kannada District of Karnataka near the Castle Rock Rly. Stn. The Mandovi flows through Belagavi, Uttara Kannada in Karnataka and Cumbarjua, Divar and Chorão in Goa, eventually pouring into the Arabian Sea. The tributaries of Mandovi or Mhadei include Nerul River, Mapusa River, Valvanti River, Udnai River, Dudhsagar River, Ragada River and Kotrachi Nadi.

General

The climate of the region is semi-arid. The larger variations in rainfall from year to year both in quantity and distribution through the season render the region prone to drought and famine. The hot season begins by March and extends upto the end of May, followed by Southwest monsoon season from June

to September when the weather is cool and damp. The Northeast or the retreating monsoon season period is from October to December, while the cold season is from December to the middle of February. As per Koppen's classification, the regional climate is moderate

2.5.1 Rainfall

The project region experiences an average annual rainfall of 3854.63 mm.Though the total rainfall is not high, the area benifits both from the Southwest and Northeast monsoons. The Southwest monsoon reaches the region by about first week of June. There is a steep rise in Southwest monsoons during the months of September, October and November which brings in, the Northeast monsoon rains. The rains fail in some years.

2.5.2 Temperature

The variation in the maximum temperature during the year varies from 27°C to 35.7°C and minimum temperature varies from 13.9°C to 20.6°C. The region experiences pleasant winters and hot dry summers. The hot season extends from March to May, during which the daily maximum temperature often shoots up to 35.7°C

2.5.3 Humidity

The region on the whole enjoys a moderate climate.

a. Relative Humidity

Most humid conditions are found in the monsoon and post monsoon season. Mornings were more humid than evenings and humidity ranges from high of 54.5 to 89% in day time and low of 24.4 to 78.5% in night.

2.5.4 Cloudiness

Skies are generally clear or lightly cloudy during the months of December to March. Cloudiness begins to increase progressively from April and during monsoon months the skies are heavily clouded on most of the days.

b. Cloud Cover

Sky is generally heavily clouded during the monsoon season. During the post-monsoon months, cloudiness decreases. During the rest of the year, the sky is clear or lightly clouded. The cloud cover in the basin varies from 4.1 to 5.3 oktas.

2.5.5 Wind

Most parts of the area are exposed to strong winds almost throughout the year. By the end of October, fairly constant wind, which gets cooler with the progress of the season, sets in from the Northeast. From November to January, dry and biting winds blow from direction between northeast and southwest. In February, northerly and northwesterly winds are also common in the forenoon and these become more and more predominant in the months of March and April. The afternoon winds are variable in all these three months. With the advance of summer, dust-raising winds add to the discomfort of the hot weather. During the second half of May, winds increase in force and blow from directions between Southwest and Northwest. Although they do not bring rain, these winds are cool and refreshing. With the onset of monsoons, winds strengthen further and blow from directions West and Southwest. By the latter half of September winds begin to weaken and blow from directions between North and East.

c. Wind Speed

The area is generally calm during winter and summer periods, with mean wind speed ranging from 7 to 15 km / hr. The wind speed attain maximum during June & July months (15 Km/hr).

Chapter 3
Interstate /International Aspects

3.1 States Traversed by Mahadayi River and its Tributary

River Mahadayi (Mandovi) is a West flowing interstate river in Western Ghats. The river takes its origin in Karnataka, flows for about 35 Kms in Karnataka State, and enters Goa and joins the Arabian Sea.

The total catchment area of the river Mahadayi is 2032 Sq.km, out of which 375 Sq.km is in Karnataka, 77 Sq.km is in Maharashtra and 1580.00 Sq.km is in Goa.

3.2 Distribution of Catchment in the State and Yields from the Catchment

The total catchment area of Kalasa Nala is 25.5 Sq. Km and the distribution of the same in the basin is as indicated in **Table 3.1**

Table 3.1: Catchment area of Kalasa Nala river Basin in the state

No.	Name of the river basin	Catchment area in (Sq. Km)
1	Kalasa Nala	15.50
2	Haltara	4.00
3	Surla	6.00
		25.50

3.3 Interstate Adjudication

The State of Goa raised objections regarding Kalasa and Bhandura Nala diversion scheme before the Hon'ble Supreme Court and as per the request of Government of Goa to Hon'ble Supreme court and on the direction of Hon'ble Supreme court, the Central Government constituted the "MAHADAYI WATER DISPUTE TRIBUNAL" on 16.11.2010 and published notification. The "MAHADAYI WATER DISPUTE TRIBUNAL" has pronounced its final award on 14.08.2018. The details of the award viz State wise and project wise allocation made are tabulated below.

Table 3.2: Details of the award viz State wise and project wise allocation

No.	Name of Project	Claim Before MWDT	Allocation by MWDT	Difference (TMC)
I.	**Consumptive Use**			
1.	Diversion of Kalasa Nala to Malaprabha river for Drinking water supply of Hubli-Dharwad	3.56	1.72	1.84

No.	Name of Project	Claim Before MWDT	Allocation by MWDT	Difference (TMC)
	cities surrounding towns and enroute villages			
2.	Diversion of Bandura Nala to Malaprabha river for Drinking water supply of Hubli-Dharwad cities surrounding towns and enroute villages	4.00	2.18	1.82
	Drinking Water Total	**7.56**	**3.90**	**3.66**
3.	Within the basin use	1.50	1.50	---
4.	Diversion to Kali dam for augmentation for power generation	5.527	--	5.527
5.	Diversion of surplus water at 75% dependability from Kotni dam (MHEP) to Malaprabha river to meet irrigation, drinking water filling, irrigation tanks in DPAP talukas of Ramdurga, Bailhongal and Saundantti for meeting requirement of suffering atchakat of Malaprabha command	7.00	---	7.00
	Total (I)	**21.587**	**5.40**	**16.187**
II.	Non-Consumptive Use			
1.	Mahadayi Hydro Electric Project (MHEP) (Including evaporation loses of 0.4 TMC)	14.971	8.02	6.951
	Total (II)	14.971	8.02	6.951
	Total (I+II)	**36.558**	**13.42**	**23.138**

III.	**Project**	**Allocation Proposed by the State**	**Allocation as per Hon'ble MWDT**
1.	Kalasa Nala Diversion scheme for drinking water supply	3.56 TMC	1.72 TMC

The tribunal vide its award under volume XII, clause VIII, A, ii, d of the has directed the State of Karnataka to get the Detailed Project Reports approved by technical appraisal from central agencies and all mandatory clearances as required by law.

3.4 Operation and Regulation of the Project

The present proposal is envisaged primarily to develop scheme and divert allocated water to meet the drinking water, needs of areas falling under Hubli-Dharwad twin cities, Kundagol town and enroute villages further the regulation of diversion from kalasa project will be carriedout by the union government. Government of Karnataka being a responsible state will ensure the implementation of the project including quantum of diversion will be strictly as per the tribunal award. The GOK will share the required data and information regarding annual diversion confirming that the diversion is as per the award. The union government can have an independent status review regarding any of the issues arising out of this diversion.

3.5 Concurrence of the Riparian State for Additions / Alterations of Existing Project

The quantum of diversion will be in accoradance with the tribunal award and hence the concurrance of the riparian states is not applicable.

3.6 Details of Quantity of Water Diverted for Drinking / Cooling / Industrial Purpose

The allocated 1.72 TMC of water will meet the drinking water, needs of areas falling under Hubli-Dharwad twin cities, Kundagol town and enroute villages.

Chapter 4
Surveys and Investigations

4.1 Introduction

This chapter details the Survey, Alignment of diversion dams, reservoir survey, Head Works consisting of Intake fore bay, Jack Well cum Pump House, Rising Main and Delivery Chamber.

It involves establishment of Ground Control points, Temporary Benchmarks with respect to GTS BM and preparation of maps, Geotechnical Investigations, and analysis etc.

4.2 Data Collection

The Topo Sheets in which project area lies have been collected from Survey of India. Details of Topo Sheets are as below.

Table 4.1: Details of Topo Sheets

No.	Topo Sheet No.	Scale
1.	48 I	1:2,50,000
2.	48 I 02,(D43C02)	1:50,000

4.3 Index Map of the Scheme

All topo sheets collected are combined to form command area map. Head works consisting of Intake canal, location of jack well cum pump house, alignment of Rising Main and Gravity Mains are prepared on 1:50,000 scale topo maps. The alignments planned have been transferred to ground and detailed surveys carried out.

4.4 Identification of Benchmark

Based on the joint inspection along with the client officials, it was decided to carry out survey from the reference benchmark GTSBM situated on top of the slab near the Railway line at CH-582+020 from Hubli to Belagavi. The GTSBM location lies at 15° 37' 06.05" N, 74° 29' 52.71" E, Easting: 446186.202 m, Northing: 1726783.491 m and EL: 655.740 m is considered for the project. The images of the Reference Benchmark GTSBM and the reference control points established with reference to GTSBM is furnished in




Figure 25: Reference GTS Benchmark

4.5 Establishment of Ground Control Points

Based on the GTS benchmark Ground control points are established at every 500 m interval along the proposed pipeline alignment are established using DGPS instrument and is shown below

Table 4.2: Criteria for establishment of Ground Control Points

No.	Description	Standard
1.	Site Selection	• Protected areas like premises of permanent government offices / permanent structures or sheet rocks. • Open and clear to sky – Above 15^{o}angle • Avoid locations which interferes GPS signals
2.	Duration of observation	1 hours
3.	Accuracy	1:10,000
4.	Densification	3.5 km - 4 km apart

No.	Description	Standard
5.	Horizontal datum	WGS 84
6.	Instrument to be used	DGPS
7.	Vertical datum	Spirit height/ GTS RL
8.	Permissible error	12 √K. where K is length of levelling line in Km.

The details of DGPS control points established are enclosed to this report.

Table 4.3: Ground Control Points of Halthara Nala Diversion Scheme

Sl.No	Point name	Easting	Northing	RI	Description
1	BM-1	415661.500	1735482.730	751.225	**BM-1: -** is Taken from KNNL Irrigation Inspection Bungalow (IB) of Kanakumbi Village.10Ms North side of ASP Road Leading from Belgaum to Goa
2	GPS-4	408427.925	1731736.568	744.757	**GPS-4: -** Marked with Yellow Paint on Top of Bolder Stone.30Mt East of Temple. In Chorala Village.
3	GPS-4A	408401.815	1731779.041	739.484	**GPS-4A: -** Marked with Yellow Paint on Top of Bolder Stone. Near Temple. In Chorala Village.
4	GPS-5	408431.594	1731929.052	732.689	**GPS-5: -** Marked with Yellow Paint on Top of Pillar on Haltara Dam Centre Line.
5	GPS-5A	408453.891	1731915.823	729.371	**GPS-5A: -** Marked with Yellow Paint on Top of Pillar on Haltara Dam Centre Line .20Mt North West of Lined Well.

Table 4.4: Ground Control Points of Kalasa Diversion Scheme.

Sl No	Point name	Easting	Northing	RI	Description
1	BM-1	415661.500	1735482.730	751.225	**BM-1: -** is Taken from KNNL Irrigation Inspection Bungalow (IB) of Kanakumbi Village.10Ms North side of ASP Road Leading from Belgaum to Goa
2	GPS-1	413228.546	1733939.563	716.409	**GPS1: -** Marked with Yellow Paint on Top of Bolder Stone .100 Mt North East of National Highway Belgaum to Panaji.
3	GPS-1A	413202.475	1733875.896	715.028	**GPS1A: -** Marked with Yellow Paint on Top of Bolder Stone .100 Mt South East of Delta Hotel National Highway. Belgaum to Panaji.

Sl No	Point name	Easting	Northing	Rl	Description
4	GPS-2	411762.570	1733771.229	733.203	**GPS2: -** Marked with Yellow Paint on Top of Sine Bord. National Highway. Belgaum to Panaji.
5	GPS-2A	411788.479	1733803.718	732.880	**GPS2A: -** Marked with Yellow Paint on Top of Pipe culvert. National Highway. Belgaum to Panaji.
6	GPS-3	410017.063	1732802.314	755.051	**GPS3: -** Marked with Yellow Paint on Top of Pipe culvert. National Highway. Belgaum to Panaji.
7	GPS-3A	410076.977	1732901.106	754.598	**GPS3A: -** Marked with Yellow Paint on Top of Pipe culvert. National Highway. Belgaum to Panaji.

4.6 River survey

Based on the horizontal and vertical control established for the entire project area, the river survey is carried out in order to assess the section of the river, bed profile, including vulnerable reaches and also exposed bed rock within the battery limit of the project area. The surveyed data is downloaded and process in order to generate base map which will form the basis for the identification of the final location of the dam including all the allied structures.

4.7 Reservoir survey

Consequent to the survey of the river a base map is generated with contour at 0.5m intervals. Based on the contour generated, the capacity of the reservoir will be assessed. The storage capacity in the present scenario is limited to lowest bed level of the river and the maximum water level which will be fixed based on the extent of storage required for diverting for allocated water with minimum submergence. The base map will further used for final location of the dam, marking of the boreholes undertake, geotechnical investigation, identification of structures such as scour sluices, jackwell cum pump house, etc..

4.8 Right of way survey for the reservoir

a) Road : The survey and investigation including the master plan has confirmed that part of NH-748AA is likely to be submerged due to impounding of the water in the reservoir.The alignment survey forv the existing road is carried out in order to realign the road for ensuring smooth moment of the traffic. The extent of realignment including location etc.. has been

marked in the master plan..The width (ROW) of the realigned road is in accordance with NH standards and has confirmed by the authority

b) Water conducting system. The water conducting system from all the three-diversion sites will be through a closed conduits and it will be by gravity/pumping. Based on the master plan developed and locations are identified for taping the water including final terminal point (delivery location) the alignment of the water conducting system is planned to ensure that it will be shortest and at the same time parallel to existing utilities for easy operation and maintenances. The Right of way proposed is about 10.0 m and accordingly the alignment survey consisting of longitudinal section, cross section including strip survey for entire corridor width is carried out. The survey data will be the basis for generating require profile and also to assess the ownership of the land after superimposing the cadastral information.

4.9 Fixing Alignment on Ground and Detailed Survey

The planned alignment is fixed on the ground and all the care has been taken for the following: -

- The alignment shall be straight as for as possible.
- Alignment crosses Roads such as MDR, SH, NH perpendicularly.
- Alignment crosses nalas and valleys perpendicularly.
- Avoid steep gradients which creates high water pressure.
- Numbers of appurtenances (gate valve, check valve, drain, air release valve, pressure break valve) are minimized.
- Minimum cushion ensured at road crossings
- Alignment through rocky strata is avoided as far as possible.

The detailed strip survey along the alignment is carried out by taking centre levels at every 20 m interval and cross levels for a width of 30 m (15 m on either side) with levels at every 5 m interval. At crossing locations such as Road crossings, nala crossing, railway crossing's structure locations block levels along with cross sections and L-sections are collected for design of structures.

4.10 Detailed Topographical Survey

The proposed alignment has been physically transferred to the ground and all the care has been taken for most economical alignment. Before the commencement of alignment survey, control points have been established along the proposed alignment at about 500 m distance c/c using total station.

The traverse point established using the total station and the auto level have been ensured that they are common so as to facilitate for having data and elevation at the same point/ location.

The entire surveyed data which has been captured using the total station has been downloaded and a strip map has been generated for the entire corridor in an Auto CAD DX format. Detailed strip plan is prepared and enclosed along with longitudinal section.

The topographic survey plan so prepared has been taken as the base on which the cadastral map of the concerned villages has been super imposed in order to assess the name of the villages through which the alignment has been planned to include the survey nos.

Longitudinal section of alignment from take-off point to terminal point is drawn as per the standard scale. The below table shown the list of TBM list of Kalasa nala Diversion Scheme.

Table 4.5: Kalasa nala Diversion Scheme TBM list

Sl. No	Point	Easting	Northing	RI
1	TBMK1	415535.807	1735429.254	749.032
2	TBMK2	416157.694	1735770.207	752.611
3	TBMK3	416435.352	1736466.966	753.962
4	TBMK4	417276.894	1737063.909	733.679
5	TBMK5	417286.944	1737097.815	733.689

4.11 Geotechnical Investigation

Geo technical investigation is an important aspect in any project. This is required not only to decide about the type of foundation of the structures, but also to ensure the availability and adequacy of materials from borrow areas required for the project. An adequate Geo-tech investigation minimizes the cost and time over run-in projects.

A detailed investigation for site is essential before a design can be finalized. The object of Geo technical and related site investigation is to provide the engineer or architect with as much information as possible about the existing conditions,

The methods of Geo technical investigation enable vertical sections of the strata to be drawn and samples to be tested, on the site or in a laboratory for determining shear strength parameters, bearing capacity of the soil, permeability, water table, type classification, and other geophysical information in the field. This information, together with the normal topographical survey, provides the engineer with complete details of the site and enables him to prepare economical designs for the foundations.

4.12 Trial Pits

Geo technical Investigation shall be carried out by open trial pits or by exploratory borings depending up on the type of structure. In this project, open pits are proposed along the main & distributary pipeline.

- Trial pits are excavated at every 100 m interval along the approved alignment of rising main of size 1.5 m x 1.5 m and depth up to Canal Bed Level/ Pipe Invert level or refusal level (Hard rock) whichever is earlier.
- Two trial pits are taken on either side of the road crossing wherever structures like nala crossing, Road crossings, canal crossings etc.
- The size of the trial pit is 1.5m x 1.5m and depth minimum up to bed level or up to founding level as per the design requirements.

4.13 Bore Holes

Geo technical investigation shall be carried out in accordance with IS 1892 – 1997 Code of Practice Subsurface Investigation for foundation.

- Three Nos of bore holes are taken at Jack well location.
- The minimum diameter of boreholes is 150 mm.
- Disturbed representative samples are to be collected from boreholes at every meter depth to classify the sub soil.

4.14 Classification of soil and core logging

The soil sub strata classification and core logging are done by a senior Geologist for deciding soil classification and the type of foundation required for the structure.

4.15 Site photos showing Survey and Investigation photos

Figure 26: Kalasa Diversion Dam Location

Figure 27: Haltara Diversion Dam Location

Figure 28: Alignment survey

Figure 29: Delivery Chamber

Figure 30: Site inspection Photos

Figure 31: Trial bore at Jack well location

4.16 Geological Investigation

4.16.1 Geology of the project area

a. Initial reaches of the project

The initial reaches of the project comprising of dam across Kalasa nala and Haltara nala lies in the Western Ghats region which is a rich reserve of rock formations. Basalt is the predominant rock type found here. Besides, granites, leptynites, charnockites as well as iron ore, dolerites, laterites and bauxite ores are also found here in varying proportions.

b. The project beyond Western Ghats

i. The Archean complex made up of Dharwad schists and granitic gneisses:

These are the oldest formation and are also found in majority of the project area. They are unfossiliferous, crystalline, contrasted and faulted rocks. The chief rocks are gneisses, granites and charnockite, Dharwad schist belt of the Proterozoic alternate with the Archean crystalline rocks. In Dharwar schists, both igneous and altered sedimentary are found in 7-8 well-defined bands running in south-easterly direction. They are known for their mineral ores. They are composed of an assemblage of rocks comprising of dolomite, limestone, gabbro, quartzite, pyroxenite, manganese and iron ores and metabasalt. Gneisses, Granulites and Granites are the interrelated rock types in Karnataka. Granitic gneisses form other Archean systems and cover larger areas. They have been classified into Champion, Peninsular, Nilgiri and Bellary Gneisses.

ii. **The Deccan trappean and intertrappean deposits:**

The formation of the Deccan Trap saw the dawn of tertiary era and it represents one of the largest accumulations of basaltic continental lava covering an area of 500,000 Sq km. This landform mostly consists of greyish to black augite-basalt.

iii. The tertiary and recent laterites and alluvial deposits

Over the Deccan Trap, Laterite capping is found which started forming at the cessation of Deccan volcanic activity in the early tertiary period. It is more recent and is found on the coast as well as in several districts of Deccan Plateau. Fossil laterite is a result of sub-ariel weathering and leaching action in different rocks during monsoon in conditions of excessive wetting followed by dryness. The high-level laterite found in Belgaum, Bellary, Chikmagalur and Hassan districts are of this type.

4.16.2 Kalasa Diversion Dam

The dam site proposed across Kalasa Nala is aligned almost in SE-NW direction.

- The length of the Kalasa Diversion Dam is 101.80m at FRL 723m.
- The deepest River bed level is at RL 713.50m.
- The river bed shows the sheet rock exposures of Deccan Trap formation.
- The flanks are covered over by lateritic soil and dense vegetation.
- The left flank is steep, while the right flank is fairly gentle.
- From investigation studies, it is found that the soil and overburden material on the left flank has a thickness of about 15m followed by fresh Basalt rock.
- On right bank, the thickness of overburden is found to be about 6 to 7m.
- The overburden zone is consisted of top soil followed by Red Murrum Lateritic soil and disintegrated rock material.
- The Deccan Trap rock reveals jointed nature due to the presence of horizontal to sub horizontal joints 40° to 60° dipping joints and vertical joints.
- Presence of a bole bed has been encountered between the two flows of Deccan Trap formation between R.L. 693.70m and 695.80m which is disposed in a sub horizontal angle with a dip towards downstream.
- The bole bed is consisted of pebbles and clay material and is found to be highly permeable.
- The thickness of zone as picked up by the bores is found to be about 2.0ms.
- The zone shows undulatory nature in its extent and is a regional feature.
- The Basalt rock as such is fresh and hard and is fit for laying foundation for the dam.

4.16.3 Haltara Diversion Dam

The dam site proposed across Kalasa Nala is aligned almost in SE-NW direction.

- The length of the Kalasa Diversion Dam is 62.40 m at FRL 738.50 m.
- The deepest River bed level is at RL 727.70 m.
- The river bed shows the sheet rock exposures of Deccan Trap formation.
- The flanks are covered over by lateritic soil and dense vegetation.
- The left flank is steep, while the right flank is fairly gentle.

- From investigation studies, it is found that the soil and overburden material on the left flank has a thickness of about 15m followed by fresh Basalt rock.
- On right bank, the thickness of overburden is found to be about 6 to 7m.
- The overburden zone is consisted of top soil followed by Red Murrum Lateritic soil and disintegrated rock material.
- The Deccan Trap rock reveals jointed nature due to the presence of horizontal to sub horizontal joints 40° to 60° dipping joints and vertical joints.
- Presence of a bole bed has been encountered between the two flows of Deccan Trap formation between R.L. 693.70m and 695.80m which is disposed in a sub horizontal angle with a dip towards downstream.
- The bole bed is consisted of pebbles and clay material and is found to be highly permeable.
- The thickness of zone as picked up by the bores is found to be about 2.0sss.
- The zone shows undulatory nature in its extent and is a regional feature.
- The Basalt rock as such is fresh and hard and is fit for laying foundation for the dam.

4.17 Jack well, conveyance system (lift scheme) and Inter connecting canal (ICC)

The Inter connecting canal alignment commence from the foreshore of Kalasa reservoir. In order to know the depth of overburden and bed rock levels along the alignment bore holes at every 30 m along the canal alignment were taken.

Chapter 5
Hydrology (Working Tables, Performance Tables, Flow Tables)

5.1 Hydrologic inputs to the project planning

5.1.1. Mahadayi River

River Mahadayi (Mandovi) is a West flowing interstate river in Western Ghats. The river takes its origin in Karnataka, flows for about 35 Kms in Karnataka State, and enters Goa and joins the Arabian Sea.

The total catchment area of the river Mahadayi is 2032 Sq.km, out of which 375 Sq.km is in Karnataka, 77 Sq.km is in Maharashtra and 1580.00 Sq.km is in Goa.

However now the Hon'ble Mahadayi Disputes Tribunal has made an independent study to assess the yield of the Kalasa Nala. The comparative statement of Yield details at 75% dependability and allocation for the proposed scheme are as follows. (Vide MWDT award Volume-VII Pg.1441-1443)

Table 5.1: Comparative statement of Yield details at 75% dependability and allocation for the proposed scheme

Sl. No	Name of Project	Yield as per the tribunal	Allocation made by the tribunal
1.	Proposed Kalasa dam site (including Haltara and Surla diversion) with catchment area of 25.50 sq.km.	**2.19 TMC**	**1.72 TMC**

Further in accordance with the stipulation of MWDT Award the State of Karnataka had submitted Pre-feasibility Report for Kalasa Nala Diversion scheme for drinking water supply to CWC, New Delhi on 22.05.2020.

In the meantime, vide letter dated: 02.06.2022 the Director, Hydrology (South) has intimated the project authorities to consider the yield and Catchment area as per MWDT award, In continuation to the above the vide letter dated 28.07.2022 it was clarified that assessment of yield done by Mahadayi Water Dispute Tribunal (MWDT) would prevail over any other study. Hence, yield and catchment area for Kalasa Nala Diversion Scheme should be considered as per MWDT Award.

In backdrop of the above developments and as per the directions of CWC the State of Karnataka has now modified the PFR of Kalasa Nala Diversion Scheme (Lift scheme). The modified PFR is prepared by considering the yield series and corresponding environmental flows as stipulated MWDT award in accordance to the provisions in the “Standard Terms of Reference (TOR) for EIA / EMP Report for

Projects / Activities Requiring Environment Clearance under EIA Notification 2006" of the Ministry of Environment, Forest and Climate Change published in April 2015, i.e. Environmental Flow @ 30% of the Water Availability at 90% Dependability (the flow at proposed sites of diversion being only during the monsoon period).

The Yield assessment carried out by MWDT in its award vide volume – VII Pg.1430 is reproduced as below:

"Assessment of Water Availability (a) For the Catchment Area of Mahadayi river basin in the State of Karnataka, (b) For the Catchment Area of Mahadayi river basin in the State of Maharashtra, and (c) For various project Sites in the States of Karnataka and Maharashtra

914. As in the case of entire Mahadayi river basin, the water availability has also been assessed for (a) the catchment area of Mahadayi river and its tributaries in the State of Karnataka, (b) the catchment area of tributaries of Mahadayi river basin in the State of Maharashtra, and (c) the catchment areas of the proposed project Sites in the States of Karnataka and Maharashtra by using the same approach viz., (i) using the rainfall values of recent 40 years (from 1973-74 to 2012-13) estimated by IMD at the concerned Grid Points, and (ii) applying Inglis Formula for generation of runoff series. For the proposed project sites in the territory of Karnataka and Maharashtra, water availability at 90% dependability has also been computed in addition to the average annual water availability and water availability at 75% dependability.

Table 5.2: Annual Runoff for Proposed Projects in Mahadayi River Basin in the State of Karnataka

Year	Average Annual Rainfall (in mm) for Projects at Kalasa, Bhandura, Kotni, Bailnadi, Irti & Viranjole (Grid Point 74°15'E 15°30'N)	Average Annual rainfall (in mm) for Projects at Katla-Palna & Diggi (Grid Point 74°15'E 15°15'N)	Annual Runoff for Projects at Kalasa, Bhandura, Kotni, Bailnadi, Irti and Viranjole - [(Col.2) *0.85- 305]	Annual Runoff for Projects at Katla- Palna & Diggi - [(Col.3) *0.85 -305]	Annual Runoff for Projects at Kalasa, Bhandura, Kotni, Bailnadi, Irti & Viranjole in Descending Order	Annual Runoff (in mm) for Projects at Katla-Palna & Diggi in Descending Order	Rank No.	Dependability
1	2	3	4	5	6	7	8	9
1973-74	2260.3	3497.3	1616.3	2667.7	5024.6	5096.5	1	2.4
1974-75	1925.8	3443.7	1331.9	2622.1	4200.3	4468.1	2	4.9
1975-76	2890.8	3087.7	2152.2	2319.5	4119	3677.2	3	7.3
1976-77	2062.2	2063.6	1447.9	1449.1	4052.5	3535.6	4	9.8
1977-78	2341.5	2191	1685.3	1557.4	4004.9	3460.4	5	12.2
1978-79	3101.9	3273.6	2331.6	2477.6	3830.8	3324.5	6	14.6
1979-80	3276.3	3170.4	2479.9	2389.8	3697.6	3314.3	7	17.1
1980-81	3812.8	3391.3	2935.9	2577.6	3618.9	3259.2	8	19.5
1981-82	4534.2	4270	3549.1	3324.5	3611.7	3230.7	9	22
1982-83	4129.3	5615.4	3204.9	4468.1	3549.1	3209.6	10	24.4
1983-84	3831.2	4052.9	2951.5	3140	3405.3	3209.4	11	26.8
1984-85	3501.7	4159.6	2671.4	3230.7	3400.3	3186.7	12	29.3
1985-86	2935.4	4518.4	2190.1	3535.6	3358.9	3140	13	31.7
1986-87	3314.2	3107.4	2512.1	2336.3	3358.8	3098.7	14	34.1
1987-88	2897.2	3319	2157.6	2516.2	3305	3041	15	36.6
1988-89	4616.4	2978.5	3618.9	2226.7	3300	3016	16	39
1989-90	3804.5	3400.4	2928.8	2585.3	3292.8	2993.5	17	41.5

Year	Average Annual Rainfall (in mm) for Projects at Kalasa, Bhandura, Kotni, Bailnadi, Irti & Viranjole (Grid Point 74°15'E 15°30'N)	Average Annual rainfall (in mm) for Projects at Katla-Palna & Diggi (Grid Point 74°15'E 15°15'N)	Annual Runoff for Projects at Kalasa, Bhandura, Kotni, Bailnadi, Irti and Viranjole - [(Col.2) *0.85- 305]	Annual Runoff for Projects at Katla- Palna & Diggi - [(Col.3) *0.85 -305]	Annual Runoff for Projects at Kalasa, Bhandura, Kotni, Bailnadi, Irti & Viranjole in Descending Order	Annual Runoff (in mm) for Projects at Katla-Palna & Diggi in Descending Order	Rank No.	Dependability
1	2	3	4	5	6	7	8	9
1990-91	5070.5	4004.3	4004.9	3098.7	3204.9	2971.4	18	43.9
1991-92	4365	4258	3405.3	3314.3	2951.5	2904.3	19	46.3
1992-93	4247	4193.2	3305	3259.2	2935.9	2802.3	20	48.8
1993-94	4310.4	3775.6	3358.8	2904.3	2928.8	2729.6	21	51.2
1994-95	6270.1	6354.7	5024.6	5096.5	2893.4	2667.7	22	53.7
1995-96	3340.5	3242	2534.4	2450.7	2868.6	2663.1	23	56.1
1996-97	3725.8	4134.6	2861.9	3209.4	2861.9	2622.1	24	58.5
1997-98	5204.7	4684.9	4119	3677.2	2671.4	2592.9	25	61
1998-99	3241.6	4107.9	2450.4	3186.7	2536.3	2585.3	26	63.4
1999-00	4607.9	3854.6	3611.7	2971.4	2534.4	2577.6	27	65.9
2000-01	3762.8	3655.6	2893.4	2802.3	2512.1	2516.2	28	68.3
2001-02	3342.7	2771.0	2536.3	2050.4	2479.9	2477.6	29	70.7
2003-04	4359.2	3212.2	3400.3	2425.4	2436.4	2425.4	31	75.6
2004-05	4865.7	3570.1	3830.8	2729.6	2331.6	2389.8	32	78.0
2005-06	4232.7	3880.6	3292.8	2993.5	2324.5	2336.3	33	80.5
2006-07	5300.4	3907.0	4200.3	3016.0	2190.1	2319.5	34	82.9
2007-08	5126.5	4134.8	4052.5	3209.6	2157.6	2226.7	35	85.4
2008-09	4310.5	3491.9	3358.9	2663.1	2152.2	2084.8	36	87.8

Year	Average Annual Rainfall (in mm) for Projects at Kalasa, Bhandura, Kotni, Bailnadi, Irti & Viranjole (Grid Point 74°15'E 15°30'N)	Average Annual rainfall (in mm) for Projects at Katla-Palna & Diggi (Grid Point 74°15'E 15°15'N)	Annual Runoff for Projects at Kalasa, Bhandura, Kotni, Bailnadi, Irti and Viranjole - [(Col.2) *0.85- 305]	Annual Runoff for Projects at Katla- Palna & Diggi - [(Col.3) *0.85 -305]	Annual Runoff for Projects at Kalasa, Bhandura, Kotni, Bailnadi, Irti & Viranjole in Descending Order	Annual Runoff (in mm) for Projects at Katla-Palna & Diggi in Descending Order	Rank No.	Dependability
1	2	3	4	5	6	7	8	9
2009-10	4241.2	3936.5	3300.0	3041.0	1685.3	2050.4	37	90.2
2010-11	3093.5	2575.4	2324.5	1884.1	1616.3	1884.1	38	92.7
2011-12	4709.9	4429.9	3697.6	3460.4	1447.9	1557.4	39	95.1
2012-13	3733.6	3409.3	2868.6	2592.9	1331.9	1449.1	40	97.6
Average	**3848.1**	**3698.4**	**2965.8**	**2838.6**				

5.2 Rainfall

The Hydrology South Directorate (vide letter no U.O.7/Kar 81/2020-Hyd(s)/178 Dated 23/09/2021 the extract of the report is as below

"It has also considered IMD gridded rainfall data and calculated their Thiessen weightage for Ganjim catchment as given below

Table 5.3: IMD Grid coordinates and weights

S.NO	IMD Grid Coordinates		Thiessen Weightage
	Latitude (Degrees)	Longitude (Degrees)	
1	15.50 N	74.00 E	0.0925
2	15.50 N	74.25 E	0.6446
3	15.50 N	74.50 E	0.0612
4	15.75 N	74.00 E	0.0029
5	15.75 N	74.25 E	0.1986

From the gridded rainfall data, the average catchment representative rainfall (June-November) at Ganjim G&D site is of the order of 3650 mm. For Kalasa site, the average catchment representative rainfall (June-November) is about 4300 mm from IMD Gridded rainfall of Grid 15.5 N, 74 E. Further, the observed average yield (June-November) at Ganjim G&D site is about 3420 MCM (3886.6 mm). So, this yield gives a runoff coefficient of 1.06, which is more than 1. For the catchment representative rainfall scenario, the runoff coefficient at Ganjim G&D site should be of the order of 0.75. Therefore, the observed flow at Ganjim G&D site (June-November) need to be reduced by 30 % to make it consistent for a runoff coefficient of the order of 0.75.

Also, as per Volume-11 of Hon'ble MWDT Award, environmental flow requirement at proposed Kalasa dam site is 0.47 TMC. Therefore, water availability from Kalasa catchment alone may not be sufficient to meet the envisaged drinking water requirements. This directorate has also carried out water availability computation for catchment area of 26.6 sq.km by considering combined catchment of three nalas viz. Kalasa nala catchment, Surla nala catchment in Karnataka and Haltara Nala catchment. The estimated average yield (June-November) for Kalasa Nala Diversion Scheme (for combined catchment area of 26.6 sq.km.) is 3.113 TMC (88.148MCM). The 75% and 90% dependable yields are 2.56 TMC (72.54 MCM) and 2.26 TMC (64.12 MCM) respectively. The water availability series along with the dependable flow computation is enclosed in Annex-I of this letter. The same is utilized for the planning purpose of the project."

In continuation to the above as per the directions contained vide letters dated 02.06.2022 & 27.07.2022 of CWC, the Rainfall considered by MWDT in its award is now adopted vide MWDT award volume – VII Pg.1428 which is reproduced as below:

915. The specific Grid Point (s), whose rainfall values are used by the Tribunal for the aforesaid purpose, are as under.

Sl. No.	Details of Catchment Area	Corresponding Grid Point (s)
1	Catchment area of Mahadayi river and its tributaries in the State of Karnataka (for catchment area of 375 sq.km.)	Grid Points 74°15'E 15°15'N, 74°15'E 15°30'N and 74°E 15°45'N
2	Catchment area of tributaries of Mahadayi river in the State of Maharashtra (for catchment area of 77 sq.km.)	Grid Point 74°E 15°30'N and 74°E 15°45'N
3	Kalasa dam (including Haltara and Surla diversion) with catchment area of 25.50 sq.km.	Grid Point 74°15'E 15°30'N

Sl. No.	Details of Catchment Area	Corresponding Grid Point (s)
4	Bhandura dam with catchment area of 32.25 sq.km.	Grid Point 74°15'E 15°30'N
5	Kotni dam (including Bhandura dam Catchment and diversion of Irti, Bailnadi) with catchment area of 125.44 sq.km.	Grid Point 74°15'E 15°30'N
6	Kotni dam site (independent catchment) with catchment area of 93.19 sq.km.	Grid Point 74°15'E 15°30'N
7	Bailnadi with catchment area of 32.33 sq.km.	Grid Point 74°15'E 15°30'N
8	Irti dam site with catchment area of 8.78 sq.km.	Grid Point 74°15'E 15°30'N
9	Irti Pick-up dam (independent catchment) with catchment area of 9.91 sq.km.	Grid Point 74°15'E 15°30'N
10	Katla-Palna diversion with catchment area of 22.50 sq.km.	Grid Point 74°15'E 15°15'N
11	Diggi diversion with catchment area of 15.60 sq.km.	Grid Point 74°15'E 15°15'N
12	Viranjole diversion with catchment area of 9.50 sq.km.	Grid Point 74°15'E 15°30'N
13	Virdi Large Minor Irrigation Project of Maharashtra with catchment area of 8.25 sq.km.	Grid Point 74°E 15°45'N

5.3 Runoff

As per the directions contained vide letters dated 02.06.2022 & 27.07.2022 of CWC, the Runoff considered by MWDT in its award is now adopted vide MWDT award volume – VII Pg.1433 is reproduced as below:

916. The rainfall values related to (a) the catchment area of Mahadayi River and its tributaries in the State of Karnataka, and (b) the catchment area of tributaries of Mahadayi river basin in the State of Maharashtra have accordingly been computed and the same are shown in Table-5. The Table-5 also indicates the corresponding values of the runoff computed by using Inglis Formula and the percentile dependability value associated with each value of the runoff.

Table 5.4: Annual Runoff from Catchment Areas of Mahadayi River Basin in Territory of Karnataka and Maharashtra

Year	Average rainfall over basin area in Karnataka - Weighted av. of rain at GP 74°15'E 15°15'N, 74°15'E 15°30'N & 74°E 15°45'N	Average rainfall over basin area in Maharashtra - Weighted av. of rain at GP 74°E 15°30'N & 74°E 15°45'N	Annual Runoff for basin area in Karnataka-[(Col.2) *0.85 - 305]	Annual Runoff for Basin Area in Maharashtra [(Col.3) *0.85 - 305]	Annual Runoff Series of Karnataka Area (Col 4) in Descending Order	Annual Runoff Series of Maharashtra Area (Col. 5) in Descending Order	Rank No	Depend -ability
1	2	3	4	5	6	7	8	9
1973-74	2395.1	2279.3	1730.9	1632.4	5034.8	5448.1	1	2.4
1974-75	2096.6	2276.8	1477.1	1630.3	4078.7	5129	2	4.9
1975-76	2926.7	3938.5	2182.7	3042.7	4076.3	4924.7	3	7.3
1976-77	2060.4	1973.1	1446.3	1372.1	3959.6	4836.3	4	9.8
1977-78	2364.3	4902.4	1704.7	3862	3903.5	4476.8	5	12.2
1978-79	3166.4	6048.6	2386.5	4836.3	3673.1	4387.7	6	14.6
1979-80	3286.5	4638.4	2488.5	3637.6	3659.8	4132.9	7	17.1
1980-81	3810.7	6768.4	2934.1	5448.1	3549.2	4087.1	8	19.5
1981-82	4521	5520.8	3537.9	4387.7	3537.9	3952.6	9	22
1982-83	4307	4951	3356	3903.3	3464.4	3919.5	10	24.4
1983-84	3871.4	4866.2	2985.7	3831.3	3394.5	3903.3	11	26.8
1984-85	3587.1	4279.9	2744.1	3332.9	3356	3862	12	29.3
1985-86	3122.7	3702.9	2349.3	2842.4	3317.9	3831.3	13	31.7

Year	Average rainfall over basin area in Karnataka - Weighted av. of rain at GP 74°15'E 15°15'N, 74°15'E 15°30'N & 74°E 15°45'N	Average rainfall over basin area in Maharashtra - Weighted av. of rain at GP 74°E 15°30'N & 74°E 15°45'N	Annual Runoff for basin area in Karnataka-[(Col.2) *0.85 - 305]	Annual Runoff for Basin Area in Maharashtra [(Col.3) *0.85 - 305]	Annual Runoff Series of Karnataka Area (Col 4) in Descending Order	Annual Runoff Series of Maharashtra Area (Col. 5) in Descending Order	Rank No	Depend -ability
1	2	3	4	5	6	7	8	9
1986-87	3289.6	3200.7	2491.2	2415.6	3305.1	3710.4	14	34.1
1987-88	2949.4	3286	2202	2488.1	3279.9	3642.6	15	36.6
1988-89	4434.6	4724	3464.4	3710.4	3276.3	3637.6	16	39
1989-90	3768.3	4351.4	2898.1	3393.7	3275.9	3612.5	17	41.5
1990-91	4951.2	4970	3903.5	3919.5	3259.8	3598.8	18	43.9
1991-92	4352.3	4242.7	3394.5	3301.3	2985.7	3393.7	19	46.3
1992-93	4247.2	4608.8	3305.1	3612.5	2934.1	3354.1	20	48.8
1993-94	4262.3	5008.9	3317.9	3952.6	2898.1	3332.9	21	51.2
1994-95	6282.1	6393	5034.8	5129	2896.4	3301.3	22	53.7
1995-96	3326.6	3197.9	2522.6	2413.2	2889.3	3282.4	23	56.1
1996-97	3766.3	3449.9	2896.4	2627.4	2829.8	3282.2	24	58.5
1997-98	5154.4	5625.7	4076.3	4476.8	2744.1	3050	25	61
1998-99	3358.2	4644.3	2549.5	3642.6	2549.5	3042.7	26	63.4
1999-00	4534.3	5221.1	3549.2	4132.9	2522.6	2936.6	27	65.9
2000-01	3758.0	4220.4	2889.3	3282.4	2491.2	2842.4	28	68.3

Year	Average rainfall over basin area in Karnataka - Weighted av. of rain at GP 74°15'E 15°15'N, 74°15'E 15°30'N & 74°E 15°45'N	Average rainfall over basin area in Maharashtra - Weighted av. of rain at GP 74°E 15°30'N & 74°E 15°45'N	Annual Runoff for basin area in Karnataka-[(Col.2) *0.85 - 305]	Annual Runoff for Basin Area in Maharashtra [(Col.3) *0.85 - 305]	Annual Runoff Series of Karnataka Area (Col 4) in Descending Order	Annual Runoff Series of Maharashtra Area (Col. 5) in Descending Order	Rank No	Depend -ability
1	2	3	4	5	6	7	8	9
2001-02	3285.4	3690.7	2487.6	2832.1	2488.5	2832.1	29	70.7
2002-03	3188.8	3813.6	2405.5	2936.6	2487.6	2728	30	73.2
2003-04	4212.8	3148.6	3275.9	2371.3	2405.5	2627.4	31	75.6
2004-05	4680.1	2184.8	3673.1	1552.1	2386.5	2488.1	32	78.0
2005-06	4193.9	4304.8	3259.8	3354.1	2349.3	2425.0	33	80.5
2006-07	5157.3	6152.6	4078.7	4924.7	2279.8	2415.6	34	82.9
2007-08	5017.2	5167.1	3959.6	4087.1	2202.0	2413.2	35	85.4
2008-09	4217.6	4220.2	3279.9	3282.2	2182.7	2371.3	36	87.8
2009-10	4213.3	4592.7	3276.3	3598.8	1730.9	1632.4	37	90.2
2010-11	3040.9	3568.3	2279.8	2728.0	1704.7	1630.3	38	92.7
2011-12	4664.5	3947.0	3659.8	3050.0	1477.1	1552.1	39	95.1
2012-13	3688.0	3211.8	2829.8	2425.0	1446.3	1372.1	40	97.6
Average	**3837.8**	**4269.6**	**2957.1**	**3335.0**				

917. Table-6 shows the annual rainfall values of corresponding Grid Point(s) related to various identified projects in Mahadayi river basin in the State of Karnataka, the

corresponding values of runoff computed by using Inglis Formula, and the percentile dependability value associated with each value of the computed runoff.

5.4 Yield:

As per the directions contained vide letters dated 02.06.2022 & 27.07.2022 of CWC the combined catchment of 25.50Sqkm (Kalasa + Surla + Haltara combined catchment) the yield series considered by MWDT in its award is now adopted vide award volume – VII Pg.1435 & 1436 is reproduced as below:

919. Values of (a) average annual water availability, (b) water availability 75% dependability and (c) water availability at 90% dependability in respect of various proposed projects by the States of Karnataka and Maharashtra have been computed and the results are summarized as under.

Sl. No.	Various proposed projects in the States of Karnataka and Maharashtra	Average annual water availability (in mm / Mcum /	Water availability at 75% dependability (in mm / Mcum / tmc)	Water availability at 90% dependability (in mm / Mcum
Proposed Projects in Karnataka				
1.	Proposed Kalasa dam site (including Haltara and Surla diversion) with catchment area of 25.50 sq.km.	2965.8 mm i.e., 75.6 Mcum i.e., 2.67 tmc	2439.9 mm i.e., 62.2 Mcum i.e., 2.19 tmc	1724.2 mm i.e., 43.9 Mcum i.e., 1.55 tmc
2.	Proposed Bhandura dam site with catchment area of 32.25 sq.km.	2965.8 mm i.e., 95.6 Mcum i.e., 3.37 tmc	2439.9 mm i.e., 78.7 Mcum i.e., 2.77 tmc	1724.2 mm i.e., 55.6 Mcum i.e., 1.96 tmc
3.	Proposed Kotni dam site (independent catchment) with catchment area of 93.19	2965.8 mm i.e., 276.4 Mcum i.e., 9.76 tmc	2439.9 mm i.e., 227.4 Mcum i.e., 8.02 tmc	1724.2 mm i.e., 160.7 Mcum i.e., 5.67 tmc
4.	Proposed Kotni dam site (including Bhandura dam catchment and diversion of Irti, Bailnadi) with catchment area of	2965.8 mm i.e., 372.0 Mcum i.e., 13.13 tmc	2439.9 mm i.e., 306.1 Mcum i.e., 10.80 tmc	1724.2 mm i.e., 216.3 Mcum i.e., 7.63 tmc

Sl. No.	Various proposed projects in the States of Karnataka and Maharashtra	Average annual water availability (in mm / Mcum /	Water availability at 75% dependability (in mm / Mcum / tmc)	Water availability at 90% dependability (in mm / Mcum
5.	Proposed Bailnadi diversion site with catchment area of 32.33 sq.km.	2965.8 mm i.e., 95.9 Mcum i.e., 3.38 tmc	2439.9 mm i.e., 78.9 Mcum i.e., 2.78 tmc	1724.2 mm i.e., 55.7 Mcum i.e., 1.97 tmc
6.	Proposed Irti dam site with catchment area of 8.78 sq.km.	2965.8 mm i.e., 26.0 Mcum i.e., 0.92 tmc	2439.9 mm i.e., 21.4 Mcum i.e., 0.76 tmc	1724.2 mm i.e., 15.1 Mcum i.e., 0.53 tmc
7.	Proposed Irti Pick-up dam site (independent catchment) with catchment area of .91 sq.km.	2965.8 mm i.e., 29.4 Mcum i.e., 1.04 tmc	2439.9 mm i.e., 24.2 Mcum i.e., 0.85 tmc	1724.2 mm i.e., 17.1 Mcum i.e., 0.60 tmc
8.	Proposed Katla- Palna diversion scheme with catchment area of 22.50	2838.6 mm i.e., 63.9 Mcum i.e., 2.25 tmc	2431.7 mm i.e., 54.7 Mcum i.e., 1.93 tmc	2053.3 mm i.e., 46.2 Mcum i.e., 1.63 tmc
9.	Proposed Diggi diversion scheme with catchment area of 15.60 sq.km.	2838.6 mm i.e., 44.3 Mcum i.e., 1.56 tmc	2431.7 mm i.e., 37.9 Mcum i.e., 1.34 tmc	2053.3 mm i.e., 32.0 Mcum i.e., 1.13 tmc
10.	Proposed Viranjole diversion scheme with catchment area of 9.50 sq.km.	2965.8 mm i.e., 28.2 Mcum i.e., 0.99 tmc	2439.9 mm i.e., 23.2 Mcum i.e., 0.82 tmc	1724.2 mm i.e., 16.4 Mcum i.e., 0.58 tmc
Proposed Project in Maharashtra				
11.	Virdi Large Minor Irrigation Project of Maharashtra on Kattica Nalla with total catchment area of 8.25 sq.km.	3324.1 mm i.e., 27.4 Mcum i.e., 0.97 tmc	2590.6 mm i.e., 21.37 Mcum i.e., 0.75 tmc	1545.8 mm i.e., 12.75 Mcum i.e., 0.45 tmc

The MWDT in its award has adopted Inglis Formula for the period i.e., 1973-74 to 2012-13 for calculation of annual yield but it is to be noted that the diversion is only permitted during monsoon season (i.e., 1st June to 31st October) the annual rainfall-runoff considered by MWDT is adopted to compute the rainfall runoff co efficient for each year, hence by adopting these co efficient the daily, 10 daily and monthly runoff values are arrived. The daily and 10 daily yield is computed for the catchment

area based on the above runoff values. on account of the above annual available yield works out to be 2.19 TMC at 75% dependability. Vide **Table 5.5**

Table 5.5: Kalasa Nala Diversion Scheme table of list of Annexures for monsoon yield and diversion

Details of Catchment	Catchment Area in Sq.km	Annual, Monsoon available yield and Diversion works at 75.60% dependability			
		Annual yield in Mcft	Monsoon yield in Mcft	Diversion in Mcft	Remarks
Haltara	4.00	344.16	323.10	270.00	**(Ref: Annexure 2)**
Surla-1	2.63	226.29	212.44	177.40	**(Ref: Annexure 3)**
Surla-2 & 2A	0.28	24.09	22.62	18.90	**(Ref: Annexure 4)**
Surla-3	0.21	18.07	16.96	14.18	**(Ref: Annexure 5)**
Surla-4 &4A	0.11	9.46	8.89	7.43	**(Ref: Annexure 6)**
Surla-5	1.23	105.83	99.35	83.03	**(Ref: Annexure 7)**
Surla-6	1.54	132.50	124.39	103.95	**(Ref: Annexure 8)**
Kalasa	15.50	1333.62	1252.01	1042.28	**(Ref: Annexure 9)**
Total	25.50	2194.02	2059.76	1717.17	

Note: Total diversion= Diversion + Evaporation =1719 Mcft + 1 Mcft = 1720 Mcft

Table 5.6: Kalasa Nala Diversion scheme Ten Daily working table abstract for each water year from 1973-74 to 2012-13(Ref: Annexure 8)

St. Capacity	13.86	Mcft	Optimum Pumping Discharge	12.543	cumecs	Diversion	1719 (Lift)+1 (Evp)	1720 (Lift+Evp)
Year	Monsoon Opening Storage of Kalasa Diversion Dam	Overall Annual Yield available under Kalasa Nala Diversion scheme	Overall Combined Monsoon Yield available at Kalasa Diversion Dam (June-Oct)	Overall Combined Monsoon Diversion (Lift) from Kalasa Nala Diversion scheme to Malaprabha river (June-Oct)	Monsoon Evaporation under Kalasa Lift (June-Oct)	Overall Monsoon Diversion (Lift+Evp) from Kalasa Nala Diversion Dam (June-Oct)	Monsoon E-Flow from Kalasa Diversion Dam (June-Oct)	Monsoon Closing Storage of Kalasa Diversion Dam
	in Mcft							
1973-1974	0.00	1455.49	1238.51	1146.70	0.38	1147.08	85.56	5.87
1974-1975	13.86	1199.67	1087.06	1044.31	0.45	1044.77	49.73	6.42
1975-1976	13.86	1938.22	1737.34	1620.63	0.56	1621.19	124.74	5.27
1976-1977	13.55	1303.93	1124.78	1079.37	0.47	1079.84	53.69	4.80
1977-1978	13.86	1517.18	1308.09	1239.15	0.50	1239.64	82.30	0.00
1978-1979	13.86	2099.88	1859.89	1716.61	0.55	1717.17	153.89	2.69
1979-1980	13.86	2233.23	1873.84	1519.71	0.53	1520.24	361.30	6.16
1980-1981	13.76	2644.08	2219.74	1719.00	0.72	1719.72	499.95	13.83

St. Capacity	13.86	Mcft	Optimum Pumping Discharge	12.543	cumecs	Diversion	1719 (Lift)+1 (Evp)	1720 (Lift+Evp)
Year	Monsoon Opening Storage of Kalasa Diversion Dam	Overall Annual Yield available under Kalasa Nala Diversion scheme	Overall Combined Monsoon Yield available at Kalasa Diversion Dam (June-Oct)	Overall Combined Monsoon Diversion (Lift) from Kalasa Nala Diversion scheme to Malaprabha river (June-Oct)	Monsoon Evaporation under Kalasa Lift (June-Oct)	Overall Monsoon Diversion (Lift+Evp) from Kalasa Nala Diversion Dam (June-Oct)	Monsoon E-Flow from Kalasa Diversion Dam (June-Oct)	Monsoon Closing Storage of Kalasa Diversion Dam
	in Mcft							
1981-1982	13.86	3196.00	2584.92	1719.00	0.72	1719.72	865.20	13.86
1982-1983	13.86	2885.83	2415.87	1719.00	0.59	1719.59	696.28	13.86
1983-1984	13.86	2658.16	2285.63	1719.00	0.63	1719.63	565.99	13.86
1984-1985	13.86	2405.86	2126.99	1719.00	0.68	1719.68	407.31	13.86
1985-1986	13.86	1972.33	1820.13	1686.44	0.55	1686.99	147.00	0.00
1986-1987	0.00	2262.20	2028.33	1719.00	0.57	1719.57	294.89	13.86
1987-1988	13.86	1943.08	1778.27	1656.49	0.56	1657.05	129.50	5.58
1988-1989	12.49	3259.53	2631.36	1719.00	0.68	1719.68	910.32	13.86
1989-1990	13.76	2637.64	2192.47	1719.00	0.72	1719.72	472.65	13.86

St. Capacity	13.86	Mcft	Optimum Pumping Discharge	12.543	cumecs	Diversion	1719 (Lift)+1 (Evp)	1720 (Lift+Evp)
Year	Monsoon Opening Storage of Kalasa Diversion Dam	Overall Annual Yield available under Kalasa Nala Diversion scheme	Overall Combined Monsoon Yield available at Kalasa Diversion Dam (June-Oct)	Overall Combined Monsoon Diversion (Lift) from Kalasa Nala Diversion scheme to Malaprabha river (June-Oct)	Monsoon Evaporation under Kalasa Lift (June-Oct)	Overall Monsoon Diversion (Lift+Evp) from Kalasa Nala Diversion Dam (June-Oct)	Monsoon E-Flow from Kalasa Diversion Dam (June-Oct)	Monsoon Closing Storage of Kalasa Diversion Dam
	in Mcft							
1990-1991	13.86	3606.87	2799.91	1719.00	0.70	1719.70	1080.21	13.86
1991-1992	13.86	3066.37	2514.71	1719.00	0.72	1719.72	794.99	13.86
1992-1993	13.86	2976.11	2449.47	1719.00	0.66	1719.66	729.81	13.86
1993-1994	13.86	3024.49	2452.62	1719.00	0.68	1719.68	732.94	13.86
1994-1995	13.86	4524.45	3394.78	1719.00	0.72	1719.72	1675.06	13.86
1995-1996	13.86	2282.33	2051.97	1719.00	0.59	1719.59	332.38	13.86
1996-1997	13.86	2577.15	2220.02	1719.00	0.60	1719.60	500.42	13.86
1997-1998	13.65	3709.31	2882.76	1719.00	0.69	1719.69	1162.86	13.86
1998-1999	13.76	2206.56	1947.96	1719.00	0.62	1719.62	228.23	13.86

St. Capacity	13.86	Mcft	Optimum Pumping Discharge	12.543	cumecs	Diversion	1719 (Lift)+1 (Evp)	1720 (Lift+Evp)
Year	Monsoon Opening Storage of Kalasa Diversion Dam	Overall Annual Yield available under Kalasa Nala Diversion scheme	Overall Combined Monsoon Yield available at Kalasa Diversion Dam (June-Oct)	Overall Combined Monsoon Diversion (Lift) from Kalasa Nala Diversion scheme to Malaprabha river (June-Oct)	Monsoon Evaporation under Kalasa Lift (June-Oct)	Overall Monsoon Diversion (Lift+Evp) from Kalasa Nala Diversion Dam (June-Oct)	Monsoon E-Flow from Kalasa Diversion Dam (June-Oct)	Monsoon Closing Storage of Kalasa Diversion Dam
	in Mcft							
1999-2000	13.86	3252.33	2588.04	1719.00	0.69	1719.69	868.35	13.86
2000-2001	13.86	2605.49	2203.54	1719.00	0.67	1719.67	483.87	13.86
2001-2002	13.86	2284.33	2037.89	1719.00	0.70	1719.70	318.20	13.86
2002-2003	13.86	2194.02	1975.40	1719.00	0.68	1719.68	255.72	13.86
2003-2004	13.76	3061.67	2456.35	1719.00	0.67	1719.67	736.58	13.86
2004-2005	13.86	3449.51	2749.55	1719.00	0.72	1719.72	1029.83	13.86
2005-2006	13.86	2965.33	2390.67	1719.00	0.67	1719.67	671.00	13.86
2006-2007	13.86	3782.73	2949.13	1719.00	0.69	1719.69	1229.48	13.83
2007-2008	13.86	3649.15	2819.78	1719.00	0.66	1719.66	1100.12	13.86

St. Capacity	**13.86**	**Mcft**	**Optimum Pumping Discharge**	**12.543**	**cumecs**	**Diversion**	**1719 (Lift)+1 (Evp)**	**1720 (Lift+Evp)**
Year	**Monsoon Opening Storage of Kalasa Diversion Dam**	**Overall Annual Yield available under Kalasa Nala Diversion scheme**	**Overall Combined Monsoon Yield available at Kalasa Diversion Dam (June-Oct)**	**Overall Combined Monsoon Diversion (Lift) from Kalasa Nala Diversion scheme to Malaprabha river (June-Oct)**	**Monsoon Evaporation under Kalasa Lift (June-Oct)**	**Overall Monsoon Diversion (Lift+Evp) from Kalasa Nala Diversion Dam (June-Oct)**	**Monsoon E-Flow from Kalasa Diversion Dam (June-Oct)**	**Monsoon Closing Storage of Kalasa Diversion Dam**
	in Mcft							
2008-2009	13.86	3024.89	2381.54	1719.00	0.72	1719.72	661.82	13.86
2009-2010	13.86	2971.90	2428.10	1719.00	0.70	1719.70	708.43	13.83
2010-2011	13.86	2093.06	1826.49	1708.96	0.60	1709.56	128.35	2.44
2011-2012	13.86	3329.98	2681.31	1719.00	0.72	1719.72	961.59	13.86
2012-2013	13.76	2583.32	2216.13	1719.00	0.71	1719.71	496.32	13.86

As per the MWDT award, allocated diversion is 1720Mcft from Kalasa Project inclusive of all losses like Evaporation and seepage losses from reservoir. Hence in the above working total diversion = Diversion+Evaporartion=1719 Mcft + 1 Mcft = 1720 Mcft

Table 5.7: Dependable Monsoon Diversion including Evaporation from Kalasa Nala Diversion scheme. (Ref: Annexure 8)

Rank	Dependability	Total diversion= Diversion+Evaporartion =1719 Mcft + 1 Mcft = 1720 Mcft				1719+1 Mcft		1720.00 Mcft		
		Overall Annual Yield available under Kalasa Nala Diversion scheme	Overall Combined Monsoon Yield available at Kalasa Diversion Dam (June-Oct)	Overall Combined Monsoon Diversion (Lift) from Kalasa Nala Diversion scheme to Malaprabha river (June-Oct)	Monsoon Evaporation under Kalasa Nala Diversion scheme (June-Oct)	Overall Monsoon Diversion (Lift+Evp) from Kalasa Nala Diversion Dam (June-Oct)	Kalasa nala (independent) Monsoon E flow (June-Oct)	Sarala (cumulative) Monsoon E flow (June-Oct)	Haltara (independent) Monsoon E flow (June-Oct)	overall Kalasa Project Monsoon E flow and Surplus (June-Oct)
	%	in Mcft								
1	2.44	4524.45	3394.78	1719.00	0.72	1719.72	1675.06	647.98	431.77	2754.82
2	4.88	3782.73	2949.13	1719.00	0.72	1719.72	1229.48	475.47	316.78	2021.73
3	7.32	3709.31	2882.76	1719.00	0.72	1719.72	1162.86	449.78	299.60	1912.24
4	9.76	3649.15	2819.78	1719.00	0.72	1719.72	1100.12	425.40	283.40	1808.92
5	12.20	3606.87	2799.91	1719.00	0.72	1719.72	1080.21	417.71	278.26	1776.18
6	14.63	3449.51	2749.55	1719.00	0.72	1719.72	1029.83	398.22	265.26	1693.31

Rank	Dependability	Total diversion= Diversion+Evaporartion =1719 Mcft + 1 Mcft = 1720 Mcft				1719+1 Mcft	Kalasa nala (independent) Monsoon E flow (June-Oct)	1720.00 Mcft	Haltara (independent) Monsoon E flow (June-Oct)	overall Kalasa Project Monsoon E flow and Surplus (June-Oct)
		Overall Annual Yield available under Kalasa Nala Diversion scheme	Overall Combined Monsoon Yield available at Kalasa Diversion Dam (June-Oct)	Overall Combined Monsoon Diversion (Lift) from Kalasa Nala Diversion scheme to Malaprabha river (June-Oct)	Monsoon Evaporation under Kalasa Nala Diversion scheme (June-Oct)	Overall Monsoon Diversion (Lift+Evp) from Kalasa Nala Diversion Dam (June-Oct)		Sarala (cumulative) Monsoon E flow (June-Oct)		
	%	in Mcft								
7	17.07	3329.98	2681.31	1719.00	0.72	1719.72	961.59	371.80	247.65	1581.04
8	19.51	3259.53	2631.36	1719.00	0.72	1719.72	910.32	352.45	234.51	1497.28
9	21.95	3252.33	2588.04	1719.00	0.71	1719.71	868.35	335.70	223.59	1427.64
10	24.39	3196.00	2584.92	1719.00	0.70	1719.70	865.20	334.49	222.78	1422.47
11	26.83	3066.37	2514.71	1719.00	0.70	1719.70	794.99	307.31	204.66	1306.97
12	29.27	3061.67	2456.35	1719.00	0.70	1719.70	736.58	284.72	189.59	1210.88
13	31.71	3024.89	2452.62	1719.00	0.69	1719.69	732.94	283.28	188.64	1204.85

Rank	Dependability	Total diversion= Diversion+Evaporartion =1719 Mcft + 1 Mcft = 1720 Mcft				1719+1 Mcft	Kalasa nala (independent) Monsoon E flow (June-Oct)	1720.00 Mcft	Haltara (independent) Monsoon E flow (June-Oct)	overall Kalasa Project Monsoon E flow and Surplus (June-Oct)
		Overall Annual Yield available under Kalasa Nala Diversion scheme	Overall Combined Monsoon Yield available at Kalasa Diversion Dam (June-Oct)	Overall Combined Monsoon Diversion (Lift) from Kalasa Nala Diversion scheme to Malaprabha river (June-Oct)	Monsoon Evaporation under Kalasa Nala Diversion scheme (June-Oct)	Overall Monsoon Diversion (Lift+Evp) from Kalasa Nala Diversion Dam (June-Oct)		Sarala (cumulative) Monsoon E flow (June-Oct)		
	%	in Mcft								
14	34.15	3024.49	2449.47	1719.00	0.69	1719.69	729.81	282.06	187.83	1199.70
15	36.59	2976.11	2428.10	1719.00	0.69	1719.69	708.43	273.79	182.31	1164.53
16	39.02	2971.90	2415.87	1719.00	0.68	1719.68	696.28	269.05	179.17	1144.50
17	41.46	2965.33	2390.67	1719.00	0.68	1719.68	671.00	259.29	172.65	1102.94
18	43.90	2885.83	2381.54	1719.00	0.68	1719.68	661.82	255.76	170.29	1087.88
19	46.34	2658.16	2285.63	1719.00	0.68	1719.68	565.99	218.64	145.55	930.18
20	48.78	2644.08	2220.02	1719.00	0.67	1719.67	500.42	193.24	128.63	822.28

Rank	Dependability	Total diversion= Diversion+Evaporartion =1719 Mcft + 1 Mcft = 1720 Mcft				1719+1 Mcft	Kalasa nala (independent) Monsoon E flow (June-Oct)	1720.00 Mcft	Haltara (independent) Monsoon E flow (June-Oct)	overall Kalasa Project Monsoon E flow and Surplus (June-Oct)
		Overall Annual Yield available under Kalasa Nala Diversion scheme	Overall Combined Monsoon Yield available at Kalasa Diversion Dam (June-Oct)	Overall Combined Monsoon Diversion (Lift) from Kalasa Nala Diversion scheme to Malaprabha river (June-Oct)	Monsoon Evaporation under Kalasa Nala Diversion scheme (June-Oct)	Overall Monsoon Diversion (Lift+Evp) from Kalasa Nala Diversion Dam (June-Oct)		Sarala (cumulative) Monsoon E flow (June-Oct)		
	%	in Mcft								
21	**51.22**	**2637.64**	**2219.74**	**1719.00**	**0.67**	**1719.67**	**499.95**	**193.13**	**128.52**	**821.60**
22	53.66	2605.49	2216.13	1719.00	0.67	1719.67	496.32	191.73	127.59	815.64
23	56.10	2583.32	2203.54	1719.00	0.66	1719.66	483.87	186.86	124.36	795.10
24	58.54	2577.15	2192.47	1719.00	0.66	1719.66	472.65	182.57	121.48	776.71
25	60.98	2405.86	2126.99	1719.00	0.63	1719.63	407.31	157.23	104.61	669.15
26	63.41	2284.33	2051.97	1719.00	0.62	1719.62	361.30	128.19	85.25	548.15
27	65.85	2282.33	2037.89	1719.00	0.60	1719.60	332.38	125.36	82.10	545.82

Rank	Dependability	Total diversion= Diversion+Evaporartion =1719 Mcft + 1 Mcft = 1720 Mcft				1719+1 Mcft	Kalasa nala (independent) Monsoon E flow (June-Oct)	1720.00 Mcft	Haltara (independent) Monsoon E flow (June-Oct)	overall Kalasa Project Monsoon E flow and Surplus (June-Oct)
		Overall Annual Yield available under Kalasa Nala Diversion scheme	Overall Combined Monsoon Yield available at Kalasa Diversion Dam (June-Oct)	Overall Combined Monsoon Diversion (Lift) from Kalasa Nala Diversion scheme to Malaprabha river (June-Oct)	Monsoon Evaporation under Kalasa Nala Diversion scheme (June-Oct)	Overall Monsoon Diversion (Lift+Evp) from Kalasa Nala Diversion Dam (June-Oct)		Sarala (cumulative) Monsoon E flow (June-Oct)		
	%	in Mcft								
28	68.29	2262.20	2028.33	1719.00	0.60	1719.59	318.20	124.37	77.53	525.66
29	70.73	2233.23	1975.40	1719.00	0.59	1719.59	294.89	120.26	71.81	496.80
30	73.17	2206.56	1947.96	1719.00	0.59	1719.57	255.72	118.12	69.52	445.50
31	**75.61**	**2194.02**	**1873.84**	**1716.61**	**0.57**	**1717.17**	**228.23**	**115.05**	**64.00**	**410.35**
32	78.05	2099.88	1859.89	1708.96	0.56	1709.56	153.89	111.82	47.20	312.91
33	80.49	2093.06	1826.49	1686.44	0.56	1686.99	147.00	109.42	45.50	301.87
34	82.93	1972.33	1820.13	1656.49	0.55	1657.05	129.50	109.38	40.93	278.70

Rank	Dependability	Total diversion= Diversion+Evaporartion =1719 Mcft + 1 Mcft = 1720 Mcft				1719+1 Mcft	Kalasa nala (independent) Monsoon E flow (June-Oct)	1720.00 Mcft	Haltara (independent) Monsoon E flow (June-Oct)	overall Kalasa Project Monsoon E flow and Surplus (June-Oct)
		Overall Annual Yield available under Kalasa Nala Diversion scheme	Overall Combined Monsoon Yield available at Kalasa Diversion Dam (June-Oct)	Overall Combined Monsoon Diversion (Lift) from Kalasa Nala Diversion scheme to Malaprabha river (June-Oct)	Monsoon Evaporation under Kalasa Nala Diversion scheme (June-Oct)	Overall Monsoon Diversion (Lift+Evp) from Kalasa Nala Diversion Dam (June-Oct)		Sarala (cumulative) Monsoon E flow (June-Oct)		
	%	in Mcft								
35	85.37	1943.08	1778.27	1620.63	0.55	1621.19	128.35	106.46	39.34	275.30
36	87.80	1938.22	1737.34	1519.71	0.53	1520.24	124.74	103.95	38.74	267.43
37	90.24	1517.18	1308.09	1239.15	0.50	1239.64	85.56	77.70	27.60	187.60
38	92.68	1455.49	1238.51	1146.70	0.47	1147.08	82.30	73.61	26.75	185.92
39	95.12	1303.93	1124.78	1079.37	0.45	1079.84	53.69	66.06	17.84	137.59
40	97.56	1199.67	1087.06	1044.31	0.38	1044.77	49.73	63.85	17.68	131.25

Considering the above annual available yield the State of Karnataka has arrived at an optimum pumping discharge of 12.543 cumecs for Kalasa lift (Kalasa + Surla + Haltara Catchment combined 25.50 Sq.km) to divert 1.72 TMC with corresponding environmental flows as stipulated by MWDT award in accordance to the provisions in the "Standard Terms of Reference (TOR) for EIA / EMP Report for Projects / Activities Requiring Environment Clearance under EIA Notification 2006" of the Ministry of Environment, Forest and Climate Change published in April 2015, i.e. Environmental Flow @ 30% of the Water Availability at 90% Dependability (the flow at proposed sites of diversion being only during the monsoon period).

It is also to be noted that the regulations/diversions shall be routed through Mahadayi Water Management Authority, extract of the same is reproduced as below, vide para 1351 Vol XII of MWDT Award "***The Authority shall own and operate the projects for diversion of Mahadayi waters, situated/ located in the State of Karnataka and State of Maharashtra."***

5.5 Design Flood Studies

5.5.1 Kalasa Diversion Dam

For Kalasa nala dam site, 100-year return period flood has been computed by using hydro-meteorological approach. As the catchment area above Kalasa is 15.5 km^2. The method adopted to determine the synthetic unit graph and design hydrograph for catchment and flood computations based on the CWC publication (Design Office Report No. CB/11/1985) "Flood Estimation Report for West coast region Konkan and Malabar Coasts Subzones-5a & b. The 24 hr-100-year return period rainfall for Kalasa nala dam is 38 cm as per IMD Atlas of State wise Generalized Isopluvial (Return Period) Maps of Southern Peninsula. Considering high rainfall area and small catchment size, a flash flood may occur.

The time distribution coefficients may be taken from Table 5-4 of PMP Atlas for West Flowing Rivers of Western Ghats. The 100-year return period flood arrived from Hydro- meteorological approach. is **203.20 cumecs (Ref: Annexure 9)** and by Flood frequency analysis adopting Gumbel's method is 311.27 cumecs **(Ref: Annexure 10)** for a catchment area of 15.5 sq.km. Hence, the design flood to be considered for Kalasa diversion dam is **311.27 cumecs.**

5.5.2 Haltara Diversion Dam

For Haltara nala dam site, 100-year return period flood has been computed by using hydro-meteorological approach. As the catchment area above Haltara is 4 km^2. The 24 hr-100-year return period rainfall for Haltara nala dam is 38 cm as per IMD Atlas of State wise Generalized Isopluvial (Return Period) Maps of Southern Peninsula. Considering high rainfall area and small catchment size, a flash flood phenomenon is likely. Therefore, 24 hr rainfall is converted into 5 hr short duration rainfall using conversion ratio given in FER subzone 5a &5b. Rational Method has been used taking runoff coefficient of 1 after deducting losses of 0.1 cm/hr considering a very small catchment size.

The 100-year return period flood arrived from Hydro- meteorological approach. is **119.91 cumecs (Ref: Annexure 2A) and** by Flood frequency analysis adopting Gumbel's method is 125 cumecs **(Ref: Annexure 10)** for a catchment area of 4.00 sq.km. Hence, the design flood to be considered for Haltara diversion dam is **125 cumecs.**

5.5.3 Surla check Dams

For Surla nala dam site, 100-year return period flood has been computed by using hydro-meteorological approach and by Flood frequency analysis adopting Gumbel's method vide **(Ref: Annexure 10)**. The corresponding peak of 100-year return period flood as listed below

Table 5.8: 100-year return period flood values at the Surla check dams

Details of Catchment	Catchment Area in Sq.km	100-year return period flood		
		Hydro- meteorological approach		Design flood
Surla-1	2.63	78.92 cumecs.	**(Ref: Annexure 3A)**	78.92 cumecs.
Surla-2	0.28	8.42 cumecs.	**(Ref: Annexure 4A)**	8.42 cumecs.
Surla-3	0.21	6.31 cumecs.	**(Ref: Annexure 5A)**	6.31 cumecs.
Surla-4	0.11	3.31 cumecs.	**(Ref: Annexure 6A)**	3.31 cumecs.
Surla-5	1.23	36.95 cumecs.	**(Ref: Annexure 7A)**	36.95 cumecs.
Surla-6	1.54	46.25 cumecs.	**(Ref: Annexure 8A)**	46.25 cumecs.

From the above table it is inferred that the 100-year return period flood values from Hydro-meteorological approach are higher than the Flood frequency analysis by Gumbel's method hence the flood values from Hydro- meteorological approach are considered as design flood for the respective check dams.

5.5.4 Diversion flood

Majority of the construction will be carried out during the non-monsoon season (November-May). Hence, Intensity of rainfall is computed by using IDF Rainfall Analysis - Gumbel Method by considering the 48-year peak rainfall (Kankumbi rain gauge station) values during non-monsoon period. 25-year return period rainfall is considered to compute the diversion flood.

Table 5.9: Rational Method Diversion Flood values for Kalasa Nala projects

Details of Catchment	Catchment Area in Sq.km	Diversion flood is in cumecs
Kalasa	15.50	33.50
Haltara	4.00	10.60
Surla-1	2.63	6.40
Surla-2	0.28	0.70
Surla-3	0.21	0.60
Surla-4	0.11	0.30
Surla-5	1.23	3.00
Surla-6	1.54	3.90

5.6 Reservoir Sedimentation Studies

The catchment area of Kalasa Diversion dam is 15.5 sq.km only and the reservoir is very small with a gross storage capacity of 13.86 Mcft. Hence, for such a small reservoir effective sediment management practice will be adopted.

The catchment area of Haltara Diversion dam is 4.00 sq.km only and the reservoir is very small with a gross storage capacity of 2.643 Mcft. Hence, for such a small reservoir effective sediment management practice will be adopted.

The combined catchment area from six Surla check dams is 6.00 sq.km only as the check dams are very small with a gross storage capacity in the range of 0.02 to 0.03 Mcft. Hence for such a small check dams effective sediment management practice will be adopted.

5.7 Clearance by CWC for Hydrology

CWC vide their communication no. CWC U.O 7/Kar-81/2020-Hyd(S)/74 dated 21/09/2022 have accorded there in principle approval for the Hydrology confirming the availability of water including extent of diversion as per the data and information furnished in the report (PFR) by GoK.

5.8 Determination of flood level for structures on river bank

Based on the hydrology the return flood for 100 years has been computed and found to be well within the bank levels. Consequent to the construction of dam and impounding the water upto MWL (after ensuring that the required storage will ensure diversion of water) if any flash flood occurs then that will create a temporary afflux leading to sudden raise in the water level. This condition happens to be critical and hence the height of the jack well including the platform in accordance with this level. The level as computed is estimated to be 724.32 m. This level governs for fixing the safe level for structures planned along the periphery of the dam to avoid flooding.

5.9 Determination of outlet levels.

The dams proposed for diverting the water from Kalasa and Haltara nalas are designed as ungated ogee weir. Excess flood is expected to spill over naturally. However, to minimize the storage and also to ensure to release of water for environmental purpose it is essential to have outlet/scour sluice at the deepest point. These outlets will also facilitate in ensuring removal of silt annually. Three such outlets have been proposed for each of the dam location each having a clear dimension of 2.0 m x 2.0 m.

The spillway level / FRL is determined to ensure a minimum of 8 hrs retention period for pumping capacity of 12.543 cumecs in the case of Kalasa and 2.390 cumecs in case of Haltara. The 8 hrs retention computed will ensure diversion of allocated water in accordance with the award.

5.10 Tail water rating curves.

Tail water rating curve have been computed in order to fix the optimum levels the structures on the downstream of the dam and also to ensure safe disposal of the water without affecting any of the structures.

Chapter 6
Hydro Geology

6.1 Hydro Geological Setup

Water table generally follows the topography of the area and is at greater depths in the water divides and topographic highs but becomes shallower in the valleys and topographic lows and therefore, groundwater moves down and follows the gradient from the higher to lower elevations, that is, from recharge area to discharge area. Therefore, locally direction of flow from higher elevations is towards the rivers. Overall, the general flow direction of ground water in the district is generally towards the east. The district is underlain by gneisses, schist, limestone, sandstone, basalts, alluvium etc. of Archaean to Recent age. Deccan basalts cover an area of 7,650 Sq.Kms. in the northern part of the district and have a maximum thickness of around 256 m, which gradually thins out in the southern direction. Exploratory drillings were carried out to study the yield potential of fracture systems. The hydrogeology of the district is depicted in **Error! Reference source not found.**. Hard rocks occupy a major part of the district; majority of which are basaltic lava flows. Most of these rocks have poor capacity of storing and transmitting water, except through favourable zones and at favourable locations. Aquifer systems encountered are therefore limited in nature.

Ground water occurs both in weathered and fractured zones. Ground water occurs in all weathered formations. of the district under phreatic conditions and in fractured and jointed formations under semi-confined conditions. Deccan basalts act as a multilayer aquifers having low to medium permeability. In Deccan basalts that comprise different flows, fractures and interstitial pore spaces of vesicular zones, are good repositories of ground water. Groundwater occurs under phreatic conditions in weathered zone of these basalts and under semi-confined to confined conditions in inter-trapeans and also in joints and fractures at deeper levels. In limestone, solution cavities are considered to be more potential than weathered and fractured ones. In gneisses and schist, weathered zone varies from 7 to 12 m and water-bearing zones extend down to 80m. The aquifers occurring within the shallow depth range of 0 to 20 m bgl are mainly weathered and fractured formations. Groundwater occurs in these formations under phreatic conditions and the average thickness of these aquifers ranges from 5 to 15m. In general, 60% area of the district is having the weathered thickness in the range of 5 to 10 m. About 25% of the district area has weathered thickness in the range of 10 to 15m and 15% in the range of 15 to 20m. The depth to water level in the district during pre-monsoon period i.e. May 2011 ranged from 0.89 to 18.35 mbgl. Out of 70 nos. of wells monitored for water level, it is seen that 5.7% wells showed

a water level less than 2 m., 27% wells had water level in the range of 2 to 5 m., 48.6% wells had water level between 5 to 10m. And the remaining 18.6% wells had water levels in the range of 10 to 20 mbgl. During the post monsoon period, i.e. Nov 2011, the depth to water level in the district ranged from 0.81 to 12.78mbgl. Out of the 70 nos. of wells monitored, the depth to water level was less than 2m in15.71% wells, 2 to 5m in 40% wells, 5 to 10m in 35.7% wells and 10 to 20m in the remaining 8.6% wells. To know the long term changes in the water levels in the district, the depth to water level during pre- and post- monsoon period of 2011 in the district was compared with the mean water level of the preceding decade. The change in water level during May 2011 as compared with the mean pre monsoon water levels of the preceding decade.It is seen that out of 68 wells for which water levels were compared, 64.7% wells showed a rise in water level and the remaining 35.3% wells showed a fall in water level as compared to the preceding decade. In the rise category, 45.58% wells showed a rise in the range of 0 to 2m, 17.64% wells showed a rise of 2 to 4m and 1.47% wells recorded a rise of >4m. In the fall category, a fall in water level in the range of 0 to 2m is seen in 26.47% wells, fall of 2 to 4m is seen in 7.35% wells and a fall of >4m is seen in 1.47% wells.

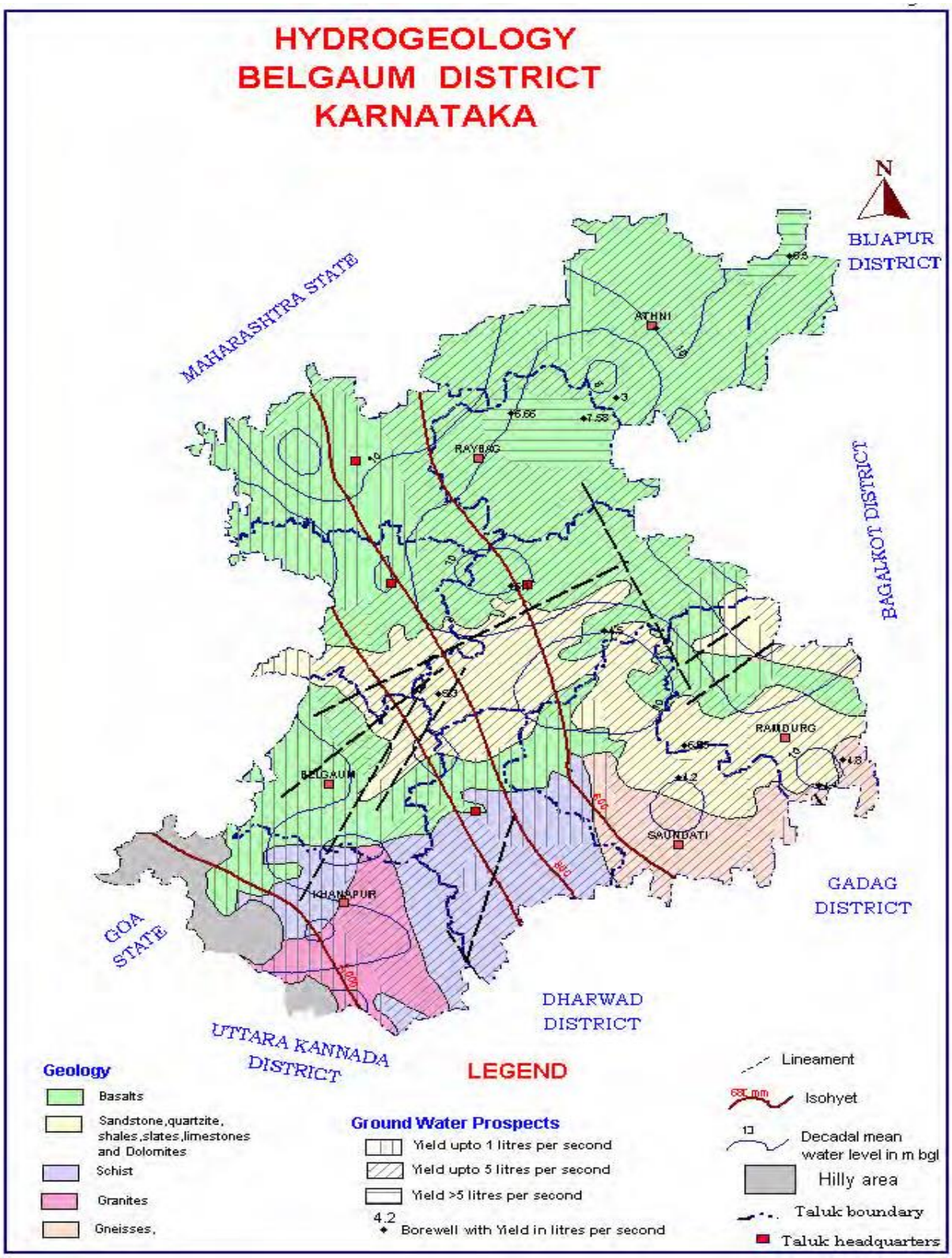

Figure 32: Hydrogeology of Belgavi district

6.2 Ground Water Resource Availability

The resource estimation and categorization is carried out as per the recommendations of 'Ground Water Estimation Methodology – 97 '(GEM – 97) considering water shed as a unit. Water shed and hydrological boundaries do not match with the administrative boundaries. As a result different parts of taluk fall in different watersheds having different stages of ground water development and categorization. However for administrative convenience talukwise data is preferred. Hence talukwise resource and average stage of development is computed on prorata basis from watershed data and presented in table 7. Resources estimated are as follows: 1. Net Ground water availability = 1,13,799 ham 2. Total Draft = 1,21,866 ham 3. Groundwater availability for future irrigation = 19,941 ham Areas falling in different categories of stage of development in the district. It is seen from the figure that in the entire district, only in Khanapur taluk 100% taluk area falls in 'safe' category followed by Belgaum taluk, in which about 91% of the area is in the safe category, bothe of which receive high rainfall. All the remaining taluks are at different states of high stage of development. While Chikkodi and Hukkeri taluks have about 50% of the area under critical /Over Exploited (OE) stage, all the remaining taluks have more than 70% of the taluk areas under critical / OE categories. Major portions of the taluks under very high stage of ground water development in the district is seen in Athani, ramdurg and Bailhongal taluks.

6.3 Ground Water Development Prospects

6.4 Anticipated Behavior of Ground Water on Downstream After Implementation of the Project

The project development and the creation of reservoir due to impounding of water u/s of dam could lead to substantial increase in the ground water table around the nearby reaches of the Reservoir which in turn benefit the people.

6.5 Quality of Ground Water

The analyses of groundwater samples of the district between 2005 and 2007 revealed that the groundwater quality was in general found to be potable in nearly half of the district. It was also found suitable for irrigation purposes in the major parts of the district (**Error! Reference source not found.**) Drinking water: It is essential to know the quality of water as it affects the health of those who consume it. Therefore, quality of groundwater was compared with BIS standards and parameters like Chloride, nitrate, pH and fluoride were evaluated. Chloride concentrations in general are within permissible limits i.e. 1,000mg/l in the district. Gokak (2,691mg/l) is the only station where chloride concentration is more

than permissible limits. Though major part of the district have chloride concentration within desirable limits i.e. less than 250mg/l, isolated patches of higher concentration but below permissible limits i.e.

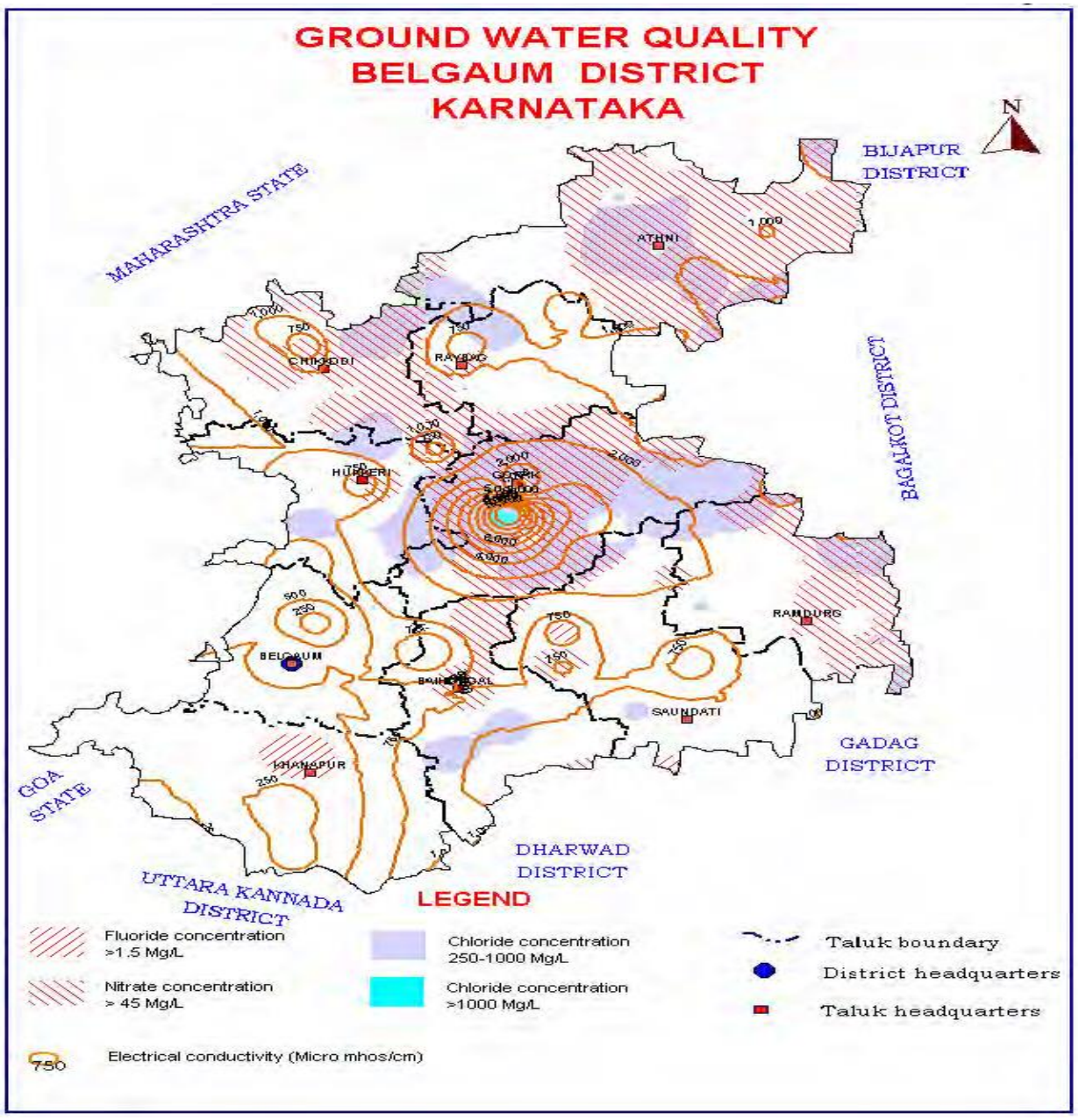

Figure 33:Groundwater quality of Belgavi District

6.6 Proposal of Conjunctive Use of Surface Water

The present project doesn't envisage conjuctive use of surface water.

Chapter 7 Design Features and Criteria for River Valley Structures

7.1 Structure and Development

7.1.1 General Brief

Based on the topographical survey of the site covering U/S and D/S including submergence area required base map and sections have been generated. Detailed longitudinal sections and cross sections are prepared for the Dam/Checkdams. Detailed survey for the Jack well cum Pump house locations including alignment survey for raising main and gravity pipelines have been carried out. Available data and information has been compiled to prepare the capacity contours and storage capacity tables.

7.1.2 Design Flood and Sediment Studies - Brief

Refer Chapter 5.

7.1.3 Freeboard

As per IS 6512:1984, freeboard is calculated and provided.

7.1.4 Construction Materials - Brief

Refer Chapter 15, para 15.2

7.1.5 Model Studies

Since the Kalasa and Haltara and also Surla diversion Dams are of smaller heights (max 10.5m at Kalasa dam) and also the flood discharge values are also not large, it is felt not necessary to conduct any hydraulic model studies regarding spillway discharging capacity and energy dissipating arrangements.

7.2 Dam

7.2.1 Embankment Dam

Not Applicable

7.2.2 Concrete Gravity Dam

The Kalasa diversion dam is about 10.5m (max. ht from deepest foundation level) with ungated concrete spillway and end connections. The design inflow flood as approved by the hydrology directorate of CWC is considered as 342 cumecs with 10% over design flood of 311 cumecs (as per CWC suggestion). The ungated spillway consists of 11 nos. of ungated vents. The spillway crest level is fixed at RL 723.00m and the MWL is at RL724.32m.

Three silt removal cum river sluices are provided in the gorge portion of the river. The size of the sluices are 2m x 2m. Bellmouth entry with horizontal bottom is proposed. Vertical lift roller gates are proposed for discharge control for the sluices. These gates are operated by screw rod type hoist of required capacity located at the road level.

Necessary foundation treatment in the form of consolidation grouting and anchor rods are proposed.

The stilling basin is horizontal hydraulic jump type of required length with end sill.

A walkway of 2.7m overall width and 2.4m of clear width is propsed at the top of the Dam for inspection purpose and also for the operation of river sluice gates.

7.2.3 Construction of Diversion Dam across Haltara nala

Construction of Jack well cum pump house along with rising main for diverting water from Haltara diversion dam to the reservoir of Kalasa diversion dam.

The Haltara diversion dam is about 11.30m (max. ht from deepest foundation level) with ungated concrete spillway, NOF and end connections. The design inflow flood as approved by the hydrology directorate of CWC is considered as 137.50 cumecs with 10% over design flood of 125 cumecs (as per CWC suggestion). The ungated spillway consists of 8 nos. of ungated vents. The spillway crest level is fixed at RL 736.00m and the MWL is at RL737.01m.

Three silt removal cum river sluices are provided in the gorge portion of the river. The size of the sluices are 2m x 2m. Bellmouth entry with horizontal bottom is proposed. Vertical lift roller gates are proposed for discharge control for the sluices. These gates are operated by screw rod type hoist of required capacity located at the road level.

Necessary foundation treatment in the form of consolidation grouting and anchor rods are proposed.

The stilling basin is horizontal hydraulic jump type of required length with end sill.

A walkway of 2.7m overall width and 2.4m of clear width is propsed at the top of the Dam for inspection purpose and also for the operation of river sluice gates.

7.2.4 Construction of Diversion Dam across Surla nala

The proposal of diversion of Surla Nala to Kalasa Dam Reservoir consists of eight check dams across Surla sub-nalas contributing from the Catchment in the state of Karnataka will be intercepted by construction of check dams within the Karnataka state. These waters will be intercepted and transferred to a receiving chamber through MS gravity feeder pipeline which will run perpendicular to these six check dams. Further the intercepted water will be received by a receiving chamber located near the confluence of Kalasa and Surla Nalas in the sixth Surla sub-nala. A Retention period of 90 seconds has been provisioned in the receiving chamber; the water will be diverted by a Jack well cum pump house along with rising main to the reservoir of Kalasa diversion dam.

The height of the 8 check dams varies from about 2m to 6m. These check dams are of concrete with nominal stilling basin lenegth of 10m. In each of the check dams provisions for the pipe out let of required size is made for onward transmission of water to receiving chamber.

- The overflow and NOF Dams are analyzed as Gravity section for following conditions as per BIS Code 6512-1994.

  1. Load combination A – Reservoir Empty
  2. Load combination B – Reservoir Full upto FRL with no tail water
  3. Load combination C – Maximum Flood discharge condition
  4. Load combination D – Combination A with Earthquake condition
  5. Load combination E – Combination B with Earthquake condition
  6. The area falls under Zone III, where the basic seismic coefficient αh is 0.04. With importance factor of 3.00, the seismic coefficient becomes, αh = 0.012. Vertical component to an extent of ½ αh, i.e., 0.06 is considered.

- The analysis of the dam both overflow and NOF is done to determine the factor of safety against sliding. In the formula, factors like Cohesion of the material at the plane is considered and coefficient of internal friction of the material is also considered.

7.2.5 Transverse Contraction Joints

Transverse contraction joints are provided at suitable intervals in the Dam except the check dams.

7.2.6 Piers

3.5 m thick RCC peirs with grooves for sluice gates and provision for screw rod type hoisting arrangements for the operation of the vertical lift roller gates is proposed.

7.2.7 Walkway Bridge

A walkway of 2.7m overall width and 2.4m of clear width is propsed at the top of the Dam for inspection purpose and also for the operation of river sluice gates.

7.2.8 Energy Dissipating Arrrangements

The energy dissipation arrangement proposed in all the dams is of horizontal stilling basin type of required length as already detailed above.

7.2.9 Training Wall

Training wall is designed for earth pressure and water pressure considering the following combination of loading.

Case A: No water in the River
Case B: Case A + Earth quake
Case C: Case B + Earth pressure due to backfill behind training wall
The stability analysis has been done considering the permissible stresses both in compression and tension, vide IS 12720:1993 for structural design of spillway training walls and divide walls.

7.2.10 Hydro-Mechanical Works (Gates, Type, Size and Hoist Arrangements)

The hydromechanical works consists of Vertical lift roller type gates (service and emergency gates) proposed for discharge control for the silt removal cum river sluices. These gates are operated by screw rod type hoist of required capacity located at the road level.

7.3 Barrage

Not applicable.

7.4 Canals

Not envisaged in the present proposal except the cost towards construction of interconnecting canal, which has been completed.

7.5 Canal Structures / Gates etc.

Not applicable.

7.5.1 De-Silting Arrangements

Not applicable.

7.6 Compendium Planning of the Lift Scheme

7.6.1 Proposed Lift Scheme

Subsequent to the revised Hydrology, finalization of discharge requirement for lifting water from Surla nala is also included in the present proposal. The following streams are proposed to be harnessed

Table 7.1: Nalas proposed to be harnessed under the scheme

Sl No.	Particulars	Catchment Area	Annual Yield @ at 75.60% dependability	Monsoon Diversion @ at 75.60% dependability
		Sq. Km.	TMC	TMC
1	Kalasa Nala	15.500	1.330	1.042
2	Halthara Nala	4.000	0.340	0.270
3	Surla Nala	6.000	0.520	0.405
	Total	**25.500**	**2.190**	**1.717**

7.7 Planning of the Lift Scheme

Since the additional lift is included from the Surla nala, it is now proposed to pump the water from Halthara and Surla nala and deliver to Kalasa reservoir. The diverted water including Kalasa is pumped to the entry of cut and cover is combined to economies' the scheme.

The details of the individual scheme are as under: -

7.7.1 Halthara Lift Scheme

The proposed scheme of lifting water from foreshore of Halthara dam is located on left flank of Halthara dam. The geographic location of Lift headwork is at 15º 39' 46" N and 74º 08' 37" E Intake level proposed is 729.50 m. The discharge to be pumped is 2.39 Cumecs.

The rising main is planned parallel to National Highway (NH 748 AA) up to peak point. Length of rising main upto this point works out to 729.50 m. A delivery chamber (DC-1) is proposed at this point with delivery level at 779.50 m.

7.7.2 Surla Lift Scheme

Under Surla nala there are 6 streams which are to be harnessed to achieve combined discharge requirement. The check dams are proposed across the nala only for diversion with minimum height, minimum submergence and no storage. The details of 6 nalas are as under: -

Table 7.2: Details of Nalas proposed to be harnessed for Surla Lift Scheme

Sl No.	Particulars	Catchment Area	Discharge	Cumulative Discharge
		Sq. Km.	Cumecs	Cumecs
1	Check Dam-1 (CD-01)	2.63	2.051	2.051
2	Check Dam-2 (CD-02)	0.28	0.218	2.270
3	Check Dam-3(CD-03)	0.21	0.164	2.434
4	Check Dam-4 (CD-04)	0.11	0.086	2.519
5	Check Dam-5 (CD-05)	1.23	0.959	3.479
6	Check Dam-6 (CD-06)	1.54	1.201	4.680
	Total		**4.680**	

It will be economical to pump the water from individual streams. Hence, it is proposed to provide a Gravity Pipe from Nala-1 (CD-1) upto Nala-6 (CD-6) by providing a cross country pipeline. Inlets are proposed at every nala which will feed the discharge to Gravity Pipe. Looking to the topography, difference in Nala-1 to Nala-6 is about 7.0 m. Hence, Gravity Pipe can be proposed.

From the end of Gravity Pipe i.e. after crossing Nala-6, a collection sump cum pump house is proposed from which combined water from all the 6 nalas is pumped to a Delivery chamber (DC-2) and further by gravity to Receiving chamber (RC-1). The discharge to be pumped is 4.68 Cumecs. The receiving chamber will receive water from both Halthara and Surla leading to Kalasa reservoir.

Refer Appendix 5 for detailed note on Surla gravity main for collecting water from six nalas and conveying it to DC.

7.7.3 Kalasa Lift Scheme

The proposed scheme of lifting combined water (Halthara+Surla+Kalasa) from foreshore of Kalasa dam is located on Right flank of Halthara dam. The geographic location of Lift headwork is at 15º 40' 46" N and 74º 11' 20" E. Intake level proposed is 714.50 m. The combined discharge to be pumped is 12.543 Cumecs.

The combined discharge to be pumped from Kalasa nala is as under: -

The rising main is planned parallel to National Highway (NH 748 AA) up to 3360 m. is proposed at this point with delivery level at 737.80 m.

7.8 Design Details of the Scheme

The design details are as follows Diversion Dam, Intake forebay, Jack well cum pump house, Pumping Machinery, Electrical substation, Rising Main, Delivery Chamber, Gravity main and Receiving Chamber are as under:

7.8.1 Halthara Lift Scheme

The scheme comprises of following components:

- Construction of Diversion Dam.
- Construction of Intake forebay and Jack well cum pump house to accommodate **3 No's of Submersible Pumps (2 Working + 1 Standby)** for lifting the water.
- Supply, Installation, testing and commissioning of **Pumping Machinery** and pump house electrical works.
- Construction of **11/6.6 KV** Electrical substation with 2 No's (1 working + 1 standby) **2.75 MVA** capacity Transformer including 11 kV terminal bay and Erection of 11 KV 3 core 400 sq.mm UG cable (6 km) from Kalasa proposed substation for power supply to pumping station.
- Supply, jointing, laying, testing and commissioning of **MS Rising Main** for conveying water from jack well cum pump house to Delivery Chamber (DC-1).
- Construction of **Delivery Chamber (DC-1)** at the end of the Rising Main.
- Construction of **Combined Receiving Chamber (RC-1)** (Halthara + Surla) at the end of the Gravity Main leading to Kalasa Reservoir.
- Operation and Maintenance of the scheme for 5 years.

7.8.2 Surla Lift Scheme

The scheme comprises of following components:

- Construction of Check Dams across nalas (6 Nos).
- Construction of Inlets (6 Nos).
- Supply, jointing, laying, testing and commissioning of **MS Gravity Main (GM-1)** for conveying water from individual nalas to Sump cum pump house.
- Construction of Sump cum pump house to accommodate **5 No's of Submersible Pumps (4 Working + 1 Standby)** for lifting the water..
- Supply, Installation, testing and commissioning of **Pumping Machinery** and pump house electrical works.
- Construction of **11/0.433 KV** Electrical substation with 2 No's (1 working + 1 standby) **1.3 MVA** capacity Transformer including 11 kV terminal bay and Erection of 11 KV 3 core 400 sq.mm UG cable (3 km) from Kalasa proposed substation for power supply to pumping station.
- Supply, jointing, laying, testing, and commissioning of **MS Rising Main** for conveying water from Sump cum pump house to Delivery Chamber (DC).
- Operation and Maintenance of the scheme for 5 years.

7.8.3 Kalasa Lift Scheme

The scheme comprises of following components:

- Construction of Diversion Dam.
- Construction of Intake trough, forebay and Jack well cum pump house to accommodate **6 No's of Vertical Turbine Pumps (5 Working + 1 Standby)** for Lifting the water of combined discharge (Kalasa+Halthara+Surla).
- Supply, Installation, testing and commissioning of **Pumping Machinery** and pump house electrical works.
- Construction of **110/11 KV** Electrical substation with 2 No's (1 working + 1 standby) **6 MVA** capacity Transformer including construction of Terminal Bay and Erection of 110 KV

SC line using DC towers (28 km) & UG cable of single core 630 sq.mm (12 Km) from nearest KPTCL substation (Khanapur) for power supply to pumping station.

- Supply, jointing, laying, testing and commissioning of **MS Rising Main** for conveying water from jack well cum pump house to **Receiving** Chamber (RC).
- Construction of **Receiving Chamber (RC)** at the end of the **MS Rising Main** leading to Existing cut and cover.
- Operation and Maintenance of the scheme for 5 years.

7.9 Diversion Dam

It is proposed to construct a diversion Dam for impounding of water and assuring minimum required storage for pumping of water. The details of the proposed diversion Dam are as under:

Table 7.3.Design details of Diversion Dam

Particulars	Kalasa	Haltara
Discharge (Q)	342.100 Cumecs	137.500m
Type of spillway	Ogee	Ogee
Full Reservoir level /	723.000 m	736.000 m
Maximum Water Level	724.320 m	737.01 m
Top of Road	727.100 m	739.60m
Tail water level	715.921 m	730.61m
Length	120.600m	72.80m
Maximum height above	10.500m	11.30m
EL of deepest	712.500m	724.70m
Number of Vents	11	8
Size of Vents	7 nos of 9.4m x 1.32m	7 nos of 9.4m x 1.32m
Number of bridge piers	10	8
Thickness of bridge	0.6m	0.6m
Number of Sluice piers	3	2
Thickness of Sluice piers	3.5m	3.5m
Type of energy	Trajectory Bucket Type	Trajectory Bucket Type
River sluice(s),	River sluice	River sluice
Purpose	Regulate the discharge on d/s	Regulate the discharge on d/s

Particulars	Kalasa	Haltara
Number	3 Nos	2 Nos
Size(m)	2.0 x 2.0 m	2.0 x 2.0 m

7.10 Jack well cum Pump House

Intake Forebay is proposed to draw the water from the Nala to the jack well cum pump house for Kasala, Haltara lift and for Surla lift Sump is proposed.

Rectangular RCC framed structure is proposed at end of forebay for accommodating Vertical Turbine pumps for Lifting water from Nala. Provision of accommodating HT board panels, starters, EOT crane are made in the jack well. Details of the Jack well cum pump house are as under:

Table 7.4: Details of Jack well cum pump house

No.	Particulars	Haltara Lift	Surla Lift	Kalasa Lift
1.	Type of Pump	Submersible	Submersible	Vertical Turbine
2.	No's of Pumps (Working+Stand by)	2W+1S	4W+1S	5W+1S
3.	Type of structure	RCC framed structure	RCC framed structure	RCC framed structure
4.	Minimum water level / Intake level	729.500 m	720.500 m	714.500 m
5.	High Flood Level	736.000 m	722.000 m	724.320 m
6.	Sump bottom level	725.500 m	715.500 m	710.500 m
7.	Delivery floor level/ Pump floor level	740.000 m	723.000 m	727.000 m
8.	Control room floor level	743.000 m	726.500 m	730.500 m
9.	Corbel level	747.650 m	729.000 m	735.000 m
10.	Roof level	747.150 m	732.000 m	737.250 m
11.	Overall size of the pump house	15.8 m x 18.0 m	21.45 m x18.3 m	31.0 m x 16.50 m

No.	Particulars	Haltara Lift	Surla Lift	Kalasa Lift
12.	Sump Size	-	42.0 x 42.0 x 6.5m	-

Based on the minimum water level available in the sump and the specific speed requirements, the Sump bottom level is decided, to ensure cavitation free and satisfactory operation of the pumps.

The motor/Pump/Delivery floor and service bay level are kept at approach level for ease of approach of heavy trucks carrying the large equipment to the Pump house. The panel room floor level is maintained same as that of the mortar floor level. A cable cellar is proposed below the Panel room, for routing various cables as required for various electrical equipment.

Based on the size of the equipment and clearance required for erection and dismantling of the pump house equipment, such as pump, pump shafts, motors, valves etc. the crane girder level is decided. The level of fitting the monorail for gates and trash racks shall be decided during detailed engineering, considering the clearances required for lowering, lifting and shifting of Gates and Trash racks.

It is proposed to provide all-round embankment for Jack well for accommodating service bay, electrical substation, surge protection equipment's etc.

7.10.1 Fixing the dimensions of Jack well Cum Pump House

General rule the size of the suction pipe should be 1 to 2 sizes larger than the nominal suction size of the Pump. Alternatively, the suction pipe should be of such size that the velocity shall be about 2m/s. Where bell mouth is used, the inlet of the bell mouth should be of such size that the Velocity at the bell mouth shall be about 1.5m/s.

A dummy wall (baffle wall) may be provided to avoid dead spots by keeping rear clearance, the dimension 'B' to about 0.75D from the Centre line of the pump.

Avoid dead spots at the suction bell mouth by maintaining the bottom clearance, dimension 'C' between D/4 to D/2, preferably D/3 in the GAD D/4 is considered.

Avoid mutual interference between two adjoining pumps by maintaining minimum sufficiency clearance, the 'S' is equal to 2D to 2.5 D. it is also advisable to provide diving walls between the pumps. In GAD 4D is considered.

The floor underneath the pump suction should be flat up to ≥3 D.

Distance from the pump inlet bell centerline to the intake structure entrance shall be ≥5 D.

Pump inlet bay entrance width shall be =2 D. in the GAD > 5D is considered.

Provide tapered walls between the approach channel and sump. By this velocity should reduce gradually to about 0.3m/s near the pump. This also helps to avoid sudden change in the direction of the flow (Max =15 Deg. and preferred =10 Deg.) in the GAD 11 Deg. is considered.

To avoid sudden drop between the approach channel and the sump. A slop of Max =15 Deg. is recommended (preferred =10 Deg.) in the GAD 4 Deg. Is considered.

7.10.2 Fixing of dimensions of Pumping Station

Pumping station Layout to be prepared with sufficient space for the purpose of safe maintenance and operation. Pumps, piping and equipment must be protected from the weather as dictated by local climatic conditions by suitable coating/painting etc. The impact of noise on the surrounding area and the need for security fencing will be considered for all stations. Structures will be fire-resistive construction.

1. A minimum clear distance of 1 m. To be provided between each pump set (between pump to pump or motor to motor whichever is more).
2. F/F distance of min. 300 mm to be provided between each valve (or as per flange fixing bolt dimension for ease of fixing and dismantling).
3. Walkway of min. 1 m. Width to be provided on the pump floor with suitable handrails all around wherever necessary.
4. Service/loading & unloading Bay shall be provided with sufficient space (min. 2 times the dimension of the pump or motor whichever is more.
5. Crossover of min. 1 m. Width shall be provided between each pump delivery pipes and wherever required for the ease of maintenance.
6. Height of pump floor shall be kept according to the maximum height of the pump assembly of motor to avoid fouling/ease of maintenance.
7. Vendor instructions shall be followed while installing of mechanical equipment (for pump set foundation design, Headroom clearance for EOT Crane, Trash rack etc.). And vendor data for loading and spacing shall be considered while designing of design of jack well.
8. Pump floor shall be provided with sufficient lighting and ventilation.
9. Inspection Manhole of in. 1m x 1m shall be provided for maintenance and monitoring purpose.

10. Ladder/ satire case shall be provided wherever necessary for ease of maintenance with suitable coating/painting.
11. All pipes and valves shall be supported by proper support.
12. Thrust blocks shall be provided for as per structural design for elbows, tees etc.
13. Pump set foundation, thrust block, pipe support etc. shall be as per structural drawings and cable routing, earthling etc. electrical drawing.

7.11 All possible dimensions shall be shown in the mechanical GAD.

7.12 Pumps and Motors

Vertical Turbine Pumps and Submersible pumps depending on the discharge and head for lifting are recommended for this project. These pumps provide trouble free service for long time. It is recommended to have minimum 1 stand-by for the ease of maintenance.

Table 7.5: Details of Pumping Machinery

No.	Particulars	Haltara Lift	Surla Lift	Kalasa Lift
1	Type of Pump	Submersible Pumps	Submersible Pumps	Vertical Turbine Pumps
2	Efficiency of Pump	82%	80%	86%
3	Intake Level	729.500 m	720.500 m	714.00 m
4	Delivery Level	779.500 m	731.000 m	737.800 m
5	Static Head	50.00 m	10.50 m	23.30 m
6	Losses (Friction + pump internal + other)	4.00 m	3.50 m	4.70 m
7	Total Pump Head	54.00 m	14.00 m	28.00 m
8	Required Discharge	2.39 cumecs	4.68 cumecs	12.543 cumecs
9	Number of Pumps	2 working + 1 Standby	4 working + 1 Standby	5 working + 1 Standby
10	Discharge for each Pump	1.195 cumecs, 4302.00 m^3/ hr	1.170 cumecs, 4212 m^3/ hr	2.509 cumecs, 9030.96 m^3/ hr

No.	Particulars	Haltara Lift	Surla Lift	Kalasa Lift
11	Capacity of each Pump	1160.00 HP (865.36 KW)	320.00 HP (238.72 KW)	1260.00 HP (939.96 KW)
12	Total Installed Capacity	3480.00 HP (2596.08 KW)	1600.00 HP (1193.60 KW)	7560.00 HP (5639.76 KW)
13	Total Power Requirement	2.75 MVA	1.3 MVA	6.00 MVA
14	Electrical Sub-station	11 KV / 6.6 KV outdoor type with 2 No's of 2.75 MVA Power transformer (1 Working + 1 Standby)	11 KV / 0.433 KV outdoor type with 2 No's of 1.3 MVA Power transformer (1 Working + 1 Standby)	110 KV / 11 KV outdoor type with 2 No's of 6.0 MVA Power transformer (1 Working + 1 Standby)
15	Delivery pipe	850 mm diameter 8.0 mm thick MS pipes	900 mm diameter 8.0 mm thick MS pipes	1200 mm diameter 12.0 mm thick MS pipes
16	Manifold system	1600 mm diameter 10.0 mm thick MS pipe	2300 mm diameter 24.0 mm thick MS pipe	3700 mm diameter 28.0 mm thick MS pipe

7.13 Power Requirement and Electrical Substation

7.13.1 Halthara Lift Scheme

The total power requirement for diverting water from Halthara Nala is **2.75 MVA.** The power requirement is calculated taking into account of no. of working pumps and auxiliary power supply. The voltage level at which power is required is 6.6 KV and required transformer capacity is to receive 11 KV for power stepping down to 6.6 KV for feeding HT motors.

It is proposed to provide 11 KV sub-station with transformer capacity of 2.75 MVA power for Lifting water from Halthara Nala catering the above loads with OLTC & RTCC panels. Provision of 2 No's of transformers (1 working + 1 standby) is made.

7.13.2 Surla Lift Scheme

The total power requirement for diverting water from Surla Nala is **1.3 MVA.** The power requirement is calculated taking into account of no. of working pumps and auxiliary power supply. The voltage level at which power is required is 0.433 KV and required transformer capacity is to receive 11 KV for power stepping down to 0.433 KV for feeding LT motors.

It is proposed to provide 11 KV sub-station with transformer capacity of 1.3 MVA power for Lifting water from Surla Nala catering the above loads with OLTC & RTCC panels. Provision of 2 No's of transformers (1 working + 1 standby) is made.

7.13.3 Kalasa Lift Scheme

The total power requirement for diverting water from Kalasa Nala is **6.0 MVA.** The power requirement is calculated taking into account of no. of working pumps and auxiliary power supply. The voltage level at which power is required is 11 KV and required transformer capacity is to receive 110 KV for power stepping down to 11 KV for feeding HT motors.

It is proposed to provide 110 KV sub-station with transformer capacity of 6.0 MVA power for Lifting water from Kalasa Nala catering the above loads with OLTC & RTCC panels. Provision of 2 No's of transformers (1 working + 1 standby) is made.

The details are as under:-

Table 7.6: Details of Power Requirement and Electrical Substation

No.	Particulars	Haltara Lift	Surla Lift	Kalasa Lift
1	Power Requirement	2.75 MVA	1.3 MVA	6.00 MVA
2	Transformer Rating & Voltage	2 Nos x 2.75 MVA 11 KV / 6.6 KV	2 Nos x 1.3 MVA 11 KV / 0.433 KV	2 Nos x 6.00 MVA 110 KV / 11 KV
3	Number	1 Working+1 Stand by	1 Working+1 Stand by	1 Working+1 Stand by
4	Source Substation Location	Proposed Reference Substation at Kalasa Scheme	Proposed Reference Substation at Kalasa Scheme	Khanapur KPTCL Substation
5	Length of	6 Km	3 Km	12 Km

No.	Particulars	Haltara Lift	Surla Lift	Kalasa Lift
	powerline by providing underground cable			
6	Length of powerline by providing overhead SC line using DC tower	-	-	28 Km
7	Total Length of powerline	Approx. 6 Km	Approx. 3 Km	Approx. 40 Km

7.14 Rising Main and Gravity Main

7.14.1 Selection of Pipe Material and design velocity

It is proposed to use Mild Steel (MS) as a material of rising/gravity main pipe. Designing of M.S. Rising/Gravity Main is based on following considerations:

i. Velocity of flow shall be as far as possible, limited to 2.0 m/sec.

ii. Wall Thickness:

   a. D/t ratio not exceeding 150.

   b. Safe check for hoop stress.

   c. The thickness shall not be less than as specified in IS 1916

   d. Check for design pressure 150% of pump head.

   e. Check for 150% of Working Pressure.

It is proposed to consider External coating as Pipe coating of fibres, coal tar and solvent based rubber modified bituminous primer of density 0.92 gms/cu cm and viscosity of 1000-2000 cps @ 150 gms/sqm followed by seven layers (4 mm thick) of polythene polymerized bitumen and polyester of total 7 layers pipe coat 4 mm should conform to requirement of IS-10221 and AWWA C-203 for prefabricated tapes to speed up the work.

MS pipes with inner lining and outer tar tape coating is considered for the design of Rising/Gravity Main. The details of the Rising/Gravity Main areas under.

7.14.2 Halthara Lift

Table 7.7: **Details of Rising Main and Gravity Main for Halthara Lift**

No.	Particulars	Raising Main
1	Length of the Rising Main (m)	6100.00
2	Peak Discharge (Cumecs)	2.390
3	Number of Rows (No)	1
4	Discharge for each Row (Cumecs)	2.390
5	Velocity considered (m/s)	1.98
6	Actual Velocity (m/s)	1.98
7	Diameter of Pipe (ID) (mm)	1240.0
8	Pipe Type	MS
9	Grade of Steel	E 250
10	Thickness of Pipe (mm)	8.1
11	Internal Epoxy Coating (mm)	0.406
12	External tar tape coating (in mm)	4

7.14.3 Surla Lift

Table 7.8: **Details of Gravity Main**

Reach	Chainage m		Dia mm	Q, cumecs	Reach Head Loss, m	Check Dam FRL, m	HGL at Start m	Velocity m/s
	From	To						
Check Dam-1 to 2	0	300	980.0	2.051	1.637	736.600	736.600	2.720
Check Dam -2 to 3	300	1020	1070.0	2.270	3.066	735.000	734.963	2.524
Check Dam -3 to 4	1020	1220	1000.0	2.434	1.355	732.000	731.896	3.099
Check Dam -4 to 5	1220	1670	1000.0	2.519	3.251	730.700	730.541	3.208
Check Dam -5 to 6	1670	2000	1000.0	3.479	4.334	727.600	727.290	4.429

Check Dam -6 to DC	2000	2030	2000.0	4.680	0.360	723.400	722.956	1.490
DC	2030					723.000		

Table 7.9: **Details of Rising Main and Gravity Main for Surla Lift**

No.	Particulars	Rising Main	Gravity Main
1	Length of the Rising Main (m)	985	880.0
2	Peak Discharge (Cumecs)	4.68	4.68
3	Number of Rows (No)	1	1
4	Discharge for each Row (Cumecs)	4.68	4.68
5	Velocity considered (m/s)	2.00	2.00
6	Actual Velocity (m/s)	2.00	2.00
7	Diameter of Pipe (ID) (mm)	1730.0	1730.0
8	Pipe Type	MS	MS
9	Grade of Steel	E 250	E 250
10	Thickness of Pipe (mm)	10.7	10.7
11	Internal Epoxy Coating (mm)	0.406	0.406
12	External tar tape coating (in mm)	4	4

7.14.4 Kalasa Lift

Table 7.10: **Details of Rising Main and Gravity Main for Kalasa Lift**

No.	Particulars	Raising Main
1	Length of the Rising Main (m)	3360.00
2	Peak Discharge (Cumecs)	12.543
3	Number of Rows (No)	1
4	Discharge for each Row (Cumecs)	12.543
5	Velocity considered (m/s)	1.99
6	Actual Velocity (m/s)	1.99
7	Diameter of Pipe (ID) (mm)	2830.0

No.	Particulars	Raising Main
8	Pipe Type	MS
9	Grade of Steel	E 250
10	Thickness of Pipe (mm)	17.5
11	Internal Epoxy Coating (mm)	0.406
12	External tar tape coating (in mm)	4

Following provisions are made in the estimate of pipeline:

- Earthwork Excavation for pipeline trenches.
- Supplying, Laying, jointing Testing & commissioning of M.S Pipes.
- Provision for Air valves and scour valves.
- Construction of Thrust Blocks & Anchor Blocks.
- Construction of Valve chambers.
- Construction of Hard passage for nala crossing
- Construction of Cart Track & Asphalt Road Crossings
- Construction of Railway crossings
- Construction of National Highway crossing
- Refilling of trenches.
- Provision of Boundary pillars, Kilo meter stones as per specifications.

7.15 Preliminary Surge Analysis.

Preliminary surge analysis is carried out for all the three lift schemes and the stand pipes are proposed for individual lift schemes the details are as under

Table 7.11: **Details of Stand pipe for Haltara Lift**

Sl No.	Description	Details
1.	Connected at	Ch 220 m
2.	Material of Stand Pipe	MS
3.	Inner Diameter of Stand Pipe	800 mm

4.	Thickness of Stand Pipe	8.1 mm
5.	FTL of Stand Pipe	RL 767.619 m
6.	Freeboard	1.2 m
7.	Top of Stand Pipe	RL 768.82 m
8.	Floor Level of Stand Pipe	At the top of Rising Main
9.	Height of Stand Pipe (Approximate)	5.82 m above Rising Main
10.	Overflow Pipe	As per Normal Practice

Table 7.12: Details of Stand pipe for Surla Lift

Sl No.	Description	Details
1.	Connected at	Ch 62 m
2.	Material of Stand Pipe	MS
3.	Inner Diameter of Stand Pipe	800 mm
4.	Thickness of Stand Pipe	10.7 mm
5.	FTL of Stand Pipe	RL 733.350 m
6.	Freeboard	1.2 m
7.	Top of Stand Pipe	RL 734.550m
8.	Floor Level of Stand Pipe	At the top of Rising Main
9.	Height of Stand Pipe (Approximate)	7.55 m above Rising Main
10.	Overflow Pipe	As per Normal Practice

Table 7.13: Details of Stand pipe for Kalasa Lift

Sl No.	Description	Stand Pipe No. 1	Stand Pipe No. 2
1.	Connected at	Ch 80 m	Ch 1860 m
2.	Material of Stand Pipe	MS	MS
3.	Inner Diameter of Stand Pipe	1600 mm	1600 mm

4.	Thickness of Stand Pipe	17.5 mm	17.5 mm
5.	FTL of Stand Pipe	RL 741.920 m	RL 740.411 m
6.	Freeboard	1.2 m	1.2 m
7.	Top of Stand Pipe	RL 743.120 m	RL 741.611 m
8.	Floor Level of Stand Pipe	At the top of Rising Main	At the top of Rising Main
9.	Height of Stand Pipe (Approximate)	12.6 m above Rising Main	5.6 m above Rising Main
10.	Overflow Pipe	As per Normal Practice	As per Normal Practice

Apart from the proposed surge protection works necessary provision of Air valves, sluice valves along rising main are proposed as per standard guidelines. **Refer Appendix-4 for Preliminary surge analysis.**

7.16 Delivery Chamber

It is proposed to provide a Delivery chamber at the rising main to dissipating water turbulence to avoid erosion of bed of nala. Chamber have three side RCC retaining wall with one side board crest weir structure is proposed. The details of the proposed Delivery chamber are as indicated below **Table 7.14.**

Table 7.14: Details of Delivery chamber

No.	Particulars	Halthara & Surla (DC)
1	Delivery level	725.000 m
2	Average Ground level	723.900 m
4	Depth of water	3.625m
5	Inner Size	5.250 m x 6.500 m x5.125 m
6	Water cushion	0.50 m
7	Free Board	1.0 m
8	Overall depth	5.125 m
9	Bed Level of Delivery chamber	720.875m
10	Top of Delivery	726.000 m

No.	Particulars	Halthara & Surla (DC)
	chamber	
11	Crest level;	724.000 m

7.17 Receiving Chamber

Receiving Chamber (RC) is proposed at the end of Kalasa rising Main conveying combined discharge of 12.543 Cumecs (Kalasa+Halthara+Surla) leading to existing cut and cover.

Chapter 8
Reservoir

8.1 Fixation of Storage and Reservoir Levels

8.1.1 Dead Storage

As per the standard practice, the Dead Storage is fixed at 10 % of the Total storage.

8.1.2 Low Water Level

Deepest bed level has been fixed at 712.50 m and 724.70 m for Kalasa and Haltara respectively.

8.1.3 Full Reservoir Level

The Full Resevoir Level is fixed at EL 723.00 m and 736.0 mfor Kalasa and Haltara respectively

8.1.4 Maximum Water Level

Maximum Water level is EL 724.320 m and 737.01 m for Kalasa and Haltara respectively

8.1.5 Direction of Wind Velocity

8.5.1 Wind

Most parts of the area are exposed to strong winds almost throughout the year. By the end of October, fairly constant wind, which gets cooler with the progress of the season, sets in from the Northeast. From November to January, dry and biting winds blow from direction between northeast and southwest. In February, northerly and northwesterly winds are also common in the forenoon and these become more and more predominant in the months of March and April. The afternoon winds are variable in all these three months. With the advance of summer, dust-raising winds add to the discomfort of the hot weather. During the second half of May, winds increase in force and blow from directions between Southwest and Northwest. Although they do not bring rain, these winds are cool and refreshing. With the onset of monsoons, winds strengthen further and blow from directions West and Southwest. By the latter half of September winds begin to weaken and blow from directions between North and East.

8.1.6 Salient features of Kalasa and Haltara dams

Table 8.1: Salient features of Kalasa and Haltara dams

Sl No.	Particulars	Kalasa	Haltara
1.	**Discharge (Q)**	342.100 Cumecs	137.500m
2.	**Type of spillway**	Ogee	Ogee
3.	**Full Reservoir level / Crest**	723.000 m	736.000 m
4.	**Maximum Water Level**	724.320 m	737.01 m
5.	**Top of Road**	727.100 m	739.60m
6.	**Tail water level**	715.921 m	730.61m
7.	**Length**	120.600m	72.80m
8.	**Maximum height above**	10.500m	11.30m
9.	**EL of deepest foundation**	712.500m	724.70m
10.	**Number of Vents**	11	8
11.	**Size of Vents**	7 nos of 9.4m x 1.32m	7 nos of 9.4m x 1.32m
12.	**Number of bridge piers**	10	8
13.	**Thickness of bridge piers**	0.6m	0.6m
14.	**Number of Sluice piers**	3	2
15.	**Thickness of Sluice piers**	3.5m	3.5m
16.	**Type of energy**	Trajectory Bucket Type	Trajectory Bucket Type
17.	**River sluice(s),**	River sluice	River sluice
18.	**Purpose**	Regulate the discharge on	Regulate the discharge on
19.	**Number**	3 Nos	2 Nos
20.	**Size(m)**	2.0 x 2.0 m	2.0 x 2.0 m

8.2 Life of Reservoir in Years with Basis

8.3 Capacities

8.3.1 Capacities (Mcum)

The capacity of the proposed reservoir at FRL will be 12.32 Mcft and 3.48 Mcft for Kalasa and Haltara respectively.

8.3.2 Water Tightness of the Reservoir

All the parameters required for designing the water tightness of the reservoir are considered.

8.4 Effect on Sub Soil Water Table in the Adjoining Areas

The resultant ponding of water due to storage in the proposed reservoir will help in energizing and improving the sub soil water table in the adjoining areas.

8.5 Reservoir Rim Stability

Slopes are stable and no possibility of any slope failures in the reservoir area

8.6 Area of submergence

No.	FRL (in m)	Submergence (in Ha)		Total (in Ha)	Remarks
		Forest	Revenue		
1.	723.00	10.2831	1.6183	11.9014	Kalasa
2.	736.00	2.9203	0.2057	3.126	Haltara
3.	-	1.5249	2.2453	3.7702	Surla sub nalas
	Total	**14.7283**	**4.0693**	**18.7976**	

8.7 Land Acquisition, Property Submerged and Rehabilitation

8.7.1 Land Acquisition

The proposed project involves land acquisition in view of submergence and for seating of dam, construction of approach roads, jack well cum pump house, rising main, gravity main and related activities. The acquisition comprises of forest lands and revenue lands.

Total area to be acquired is 129.7482 Ha

- Forest lands – 33.0507 Ha
- Revenue lands – 96.6975 Ha

Chapter 9 Irrigation Planning

This project is conceived as a Drinking water project involving diverting the extent of water as per the allocation by the tribunal and no irrigation component has been envisaged.

Chapter 10
Command Area

This project is conceived as a Drinking water project involving diverting the extent of water as per the allocation by the tribunal and no irrigation component has been envisaged.

Chapter 11
Flood Control

Flood control is not a part of the present proposal since the project involves construction of diversion dam with suitable structure for effective disposal of flood water.

Chapter 12
Drainage

This project is conceived as a Drinking water project involving diverting the extent of water as per the allocation by the tribunal and no irrigation component has been envisaged.

Chapter 13
Power

Hydro Power production is not the component a part of the present proposal.

Chapter 14
Navigation

There is no proposal to use for Navigation purposes since this project is conceived as a Drinking water project involving diverting the extent of water as per the allocation by the tribunal and no irrigation component has been envisaged.

Chapter 15
Construction Methodology, Schedule, Manpower and Plant Planning

15.1 Construction Program

The planning for the time of construction is considered as days on the basis of 24 hours working per day. Every Sunday is deemed to be weekend and has been considered as a workday off.

Due to the nature of hydrology, the full phase construction is affected during the monsoon season i.e. Second half of June, July, August and September when the river discharge is high, making it difficult to work at the areas below the flood level. This effect has been considered in preparing the schedule.

15.2 Key materials planning

15.2.1 Construction Materials

The sources of the major construction materials required for the project have been anticipated as follows:

- Explosives for blasting will be obtained from suppliers in Belagavi.
- Cement in bulk will be obtained from cement factories/ nearest cement dealers.
- Coarse aggregate which will be produced on site from the excavated materials, selected Rock quarries and River Course
- Fine aggregate which will be processed from the excavated material and other nearest local sources if necessary.
- Reinforcement & Structural steel will be obtained from SAIL/TATA or any other approved dealers.

15.2.2 Abstract of Major Quantities of Construction Materials

Abstract of major quantities of construction materials required for different components of the work are assessed based on Preliminary Designs & Drawings

Table 15.1: Requirement of Construction Materials

No	Components	Explosive in MT	Sand in cum	Coarse aggregate in cum	Cement in MT	Reinforced steel in MT	Structural Steel in MT
1	Dam and allied	15.00	25,000	75,000	1,00,000	100	50

No	Components	Explosive in MT	Sand in cum	Coarse aggregate in cum	Cement in MT	Reinforced steel in MT	Structural Steel in MT
	works						

15.2.3 Transportation Method

All the Hydro- Mechanical equipment, materials required for civil works such as cement, reinforcement steel, pipes, shuttering materials etc., including explosives are to be transported from Belagavi by road on state highway/national highway. Other materials required in small quantity could be procured from nearby towns.

15.3 Construction Power Requirement and Proposed Supply Arrangement

The total Power requirement would be 10 MVA. The details are as follows:

Air Compressors	1 MVA
Aggregate Processing Plant	2 MVA
Batching Plant	1 MVA
Dewater Pumps	1 MVA
Grout Pumps	0.5 MVA
Other Facilities	2 MVA
Welding Machine	2.5 MVA
Bending Machine	
Total	**10 MVA**

Any additional power requirement needs to be supplemented with the help of temporary power supply from DG sets.

15.3.1 Telecom Facility

In order to establish 24/7 communication, required infrastructure will be established with the help of DOT which will also be continued during the period of O & M

15.3.2 Wireless System

The project will be tendered and work will be entrusted to a single or multiple agencies, Respective implementing agency will be directed to maintain required communication system in terms of wireless system after taking necessary approval from the concerned department /s

15.3.3 Land Requirement for Infrastructure Development of the Project

All the above facilities require land. The tentative requirement of land for various component of the project is as below:

No.	Description	Area in sqm	Remarks
1	Project Roads	20,000	Required land of 4.25 ha will be identified in revenue property and will be taken on lease/rent for the required duration.
2	Dump Yard	5,000	
3	Stack Yard including cement godowns	15,000	
4	Magazine Building	2,500	
	Total land in Sqm	**42,500**	
	Total land in Ha	**4.25**	

15.4 Plant / Equipment Planning

Requirement of plant/ machinery for the deployment for the works has been proposed based on the works involved and similar works carried out in other projects. List of various plant/machinery to be deployed is given below. The list is indicative since same equipment can also be planned for the use for nearby works depending on the planning of the construction agency.

Table 15.2: List of plant/machinery

No	Equipment	Dam, Weirs, Jackwell cum pumphouse ,Substation & allied works	Road works	Total
1.	Tippers (20/25t)	15	5	20
2.	Tippers (5.0 m3)	5	5	10
3.	Excavators (1.5 m3)	3	3	6
4.	JCB	2	2	4
5.	Compressors (500cfm/600cfm)	2		2
6.	DG set(250 KVA)	2		2
7.	Dewatering pumps	5		5
8.	Shotcrete machine (30m3/HR)	2		2
9.	Concrete placer	2		2
10.	Concrete pump (38m3/hr)	4		4
11.	Grouting pump	3		3
12.	Transit mixer (6.0m3)	8		8
13.	Batching plant (30m3/hr)	1		1
14.	D-8 Dozer (200 HP)	3		3
15.	Vibrators	10		10
16.	Jack hammers	10		10
17.	Mobile crane (10t)	Nil		
18.	Water tanker (11000ltrs)	3		3
19.	Crawler drill	Nil		
20.	Concrete mixers (14/10)	2		2
21.	Rock bolter	1		1
22.	Vibratory compactor	4		4
23.	Road roller	Nil	2	2
24.	Electric winch (5t)	2		2
25.	Excavator BC -30	1		1
26.	Explosive van	1		1
27.	Ambulance	1		1
28.	Bus/mini bus	Nil		
29.	Workshop equipment	Nil		
30.	Ventilation ducting	Nil		
31.	Diesel tanker 7000 ltrs	1		1
32.	Water sprinkler 10000 ltrs	1	1	2
	The above plant and machinery is the minimum requirement for ensuring completion of the project within 24 months which include monsoon period. During the execution if authority feels need for additional equipment due to unforeseen then, the same should be deployed.			

15.5 Manpower Planning

15.5.1 Peak Deployment of Man Power

The approximate number of man power required is given below and is indicative only and depends on construction agency's methodology of execution of works, machinery deployed schedule etc.

Works	Managers and Supervisors	Highly Skilled	Skilled	Unskilled	Total
Dam and appurtenant works	5	10	30	100	145

15.6 Construction Methodology

15.6.1 Construction Methodology

The present proposal envisages construction of Dam across Kalasa and Haltara Nalas respectively including 8 weirs along with its appurtenant works, and all infrastructure works. The methodology and equipment planning for various works depends on the site conditions prevailing in the project area.

The activities are planned in such a way that the project shall be completed as per schedule with no or minimum spillover. It is assumed that all the pre-construction activities having a bearing on the proposed schedule such as land acquisition, infrastructure works and relevant statutory approvals from the Government are in place before commencement of the construction works.

It is proposed to execute the project as under:

- Civil works:
    - ✓ Civil works of dam and appurtenant works including energy dissipation arrangements, Intake structure etc.
- Hydro Mechanical Works
    - ✓ Hydro Mechanical Works comprising of gates, pipeline, erection etc.

15.6.2 Methodology of Assessment of Construction

It is necessary to assess the methodology of construction in the present proposal. The works involve taking them up simultaneously which includes hydro mechanical and electro mechanical components. There is a need to see that the work shall continue uninterrupted till completion of the project by identifying critical item which will have a bearing on the execution of the project.

15.6.3 Pre-Construction Activity

For a project to be implemented in a systematic manner and to complete it within the time schedule, it is imperative to see that certain pre construction activities are completed in a proper manner. Some of the activities which are proposed to be undertaken during this period will be:

- Detailed Topographical Survey and marking the Layout at site, Pre- construction geotechnical investigation
- Clearance from Government agencies like Pollution control board, Public health, Irrigation and Forest Clearance
- Acquisition of Land including muck disposal areas
- Financial closure
- Detailed design and preparation of tender documents for Civil, Electro-mechanical, Hydro mechanical works including pre construction investigation.
- Award of Contracts
- Setting up of Site office and store
- Arranging of construction power
- Construction of approach roads and bridges
- Formation of project team

15.6.4 Equipment Planning

"Guidelines for preparation of Detailed Project Reports of River Valley and multipurpose Projects" issued by Central water Commission have been used for the planning of equipment. Assumptions made for planning of equipment for various construction activities are indicated hereunder:

15.6.5 Working Hours

It is necessary that the work will progress systematically with an intention to complete the activities as per schedule. Accordingly, it is assumed that works is proposed to be done in three shifts with effective working hours at 20 Hrs per day of 25 days in a month.

15.6.6 Densities of Materials

All the calculations are based on capacity of hauling units. The densities of different types of materials are not considered for excavation and fill material.

15.6.7 Conversion Factor for Earth Volume

Standard norms have been adopted for conversion of volumes in natural, loose and compacted state.

15.6.8 Efficiency of Operation

The efficiency of operation for various equipment's are considered as per standards

15.6.9 Construction Methodology for Different Activities of Civil Works

15.6.10 Diversion of River During Construction

During the construction of civil activities for Head Works, it is necessary to divert the river for smooth execution of civil works. The construction activity for dam needs to be taken up during the non-monsoon months when the flow is less. The water in the river has to be diverted to one side of construction by providing temporary cofferdams for the construction of upstream works. The cofferdam will be made of river bed material properly compacted to the required level to prevent overtopping. An impervious material will be provided to prevent seepage through the body of the dam. Rip rap protections will be provided on the river side to prevent scouring of the dam. It is expected that the cofferdam will be damaged during the monsoon season which will be repaired for the dry season.

The construction of dam structure will be done in two stages and cofferdam will be provided accordingly. In the first stage, the river will be diverted towards the left bank. During the period, construction work on the right bank will be done. The work includes construction of Spillway, under sluice, Intake, Feeder Channel, intake structures and flood walls, upstream and downstream aprons and stilling basins. Likewise, the remaining bays of spillway that are on the left bank will be constructed during the second phase. During the period, the river will be diverted through the Under sluice and gated Spillway. The cofferdam will create the dry space on the left bank during this period.

15.6.11 Cofferdam Works

The deposits on the river bank shall be removed to have enough space for construction activities. The deposit will be used for the river diversion work and for rip rap protection works. The construction of cofferdam will be taken up parallel with the removal of deposits. The construction of Coffer dam would be taken up with Dozers and Hydraulic Excavators of required capacity, Vibratory Roller and sufficient number of 15/20 T Dumpers. The Coffer Dam is planned to be completed in a shortest time.

15.6.12 Proposed Roads:

The entire project activity is planned in a highly intricate and rugged terrain with thick undergrowth infected with poisonous snakes. GOK/KNNL and other agencies should plan network of roads and this

will facilitate in speedy movement of the men and material to the site besides not compromising safety issues for the men working.

15.7 Concrete Dam Construction

15.7.1 Aggregate Production.

The acceptability of natural aggregates is judged upon the physical and chemical properties of the material and the accessibility, proximity to the site and economic workability of the deposit.

15.7.2 Concrete Handling, Placing and Consolidation.

The procedure to be adopted for moving concrete from the mixers on to the dam will be governed by site conditions. The problem is to transport it to the dam with the least possible segregation or change in its consistency so it may be compacted uniformly into the dam without unreasonable effort. The cableway is probably the simplest arrangement. The tilting mixers will feed the buckets; these are then moved to a pick up point under the cableway, transported smoothly to the block and emptied quickly through an air operated gate.

15.7.3 Formwork

Probably the most widely used lift is 1.5m, however, on large dams a height of 2.3-3.0m is frequently used. With the larger lifts there are fewer movements of forms and fewer horizontal lift surfaces to be cleaned. The high-lift formwork is unique and expensive with less prospect for re-use, heavier equipment is required for lifting the forms and the heat problems and risks of cracking in the concrete are accentuated.

15.8 Project Organization

15.8.1 General

The project area is spread over a length of about 500 m on the left and right flanks of River Mahadayi. Any planning of construction of a major dam including its components shall be supported by a proper infrastructures all located within the project area. They are but not limited to

- Permanent and temporary colonies
- Offices
- Roads
- Workshops etc

The present project envisages completing all the activities within 18 months including the required infrastructure facilities.

The construction proposal considers carrying out the construction through contracting agencies by dividing the project into probable suitable packages as under:

- Access roads, slope stabilization and cross drainage works. Permanent and temporary buildings, water supply, electrification of colonies, communication systems, workshops and stores, etc.
- Constructions of dam and other appurtenant works including energy dissipation arrangements, etc
- Hydro mechanical works including fabrication and erection of gates and Hoist etc.

The terrain in which the project is proposed is a hilly terrain and the quantum of design and construction work involved is substantial. For ensuring timely completion of the project, close coordination is required with all the stake holders. The organization of the project has, therefore, been planned keeping the above in view. Broad features of this organization structure are described in the following paragraphs.

15.8.2 Project Organization

The implementation of the project to meet the schedule of completion will be under the purview of various officers of the department. In this connection, an organization chart has been prepared as under:

The overall supervision will be under a Chief Engineer specially designated for the Project. The Chief Engineer would be assisted by separate wings to look after the planning, construction management, quality control, administration, financial and accounts aspects of the project. There will be a circle, headed by a Superintending Engineer to monitor all the activities envisaged in the project. For civil works and other infrastructure development there will be 2 divisions headed by 2 Executive Engineer, 1 for each dam. Each Executive Engineer will be assisted by 3 Assistant Executive Engineers, and 6 Assistant Engineers and other support staff.

15.8.3 Project Administration

The Project Administration which also includes maintenance of colonies, dispensaries, public relations, welfare etc. are looked after by an Assistant executive Engineer (Administration) posted in the office of the Chief Engineer.

It is also proposed to have a Security officer along with supporting staff to carry out aspects concerned with vigilance and security of the project areas.

The organization structure will be reviewed and firmed up as part of the detailed planning in the pre-construction stage.

The project management shall function as a fully integrated team dedicated to the implementation of the project. Every member of the team shall report regularly to his officer-in charge and shall be subject to review of his performance.

The Chief engineer assumes responsibility for all aspects of the project. His deputies have to ensure that their reports reflect the up to date status of the project at any point of time. It is their duty to periodically review the progress of works, identify the problem areas, suggest remedial measures including their implementation and have a realistic forecast of the status of the project in the intermediate time frame.

To achieve the above objective, the Divisional Engineers shall ensure that they and their personnel are interacting regularly on a day-to-day basis with all the concerned personnel of the project whose work has a direct impact on the progress of their own work, and take corrective actions, wherever called for, to adhere to work schedule.

15.8.4 Technical Advisory Committee

A Technical Advisory Committee comprising of renowned experts in respective fields shall be constituted by KNNL. This committee will advise the project team through the Chief Engineer on all critical aspects of project planning, design and construction activities

15.8.5 Reporting / Reviews

The project will be subject to monthly reviews so that all concerned are aware of progress to date. The monthly report will give details of manpower, productivity, schedule and costs. The purpose of these reviews will be to highlight the problem areas and provide the required additional supervision and action to resolve the problem. The reports will be prepared using inputs from consultants, contractors,

construction supervisors, procurement officers etc., so that a realistic picture of the project is available for review and report.

Chapter 16
Foreign Exchange Element

No Foreign Exchange Element is envisaged in this project.

Chapter 17
Environment, Ecology and Forest aspects of the Project

17.1 Kalasa Nala Project

The total forest area required is 33.0507 Ha for the construction of Kalasa nala diversion weir, Kalasa nala jackwell, Kalasa nala submergence, Surla nala Check dams, Surla nala jackwell, Surla nala raising main, Haltara nala intake and jackwell, haltara nala diversion weir, haltara nala submergence, raising main from haltara weir to kalasa reservoir, receiving chambers, Delivery chambers, approach raods, Electrical lines, etc.

For total 33.0507 Ha of forest land a compensatory a forestation land has been identified in Sy. No. 66 of Halahalli Village, Telasang Hobli, Athani Taluk, Belgaum District.

The Karnataka State Pollution Control Board has cleared the Project from Water and Air Pollution Act vide letter No.CFB: DEO-5: AEO-3:2000-2001:107 Dated: 29-06-2000. A Proposal for Diversion of Forest Land has been submitted to MOEF, Delhi for obtaining Forest Clearance. Now as per the directions of tribunal submission of fresh proposals for obtaining clearances are under process.

17.2 Environmental Clearance

The Kalasa Drinking Water Supply Scheme doesn't envisage creating new command area or providing water to suffering existing command areas for irrigation. Further, the project doesn't involve hydro-electric power generation also. Hence, the proposed project does not find place in the schedule of EIA Notification, 2006 and its subsequent amendments in 2018.

Further, as per the orders of the Mahadayi Water Dispute Tribunal (MWDT), online application regarding the clarification on applicability of EIA notification, 2006 and its amendments has been submitted to the Ministry on 02.05.2019. The MoEF&CC, New Delhi vide letter dt: 17.10.2019 issued an exemption of Environmental Clearance with a condition for the preparation of an Environmental Management Plan (EMP) for the project and obtaining requisite clearances as per Forest (Conservation) Act, 1980 and Wildlife (Protection) Act, 1972.

17.3 Environmental Sensitivity

The Kalasa Nala diversion weir is located at a distance of 7.4 Km from the boundary of Bhimgad Wildlife Sanctuary. Further, Haltara Nala diversion weir is located at a distance of 1.5 Km from the

interstate boundary of Goa. Surla nala diversion components lies across Surla Nala within the State of Karnataka.

Figure 17.1 Pandanus tectorius

Figure 17.2 Bombax ceiba

Figure 17.3 Acacia auriculiformis

Figure 17.4 Memecylon edule

Figure 17.5 Symplocos racemosa

Figure 17.6 Mangifera indica

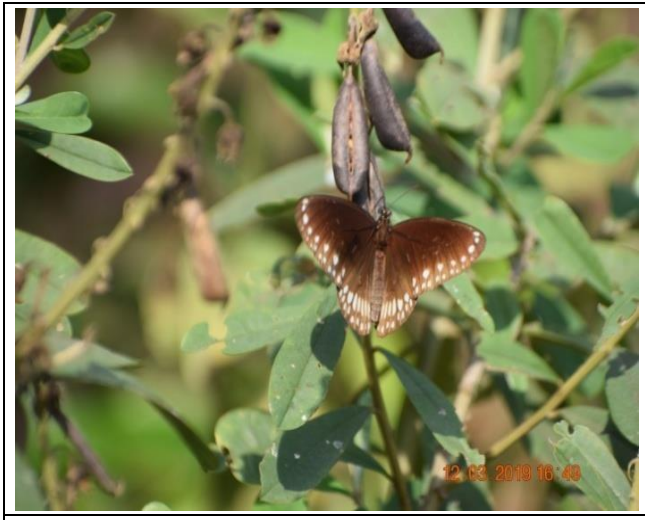	
Figure 17.7 Common Crow	**Figure 17.8 Bonnet macaque**
Flora and Fauna at project site	

17.4 Flora

17.4.1 Trees

Commonly found trees in the region are *Ficus benghalensis, Acacia auriculiformis, Nothopegia beddomei, Memecylon edule, Bahunia racemose, Acrocarpus fraxinifolius, Phullanthus emblica, Holigarna grahamii, Cardia dicotama, Macaranga peltate, Ziziphus oenoplia, Cinnamomum verum, Grewia tiliifolia, Pterocarpus marsupium, Terminalia bellirica, Terminalia arjuna, Pongamia pinnata, Hydnocarpus laurifolia, Neolamarckia cadamba, Anacardium occidentale, Cassia fistula, Diospyros montana*, etc.

17.4.2 Shrubs

Shrubs such as *Acacia latronum, Bridelia stipularis, Caesalpinia mimosoides, Callicarpa tomentosa, Canthium dicoccum, Carissa carandas, Clerodendrum viscosum, Desmodium pulchellum, Eranthemum roseum, Helicteres isora, Holarrhena antidysenterica, Ixora arborea, Lantana camara, Solanum giganteum, Strobilanthes callosus, Ipomoea Illustris, etc. Climbers such as Phanera vahlii, Acacia pennata, Calycopteris floribunda, Dalbergi avolubilis, Gnetum ula, Ipomea spp., etc.* Bamboos such as *Bambusa arundinacea, Dendrocalamus strictus, Oxytenanthera monostigma, Ochlandra scriptoria, etc.* are some of the important species available in the study area.

17.4.3 Medicinal Plants

Ficus virens, Semecarpus anacardium, Syzygium cumini, Terminalia bellirica (trees); Blumea lacera, Cassia fistula, Canthium parviflorum, Costus woodsonii, Cyperus compressus, Cyperus iria, Euphorbia hirta, Hygrophila auriculata, Hibiscus vitifolius, Leucas aspera, Nicotiana rustica, Phyllanthus niruri, Phyllanthus simplex ,etc (Herbs); *Clerodendrum phlomidis, Phyllanthus reticulatus, Randia dumetorum, etc (Shrubs); Asparagus racemosus, Cyclea peltata* (Climbers) and *Vanda tessellate (*Epiphyte) are some of the species of Medicinal values.

17.5 Fauna & Avifauna

17.5.1 Avifauna

Avifaunal species such as Black Headed Ibis, Black-shouldered Kite, Blue beard bee-eater, Chestnut headed bee-eater, Grey jungle fowl, Indian peafowl, Malabar Grey Hornbill, Malabar pied hornbill, Malabar trogon, Malabar whistling thrush, Oriental Honey-buzzard, Paradise flycatcher, River Tern, Serpent eagle, Scarlet minivet, spotted owlet, Sun bird, Steppe Eagle, etc are recorded.

17.5.2 Mammals and reptiles

Mammals such as Barking deer, Bonnet Macaque, Common hare, Common Palm Civet, Golden Jackal, Hanuman langur, Indian Bison, Indian Elephant, Indian fox, Indian giant squirrel, Indian grey mongoose, Indian Pangalion, Indian Porcupine, Jungle Cat, Leopard, Malabar Civet, Mouse deer, Sloth Bear, spotted deer, Tiger, Wild Boar and Wild dog. Wroughton's Free-Tailed Bat., etc and reptiles such as Common Indian Monitor, Indian cobra, Rat snake, Common Garden Lizard, Common Krait, Indian Chameleon, Russell's viper, etc are some of the important species available in other seasons in the study area.

17.5.3 Fishes

The streams Kalasa Nala, Haltara nala, Surla nala and river Malapraprabha is home to various fish species such as *Notopterus notopterus, Salmophasia acinaces, Salmophasia balookee, Salmophasia untrahi, Barilius barila, Esomus danrica, Rasbora daniconius, Amblypharyngodon mola, Cyprinus carpio, Osteobrama vigorsii, Puntius amphibius, Puntius chola, Puntius sophore, Pethia ticto, Systomus sarana, Hypselobarbus kolus,* etc

17.6 Environmental Impacts and Mitigation Measures

17.6.1 Impact on Biological Environment during Construction Phase

17.6.1.1 Air Impacts on Flora

- Construction activities lead to deposition of dust on leaves thereby affecting photosynthetic activities of trees causing wilting/necrosis of leaves.

- Mitigation measures: water sprinkling activities will be carried out to avoid deposition of dust on trees.

17.6.1.2 Noise Impacts on Avifaunal Species

- The noise generated due to blasting, construction activities, vehicular movements, DG sets, operation of construction equipment's, etc will affect the faunal and avifaunal behavior of Bhimgad Wildlife Sanctuary and the local region.

- Mitigation measures: Construction activities will be carried out during day time. Controlled blasting shall be adopted for blasting activities. No construction activities will be carried out during night time.

17.6.1.3 Water Impacts on Aquatic Biodiversity

- Improper storage and management of muck or debris, solid waste and sewage from labour camps leads to water pollution thereby affecting water quality and aquatic biota.

- Mitigation measures: Segregation of wastes and disposal of wastes to municipal authorities, storage of muck properly in designated areas, hanging solar fences etc will be implemented.

17.6.1.4 Land use Impact on Biodiversity

- The project involves land acquisition of 96.6975 Ha and diversion of 33.0507 Ha of forest land thereby affecting the land use and land cover of the region. Removal of trees for construction activities leads to loss of habitat. Construction of diversion weirs and checkdams leads to submergence of 18.6573 Ha of land (14.7108 Ha of forest land and 3.9465 Ha of non forest land).

- Mitigation measures: Land acquisition will be carried out as per The Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act,

2013. Green belt development and compensatory afforestation activities will be carried out as per the provisions of Forest (Conservation) Act, 1980.

17.6.1.5 Impacts during Construction Activities

- Hunting, poaching, road kills and accidents of avifauna and mammals may be noticed during construction activities. Construction of checkdams and diversion weirs may affect the movements of fishes in the Kalasa, Haltara and Surla Nalas. Construction of checkdams and weirs involves submergence of 18.6573 Ha of land) leading to habitat loss of biodiversity.
- Mitigation measures: Awareness to the labourers with respect to importance of scheduled species and RET species will be provided to avoid hunting of animals. Sluice gates will be provided in the dam for movement of fishes. Introduction of fingerlings enhances proliferation of fishes thereby improving aquatic fauna of Kalasa, Haltara and Surla Nalas. The project upon implementation will enhance the local biodiversity, create habitats in the backwaters.

The detailed impacts and mitigation measures will be studied during EIA/EMP studies.

17.6.2 Impact on Biological Environment during Operation Phase

- There will be creation of wildlife habitats in the backwaters of the proposed checkdams.
- There will be proliferation of fish species.
- There will be increase in the diversity of floral and faunal species.
- It acts as water hole for the large, medium and small sized mammals of the region and it also improve prey-predator relationship.

17.7 Compensatory Afforestation and Net Present Value

The project involves diversion of 33.0507 Ha of forest land. Further, a total 33.0507 Ha of compensatory afforestation land has been identified in Sy. No. 66 of Halahalli Village, Telasang Hobli, Athani Taluk, Belgaum District. Further, a Net Present Value of Rs. 15,451.76 Lakhs (for 30 years) will be deposited to Forest Department as per the guidelines issued by MoEF&CC keeping in view of Economic Value of loss of eco-system services due to diversion of very dense forest land.

Chapter 18
Estimate

18.1 Guidelines

The estimates are based on IS 4877 – 1968 entitled "Guidelines for preparation of estimates for River valley projects", Part 1- namely "Guidelines for preparation of detailed Project Reports of Irrigation and Multipurpose Projects".

18.2 Preparation of Estimates

The estimate for various components of the project work comprises of two parts. Firstly, the estimate of quantities for the identified items for each work and secondly the cost estimate which is based on rates for each item of work.

Further the estimates comprise of three major categories namely estimate for civil works and estimate of hydro mechanical works, lift and headworks estimates including gravity and raising mains. There will be other components like project roads, buildings etc.

The estimate for quantities for civil works is based on the drawings prepared based on preliminary designs and assumptions.

The rates for hydro mechanical works is based on S.R of W.R.D.O Government of Karnataka.

For each item of work, provision is made for GST and contingency @ 3% and 2% towards work charged establishment.

The cost arrived at for each item is rounded off to the near rupee in Crores

18.3 Account heads

The total cost of Kalasa Nala Project under I – works is detailed hereunder.

Detailed sub heads under I – Works

A. PRELIMINARY

A provision of **Rs. 1667.00 lakhs** is made for consultancy charges for detailed survey and investigation and other preliminary works for Construction of Kalasa Dams and Inter Connecting Canal f Geological

& Geophysical, Hydrology, Sedimentation analysis, River gauging, Investigation for foundations, models

Survey, investigation, preparation of Design, Drawings, Estimates, Draft tender papers for Kalasa Nala Diversion Scheme (Lift Scheme) etc.,

B. LAND

A provision of **Rs. 5371.00 lakhs** is made in the estimate towards Land acquisition for construction of Diversion Dam, Lift conveyance system including compensation for houses and trees including crop compensation etc.,

C. WORKS

A provision of **Rs 66487.00 lakhs** is made in the estimate towards construction of Kalasa Diversion Dam Jack well cum pump houses, Electrical sub stations, rising mains, Delivery chambers etc., etc.,

D. REGULATOR AND MEASURING DEVICE

A provision of **Rs 130.00 lakhs** is made in the estimate.

E. FALLS

No provision is made in the estimate.

F. **CDWORKS**

A provision of **Rs 50.00 lakhs** is made in the estimate towards construction of CD work for existing roads.

G. BRIDGES

A provision is made in the estimate **Rs 2000.00 lakhs**.

H. ESCAPES

No provision is made in the estimate.

I. NAVIGATION WORKS

No provision is made in the estimate.

J. POWER PLANT CIVIL WORKS

No provision is made in the estimate.

K. BUILDINGS

A provision of **Rs 1780.00 lakhs** is made in the estimate towards construction of Temporary and permanent Office buildings.

L. EARTHWORK

A provision of **Rs 252.00 lakhs** is made.

M. PLANTATION

A provision of **Rs 1386.00 lakhs** is made in the estimate for planting trees on foreshore of reservoir & colony etc.

O. MISCELLANEOUS

A provision of **Rs. 57.90 lakhs** is made for electrification, telephone lines, and Maintenance & Services & Other items.

P. MAINTENANCE

A provision of **Rs 194.00 lakhs** is made for maintenance of Dam & appurtenant works, roads, machinery, colony etc.

Q. SPECIAL TOOLS AND PLANTS

A provision of **Rs. 35.00 lakhs** is made in the estimate towards procurement of inspection vehicles for officers of WRD.

R. COMMUNICATIONS

A provision of **Rs 1365.00 lakhs** is made in the estimate for construction of diversion roads. (**Interconnecting Roads)**

S. POWER PLANT AND ELECTRICAL SYSTEM

No provision is made in the estimate.

T- WATER SUPPLY WORKS(LS)

No provision is made in the estimate

U- DISTRIBUTARIES, MINORS & SUB MINORS

No provision is made in the estimate

V- WATER COURSES AND FIELD CHANNELS

No provision is made in the estimate

W- DRAINAGE

No provision is made in the estimate

X. ENVIRONMENT AND ECOLOGY

A provision of **Rs 1546.00. Lakhs** is made in the estimate for compensatory afforestation, public health measures and catchment area treatment.

Y- LOSS ON STOCK & UNFORESEEN

A provision of **Rs. 180.16 lakhs** is made in the estimate at 0.25% of the cost of I – works less A, B, M,P,Q and X as per CWC guidelines.

Total cost of I- works is Rs.82501.05 lakhs

II ESTABLISHMENT CHARGES

A provision of **Rs. 2313.90 lakhs** is made in the estimate @ 3% of the cost of I – Works less B- Lands.

III TOOLS AND PLANTS

SMALL T&P 1% OF I - WORKS

A provision of **Rs. 825.01 lakhs** is made in the estimate

IV SUSPENSE

No provision is made in the estimate.

V RECEIPTS AND RECOVERIES ON Capital

Resale value of temporary buildings @ 15% cost of buildings. Rs (-) 267.00 lakhs

Total Direct Charges: 85372.97 Lakhs

INDIRECT CHARGES

a) Capitalised value of abatement of land revenue (5% of B-Lands) Rs 268.55 lakhs

b) Audit and Account charges (1% of cost of I works) Rs 825.01 lakhs

c) Add GST for work portion Rs 13061.95 lakhs

Total In Direct Charges: 14155.51 Lakhs

Total Direct and Indirect Charges: 99528.47 Lakhs.

Rounding off 1.53 lakhs

Total cost of the project 99530.00 lakhs 995.30 crores

The cost estimates are based on Common Schedule of Rates for Engineering Departments 2021-2022. The recommended SR Volumes for 2021-2022 is giver below: -

Table 18.1 SR Volumes for 2021-2022

Volume.	SR's of Organizations Concerned Under
1	COMMON SR for Earthwork & Concrete Works
2	PWD (C&B) - Buildings
3	PWD (C&B), NH & PRED - Roads & Bridges
4	WRD, MI & KPCL
5	BWSSB, KUWSDB & RWS
6	KPTCL, ESCOMS, PWD ELECTRICAL
7	PORTS & IWTD
8	FOREST, WATERSHED, HORTICULTURE

The issue rates of Cement, Steel, Structural steel and Bitumen for the 3rd quarter for the year 2022-23 (01/10/2022 to 31/12/2022) are issued by the Superintending Engineer, PWD, Bangalore Circle, Bangalore. For the items involving the above-mentioned material, basic rates of Volume-1, 2 & 3 are revised and issued by the Superintending Engineer, PWD, Bangalore Circle, Bangalore.

The difference in cost is worked out by considering present quarter Cement rate Rs.400.00/Bag, Reinforcement Steel rate of Rs. 65.00 /Kg, Structural steel rate of Rs. 70.00 /Kg for the items from Volume- 4.

The issue rates for items in Volume-5 is issued by the Chief Engineer, BWSSB, Bangalore.

For items where market rates are considered, such rates are obtained from various vendors to arrive at a reasonably correct cost and it is approved from competent authority.

The total cost of the project works out to Rs 995.30 Crores.

18.4 Preparation of estimates

18.4.1 Capital cost

The capital cost of the project is **Rs. 995.30 Crores** which includes all cost associated with investigations, design, construction and maintenance during construction period of the project.

18.4.2 Analysis of rates for various items

The analysis of rates for various items of works is done considering the cost of materials, carriage, Handling, storing including labour and costing machines.

18.4.3 Quantitative assessment of material requirement

This has been done considering the unit cost of materials prevalent in the region which includes fright, unloading, cartage, storage, inspection and testing.

18.4.4 Guidelines on use rates of machinery, hire charges etc

The rates considered are as per schedule of rates of the department which includes the rates for machinery, higher charges etc.

18.4.5 Contingencies and work charged establishment

Provision for contingencies and work charged establishment is about 3% to 5%.

18.4.6 Communication facilities

The project lies in Western Ghats with completely hilly terrain and is approachable by National highway connecting Belagavi and Goa.

18.5 Abstract of Cost

Sl No.	Particulars	Amount Rupees in Lakhs	Remarks
1	A- Preliminary	1667.00	
2	B- Land	5371.00	
3	C- Works	66487.00	
4	D- Regulators	130.00	
5	E- Falls (for canals only)	NIL	
6	F- Cross Drainage works (for canals only)	50.00	
7	G- Bridges (for canals only)	2000.00	
8	H- Escapes	NIL	
9	I- Navigation works	NIL	
10	J- Power plants civil works	NIL	
11	K- Buildings	1780.00	
12	L-for canals only	252.00	
13	M-Plantation	1386.00	
14	N- Tank and Reservoir	NIL	
15	O- Miscellaneous	57.90	
16	P- Maintenance	194.00	
17	Q- Special T and P	35.00	
18	R- Communication	1365.00	
19	S- Power plant and Electrical system	NIL	
20	T- Water supply works (LS)	NIL	
21	U- Distributaries, Minors & sub minors	NIL	
22	V- Water courses and Field channels	NIL	
23	W- Drainage	NIL	
24	X- Environment and ecology	1546.00	
25	Y- Loss on stock & Unforeseen		
	0.25% of I works less (A+B+M+O+Q+X+P)	180.16	
	Total cost of I works	**82501.05**	
II	Establishment (3% of cost of I works less B - Land)	2313.90	
III	Tools & Plants (1% of I works including B)	825.01	
IV	**Suspense**	NIL	
V	**Receipts and recoveries on capital account**		
	a) Recoveries on account of K-building 15 % salvage value of building cost.	-267.00	

Sl No.	Particulars	Amount Rupees in Lakhs	Remarks
	b) Recoveries towards resale transfer of special T & P @ 75 % of machinery & 20% of cost of vehicle	NIL	
	Total Direct charges	**85372.97**	
	INDIRECT CHARGES		
	a) Capitalised value of abatement of land revenue (5% of B-Lands)	268.55	
	b) Audit and Account charges (1% of cost of I works)	825.01	
	c) Add GSTfor work Portion	13061.95	
	Total Indirect charges	**14155.51**	
	TOTAL DIRECT AND INDIRECT CHARGES	**99528.47 Lakhs**	
	Rounding off	**1.53 Lakhs**	
	Total cost of the project	**99530.00 Lakhs**	
		995.30 Crores	

Refer **Addendum-3** for A to Z Abstracts.

Chapter 19
Financial Resources

19.1 Present Position of the Scheme Regarding its Inclusion in the Plan – Concurrence of the State Planning Finance Department

In order to meet drinking water needs of Hubli and Dharwad towns including Kundagol town and enroute villages Government of Karnataka is planning to divert the allocated water from Kalasa, Haltara and Surla Nalas by having suitable diversion structures.

The total outlay of the project as per the preliminary estimate prepared based on the current Schedule of Rates 2021-22 is estimated to be **Rs.995.30 Crores**.

Government of Karnataka has already earmarked Rs. 500.00 crores in the current budget to meet the project expenses in the current financial year.

19.2 Provision for the Sector / for the Scheme in the Plan

Consequent to the approval of the scheme by the statutory authority such as CWC, and also from Ministry of environment Forest and Climate Change, the project implementation agency / authority will revise the estimate and update the same to the current year of Schedule of Rates before start of implementation.

The revised estimate will be presented to the State Planning Finance Department of Government of Karnataka for giving its concurrence and obtain necessary project funds. Besides, the extent of project funding approved by the Finance Department will be allocated in the budget of the respective year.

19.3 Central / Foreign Aid Contemplated, If Any

The present project envisaged by the Government of Karnataka meets the basic requirement of common man such as, drinking water and ecology and environment conservation. As such, it is the responsibility of the Government of Karnataka to ensure when such projects are implemented, necessary funds are allocated.

19.4 Information on Similar / Related Pending Projects in the State, Their Status. Stage / Percentage of Completion, Percentage of Expenditure Incurred and

Average Annual Expenditure by the state on these Projects Put Together Year-Wise during the Last 5 Years

Not applicable.

19.5 Commitment on the Work in Progress in the Plan and Allocation Available for Starting New Scheme

As narrated in the earlier paragraph, looking into the need for meeting the basic requirement such as drinking water and improving the Ecology and Environment, Government of Karnataka is likely to earmark necessary budget to meet the initial project expenses and also the entire project cost. Government of Karnataka will definitely initiate action in making further allocation for the speedy implementation of the project.

19.6 Effect of Inclusion of the Scheme in the Plan on the Schedule of Other Works in Progress Budget Staff, etc

Government of Karnataka has excellent track record in terms of managing the revenue and also allocating the budgets for projects of national importance and projects which will meet the basic needs of the people.

Hence, while allocating the necessary budget, it will be ensured that other on-going similar projects will not be disturbed due to the inclusion of this and to that extent necessary provision will be made.

19.7 Requirement of Funds for the Scheme and its Yearly Phasing as in Project Report

The project is proposed to be completed in two years and accordingly the budget will be as under:

No	Year	Amount in INR Crores
1.	First Year	400.00
2.	Second Year	595.30
	Total	**995.30**

Chapter 20
Revenues

Kalasa diversion scheme is meant for augmenting drinking water and it will be responsibility of KNNL to ensure diversion of bulk water from kalasa scheme to Malaprabha basin. The end users will be responsible for planning further activity till the project objectives are met. Hence revnues from yhe proposed project is not envisaged for the present proposal.

Chapter 21
B.C.Ratio, Financial Return and Internal Rate of Return

Kalasa diversion scheme project to meet drinking water needs and envisaged to be developed in single stage for ensuring speedy implementation of the project. There are no components such as irrigation, power, Navigation etc., and hence the B.C ratio is not computed. The project proponent propose to divert water and augment the Malaprabha basin beyond which the end user will implement the project by having proper treatment followed by distribution till the last mile. Hence in the present scenario financial return and internal rate of return are not computed.

Chapter 22
Future Utilization of Facilities Created (Buildings)

Most of the facilities such as buildings, accessibility, communication network, treatment plants (STP & WTP) and other infrastructures will be located above the FRL and the same will be retained after carrying out minimum repairs and maintenance and utilized during O & M.

Chapter 23
Conclusion and Recommendations

23.1 Conclusion

The present proposal of Kalasa Drinking water Project will help in achieving the following objectives.

- To meet the ever grow growing drinking water needs of Hubli & Dharwad cities.
- To meet the ever grow growing drinking water needs of Kundagol town and enroute villages.
- To maintain the ecology and environment of the entire project area.

23.2 Recommendation

23.2.1 General

The project involves construction of conventional civil structures as detailed below. The project construction work is recommended to be taken up on fast track basis and construction shall be completed in a period of 24 months.

The project component includes:

- Civil works comprising of Dam and appurtenant works
- Lift scheme involving Jack well cum Pump house, electromechanical works, electrical works, raising main, gravity main and transmission lines.

23.2.2 Preliminary and Pre Construction Works

To ensure project completion in 24 months, it is essential to accomplish the following activities in a period of 3 months before start of Main Civil works. However some of the activities will continue during project phase. The following main activities are required for preconstruction and construction phases of the project:

- Techno economic Clearance
- Pre-construction investigation
- Environment, Forest and other statutory clearances
- Acquisition of land
- Completion of main infrastructure facilities such as roads and buildings.
- Completion of detailed design and specifications
- Financial Closure

- Tender and Award of main Civil, Hydro Mechanical and Electromechanical/Electrical works.
- Commissioning related activities.

23.2.3 Civil & Hydro Mechanical Works

For completion of the Civil & Hydro Mechanical works, the total time proposed is 24 months. Adequate construction equipment planning has been done to achieve the desired progress rates.

Timely completion of construction works also depends on the timely supply of construction material to Diversion site, through existing approach roads. Sufficient storage shall be ensured at project site to ensure continuous construction and implementation within the schedule.

23.2.4 Construction Power

Availability of adequate construction power plays a major role in the scheduled completion of construction works. Construction power required for various components shall be mainly arranged by contractors. Power for project offices and colony shall be supplied through dedicated D.G.Sets. However, if power is available in the local grid the same shall also be utilized for construction of the project.

23.2.5 Project Cost

The total cost of the Kalasa Nala Diversion Scheme Drinking water Project is worked out to be **Rs.995.30 Crores.**

23.2.6 Recommendation

The DPR of Kalasa Nala Diversion Scheme Drinking water Project, on implementation will meet drinking water needs within the project area and is techno-economically viable. Hence the project is recommended for implementation.

Executive Engineer,
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