Ref: IRE-Saundatti/MoEF&CC/EC/200925 **Dated: 25.09.2020**

To

The Director (IA.I Division)
Ministry of Environment Forest & Climate Change
Government of India
Indira Paryavaran Bhawan
Jor Bagh Road, New Delhi – 110 003

Sub: 1260 MW Saundatti Pumped Storage Component of Integrated Renewable Energy Project near Village Karlakatti, Tehsil Saundatti in Belagavi District of Karnataka being implemented by M/s Greenko Solar Energy Private Limited-Environment Clearance- reg

Ref: (1) MOEF & CC Letter No F.No.J-12011/11/2018.IA.I(R) dated 25.02.2020

(2) KSPCB letter No.PCB/462/17 Cat/EPH-HPI/GreenKo Solar Energy Ltd/2020-21/1879 dated 27-08-2020

Dear Sir,

MoEF & CC vide ref (1) on the above subject matter, has *inter-alai* directed M/s Greenko Solar Energy Private Limited (GSEPL) to submit the revised EIA/EMP report incorporating the One Season Baseline Studies and after duly displaying the said updated EIA/EMP report on Karnataka State Pollution Control Board (KSPCB) web portal for a period of 30 days for inviting public comments.

In this regard, KSPCB has issued a confirmation letter vide ref (2) addressed to MoEF & CC that the said EIA/EMP report was duly displayed on their website for a period of 30 days and no comments were received during the said period.

Accordingly, the updated EIA/EMP report is herewith submitted for consideration of the project for grant of Environmental Clearance as per the provisions of EIA, notification, 2006. Further, as directed by MoEF & CC vide ref (1), the copy of Hydrology Studies, Layout and Power Potential Studies as approved by CEA/CWC are also herewith submitted for your kind consideration.

Thanking you
Yours sincerely,
For **M/s Greenko Solar Energy Private Limited**

Authorised Signatory

Encl: As above

Annexure-1

ಫ್ಯಾಕ್ಸ್ / Fax : 080-25586321
ಈಮೇಲ್ / Email : ho@kspcb.gov.in
ವೆಬ್‌ಸೈಟ್ / Website : http://kspcb.gov.in

☎ 080-25581383, 25589112
080-25589113, 25589114

ಕರ್ನಾಟಕ ರಾಜ್ಯ ಮಾಲಿನ್ಯ ನಿಯಂತ್ರಣ ಮಂಡಳಿ

Karnataka State Pollution Control Board

"ಪರಿಸರ ಭವನ", 1 ರಿಂದ 5ನೇ ಮಹಡಿಗಳು, ನಂ. 49, ಚರ್ಚ್ ಸ್ಟ್ರೀಟ್, ಬೆಂಗಳೂರು - 560 001, ಕರ್ನಾಟಕ ರಾಜ್ಯ, ಭಾರತ
"Parisara Bhavan", 1st to 5th Floor, # 49, Church Street, Bangalore - 560 001, Karnataka State, India

PCB/462/17 Cat/EPH-HPI/GreenKo Solar Energy Ltd/2020-21/ 1879 Dated: 27 AUG 2020

ರವಾನಿಸಲಾಗಿದೆ

To,
The Director,
MOEF, Indira Paryavana Bhavan,
3rd Floor, Vayu Wing,
Jor Bhag Road,
New Delhi -110003

Sir,

Sub: Issue of conformation letter with respect to uploading of modified EIA/EMP report for public comments in respect of project implemented by GreenKO Solar Energy Ltd.

Ref: 1. MOEF &CC letter No. F. No. J-12011/11/2018IA.I(R) Dated 25.02.2020
2. Letter from GreenKo Solar Energy Pvt. Ltd. Dated 11.06.2020.
3. Internal letter Dated 11.06.2020 for uploading the modified EIA/EMP report
4. Proceedings from Government of Karnataka Dated 16.06.2020
5. Industry letter Dated 11.06.2020

*****

Inviting your attention to the above cited letter at ref (1) directing the industry to request KSPCB for uploading the modified EIA/EMP report incorporating the compliances on the comments /suggestions received.

Accordingly industry authorities have revised the EIA/EMP report and submitted to the Board and requesting the Board to upload the same in KSPCB website.

Accordingly the information was uploaded on 26.06.2020 for the period of 30days for public display to submit their comments/suggestion on the revised EMP/EIA report of the proposed project.

Now the industry authorities have submitted a letter with the screenshot of email displaying the comments and suggestions received during the said period, it is observed from the information

given by the industry that, no comments /suggestions are received from the public on the above report.

This is for your kind information and for your needful action

Yours Faithfully
Sd/-
Member Secretary

Copy to:

1. The Occupier, M/s. Greemnko Solar Energy Pvt Limited, Ground Floor, Prestige Koday Tower, No:5, Raj Bhavan Road, Bangalore -560 001 for information
2. The Regional Officer, Belagavi, KSPCB for information.
3. Case File

CHIEF ENVIRONMENTAL OFFICER

Government of India
Central Water Commission
Hydrology (South) Directorate
7th Floor (S), Sewa Bhawan
R.K.Puram, New Delhi-110066
Phone/Fax:011-29583507
Email: hydsouth@nic.in

Subject : Hydrology chapter of DPR of Saundatti PSP, Karnataka – reg.

Ref: Email receipt from M/s Greenko dated 08.07.2020 forwarding Hydrology chapter of DPR of Saundatti PSP

Reference is invited to above email dated 08.07.2020 from ED, Greenko Group forwarding the DPR chapter of hydrological studies of **Saundatti Pump Storage Project, Karnataka**. The hydrological studies have been examined and observations/findings of this office are as under:

A. PROJECT PROPOSAL

The Saundatti PSP is proposed in between two reservoirs i.e. Saundatti Upper Reservoir (to be constructed newly) and existing Renuka Sagar Reservoir as lower reservoir. For the power generation water will be pumped from existing Renuka Sagar Reservoir on daily basis. The scheme envisages construction of rock fill embankment dam for formation of upper reservoir. A plateau surface having substantial extents was identified to develop a reservoir having approximately 1.125 sq. km surface area over the plateau by constructing a 5776.0 m long & height varying from 10 m to 43.0m high rockfill dam with clay core all along its perimeter. The gross storage capacity of the upper reservoir at this location is 1.03 TMC with a live storage of 1.00 TMC keeping the FRL and MDDL at EL + 855.0m and EL + 825.00 m respectively.

B. WATER AVAILBILITY STUDIES

As mentioned in the DPR, the proposed storage project is being planned on the allocated water for utilization by recirculation from Renuka Sagar Reservoir. The upper reservoir is far away from any river course and do not have any natural streams draining into the reservoirs. The yield into the reservoir is assumed to be exactly proportional to surface area of the reservoir (1.125 Sq.km at FRL). The 90% dependable yield (arrived from 26 years of annual rainfall 1988-89 to 1996-97 & 1998-99 to 2014-15) into the reservoir through precipitation works out to 0.375MCum (1.125 Sq.km X 333.3 mm). Since the reservoir is not located across any stream, therefore, no specific hydrological studies are required to assess the specific yield in to the reservoir through rainfall-runoff correlations and the design flood. Hence, the hydrological studies have been carried out to assess the water availability for running the proposed PSP scheme throughout the year and the demand of water for refilling the reservoir due to evaporation, pumping operation etc. No consumptive loss of water except evaporation is envisaged. The project authorities estimated annual evaporation loss from the Upper reservoir surface as 1.704 MCM, while the 90% dependable yield into the Upper reservoir from rainfall is 0.375 MCM. As stated by project authorities the balance loss of 1.329 MCM due to evaporation will be compensated by pumping from Renuka Sagar reservoir.

B.1 Observations & findings

The rainfall near proposed upper reservoir site has been verified by this Directorate using the Gridded rainfall data of Grid 75^0N and 15.75^0E. The estimated 90% dependable yield of 0.375 MCM in the Upper reservoir due to rainfall directly occurring on the surface area of reservoir is generally in order. Further, the gross and live storage of Renuka sagar reservoir is 37.69 TMC and 29.34 TMC respectively, hence pumping 1 TMC water for one time is not an issue in any good year. The balance annual loss of 1.329 MCM due to evaporation is also a small quantity which can be compensated from the Renuka Sagar reservoir.

The overall water availability aspects for the proposed Saundatti PSP project are generally in order and the same may be utilized for the planning purpose of the project.

C. DESIGN FLOOD STUDIES

As mentioned in the DPR, the Saundatti PSP upper reservoir dam shall be classified as large dam since its hydraulic head is more than 30 m. Therefore, the dam should be designed for the Probable Maximum Flood (PMF). As the catchment areas of the upper dam (1.125 Sq.km) is small and the time of concentration is short, Rational Formula and 1 hr storm depth will be applicable for design flood study. The design flood has been estimated based on Rational Formula. 1-hour PMP was calculated as 299.42 mm/hr. The PMF of the upper dam works out to 52.5m3/s. The design storm duration is taken as 1.0 Hr. The corresponding volume for upper dam works out to 0.189 MCM. The maximum rise in the water level above FRL (EL 855.20m) in the upper reservoir is negligible. As the volume of flood is very small, the same can be contained in the reservoir itself and hence, no separate spillway provision is provided for the probable maximum flood.

C.1 Observations & findings

The project lies in PMP Atlas of Krishna basin and not in Cauvery basin. The PMP value adopted in study has also been checked from the PMP Atlas of Krisna basin published by IMD in March 2017. The 1 day PMP depth is 520 mm. The corresponding 24 hour PMP depth shall be 570 mm considering a clock hour correction of 50 mm. Further from the FER of Krishna and Pennar Subzone 3(h) the 1 hour rainfall shall be 44% of 24 hour rainfall. Since the rainfall will occur directly over the surface of upper reservoir, hence, runoff coefficient shall be considered as 1. Using Rational formula (0.278CIA) the estimated PMP for 1 hour rainfall depth is 78 cumec. Hence, a design flood (PMF) of 78 cumec may be adopted for the planning purpose of the Upper reservoir of the project and arrangement for passing the flood may be planned accordingly. The necessary corrections may please be incorporated in DPR also.

D. Reservoir sedimentation study

The reservoir sedimentation study has been carried out taking the average annual sedimentation rate as 378 m^3/sq.km/year from the compendium of silting of reservoirs in India published by CWC in year 2015. The estimated sediment trapped in proposed upper reservoir in 70 years is 0.0297 MCM.

D.1 Observations & findings

In the upper reservoir basically suspended sediment will come due to pumping of water from lower reservoir. The adopted sedimentation rate of 378 m^3/sq.km/year is generally in order. Further considering the nature of sediment as suspended sediment, its deposition in upper reservoir shall be almost negligible. Hence, sedimentation may not be considered an issue for upper reservoir. However, the sediment deposition of 0.0297 MCM in 70 years as computed by project authorities may be considered a conservative estimate which is generally in order and the same may be adopted for planning purpose of the project.

This issues with the approval of Chief Engineer (HSO), CWC.

10/8/2020

(NITYA NAND RAI)
(Director)

Director, HPP&I, CEA, New Delhi
CWC U.O 7/Kar-78/2020-Hyd(S)/57-58 Dated: 10.08.2020

Copy to: Director, PA (S), CWC, New Delhi

भारत सरकार
Government of India
विद्युत मंत्रालय
Ministry of Power
केन्द्रीय विद्युत प्राधिकरण
Central Electricity Authority
जल परियोजना आयोजन एवं अन्वेषण प्रभाग
Hydro Project Planning & Investigation Division

No. 81/3/2020-HPP&I/ 646 - 658 **Date:** 11 .02.2020

Sub: Minutes of first consultation meeting to discuss Saundatti Pumped Storage Project (1260 MW) in Karnataka -reg.

Please find enclosed herewith the minutes of first consultation meeting to discuss Saundatti Pumped Storage Project (1260 MW) in Karnataka of M/s Greenko Energies Pvt. Ltd held on **6th January, 2020** in CEA, Sewa Bhawan, R.K. Puram, New Delhi.

Encl.: As above.

Mukesh 11/2/2020
(Mukesh Kumar)
Dy. Director

1. Member (D&R), Central Water Commission, Sewa Bhawan, New Delhi. Fax 26108340.
2. Special Chief Secretary & Head (Energy Dept.), Government of Andhra Pradesh, Secretariat, Hyderabad – 500001
3. M/s Greenko Ltd., Plot no. 1071, Road No. 44, Jubilee Hills, Hyderabad-500033 (Fax: 040-23555503).
4. Director, EPE Division, DGCO, Geological Survey of India, A-II Pushpa Bhawan, Madangir Road, New Delhi. Fax: 011-29962671.
5. Director, CSMRS, Olof Palme Marg, Hauz Khas, New Delhi. Fax: 011-26967985.
6. Chief Engineer, Designs (NW&S), Central Water Commission, Sewa Bhawan, New Delhi.
7. Chief Engineer (HSO), Central Water Commission, Sewa Bhawan, New Delhi.
8. Chief Engineer (HE&TD), CEA.
9. Chief Engineer (HPA), CEA.
10. Chief Engineer (HEPR), CEA.
11. Director (FE&SA), Central Water Commission, Sewa Bhawan, New Delhi.
12. Director (PAC), CEA.
13. Director, Inter-State Matters, Central Water Commission, Sewa Bhawan, New Delhi.

Minutes of the First Consultation Meeting held on 6th January, 2020 at 03:00 P.M in CEA to discuss Saundatti Pumped Storage Project (1260 MW), Karnataka.

1. The first consultation meeting to discuss the layout & Investigation plan of Saundatti PSP (1260 MW), Karnataka was taken by Member (Hydro), CEA on 06.01.2020. The officers from CEA, CWC, GSI, CSMRS and M/s Greenko attended the meeting. List of participants is enclosed at **Annex-I**.

2. Chief Engineer (HPP&I), CEA stated that as per present guidelines for accord of concurrence to Hydro Electric Schemes by CEA, the Project Proponent (Developer) is required to first prepare and finalize nine aspects/ chapters of the DPR through consultation with concerned appraising groups of CEA, CWC, GSI, CSMRS and MOWR before DPR is submitted to CEA for concurrence.

   As per the procedure, CEA along with other agencies hold first consultation meeting with developer to discuss/ finalize different alternatives of the project layouts along with detailed plan of investigations to be carried out by the developer in first phase for the finalized alternative. Accordingly, first consultation meeting to discuss Saundatti PSP (1260 MW) in Karnataka has been convened to discuss various issues concerning these nine aspects.

3. At the outset, Member (Hydro), CEA extended a warm welcome to all the participants and requested M/s Greenko to make a brief presentation. A detailed presentation was made by M/s Greenko about the need, regional geology, construction material and status of investigation of the project. It was informed that proposed Saundatti Integrated Renewable Energy Project comprises solar (2.4 GW) and wind (2.4 GW) power which would be integrated with pumped storage scheme (1260 MW) proposed to be located about 70 km from Belgavi district headquarters.

   It was indicated that the project envisages construction of one off-stream reservoir at flat terrace on top of hill which would act as upper reservoir while existing Renuka Sagar Reservoir would act as lower reservoir for the project. The Upper Reservoir would have a live storage capacity of 1.0 TMC for about 11 hours operation of the plant.

   During the presentation, the following two alternatives of project layouts studied/ considered for the project were discussed by the developer:

   i) Alt.-I - comprising a Surface Power House with no Surge Shaft.
   ii) Alt.-II - comprising an Underground Power House and Tail Race Surge Chamber.

   After discussions & detailed deliberations about the topographical, geological and geo-technical constraints as well as the relative advantages and disadvantages of each of the above alternatives, the Alternative-I emerged as the preferred choice for implementation of project owing to least construction time, least cost, techno-economic feasibility and least geological & geotechnical adverse conditions during tunneling etc. As such, M/s Greenko were advised to go ahead for further detailed investigations for the project scenario corresponding to the Alternative-I.

4. Chief Engineer (HEPR), CEA opined that Saundatti PSP could not be referred as a 'Standalone Project' since the lower reservoir for the project is an existing reservoir. Accordingly, M/s Greenko were advised to take note of the same.

5. Representative from Hydrology (South), CWC informed that Design Flood and Sedimentation Studies for the project would be required. Director (CMDD), CWC stated that seepage losses through embankment would need to be taken into account by the developer.

6. To a query from Member (Hydro), CEA regarding initial filling of the upper reservoir, it was informed by the developer that the same would be carried out during Monsoon season and would take around 90 days.

7. Director (GSI) stated that details of geological investigations of the project is yet to be submitted to GSI for examination by the developer. M/s Greenko were advised to expedite the same.

8. Chief Engineer (HE&TD), CEA stated that the type of turbine would need to be decided based on consideration of minimum head variation and not the input power. It was decided that the Developer would discuss the issue in detail with HE&TD Division of CEA.

9. Chief Engineer (HPP&I), CEA advised developer to submit a chapter on inter-state aspects to ISM Directorate of CWC for examination from Inter-State angle.

10. M/s Greenko were requested to ensure that the relevant chapters are submitted to the concerned appraising agencies. They were also advised to follow up regularly with the appraising agencies in order to expedite any clarification/ information required.

The meeting ended with vote of thanks to the chair.

--xx--

First Consultation Meeting to discuss Saundatti Pumped Storage Project (1260 MW), Karnataka held on 6th January, 2020 in CEA.

List of Participants

Central Electricity Authority

Shri/Smt.

1. Dinesh Chandra, Member (Hydro) – In Chair
2. J. S. Bawa, Chief Engineer (HPP&I)
3. P.K. Shukla, Chief Engineer (HEPR)
4. Sanjay Srivastava, Chief Engineer (HE&TD)
5. Sharvan Kumar, Director (HPA)
6. Anita Gahlot, Director (PAC)
7. Deepak Sharma, Dy. Director (HE&TD)
8. Mukesh Kumar, Dy. Director (HPP&I)
9. Ratnesh Kumar Yadav, Dy. Director (PAC)
10. Vikram Awasthi, Dy. Manager (HPP&I)

Central Water Commission

11. Kayum Mohammad, Director, CMDD (NW&S)
12. Vimal Kumar, Director, ISM
13. Manjeet Kaur, Dy. Director, Hydrology (South)
14. Aditya Mishra, Dy. Director, Gates (NW&S)
15. Ashwani Kumar Verma, Dy. Director, Emb. (NW&S)
16. Ms. Manu Dubey, Dy. Director, HCD (NW&S)
17. Payal Goyal, Asst. Director, Hydrology (South)

Geological Survey of India

18. Dharmendra Kumar, Sr. Geologist

Central Soil & Materials Research Station

19. S. L. Gupta, Director

Greenko

20. Y K Sehgal, Executive Director
21. P M Nanda, Sr. VP
22. Deepak K Gopalani, VP
23. B. Nagendra Reddy, AVP (Aarvee Associates)
24. Vinod Kumar, AGM
25. Anish Pasrija, DGM
26. Hema Kumar K, Sr. Manager
27. Sunny Kumar Singh, Asst. Manager
28. Dr. S S Garhia, Consultant (AEMPL)

I/11269/2020(1)

Annexure-4

भारत सरकार
Government of India
विद्युत मंत्रालय
Ministry of Power
केन्द्रीय विद्युत प्राधिकरण
Central Electricity Authority
जल विद्युत परियोजना मूल्यांकन प्रभाग
Hydro Project Appraisal Division

संख्या: CEA-HY-12-12/4/2020-HPA Division/ 658 to 659 **दिनांक:** 07.09.2020

To,

M/s. Greenko Solar Energy Private Limited,
Plot no. 8-2-293/82/A/1131A, Road no.- 36,
Jubilee Hills, Hyderabad- 500033,
Telangana.

विषय: Pumped Storage Project of Saundatti IREP (1260 MW) in Karnataka by M/s. Greenko Solar Energy Private Limited (GSEPL) - Power Potential Studies (PPS) - regarding.

महोदय,

Reference is invited to M/s Greenko Solar Energies Pvt. Ltd. letter no. GEPL/ 2019/02 dated 29.11.2019 submitting herewith Power Potential Studies (PPS) chapter in respect of proposed Pumped Storage Project of Saundatti IREP (1260 MW) in Karnataka. The PPS was examined and this division vide letter dated 07.02.2020 issued comments. M/s. GSEPL furnished their replies vide e-mail dated 10.07.2020 and subsequently furnished the copy of MOU with State Govt and copy of approved hydrology chapter vide e-mail dated 10.08.2020 and 12.08.2020 respectively.

The PPS chapter and subsequent submissions have been examined in CEA and it is observed that:

PPS submitted by M/s. GSEPL are based on reservoir simulation studies carried out on daily basis for generation and pumping of water. The simulation studies have been done based on variable head due to which the corresponding head loss has also varied. The developer has taken a unit combination of 4x252 MW+2x126 MW for PPS in order to optimally utilize the available potential.

As per PPS studies, FRL/MDDL of Upper Reservoir and Lower Reservoir are considered as EL 855.0/825.0 m and 633.83/623.93 m with live storage as 1 TMC and 29.32 TMC respectively.

The proposed Saundatti Pumped Storage Project (1260 MW) would be utilizing 1 TMC discharged water from upper reservoir for generation of about 1260 MW capacity for 11.59 hrs per day.

9/C

After detailed examination, an installed capacity of about 1260 MW for Saundatti Pumped Storage Project in Karnataka is found to be generally in order subject to following conditions:

1. Head Losses in the water conductor system and Evaporation Losses need to be approved by CWC.
2. Allocation of 1.329 MCM of water for top-up the water evaporated from upper reservoir by Govt. of Karnataka.
3. Transportation aspects, project general layout and TG/PM efficiencies of the Units sizes of 252 MW and 126 MW need to be approved by HE&TD division, CEA.

Design Energy of 5063.24 MU is envisaged to be generated from the project and it would require 6266.47 MU of energy for pumping of water from lower reservoir to upper reservoir annually. As such, the project would operate at cycle efficiency of 80.80%.

However, the installed capacity and energy benefits would require a review under following conditions:

i) Change in various operating levels (FRL, MDDL and TWL) etc, if any.
ii) Change in Water Conductor System Losses, if any.
iii) Consequential change in Design Head.
iv) Change of Combined efficiency of TG/PM, if any.
v) Change of Layout Plan.

This issues with the approval of competent authority.

भवदीय

(बुधबीर सिंह)
उप निदेशक (एच.पी.ए.)

प्रतिलिपि : Chief Engineer (HPP&I), CEA.

9/C

Signature Not Verified

Digitally signed by BUDHBIR SINGH
Date: 2020.09.09 14:48:52 IST

******

ENVIRONMENTAL IMPACT ASSESSMENT
STANDALONE PUMPED STORAGE COMPONENT (1260 MW) OF SAUNDATTI INTEGRATED RENEWABLE ENERGY PROJECT
(Sector 1(c); Cat "A")

May, 2020

Prepared for:

GREENKO SOLAR ENERGY PRIVATE LIMITED, HYDERABAD

Prepared by:

R. S. Envirolink Technologies Pvt. Ltd.

402, RADISSON SUITES COMMERCIAL PLAZA,
B-BLOCK, SUSHANT LOK-I, GURGAON
Ph: +91-124-4295383: www.rstechnologies.co.in

QCI Certificate No.	**:**	**NABET/EIA/1922/RA 0152**
Laboratory	**:**	**APEX TESTING AND RESEARCH LABORATORY ISO/IEC 17025:2005 (NABL Accredited Testing Laboratory)**
Baseline Data Monitoring Period	**:**	**Winter/ Lean (January 2018)** **Pre-Monsoon (May 2018)** **Monsoon (August 2018)**
Additional Seasonal Baseline Data	**:**	**Winter/ Lean (December 2019)**

Quality Council of India

National Accreditation Board for Education & Training

CERTIFICATE OF ACCREDITATION

R S Envirolink Technologies Pvt. Ltd., Gurugram

403, Bestech Chamber Commercial Plaza, B Block, Sushant Lok 1, Gurugram – 122009

Accredited as Category - A organization under the QCI-NABET Scheme for Accreditation of EIA Consultant Organizations: Version 3 for preparing EIA-EMP reports in the following Sectors:

Sl. No.	Sector Description	Sector (as per)		Cat.
		NABET	MoEFCC	
1	Mining of minerals- opencast only	1	1 (a) (i)	A
2	River Valley projects	3	1 (c)	A
3	Oil & gas transportation pipeline (crude and refinery/ petrochemical products), passing through national parks/ sanctuaries/coral reefs /ecologically sensitive Areas including LNG terminal	27	6 (a)	A
4	Jetties only	33	7 (e)	A
5	Highways	34	7 (f)	A

Note: Names of approved EIA Coordinators and Functional Area Experts are mentioned in RAAC and Supplementary minutes dated Nov 15, 2019 and Jan 31, 2020 dated posted on QCI-NABET website.

The Accreditation shall remain in force subject to continued compliance to the terms and conditions mentioned in QCI-NABET's letter of accreditation bearing no. QCI/NABET/ENV/ACO/20/1237 dated Feb 18, 2020. The accreditation needs to be renewed before the expiry date by R S Envirolink Technologies Pvt. Ltd., Gurugram following due process of assessment.

Sr. Director, NABET
Dated: Feb 18, 2020

Certificate No.
NABET/EIA/1922/RA 0152

Valid till
August 14, 2022

For the updated List of Accredited EIA Consultant Organizations with approved Sectors please refer to QCI-NABET website.

List '1' – Accredited EIA Consultant Organizations (ACOs) - as on May 2020#

S. No.	Consultant Organization	Scope of Accreditation			
		As per NABET Scheme			Project or Activity as per Schedule of MoEFCC Notification dated September 14, 2006 and subsequent Amendments
		Sector Number	Name of Sector	Category	
1	**Aadhi Boomi Mining and Enviro Tech Private Limited** (formerly known as Suriya Mining Services) **Address:**3/216, K.S.V.Nagar, Narasothipatti, Salem-636004 **Email:**suriyakumarsemban@gmail.com **Tel.:**09842729655, 09443290855 *Conditions apply*	1	Mining of minerals – opencast only	A	1 (a) (i)
		3	River Valley Projects	A	1 (c)
		7	Mineral beneficiation	A	2 (b)
		9	Cement Plants	A	3 (b)
		34	Highways	B	7 (f)
		38	Building and construction projects	B	8(a)
2	**Aakhivi Consultants** **Address:**57 C, Block E5, Shatabdi Vihar, Sector 52, Noida, UP - 201 308 **Email:**aakhivi.2016@gmail.com **Tel.:**08409580043; 07210434847	1	Mining of minerals - opencast only	A**	1 (a) (i)
		4	Thermal power plants	A**	1 (d)
		34	Highway	A**	7 (f)

S. No.	Consultant Organization	Scope of Accreditation			
		As per NABET Scheme			Project or Activity as per Schedule of MoEFCC Notification dated September 14, 2006 and subsequent Amendments
		Sector Number	Name of Sector	Category	
132	**R. S. Envirolinks Technologies Pvt. Ltd.** **Address:** 403, Bestech Chamber Commercial Plaza, B Block, Sushant Lok 1, Gurugram – 122009 **Email:** ravi@rstechnologies.co.in **Tel.:** 0124 – 4295383, 09810136853 *Conditions apply*	1	Mining of minerals- opencast only	A	1 (a) (i)
		3	River Valley projects	A	1 (c)
		27	Oil & gas transportation pipeline (crude and refinery/ petrochemical products), passing through national parks/ sanctuaries/coral reefs /ecologically sensitive Areas including LNG terminal	A	6 (a)
		33	Jetties only	B	7 (e)
		34	Highways	A	7 (f)
133	**Ramans Enviro Services Pvt. Ltd.** **Address:** SF 23 & 24, Camps Corner, Nr. AUDA Garden, Prahladnagar, Ahmedabad – 380015 **Email:** ramans.consultancy@gmail.com samirchoksi88@yahoo.com **Tel.:** 079 – 26937472, 26937411, 09824034495	4	Thermal power plants	A	1 (d)
		21	Synthetic organic chemicals industry (dyes & dye intermediates; bulk drugs and intermediates excluding drug formulations; synthetic rubbers; basic organic chemicals, other synthetic organic chemicals and chemical intermediates)	A	5 (f)
		28	Isolated storage & handling of hazardous chemicals (As per	B	6 (b)

Declaration by Experts contributing to the EIA/EMP Report of Saundatti IRE Project.

I, hereby, certify that I was a part of the EIA team in the following capacity that developed the above EIA.

EIA Coordinator: Dr. Arun Bhaskar

Name: Dr. Arun Bhaskar

Signature & Date: 30/1/2019 Date- 30/01/2019

Period of Involvement: May 2018 – January 2019

Contact Information: 0124-4295383

Functional Area Experts:

S.No.	Functional Areas	Name of the expert/s	Involvement (Period & Task)	Signature
1	AP	Vimal Garg	• Baseline Data Review and Analysis • Impact Assessment • Preparation of Air Management Plan	30/1/19
2	WP	Ravinder P S Bhatia	• Baseline Data Review and Analysis –Water Quality • Impact Assessment and Management Plan	30/01/19
3	SHW	Ravinder P S Bhatia	• Impact Assessment • Preparation of Waste Management Plan • Public Health Delivery System • Muck generation analysis and Dumping Plan	30/01/19
4	SE	Zahoor A Wani	• Social Data Collection and Interpretation • Social Impact Assessment • Preparation of R&R Plan	Z Awani 30/1/2019
5	EB	Arun Bhaskar	• Impact Assessment • Preparation of Biodiversity Management Plan • Compensatory Afforestation Plan	30/1/2019
		Vivek Jhaldiyal	• Baseline Data Collection, Analysis and Interpretation	30/1/2019

6	SC	Arun Bhaskar	• Baseline Data Review and Analysis • Impact Assessment	30/11/2019
		Vivek Jhaldiyal	• Sampling and Interpretation	30/11/2019
7	AQ	Ravinder P S Bhatia	• Impact Assessment of Air and Water Environment	30/11/2019
8	NV	Ravinder P S Bhatia	• Baseline Data Review and Analysis – Sound levels, Impact Assessment and Mitigation Plan	30/11/2019
9	HG	Vimal Garg	• Impact Assessment	30/11/19
10	LU	Vimal Garg	• Impact Assessment • Data Review and Analysis	30/11/19
		Dimple Razdan	• Preparation of Thematic maps	30/11/19
11	RH	Harsh Pandya	• Risk Assessment	30/11/2019
12	GEO	Trilochan Singh Kaith	• Geological & Geotechnical Investigations	30/11/2019

Declaration by the Head of the Accredited Consultant Organization/ authorized person

I, Arun Bhaskar, hereby, confirm that the above mentioned experts prepared the EIA/EMP Report of Saundatti IRE project. I also confirm that the consultant organization shall be fully accountable for any mis-leading information in this statement.

Signature: 30/11/2019

Name: Dr. Arun Bhaskar

Designation: Managing Director

Name of the EIA Consult Organization: RS Envirolink Technologies Pvt. Ltd.

NABET Certificate No. & Issue Date: NABET/EIA/1922/RA0152, 18th February 2020

S.No.	Functional Areas	Complete name of the Functional Areas
1	AP	Air Pollution Prevention, Monitoring & Control
2	WP	Water Pollution Prevention, Control & Prediction of Impacts
3	SHW	Solid Waste and Hazardous Waste Management
4	SE	Socio-Economics
5	EB	Ecology and Biodiversity
6	SC	Soil Conservation
7	AQ	Meteorology, Air Quality Modeling & Prediction
8	NV	Noise/ Vibration
9	HG	Hydrology, Ground Water & Water Conservation
10	LU	Land Use
11	RH	Risk Assessment & Hazard Management

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CHAPTER 11: SUMMARY AND CONCLUSION

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chapter 1 INTRODUCTION

1.1 PURPOSE OF THE REPORT

Pumped-storage hydroelectricity allows energy from intermittent sources (such as solar, wind) and other renewables, or excess electricity from continuous base-load sources (such as coal or nuclear) to be saved for periods of higher demand. The reservoirs used with pumped storage are quite small when compared to conventional hydroelectric dams of similar power capacity, and generating periods are often less than half a day. Along with energy management, pumped storage systems are also helpful in controlling electrical network frequency and provide reserve energy.

Environment Impact Assessment (EIA) study of Standalone Pumped storage component (1260 MW) of Saundatti IRE Project has been carried out with a view to assess the impacts of project on the surrounding area so as to suggest mitigation and management measures to minimize such impacts. EIA study for such projects is mandatory as per EIA Notification of September 2006, which describes the environment clearance procedure.

An **Environmental Impact Assessment** (EIA) is a tool used to predict the environmental consequences (positive or negative) of a plan, policy, program, or project prior to the implementation decision. It proposes measures to adjust impacts to acceptable levels or to investigate new technological solutions. Although an assessment may lead to difficult economic decisions and political and social concerns, environmental impact assessments protect the environment by providing a sound basis for effective and sustainable development.

The **Environment Management Plan** (EMP) outlines a plan which, upon implementation, will reduce negative impacts of the project during construction and operational phase and minimize environmental degradation. This minimization may be a result of implementation of a project alternative or project modifications or environmental protection measures which simply reduces the severity or magnitude of impacts.

1.2 IDENTIFICATION OF PROJECT AND PROJECT PROPONENT

Greenko Group has been in the process of evaluating suitable locations for such integrated projects for over an year and has identified Saundatti (Near Karlakatti Village), Belagavi District, Karnataka as possible location for the proposed Saundatti Integrated Renewable Energy Project (IREP). Saundatti IREP is envisaged as a 4.0 GW project i.e. 2.0 GW of Solar Project and 2.0 GW of wind project with storage capacity of 1260/14616 MWH.

With this in view, Greenko Group has undertaken feasibility studies to harness the wind and solar potential within the state of Karnataka and has approached the state government to establish Integrated Renewable Energy Project (IREP) encompassing development of 600 MW Pumped Storage Energy, 1000 MW Solar Power and 400 MW Wind Power Project to be developed in Saundatti Taluk of Belagavi District. After evaluating the said proposal in the 51st SHLCC meting dtd. 02.03.2018, the Government of Karnataka, vide G.O. No. CI 83 SPI 2018, dtd. 08.03.2018 has accorded in-principle approval for the said project along with

in-principal approval for lifting 1.0 TMC of non-consumptive water from Renuka Sagar reservoir by re-circulation. However, taking into consideration the requirements and demands from various State DISCOMs/STU and other consumers, Greenko Group intended to augment this capacity subsequently to develop 2400 MW Solar, 2400 MW Wind & 1260 MW Standalone Pumped Storage depending on technical feasibility and site suitability. Even though the capacity is envisaged to be augmented, particularly for the Pumped Storage component, the feasibility carried out by PP indicate that 1.0 TMC of water will suffice the purpose for establishing 1260 MW Pumped Storage with 11.60-hour storage capacity.

Further, all three components of Saundatti IREP (wind, solar & pumped storage) are in close vicinity of each other and therefore power from all three components will be pooled into common pooling station and will be connected to PGCIL/CTU sub-station at Dharwad for further supply into the National Grid. The IREP Project is a self-identified project and first of its kind and is intended to cater the dynamic needs of DISCOMs/STUs, through:

1. 24 Hours Round the Clock (RTC) Base Load Energy
2. 18 Hours Base Load Energy as per Demand
3. 12 Hour Peak Load Energy (6 hours + 6 hours)
4. Energy Storage Service, Grid Management, Frequency Management & Ancillary Services

1.3 BRIEF DESCRIPTION OF NATURE, SIZE, LOCATION OF THE PROJECT AND ITS IMPORTANCE TO THE COUNTRY, REGION

India is leading the world's renewable energy revolution and is on track to achieve 175 GW of RE capacity by 2022. Today, Wind & Solar, are the lowest cost source of new energy, however their inherent infirm nature & non-schedulability presents a huge challenge for integrating large RE capacities, while maintaining grid stability. Today, increasing RE capacities coupled with ever changing dynamic demand curves of the States/DISCOMs/STUs are leading to sub-optimal utilization of the existing base-load assets resulting in high fixed cost pass through per kWh and additional burden to the consumers.

Flexible Energy Generation Assets that have a capability to supply both Base Load & Peaking Power efficiently and economically are the need of the future and the necessary solution to address the dynamic evolving energy needs of India. The increasing energy demand of the country can only be met sustainably by developing the much-required Flexible Energy Generation Assets immediately.

Wind-Solar-Storage Hybrid Projects present a viable solution to the problem at hand and for future wherein large RE capacities are being planned to be added to National grid. While battery storage solutions are still evolving, **integrating Wind & Solar** with time tested and proven **Pumped Storage** solutions presents an **optimal, economically viable & scalable solution to supply Schedulable Power On-Demand (SPOD)** with both base load and peak load capabilities. Pumped Storage solutions provide the necessary scale (large volume of energy storage) and have a long life-cycle resulting in lowest cost of delivered SPOD energy over the life of the projects. Developing such integrated projects in Wind-Solar resource rich locations along with standalone Pumped Storage capacities independently, without

impacting the existing natural water systems / irrigation systems is necessary to sustainably power the future needs of our country while maintaining grid stability.

Power sector is a critical infrastructure element required for the smooth functioning of the economy of the Nation. An efficient, resilient and financially healthy power sector is essential for growth and poverty reduction. The availability of reliable, quality and affordable power helps in the rapid agriculture, industrial and overall economic development of the state.

The need for implementing new hydroelectric schemes in the region for providing peak power besides energy at competitive rates therefore needs no further emphasis. The most reliable option for energy storage is development of Pumped storage schemes. Pumped Hydroelectric Energy Storage (PHES), is a type of hydroelectric energy storage used by electric power systems for load balancing. This method stores energy in the form of gravitational potential energy of water, pumped from a lower elevation reservoir to a higher elevation. Low-cost surplus off-peak electric power is typically used to run the pumps. During periods of high electrical demand, the stored water is released through turbines to produce hydroelectric power. Although the losses of the pumping process make the plant a net consumer of energy, overall the system increases revenue by selling more electricity during periods of peak demand, when electricity prices are highest.

'**Standalone pumped Storage component of Saundatti IREP**' is located in Belagavi district of Karnataka state. It comprises of two reservoirs i.e. Renuka Sagar Reservoir (already existing) and Saundatti IREP Reservoir (proposed to be constructed). This project is a one of its kind because the proposed reservoir is not located on any river course and the existing Renuka Sagar reservoir is located across River Malaprabha.

This scheme envisages non-consumptive re-utilization of 1 TMC of water of Renuka Sagar reservoir by recirculation. The water in the Renuka Sagar reservoir (existing lower reservoir) will be pumped up and stored in the proposed Saundatti IREP reservoir (upper Reservoir) and will be utilized for power generation.

The location of the project is shown in **Figure 1.1.**

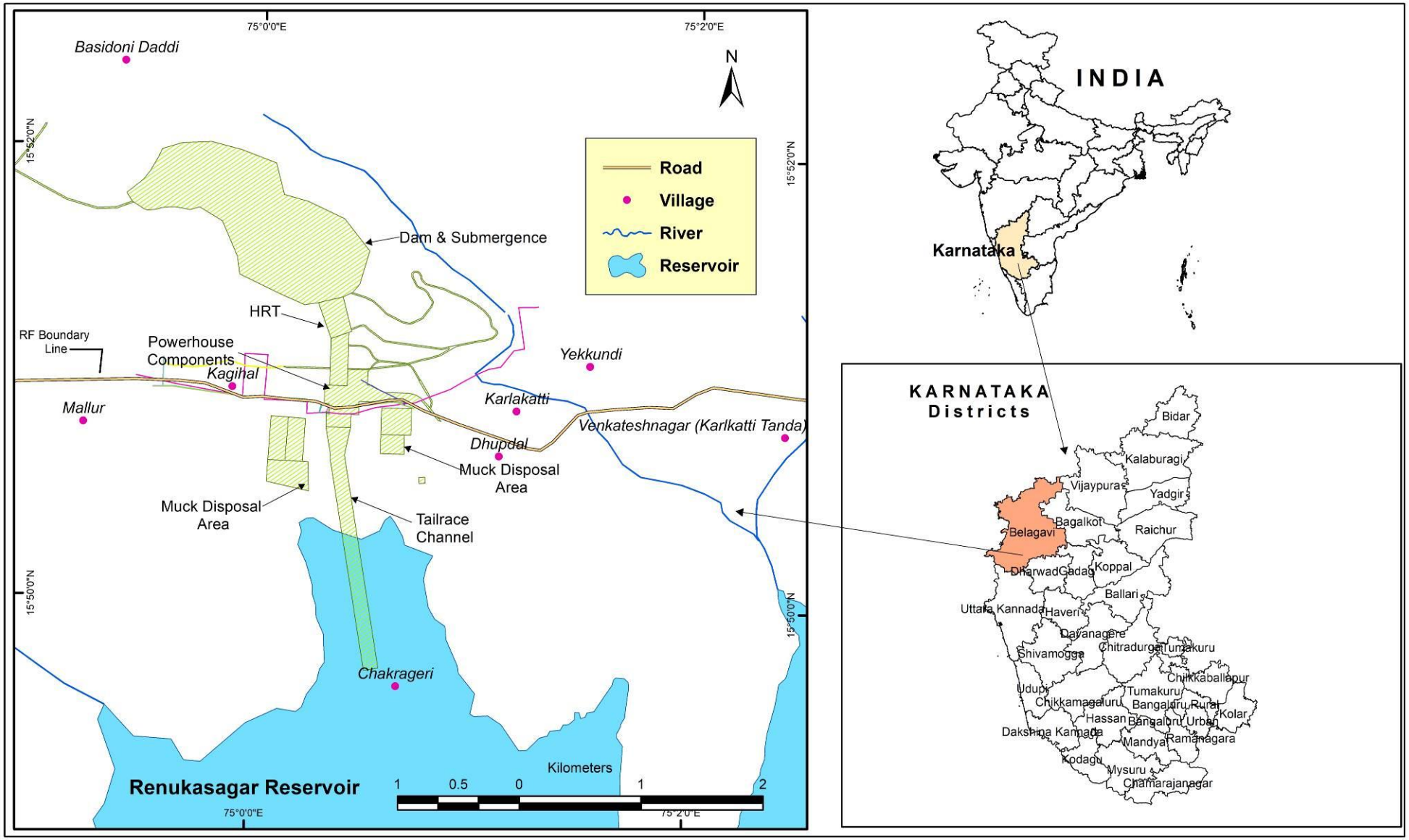


Figure 1.1: Location Map of Saundatti- Standalone Pumped Storage component of Saundatti IREP

1.4 SCOPE OF THE STUDY

Scoping clearance of Saundatti IREP of 1200 MW project was accorded by Ministry of Environment Forests and Climate Change (MoEF&CC), Government of India vide letter no. J-12011/11/2018-IA.l (R), dated: 18.05.2018. **(Refer Annexure Ia).**

Subsequently, Amendment to Scoping Clearance for Standalone Pumped storage component (1260 MW) of Saundatti IRE Project received from MoEF&CC for change in Capacity etc. of the proposed project vide letter no. J-12011/11/2018-IA.I (R) dated 25th September, 2018 **(Refer Annexure-Ib).** Compliance to TOR is given at **Annexure II.**

The project requires to divert **160.40 Ha** (153.93 ha surface area and 6.47 ha underground area) of forest land for non-forestry purposes i.e. for the purpose of construction of various project components. For diversion of 160.40 ha of forest land, online application has been submitted to MoEF&CC vide proposal No.: FP/KA/HYD/37723/2018. The entire forest land falls in Karlakatti, Chakrageri and Kagihal Villages of Belagavi district (refer **Annexure III**).

On completion of draft EIA report and its executive summary in English and vernacular language (Kannada), report was submitted to Karnataka State Pollution Control Board (KSPCB) to initiate the process of Environmental Public Hearing (PH). PH was held on 07th January, 2019 adjacent to Mallur Electrical Sub-station, Karlakatti village, Yakkundi Panchayat, Saundatti taluka, District Belagavi, Karnataka.

The proceedings of the same have been appended as a separate document. The outcome of the EPH process in the form of report detailing the proceedings and video of the entire event is submitted to MoEF&CC by Karnataka State Pollution Control Board. Major issues raised during Public Consultation process and response is covered as part of **Chapter 7**.

On completion of the Public Hearing, final EIA report prepared and submitted online for appraisal. Project was discussed in EAC meeting held on 27.02.2019, where EAC after detailed deliberations recommended the project for environment clearance. Post EAC's recommendation for environment clearance, MoEF&CC has sought additional information vide its letter F.No.-J-12011/11/2018-IA-I dated 13.06.2019. Detailed response to the queries was submitted vide letter No. **IRE-Saundatti/MoEF&CC/EC/191097** dated 07/10/2019.

It was also requested that during DPR studies, it was evaluated that the project can be further optimized with minor change in upper reservoir, accordingly optimization studies have been carried out. Based on the optimization studies it was evaluated that by shifting the Upper Reservoir to the adjacent hillock having gradually sloping surface from the earlier proposed gorge/valley, the project shall result in

- An increase in MWH from earlier **8.0 hr to 11.60 hr** with the same quantity of water.
- The Gross Storage capacity has been optimized from 1.75 TMC to 1.03 TMC.
- Dead Storage reduces from 0.494 TMC to 0.03 TMC
- Storage Capacity Increased from 11340 MWH to 14616 MWH
- Except shifting of Upper Reservoir, all other project component locations remain same.

- Apart from increase in MWH, civil structures like HRT and Surge Shaft had been eliminated reducing the overall length of water conductor system.
- The total land requirement has been reduced from 228.97 ha to 213.70 Ha
- Private land requirement reduced to 34.64 ha from earlier estimate of 37.34 ha.
- Forest land has been reduced from 169.97 ha to 160.40 ha.
- The density of Forest land also changes from Medium Dense Forest Type to Open forest type.
- All the Project Affected Villages and the Project Affected Persons remains the same.
- No significant change in study area as only minor shift in location of upper reservoir.

Response to queries and minor changes in layout were discussed in 28th EAC meeting held on October 31, 2019. EAC noted that there are few changes proposed in the project configuration especially location of the dam site. However, Installed Capacity of the project (1260 MW) is the same. EAC based on the information as presented and submitted to the Ministry by the PP, decided to revisit the recommendation made in the meeting held on 27.02.2019 and deferred the project for following additional information:

1. One season baseline data to be collected afresh for all the environmental attributes and compared with the existing data.
2. Pre-DPR Chapters viz., Hydrology and Layout Map and Power Potential Studies duly approved by CWC/CEA.
3. Consolidated report based on the fresh one season baseline data to be prepared and uploaded on the Karnataka State PCB website for inviting the comments/suggestion from the general public for one month.
4. EIA/EMP report incorporating the compliance on the comments/suggestion received shall be submitted to the Ministry for further necessary action.

Ensuring compliance to the EAC's recommendations, baseline data was collected covering physio-chemical and biological parameters during December 2019. Report was updated to include additional baseline data and revised project features. Dam break Analysis was also updated for changed project features as well other sections updated based on changes and EAC's recommendation. The updated draft final report was submitted to Karnataka State Pollution Control Board (KSPCB) for display on website inviting comments/suggestions from general public on 11/06/2020. The report was uploaded on PCB website on 26/06/2020 for a period of 30 days; no comments and suggestions have been received from the public in 30 days period as confirmed by KSPCB's letter number PCB/462/17 Cat/EPH-HPI/GreenKo Solar Energy Ltd/2020-21 dated 27/08/2020. Copy of the KSPCB letter is enclosed as **Annexure VII** for ready reference.

The final report is being submitted to MoEF&CC for appraisal and issue of environment clearance.

Chapter 2 PROJECT DESCRIPTION

2.1 TYPE OF PROJECT

'**Standalone pumped Storage component of Saundatti IREP**' comprises of two reservoirs i.e. Renuka Sagar Reservoir (already existing) and Saundatti IREP Reservoir (proposed to be newly constructed). This project is a one of its kind because the proposed reservoir is not located on any river course and the existing Renuka Sagar reservoir is located across River Malaprabha.

2.2 NEED FOR THE PROJECT

The most reliable option for energy storage is development of Pumped storage schemes. Pumped hydroelectric energy storage (PHES), is a type of hydroelectric energy storage used by electric power systems for load balancing. The method stores energy in the form of gravitational potential energy of water, pumped from a lower elevation reservoir to a higher elevation. Low-cost surplus off-peak electric power is typically used to run the pumps. During periods of high electrical demand, the stored water is released through turbines to produce electric power. Although the losses of the pumping process make the plant a net consumer of energy overall, the system increases revenue by selling more electricity during periods of peak demand, when electricity prices are highest.

Pumped-storage hydroelectricity allows energy from intermittent sources (such as solar, Wind) and other renewables, or excess electricity from continuous base-load sources (such as coal or nuclear) to be saved for periods of higher demand.

In view of the power scenario described above, the Saundatti IRESP - Storage Scheme envisaged with Storage Capacity of 14616 MWH with Rating of 1260 MW and will help a long way in meeting the projected power demand.

2.3 LOCATION

Proposed Standalone Pumped storage component of Saundatti Integrated Renewable Energy Project (IREP) is located in Belagavi District of Karnataka. It envisages creation of upper reservoir which is located away from all existing natural systems and have no/negligible catchment area. The project is about 80 Kms from district headquarters Belagavi via Yeragatti. Nearest railhead and Airport are located at Dharwad, Hubli and Belagavi respectively. The nearest Village to project is Somapura about 3 Km, which comes under, Tallur Grama Panchayat, Saundatti Taluk.

This scheme envisages non-consumptive re-utilization of 1 TMC of water of the Renuka Sagar reservoir by recirculation. The water in the Renuka Sagar reservoir (existing lower reservoir) will be pumped up and stored in the proposed Pumped Storage component of Saundatti IREP reservoir (upper Reservoir) and will be utilized for power generation. The Geographical co - ordinates of the proposed Standalone Pumped Storage component of Saundatti IREP reservoir are at longitude 75° 00' 19.50" East and latitude is 15° 51' 21.84" North and that of Renuka Sagar reservoir (existing) are 15°49'17.15"N N and 75° 05'48.23"E (**refer Figure 2.1**).

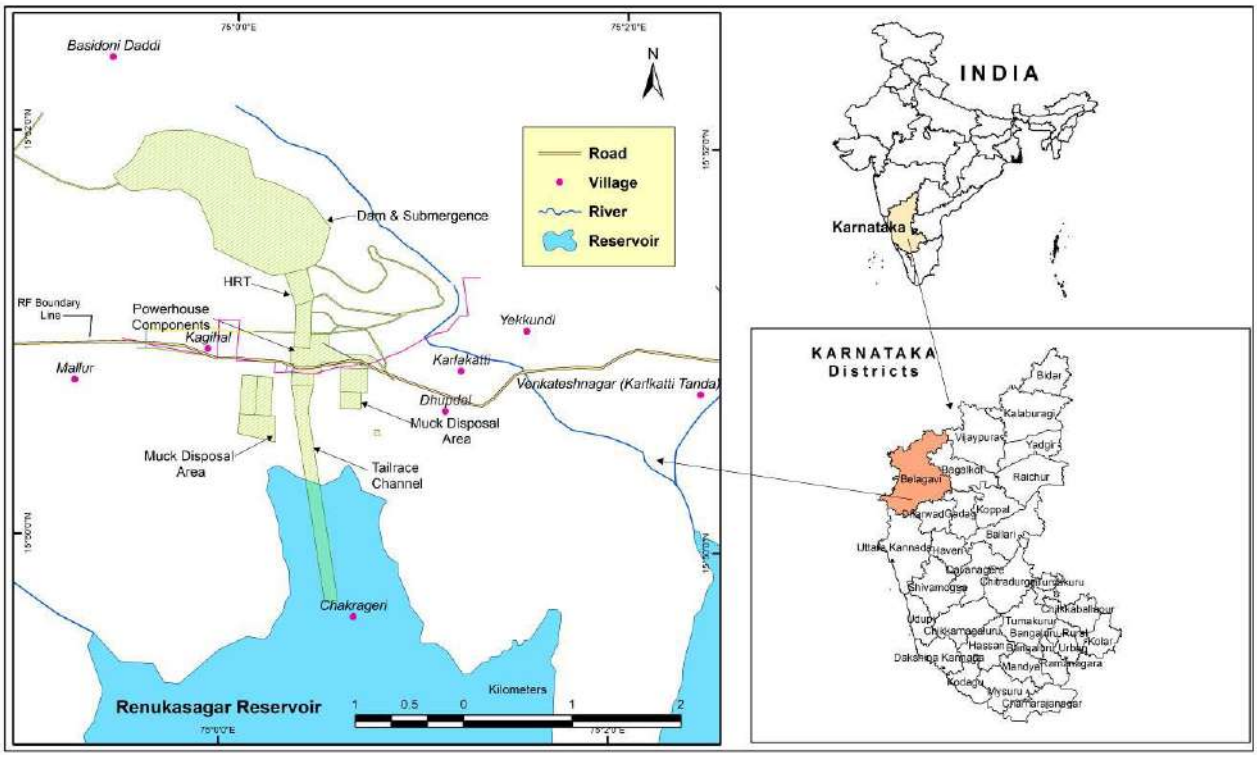


Figure 2.1: Location Map of Saundatti- Standalone Pumped Storage component of Saundatti IREP

2.4 SIZE OR MAGNITUDE OF OPERATION

The Standalone Pumped Storage Component of Saundatti IREP envisages construction of upper reservoir (proposed) located in Saundatti Taluk of Belagavi District. The Renuka Sagar reservoir (Existing) is under operation with a live storage capacity of 29.34 TMC and Saundatti IREP reservoir is proposed for the live storage capacity of 1.00 TMC.

Proposed Scheme will involve construction of rockfill embankment with height of 43m for the length of 5776m for creation of Saundatti IREP upper reservoir of 1.03 TMC gross capacity. Intake structure and trash rack for five numbers of independent penstocks in which one penstock will be bifurcated in to two penstocks as hydraulic short circuit to connect two units will be taking off from Saundatti IREP upper reservoir. Surface Power House will be located at about 824.12 m from the intake structure and shall be equipped with four vertical-axis reversible Francis type units composed each of a generator/motor and a turbine/pump having generating/pumping capacity of 252MW/297MW and two units of 126MW/170MW respectively.

The salient features of the project are given at **Table 2.1**.

Table 2.1: Salient features of the Standalone Pumped Storage component of Saundatti IREP

1		**NAME OF THE PROJECT**	**STANDALONE PUMPED STORAGE COMPONENT OF SAUNDATTI IREP**
2		**Location**	
	a	Country	India
	b	State	Karnataka
	c	District	Belagavi
3		**Geographical Co-Ordinates**	
	a	**Saundatti PSP Reservoir - Upper (Proposed)**	
		Latitude	15° 51' 21.84" N
		Longitude	75° 00' 19.50" E

	b	**Renuka Sagar Reservoir - Lower (Existing)**	
		Latitude	15° 49' 17.15" N
		Longitude	75° 05' 48.23" E
4		**Access to Project Site**	
	a	Airport	Belagavi
	b	Rail head	Dharwad
	c	Road	Dharwad (45 Km)
	d	Port	Karwar
5		**Project**	
	a	Type	Pumped Storage Project
	b	Storage Capacity	14616 MWH
	c	Rating	1260 MW
6		**Upper Reservoir (Proposed)**	
	a	Live Storage	1.00 TMC
	b	Dead Storage	0.03 TMC
	c	Gross Storage	1.03 TMC
7		**Upper Dam**	
	a	Top of Dam	EL +858.00 m
	b	Full Reservoir level (FRL)	EL +855.00 m
	c	Min. Draw Down Level (MDDL)	EL +825.00 m
	d	Type of Dam	Rock fill Dam with central clay core
	e	Height of Rockfill Dam	43.00 m
	f	Length at the top of Rockfill Dam	5776 m
	g	Top width of the Rockfill Dam	10.0 m
8		**Renuka Sagar Dam – Lower Reservoir (Existing)**	
	a	Catchment Area	2176 Sq. KM
	b	Max. flood discharge	5239 cumecs
	c	Live Storage	830.81 MCum (29.34 TMC)
	d	Dead Storage	236.46 MCum (8.35 TMC)
	e	Gross Storage	1067.27 MCum (37.69 TMC)
	f	Full Reservoir level (FRL)	EL +633.83 m
	g	Min. Draw Down Level (MDDL)	EL +623.93 m
	h	Length of Dam	154.53 m
	i	Max. Height of Dam above lowest river bed level	40.23 m
	j	Max. Height of Dam above lowest foundation level	43.10m
9		**Intake Structure**	
	a	Type	Diffuser Type
	b	No. of Vents	5 nos.
	c	Size of Each Intake	23.50m (W) x 7.50 m (H) including piers
	d	Length of each Intake	39.55 m (covered with RCC slab at top up to Intake Gate)
	e	Elevation of Intake bottom at start	EL +811.40 m
	f	Design Discharge of each Intake (Turbine mode)	136.49 Cumec for units 3 to 6 136.88 Cumec for units 1 & 2
10		**Penstock/Pressure Shafts**	
	I	**Top Inclined Pressure Shaft**	
	a	Type	Steel lined – circular
	b	Number of Penstocks	5 Nos
	c	Diameter of Each Pressure shaft	6.0 m dia
	d	Length of Each Pressure shaft	173.50 m
	e	Design Discharge of each Pressure Shaft	136.49 Cumec
	f	Velocity in the Penstock	4.83 m/sec
	II	**Vertical Pressure Shaft**	
	a	Type	Steel lined – circular

	b	Number of Pressure Shafts	5 Nos.
	c	Diameter of shaft	6.0 m dia.
	d	Length of Vertical Shaft	235.31 m each (up to start of Horizontal Shaft)
	IV	**Bottom Horizontal Pressure Shaft**	
	a	Type	Steel lined – circular
	b	Number of Pressure Shafts	5 Nos. wherein 1 No Independent Pressure shaft bifurcated in to 2 for Smaller units
	c	Diameter of main pressure shaft	6.0 m
	d	Discharge in Main Pressure shaft	136.49 Cumec
	e	Velocity in Main Pressure shaft	4.83 m/sec
	f	Diameter of branch Pressure shaft	4.25 m
	g	Discharge in Branch Pressure Shaft	68.44 m^3/s
	h	Velocity in Branch Pressure shaft	4.83 m/s
	i	Length of Bottom Horizontal Main Pressure Shaft	4 nos. 620.69 m each & 1 No. 502.0 m
	j	Length of Bottom Horizontal branch Pressure Shaft	2 nos. of 65.85 m (for Unit-1& 2) each
	V	**Main Inlet Valve (MIV)**	
	a	Size of MIV	4.2 m Diameter (for Larger unit) 3.15 m diameter (for Smaller unit)
11		**Powerhouse**	
	a	Type	Surface Powerhouse
	b	Centre line of Unit	EL 587.00 m
	c	Dimensions including Service Bay	L 196.50m x B 24.00 m x H 51.10 m
12		**Tail Race Tunnel**	
	a	Type	Concrete Lined – Circular
	b	No. of Tunnel	6 nos. (4 individual tunnels for Larger units & 2 individual tunnels for Smaller units)
	c	Dia. of Tunnel	7.0m for larger units & 5.0m for Smaller units
	d	Length of Tunnel	225.47 m
13		**Tail Race Outlet**	
	a	Type	Diffuser Type
	b	No. of Outlet	6 Nos.
	c	Size of Outlet	23.50 m (W) x 8.0 m (H) for Larger Unit 20.0m (W) x 5.20m (H) for Smaller Unit
	d	Length of each Outlet	37.40 m (covered with RCC slab at top up to Intake Gate)
	e	Elevation of Outlet Centre line	EL +614.10m
	f	Elevation of Outlet bottom	EL +610.60m for Larger Unit EL +611.60 for Smaller Unit
14		**Tail Race Channel**	Trapezoidal Unlined
	a	Length of the channel	1749 m
	B	Bed width	45m
15		**Electro Mechanical Equipment**	
	a	Pump Turbine	Francis type, vertical shaft reversible pump-turbine
	b	Total No of units	6 nos. (4 X 252MW & 2 X 126 MW)
	c	Centerline of Unit	EL +587.00m
	15.1	**252MW Turbines**	
	a	Total No. of units	4 Units (All units are Variable speed)
	b	Turbine Capacity	252 MW
	c	Turbine Design Discharge	136.49 Cumec for each unit
	d	Rated Head in Turbine Mode	206.82 m
	e	Pump Capacity	297 MW
	f	Rated Head in Pumping Mode	216.12 m
	15.2	**Generator-Motor**	
	a	Type	Three phase, alternating current asynchronous, generator motor semi umbrella type with vertical

			shaft
	b	Number of units	4Units
	c	Rated Capacity	Generator – 252 MW Pump Input – 297 MW
	15.3	**Generator Motor Transformer**	
	a	Type	Indoor Single-Phase Power transformers with Off- Circuit tap changer (OCTC)
	b	Number of units	12 Units i.e 3 Nos. per unit
	c	Rated Capacity of each unit	Single Phase 125 MVA
	15.4	**126MW Turbines**	
	a	Total No of units	2 Units (Both are Variable speed)
	b	Turbine Capacity	126 MW
	c	Turbine Design Discharge	68.44 Cumec
	d	Rated Head in Turbine Mode	206.22 m
	e	Pump Capacity	170 MW
	f	Rated Head in Pump Mode	217.42 m
	15.5	**Generator-Motor**	
	a	Type	Three (3) phase, alternating current Asynchronous, generator motor semi umbrella type with vertical shaft
	b	Number of units	2 Units
	c	Rated Capacity	Generator – 126MW; Pump Input - 170MW
	15.6	**Generator Motor Transformer**	
	a	Type	Indoor, 1-Ph transformers with Off-Circuit tap changer (OCTC)
	b	Number of units	6 Units i.e. 3 Nos. per unit
	c	Rated Capacity of each unit	Single Phase 70 MVA
16		**420KV GIS**	**Gas Insulated Switchgear**
	a	Type of GIS	Indoor Type
	b	No. of GIS units	One No. with bus sectionaliser
	c	Location	Inside GIS Building above ground
	d	Scheme	Double Busbar Arrangement with bus sectionaliser
17		**POWER EVACUATION**	
	a	Voltage Level (KV)	400 kV
	b	No. of Transmission lines	One Double Circuit Transmission Line
	c	Terminating at	Central Pooling Substation (CPSS)
18		Estimated Project Cost (June 2019 Price level xxx)	
	a	Civil and other Works	3294.94 Cr
	b	E&M Works incl. transmission	2031.25 Cr
		Sub-Total	5326.19 Cr
	a	IDC & Others	639.14 Cr
	b	Total Project Cost	5965.33 Cr

Source: PR of Standalone Pumped storage component of Saundatti IREP

2.5 PROPOSED SCHEDULE FOR APPROVAL AND IMPLEMENTATION

Construction of Saundatti IREP including erection of six generating units is planned to be completed in period of three (3) years including Pre-construction works, creation of infrastructure facilities viz. additional investigations, improvement of road network and colonies.

Target Schedule

The Total Construction period is scheduled as follows.

Preconstruction Period : 6 months
Construction Period (Main Works) : 2.5 Years
Total Construction Period : 3 Years

2.6 TECHNOLOGY AND PROCESS DESCRIPTION

Pumped Hydroelectric Energy Storage (PHES), is a type of hydroelectric energy storage used by electric power systems for load balancing. This method stores energy in the form of gravitational potential energy of water, pumped from a lower elevation reservoir to a higher elevation. Low-cost surplus off-peak electric power is typically used to run the pumps. During periods of high electrical demand, the stored water is released through turbines to produce hydroelectric power. Although the losses of the pumping process make the plant a net consumer of energy, overall the system increases revenue by selling more electricity during periods of peak demand, when electricity prices are highest.

2.7 PROJECT DESCRIPTION

The Standalone Pumped Storage Component of Saundatti IREP envisages construction of:

- Upper Dam consists of Rockfill embankment of varying from 10m to 43m height for creation of upper reservoir and the existing Renuka Sagar Reservoir is the lower reservoir,
- Intake Structure,
- 5 Nos. of 173.50 m long and 6.0 dia. circular top inclined pressure shaft,
- 4 nos. each of 856m long (includes top vertical bend, Vertical Pressure Shaft of length 179.67 m, bottom vertical bend & bottom horizontal pressure shaft) and 6.0 m dia. circular steel lined pressure shaft to feed unit of 252 MW,
- 1 no. of 804m long (includes top vertical bend, Vertical Pressure Shaft of length 179.85 m, bottom vertical bend & bottom horizontal pressure shaft) and 6.0 m dia circular steel lined pressure shaft bifurcated into 2 penstocks of 4.25 m dia & 65.85 m length to feed 2 units each of 126 MW,
- A surface Power house having an installation of four nos. reversible Francis turbine each of 252 MW capacity operating under a rated head of 206.82 m in generation mode & 216.1 m in pumping mode and two nos. reversible Francis turbine each of 126 MW capacity (both units are variable speed turbines) operating under a rated head of 206.22 m in generating mode and 217.42 m in pumping mode,
- 4 Nos. of each 228 m long, 7.0 m dia. and 2 nos. of each 230 m long, 5.0 m dia. Tail Race Tunnels lead water from power house to outlet structure
- Outlet Structure with transition
- 45m wide and FSD of 6.0m Tail race channel 1749 m long connecting to the Existing Renuka Sagar reservoir.

The layout map of the Standalone pumped storage of Saundatti IRE project is given at **Figure 2.2.**

2.7.1 Renuka Sagar Reservoir (Existing)

The existing Renuka Sagar reservoir will be utilized as a lower reservoir to enable Pumped Storage Component of Saundatti IREP to operate as a peak station. The FRL & MDDL of existing Renuka Sagar reservoir is at EL 633.832m & EL 623.93 m respectively. The live storage capacity of existing reservoir is 29.34 TMC. Water will be pumped to the proposed upper reservoir through TRC.

The proposed upper reservoir is located at EL 820.00m and the FRL and MDDL of this reservoir is at EL 855.00m & 825.00m respectively. The live storage of the proposed reservoir is kept for 1.00 TMC. A tail race channel of approx. 1749m will discharge the flows in to existing Renuka Sagar reservoir after power generation.

Figure 2.2: Layout map for Standalone Pumped storage component of Saundatti Integrated Renewable Energy Project (IREP)

2.7.2 Infrastructure Facilities

This part outlines the preliminary planning of infrastructure facilities.

2.7.2.1 Approach to the Project

The project can be approached through various routes and modes of transportation like railways, airways and roadway.

Transportation by air

The nearest airport is at Belagavi which is about 60 kms from Karlakatti village.

Transportation by Railway

Project site is accessible by railway up to Dharwad railway station about 45kms from project site.

Transportation by road

The project site is 31 Km away from sub-district headquarter Saundatti and about 80km away from district headquarter Belagavi.

2.7.2.2 Land Requirement

For the development of Standalone Pumped Storage component of Saundatti IREP, land would be acquired for construction of project components, reservoir area, muck dumping, quarrying, construction camps and colony, etc. Based on the final project layout (**Figure 2.1**), land requirement has been finalized as **213.70 Ha** (**Table 2.2**).

Land would be required for locating the permanent works as well as for setting up the infrastructural and job facilities necessary for constructing the project in an expeditious and optimal manner. Of the total extent of area of land required, some areas would be acquired permanently while the balance can be obtained on lease from the owners for a definite time period and returned to them after the project is completed. In the latter case, it would be restored to its original condition as far as possible.

Diversion of Forest Land

For diversion of 160.40 ha of forest land, online application has been submitted to MoEF&CC vide proposal No.: FP/KA/HYD/37723/2018. The entire forest land falls in Karlakatti, Chakrageri and Kagihal Villages of Balgaum district.

Table 2.2: Land Requirement of Standalone Pumped Storage component of Saundatti IREP

S.No	Components	Forest Area (Ha)		Non-forest Area (Ha)		Total Area (Ha)
		Surface	Underground	Pvt.	Govt.	
1	Upper Reservoir	128.58	0.00	0.00	0.00	128.58
2	Penstock	5.79	0.00	0.00	0.00	5.79
3	Pressure Shaft	0.00	5.84	0.00	0.00	5.84
4	Power House, Switch Yard & Tail Race Outfall including Permanent access road to Power House	12.93	0.00	2.31	0.00	15.24
5	Adit to Pressure shaft	0.10	0.63	0.00	0.00	0.73
6	Approach Road to all other Project Components	6.53	0.00	0.62	0.00	7.15
7	Contractor facilities, Cement and	0.00	0.00	10.00	0.00	10.00

S.No	Components	Forest Area (Ha)		Non-forest Area (Ha)		Total Area (Ha)
		Surface	Underground	Pvt.	Govt.	
	E&M stores, Temporary Colony area					
8	Muck Disposal area (1 & 2)	0.00	0.00	10.00	0.00	10.00
9	Tail Race Channel	0.00	0.00	6.16	18.66	24.82
10	Magazine	0.00	0.00	0.25	0.00	0.25
11	Job Facility Yard & others	0.00	0.00	5.30	0.00	5.30
Total		**153.93**	**6.47**	**34.64**	**18.66**	**213.70**

Source: PR of Standalone Pumped storage component of Saundatti IREP

Acquisition of Private Land

As stated above the total private land for various construction activities is about **34.64 ha** (**Refer Table 2.2**). The private land required for the project is proposed to be purchased through a voluntary sale with a willing buyer and seller process. The process is undertaken through direct negotiations between land owners and Project Proponent with no obligation on the seller. The land owners are informed in advance and each land owner negotiated on the cost of land as part of land take.

The some of the steps in the land procurement process included the following:

- Identification of land required for the project and due diligence of land through verification of Revenue Records.
- Undertake consultation and negotiations with the land owners about the project and private land requirement.
- After negotiations on all aspects of purchase the voluntary sale of land is completed through a registered sale agreement.

2.7.3 Project Roads

It has been assessed that about 5.07 kms length of new road is required to be constructed to access the Dam Site from the Power House. The total land required for the construction of new road is 7.15 ha.

2.7.4 Temporary Colony, Contractor facilities, Job facility Yard & E&M Stores

In order to execute the project, it has been envisaged that proper infrastructure works are required as permanent and temporary staff residential buildings, administrative building, workshop, quality control laboratory etc. For the proposed project accommodation for residential and non-residential facilities will be spread over 10 ha of land near proposed Power House area.

2.7.5 Aggregate Processing Plants/Batching and Mixing Plant

Based on the construction planning, methodology & schedule the peak requirement of concrete and raw aggregates has been estimated to decide the plant capacities for Aggregate Processing (APP) and Batching & Mixing (BM). The capacities of aggregate processing and concrete batching & mixing plants are given in **Table 2.3**.

Table 2.3: Size and location of aggregate processing and batching plants

S.No.	Site	Nos.	Capacity
1	Aggregate Processing Plant (APP)	01	250 TPH
2	Batching & Mixing (BM) Plant	05	60/90 Cum/hr

Source: PR Standalone Pumped storage component of Saundatti IREP

2.7.6 Construction Material Requirement

For the construction of various project components approximately 943406 m^3 of coarse aggregate 445644 m^3 fine aggregate and 7094437 m^3 for Rockfill are required (**Table 2.4**)

As the proposed site is a hard-rocky terrain, excavated material from the project sites will also be used for the construction purpose. However, the required balance quantity, if any will be procured from nearby identified Quarry.

Table 2.4: Total requirement of Construction materials for the Project

Construction Material Requirement	Quantity	
Aggregates	943406	Cum
Sand	445644	Cum
Cement	2976196	Bags
Steel	23540	MT
Structure Steel	5068	MT
Steel Liners	29534	MT
Rockfill material	7094437	Cum
Soil / Clay	1471206	Cum

2.7.7 Muck Disposal Areas

The total quantity of muck generated from soil and rock excavation is about **7.21 Mcum.** About **5.33 Mcum** of excavated muck are expected to be utilized for Rockfill and aggregate for construction, it is also proposed to dispose 1.00 Mcum in the reservoir for filling of depression and leveling of the reservoir bed. Total quantity of muck proposed to be disposed in designated muck disposal area, after considering 40% swelling factor would be **1.64 Mcum (Table 2.5)**.

Table 2.5: Quantity of muck to be generated from different project construction activities and quantity required to be disposed off

S. no.	Description	As per revised layout	
		Quantity Details	Unit
1	Total quantum of muck generated from the project	7.21	Mcum
2	Total quantity of aggregate requirement	5.33	Mcum
3	Quantity of muck to be disposed	1.88	MCum
4	Swelling factor for loose muck	40.00	%
5	Total quantity of muck to be disposed	2.64	MCum
6	Muck Proposed to be disposal in Reservoir	1.00	MCum
7	Muck Proposed to be disposal in MD Areas	1.64	MCum

Net Quantity of Muck to be rehabilitated/disposed of is estimated as 1.64 Mcum (approx.). Keeping the above requirement and vicinity of the excavation sites, two muck disposal areas has been identified. Total area of these site is 10 ha.

2.7.8 Explosive Magazine

For the storage and handling of explosives required for the drilling and blasting operations, permanent and portable magazines will be constructed for which necessary approvals will be taken from the concerned authorities. All safety codes and regulations prescribed by the central and state government in this respect will be followed and magazines will be suitably guarded round the clock. It is proposed to install a 20 T magazine to cater to requirement

of project works. Location of explosive magazine has been proposed near Muck Dumping site along the proposed road connecting power house to Upper reservoir area. The explosive magazine complex has been planned to keep the distance traveled by the explosive van to the minimum.

As laid down in the Explosive Rules of 1983, a safe distance of 300m is required to be maintained from public roads, etc.

2.7.9 Construction Power

The requirement of peak construction power requirement of the project is 2.5 MW. Basic construction power for the project is to be arranged from by tapping 11 KV line.

In addition to grid power, the provision for DG sets has been made as standby arrangement in case of non-supply from grid.

- 1.0 MVA, 415V, 3 phase Diesel Generator Set
- 220 V, 400 AH (tentative) battery bank

2.7.10 Tele-Communication and Other Facilities

Presently, the project site (Power House) is connected with mobile networks from various service providers. In order to boost mobile connectivity, if required, one number of mobile network tower will be arranged nearby.

2.8 MITIGATION MEASURES INCORPORATED INTO THE PROJECT (AS REQUIRED BY THE SCOPE)

Pumped-storage hydroelectricity allows energy from intermittent sources (such as solar, wind) and other renewables, or excess electricity from continuous base-load sources (such as coal or nuclear) to be saved for periods of higher demand. The reservoirs used with pumped storage are quite small when compared to conventional hydroelectric dams of similar power capacity, and generating periods are often less than half a day. Along with energy management, pumped storage systems are also helpful in controlling electrical network frequency and provide reserve energy.

Many of the impacts of conventional hydropower projects, such as reduced flow in river and impact on natural fish habitats, are not there in standalone schemes, which are not on any river/stream. In addition, during the project design, land requirement has been assessed and optimized to ensure minimum R&R issues and forest land diversion.

2.9 ASSESSMENT OF NEW & UNTESTED TECHNOLOGY FOR THE RISK OF TECHNOLOGICAL FAILURE

Pump storage schemes are based on tested technology and there is no risk of technology failure in this project.

Chapter 3 DESCRIPTION OF ENVIRONMENT

Environmental Impact Assessment define and assess the potential physical, biological and socio-economic impact of the proposed project in a manner that allows for a logical and rational decision to be made about the proposed action. This chapter covers the baseline status of physical and biological environment in the study area of proposed Standalone Pumped Storage Component of Saundatti IRE Project covering the description of study area, study period, methodology of baseline data collection leading to establishment of baseline for valued environmental components, as identified in the scope.

The baseline data presented in this chapter has been prepared from primary data collected during field studies which was then supplemented with data/information gathered during interaction with concerned persons of various government departments and available literature and reports published by various institutions and organizations.

3.1 STUDY AREA, PERIOD, COMPONENTS & METHODOLOGY

3.1.1 Study Area

Study area for environmental study has been delineated as project area or the direct impact area within 10 kms radius of the main project components like, Pump house, Power House, Dam, Reservoirs and approach roads, etc.

A map of the study area prepared based on the above criteria is given at **Figure 3.1**.

3.1.2 Study Period

The field surveys for the collection of primary data commenced from January 2018 and completed in August 2018 covering winter, pre-monsoon/summer and monsoon to collect data/ information on terrestrial ecology and physical environment parameters. In addition, surveys and studies were also conducted for understanding surface and ground water quality in the study area. The details of sampling are given in **Table 3.1**.

Field surveys in the study area were also conducted for the purpose of ground truthing and augmenting the remote sensing data. For this purpose, various attributes such as land features, rivers, forests and vegetation types were recorded on the ground.

Table 3.1: Sampling schedule for various Environmental Parameters

Parameters	Winter	Pre-Monsoon/Summer	Monsoon
Vegetation sampling	January 2018	May 2018	August 2018
Faunal surveys	January 2018	May 2018	August 2018
Water Quality	January 2018	May 2018	August 2018
Air Environment	January 2018	May 2018	-
Noise & Traffic	January 2018	May 2018	August 2018
Soil sampling	July 2018		
Socio-Economic	July 2018		

In addition, as recommended by EAC during its meeting held on October 31, 2019; the field surveys were carried out for the collection of additional one season data in the study area during December 2019 covering data/ information on physical and biological environment parameters. Additional data collected is discussed at section 3.2.5 and data comparison is provided at section 3.2.6.

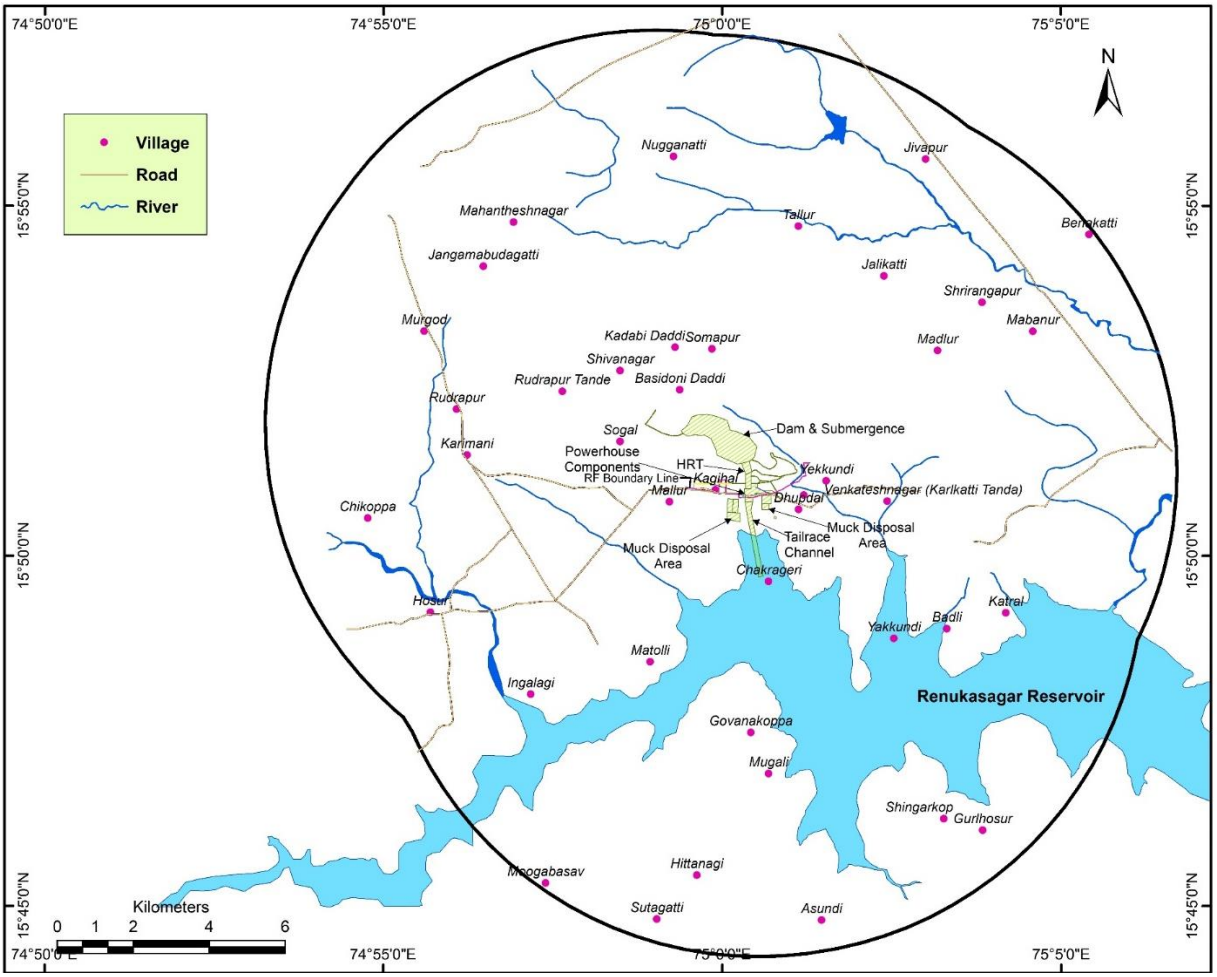


Figure 3.1: Study Area delineated as per approved TOR of Standalone Pumped storage component of Saundatti IRE Project

3.1.3 Components and Methodology

Baseline data on environmental parameters was collected at two levels – primary and secondary. Primary data generated from sampling done during field surveys for physical and chemical attributes of soil, surface as well as ground water quality, ambient air quality, noise and traffic and also sampling and surveys for collection of data on floral and faunal elements covering terrestrial as well as aquatic environment. In addition to primary surveys, substantial secondary data was also collected through interaction with various state and project officials. Sources and data so collected have been mentioned below:

- "A Revised Survey of the Forest Types of India" by Champion and Seth (1968) was used for forest type classification of forests in the study area.
- Office of Divisional Forest Officer, Gokak Forest Division: Forest Working Plan.
- National Ambient Air Quality Series: NAAQMS/36/2012-13, Guidelines for the measurement of Ambient Air Pollutants
- Water Quality Criteria of Central Pollution Control Board (http://www.cpcb.nic.in/Water Qualitycriteria.php)

- Census of India 2011: Demography of the study area
- Meteorological Data: Indian Meteorological Data (IMD) and https://www.worldweatheronline.com
- For the generation of FCC, Landsat 8 data was used
- Soil map of the study area was prepared using Soil Map prepared by Atlas of Karnataka by National Bureau of Soil Survey & Land Use Planning (NBSS & LUP).
- Consultation with villagers and panchayat head to gather information on the basic infrastructural facilities in their concerning villages.

3.2 ESTABLISHMENT OF BASELINE FOR VALUED ENVIRONMENTAL COMPONENTS

3.2.1 Physical Environment

The description of physical environment deals with physiography, meteorology, soil characteristics, air & noise monitoring, water quality both surface as well as ground water.

3.2.1.1 Physiography

Physiography describes the landscape and terrain of the study area. To understand this, relief and slope maps of study area were generated. For this Digital Elevation Model of Advanced Space borne Thermal Emission and Reflection Radiometer (ASTER) Global Digital Elevation Model (GDEM) data was downloaded from https://earthexplorer.usgs.gov/ downloaded in GeoTIFF format and was used for the preparation of relief and slope maps. Digital Terrain Model (DTM) of the study area thus prepared is shown below in **Figure 3.2**.

The study area of the proposed project is comprised of moderately sloping, exposed rocks, and scrub vegetation. Elevation in the study area ranges from El. 550 to 850 m above MSL. The denudation landforms are visible in the form of scree slope, scarps ridges valleys, etc.

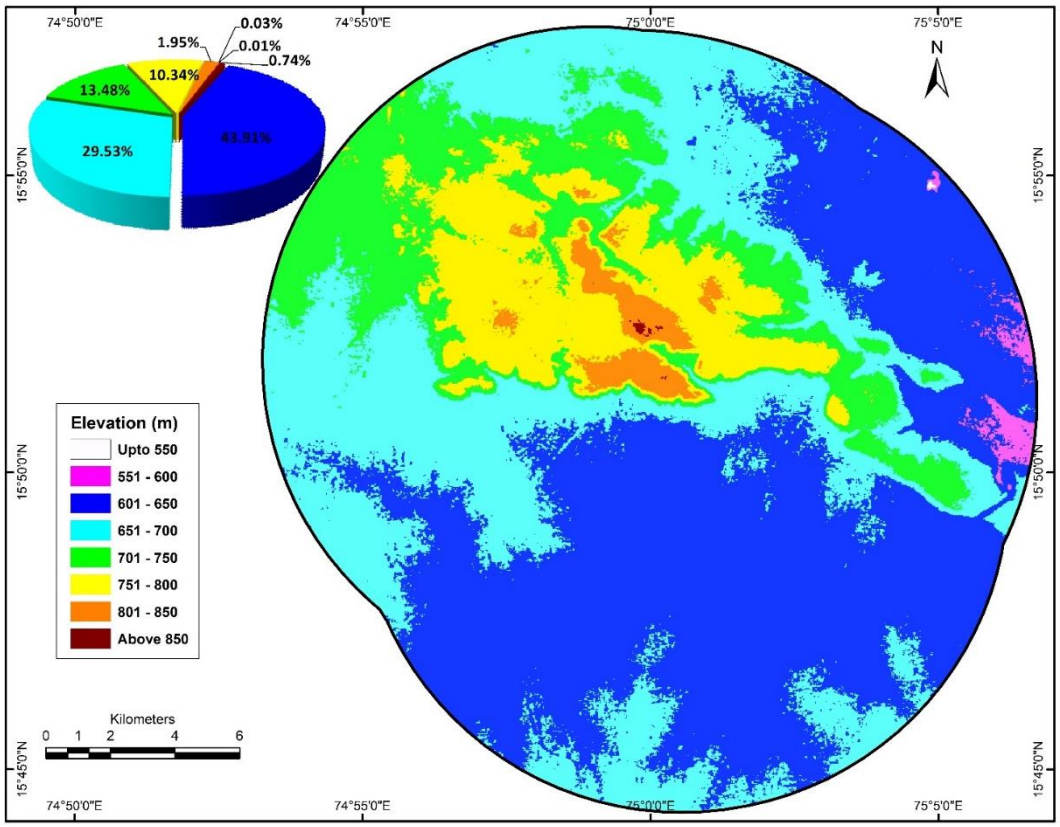


Figure 3.2: Digital Terrain Model (DTM) of the study area generated from ASTER GDEM data

The slope map of the study area is given at **Figure 3.3** and the area falling under various slope categories (as per SLUSI) has been tabulated below in **Table 3.2**. As seen from the map and table nearly 63.54 % of the study area is under moderately sloping followed by the area under Gently Sloping category with 21.57% of the total area (**Table 3.2**).

Table 3.2: Areas falling under different slope categories in the study area

Slope Categories (Degrees)	Area (ha)	Area (%)
Gently Sloping (Up to 2)	9428.40	21.57
Moderately Sloping (2- 8)	27778.88	63.54
Strongly Sloping (8 - 15)	5116.88	11.70
Moderately Steep (2- 8)	1318.35	3.02
Steep (Above 30)	76.33	0.17
Total	**43718.84**	**100.00**

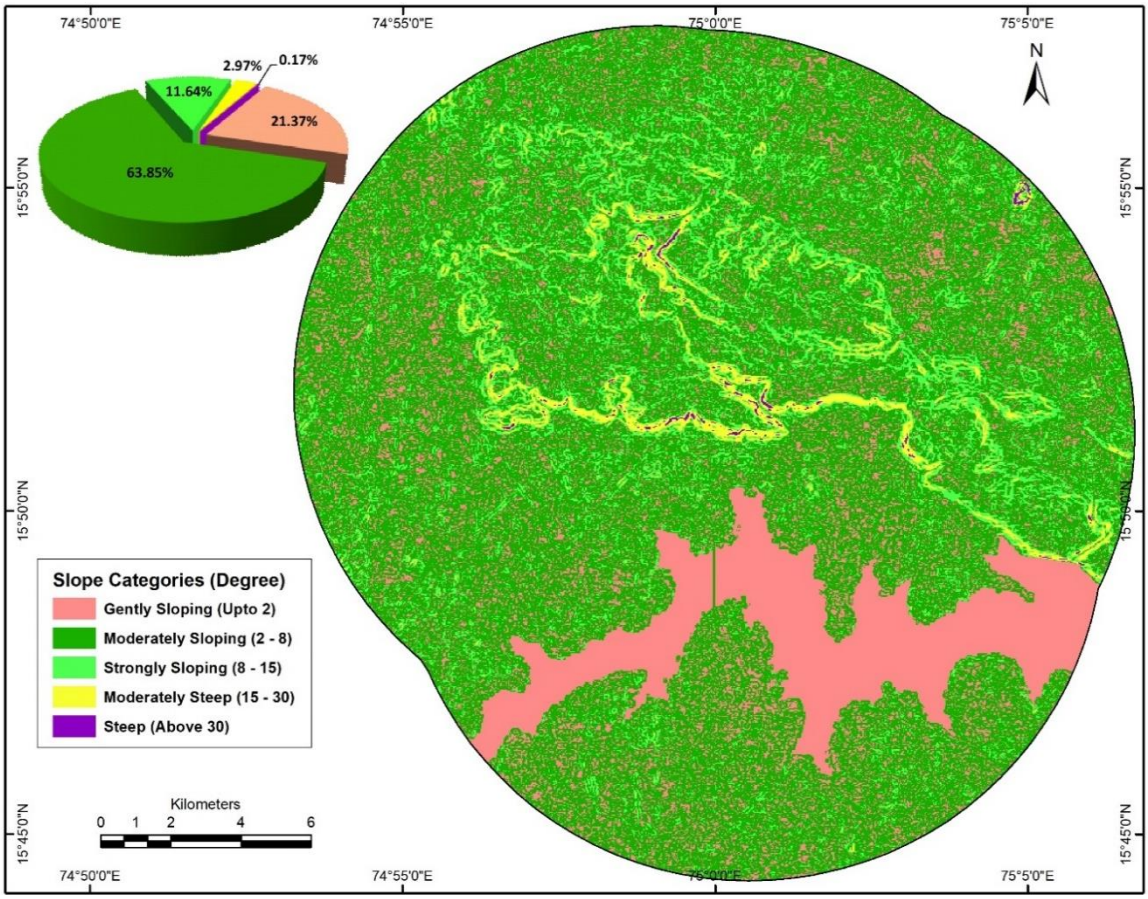


Figure 3.3: Slope map of the study area generated from DEM

3.2.1.2 Geology

I. Regional Geology

Karnataka forming a part of the Indian Shield is constituted of rock formations ranging in age from 3300 m.y. to 5 m.y. Barring a narrow coastal strip of about 5000 sq.km of Tertiary and Quaternary sediments and another 31,250 sq.km of Deccan basalts, the remaining area is dominated by Archaean-Proterozoic rocks. Mysore Plateau geologically constituted of Dharwar Craton comprises of greenstone-granite belts, gneisses and granulites.

The crescent shaped Cuddapah Basin (1600 Ma) covers a good part of the gneissic terrain to the east, and the northern extensions of the cratonic block are hidden beneath the cover of Deccan Traps of Mesozoic - Tertiary age. The north-eastern margin of the Dharwar craton is limited by the Godavari graben, a structural element active since Proterozoic.

Lithological variations, differences in volcano - sedimentary environments, magmatism and grade of metamorphism have prompted the division of the Dharwar Craton into a western block characterized by larger schist belts (Dharwar Type) showing evidences of having accumulated in distinct sedimentary basins and an eastern block characterized by reworked and remobilized gneiss with remnants and slivers of schist belts (Kolar Type) which are auriferous and developed in an oceanic environment. The N-S trending Closepet granite demarcates the boundary between the eastern and western block.

Dharwar Craton, a Precambrian greenstone-granite terrain, is the rigorously studied area of the Indian Shield. This shield predominantly comprises the Archaean greenstone belts, gneisses, granites, and dyke swarms. Epicratonic or intracratonic undeformed sedimentary basins called Purana Basins (Kaladgi & Bhima) occupy the northern segment of the craton whose northern part in turn is concealed by Deccan basalts. Thus younging of lithosequence from south to north is evident. These Proterozoic sedimentary basins rest over the shield (Pichamuthu and Srinivasan, 1983; 1984; Radhakrishna and Naqvi, 1986) and are exposed near the junction of Dharwar Craton and Deccan Traps.

Litho-stratigraphy of the Saundatti Pump Storage Project area:

Age	Super group	Group	Subgroup	Formation	Member	Lithology
Pliestocene to recent						Colluvial / talus material
Proterozoic	Kala dgi	Bgalkot	Lokapur	Ramdurg	Saundatti quartzite	Quartzite with thin layers/bands of conglonerate
A nniihr i iby /						
/■ Miyuidi ui ICUI n uniiiiy						
Late Archaean 3000 ma	Dhar war	Peninsular Geniss				Granitoids, Gneisses

II. Physiography of the Project Area

North Karnataka is a geographical region consisting of mostly semi-arid plateau from 300 to 730 metres elevation that constitutes the northern part of the Karnataka state in India. It is drained by the Krishan River and its tributaries the Bhima, Ghataprabha, Malaprabha, and Tungabhadra. North Karnataka lies within the Deccan thorn scrub forests ecoregion, which extends north into eastern Maharashtra. The area of present investigation is located at about 45 km ENE of Belgam, 15km northeast of Bailhongal, 10km west of Monali, 15km northwest of Saundatti and 12km southwest of Yaragatti in Belgam district of north Karnataka. Though the region is semi-arid, part of Belgaum district receives enough rainfall to make them lush and green throughout the year. Belgaum district is quite big and though the north parts of

the district are arid and receive less rainfall, the southern parts which are adjacent to North Canara district, have an almost highland tropical climate.

The project area and its surroundings may be broadly subdivided into three geomorphic units, viz., the low lying near flat area extensively irrigated and cultivated; gently sloping plateaus and isolated near flat areas occurring as inliers surrounded by plateaus. The low lying near flat areas varying in elevation between 600m and 640m, characterized by dark tone & extensive cultivation in Google Earth map occur to the south, southeast and northwest of the proposed surface Power house located to the northwest of Karlakatti.

Yekundi villages. Similarly, a large near flat, low lying area extends between Yargatti and Manoli which extends towards katkol and Torgal villages**.** Towards east and northeast of Manoli several isolated small plateaus forming mesa structures are also noticed within flat areas, suggesting detachment from the adjacent main plateaus.

The project area is located on left bank of Mallaprabha River, and to the north of Renuka Sagar reservoir. On either side of the proposed surface powerhouse the low lying near flat area extend for kilometers, and is extensively irrigated & cultivated **(refer Figure 3.4b).**

Figure 3.4: Plateau flanked by a 50- 150m wide pediment zone merging with low lying flat area extending for kms. Photographs taken from the plateau located to the north of proposed Powerhouse

IV.

Invariably a well-defined pediment zone having gentle to moderate slopes, varying in width from 50 - 150m occurs in between near flat, low lying areas and plateaus. It has resulted by the merging of tutus/debris fans resulted by the mechanical weathering of adjacent near vertical cliffs **(refer Figure 3.4).** The pediment zones support growth of shrubs and scanty bushes.

The ephemeral streamlets draining shows throughout near parallel to sub-parallel drainage pattern. In the project and its surrounding areas thin landform occur to the north of the proposed Power House, Karlakatti, northwest & south of Manoli, between Katkol and Ramdurg and extend for considerable distance **(Figure 3.5).** The elevation of these plateaus ranges from 760m to 840m, and are flanked by near vertical cliffs exposing quartzite **(Figures 3.6a & 3.6b).** The plateau occurring to the north of the power house extends from SE to NW direction for considerable distance.

Figure 3.5: Plateau hills present to the east of the project area

VII.

Figure 3.6: Vertical scarps exposing gently dipping quartzite adjacent to plateau surface

IX. General Geological Setup of the Project Area

Detailed geological mapping (1:1000 scale) of the project area located to the northwest of Yekundi/Karlakatti suggests that the proposed layout spreads across the southern margin of the Kaladgi basin into the northern margin of Western Dharwad Craton**.** The sedimentary litho-assemblage constituting a part of the Proterozoic Kaladgi basin is represented by quartzite exposed along the near vertical cliffs **(Figures 3.7a & 3.7b)** and capping the residual hills having near flat to gently dipping plateau surface extending on either side for considerable distances. Adjacent low lying & near flat terrain covered in general with top soil underlain by in situ weathered profile developed over the Peninsular Gneiss represents northern margin of Western Dharwar Craton (WDC).

The quartzite exposed in the project area extends towards NW & SE direction, and its continuity can be traced up to Saundatti **(refer Figure 3.6)** thus corelatable with Saundatti Qurtzite of the Ramdurg Formation comprising lower part of the Lokapur Subgroup (Jaya Prakash et al., 1987; Kale et al. 1996). A conglomerate horizon (4 - 15m thick) with a few intercalated sandstone beds has been reported at the basal part of the Saundatti Quartzite.

Figure 3.7a & b. Vertical cliff exposing quartzite (a) and quartzite exposed along steep slopes & capping gently sloping plateau

Figure 3.8: Contact between quartzite and underlying Peninsular Gneiss covered under Pediment zone comprising debris & talus material

In a few quarry sections located in the surrounding areas of the proposed project layout well developed in situ weathered profile giving rise to cherry red to ash grey soil was noticed occurring below the overlying quartzite outcrops. The thickness of in situ soil varies from a couple of meters to more than 5 - 6m **(Figure 3.9).**

During detailed geological mapping the contact between quartzite and underlying fresh, hard & compact, coarse grained granite was noticed at about 1.6km NW and 2.5km NNW of the proposed surface Powerhouse location. The contact located to the northwest of Powerhouse location at EL. 705.65m is sharp in nature with near parallel strike of foliation and overlying bedding planes **(Figure 3.10).**

Quartzite is highly fractured in nature whereas the underlying granite gneiss is moderately fractured. Bedding planes noticed in overlying quartzite exhibit variation in dip from 26 -37° and foliation planes in the underlying granite gneiss have higher dip (50°) thus suggesting presence of angular unconformity.

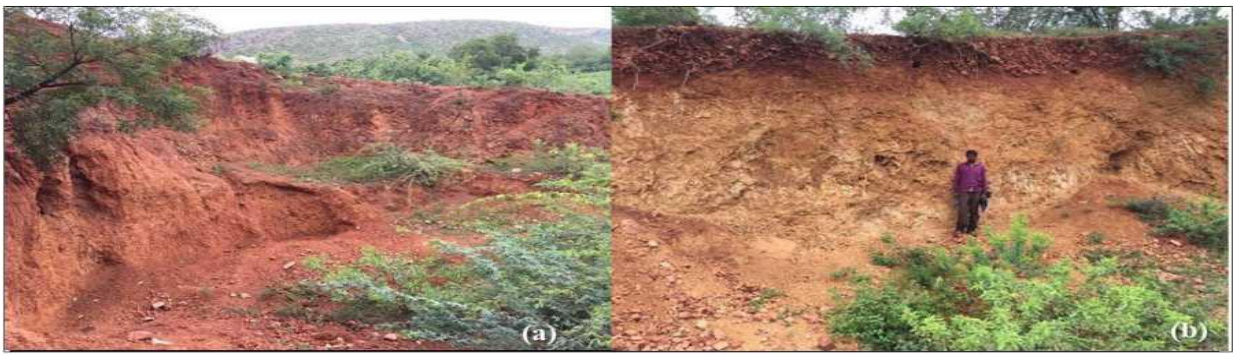


Figure 3.9: Highy weathered in situ profile developed over granite noticed in a few quarry sections

Figure 3.10: Sharp contact between fresh, hard granite and overlying fractured quartzite. Loc: 1.6km northwest of prposed Powerhouse location

Figure 3.11: Upright, open folds developed in interbedded sequence of sandstone-shale occurring over the moderately weathered granite

Based on the detailed geological mapping (1:1000 scale) and order of superimposition of the litho-units, general litho-stratigraphy of the project area has been established and correlated with the regional stratigraphy (after Jayaprakash et al., 1987) and given below.

Lithostratigraphy of the Saundatti Pump Storage Project area

Age	Super group	Group	Subgroup	Formation	Member	Lithology
Pliestocene to recent						Colluvial / talus material
Proterozoic	Kala dgi	Bgalkot	Lokapur	Ramdurg	Saundatti quartzite	Quartzite with thin layers/bands of conglomerate
==========		Un - Conformity				==========
Late Archaean 3000 ma	Dhar war	Peninsular Geniss				Granitoids, Gneisses

X. Upper Reservoir Area

A plateau surface having substantial extents was identified to the north-west of Karlakatti village. The maximum elevation within the plateau surface has been recorded as EL. 845m towards the south eastern part of the reservoir which gradually decreases to EL. 820m towards its north-western margin. The southeastern margin of the proposed upper reservoir is located between El 805 to 845m which will be occupying about 2176 Sq. KM area for reservoir capacity of 1.03 TMC water, It is having about 1.90km from the nearest margin of Renuka Sagar reservoir which will serve the purpose of lower reservoir.

Detailed geological mapping (1:1000 scale) with total station and reflector targets, the reservoir and its surrounding areas was carried out over 7.50 Sq. Km area to delineate rock outcrops, litho-contacts, attitude of discontinuities & to record geotechnical parameters of the rock mass, and also delineate overburden and record its geotechnical characteristics.

Figure 3.12: Near flat area (a) towards northern part of the reservoir and gently sloping surface (b)

The top layer/venier of overburden comprises of rock fragments and interspaces occupied by admixture of light brown clay-silt - sand. In the surveyed areas, the thickness of overburden varies from 0.50m to +3.0m, at places above quartzite which is hard and massive and pinkish to whitish in colour and having colour bending structures due to mineral composition which is reflecting of bedding direction of deposition.

The overburden material is comprised with fragments quartzites and admixture of gravel, sand, silt & soil are in equal proportion, whereas the finer fraction is more than 90 volume percent in some areas **(Figure 3.13a & 3.13b).**

Figure 3.13: Quartzite outcrops exposed on plateau surface where upper reservoir is proposed

Figure 3.14: Thin scree material over the bed rock (a) & rock blocks/boulders of quartzite occurring at the top

In general, on surface quartzite is having light yellow to pink-brown staining but fresh outcrops having light grey to white colours are observed at many locations. Bedding planes (So) could be identified by colour laminations and variation in grain size **(Figure 3.14),** however, at places differential weathering has given rise to alternate groove & ridge structure representing bedding structure resulted possibly due to variation in mineral assemblage or grain size.

Figure 3.15: Bedding planes in quartzite represented by colour laminations and variation in grain size

Thickness of quartzite in the upper reservoir area has been estimated to be varying from 95m to 110m, based on the geomorphic expressions, presence of sparsely exposed & highly weathered granite outcrops along the pediment zone extending along the cliffs, and the contact of quartzite with underlying granite in the surrounding areas.

XI. Intake & Penstock Area

The proposed intake area for housing 5 intakes structures of 23.50m (W) x 7.50 m (H) and Penstocks of 155 x 5m plus 109 x 5 and a are planned along vertical to sub vertical extend of quartzite as shown (Fig. 3.17). The exposed rock mass are exhibits thin to moderately thick bedded nature **(Figure 3.16)**, and shows variation in mineral constituents and texture from basal part to top. Above the older granitoids (=Peninsular Gneiss) hard, compact & moderately thick bedded quartzite is exposed and is composed of fine to medium grained quartz embedded in fine grained siliceous matrix suggesting arenite composition of the parent rock. At places feldspar grains could be deciphered occurring as accessory minerals **(Figure 3.17**).

Figure 3.16: Moderately thick bedded quartzite (a) and thin bedded quartzite underlain by moderately thick bedded quartzite

XIII.

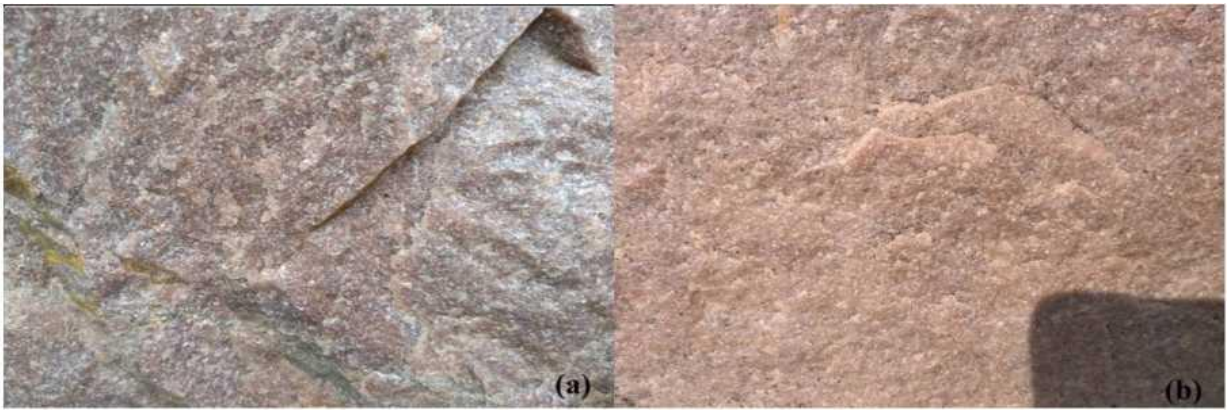


Figure 3.17: Medium to fine grained quartzite of arenite composition (a) and quartzite with feldspar as accessory mineral

XV.

Along the dip direction in the middle portion moderately thick quartzite is overlain with sharp contact by medium to coarse grained, hard & compact, light to dark grey to brownish pink, gritty quartzite of high strength. Grity clasts composed of quartz, feldspar & mafic minerals are embedded in siliceous to arkoses groundmass. The thickness of grity quartzite varies from a couple of meters to 20m.

XVI. Power House Complex & TRC

A surface pit power house of L 196.50m x B 24.00 m x H 51.10 m including service way and unloading way, has been planned near the vertical cliff forming the southern margin of the plateau over which upper reservoir has been proposed is flanked by a pediment zone having gentle to moderate slopes and varying in width from 100m to 150m **(refer Figures. 3.7, 3.8).** It has resulted by the merging of tutus/debris fans resulted by the mechanical weathering of adjacent near vertical cliffs and extends from cliffs to near flat, low lying areas. The thickness of overburden spread over the pediment zone is estimated to vary from a couple of meters to +10m, and it comprises predominantly of an aggregate of angular fragments of quartzite of different shape & size and inter-fragment spaces filled up with brown admixture of silt, sand and clay **(Figure 3.18).** The volume percent of different fractions varies from place to place, however, it is expected that adjacent to the cliffs large rock blocks will constitute the overburden.

Figure 3.18: Nature of overburden in pediment zone extending between cliff and low lying flat area near to Proposed Power House area

Figure 3.19: Highy weathered granite outcrops surrounded by debris / talus noticed along the pediment zone flanking the plateau margin

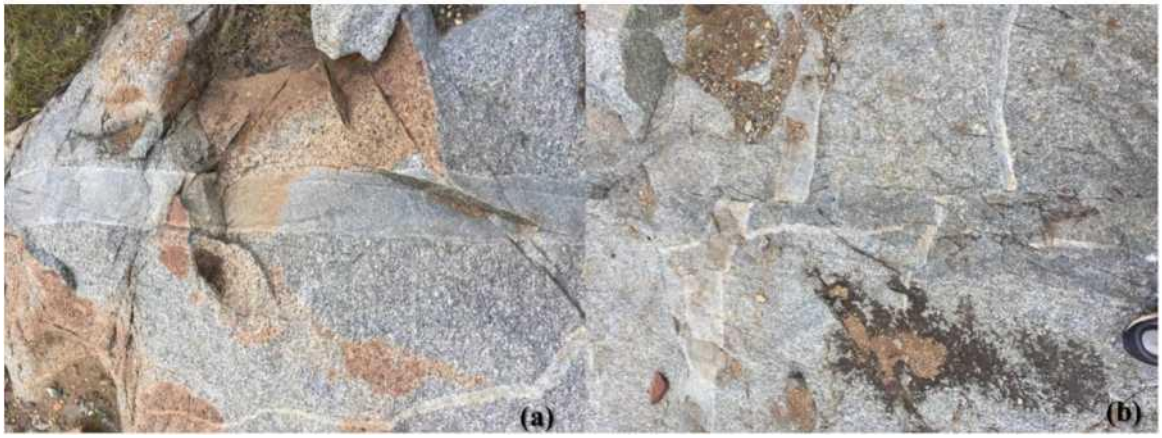


Figure 3.20: Fresh granite rock may intercept in Power house area after crossing of weathered granite profile.

XIX.

A 1749m long Trapezoidal Unlined TRC will be made through 5 -12 m thick overburden of weathered granite rock profile and humas agriculture soil which has categorized as beyond the pediment zone and slightly to fresh granite which exposers are visible all along the low lying near flat area extending up to the lower reservoir (Renuka Sagar reservoir) thin veneer of reddish brown admixture of sand-silt-clay in increasing order of abundance with sparsely distributed rock fragments if variable shape & size will be underlain by 20m - 30m thick in-situ weathered profile. The thickness of weathered zone will decrease gradually towards lower reservoir where coarse grained, grey, fresh, hard and compact granite of very high strength is exposed **(Figure 3.20).** The granites are characterized by strong preferred orientation of feldspar laths defining foliation planes (Si) and composed of quartz, feldspar and amphiboles in decreasing order of abundance. A number of aplite and pegmatite veins have been noticed criss crossing the granite and emplaced along widely spaced discontinuities **(refer Figure 3.20).**

Main Geotechnical discontinuity data have been recorded and their geotechnical parameters given in following table.

Joint set	Average Orientation	Aperture (mm)	Spacing (cm)	Persistence (m)	Joint Condition
Sla	271775°	Tight to open	20-100	10-15	Rough, Planar
Sib	020756°	Tight to open	20-100	10-15	Rough, Planar
S2	301785°	Tight to open	40-100	8-10	Smooth, Planar

S3	075749°	Tight to open	60-120	6-10	Rough, smooth, Planar
S4	198766°	Tight to open	60-120	1-3	Smooth, Planar

3.2.1.3 Meteorology

The study area of the proposed project lies in Belagavi district, located east of the Western Ghats and is situated in the northwestern part of Karnataka state. The area lies in the tropical climate zone and can be termed as semi-arid. The climate in the area is governed mainly by southwest monsoon and the year can be divided into three seasons; (i) Monsoon (mid-June to mid-October), (ii) Winter (mid-October to February) and (iii) Summer season (March to mid-June). The meteorological data for Belagavi district was downloaded from online weather portal https://www.weatheronline.in/. Monthly data for the years 2013-2017 is given in the **Annexure-IV**.

a. Temperature

The temperature of the study area recorded monthly data for the five years from 2013 to 2017. The average maximum temperature of 41.0˚C was recorded during the month of April and average minimum temperature of 17˚C during the month of December & January (reference year 2013-17). The monthly variation of average maximum and minimum temperatures is shown in **Figure 3.21**.

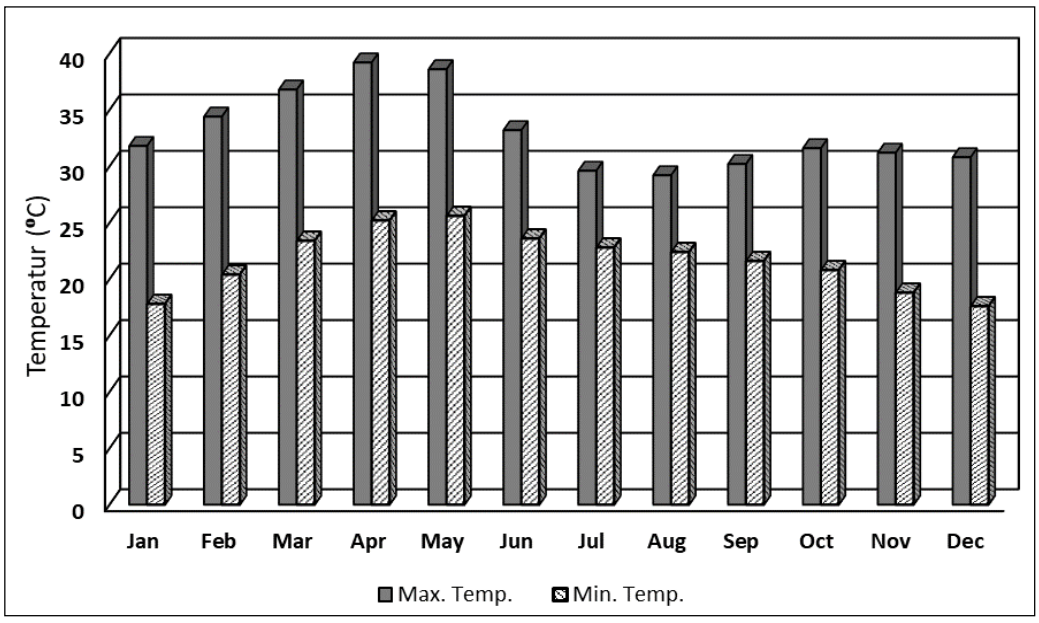


Figure 3.21: Monthly Average (2009-2017) Max. and Min. Temperature (District Belagavi)

b. Rainfall

The annual average rainfall of Belagavi district was recorded as 768 mm (based on data for a period of 2013-2017). Maximum Rainfall in the area was recorded during 2013 with annual rainfall of 789.73 mm and 162 rainy days. Minimum annual rainfall was recorded during 2015 with annual average of 658.37mm (**Annexure-IV**). The area receives maximum rainfall during south west monsoon i.e. between June and October, where about 87.0% of the annual average rainfall is received (**Figure 3.22**).

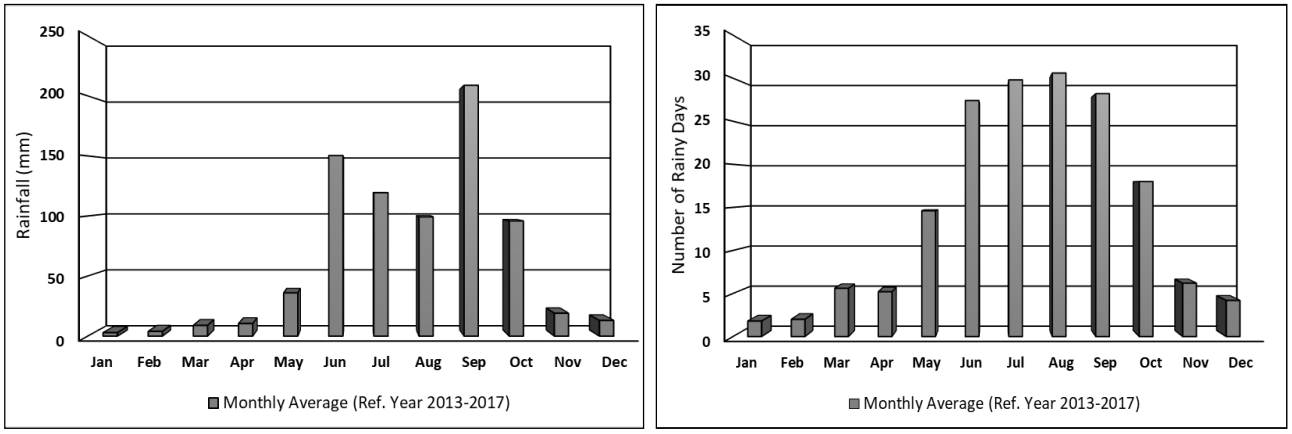


Figure 3.22: Monthly Average Rainfall and Number of Rainy Days (Distt- Belagavi)

c. *Relative Humidity*

The Relative Humidity is generally high throughout the year, average relative humidity is close to 79% during September. Relative humidity is lowest during summer period between February to March ranges from 34 to 37% (reference year 2013-2017). Average monthly variation in relative humidity is given at **Figure 3.23** and **Annexure-IV**.

d. Wind Speed

The wind speed is higher during the March to September as compared to the post monsoon and winter period. The average maximum wind speed of 29.2 Kmph is observed during the month of June. Monthly variation in wind speed during reference years 2013-17 is given at **Figure 3.24 and Annexure-IV**.

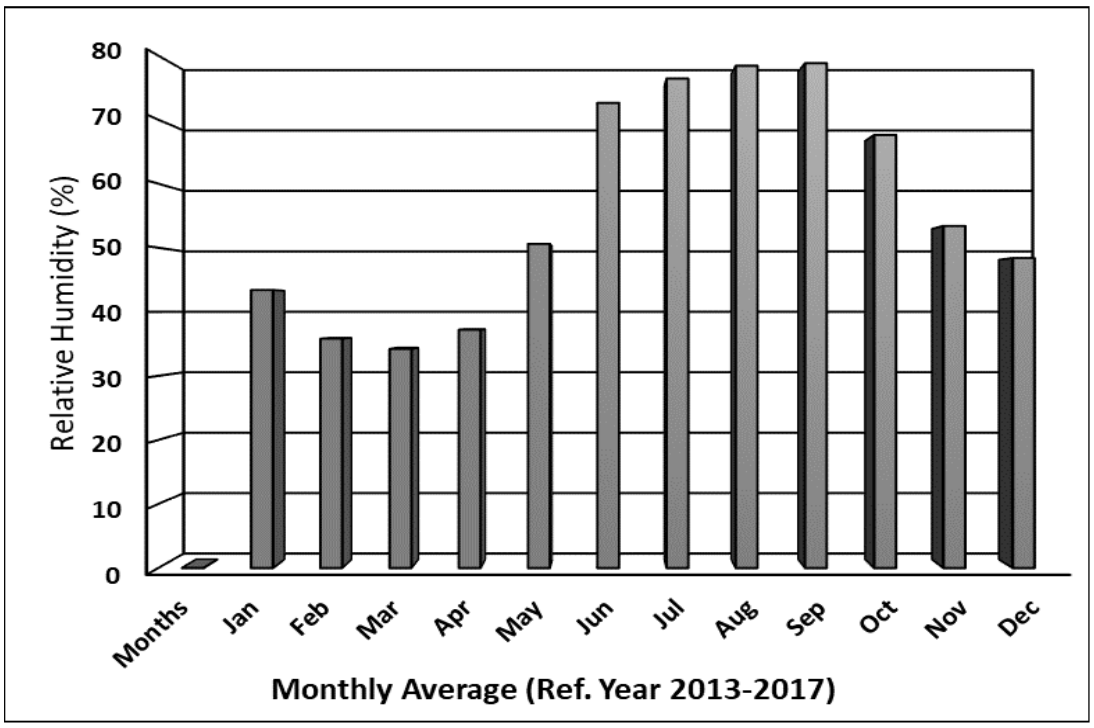


Figure 3.23: Monthly Variation in Average Relative Humidity, District- Belagavi

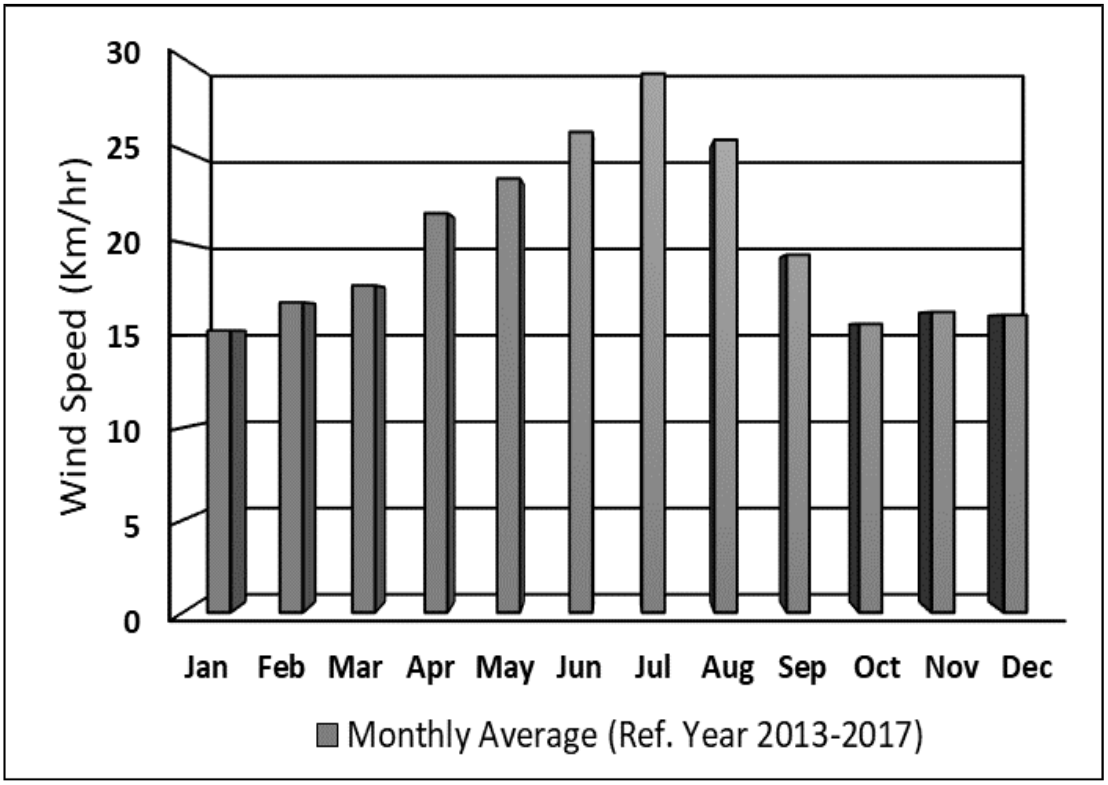


Figure 3.24: Monthly Variations in Wind Speed (2013-17) Distt. Belagavi

3.2.1.4 Soil

The soil taxonomic (family) classification map for study area of Standalone Pumped storage component of Saundatti IRE project was prepared as per the Soil Atlas of Karnataka State procured from National Bureau of Soil Survey & Land Use Planning (NBSS & LUP). Soil resource map of the study area was prepared and the area under each soil taxonomic class was calculated using GIS.

To assess the nutrient and fertility status of the soil in the study area the samples were collected from six different locations given in **Table 3.3 and Figure 3.25**. The sampling for soil was carried out at locations where major components of the projects are planned. Soil samples were collected with help of *khurpi* from a depth of 20-30 cm (deep soil) and from surface (top soil) after removing they were brought to laboratory for physico-chemical analysis. The soil analysis was carried out at the Apex Testing and Research Laboratory (NABL accredited Lab.), New Delhi.

Table 3.3: Description of Soil sampling location in the Study Area

S. No.	Site code	Sampling Location	Site Description
1	S1	Karlakatti village	Agriculture field
2	S2	Chakrageri village	Agriculture field
3	S3	Proposed Reservoir Area	Forest Area
4	S4	Basidoni Daddi	Agriculture field
5	S5	Sogal Village	Scrub/ fallow land
6	S6	Mallur Village	Agriculture field

The following parameters were analyzed for soil quality.

Physico-chemical parameters included:

- Bulk density (gm/cc)
- Water holding capacity (%w/w)
- Porosity (%)
- Soil texture
- Electrical conductivity (µmho/cm)
- pH
- Organic matter (%)
- Available Nitrogen as N (kg/ha)
- Available Phosphorus as P (kg/ha)
- Available Potassium as K (kg/ha)
- Magnesium as Mg (mg/kg)
- Chloride as Cl (mg/kg)
- Sodium as Na (mg/kg)
- Calcium as Ca (mg/kg)
- Total Alkalinity (mg/L)
- SAR (Sodium Adsorption Ratio)
- Salinity (ppt)

Soil Type in the Study Area

The description of soil type in study area is based upon the soil map of the study area prepared using the Soil Map prepared by Atlas of Karnataka by National Bureau of Soil Survey & Land Use Planning (NBSS & LUP). The majority of project study area i.e. more than 45.67% of soil is characterized under Vertisols type followed by Entisols soil (32.66%), while 16.73% of total study area is under water bodies (**see Table 3.4 & Figure 3.26**).

Table 3.4: Description and Area under different Classes

Soil Type	Area (ha)	(%)
Entisols	14665.40	32.66
Inceptisols	2217.98	4.94
Vertisols	20505.90	45.67
Waterbody	7512.72	16.73
	44902.00	**100.00**

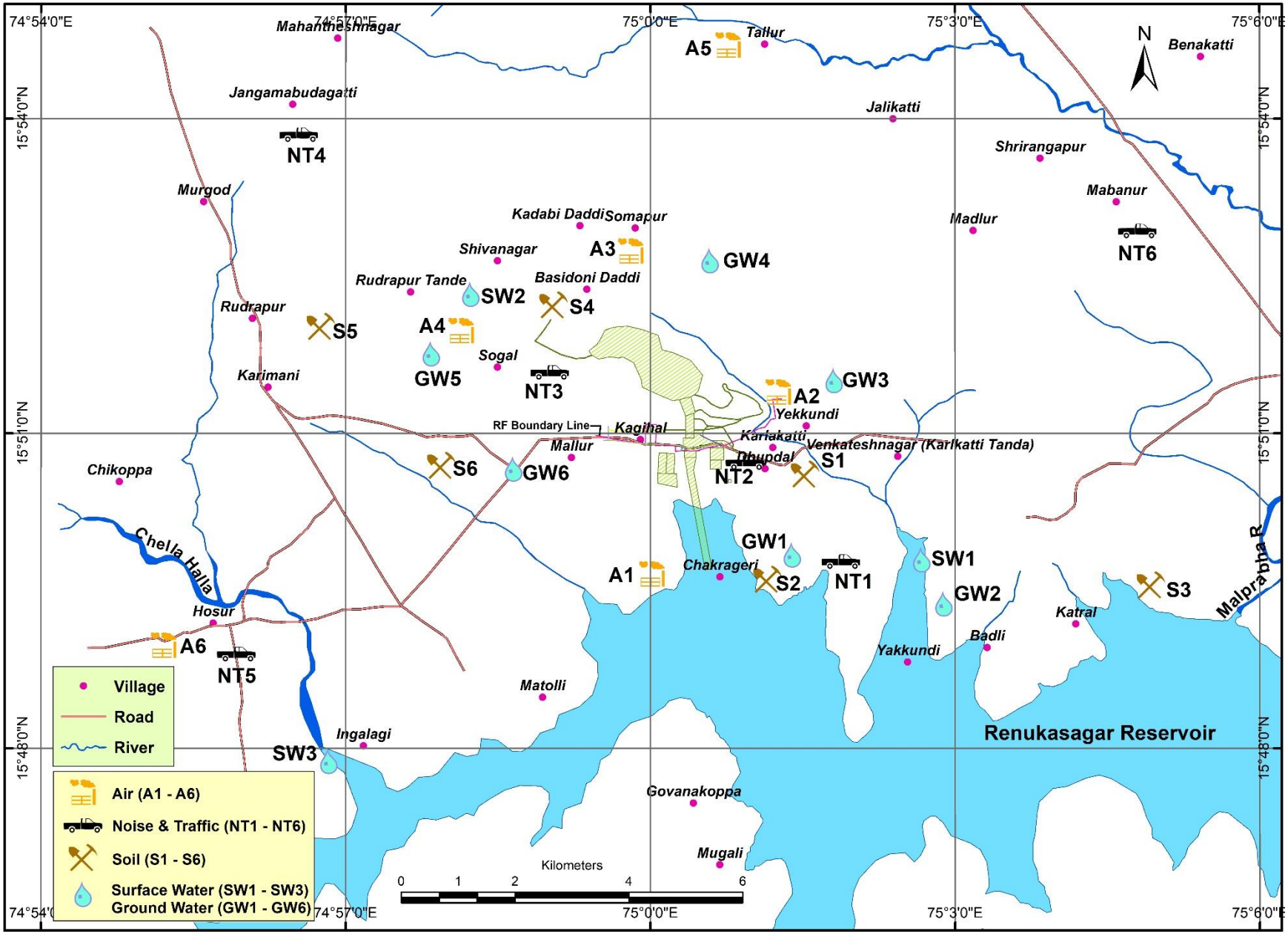


Figure 3.25: Map showing locations for collection of soil samples, air and noise monitoring and collection of surface and ground water samples in the study area

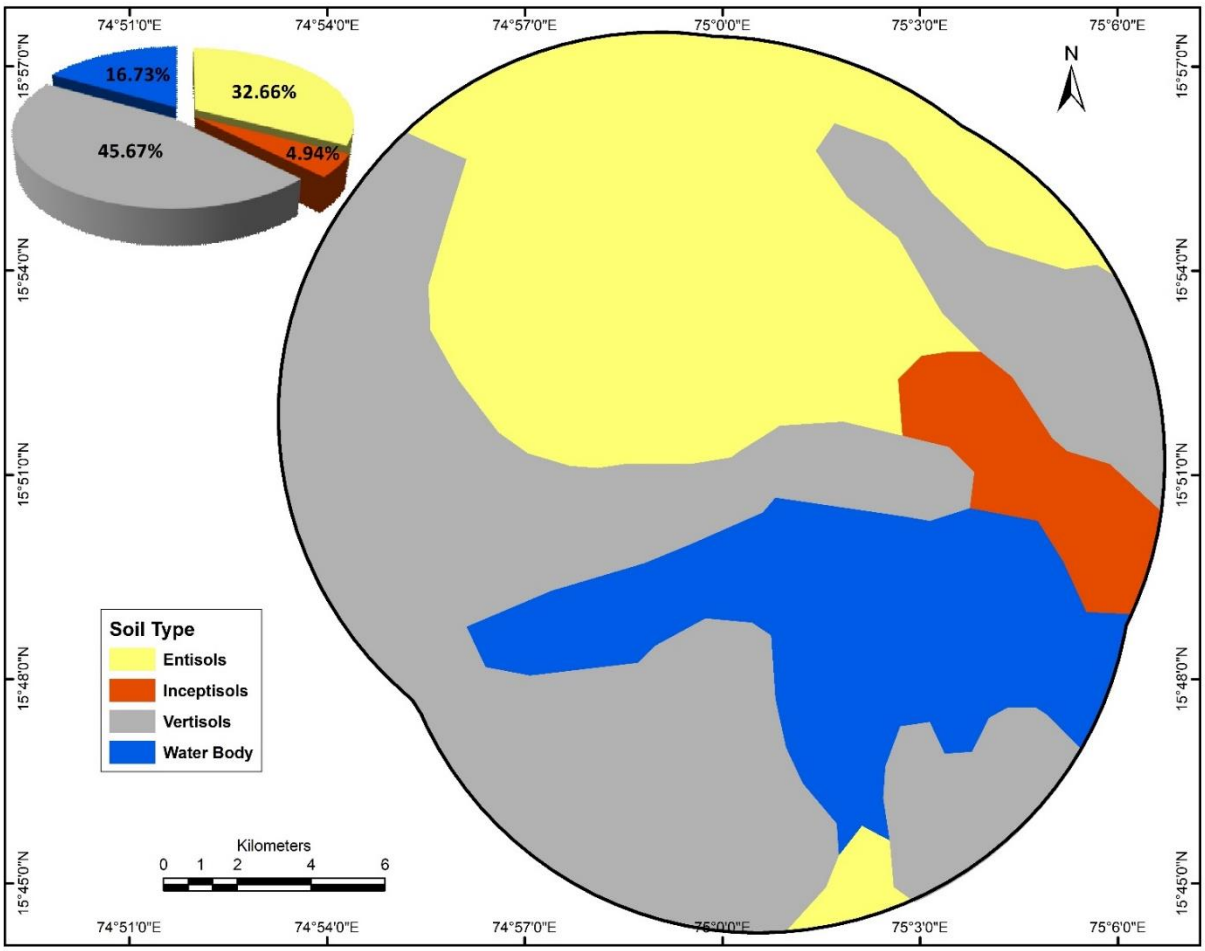


Figure 3.26: Soil map of the Study Area

Soil Fertility in the Study Area

To ascertain the fertility status of the soil in the area the soil samples were collected from 6 locations in the study area **(Figure 3.25).** Physico-chemical analysis of soil samples was carried out at the Apex Testing and Research Laboratory (NABL accredited Lab.), New Delhi. The results of soil analysis of each parameter are given in **Table 3.5**.

The bulk density of soil varied from 1.32 to 1.37 (gm/cc). The dry bulk density of a soil is inversely related to the porosity of the same soil: the more pore space in a soil the lower the value for bulk density. Water holding capacity was recorded highest (36.8) from the soil sample collected from sampling site S3 and lowest was from (33.3) sampling site S1. Electrical conductivity ranged between 300 µmho/cm and 868 µmho/cm. Soil pH is normal in nature with pH values ranging from 7.6 to 8.2 (**Table 3.5**).

Table 3.5: Physico-chemical Composition of Soil in the Study Area

Parameters	S1	S2	S3	S4	S5	S6
Texture						
Sand (% w/w)	19	15	18	20	18	21
Silt (% w/w)	35	27	25	32	30	28
Clay (% w/w)	46	58	57	48	52	51
Porosity (% w/w)	34.8	31.6	31.4	33.2	32.2	32.7
Bulk Density (gm/cc)	1.32	1.37	1.37	1.33	1.35	1.35
Water Holding Capacity (%)	33.3	36.2	36.8	34.3	34.8	34.5

pH	7.8	8.2	7.	7.6	7.9	7.7
Electrical Conductivity (µmho/cm)	320	420	300	440	420	868
Calcium (mg/kg)	230.3	273	318.4	275	306	275
Magnesium (mg/kg)	118	138	190	144	128	265
Alkalinity (mg/l)	52	58	51	52	56	46
Chloride Content (mg/kg)	48.6	44.3	39.7	42.4	55.2	65.8
Sodium (mg/kg)	125	91	86	120	82.4	155
Organic Carbon (%)	0.36	0.34	0.42	0.33	0.32	0.36
Available Phosphorus (kg/ha)	24.7	23.5	23.2	23.7	24.4	24.3
Available Nitrogen (kg/ha)	360	325	382	368	352	367
Available Potassium (kg/ha)	145	150	140	159	143	150
Salinity (ppt)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01

Soil fertility status of the area was assessed based upon soil test results. Based upon Soil Fertility Rating given in **Table 3.6.**

Table 3.6: Soil Fertility Rating as per Soil Fertility Book*

Parameter	Value	Fertility Rating
Organic Carbon (%)	Less than 0.50	Low
	0.50 to 0.75	Medium
	More than 0.75	High
Available Nitrogen (kg/ha)	Less than 240	Low
	240 - 480	Medium
	More than 480	High
Available Phosphorus (kg/ha)	Less than 25	Low
	25 to 50	Medium
	More than 50	High
Available Potassium (kg/ha)	Less than 130	Low
	130 to 330	Medium
	More than 330	High

**Source: www.chambalfertilisers.com/pdf/annual/SoilFertilityBookApr1812OPf.pdf*

Organic matter an important indicator of soil health is in Low range. The soil fertility rating in terms of nitrogen and potassium concentration is in Medium range varies from 325 kg/ha to 382 kg/ha and 140 kg/ha to 159 kg/ha respectively, whereas the concentration of phosphorus ranges between 23.2 kg/ha and 24.7 kg/ha with fertility rating in low range.

Parameter/Site	S1	S2	S3	S4	S5	S6
Organic Carbon (%)	Low	Low	Low	Low	Low	Low
Available Nitrogen (kg/ha)	Medium	Medium	Medium	Medium	Medium	Medium
Available Phosphorus (kg/ha)	Low	Low	Low	Low	Low	Low
Available Potassium (kg/ha)	Medium	Medium	Medium	Medium	Medium	Medium

Based upon Soil Fertility rating Nutrient Index vis-à-vis NPK was calculated as follows:
(Percent samples falling in Low category x 1) + (Percent samples falling in Medium category x 2) + (Percent samples falling in High category x 3)/100.
Based upon above Nutrient Index Soil Fertility is assessed as follows:

< 1.67 : Low
1.67 – 2.33 : Medium
> 2.33 : High

The soil fertility based upon Nutrient Index in terms of NPK as above in case of Nitrogen and Potassium is Medium (2.00), in case of Phosphorus is Low i.e. NI is 1.00.

SOIL SAMPLING

Conclusions

Clayey Loamy soils are predominant in the study area. The soil fertility in general varies from Low to Medium category. Based upon Nutrient Index in terms of NPK in case of Nitrogen and Potassium is Medium (2.00), in case of and Phosphorus is Low i.e. NI is 1.00. Sugarcane, cotton and vegetables are the major crops in the area.

3.2.1.5 Air Environment

Ambient Air Quality Monitoring was carried out to establish the baseline data with respect to ambient air quality of the region and superimposition of potential release of air pollutants during the project's construction and operation; for impact assessment and preparation of mitigation and management measures. Release of air pollutants will be limited to project construction phase. However, it is important to establish baseline by way of ambient air quality monitoring.

Ambient air quality monitoring was carried out for Sulphur dioxides (SO_2), nitrogen oxides (NOx), PM_{10} and $PM_{2.5}$. The sources of air pollution in the study area are vehicular traffic and dust arising from village roads. The air environment around project site is free from any significant pollution source.

Air quality monitoring was carried out conforming to the National Ambient Air Quality Standards for Industrial Residential, Rural & Other Areas and Ecologically Sensitive Areas. The National Ambient Air Quality Standard 2009 notified by CPCB.

Identification of Sampling Locations

Sampling locations are identified keeping in view the following:

- Potential source of pollution - location of construction machinery and equipment, DG sets, material storage and handling areas
- Receptors - populated area or habitation, typically villages in the vicinity
- Predominant wind direction

Accessibility – Based on the above analysis sampling locations are identified, however, they are finalized keeping in view the accessibility of the identified sites; acceptance of the locals to monitoring, safety of equipment and source of power supply. Ambient air was monitored during the studies at locations in the study area the project is given in **Table 3.7 and Figure 3.25**.

Table 3.7: Ambient air quality, monitoring locations

S. No.	Monitoring location
A1	Chakrageri village
A2	Karlakatti Tand village
A3	Basidoni Daddi
A4	Sogal Village
A5	Tallur Village
A6	Hosur Village

Ambient Air Quality

The sources of air pollution in the study area are vehicular traffic, dust arising from unpaved village roads and domestic fuel burning. The air environment around project site is free from any significant pollution source. Air quality monitoring was carried out as per the new air quality parameters conforming to the National Ambient Air Quality Standards for Industrial Residential, Rural & Other Areas and Ecologically Sensitive Areas.

During monitoring of ambient air quality at various locations in the study area, it was observed that the main source of pollutants in the area is vehicular movement along the National Highway and village approach roads.

a. $PM_{2.5}$ levels

In the study area maximum level of $PM_{2.5}$ was observed during pre-monsoon season. The maximum $PM_{2.5}$ levels were observed at Chakrageri village with 30.8 $\mu g/m^3$ to minimum levels at Karlakatti Tand village with 16.7 $\mu g/m^3$ during winter season.

b. PM_{10} levels

The $PM_{10.0}$ values ranged from minimum 45.8$\mu g/m^3$ at Karlakatti tand village during winter season and 61.6 $\mu g/m^3$ at Sogal village during pre-monsoon.

c. SO_2 levels and NOx levels

The SO_2 and NO_x levels observed during the study was much lower than the permissible limit of 80 $\mu g/m^3$ and for industrial, residential and rural areas. The SO_2 values ranged from 4.6 $\mu g/m^3$ to 6.5 $\mu g/m^3$ at various stations covered as a part of the ambient air quality monitoring study. Similarly, the NO_x values ranged from 5.9 $\mu g/m^3$ to 8.2 $\mu g/m^3$ at various stations covered as a part of the study.

Table 3.8: Air Quality Monitoring of the Study Area (unit: $\mu g/m^3$)

Site	Season	$PM_{2.5}$	PM_{10}	SO_2	NOx
A1	W	19.5	49.5	5.4	7.1
	PM	30.8	56.1	6.5	8.2
A2	W	16.7	45.8	5.4	5.9
	PM	23.2	52.4	5.5	6.6
A3	W	17.5	50.3	5.4	6.1
	PM	21.4	52.4	6.1	6.7
A4	W	17.7	54.2	5.1	6.5
	PM	26.6	61.6	6.1	7.0

A5	W	19.6	46.1	4.6	6.5
	PM	18.9	56.6	5.7	7.3
A6	W	21.6	46.7	5.0	6.4
	PM	25.0	57.5	5.7	6.9
24h NAAQS		**100**	**60**	**80**	**60**

*** W = Winter; PM = Pre-Monsoon/ Summer**

The AAQ at various stations covered during ambient air quality monitoring was much below the permissible limits for all the parameters specified for industrial, residential, rural and other areas (**Table 3.8**). It was observed during the air quality monitoring that the air pollution sources along with the local sources are only vehicles in study area.

3.2.1.6 Noise & Traffic Analysis

Noise Level monitoring was carried out using digital sound level type 2230 (Digital-Instrument) in terms of dB(A) levels along with time of the day and source of sound, if any, to establish baseline data. Monitoring locations were selected keeping in view the project activity area along the roadside and the location of receptors. Hourly monitoring was carried out at 6 locations (**Table 3.9 & Figure 3.25**) where levels are recorded during the daytime and Night time. Data collected is compiled and analyzed to establish base line equivalent levels.

The monitored levels were compared against the Noise Pollution (Regulation and Control) Rules 2000, as amended through the Noise Pollution (Regulation and Control) Amendment Rules 2010.

Table 3.9: Ambient Noise and Traffic density monitoring locations

S. No.	Monitoring location	Zone
NT1	Chakrageri village	Residential
NT2	Karlakatti Tand village	Residential
NT3	Sogal Village	Commercial
NT4	Jangamabudagatti	Residential
NT5	Hosur village	Residential
NT6	Mabanur Village	Commercial

Traffic density data was recorded by physically counting the number of different types of vehicles passing through a point in a fixed time interval. Some major villages along the road were considered as nodes for monitoring movement of traffic.

Noise Levels

The Ambient noise standards and results of noise level monitoring in terms of equivalent sound levels are given in **Tables 3.10 & 3.11,** respectively.

All villages are well connected with road network, settlements in the area are along the village approach roads. Monitoring location NT3 in Sogal village and NT6 in Mabanur villages is considered as commercial area, while rest of the monitoring location is cauterized under residential area.

Main source of noise pollution in the study area is vehicular movement. However, as per the standards the ambient noise levels in the area are well within the permissible limits.

Table 3.10: Equivalent Noise levels in study area during day time [Leq dB(A)]

Site Code / Monitoring location	Winter			Pre-Monsoon			Monsoon			CPCB Limits Leq dB(A)	
	Leq Day dB(A)	Leq Night dB(A)	Leq Day and Night dB(A)	Leq Day dB(A)	Leq Night dB(A)	Leq Day and Night dB(A)	Leq Day dB(A)	Leq Night dB(A)	Leq Day and Night dB(A)	Day	Night
NT1/Chakrageri village	53.5	40.4	52.5	54.4	40.5	53.5	52.2	40.4	51.2	55	45
NT2/Karlakatti Tand village	52.5	41.0	51.9	53.6	41.0	52.1	50.4	39.9	49.8	55	45
NT3/Sogal Village	55.0	40.8	54.2	54.5	40.9	53.4	51.6	40.2	50.1	65	55
NT4/Jangamabudagatti	48.0	39.3	48.8	51.5	39.3	50.7	49.4	39.5	50.2	55	45
NT5/Hosur village	54.3	40.3	53.3	54.7	41.0	54.1	54.2	41.1	54.1	55	45
NT6/Mabanur Village	52.6	40.9	51.7	55.9	40.5	54.3	53.2	40.4	51.5	65	55

Traffic Density

Traffic density data was recorded by physically counting the number of different types of vehicles passing through a particular point in a fixed time interval. Traffic density was recorded maximum at near Sogal Village and Hosur village. The traffic density recorded at different sites is presented in **Table 3.11.**

Table 3.11: Traffic density in the study area

Site Code	Monitoring location	Winter			Pre-monsoon			Monsoon		
		HV	LV	TW	HV	LV	TW	HV	LV	TW
NT1	Chakrageri village	3	9	15	4	10	13	4	8	14
NT2	Karlakatti Tand village	2	8	13	2	8	14	3	7	12
NT 3	Sogal Village	1	9	15	1	10	15	1	8	14
NT 4	Jangamabudagatti	2	6	8	2	8	10	2	6	8
NT 5	Hosur village	3	8	14	5	12	15	4	10	15
NT 6	Mabanur Village	2	8	12	3	12	14	3	9	10

HV= Heavy Vehicle; LV= Light Vehicle; TW= Two Wheelers

NOISE AND TRAFFIC MONITORING




Conclusions

As seen from the results of ambient air quality monitoring the air quality is very good in the study area and noise levels are also well within permissible limits as per CPCB standards.

3.2.1.7 Water Quality

Water quality of both surface and ground water was assessed in the study area. The data on water quality has been collected to evaluate surface water (reservoir and pond) and ground water quality (tube wells, hand pumps, borewells, etc.) in study area.

Selection of Sampling Sites

The sampling was carried out at 9 different locations (Surface water: 3 samples and ground water: 6 samples) during three seasons as described below in the table to study various physico-chemical and biological characteristics of surface and ground water (**Table 3.12 and Figure 3.25).** Water samples were collected during each sampling season for physico-chemical parameters.

Table 3.12: Water sampling locations

Sites	Location	Remarks
Ground Water		
GW1	Chakrageri Village	Tube well
GW2	Yakkundi Village	Borewell
GW3	Karlakatti Tand Villages	Borewell
GW4	Basidoni Dadi village	Tube well
GW5	Sogal village	Handpump
GW6	Mallur village	Borewell

Surface Water		
SW1	Renuka Sagar Reservoir	Near Water lifting Point near Chakrageri Village
SW2	Sogal Village	Sogal Waterfall
SW3	Renuka Sagar Reservoir	Near Mallaprabha Dam Site

Sampling Parameters

The analysis of physico-chemical parameters includes pH, temperature, electrical conductivity, turbidity, Total Suspended Solids, total hardness, DO, BOD, COD, nitrates, phosphates, chlorides, sulphates, sodium, potassium, calcium, magnesium, silicates, oil and grease, phenolic compounds, residual sodium carbonate and Total Coliform. Heavy metals included Pb, As, Hg, Cd, Cr-6, total Chromium, Cu, Zn, Fe. The samples were taken in the replicates at each site and composite samples were then analyzed.

Some of the physico-chemical parameters of water quality were measured in the field with the help of different instruments. The water temperature was measured with the help of graduated mercury thermometer. The hydrogen ion concentration (pH), electrical conductivity and total dissolved solids were recorded with the help of a pH, EC and TDS probes of Hanna instruments (Model HI 98130) in the field. Dissolved oxygen was measured with the help of Digital Dissolved Oxygen meter (Eutech ECDO 602K). For the analysis of rest of the parameters the water samples were collected in polypropylene bottles from the different sampling sites and brought to the laboratory for further analysis after adding formalin as preservative. The turbidity was measured with the help of Digital Turbidity meter and other parameters such as total alkalinity, total hardness, chloride, nitrate, phosphate and silicates were analyzed at the Apex Testing and Research Laboratory (NABL accredited Lab.), Kirti Nagar, New Delhi. These parameters were analyzed as per the standard procedures given by Adoni (1980) and APHA (1992) and Bureau of Indian Standards (BIS): IS 3025 (Indian Standard: methods of sampling and test (physical and chemical) for water used in industry.

Ground Water Quality

The results of physico-chemical analysis in different seasons along with BIS Standards for Drinking Water are given at **Tables 3.13 - 3.15**.

Table 3.13: Physico-Chemical Characteristics of Ground Water During Winter Season

S. No.	Test Parameters	Permissible Limits*	GW1	GW2	GW3	GW4	GW5	GW6
1	Temperature (^{0}C)	--	24.2	24.5	25.1	24.5	25.5	25.9
2	pH	6.5-8.5	7.7	7.8	8	7.8	8	7.79
3	Electrical Conductivity (µS/cm)	--	720	780	812	790	800	690
4	Total Dissolved Solids (mg/l)	2000	439.2	475.8	495.3	481.9	488.0	420.9
5	Total Hardness (as $CaCO_3$) (mg/l)	600	140.78	147.46	154.74	142.79	154.75	148.49
6	Total Alkalinity (mg/l)	600	78	60	68	52	70	55.4
7	Calcium (as Ca) (mg/l)	200	30.4	33.4	35	33.5	33.2	32.5
8	Magnesium (as Mg) (mg/l)	100	15.8	15.6	16.4	14.4	17.5	16.4
9	Sulphate (SO_4) (mg/l)	400	53.6	65	60	65	47.5	63
10	Chloride (as Cl) (mg/l)	1000	60	65	62	58	68.3	65.4
11	Nitrate (NO_3) (mg/l)	45	6	4.5	9.8	7.8	7.4	8.4
12	Phosphate (as PO_4) (mg/l)	--	0.08	0.02	0.22	0.12	0.11	0.04
13	Silicate (Si) (mg/l)	--	BDL	BDL	BDL	BDL	BDL	BDL
14	Salinity (mg/l)	--	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1

S. No.	Test Parameters	Permissible Limits*	GW1	GW2	GW3	GW4	GW5	GW6
15	Sodium (mg/l)	--	32	30.2	27.6	25.6	25.5	28.2
16	Potassium (mg/l)	--	0.4	0.24	0.38	0.33	0.42	0.38
17	Iron (Fe) (mg/l)	0.3	0.12	0.11	0.13	0.15	0.18	0.21
18	Phenolic Compounds (mg/l)	0.002	BDL	BDL	BDL	BDL	BDL	BDL
19	Oil & Grease (mg/l)	0.2	BDL	BDL	BDL	BDL	BDL	BDL
20	Residual Sodium Carbonate (mg/l)		1.4	1.2	1.4	1.2	1.5	1.34
21	Cadmium (Cd) (mg/l)	0.003	BDL	BDL	BDL	BDL	BDL	BDL
22	Arsenic As) (mg/l)	0.05	BDL	BDL	BDL	BDL	BDL	BDL
23	Mercury (Hg) (mg/l)	0.001	BDL	BDL	BDL	BDL	BDL	BDL
24	Copper (Cu) (mg/l)	1.5	BDL	BDL	BDL	BDL	BDL	BDL
25	Zinc (Zn) (mg/l)	15	BDL	BDL	BDL	BDL	BDL	BDL
26	Total Chromium (Cr) (mg/l)	0.05	BDL	BDL	BDL	BDL	BDL	BDL
27	Chromium-6 (mg/l)	--	BDL	BDL	BDL	BDL	BDL	BDL
28	Manganese (Mn) (mg/l)	0.3	BDL	BDL	BDL	BDL	BDL	BDL
29	Lead (Pb) (mg/l)	0.01	BDL	BDL	BDL	BDL	BDL	BDL

***Indian Standard* Drinking Water - Specification (Second Revision) Permissible Limits (IS: 10500:2012)**

GW1-GW6: Sampling sites; BDL: Below Detectable Limits

Table 3.14: Physico-Chemical Characteristics of Ground Water During Pre-Monsoon Season

S. No.	Test Parameters	Permissible Limits*	GW1	GW2	GW3	GW4	GW5	GW6
1	Temperature (^{0}C)	--	28.6	28.9	28.5	28.3	28.5	29
2	pH	6.5-8.5	8	8.1	7.8	7.9	8	8.2
3	Electrical Conductivity (µS/cm)	--	820	715	830	700	765	740
4	Total Dissolved Solids (mg/l)	2000	500.2	436.2	506.3	427.0	466.7	451.4
5	Total Hardness (as $CaCO_3$) (mg/l)	600	158.18	164.23	158.98	162.06	174.08	170.83
6	Total Alkalinity (mg/l)	600	72	68	70	68	75	72
7	Calcium (as Ca) (mg/l)	200	34.9	36.5	34.4	37.6	38.8	37.5
8	Magnesium (as Mg) (mg/l)	100	17.3	17.8	17.8	16.6	18.8	18.8
9	Sulphate (SO_4) (mg/l)	400	52.7	75	74	68	82.3	85
10	Chloride (as Cl) (mg/l)	1000	74	62.3	67.8	75	68	66.5
11	Nitrate (NO_3) (mg/l)	45	10.2	9.9	9.9	10.5	12.1	10.2
12	Phosphate (as PO_4) (mg/l)	--	0.09	0.15	0.06	0.03	0.14	0.05
13	Silicate (Si) (mg/l)		BDL	BDL	BDL	BDL	BDL	BDL
14	Salinity (mg/l)		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
15	Sodium (mg/l)		32.2	30.5	37.5	32.1	32.5	36.7
16	Potassium (mg/l)		0.4	0.38	0.34	0.42	0.4	0.34
17	Iron (Fe) (mg/l)	0.3	0.13	0.22	0.09	0.2	0.21	0.12
18	Phenolic Compounds (mg/l)	0.002	BDL	BDL	BDL	BDL	BDL	BDL
19	Oil & Grease (mg/l)	0.2	BDL	BDL	BDL	BDL	BDL	BDL
20	Residual Sodium Carbonate (mg/l)		1.2	1.12	1.23	1.3	1.32	1.2
21	Cadmium (Cd) (mg/l)	0.003	BDL	BDL	BDL	BDL	BDL	BDL
22	Arsenic As) (mg/l)	0.05	BDL	BDL	BDL	BDL	BDL	BDL
23	Mercury (Hg) (mg/l)	0.001	BDL	BDL	BDL	BDL	BDL	BDL
24	Copper (Cu) (mg/l)	1.5	BDL	BDL	BDL	BDL	BDL	BDL
25	Zinc (Zn) (mg/l)	15	BDL	BDL	BDL	BDL	BDL	BDL
26	Total Chromium (Cr) (mg/l)	0.05	BDL	BDL	BDL	BDL	BDL	BDL
27	Chromium-6 (mg/l)	--	BDL	BDL	BDL	BDL	BDL	BDL
28	Manganese (Mn) (mg/l)	0.3	BDL	BDL	BDL	BDL	BDL	BDL
29	Lead (Pb) (mg/l)	0.01	BDL	BDL	BDL	BDL	BDL	BDL

***Indian Standard* Drinking Water - Specification (Second Revision) Permissible Limits (IS: 10500:2012)**

GW1-GW6: Sampling sites; BDL: Below Detectable Limits

Table 3.15: Physico-Chemical Characteristics of Ground Water During Monsoon Season

S. No.	Test Parameters	Permissible Limits*	GW1	GW2	GW3	GW4	GW5	GW6
1	Temperature (^{0}C)	--	27.3	27.8	28.1	27.9	28.4	28.2
2	pH	6.5-8.5	7.45	7.62	7.22	7.44	7.59	7.38
3	Electrical Conductivity (µS/cm)	--	950	840	940	790	830	932
4	Total Dissolved Solids (mg/l)	2000	579.5	512.4	573.4	481.9	506.3	568.5
5	Total Hardness (as $CaCO_3$) (mg/l)	600	193.94	202.68	207.94	207.94	199.52	213.13
6	Total Alkalinity (mg/l)	600	84.4	92.5	90.6	90.6	95.1	96.2
7	Calcium (as Ca) (mg/l)	200	43.3	44.5	44.8	44.8	43.4	45.4
8	Magnesium (as Mg) (mg/l)	100	20.9	22.3	23.4	23.4	22.2	24.3
9	Sulphate (SO_4) (mg/l)	400	76.4	73.5	73	72	80.5	79.4
10	Chloride (as Cl) (mg/l)	1000	90.4	100.5	100.4	100.4	100.54	102.5
11	Nitrate (NO_3) (mg/l)	45	11.4	12.5	10.2	10.2	13.5	10.4
12	Phosphate (as PO_4) (mg/l)	--	0.06	0.2	0.09	0.09	0.21	0.05
13	Silicate (Si) (mg/l)	--	BDL	BDL	BDL	BDL	BDL	BDL
14	Salinity (mg/l)	--	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
15	Sodium (mg/l)	--	42.2	40.4	39.5	40.5	54.2	46.5
16	Potassium (mg/l)	--	0.42	0.44	0.43	0.43	0.7	0.6
17	Iron (Fe) (mg/l)	0.3	0.22	0.25	0.16	0.23	0.18	0.2
18	Phenolic Compounds (mg/l)	0.002	BDL	BDL	BDL	BDL	BDL	BDL
19	Oil & Grease (mg/l)	0.2	BDL	BDL	BDL	BDL	BDL	BDL
20	Residual Sodium Carbonate (mg/l)	--	1.2	1.4	1.21	1.2	1.12	1.23
21	Cadmium (Cd) (mg/l)	0.003	BDL	BDL	BDL	BDL	BDL	BDL
22	Arsenic As) (mg/l)	0.05	BDL	BDL	BDL	BDL	BDL	BDL
23	Mercury (Hg) (mg/l)	0.001	BDL	BDL	BDL	BDL	BDL	BDL
24	Copper (Cu) (mg/l)	1.5	BDL	BDL	BDL	BDL	BDL	BDL
25	Zinc (Zn) (mg/l)	15	BDL	BDL	BDL	BDL	BDL	BDL
26	Total Chromium (Cr) (mg/l)	0.05	BDL	BDL	BDL	BDL	BDL	BDL
27	Chromium-6 (mg/l)	--	BDL	BDL	BDL	BDL	BDL	BDL
28	Manganese (Mn) (mg/l)	0.3	BDL	BDL	BDL	BDL	BDL	BDL
29	Lead (Pb) (mg/l)	0.01	BDL	BDL	BDL	BDL	BDL	BDL

***Indian Standard* Drinking Water - Specification (Second Revision) Permissible Limits (IS: 10500:2012)**

GW1-GW6: Sampling sites; BDL: Below Detectable Limits

According to BIS standards for Drinking Water (2012) all the water samples collected from the study area fall within permissible limits of the same.

In addition to the above Water Quality Index developed for ground water quality by Tiwari & Mishra (1985) and Singh and Hussain (2016) was also used to assess the ground water quality in the study area. It is based upon key parameters like Total Dissolved Solids, Chlorides, Sulphate, Nitrate, Calcium, Magnesium, Sodium, Potassium and pH. Based upon WQI range calculated based formula using parameters they have categorized the ground water into different groups as follows:

WQI range	Water Quality
<50	Excellent water
50-100	Good water
100-200	Poor water
200-300	Very poor water
>300	Water unsuitable for drinking purpose

The WQI calculated for ground water samples collected from different locations in the study area is given in table below.

Ground Water Quality Index

Season	GW1	GW2	GW3	GW4	GW5	GW6
Winter	23.39	23.79	25.64	24.41	24.41	24.46
Pre-monsoon	26.04	26.28	25.66	26.07	27.64	27.50
Monsoon	27.05	27.29	26.33	26.04	28.56	27.32

According to WQI tabulated in table above all the ground water samples fall in Excellent ground water quality class.

Surface Water

For analysis of surface water quality samples were collected from three sites: 2 from Malaprabha river and one from Sogal village Pond. Results of water samples are given in **Table 3.16**.

Surface water quality of all the samples collected during winter, Pre-Monsoon and monsoon season was compared with the Water Quality Criteria of Central Pollution Control Board (http://www.cpcb.nic.in/Water_Quality_Criteria.php) (**Table 3.17**). None of the samples fall under Class 'A' with designated best use as drinking water source due to total coliform is more than 50 MPN/100 ml in all samples collected during different season. All the samples of surface water qualify for **Class 'B'** i.e. designated best use of outdoor bathing (organized). This is due to total coliform less than 500 MPN/100 ml, DO of more than 5 mg/l and BOD less than 3 mg/l.

Table 3.16: Surface Water quality in the study area

S. No.	Test Parameters	Winter			Pre-monsoon			Monsoon		
		SW1	SW2	SW3	SW1	SW2	SW3	SW1	SW2	SW3
CHEMICAL PARAMETRES										
1	Temperature (°C)	23.1	26.8	25.3	24	27	26.6	24.5	27.1	25.8
2	pH	7.8	8	8.21	7.45	7.82	7.65	7.9	8	8.2
3	Turbidity (NTU)	2.2	3.2	3.3	1.5	3	3.8	3.3	4.5	4.8
4	Dissolved Oxygen (mg/l)	7.2	7.3	7.8	7.32	7.5	7.6	7.4	7.5	7.6
5	Electrical Conductivity (mg/l)	78	80	90	178	190	220	95	110	132
6	Total Dissolved Solids (mg/l)	47.58	48.8	50	108.58	115.9	134.2	57.95	67.1	80.52
7	Total Suspended Solids (mg/l)	7	6	8	5.4	7	8	8	10	16.5
8	Chloride (as Cl) (mg/l)	52.2	56	66	55.4	56.4	67.3	49.5	60.5	60.7
9	Total Hardness (mg/l)	99.27	107.59	134.22	100.68	112.57	137.43	112.52	131.43	91.59
10	Alkalinity (mg/l)	45.4	46.9	56.4	44.8	53.4	64.3	44	51.4	55.3
11	Calcium (as Ca) (mg/l)	23.8	26.8	30.4	24.2	28.3	30.7	24.2	28.6	29.2
12	Magnesium (as Mg) (mg/l)	9.7	9.9	14.2	9.8	10.2	14.8	9	10.3	14.2
13	Nitrate (NO_3) (mg/l)	2	3.2	5.4	2.8	3	6.2	2.2	2.5	4.6
14	Phosphate (as PO_4) (mg/l)	0.1	0.13	0.18	0.9	0.13	0.16	0.12	0.22	0.15
15	Sulphate (SO_4) (mg/l)	10.2	14	18.2	12.2	14.23	19.7	14.5	16.6	22.5
16	Silicon Dioxide (mg/l)	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
17	Silicate (Si) (mg/l)	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
18	Sodium (mg/l)	10.5	12	15.43	14.9	14.5	17.5	12.2	16.5	13.8
19	Potassium (mg/l)	1.2	1.3	1.3	1.9	1.5	2.1	1	1.5	1.3
20	Phenolic Compounds (mg/l)	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
21	Oil & Grease (mg/l)	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
22	Iron (Fe) (mg/l)	0.05	0.09	0.07	0.06	0.1	0.02	0.04	0.03	0.06
23	Cadmium (Cd) (mg/l)	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
24	Arsenic As) (mg/l)	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
25	Mercury (Hg) (mg/l)	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
26	Copper (Cu) (mg/l)	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
27	Zinc (Zn) (mg/l)	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
28	Total Chromium (Total Cr) (mg/l)	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
29	Chromium-6 (Cr-6) (mg/l)	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL

S. No.	Test Parameters	Winter			Pre-monsoon			Monsoon		
		SW1	SW2	SW3	SW1	SW2	SW3	SW1	SW2	SW3
30	Manganese (Mn) (mg/l)	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
31	Lead (Pb) (mg/l)	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
32	Residual Sodium Carbonate (mg/l)	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
33	Biological Oxygen Demand (mg/l)	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
34	Chemical Oxygen Demand (mg/l)	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
35	Sodium Adsorption Ratio	0.46	0.5	0.58	0.65	0.59	0.65	0.54	0.67	0.52
36	Total Coliform (MPN/100ml)	145	160	150	174	140	200	160	180	212

SW1-SW3: Sampling sites: BDL: Below Detectable Limits

Table 3.17: Water Quality Criteria for designated Best Use by CPCB, New Delhi
(http://www.cpcb.nic.in/Water_Quality_Criteria.php)

Designated-Best-Use	Class of water	Criteria
Drinking Water Source without conventional treatment but after disinfection	A	Total Coliforms Organism MPN/100ml shall be 50 or less
		pH between 6.5 and 8.5
		Dissolved Oxygen 6mg/l or more
		Biochemical Oxygen Demand (5 days @ 20^0C) 2mg/l or less
Outdoor bathing (Organised)	B	Total Coliforms Organism MPN/100ml shall be 500 or less, pH between 6.5 and 8.5, Dissolved Oxygen 5mg/l or more
		Biochemical Oxygen Demand (5 days @20^0C) 3mg/l or less
Drinking water source after conventional treatment and disinfection	C	Total Coliforms Organism MPN/100ml shall be 5000 or less, pH between 6 and 9, Dissolved Oxygen 4mg/l or more
		Biochemical Oxygen Demand (5 days @ 20^0C) 3mg/l or less
Propagation of Wild life and Fisheries	D	pH between 6.5 to 8.5, Dissolved Oxygen-4 mg/l or more
		Free Ammonia (as N) 1.2 mg/l or less
Irrigation, Industrial Cooling, Controlled Waste disposal	E	pH between 6.0 and 8.5
		Electrical Conductivity at 25^0C micromhos/cm Max.2250
		Sodium Absorption Ratio Max. 26
		Boron Max. 2mg/l
	Below-E	Not Meeting A, B, C, D & E Criteria

Sodium Adsorption Ratio (SAR) is an irrigation water quality parameter used in the management of sodium-affected soils. It is calculated using Sodium, Calcium and Magnesium concentrations expressed in meq/L. At a given SAR, the infiltration rate increases as salinity increases or the other way around. Therefore, the SAR and EC are used in combination to evaluate potential problems.

In the present study, Electrical conductivity values varied between 78 µS/cm and 220 µS/cm while SAR varied from 0.46 to 0.67 (**Table 3.16**). All the samples from the study area have SAR below 10. Based on the classification given by Todd, 1959; SAR values from the study area is grouped as excellent class (**Table 3.18**).

Table 3.18: Classification of Water Based on SAR Values (Todd, 1959)

SAR Value	Water Quality
<10	Excellent
10-18	Good
19-26	Doubtful
>26	Unsuitable

A commonly-used water quality index (WQI) developed by the National Sanitation Foundation (NSF) in 1970 by Brown *et al*. (www.water-research.net/watrqualindex/waterqualityindex.htm) and Washington State Department of Ecology, Environmental Assessment Programme was used for assessing the surface water quality. The NSF WQI was developed to provide a standardized method for comparing the

water quality of various bodies of water. Water quality index is a 100-point scale that summarizes results from a total of 9 different parameters listed below in the table.

pH	Delta Temperature Change (^{0}C)	Total Phosphates (mg/L)
Dissolved Oxygen (DO) Saturation (%)	Total Coliforms (MPN/100ml)	Nitrates (mg/L)
Turbidity (NTU)	Biochemical Oxygen Demand (BOD) (mg/L)	Total Suspended Solids (TSS) (mg/L)

The analysis of water quality therefore is based upon 9 parameters as defined for WQI above and based upon the score at each sampling site water quality has been designated as Excellent, Good, Medium, etc. as per the range defined in the table below.

Water Quality Index	
Range	**Quality**
90-100	Excellent
70-90	Good
50-70	Medium
25-50	Bad
0-25	Very bad

Water quality index based upon the above parameters is given in table below

Sampling Site	**Winter**			**Pre-Monsoon**			**Monsoon**		
	SW1	**SW2**	**SW3**	**SW1**	**SW2**	**SW3**	**SW1**	**SW2**	**SW3**
WQI	74.38	72.79	71.21	69.34	72.51	70.52	73.81	71.60	71.03

According to WQI values obtained for different samples surface water quality in general is in Good category throughout the study area except for the water sample of Renuka Sagar reservoir (Malaprabha river) during Pre-monsoon which lies in Medium category.

Conclusions

The water quality in the study area in general is good. Except for agricultural activities there are no sources of pollution of water bodies in the area. Summary of the same is as follows:

1. According to BIS standards for Drinking Water (2012) all the ground water samples collected from the study area fall within permissible limits of the same.
2. According to WQI all the ground water samples fall in Excellent ground water quality class.
3. All the samples of surface water qualify for **Class 'B'** i.e. designated best use of outdoor bathing (organized) according to Water Quality Criteria of Central Pollution Control Board.
4. According to WQI surface water quality in general is in Good throughout the study area.

WATER SAMPLING

Surface Water Sampling Renuka Sagar Reservoir (Malaprabha River)

3.2.1.8 Land Use/ Land Cover

For the present study, Land use/ Land cover maps prepared by National Remote Sensing Centre (NRSC), Indian Space Research Organisation (ISRO) of Dept. of Space with Directorate of Ecology, Environment and Remote Sensing, Karnataka as partner under Natural Resource Census (NRC) project of National Natural Resource Repository (NRR) programme was used. In addition, False Color Composite of the study area was extracted from Landsat 8 data which was downloaded from https://earthexplorer.usgs.gov/. The FCC was used to refine the data obtained from NRSC.

The FCC and land use/ land cover map of the study area are given at **Figures 3.27 & 3.28**. 61.95 % of the study area is comprised of agricultural fields and settlements. Forests constitute 12.66% of the area and 16.02% of the area is under waterbodies (**Table 3.19**).

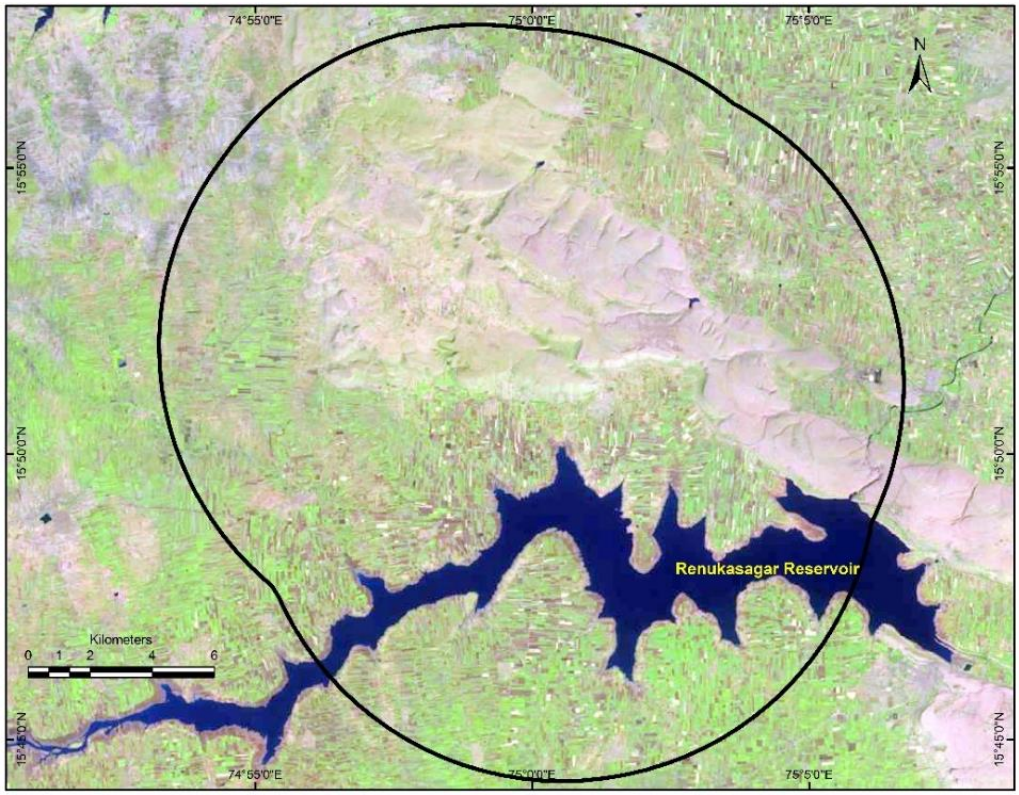


Figure 3.27: False Color Composite of the Project Study Area

Table 3.19: Area under different Land use/ Land cover in the study area

S. No.	Land Use/ Land Cover	Area (Sq km)	Area (%)
1	Forest	196.45	0.44
2	Scrub Forest	5486.06	12.22
3	Scrub Land	3431.93	7.64
4	Agriculture/ Fallow Land	27815.33	61.95
5	Settlement	776.70	1.73
6	Waterbody	7195.53	16.02
	Total	**44902.00**	**100.00**

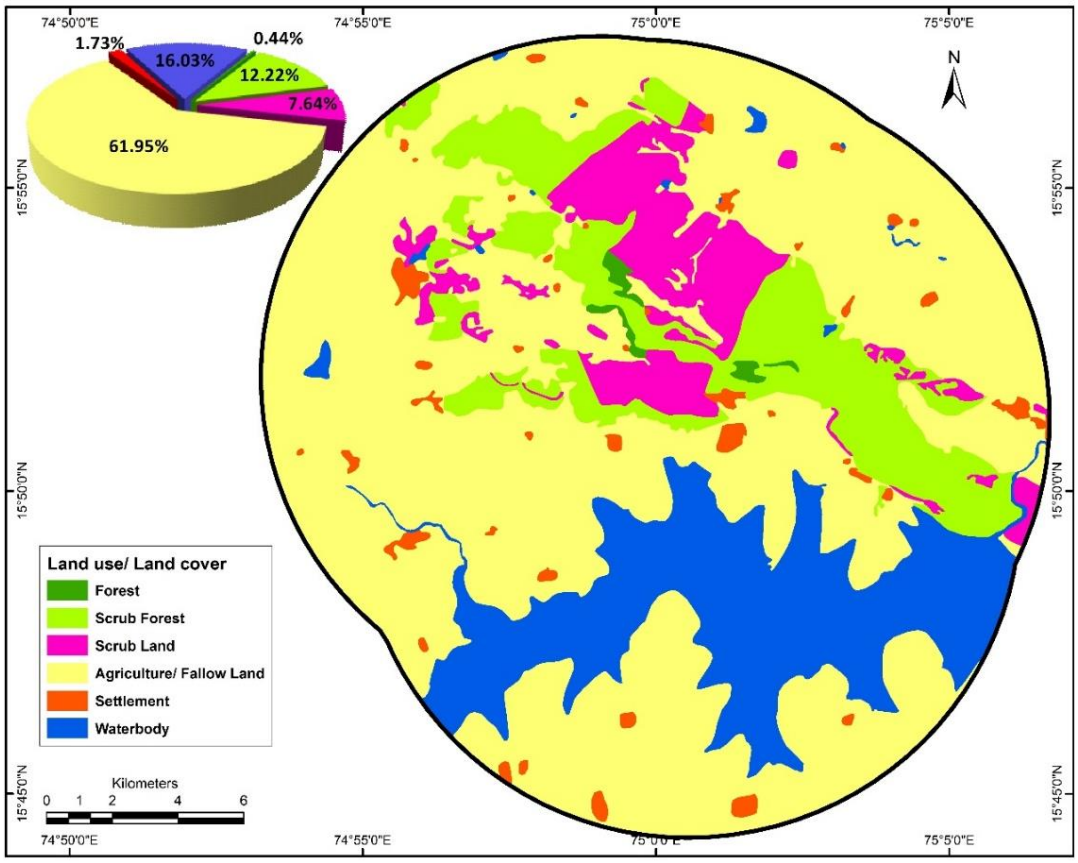


Figure 3.28: Land Use/ Land Cover Map of the Project Study Area

3.2.2 Biologial Environment

3.2.2.1 Forest Type in Study Area

The project area falls in Gokak Forest Division of Belagavi Circle under Karnataka State Forest Department. The forests occurring in the study area of Standalone pumped storage component of Saundatti IRE Project are classified as per classification given by Champion and Seth (1968).

Forest types of study area are under Tropical Dry Deciduous Forest and Tropical Throne Forest, with 2 sub-types of each Group and same is given in **Table 3.20**.

Table 3.20: Forest types found in the Study area

Group	Sub Group	Forest Type
Group 5. Tropical Dry Deciduous Forest	5A. Southern Tropical Dry Deciduous Forests	5A/C1b. Dry Teak Forest 5A/C3. Southern Mixed Deciduous forest
Group 6. Tropical Thorn Forest	6A. Southern Tropical Thorn Forests	6A/C1. Southern Thorn Forest 6A/DS1. Southern Thorn Scrub

LANDUSE PATTERN IN STUDY AREA

PROPOSED AREA FOR WATER CONDUCTOR SYSTEM






PROPOSED POWER HOUSE AREA






PROPOSED RESERVOIR AREA - SOUTHERN DIRECTION






3.2.2.2 Floristic Diversity

Methodology

The objectives of the present floristic study are as follows:

- To prepare an inventory of different plant groups in the study area
- To assess the community structure in the study area
- To determine Importance Value Index and
- Shannon Wiener Diversity Index for trees, shrubs and herbs present in the study area.

The detailed account of floristic diversity and ecology has been described based on the primary surveys study area of the proposed project. These surveys were undertaken during different seasons of the year to assess the vegetation structure and to prepare inventory of plant species found in the study area.

The community structure of the study area was studied by Quadrat method. The size and number of quadrats needed were determined using the species- area curve (Misra, 1968). The data on vegetation were quantitatively analyzed for abundance, density, frequency as per the methodology given in Curtis & McIntosh (1950). The Importance Value Index (IVI) for trees was determined as the sum of relative density, relative frequency and relative dominance (Curtis, 1959).

Identification of plants was made with the help of research papers, reports and with the help of consultation with local peoples. Botanical names, family, local name, status, uses and presence in influence and non-influence zone was noted. Status of plants was analyzed on the basis of habitat, population, distribution range and utility.

Sampling Site Selection

For vegetation sampling, study area was divided in grids of 5km x 5km in GIS domain. There after 25% of the total grid cover of entire study area was selected randomly for sampling. Half of the selected sampling location lies in the directly affected area (direct impact zone: grids including project components such as proposed reservoir area, access roads, etc.) and remaining sampling sites lies in the rest of the area or indirect impact zone (10 km buffer zone of the study area).

Sampling was undertaken to assess the composition of forest type/s in that area. Six sampling locations were selected for carrying out Phyto-sociological surveys of the vegetation and in addition an inventory of various floristic elements was also prepared by walking along different transects around these sampling sites. The location of sampling sites has been described later in the document. To understand the composition of the vegetation, most of the plant species were identified in the field itself whereas the species that could not be identified an herbarium specimen was made along with their photographs for identification later with the help of available published literature and floras of the region. Detailed list of sampling locations is given at **Table 3.21 and Figure 3.29**.

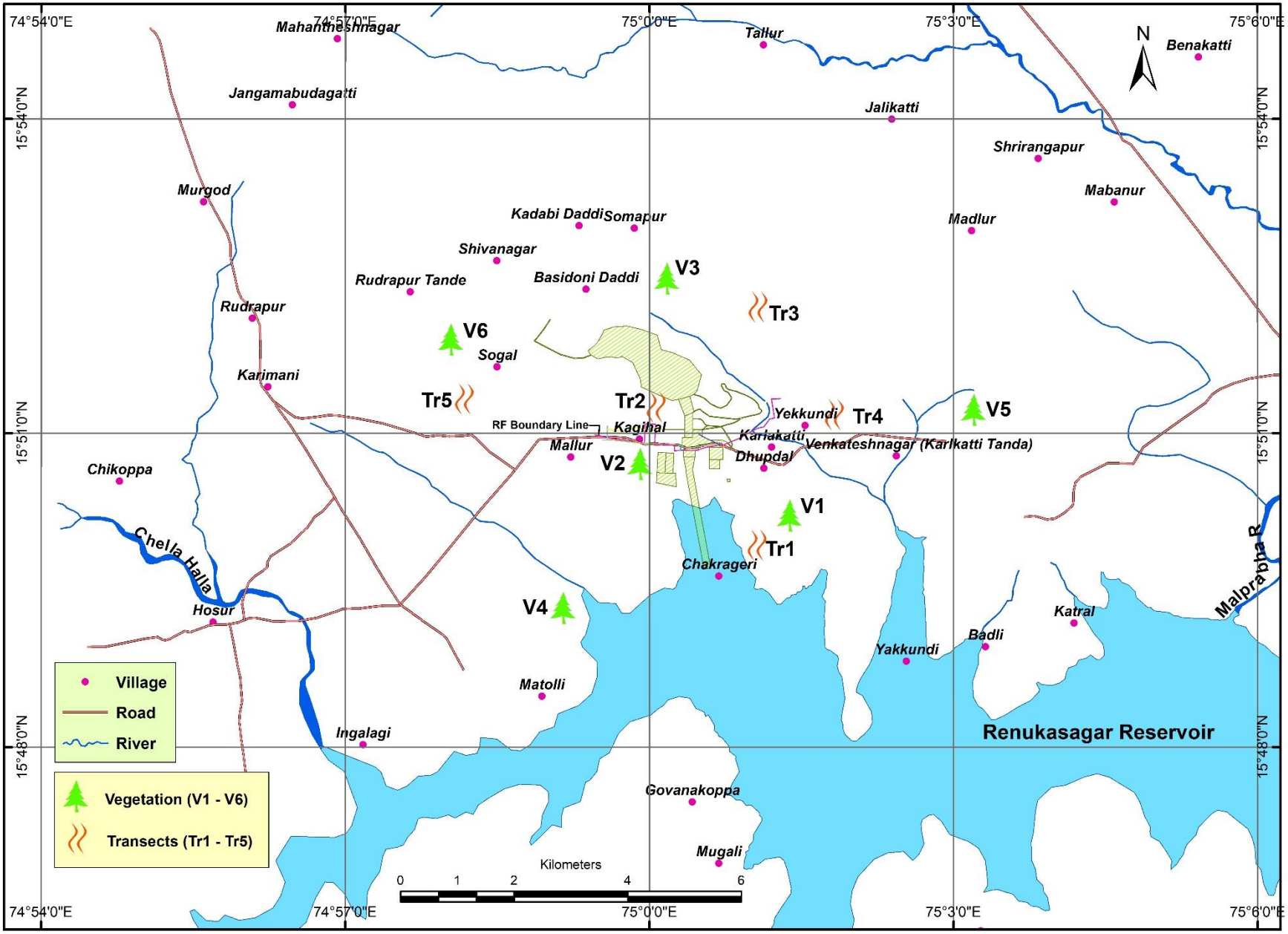


Figure 3.29: Location of Biological Sampling Sites in the study area

Table 3.21: Sampling Locations for Vegetation Sampling

Site	Sampling Location
V1	Chakrageri Village: Right Bank of Renuka Sagar Reservoir
V2	Near proposed Powerhouse Site
V3	Near Basidoni Village
V4	Near Renuka Sagar Reservoir area
V5	Near Karlakatti Tand Village
V6	Near Sogal Village

The inventory of plant species in the study area was prepared by recording plant species encountered during the field visit. Most of the plant species were identified in the field itself whereas the species that could not be identified, their photographs were taken for identification later with the help of available published literature.

Sampling Methodology

Standard methods of vegetation sampling were used for quantitative analysis of community structure. For these quadrats (a sampling unit) of different sizes were used depending upon the habit. For trees quadrat size of 10m x 10m was used and for shrubs quadrats of 5m x 5m were used while for herbs quadrat size of 1m x 1m was used. In each quadrat number of individuals of each plant species present was counted. For trees, shrubs and herbs 10 quadrats were laid at each sampling site.

The data thus obtained was compiled in tabular form and analyzed for different attributes like density, frequency and basal cover (basal area).

The density was calculated as follows:

$$\text{Density} = \frac{\text{Total no. of individuals of a plant species recorded from all quadrats}}{\text{Total number of quadrats studies}}$$

$$\text{Frequency (\%)} = \frac{\text{Number of quadrats of occurrence of a species}}{\text{Total number of quadrats studied}} \times 100$$

For calculation of dominance Basal area/cover of trees was calculated by measuring the 'cbh' (circumference at breast height) of each individual tree belonging to different species, which was then converted into basal area using the formula as follows:
Basal area = πr^2 where r value was calculated from cbh using the formula cbh= $2 \pi r$

The data on density and basal cover obtained above was then converted into per ha.

The Importance Value Index (IVI) for trees was determined as the sum of relative density, relative frequency and relative dominance (Curtis, 1959).

Diversity Indicies

The index of diversity was computed by using Shannon Wiener Diversity Index (Shannon Wiener, 1963) as:
$H = - \Sigma (ni/n) \times \ln (ni/n)$

Where, ni is individual density of a species and n is total density of all the species
The Evenness Index (E) is calculated by using Shannon's Evenness formula (Magurran, 2004).
Evenness Index (E) = H / ln(S)
Where, H is Shannon Wiener Diversity index; S is number of species

Species Composition

During the field surveys an inventory of 170 flowering plant species belonging to 51 families. This list includes 65 species of trees, 35 species of shrubs and 70 herbaceous species (refer **Table 3.22)**. Most of the vegetation is found mainly in the forest area, along and nearby the crop fields, as weeds of the agricultural fields and nearby the roads, etc. Trees are found mainly as plantations in the forest area or in the bunds of agricultural fields. Dominant angiosperm families in the area are Fabaceae (26 species), Malvaceae and Poaceae (17 species each), and Asteraceae (10 species) followed by Rubiaceae (8 species), Euphorbiaceae and Lamiaceae with 7 species each. Among the lower plants 8 species of pteridophytes was observed during field survey belongs to 7 families. The taxonomic classification and nomenclature are as per www.theplantlist.org.

List of plant species recorded from the area is given in **Annexure- V.**

Table 3.22: Family wise details of angiosperms species

S. No.	Vegetation Type	No. of Families	No. of Species
1	Trees	31	65
2	Shrubs	19	35
3	Herbs	27	70

Source: *field survey RSET*

In addition to angiosperms, 10 species of pteridophytes belonging to 7 families were also recoded from the study area (**refer Annexure V**).

Rare Threatened and Endangered Species

The conservation status of all 170 species of plants recorded from the study area was assessed. Their conservation status following IUCN Red list of Threatened Species Version 2018-2. *Acacia ferruginea* and *Chloroxylon swietenia* in Vulnerable (VU) category, *Gardenia gummifera* and *Wrightia tinctoria* are under Low risk/least concern (LR/lc) category. 10 species reported from the area are under Least Concern (LC) category (**Table 3.23**).
Mangifera indica and *Porteresia coarctata* are cultivated species.

Table 3.23: Conservation Status of Plant Species

S. No.	Family	Name of Species	IUCN Ver. 2018-2
1	Anacardiaceae	*Mangifera indica*	DD
2	Apocyanaceae	*Wrightia tinctoria*	LR/lc
3	Apocynaceae	*Holarrhena pubescens*	LC
4	Asteraceae	*Eclipta prostrata*	LC
5	Asteraceae	*Sphaeranthus indicus*	LC
6	Euphorbiaceae	*Euphorbia tirucalli*	LC
7	Fabaceae	*Acacia auriculiformis*	LC
8	Fabaceae	*Acacia nilotica*	LC
9	Fabaceae	*Pongamia pinnata*	LC
10	Fabaceae	*Tamarindus indica*	LC
11	Fabaceae	*Acacia ferruginea*	VU

S. No.	Family	Name of Species	IUCN Ver. 2018-2
12	Fabaceae	*Rhynchosia minima*	LC
13	Malvaceae	*Thespesia populnea*	LC
14	Meliaceae	*Azadirachta indica*	LC
15	Poaceae	*Porteresia coarctata*	DD
16	Poaceae	*Brachiaria eruciformis*	LC
17	Poaceae	*Cenchrus ciliaris*	LC
18	Rubiaceae	*Gardenia gummifera*	LR/lc
19	Rutaceae	*Chloroxylon swietenia*	VU
20	Solanaceae	*Physalis minima*	LC

Community Structure

The study area is characterized by agricultural fields, grassland, scrub forest and settlements. The vegetation in the study area comprises of Dry tropical thorn forest along with the agricultural crops and weeds. Trees were mostly recorded from the plantation sites within the forest area and near the habitation and bunds of agricultural farms. Pteridophytes are very scarce. These are mainly species like *Adiantum capillus-veneris, Adiantum caudatum, Pteris biaurita* and *Dryopteris cochleata*. Among bryophytes only *Riccia discolor* and *Plagiochasma* sp. which can be seen occasionally only after rains. Description of vegetation at various sampling location is discussed below:

V1: Chakrageri Village: Right Bank of Renuka Sagar Reservoir

The sampling site is V1 is on the right bank of Renuka sagar reservoir (Malaprabha river) near Chakragiri village. This area is characterized by agriculture farms and fallow land. Sugarcane and vegetables are the main crop in the area. Tree cover is comprised of *Cocos nucifera, Corymbia citriodora, Azadirachta indica, Ziziphus jujuba* and *Acacia auriculiformis. Cocos nucifera* and *Azadirachta indica* occur along the bunds of agricultural fields. *Corymbia citriodora, Ziziphus jujuba* and *Acacia auriculiformis* are recorded from fallow land and along the road side (**see Table 3.24**).

Shrub layer is dominated by weed species like *Lantana camara* followed by *Ziziphus xylopyrus* (**Table 3.25**). *Calotropis procera, Ipomoea carnea, Senna auriculata, Euphorbia caducifolia, Justicia adhatoda* and *Abutilon crispum* are the other shrub species recorded from the sampling site.

Herbaceous flora in sampling site V1 is comprised of 33 species. At this site 8 species of herbs were found during winter, 12 in summer and 13 species in monsoon season sampling (**Table 3.26**). *Argemone mexicana, Biophytum sensitivum, Euphorbia hirta, Parthenium hysterophorus, Porteresia coarctata, Thysanolaena latifolia, Apluda mutica, Sorghum halepense* are the common herbs of this area.

Table 3.24: Community structure –Site: V1 (Trees)

S. No.	Name of Species	Frequency (%)	Density (Indiv./ha)	Basal Area (sq m/ha)
1	*Acacia auriculiformis*	20	20	0.86
2	*Ziziphus jujuba*	30	30	0.39
3	*Azadirachta indica*	30	30	1.21
4	*Corymbia citriodora*	20	30	0.97
5	*Cocos nucifera*	50	60	0.85
	Total		**170**	

Table 3.25: Community structure –Site: V1 (Shrubs)

S. No.	Name of Species	Frequency (%)	Density (Indiv./ha)
1	*Abutilon crispum*	30	200
2	*Calotropis procera*	50	440
3	*Senna auriculata*	40	360
4	*Euphorbia caducifolia*	40	360
5	*Ipomoea carnea*	40	400
6	*Justicia adhatoda*	40	360
7	*Lantana camara*	60	600
8	*Ziziphus xylopyrus*	40	520

Table 3.26: Community structure –Site: V1 (Herbs)

S. No.	Name of Species	Frequency (%)	Density (Indiv./ha)
	Winter		
1	*Achyranthes aspera*	30	1900
2	*Argemone mexicana*	50	4500
3	*Biophytum sensitivum*	40	2800
4	*Corchorus trilocularis*	30	1700
5	*Euphorbia hirta*	50	2300
6	*Parthenium hysterophorus*	40	2500
7	*Porteresia coarctata*	60	3600
8	*Sida cordifolia*	20	1100
	Pre - Monsoon		
1	*Achyranthes aspera*	40	2500
2	*Argemone mexicana*	40	1400
3	*Biophytum sensitivum*	40	2500
4	*Corchorus trilocularis*	30	2000
5	*Euphorbia hirta*	50	3400
6	*Parthenium hysterophorus*	40	2100
7	*Porteresia coarctata*	60	3300
8	*Sida cordifolia*	40	2700
9	*Sorghum halepense*	50	2700
10	*Tephrosia purpurea*	40	2400
11	*Thysanolaena latifolia*	70	4200
12	*Xanthium strumarium*	40	2600
	Monsoon		
1	*Achyranthes aspera*	40	2700
2	*Apluda mutica*	30	3100
3	*Argemone mexicana*	40	2500
4	*Biophytum sensitivum*	60	3900
5	*Corchorus trilocularis*	40	2000
6	*Digitaria ciliaris*	40	2800
7	*Euphorbia hirta*	40	3800
8	*Oxalis latifolia*	30	2100
9	*Parthenium hysterophorus*	50	3800
10	*Porteresia coarctata*	40	2900
11	*Sida cordifolia*	40	2000
12	*Sorghum halepense*	40	2100
13	*Xanthium strumarium*	30	1800

V2: Near proposed Power House Area

Sampling site V2 is located in the proposed Power House area. The area is characterized by hillocks with open forest at one side and agricultural fields and habitation at toe of the hill. *Corymbia citriodora* is the dominant tree species planted in the forest area in the hill side and around the agricultural farms. Other associated tree species in sampling area are *Bauhinia racemosa, Casuarina equisetifolia, Holoptelea integrifolia, Bombax ceiba, Sapium insigne* and *Bauhinia racemosa* (**Table 3.27**).

In shrub layer 10 species were recorded from this location during sampling (**Table 3.28**). Shrub layer is represented mainly by *Lantana camara* and *Dodonaea viscosa.* Among other shrub species *Carissa carandas, Phyllanthus reticulatus, Abutilon crispum, Ziziphus xylopyrus, Urena lobata* and *Senna auriculata* was recorded from scrub land or from the bunds of agricultural fields. While, *Tecoma stans and Jatropha curcas* was found along the approach road in the forest area.

The herbaceous layer is comprised of 32 species in this area. Maximum density of herb species was recorded during monsoon season. *Ageratum conyzoides, Argemone mexicana, Parthenium hysterophorus, Pouzolzia zeylanica, Tagetes erecta, Grewia hirsuta, Sida cordifolia* and *Xanthium indicium* are the pre-dominant shrub species in the area (**Table 3.29**). Other most common species were *Achyranthes aspera, Anisomeles indica, Celastrus paniculatus, Cymbopogon martini, Eragrostis amabilis, Oxalis latifolia, Pouzolzia zeylanica* and *Tagetes erecta.*

Table 3.27: Community structure –Site: V2 (Trees)

S. No.	Name of Species	Frequency (%)	Density (Indiv./ha)	Basal Area (sq m/ha)
1	*Bauhinia racemosa*	30	50	0.27
2	*Bombax ceiba*	20	30	0.63
3	*Casuarina equisetifolia*	30	40	0.31
4	*Corymbia citriodora*	60	100	1.37
5	*Ficus benghalensis*	10	10	1.04
6	*Holoptelea integrifolia*	20	40	0.79
7	*Lannea coromandelica*	20	20	0.68
8	*Sapium insigne*	30	30	0.46
	Total		**320**	

Table 3.28: Community structure –Site: V2 (Shrubs)

S. No.	Name of Species	Frequency (%)	Density (Indiv./ha)
1	*Abutilon crispum*	40	280
2	*Carissa carandas*	30	360
3	*Senna auriculata*	30	200
4	*Dodonaea viscosa*	30	560
5	*Jatropha curcas*	20	240
6	*Lantana camara*	50	640
7	*Phyllanthus reticulatus*	50	320
8	*Tecoma stans*	40	280
9	*Urena lobata*	30	240
10	*Ziziphus xylopyrus*	30	240

Table 3.29: Community structure –Site: V2 (Herbs)

S. No.	Name of Species	Frequency (%)	Density (Indiv./ha)
	Winter		
1	*Ageratum conyzoides*	50	2900
2	*Anisomeles indica*	30	1500
3	*Argemone mexicana*	40	2100
4	*Cocculus hirsutus*	40	2100
5	*Eclipta prostrata*	50	2600
6	*Parthenium hysterophorus*	50	2800
7	*Pouzolzia zeylanica*	40	2400
8	*Rhynchosia minima*	30	2100
9	*Tagetes erecta*	40	2200
	Pre- Monsoon		

S. No.	Name of Species	Frequency (%)	Density (Indiv./ha)
1	*Ageratum conyzoides*	40	3300
2	*Argemone mexicana*	60	5900
3	*Celastrus paniculatus*	30	1400
4	*Cocculus hirsutus*	20	1900
5	*Cymbopogon martini*	40	3800
6	*Eragrostis amabilis*	40	2300
7	*Parthenium hysterophorus*	20	1800
8	*Pouzolzia zeylanica*	40	3500
9	*Rhynchosia minima*	50	2700
10	*Tagetes erecta*	20	1900
11	*Xanthium strumarium*	10	700
	Monsoon		
1	*Achyranthes aspera*	40	3400
2	*Ageratum conyzoides*	30	2400
3	*Argemone mexicana*	50	4600
4	*Cocculus hirsutus*	30	2600
5	*Corchorus trilocularis*	30	2700
6	*Grewia hirsuta*	30	3800
7	*Oxalis latifolia*	60	5300
8	*Parthenium hysterophorus*	30	3600
9	*Physalis minima*	30	2900
10	*Sida cordifolia*	30	2400
11	*Tragia involucrata*	20	2400
12	*Xanthium indicium*	40	2400

V3: Basidoni Village: Near proposed reservoir area

The sampling location is near Basidoni village (near proposed reservoir area). The area is characterized by agricultural as pre-dominant land use associated with scrub and barren land.

During the field surveys 6 species of trees were recorded at this site. *Corymbia citriodora* and *Tectona grandis* are the most dominant tree of this area (**Table 3.30)**. *Azadirachta indica, Bauhinia racemosa, Cocos nucifera* and *Ziziphus jujuba* are the other tree species recorded near agricultural farms and settlements.

Shrub layer is comprised of 9 species. *Grewia flavescens, Annona reticulata* and *Mundulea sericea* are the dominant shrub species in the area. *Helicteres isora, Urena lobata, Tecoma stans, Helicteres isora, Carissa carandas* and *Justicia adhatoda* are other shrub species found in the site. Plantation of *Pseudoxytenanthera stocksii* was also recorded from this site (**Table 3.31**).

Herbaceous flora at this location is comprised of 35 species. During winter sampling 8 species were recorded, 12 species during summer season and 15 during monsoon season (**Table 3.32**). Herbaceous layer was dominated by species like *Argemone mexicana, Achyranthes aspera, Parthenium hysterophorus, Gomphrena globosa, Tagetes erecta, Tragia involucrata, Xanthium strumarium, Porteresia coarctata* and *Biophytum sensitivum.*

Table 3.30: Community structure –Site: V3 (Trees)

S. No.	Name of Species	Frequency (%)	Density (Indiv./ha)	Basal Area (sq m/ha)
1	*Azadirachta indica*	30	30	1.14
2	*Bauhinia racemosa*	20	20	1.03
3	*Cocos nucifera*	20	20	1.28
4	*Corymbia citriodora*	30	50	0.65

S. No.	Name of Species	Frequency (%)	Density (Indiv./ha)	Basal Area (sq m/ha)
5	*Tectona grandis*	40	40	0.79
6	*Ziziphus jujuba*	30	30	0.41
	Total		**190**	

Table 3.31: Community structure –Site: V3 (Shrubs)

S. No.	Name of Species	Frequency (%)	Density (Indiv./ha)
1	*Annona reticulata*	30	400
2	*Carissa carandas*	40	320
3	*Grewia flavescens*	40	440
4	*Helicteres isora*	40	360
5	*Justicia adhatoda*	30	240
6	*Mundulea sericea*	40	360
7	*Pseudoxytenanthera stocksii*	30	280
8	*Tecoma stans*	30	320
9	*Urena lobata*	30	320

Table 3.32: Community structure –Site: V3 (Herbs)

S. No.	Name of Species	Frequency (%)	Density (Indiv./ha)
	Winter		
1	*Achyranthes aspera*	30	1900
2	*Argemone mexicana*	50	4500
3	*Biophytum sensitivum*	40	2800
4	*Corchorus trilocularis*	30	1700
5	*Euphorbia hirta*	50	2300
6	*Parthenium hysterophorus*	40	2500
7	*Porteresia coarctata*	60	3600
8	*Sida cordifolia*	20	1100
	Pre-Monsoon		
1	*Achyranthes aspera*	60	4900
2	*Ageratum conyzoides*	30	1900
3	*Argemone mexicana*	30	2100
4	*Cocculus hirsutus*	30	3000
5	*Corchorus trilocularis*	20	900
6	*Grewia hirsuta*	40	2700
7	*Oxalis latifolia*	30	1000
8	*Parthenium hysterophorus*	40	3300
9	*Physalis minima*	40	2200
10	*Sida cordifolia*	40	2900
11	*Tragia involucrata*	50	3200
12	*Xanthium strumarium*	40	3200
	Post-Monsoon		
1	*Achyranthes aspera*	20	2300
2	*Ageratum conyzoides*	20	2200
3	*Argemone mexicana*	30	2600
4	*Cocculus hirsutus*	20	1400
5	*Datura metel*	50	3300
6	*Eclipta prostrata*	30	2200
7	*Gomphrena globosa*	50	3600
8	*Grewia hirsuta*	20	1600
9	*Hedyotis puberula*	30	2700
10	*Heteropogon contortus*	10	1500
11	*Parthenium hysterophorus*	60	5300
12	*Porteresia coarctata*	10	800
13	*Sida cordifolia*	10	800
14	*Tagetes erecta*	40	3300
15	*Xanthium strumarium*	30	2600

V4: Renuka Sagar Reservoir area

Sampling site V4 site is located near Renuka sagar reservoir area. The area is characterized by open canopy forest surrounded with scrub land with open rocky surface with thorny vegetation on the slopes of hills. *Acacia nilotica*, *Corymbia citriodora* and *Ziziphus jujuba* are the dominant tree species in the area mainly found at the lower elevations. On the upper hills *Tectona grandis, Melia azedarach, Aegle marmelos, Azadirachta indica, Bauhinia racemosa, Acacia auriculiformis* and *Wrightia tinctoria* are the common tree species (**Table 3.33**).

Shrub layer is represented by 12 species (**Table 3.34)**. In open places *Phyllanthus reticulatus Lantana camara* and *Euphorbia caducifolia* are most common shrub species. *Aerva javanica, Abrus precatorius, Carissa carandas, Senna auriculata, Helicteres isora*, *Grewia flavescens, Hibiscus micranthus, Morinda pubescens* and *Triumfetta rhomboidea* was other associated shrub species found under the tree canopy as well as in open scrub land.

Herb layer was represented by 37 species. Maximum density of herbaceous species was recorded during Post-Monsoon season with 14 species. During winter and Pre-Monsoon season 10 species of herbs were recorded from this sampling site (**Table 3.35**). The herbaceous layer mainly consists of *Achyranthes aspera, Ammannia baccifera, Ageratum conyzoides, Sonchus oleraceus, Oxalis latifolia, Tragia involucrata, Sida cordifolia, Porteresia coarctata, Cocculus hirsutus* and *Heteropogon contortus*.

Table 3.33: Community structure –Site: V4 (Trees)

S. No.	Name of Species	Frequency (%)	Density (Indiv./ha)	Basal Area (sq m/ha)
1	*Acacia auriculiformis*	30	40	0.37
2	*Acacia nilotica*	40	60	0.73
3	*Aegle marmelos*	20	20	0.40
4	*Azadirachta indica*	20	40	1.12
5	*Bauhinia racemosa*	20	30	1.21
6	*Corymbia citriodora*	30	60	1.66
7	*Melia azedarach*	40	50	1.09
8	*Tectona grandis*	20	30	0.54
9	*Wrightia tinctoria*	30	40	0.87
10	*Ziziphus jujuba*	30	60	0.66
	Total		**430**	

Table 3.34: Community structure –Site: V4 (Shrubs)

S. No.	Name of Species	Frequency (%)	Density (Indiv./ha)
1	*Abrus precatorius*	50	400
2	*Aerva javanica*	40	360
3	*Carissa carandas*	30	240
4	*Senna auriculata*	40	320
5	*Euphorbia caducifolia*	40	440
6	*Grewia flavescens*	30	240
7	*Helicteres isora*	30	320
8	*Hibiscus micranthus*	30	280
9	*Lantana camara*	40	480
10	*Morinda pubescens*	30	280
11	*Phyllanthus reticulatus*	60	520
12	*Triumfetta rhomboidea*	30	240

Table 3.35: Community structure –Site: V4 (Herbs)

S. No.	Name of Species	Frequency (%)	Density (Indiv./ha)
	Winter		
1	*Achyranthes aspera*	40	2700
2	*Ammannia baccifera*	40	2300
3	*Datura metel*	20	1000
4	*Grewia hirsuta*	30	1000
5	*Lepidagathis cristata*	50	2900
6	*Oxalis latifolia*	40	2100
7	*Physalis minima*	30	1500
8	*Sida cordifolia*	30	1000
9	*Tagetes erecta*	40	3100
10	*Tragia involucrata*	50	3200
	Pre-Monsoon		
1	*Achyranthes aspera*	50	3000
2	*Ageratum conyzoides*	50	2500
3	*Datura metel*	50	1700
4	*Grewia hirsuta*	50	2400
5	*Oxalis latifolia*	50	4200
6	*Parthenium hysterophorus*	50	3600
7	*Physalis minima*	50	3100
8	*Sida cordifolia*	50	2000
9	*Sonchus oleraceus*	50	4100
10	*Tragia involucrata*	50	3200
	Post-Monsoon		
1	*Achyranthes aspera*	4200	2300
2	*Ageratum conyzoides*	2500	800
3	*Datura metel*	1500	800
4	*Eclipta prostrata*	3600	1400
5	*Grewia hirsuta*	3200	1500
6	*Hedyotis puberula*	2600	1600
7	*Heteropogon contortus*	2500	2200
8	*Oxalis latifolia*	1700	2200
9	*Parthenium hysterophorus*	2200	2600
10	*Physalis minima*	3600	2600
11	*Porteresia coarctata*	1600	2700
12	*Sida cordifolia*	2200	3300
13	*Sonchus oleraceus*	400	3300
14	*Tragia involucrata*	5300	3600

V5: Near Karlakatti Tand Village

The sampling site V5 is located in Karlakatti Tand village. Agriculture is the pre-dominant land use in the area. Tree layer dominated by *Cocos nucifera* and *Tectona grandis* (**Table 3.36**). *Aegle marmelos, Albizia lebbeck, Azadirachta indica, Neolamarckia cadamba* and *Cassia fistula* are main tree associates.

The shrub layer is dominated by *Lantana camara* which is recorded near agricultural farms and along the road. *Ziziphus xylopyrus* are the species dominating the scrub and fallow/barren land. (**Table 3.37**).

The herb layer was represented by 11 species during winter and pre-monsoon season each, and 13 species during post-monsoon (**Table 3.38**). The herbaceous species dominant in the area are *Parthenium hysterophorus, Cissus vitiginea, Saccharum bengalense, Gomphrena globosa, Oxalis latifolia* and *Xanthium strumarium. Ageratum conyzoides, Brachiaria*

eruciformis, Cymbopogon martini, Sida cordifolia, Tribulus terrestris and *Waltheria indica* are the other common herb species recorded from this area.

Table 3.36: Community structure –Site: V5 (Trees)

S. No.	Name of Species	Frequency (%)	Density (Indiv./ha)	Basal Area (sq m/ha)
1	*Aegle marmelos*	20	30	0.32
2	*Albizia lebbeck*	30	30	0.34
3	*Azadirachta indica*	30	30	0.71
4	*Cassia fistula*	10	10	0.19
5	*Cocos nucifera*	30	50	1.11
6	*Neolamarckia cadamba*	20	20	0.73
7	*Tamarindus indica*	30	30	0.43
8	*Tectona grandis*	30	30	0.44
9	*Ziziphus jujuba*	20	20	0.21
	Total		**250**	

Table 3.37: Community structure –Site: V5 (Shrubs)

S. No.	Name of Species	Frequency (%)	Density (Indiv./ha)
1	*Abutilon crispum*	60	400
2	*Canthium parviflorum*	20	160
3	*Senna auriculata*	40	360
4	*Euphorbia caducifolia*	40	320
5	*Grewia flavescens*	40	360
6	*Holarrhena pubescens*	30	160
7	*Lantana camara*	20	160
8	*Mundulea sericea*	30	240
9	*Pavetta tomentosa*	20	240
10	*Phyllanthus reticulatus*	30	200
11	*Ziziphus xylopyrus*	30	240

Table 3.38: Community structure –Site: V5 (Herbs)

S. No.	Name of Species	Frequency (%)	Density (Indiv./ha)
	Winter		
1	*Brachiaria eruciformis*	30	1500
2	*Cissus vitiginea*	60	3600
3	*Cymbopogon martini*	20	1000
4	*Saccharum bengalense*	20	1000
5	*Gomphrena globosa*	20	900
6	*Oxalis latifolia*	50	2900
7	*Parthenium hysterophorus*	30	2800
8	*Pavonia zeylanica*	40	2600
9	*Tragia involucrata*	20	800
10	*Waltheria indica*	40	1900
11	*Xanthium strumarium*	30	1400
	Pre-Monsoon		
1	*Cissus vitiginea*	30	1800
2	*Echinops echinatus*	50	3000
3	*Saccharum bengalense*	60	4400
4	*Gomphrena globosa*	50	3400
5	*Lepidagathis cristata*	30	2100
6	*Parthenium hysterophorus*	40	4100
7	*Sida cordifolia*	20	1000
8	*Tagetes erecta*	30	2800
9	*Tribulus terrestris*	40	2700
10	*Waltheria indica*	40	2500
11	*Xanthium strumarium*	40	3100
	Post-Monsoon		
1	*Ageratum conyzoides*	40	3300

S. No.	Name of Species	Frequency (%)	Density (Indiv./ha)
2	*Cissus vitiginea*	40	4200
3	*Echinops echinatus*	30	2200
4	*Saccharum bengalense*	40	3600
5	*Gomphrena globosa*	50	3600
6	*Lepidagathis cristata*	40	3500
7	*Parthenium hysterophorus*	30	2800
8	*Porteresia coarctata*	30	1900
9	*Sida cordifolia*	30	2100
10	*Sorghum halepense*	40	3200
11	*Tribulus terrestris*	20	2300
12	*Waltheria indica*	20	2200
13	*Xanthium strumarium*	50	4200

V6: Near Sogal Village

The sampling site V6 is located near Sogal village. The vegetation of this area is characterized by scrub land.

Tree canopy is represented by 6 species dominated by *Acacia nilotica* and *Phoenix sylvestris* (**Table 3.39**). Other common tree recorded from the area are *Bauhinia racemosa*, *Phyllanthus emblica* and *Ziziphus jujuba. Tectona grandis* was also recoded from the edges of village road and bunds of the agricultural farms.

Shrub layer is comprised of 13 species (**Table 3.40**). *Euphorbia caducifolia, Dodonaea viscosa, Morinda pubescens, Lantana camara* and *Ziziphus xylopyrus* are the species recorded from scrub or fallow land*. Carissa carandas, Justicia adhatoda* and *Phyllanthus reticulatus* were found dominant near agricultural farms (**Table 3.40**).

Herbaceous flora in the sampling area is comprised of 21 species (**Table 3.41**). At this site 7 species of herbs were found during winter, 8 in pre-monsoon and 6 species in post-monsoon season sampling (**Table 3.41**). *Argemone mexicana, Eclipta prostrata, Polycarpaea corymbosa* and *Waltheria indica* and are the most dominant species in the area. Other commonly occurring herb species recorded from are the area were *Tiliacora racemosa, Cissus quadrangularis* and *Grewia hirsuta.*

Table 3.39: Community structure –Site: V6 (Trees)

S. No.	Name of Species	Frequency (%)	Density (Indiv./ha)	Basal Area (sq m/ha)
1	*Acacia nilotica*	50	50	0.58
2	*Bauhinia racemosa*	30	30	0.48
3	*Phoenix sylvestris*	40	40	0.96
4	*Phyllanthus emblica*	20	20	0.81
5	*Tectona grandis*	30	30	0.63
6	*Ziziphus jujuba*	20	20	0.68
	Total		**190**	

Table 3.40: Community structure –Site: V6 (Shrubs)

S. No.	Name of Species	Frequency (%)	Density (Indiv./ha)
1	*Abrus precatorius*	30	200
2	*Abutilon crispum*	40	280
3	*Carissa carandas*	30	200
4	*Senna auriculata*	50	280
5	*Dodonaea viscosa*	30	400
6	*Euphorbia caducifolia*	40	440
7	*Hibiscus micranthus*	40	360
8	*Justicia adhatoda*	30	320

S. No.	Name of Species	Frequency (%)	Density (Indiv./ha)
9	*Lantana camara*	30	240
10	*Morinda pubescens*	40	360
11	*Phyllanthus reticulatus*	40	320
12	*Triumfetta rhomboidea*	40	320
13	*Ziziphus xylopyrus*	30	200

Table 3.41: Community structure –Site: V6 (Herbs)

S. No.	Name of Species	Frequency (%)	Density (Indiv./ha)
	Winter		
1	*Argemone mexicana*	50	2300
2	*Cocculus hirsutus*	40	2200
3	*Eclipta prostrata*	50	2500
4	*Polycarpaea corymbosa*	40	2100
5	*Sida acuta*	30	1500
6	*Tiliacora racemosa*	40	2300
7	*Waltheria indica*	40	2200
	Pre-Monsoon		
1	*Ammannia baccifera*	30	2900
2	*Argemone mexicana*	40	3100
3	*Cissus quadrangularis*	50	3600
4	*Eclipta prostrata*	60	5700
5	*Grewia hirsuta*	40	2900
6	*Pavonia zeylanica*	30	2600
7	*Tephrosia purpurea*	30	2700
8	*Waltheria indica*	20	1400
	Post-Monsoon		
1	*Argemone mexicana*	60	6700
2	*Eclipta prostrata*	50	6600
3	*Polycarpaea corymbosa*	40	2400
4	*Sida acuta*	40	2400
5	*Tiliacora racemosa*	60	4500
6	*Waltheria indica*	40	3800

Density, Dominance & Diversity

i) Density

Density is one of the indicators to assess the dominance of a plant species occurring in an area. The density of trees varied from site to site depending upon elevation and the extent of area subjected to road construction in the area. The overall tree density throughout the study area ranged from minimum of 170 number of trees/ha to maximum of 430 trees/ha (**Table 3.42**). Highest tree density was recorded at sampling site V3 located near proposed reservoir area and lowest was at sampling site V1 located near Chakrageri village near the bank of Malaprabha river.

The shrub layer was quite prominent on scrub land and forest area. The density of shrub layer varied from 2840 plants/ha to 4120 plants/ha, lowest density was found at sites located near Karlakatti village and highest at sampling site located on left bank of proposed reservoir area characterized under open and scrub forest (**Table 3.42**).

The density of herbaceous plant species varied from season to season amongst all sampling sites (**Table 3.42**). In winter season herb density is highest at sampling site located near Basidoni village (21900 plants/ha) and lowest at Sampling site located near Chakrageri and Karlakatti village (20400 plants/ha). In Pre-Monsoon season, highest density was recorded from sampling site V1 (31800 plants/ha) located near Chakrageri village and lowest herb

density (29200 plants/ha) was found near proposed power house site. In monsoon season herb density varies from minimum 35500 plants/ha to maximum 39300 plants/ha.

Table 3.42: Density (plants per ha) of Trees, Shrubs and Herbs

Sampling Site	Trees	Shrubs	Herbs		
			Winter	Summer	Monsoon
V1	170	3240	20400	31800	35500
V2	320	3360	20700	29200	38500
V3	190	3040	21900	31300	36200
V4	430	4120	20800	29800	37100
V5	250	2840	20400	30900	39100
V6	190	3920	20500	31600	39300

ii) Dominance (IVI)

Based upon the Importance Value Index (IVI) the trees in the project area given in table below species like *Azadirachta indica, Acacia nilotica, Bauhinia racemosa, Corymbia citriodora, Cocos nucifera, Tectona grandis* and *Ziziphus jujuba* are most dominant trees in the project area (**Table 3.43**).

Table 3.43: Importance Value Index (IVI) of Trees

S. No.	Name of Species	V1	V2	V3	V4	V5	V6
1	*Acacia auriculiformis*	47	--	--	48	--	--
2	*Acacia nilotica*	--	--	--	69	--	56
3	*Aegle marmelos*	--	--	--	80	34	--
4	*Albizia lebbeck*	--	--	--	--	30	--
5	*Azadirachta indica*	32		83	26	36	--
6	*Bauhinia racemosa*	--	28	31	55	--	42
7	*Bombax ceiba*	--	46	--	--	--	--
8	*Cassia fistula*	--	--	--		56	--
9	*Casuarina equisetifolia*	--	60	--	--	--	--
10	*Cocos nucifera*	41		24		37	--
11	*Corymbia citriodora*	--	16	29	28	44	--
12	*Ficus benghalensis*	--	38	--	--	--	--
13	*Holoptelea integrifolia*	--	20	--		--	--
14	*Lannea coromandelica*	--	30	--		--	--
15	*Melia azedarach*	--		--	32	--	--
16	*Neolamarckia cadamba*	--	--	--	--	28	--
17	*Phoenix sylvestris*	--	--	--	--	--	33
18	*Phyllanthus emblica*	--	--	--	--	--	41
19	*Sapium insigne*	--	13	--	----	--	--
20	*Tamarindus indica*	--	--	--	--	58	--
21	*Tectona grandis*	--	--	33	35	35	22
22	*Wrightia tinctoria*	--	--	--	67	--	--
23	*Ziziphus jujuba*	43	--	65	41	47	37

iii) Diversity

To understand the species diversity Shannon Wiener Diversity was calculated separately for trees, shrubs and herbs. Amongst the trees the diversity Index ranged from low of 1.54 at sampling site V1 (near Chakrageri village) to highest of 2.25 at sampling site V4 (proposed reservoir area) (**Table 3.44**).

Amongst shrubs the highest diversity was recorded at sampling site V4 i.e. 2.45 and lowest at sampling site V1 with 2.04 (**Table 3.44**).

The species diversity in herbs was observed higher during monsoon period and varied from 2.41 (site V6) to 2.60 (site V3) at different sampling location. During winter diversity index varied from low of 2.00 at Site-V1 to 2.28 at Site-V5. During pre-monsoon highest diversity value 2.45 was recorded from site V1 and lowest 2.27 was recorded from site V2 and V4 (**Table 3.44**).

Table 3.44: Shannon Wiener Diversity Index (H)

Sampling Site	Trees	Shrubs	Herbs		
			Winter	Pre-Monsoon	Monsoon
V1	1.54	2.04	2.00	2.45	2.53
V2	1.90	2.23	2.18	2.27	2.45
V3	1.41	2.18	2.24	2.40	2.60
V4	2.25	2.45	2.21	2.27	2.53
V5	2.13	2.35	2.28	2.34	2.53
V6	1.74	2.53	2.06	2.37	2.41

3.2.2.3 Faunal Elements

The fauna of the study area has been compiled with the help of direct sighting during field survey, supplemented with secondary sources and information provided by local people during field survey in the study area. For the preparation of checklist of animals, Forest Working Plan of North Sagar Forest Division was consulted. In addition, data was compiled from published literature like Prater (1998) for mammals, Daniel (2002) for reptiles and Ali & Ripley (1983) for birds.

Sampling Methodology & Constraints

Since observations of fauna and wildlife take long time, primary surveys were limited to field visits and direct and indirect sightings of animals. The presence of wildlife was also confirmed from the local inhabitants depending on the animal sightings and the frequency of their visits in the study area at locations given in **Table 3.45**.

Table 3.45: Transects and trails for faunal elements

Transect Code	Location
Tr 1	Chakrageri Village: Right Bank of Renuka Sagar Reservoir
Tr 2	Near proposed Powerhouse Site
Tr 3	Near Proposed Reservoir area
Tr 4	Near Karlakatti Tand Village
Tr 5	Near Sogal Village

The study area was divided into different strata based on vegetation and topography. Sampling for habitat and animals was done in different strata. As the normal systematic transects for mammals and birds were not possible in this study area due to undulating terrain, therefore mostly trails were used for faunal sampling. In addition to the field sampling the data/ information was also collected as follows:

Direct sighting and indirect evidences such as calls, signs and skeletons of mammals were recorded along the survey routes. The interviews of local villagers were conducted for the presence and relative abundance of various animal species within each locality. In addition, the data was also collected on habitat condition, animal presence by direct sighting and indirect evidences by forest personnel and villagers.

Transect walks along the forest trail in the study area were undertaken to observe wildlife status in each forest areas that belong to the impact or activity area of proposed project. To study the wild mammalian fauna of the study area, 2 – 5 kms long transects and trails were walked during early morning and evening hours. Direct sighting of animals as well as indirect signs like scat, pellets, pugmarks, scraps, vocalizations, horns etc. were also recorded during the survey trails. Animals and birds observed along the route were recorded, together with information on their habitat. Secondary data as well as information gathered from the locals were also noted for the presence or absence of wild animals in the area. These indirect evidences and information were analyzed and ascertained with the help of literature available.

The birds were also sighted on the same transect and trails marked for mammals. Sampling was carried out on a fixed width trails of 2 km wherever the terrain permitted, and point counts were carried out at a fixed distance at regular intervals. A prismatic field binocular (10 × 50) was used for bird watching during transect survey and nearby the human habitation of study area.

For herpetofauna exploratory surveys were undertaken for probable sightings by walking along the identified linear transects cum trails comprised of narrow strips (which included the adjoining areas). The data collected was supplemented with data from secondary sources and information provided by locals.

i) Mammals

During the surveys 5 mammalian species viz; *Semnopithecus entellus* (Grey Langur) *Macaca mulatta* (Rhesus macaque) *Funambulus palmarum* (Indian Palm Squirrel), *Cynopterus sphinx* (Short-nosed Fruit Bat), *Herpestes auropunctatus* (Small Indian Mongoose), were sighted near the habitation as well as in forest area.

According to the list prepared based upon secondary data 22 species of mammals are reported from the area and the same is given at **Table 3.46**.

Table 3.46: A list of Mammalian species reported in the study area (The species marked with* were sighted during the survey)

S. No.	Family	Scientific Name	Common Name	IWPA 1972	IUCN
	Order: Carnivora				
1	Canidae	*Vulpes bengalensis*	Indian Fox	II	LC
2	Canidae	*Canis aureus naria*	Asiatic Jackal	--	NE
3	Felidae	*Felis chaus*	Jungle cat	II	LC
4	Herpestidae	*Herpestes edwardsii*	Indian Grey Mongoose	II	LC
5	Herpestidae	*Herpestes auropunctatus*	Small Indian Mongoose	V	LC
	Order: Cetartiodactyla				
6	Cervidae	*Axis axis*	Spotted deer	III	LC
7	Suidae	*Sus scrofa*	Wild Boar	III	LC
	Order: Chiroptera			V	LC
8	Pteropodidae	*Cynopterus sphinx*	Short-nosed Fruit Bat	V	LC
9	Pteropodidae	*Eonycteris spelaea*	Cave Fruit Bat	V	LC
10	Pteropodidae	*Pteropus giganteus*	Indian flying fox	IV	LC
	Order: Eulipotyphla				
11	Erinaceidae	*Paraechinus micropus*	Indian Hedgehog	V	LC
12	Soricidae	*Suncus murinus*	House Shrew	IV	LC

S. No.	Family	Scientific Name	Common Name	IWPA 1972	IUCN
	Order: Lagomorpha				
13	Leporidae	*Lepus nigricollis*	Common hare	II	LC
	Order: Primates				
14	Cercopithecidae	*Macaca mulatta*	Rhesus macaque	II	LC
15	Cercopithecidae	*Semnopithecus entellus*	Grey Langur	V	LC
	Order: Rodentia				
16	Muridae	*Bandicota indica*	Large Bandicoot Rat	V	LC
17	Muridae	*Mus booduga*	Field Mouse	V	LC
18	Muridae	*Mus musculus*	House mouse	V	LC
19	Muridae	*Rattus rattus*	House rat	V	LC
20	Muridae	*Tatera indica*	Indian Gerbil	IV	LC
21	Sciuridae	*Funambulus palmarum*	Indian Palm Squirrel	V	LC
	Order: Scandentia				
22	Tupaiidae	*Anathana ellioti*	Madras Tree Shrew	--	LC

IUCN Ver. 2018-2 - *International Union for Conservation of Nature; LC - Least Concern; NE: Not Evaluated; I WPA – Indian Wildlife (Protection) Act, 1972*

ii) Avifauna

The survey for birds was carried out on fixed width trails of 2 km wherever the terrain permitted. Birds were identified as per the field guide of birds by Ali & Ripley (1983), Grimmett *et al.* (1998, 2011), Inskipp *et al.* (1999) and Kazmierczak (2000).

During the field surveys, 25 species of birds were sighted from the study area. House sparrow, Jungle Babbler, crow, Common Myna, Red-wattled Lapwing and Cattle Egret were most frequently sighted bird species in the study area. A total of 41 species of bird species belonging to 28 families was compiled based upon sighting as well as secondary data. List of bird species and their conservation status has been given in **Table 3.47.** The classification and nomenclature of bird species is as per https://avibase.bsc-eoc.org.

Table 3.47: List of avifauna reported from the study area with their conservation status in the study area (*Species marked as* were sighted during the field survey*)

S. No.	Family	Species Name	Common Name	IUCN Redlist 2018-2	IWPA Schedule	Habit
1	Accipitridae	*Elanus caeruleus*	Black Shoulderd kite	LC	IV	R
2	Alaudidae	*Mirafra cantillans*	Singing Bush Lark	LC	IV	R
3	Alcedinidae	*Alcedo atthis**	Common Kingfisher	LC	IV	RM
4	Alcedinidae	*Ceryle rudis *	Pied Kingfisher	LC	IV	R
5	Alcedinidae	*Halcyon smyrnensis*	White-breasted Kingfisher	LC	IV	R
6	Apodidae	*Apus affinis**	House Swift/ Little Swift	LC	--	RM
7	Ardeidae	*Bubulcus ibis**	Cattle Egret	LC	IV	R
8	Ardeidae	*Egretta garzetta**	Little Egret	LC	IV	R
9	Charadriidae	*Vanellus indicus *	Red-wattled Lapwing	LC	IV	R
10	Charadriidae	*Vanellus malabaricus**	Yellow-wattled Lapwing	LC	IV	R
11	Columbidae	*Chalcophaps indica**	Green-winged Pigeon	LC	IV	R
12	Columbidae	*Streptopelia decaocto*	Indian Ring Dove	LC	IV	R
13	Columbidae	*Streptopelia senegalensis*	Laughing Dove	LC	IV	R
14	Coraciidae	*Coracias benghalensis*	Indian Roller	LC	IV	R
15	Corvidae	*Corvus splendens *	House Crow	LC	V	R
16	Corvidae	*Corvus macrorhynchos**	Jungle Crow	LC	IV	R
17	Cuculidae	*Eudynamys scolopaceus*	Asian Koel	LC	IV	R
18	Cuculidae	*Hierococcyx varius**	Common Hawk-cuckoo	LC	IV	R
19	Cuculidae	*Centropus bengalensis*	Lesser Coucal	LC	IV	R

S. No.	Family	Species Name	Common Name	IUCN Redlist 2018-2	IWPA Schedule	Habit
20	Dicruridae	*Dicrurus macrocercus**	Black Drongo	LC	IV	R
21	Estrildidae	*Lonchura malacca*	Black Headed Munia	LC	IV	R
22	Hirundinidae	*Hirundo concolor*	Dusky Crag Martin	LC	--	R
23	Meropidae	*Merops orientalis**	Small Green bee-eater	LC	--	R
24	Nectariniidae	*Nectarinia asiatica**	Purple Sunbird	LC	IV	R
25	Paridae	*Parus major**	Great Tit	LC	IV	R
26	Passerinae	*Passer domesticus **	House Sparrow	LC	IV	R
27	Phasianidae	*Pavo cristatus**	Indian Peafowl	LC	I	R
28	Phalacrocoracidae	*Phalacrocorax niger**	Little Cormorant	LC	IV	R
29	Psittacidae	*Psittacula krameri**	Rose-ringed Parakeet	LC	IV	R
30	Pycnonotidae	*Pycnonotus cafer**	Red-vented Bulbul	LC	IV	R
31	Rhipidurinae	*Rhipidura aureola**	White-browed Fantail	LC	IV	R
32	Scolopacidae	*Actitis hypoleucos*	Common Sandpiper	LC	IV	RM
33	Sturnidae	*Acridotheres tristis **	Common Myna	LC	IV	R
34	Sylviinae	*Prinia socialis*	Ashy Prinia	LC	--	R
35	Sylviinae	*Orthotomus sutorius**	Common Tailorbird	LC	IV	R
36	Sylviinae	*Prinia buchanani*	Rufous fronted Prinia	LC	IV	R
37	Timaliinae	*Turdoides caudata **	Common Babbler	LC	IV	R
38	Timaliinae	*Turdoides malcolmi**	Large-grey Babbler	LC	IV	R
39	Turdinae	*Saxicoloides fulicata*	Indian Robin	LC	IV	R
40	Turdinae	*Copsychus saularis*	Oriental Magpie-Robin	LC	IV	R
41	Tytonidae	*Tyto alba*	Common Barn-owl	LC	IV	R

IUCN Ver. 2018-2 - *International Union for Conservation of Nature; LC - Least Concern WPA – Wildlife (Protection) Act, 1972; R=Resident; RM=Resident migrant*

iii) Butterflies

The butterflies are common in the area and were sighted throughout the study period. Their presence was abundant in monsoon and summer season however their visibility was low in winter months.

Total of 11 species of butterflies belonging to 4 families were recorded (**Table 3.48**) from the surroundings of proposed project area. Nymphalidae family was represented by 5 species followed by Papilionidae. Among the butterflies, Cabbage White (*Pieris rapae*), Plain Tiger (*Danaus chrysippus)* and Blue Pansy (*Precis orithya)* were most frequently sighted species in the study area.

Table 3.48: List of Butterflies found in the Study Area

S. No.	Family	Species Name	Common Name
1	Lycaenidae	*Pseudozizeeria maha*	Pale Grass Blue
2	Nymphalidae	*Mycalesis perseu*	Common Bush brown
3	Nymphalidae	*Danaus chrysippus*	Plain Tiger
4	Nymphalidae	*Precis orithya*	Blue Pansy
5	Nymphalidae	*Aglais cachmirensis*	Indian Tortoise shell
6	Nymphalidae	*Junonia hierta*	Yellow pansy
7	Papilionidae	*Papilio machaon*	Swallow Tailed
8	Papilionidae	*Papilio crino*	Common Banded Peacock
9	Papilionidae	*Papilio polytes*	Common Mormon
10	Papilionidae	*Papilio demoleus*	Lime Yellow
11	Pieridae	*Pieris rapae*	Cabbage White

iv) Herpetofauna

Herpetofauna comprised of snakes and lizards is given in **Table 3.49**. Fan throated Lizard, Garden lizard, Chameleon and skink are commonly sighted species in the area.

Table 3.49: List of Herpetofauna found in the Study Area

S. No.	Scientific Name	Common Name	Local Name
1	*Calotes versicolor*	Garden lizard	Tonda
2	*Chamaeleo zeylanicus*	Indian Chameleon	Usaravilli
3	*Mabuya carinata*	Common skink	Raktapinjari
4	*Naja naja*	King cobra	Nagu Pamu
5	*Python molurus*	Python	Kondachiluva
6	*Sitana ponticeriana*	Fan throated Lizard	
7	*Varanus varius*	Lace monitor	Guhera
8	*Zamenis mucosus*	Common rat snake	Jerripotu

v) Conservation Status of Fauna

As per IUCN Red list of Threatened Species. Version 2018.2 all the mammalian species reported from the area are under Least Concern (LC) category (**refer table 3.46**).

Among the avifaunal species only one species is listed as Schedule I under WPA (1972) i.e. Indian Peafowl, and rest of the species fall under Schedule IV except House crow under Schedule-V (**see Table 3.47**).

Conclusions

i) Agriculture is dominant land use pattern in the study area, cotton, sugarcane, maize and vegetables are the main crop in the area.

ii) The factors responsible for degradation of forests are anthropogenic activities. Forest land in the area was encroached by villagers resettled due to Renuka Sagar reservoir (Malaprabha Dam) for farming.

iii) There are small patches of forests mostly secondary in nature are dominating by *Corymbia citriodora* (Eucalyptus) species associated with *Acacia auriculiformis, Acacia nilotica, Ziziphus jujuba, Azadirachta indica, Lannea coromandelica, Bauhinia racemosa.*

iv) According to 'A Revised Survey of the Forest Types of India' by Champion and Seth (1968) the forests types are under Tropical Dry Deciduous Forest and Tropical Thorn Forest.

v) According to Rodgers & Panwar (1988) biogeographic classification the regions falls in Biogeographic zone (6) Deccan Peninsula; Deccan South (6E) biotic province.

vi) The most common tree species are *Azadirachta indica, Ziziphus jujuba, Bauhinia racemosa, Cassia fistula* and *Holoptelia integrifolia*. *Capparis divaricata, Calotropis gigantea, Dodonaea viscosa, Lantana camara, Ziziphus xylopyrus* and *Justicia adhatoda* are the common shrubs occurring in the area.

vii) Total numbers of plant species recorded were 170 including herbs (65), trees (35) and shrubs (70).

viii) *Lantana camara, Argemone mexicana, Parthenium hysterophorus* and *Achyranthes aspera* are the common invasive exotic species found in the area.

ix) As per IUCN Red list of Threatened Species. Version 2018.2 all the mammalian and avifaunal species reported from the area are under Least Concern (LC) category.

x) Mammals are represented by 22 species of which only 5 mammalian species viz; *Semnopithecus entellus* (Grey Langur) *Macaca mulatta* (Rhesus macaque) *Funambulus palmarum* (Indian Palm Squirrel), *Cynopterus sphinx* (Short-nosed Fruit Bat), *Herpestes auropunctatus* (Small Indian Mongoose), were sighted.

xi) Birds are represented by 41 species of which 25 were sighted during surveys.

xii) As per the Indian Wildlife (Protection) Act 1972 only one bird species falls under Schedule I i.e. *Pavo cristatus* (Indian Peafowl).

3.2.3 Proximity to Protected Area

Ghataprabha Bird Sanctuary is about 38.40 kms aerial distance from the proposed project reservoir area of the Standalone Pumped Storage Component of Saundatti IRE Project. The location of Ghataprabha Bird Sanctuary in relation to Standalone Pumped Storage component of Saundatti IRE Project is shown in **Figure 3.30**.

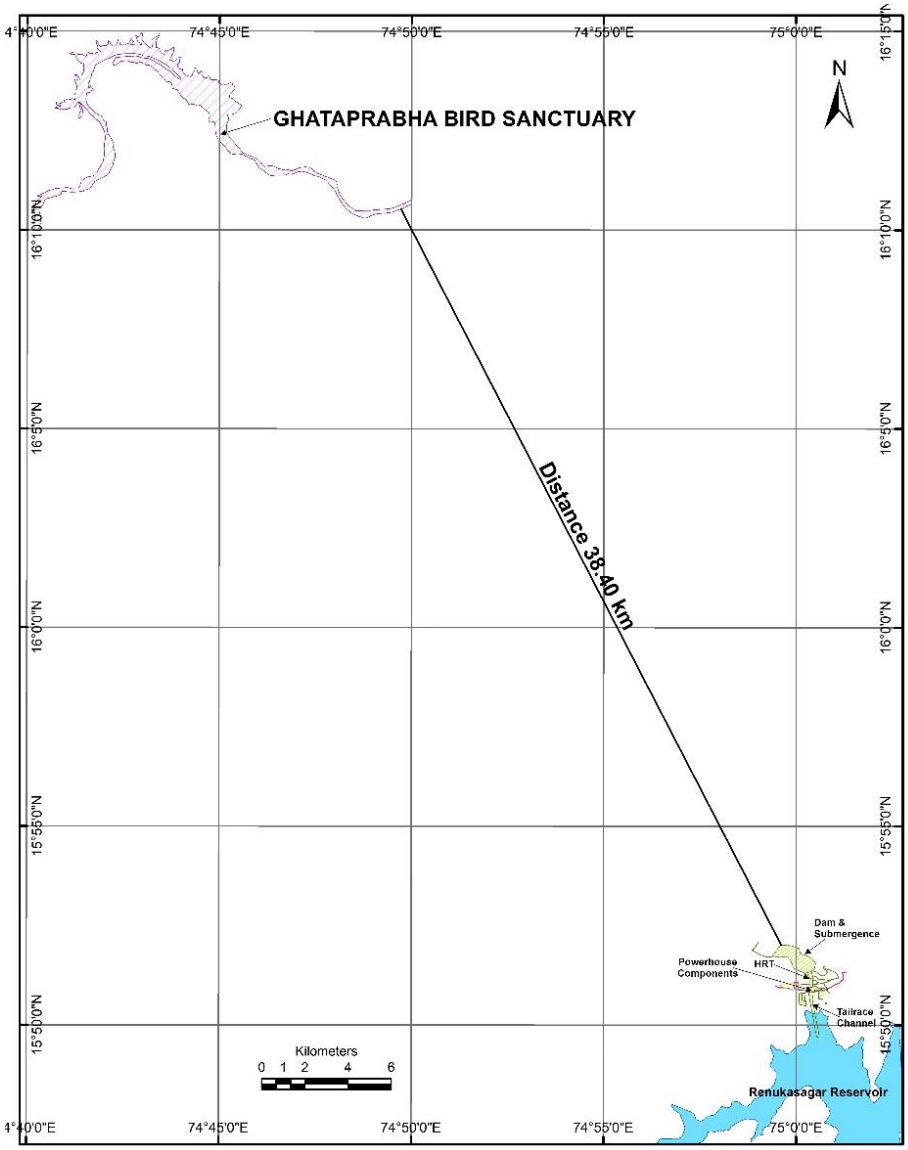


Figure 3.30: Map showing aerial distance of Ghataprabha Bird Sanctuary from Standalone Pumped storage component of Saundatti IRE Project

3.2.4 Socio-Economic Environment

Socio economic environment refers to a wide range of interrelated and diverse aspects and variables relating to or involving a combination of social and economic factors. For

sustainable development it is important to understand social and economic conditions of the community in the region, impacts of development on the community, measures to mitigate negative impacts and enhance the positive impacts. Development work depends on an effective partnership between project developer and the local community. For new development initiatives, socio economic assessment plays an important role to ensure community participation and their acceptance of the development activity and also helps in planning the activities for local area development.

The proposed Standalone Pumped Storage Component of Saundatti IRE Project is located in Belagavi district of Karnataka. It envisages creation of reservoir across Jagavalla Halla which joins river Malaprabha, a tributary of River Krishna near village Karlakatti under Yekkundi Grama Panchayat, Saundatti Taluk about 80 Kms from Belagavi.

3.2.4.1 Description of District

Belgaum, officially known as Belagavi is the district of Karnataka with its administrative headquarters located at the Belgaum city. The district of Belagavi occupies an area of approximately 13,433 sq.km. Administrative wise, the district is divided into 10 taluks/sub-districts. Belagavi district is bounded by Goa on southwest, on the west, northwest and north by the districts of Ratnagiri, Kolhapur and Sangli of Maharashtra State, on the east by Bijapur and Bagalkot districts and on the south by the districts of Dharwad and Uttara Kannada. It lies in the zone of cultural transition between Karnataka, Maharashtra and Goa. The Krishna, the Ghataprabha and the Malaprabha are the principal rivers, which flow in the northern, central and southern tracts of the district respectively.

After Bangalore, Belgaum is the most important commercial hub of Karnataka. It is the chief exporter of vegetables, fruits, meat, poultry, fish, mining production and wood. Belgaum is rich in milk production and has the highest number of sugar factories.

Demographic Profile of Belagavi District

According to Census 2011, there are 10 tehsils, 10 CD blocks and 31 towns in the district. There are total 1263 villages in the district. Total households in the district are 9,83,854 with household size of 4.9 and density of 356 persons per Sq. km. Total population of the district is 47,79,661, out of which, 24,23,063 are male 23,56,598 are female and the sex ratio of district is 973. The Scheduled Caste population contributes 12.1 percent to the total population of the district and the Scheduled Tribe population contributes 6.2 percent.

The district has a literacy rate of 73.5 percent. The male literacy rate in the district is 82.2 percent and the female literacy rate is 64.6 percent. The district has registered a work participation of 44.1 percent.

The work participation rates for male and female population are 56.6 and 31.1 respectively in the district. Among the total workers in the district 82.4 percent are Main workers and 17.6 percent are Marginal workers. Major work force of 64.6 percent is engaged in Agricultural sector i.e., Cultivators (33.8 percent) and Agricultural Labourers (30.8 percent). About 55.9 percent of the total population in the district is non-workers.

3.2.4.2 Study Area

The Study Area for the collection of data on socio-economic status has been delineated as the area within 10 kms radius of the main project components like proposed reservoir area, powerhouse, tailrace channel, muck dumping site etc. A map of the study area villages is given at **Figure 3.31**.

Demographic Profile of Study Area

All project components as well as entire study area falls under Saundatti taluka (Parasgad) in Belagavi district. Socio-economic profile of the study area covering aspects like demography, occupational pattern, literacy rate and other important socio-economic indicators of the villages. The baseline socio-economic profile is based on field survey and Census of India 2011.

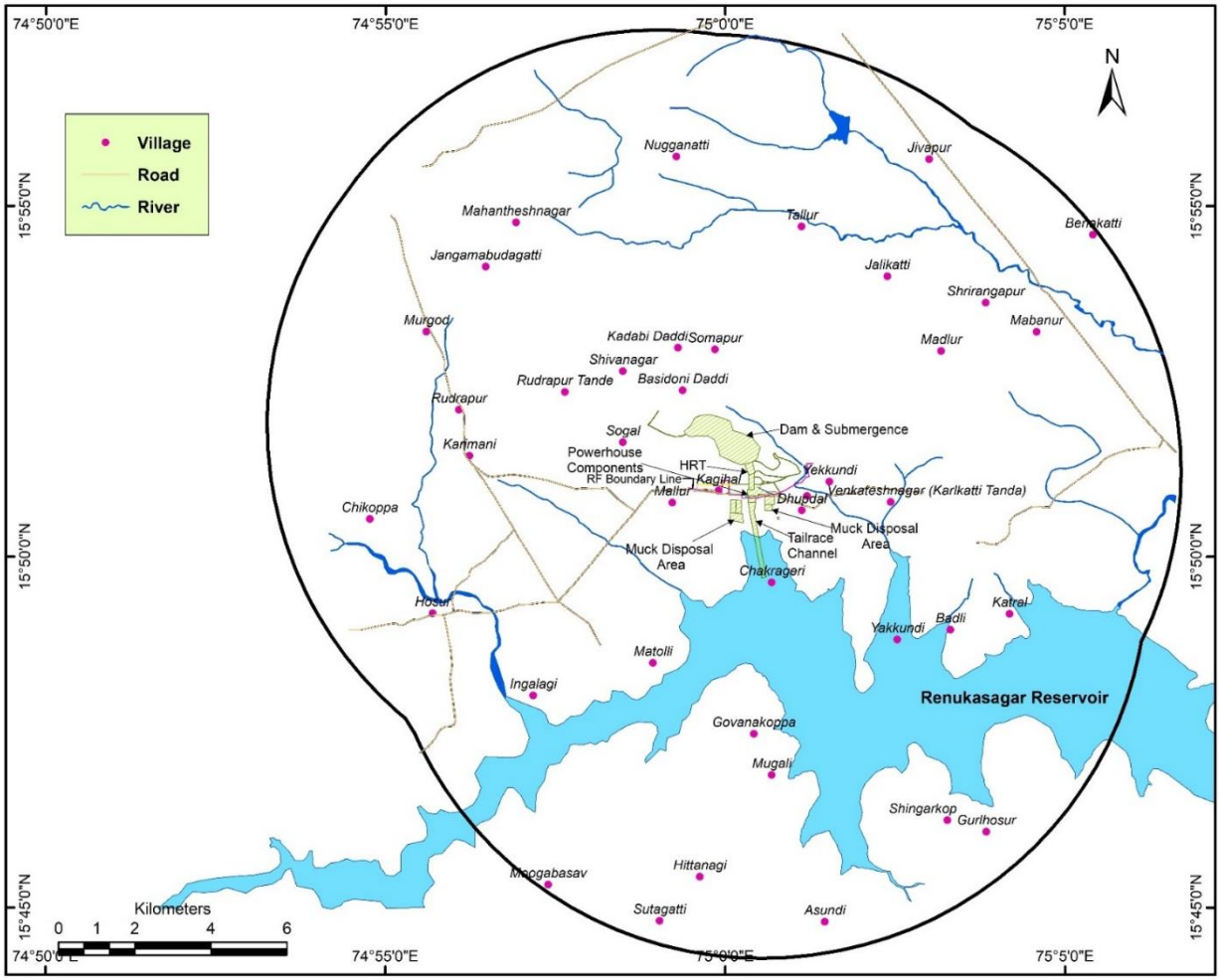


Figure 3.31: Map showing villages in the Study Area

Total households in study area tehsil are 70063. The total population of study area is 352929, of which 178755 are male and 174174 are female. Sex ratio in study area is 966 females per 1000 males.

The scheduled caste and scheduled tribe's percentage population of the district is 9.54% and 11.07% respectively. The literacy rate of the Suandatti taluka is 59.0 % of which the male 58.45% while the female 41.55%.

Total working population of the Saundatti taluka is 46.34%, while, the rest 53.66% of the population is classified are non-workers. Out of the total working population, 81.19% are main workers, while, 18.09% are marginal workers.

Socio-Economic Profile of Villages in Project Area

Due to project construction, only one Village i.e. Karlakatti is directly affected by the project due to acquisition of land. However, the villages in the direct proximity of project construction area likely to be affected by the proposed project activities, have been categorized as affected villages. A total of 13 villages will be directly or indirectly affected by the project activities of proposed Stanalone Pumped Storage component of Saundatti IREP. The socio- economic profile of these villages is discussed in the following text.

Demographic Profile

Demographic profile of the 13 villages in study area is given **Tables 3.50** below. The study area villages have 6365 households with a total population of 32726, of which the males 16645 and females 16081. The sex ratio is 966 females per thousand males. Murgod is the largest village with maximum number of households (2312) with a population of 11551 whereas Mallur is smallest with 70 households and a population of only 326 persons.

Table 3.50: Demographic Profile of the study Villages

S.No	Village Name	Total Households	Population			Sex ratio
			Total	Male	Female	
1	Aladakatti K.Y	176	942	467	475	1017
2	Basidoni	425	2277	1170	1107	946
3	Girinagar	128	673	335	338	1009
4	Kagihal	500	2645	1335	1310	981
5	Karimani	210	931	450	481	1069
6	Karlakatti	1335	6799	3467	3332	961
7	Mallur	70	326	165	161	976
8	Murgod	2312	11551	5840	5711	978
9	Rudrapur	285	1356	704	652	926
10	Shivanagar	85	574	290	284	979
11	Sogal	194	957	495	462	933
12	Somapur	316	1893	990	903	912
13	Venkateshnagar	329	1802	937	865	923
	Total	**6365**	**32726**	**16645**	**16081**	**966**

Social Category

The population of Scheduled Castes and Scheduled Tribes in the study area villages is 18.74% and 18.25 %, respectively. The village-wise social category is presented in **Table 3.51**.

Table 3.51: Social Category in Project Affected Villages

S.No	Village Name	Total Population	Scheduled Castes			Scheduled Tribes		
			T	M	F	T	M	F
1	Aladakatti K.Y	942	861	425	436	3	3	0
2	Basidoni	2277	218	108	110	321	161	160
3	Girinagar	673	666	331	335	2	2	0
4	Kagihal	2645	510	243	267	354	176	178
5	Karimani	931	3	1	2	371	190	181
6	Karlakatti	6799	539	288	251	377	189	188
7	Mallur	326	0	0	0	84	44	40
8	Murgod	11551	776	379	397	1388	702	686

S.No	Village Name	Total Population	Scheduled Castes			Scheduled Tribes		
			T	M	F	T	M	F
9	Rudrapur	1356	102	48	54	910	473	437
10	Shivanagar	574	574	290	284	0	0	0
11	Sogal	957	20	13	7	377	183	194
12	Somapur	1893	97	49	48	1784	935	849
13	Venkateshnagar	1802	1799	936	863	1	0	1
	Total	**32726**	**6165**	**3111**	**3054**	**5972**	**3058**	**2914**

T-Total, M-Male, F-Female.

Literacy

The literacy profile of the project affected villages is given in **Table 3.52**. The male and female literate population is 10738 and 7525 respectively, which implies that the literacy rate of the affected villages is 58.4 %of which the male 58.8% while the female 41.2 %. Murgod village has the highest literacy rate (64.7 %) while Sompura Village has the least literacy rate of 30.8 %.

Table 3.52: Literacy Rate in project affected villages

S.No	Village Name	Total Population	Literacy population			Litercy Rate (%)		
			T	M	F	T	M	F
1	Aladakatti K.Y	942	418	265	153	44.4	63.4	36.6
2	Basidoni	2277	1185	774	411	52.0	65.3	34.7
3	Girinagar	673	352	221	131	52.3	62.8	37.2
4	Kagihal	2645	1608	921	687	60.8	57.3	42.7
5	Karimani	931	551	338	213	59.2	61.3	38.7
6	Karlakatti	6799	4065	2409	1656	59.8	59.3	40.7
7	Mallur	326	160	94	66	49.1	58.8	41.3
8	Murgod	11551	7468	4164	3304	64.7	55.8	44.2
9	Rudrapur	1356	659	395	264	48.6	59.9	40.1
10	Shivanagar	574	287	173	114	50.0	60.3	39.7
11	Sogal	957	491	300	191	51.3	61.1	38.9
12	Somapur	1893	133	93	40	30.8	69.9	30.1
13	Venkateshnagar	1802	886	591	295	49.2	66.7	33.3
	Total	**32726**	**18263**	**10738**	**7525**	**58.4**	**58.8**	**41.2**

T-Total, M-Male, F-Female.

Education Facilities

Educational facilities play an important role in the overall development of an area. These facilities enhance economic growth and employment. Details of education facility in the surrounding of project area are given in **Table 3.53**. There are Primary School facility is available in all villages. Middle school is available in 7 villages, Secondary School facilities are available at Karlakatti, Mallur and Murgod village and Secondary School facilities are available at Karlakatti and Murgod villages.

Table 3.53: Education facilities in the Project Affected Villages

S.No	Village Name	PS	MS	SC	SSC
1	Aladakatti K.Y	Yes	No	No	No
2	Basidoni	Yes	Yes	No	No
3	Girinagar	Yes	No	No	No
4	Kagihal	Yes	No	No	No
5	Karimani	Yes	Yes	No	No
6	Karlakatti	Yes	Yes	Yes	Yes
7	Mallur	Yes	Yes	Yes	No
8	Murgod	Yes	Yes	Yes	Yes

S.No	Village Name	PS	MS	SC	SSC
9	Rudrapur	Yes	Yes	No	No
10	Shivanagar	Yes	No	No	No
11	Sogal	Yes	Yes	No	No
12	Somapur	Yes	No	No	No
13	Venkateshnagar	Yes	No	No	No

PS-Primary School, MS-Middle School, SC-Secondary School and SSC-Senior Secondary School.

Health Care Facilities

Medical facility in study area villages is given in **Table 3.54.** It has been found that the only one PHC is located in Karlakatti village which serve for all nearest villages in the area. There are also some private medical practitioners in the area.

Table 3.54: Health Care facilities in the Project Affected Villages

S.No.	Village	Gram Panchayat	CHC	PHC	PHSC	M&CWC	Hospital	Disp.	Private Clinic	ASHA
1	Aladakatti K.Y	Badli	No	No	No	No	No	No	No	Yes
2	Basidoni	Gorabal	No	No	No	No	No	No	Yes	Yes
3	Girinagar	Rudrapur	No	No	No	No	No	No	No	Yes
4	Kagihal	Mallur	No	No	No	No	No	No	Yes	Yes
5	Karimani	Rudrapur	No	No	No	No	No	No	No	Yes
6	Karlakatti	Yakkundi	No	Yes	No	No	No	No	Yes	Yes
7	Mallur	Mallur	No	No	No	No	No	No	Yes	Yes
8	Murgod	Murgod	No	No	No	Yes	No	Yes	Yes	Yes
9	Rudrapur	Rudrapur	No	No	No	No	No	No	Yes	Yes
10	Shivanagar	Murgod	No	No	No	No	No	No	No	Yes
11	Sogal	Mallur	No	No	Yes	No	No	No	No	Yes
12	Somapur	Tallur	No	No	No	No	No	No	Yes	Yes
13	Venkateshnagar	Yakkundi	No	No	No	No	No	No	Yes	Yes

CHC-Community Health Centre, PHC-Primary Health Centre, PHSC-Primary Health Sub Centre; M&CWC: Metrnity and Childwalfare Center; Dis.: Dispencery

Amenities

Basic services and amenities in terms of road & transportation, fair price shops and market for daily needs good are available in all the villages. With regard to postal facility, Post office is available only in Girinagar village, while sub post office is available in 05 villages. Electricity and drinking water facility is available in all the villages. The villages in the project area are not well connected by a network of banking facility, as show in **Table 3.55**.

Table 3.55: Nearest distance from village upto corresponding amenities

S.No.	Village	PO	SPO	Bank	PDS Shop	Bus Stop	Power Supply
1	Aladakatti K.Y	No	No	No	No	No	Yes
2	Basidoni	No	Yes	No	Yes	No	Yes
3	Girinagar	Yes	No	No	No	No	Yes
4	Kagihal	No	No	No	Yes	No	Yes
5	Karimani	No	No	No	No	No	Yes
6	Karlakatti	No	Yes	No	Yes	No	Yes
7	Mallur	No	Yes	No	No	No	Yes
8	Murgod	No	Yes	No	Yes	No	Yes
9	Rudrapur	No	No	No	Yes	No	Yes
10	Shivanagar	No	Yes	No	No	No	Yes
11	Sogal	No	No	No	No	No	Yes
12	Somapur	No	No	No	Yes	No	Yes

S.No.	Village	PO	SPO	Bank	PDS Shop	Bus Stop	Power Supply
13	Venkateshnagar	No	No	No	Yes	No	Yes

CONCLUSION

In the previous sections the basic characteristics of the project affected area are highlighted. Finding of the social envieronment status of the project area is as follows:

- The education facility in the villages are good upto middle school for secondary and senior secondry education students travel upto 2 to 5 kms and for higher education.
- Medical facilities in the area are also poor, villagers depend on Primary Health Center at Karlakatti or district Hospital at Belagavi.
- Basic amenities in terms of electricity and driniking water facilities, Fair price shop is available in all the villages. Road & transporation facility in the area is good. All villages in the project area are well contacted with State Highway through metallic road.
- Banking and Postal services are not adequate in all the villages. For banking facility villagers depend on the only bank located at Yaragatti.
- The telecommunication facilities are good in the area. The mobile cellular network is also available in the study area.

3.2.5 Additional One Season Data Collection

The field surveys for the collection of one season additional baseline data in the study area was carriedout during December 2019 covering data/ information on physical and biological environment parameters.

3.2.5.1 Soil Fertility Status

To assess the nutrient and fertility status of the soil in the study area the samples were collected from six different locations. The sampling for soil was carried out at locations where major components of the projects are planned. The soil analysis was carried out at the AGSS Analytical and Research Lab Pvt Ltd, Delhi (NABL accredited Lab.). A result of soil sample analysis is given in **Table 3.56.**

Table 3.56: Physico-chemical Composition of Soil in the Study Area

Parameters	S1	S2	S3	S4	S5	S6
Texture						
Sand (% w/w)	25	22	44	28	27	24
Silt (% w/w)	21	24	18	22	22	23
Clay (% w/w)	54	54	38	50	51	53
Porosity (% w/w)	31.9	32	37	35.1	34.1	33.9
Bulk Density (gm/cc)	1.44	1.42	1.32	1.37	1.39	1.4
Water Holding Capacity (%)	41.6	41	35	36.8	37	40
pH	7.6	7.1	7.14	7.23	7.34	7.7
Electrical Conductivity (µmho/cm)	290	380	290	410	390	830
Calcium (mg/kg)	208	162	238	245	286	262
Magnesium (mg/kg)	118	138	190	144	128	155
Alkalinity (mg/l)	50	44	49	50	48	43
Chloride Content (mg/kg)	39.4	33.3	32.4	35.3	48.5	57.3
Sodium (mg/kg)	89	83	77	65	82	95
Organic Carbon (%)	0.38	0.37	0.39	0.31	0.29	0.30
Available Phosphorus (kg/ha)	20.7	21.5	20.2	19.7	21.4	20.3
Available Nitrogen (kg/ha)	290	285	328	323	310	332

Parameters	S1	S2	S3	S4	S5	S6
Available Potassium (kg/ha)	127	128	116	112	121	129
Salinity (ppt)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01

Soil fertility status of the area was assessed based upon soil test results. Based upon Soil Fertility Rating given in **Table 3.57**.

Table 3.57: Soil Fertility Rating as per Soil Fertility Book*

Parameter	Value	Fertility Rating
Organic Carbon (%)	Less than 0.50	Low
	0.50 to 0.75	Medium
	More than 0.75	High
Available Nitrogen (kg/ha)	Less than 240	Low
	240 - 480	Medium
	More than 480	High
Available Phosphorus (kg/ha)	Less than 25	Low
	25 to 50	Medium
	More than 50	High
Available Potassium (kg/ha)	Less than 130	Low
	130 to 330	Medium
	More than 330	High

*Source: www.chambalfertilisers.com/pdf/annual/SoilFertilityBookApr1812OPf.pdf

Organic matter an important indicator of soil health is in Low range. The soil fertility rating in terms of nitrogen concentration is in Medium range varies from 290 kg/ha to 332 kg/ha, whereas the concentration of phosphorus and potassium ranges between 23.2 kg/ha and 24.7 kg/ha and 116 kg/ha to 129 kg/ha respectively with fertility rating in low range.

Parameter/Site	S1	S2	S3	S4	S5	S6
Organic Carbon (%)	Low	Low	Low	Low	Low	Low
Available Nitrogen (kg/ha)	Medium	Medium	Medium	Medium	Medium	Medium
Available Phosphorus (kg/ha)	Low	Low	Low	Low	Low	Low
Available Potassium (kg/ha)	Low	Low	Low	Low	Low	Low

Low: < 1.67; Medium: 1.67 – 2.33; High: > 2.33

The soil fertility based upon Nutrient Index in terms of NPK as above in case of Nitrogen is Medium (2.00), in case of Phosphorus and Potassium is Low i.e. NI is 1.00.

SOIL SAMPLING


3.2.5.2 Ambient Air Quality

In order to evaluate and quantify the ambient air quality monitoring was carried out at 6 locations in the study area (**Table 3.58**). The monitoring locations are shown in **Figure 3.32**.

The sources of air pollution in the study area are vehicular traffic, dust arising from unpaved village roads and domestic fuel burning. The air environment around project site is free from any significant pollution source.

Observation on ambient SO_2 levels

The summary of ambient SO_2 concentration observed ranged from below detectable limits to 6.3 $\mu g/m^3$ at six sampling sites covered as a part of the ambient air quality monitoring study. The maximum SO_2 level observed highest at Sogal village. The SO_2 level observed at various sampling stations was much lower than the permissible limits (**Table 3.58**).

Observations on NO_2 levels

The NO_2 values ranged from below detectable limits to 8.8 $\mu g/m^3$ at various stations covered as a part of the study. The maximum NO_2 level observed highest at Sogal village. The NO_2 level observed at various sampling stations was much lower than the permissible limits (**Table 3.58**).

Observations on PM_{10} levels

The PM_{10} values ranged from 24.2 to 58.3 $\mu g/m^{3.}$ The maximum PM_{10} level observed during ambient air quality monitoring was 58.3 $\mu g/m^3$ at Sogal village. The PM_{10} level at various stations was well below the permissible limits (**Table 3.58)**.

Observations on $PM_{2.5}$ levels

The $PM_{2.5}$ values ranged from 10.3 to 32.6 $\mu g/m^3$. The maximum $PM_{2.5}$ level observed during ambient air quality monitoring conducted was 32.6 $\mu g/m^3$ at Hosur village. The $PM_{2.5}$ level at various stations covered during ambient air quality monitoring was well below the permissible limits (**Table 3.58**).

The air around project site in general is free from any pollution source. Based on the results of monitoring, the concentrations of $PM_{2.5}$, PM_{10}, SO_X and NO_X at all the sites were well within the Residential & Rural area permissible limits prescribed by National Ambient Air Quality Standard 2009 notified by CPCB.

Table 3.58: Air Quality Monitoring of the Study Area (unit: µg/m³)

Parameters		PM2.5	PM10.0	SO_2	NO_x
AQ1/Chakrageri Village	Min	12.7	30.4	BDL	BDL
	Max	15.7	35.3	BDL	BDL
	Average	14.7	32.3	BDL	BDL
AQ2/Karlakatti Tand Village	Min	14.0	28.3	BDL	BDL
	Max	17.4	31.1	BDL	BDL
	Average	15.4	29.3	BDL	BDL
AQ3/Basidoni Daddi Village	Min	10.3	24.2	BDL	BDL
	Max	20.4	38.5	BDL	BDL
	Average	15.2	30.0	BDL	BDL
AQ4/Sogal Village	Min	23.4	50.3	5.7	8.0
	Max	29.5	58.3	6.3	8.8
	Average	26.6	53.9	6.0	8.4
AQ5/Tallur Village	Min	24.3	47.3	5.1	7.8
	Max	30.5	51.5	6.0	8.2
	Average	26.7	49.5	5.5	8.0
AQ6/Hosur Village	Min	25.3	43.8	5.0	6.9
	Max	32.6	48.8	5.6	7.8
	Average	28.7	46.3	5.4	7.4
Permissible Limit	**24 h NAAQS 2009**	**60**	**100**	**80**	**80**

3.2.5.3 Ambient Noise Quality

The monitoring was carried out at 6 locations (**refer Figure 3.32**) by digital sound level meter in terms of dB(A). Monitoring locations were selected keeping in view the project activity area and the location of receptors. The monitoring was carried out during Day time (6.00 am to 10.00 pm) and Night time (from 10.00 pm to 11.00 am and from 4 am to 6 am). From the data on sound pressure levels equivalent levels (Leq) for day time, night time as well as day-night average were calculated using equation given in CPCB protocol.

The monitored levels were compared against the Noise Pollution (Regulation and Control) Rules 2000, as amended through the Noise Pollution (Regulation and Control) Amendment Rules 2010. From the recorded values, day time equivalent levels were calculated. The Equivalent Noise level of the study area is given below in **Table 3.59.**

Table 3.59: Equivalent Noise levels in study area during day time [Leq dB(A)]

Site	Monitoring location	Category of Area/ Zone	Leq Day dB(A)	Leq Night dB(A)	Leq Day and Night dB(A)	CPCB Limits Leq dB(A)	
						Day	Night
NT1	NT1/Chakrageri village	Residential Area	56.1	42.6	55.0	**55**	**45**
NT2	NT2/Karlakatti Tand village	Residential Area	54.4	41.5	53.5	**55**	**45**
NT3	NT3/Sogal Village	Commercial Area	55.4	42.3	54.5	**65**	**55**
NT4	NT4/Jangamabudagatti	Residential Area	52.4	39.9	51.6	**55**	**45**
NT5	NT5/Hosur village	Residential Area	54.9	41.9	54.0	**55**	**45**
NT6	NT6/Mabanur Village	Commercial Area	53.8	41.0	52.9	**65**	**55**

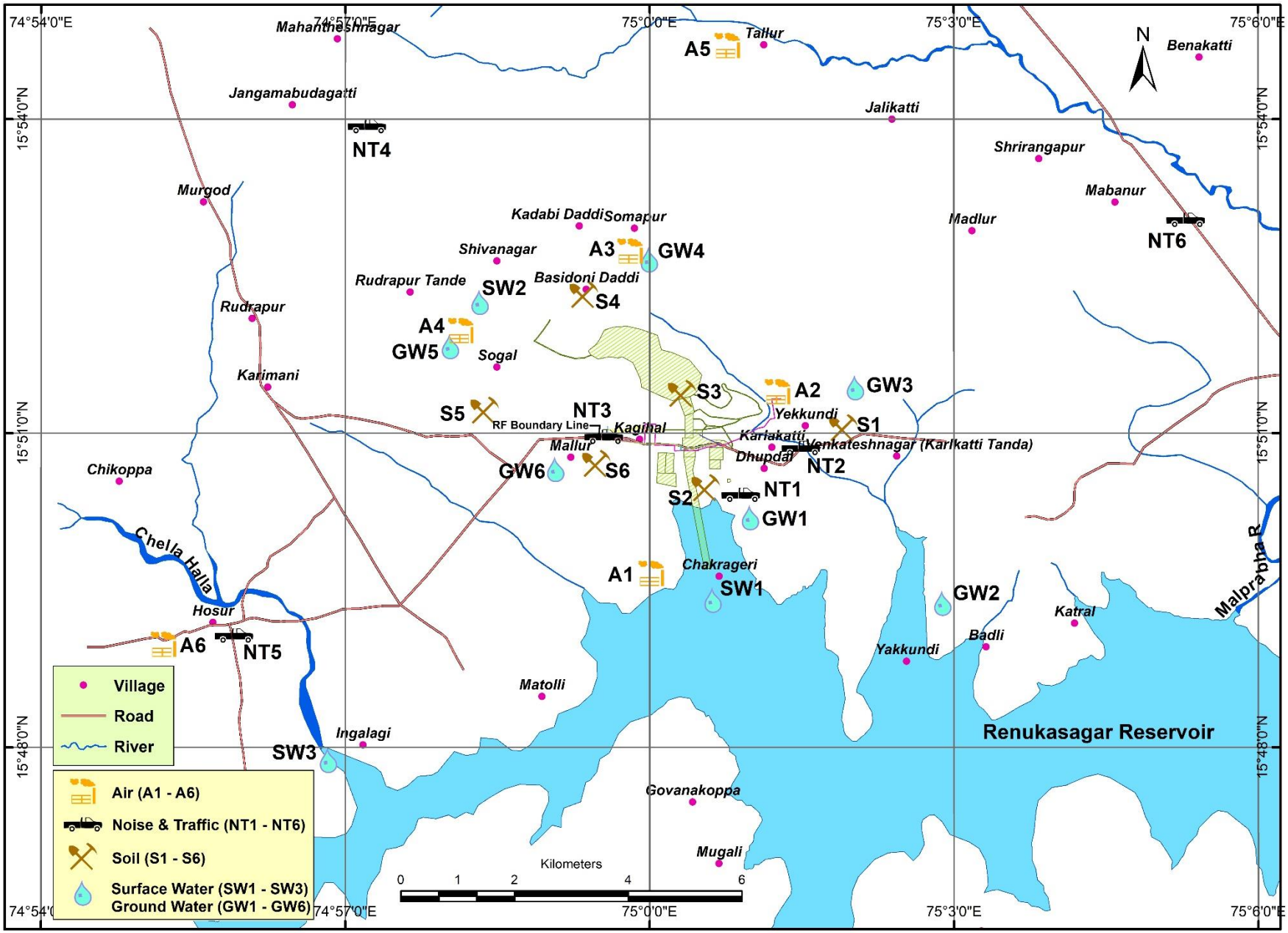


Figure 3.32: Map showing locations for collection of soil samples, air and noise monitoring and collection of surface and ground water samples in the study area (Additional Study)

NOISE AND TRAFFIC MONITORING




3.2.5.4 Traffic Density

Traffic density data was recorded by physically counting the number of different types of vehicles passing through a particular point in a fixed time interval. Traffic density was recorded maximum at near Sogal Village, Chakrageri village and Hosur village. The traffic density recorded at different sites is presented in **Table 3.60**.

Table 3.60: Traffic density in the study area

Sl. No.	Monitoring location	Monsoon		
		HMV	LMV	TW
1	Chakrageri village	10	18	12
2	Karlakatti Tand village	8	12	13
3	Sogal Village	5	20	20
4	Jangamabudagatti	4	10	12
5	Hosur village	12	17	12
6	Mabanur Village	10	14	15

HMV= Heavy Motor Vehicle; LMV= Light Motor Vehicle; TW= Two Wheelers

The traffic load at Chakrageri and Hosur village was more due to the state hightway. Sogal village considerd as a commercial area because of Sogal deer park and famous temple, hence that traffic density recorded maximum and maximum noise level oberserved in this area.

3.2.5.5 Water Quality

Water sampling was carried out at 9 different locations (Surface water: 3 samples and ground water: 6 samples) during winter season as described below in the table to study various physico-chemical and biological characteristics of surface and ground water (**Table 3.61 and Figure 3.32).**

Table 3.61: Water sampling locations

Sites	Location	Source
Ground Water		
GW1	Chakrageri Village	Tube well
GW2	Yakkundi Village	Borewell
GW3	Karlakatti Tand Villages	Borewell
GW4	Basidoni Dadi village	Tube well
GW5	Sogal village	Handpump
GW6	Mallur village	Borewell
Surface Water		
SW1	Renuka Sagar Reservoir	Near Water lifting Point near Chakrageri Village
SW2	Sogal Village	Sogal Waterfall
SW3	Renuka Sagar Reservoir	Near Mallaprabha Dam Site

Ground Water Quality

The results of physico-chemical analysis at different location in the study area along with BIS Standards for Drinking Water are given at **Tables 3.62**.

Table 3.62: Physico-Chemical Characteristics of Ground Water During Winter Season

S. No.	Test Parameters	Permissible Limits	GW1	GW2	GW3	GW4	GW5	GW6
1	Temperature (^{0}C)	--	24.9	25.2	24.2	24	26.6	26.3
2	pH	6.5-8.5	7.2	7.3	7.4	7.1	7.6	7.4
3	Electrical Conductivity (µS/cm)	--	1190	910	940	1010	830	1210
4	Total Dissolved Solids (mg/l)	2000	762	582	602	646	531	774
5	Total Hardness (as $CaCO_3$) (mg/l)	600	160.58	149.09	151.47	162.49	148.8	168.19
6	Total Alkalinity (mg/l)	600	82	75	72	72	76	85.4
7	Calcium (as Ca) (mg/l)	200	33.4	31.1	37.3	38.1	34.1	37.1
8	Magnesium (as Mg) (mg/l)	100	18.8	17.4	14.2	16.4	15.5	18.4
9	Sulphate (SO_4) (mg/l)	400	46.2	52.1	54	50	44.5	57
10	Chloride (as Cl) (mg/l)	1000	71	67	66	78	70	75.1
11	Nitrate (NO_3) (mg/l)	45	3.5	3.8	4.1	4.8	5.4	5.2
12	Phosphate (as PO_4) (mg/l)	--	0.12	0.12	0.4	0.22	0.31	0.14
13	Silicate (Si) (mg/l)	--	BDL	BDL	BDL	BDL	BDL	BDL
14	Salinity (mg/l)	--	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
15	Sodium (mg/l)	--	28	32.2	29.2	30.1	29.1	32.8
16	Potassium (mg/l)	--	0.8	0.45	0.29	0.5	0.32	0.31
17	Iron (Fe) (mg/l)	0.3	0.2	0.18	0.16	0.25	0.22	0.24
18	Phenolic Compounds (mg/l)	0.002	BDL	BDL	BDL	BDL	BDL	BDL
19	Oil & Grease (mg/l)	0.2	BDL	BDL	BDL	BDL	BDL	BDL
20	Residual Sodium Carbonate (mg/l)		1.2	1.3	1.3	1.4	1.4	1.4
21	Cadmium (Cd) (mg/l)	0.003	BDL	BDL	BDL	BDL	BDL	BDL
22	Arsenic As) (mg/l)	0.05	BDL	BDL	BDL	BDL	BDL	BDL
23	Mercury (Hg) (mg/l)	0.001	BDL	BDL	BDL	BDL	BDL	BDL
24	Copper (Cu) (mg/l)	1.5	BDL	BDL	BDL	BDL	BDL	BDL
25	Zinc (Zn) (mg/l)	15	BDL	BDL	BDL	BDL	BDL	BDL
26	Total Chromium (Cr) (mg/l)	0.05	BDL	BDL	BDL	BDL	BDL	BDL
27	Chromium-6 (mg/l)	--	BDL	BDL	BDL	BDL	BDL	BDL
28	Manganese (Mn) (mg/l)	0.3	BDL	BDL	BDL	BDL	BDL	BDL
29	Lead (Pb) (mg/l)	0.01	BDL	BDL	BDL	BDL	BDL	BDL

***Indian Standard* Drinking Water - Specification (Second Revision) Permissible Limits (IS: 10500:2012)**

GW1-GW6: Sampling sites; BDL: Below Detectable Limits

According to BIS standards for Drinking Water (2012) all the water samples collected from the study area fall within permissible limits of the same.

The Water Quality Index calculated for ground water samples collected from different locations in the study area is given in table below.

Ground Water Quality Index

Season	GW1	GW2	GW3	GW4	GW5	GW6
Winter	24.20	23.33	23.58	23.96	23.48	25.89

According to WQI tabulated in table above all the ground water samples fall in Excellent ground water quality class.

Surface Water

For analysis of surface water quality samples were collected from three sites: Renukasagar reservoir, Malaparbha River and one from Sogal village waterfall (Pond). Results of water samples are given in **Table 3.63**.

Surface water quality of all the samples collected during winter season was compared with the Water Quality Criteria of Central Pollution Control Board http://www.cpcb.nic.in/Water_Quality_Criteria.php). All the samples of surface water qualify for **Class 'B'** i.e. designated best use of outdoor bathing (organized). This is due to total coliform less than 500 MPN/100 ml, DO of more than 5 mg/l and BOD less than 3 mg/l.

Table 3.63: Surface Water quality in the study area

S. No.	Test Parameters	SW1	SW2	SW3
CHEMICAL PARAMETRES				
1	Temperature (°C)	25.1	26.1	25.7
2	pH	7.81	7.3	7.4
3	Turbidity (NTU)	4	5	4
4	Dissolved Oxygen (mg/l)	6.8	6.6	7
5	Electrical Conductivity (mg/l)	160	240	170
6	Total Dissolved Solids (mg/l)	102.4	153.6	108.8
7	Total Suspended Solids (mg/l)	8	12	10
8	Chloride (as Cl) (mg/l)	56.2	75	58.1
9	Total Hardness (mg/l)	114.82	134.96	119.5
10	Alkalinity (mg/l)	62.4	65	60.1
11	Calcium (as Ca) (mg/l)	25.1	28.4	27.3
12	Magnesium (as Mg) (mg/l)	12.7	15.6	12.5
13	Nitrate (NO_3) (mg/l)	1.8	4.8	4.7
14	Phosphate (as PO_4) (mg/l)	0.7	0.2	0.13
15	Sulphate (SO_4) (mg/l)	12.1	20.2	14.1
16	Silicon Dioxide (mg/l)	<1.0	<1.0	<1.0
17	Silicate (Si) (mg/l)	BDL	BDL	BDL
18	Sodium (mg/l)	14.5	22.1	15
19	Potassium (mg/l)	0.9	1.8	1.6
20	Phenolic Compounds (mg/l)	BDL	BDL	BDL
21	Oil & Grease (mg/l)	BDL	BDL	BDL
22	Iron (Fe) (mg/l)	0.09	0.12	0.13
23	Cadmium (Cd) (mg/l)	BDL	BDL	BDL
24	Arsenic As) (mg/l)	BDL	BDL	BDL
25	Mercury (Hg) (mg/l)	BDL	BDL	BDL
26	Copper (Cu) (mg/l)	BDL	BDL	BDL
27	Zinc (Zn) (mg/l)	BDL	BDL	BDL

S. No.	Test Parameters	SW1	SW2	SW3
28	Total Chromium (Total Cr) (mg/l)	BDL	BDL	BDL
29	Chromium-6 (Cr-6) (mg/l)	BDL	BDL	BDL
30	Manganese (Mn) (mg/l)	BDL	BDL	BDL
31	Lead (Pb) (mg/l)	BDL	BDL	BDL
32	Biological Oxygen Demand (mg/l)	BDL	BDL	BDL
33	Chemical Oxygen Demand (mg/l)	4.2	4.8	5.2
34	Sodium Adsorption Ratio	0.59	0.83	0.60
35	Total Coliform (MPN/100ml)	125	185	142

SW1-SW3: Sampling sites: BDL: Below Detectable Limits

Sodium Adsorption Ratio (SAR) is an irrigation water quality parameter used in the management of sodium-affected soils. It is calculated using Sodium, Calcium and Magnesium concentrations expressed in meq/L. At a given SAR, the infiltration rate increases as salinity increases or the other way around. Therefore, the SAR and EC are used in combination to evaluate potential problems.

In the present study, Electrical conductivity values varied between 160 µS/cm and 240 µS/cm while SAR varied from 0.59 to 0.83 (**Table 3.63**). All the samples from the study area have SAR below 10. Based on the classification given by Todd, 1959; SAR values from the study area is grouped as excellent class (**Table 3.64**).

Table 3.64: Classification of Water Based on SAR Values (Todd, 1959)

SAR Value	Water Quality
<10	Excellent
10-18	Good
19-26	Doubtful
>26	Unsuitable

A commonly-used water quality index (WQI) developed by the National Sanitation Foundation (NSF) in 1970 by Brown *et al*. (www.water-research.net/watrqualindex/waterqualityindex.htm) and Washington State Department of Ecology, Environmental Assessment Programme was used for assessing the surface water quality. The NSF WQI was developed to provide a standardized method for comparing the water quality of various bodies of water. Water quality index is a 100-point scale that summarizes results from a total of 9 different parameters listed below in the table.

pH	Delta Temperature Change (^{0}C)	Total Phosphates (mg/L)
Dissolved Oxygen (DO) Saturation (%)	Total Coliforms (MPN/100ml)	Nitrates (mg/L)
Turbidity (NTU)	Biochemical Oxygen Demand (BOD) (mg/L)	Total Suspended Solids (TSS) (mg/L)

The analysis of water quality therefore is based upon 9 parameters as defined for WQI above and based upon the score at each sampling site water quality has been designated as Excellent, Good, Medium, etc. as per the range defined in the table below.

Water Quality Index	
Range	**Quality**
90-100	Excellent
70-90	Good
50-70	Medium
25-50	Bad
0-25	Very bad

Water quality index based upon the above parameters is given in table below

Sampling Site	SW1	SW2	SW3
WQI	71.63	70.81	73.21

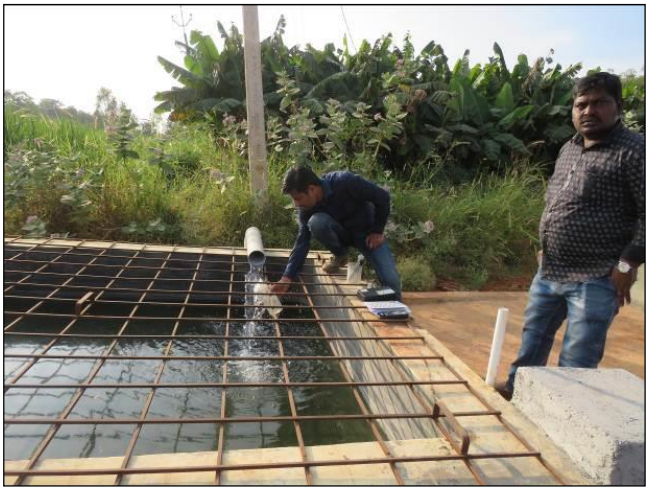
According to WQI values obtained for different samples surface water quality in general is in Good category throughout the study area.

WATER SAMPLING

Renukasagar Reservoir

Sogal Waterfall

Basidoni Dadi Village



Chakrageri Village

Sogal Village

Mallur Village

3.2.5.6 Floristic Diversity

The detailed account of floristic diversity and ecology has been described based on the primary surveys study area of the proposed project. These surveys were undertaken to assess the forest type and vegetation profile in the project area and to prepare inventory of plant species found in the study area.

Species Composition

During the field surveys 66 species of trees, 25 species of shrubs and 51 herbaceous species were recorded from the study area (refer **Table 3.65)**. In addtion to 170 species recorded during earlier survey 10 new species viz; *Macaranga peltata, Cassia auriculata, Randia dumetorum, Wattakaka volubilis, Vernonia cinerea, Mimosa pudica, Erianthus munja, Setaria glauca, Thysanolaena agrostis* and *Hedyotis puberula* were observed in the study area. An inventrory of 180 plant species recorded from the study area is given in **Annexure V.**

Table 3.65: Family wise details of angiosperms species

S. No.	Vegetation Type	No. of Families	No. of Species
1	Trees	31	66
2	Shrubs	17	25
3	Herbs	20	51

Source: *field survey RSET*

Vegetation Profile of the Study Area

The study area comprises of characterized by agricultural fields, grassland, scrub forest and settlements. The vegetation in the study area comprises of Dry tropical thorn forest along with the agricultural crops and weeds. Trees were mostly recorded from the plantation sites within the forest area and near the habitation & bunds of agricultural farms.

Forest in the area is classified under Moist deciduous, Dry deciduous and Platation. In Moist deciduous forest species like *Terminalia paniculata, Terminalia tomentosa, Xylia xylocarpa, Careya arborea, Spondias spp., Tectona grandis, Lagerstroemia parviflora, Dillenia pentagyna, Strychnos nuxvomica, Syzygium cumini and Bambusa arundinaceae* are common. Dry deciduous forest mainly consists of species like *Acacia auriculiformis, Acacia nilotica, Sepium insigne, Anoegissus spp., Bauhinia racemosa and Bombax ceiba.* While under plantation, *Tectona grandis, Areca catechu, Cocos nucifera, Casuarina equisetifolia, Eucalyptus spp., etc.* are found in the area.
Description of compostion of vegetation at various locations in the study area is discussed in following section:

SITE I: - Proposed Upper Reservoir and Surrounding Area

Proposed upper reservoir is located in hillock near Basidoni Village. This area is characterized by scrubland with thorny vegetation and agriculture farms and fallow land near Basidoni village. Vegetation along the slopes is mainly cosnit of thorny scrub vegetation. Along the hill toe on east of the proposed reservoir is charactrised under plantaion.




Among the trees *Bauhinia racemosa, Flacourtia indica, Ziziphus jujube, Chloroxylon swietenia, Acacia nilotica, Albizia odoratissima, Gmelina arborea, Wrightia tinctoria, Holoptelea integrifolia, Bombax ceib* and *Sapium insigne* are the species found in the area proposed for creation of upper reservoir.

Lantana camara, Randia dumetorum, *Annona reticulate*, *Ziziphus xylopyrus, Senna auriculata, Abutilon crispum, Calotropis procera, Cassia auriculata, Carissa carandas,* and *Phyllanthus reticulatus* are the frequently observed shrub species. Other common herbs in the area are *Urena lobata, Euphorbia caducifolia, Justicia adhatoda and Abutilon crispum*.

Herbs in the area was represented by species like *Argemone mexicana, Achyranthes aspera, Ammannia baccifera, Biophytum sensitivum, Euphorbia hirta, Parthenium hysterophorus, Porteresia coarctata, Gossypium hirsutum, Thysanolaena agrostis, Apluda mutica, Sorghum halepense Sonchus oleraceus, Oxalis latifolia, Tragia involucrata, Sida cordifolia, Porteresia coarctata, Cocculus hirsutus* and *Heteropogon contortus* are the common herbs of this area. Near the habitation tree cover is comprised of *Cocos nucifera, Eucalyptus globulus, Azadirachta indica, Ziziphus jujuba* and *Acacia auriculiformis. Cocos nucifera* and *Azadirachta indica* occur along the bunds of agricultural fields. *Eucalyptus globulus, Ziziphus jujuba* and *Acacia auriculiformis* are recorded from plantation sites, fallow land and along the edges of village road.

SITE II: - Near Proposed Power House Area

Proposed power house is located on the toe of the hill. The area is characterized by hillocks with open forest at one side and agricultural fields and habitation at toe of the hill. Along the

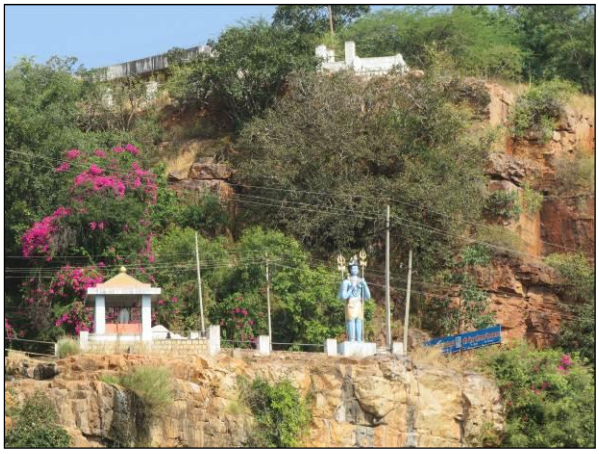
hill slope scrub and thorny vegetation was observed along with plantation of *Eucalyptus globulus associated* with *Azadrichta indica*, *Bauhinia racemosa, Holoptelea integrifolia* and *Bombax ceiba, Casuarina equisetifolia* and *Sapium insigne.*




Shrub layer is represented mainly by *Senna auriculata, Justicia adhatoda, Lantana camara,* and *Dodonaea viscosa.* Among other shrub species *Carissa carandas, Phyllanthus reticulatus, Abutilon crispum, Ziziphus xylopyrus, Urena lobata* and *Cassia auriculata* was recorded from scrub land or from the bunds of agricultural fields. While, *Tecoma stans and Jatropha curcas* was found along the approach road in the forest area. *Ageratum conyzoides, Argemone mexicana, Parthenium hysterophorus, Pouzolzia zeylanica, Tagetes erecta, Grewia hirsuta, Sida cordifolia* and *Xanthium indicum* are the dominant herb species in the area. Other common herb species were *Achyranthes aspera, Anisomeles indica, Celastrus paniculatus, Cymbopogon martini, Eragrostis amabilis, Oxalis latifolia, Pouzolzia zeylanica* and *Tagetes erecta.*

SITE III: - Near Sogal Village

Sogal village is located on the right side of the proposed upper reservoir. The vegetation of this area is characterized by scrub land. Tree canopy is represented by *Acacia nilotica* and *Phoenix sylvestris*. Other common trees recorded from the area are *Bauhinia racemosa*, *Phyllanthus emblica* and *Ziziphus jujuba. Tectona grandis* was also recoded from the edges of village road and bunds of the agricultural farms.

Shrub layer is comprised of species like *Senna auriculata, Justicia adhatoda, Lantana camara, Euphorbia caducifolia, Dodonaea viscosa, Morinda pubescens, Lantana camara* and *Ziziphus xylopyrus* are the species recorded from scrub or fallow land. *Carissa carandas, Urena lobata, Cassia auriculata, Tecoma stans, Gossypium hirsutum, Jatropha curcas, Justicia adhatoda* and *Phyllanthus reticulatus* were found dominant near agricultural farms.

Among the herbaceous flora *Achyranthes aspera*, *Ageratum conyzoides*, *Byttneria herbacea* and *Parthenium hysterophorus* are the most dominant species in the area. Other common herb species recorded from are the areaare *Oxalis latifolia, Saccharum officinarum, Heteropogon contortus, Themeda caudata, Xanthium indicum*, *Pouzolzia zeylanica, Themeda caudata* and *Tribulus terrestris*.

SITE IV: - Near Chakrageri Village: Right Bank of Renuka Sagar Reservoir

Right bank of Renuka sagar reservoir (Malaprabha river) near Chakragiri village is characterized by agriculture farms and fallow land. Sugarcane and vegetables are the main crop in the area. Tree cover is comprised of *Cocos nucifera, Eucalyptus globulus, Azadirachta indica, Ziziphus jujube, Bauhinia racemosa, Holoptelea integrifolia, Bombax ceiba* and *Acacia auriculiformis. Cocos nucifera* and *Azadirachta indica* occur along the bunds of agricultural fields. *Eucalyptus globulus, Ziziphus jujuba* and *Acacia auriculiformis* are recorded from fallow land and along the road side.



Shrub layer is dominated by weed species like *Lantana camara* followed by *Ziziphus xylopyrus* (**Table 3.25**). *Calotropis procera, Ipomoea carnea, Senna auriculata, Euphorbia caducifolia, Justicia adhatoda, Phyllanthus reticulatus, Gossypium hirsutum, Abutilon crispum, Urena lobata, Senna auriculata* and *Abutilon crispum* are the other shrub species recorded from the sampling site.

Saccharum munja, *Sorghum halepense* and *Tagetes erecta* are the frequently onserved grass species along the reservoir periphery and near the agricultural farmd. Other commonly found grass species in the area are *Cymbopogon martini, Eragrostis amabilis, Pouzolzia zeylanica, Porteresia coarctata.* Other herb species recorded from the area are *Achyranthes aspera, Argemone mexicana, Biophytum sensitivum, Euphorbia hirta, Parthenium hysterophorus, Gomphrena globosa, Sonchus oleraceus, Oxalis latifolia, Thysanolaena latifolia, Apluda mutica, Grewia hirsuta, Sida cordifolia* and *Xanthium indicium*.

SITE V: - Near Karlakatti Village

Around the Karlakatti village agriculture is the pre-dominant land use. Tree layer dominated by *Cocos nucifera* and *Tectona grandis* and *Azadrichta indica* associated with *Aegle marmelos, Albizia lebbeck, Neolamarckia cadamba, Ziziphus jujuba* and *Acacia auriculiformis* and *Cassia fistula*.


The shrub layer is dominated by *Lantana camara* which is recorded near agricultural farms and along the road. *Ziziphus xylopyrus* are the species dominating the scrub and fallow/barren land. Other shrub species reported from the area are *Carissa carandas, Urena lobata, Cassia*

auriculata, Tecoma stans, Gossypium hirsutum, Jatropha curcas, Justicia adhatoda and *Phyllanthus reticulatus*.

The herbaceous flora in the area was represented by species like *Ageratum conyzoides, Brachiaria eruciformis, Parthenium hysterophorus, Cissus vitiginea, Oxalis latifolia, Gomphrena globosa, Oxalis latifolia* and *Xanthium strumarium, Cymbopogon martini, Sida cordifolia, Tribulus terrestris* and *Waltheria indica* are the other common herb species recorded from this area.

3.2.5.7 Terrestrial Fauna

Mammals

During the surveys 5 mammalian species viz; *Semnopithecus entellus* (Grey Langur) *Macaca mulatta* (Rhesus macaque) *Funambulus palmarum* (Indian Palm Squirrel), *Herpestes auropunctatus* (Small Indian Mongoose) and *Lepus nigricollis* (Common hare) were sighted in the study area.

Avifauna

A total of 32 species of bird species belonging to 28 famlies and 11 Orders were sighted during field survey. An inventory of avifauna sighted during additional study field survey was prepared and enlisted along with their conservation status in **Table 3.66.** In addition to 41 bird species reported during earlier survey 16 new species were sighted during additional study field survey form the tudy area. The classification and nomenclature of bird species is as per https://avibase.bsc-eoc.org.

Table 3.66: List of avifauna sighted in the study area with their conservation status (*Species marked as* were other than sighted during earlier survey*)

S.No.	Family	Common Name	Scientific Name	Conservation Status	
				IUCN 2020.1	IWPA 1972
	Order: Bucerotiformes				
1	Upupidae	Eurasian Hoopoe*	*Upupa epops*	LC	Ap.I
	Order: Caprimulgiformes				
2	Apodidae	House Swift*	*Apus nipalensis*	LC	Ap. I
	Order: Charadriiformes				
3	Charadriidae	Red-Wattled Lapwing	*Vanellus Indicus*	LC	IV
	Columbiformes				
4	Columbidae	Laughing Dove	*Spilopelia senegalensis*	LC	
5	Columbidae	Ring dove	*Streptopelia decaocto*	LC	IV
	Order: Coraciiformes				
6	Meropidae	Blue- chacked Bee Eater*	*Merops persicus*	LC	IV
7	Coraciidae	Indian Roller	*Coracias benghalensis*	LC	
8	Alcedinidae	Common Kingfisher	*Alcedo atthis*	LC	IV
9	Alcedinidae	White-Throated Kingfisher	*Halcyon smyrnensis*	LC	IV
	Order: Cuculiformes				

S.No.	Family	Common Name	Scientific Name	Conservation Status	
				IUCN 2020.1	IWPA 1972
10	Cuculidae	Crow pheasant	*Centropus sinensis*	LC	IV
	Order: Passeriformes				
11	Sturnidae	Brahminy Starling*	*Sturnia pagodarum*	LC	
12	Hirundinidae	Red-rumped Swallow*	*Cecropis daurica*	LC	
13	Emberizidae	Black-Headed Bunting*	*Emberiza melanocephala*	LC	
14	Pycnonotidae	Red-Vented Bulbul	*Pycnonotus cafer*	LC	IV
15	Corvidae	House Crow	*Corvus splendens*	LC	V
16	Leiotrichidae	Common Babbler	*Argya caudata*	LC	
17	Muscicapidae	Blue-fronted Robin*	*Cinclidium frontale*	LC	
18	Cisicolidae	Rufous-fronted Prinia*	*Prinia buchanani*	LC	
19	Laniidae	Long- Tailed Shrike*	*Lanius schach*	LC	
20	Dicruridae	Black Drongo	*Dicrurus macrocercus*	LC	IV
21	Monarchidae	Fly Catcher*	*Terpsiphone purasidisi*	LC	IV
22	Estrildidae	Scaly-breasted Munia*	*Lonchura punctulata*	LC	
23	Muscicapidae	Pied Bushchchat*	Sxicola caprata	LC	
24	Motacillidae	White-Browed Wagtail*	*Motacilla madaraspatensis*	LC	IV
25	Passeridae	House Sparrow	*Passer domesticus*	LC	IV
26	Timaliidae	Jungle Babbler*	*Turdoides striata*	LC	IV
	Order: Pelecaniformes				
27	Ardeidae	Indian Pond Heron*	*Ardeola grayii*	LC	IV
28	Ardeidae	Cattle Egret	*Bubulcus Ibis*	LC	IV
29	Ardeidae	Little Egret	*Egretta garzetta*	LC	IV
	Order: Psittaciformes				
30	Psittacidae	Rose Ringed Parakeet	*Psittacula krameri*	LC	IV
	Order: Seriformes				
31	Sturnidae	Common Myna	*Aerodotheres tristis*	LC	IV
	Order: Suliformes				
32	Phalacrocoracidae	Little cormorant	*Phalacrocorax niger*	LC	IV

LC- Least Concern; Ap. I (Appendix I)- Bird families that do not appear either in Schedule-I (Part-III) or Schedule-IV (No.11) of the Wildlife (Protection) Act, 1972 but should be included in the future amendments.

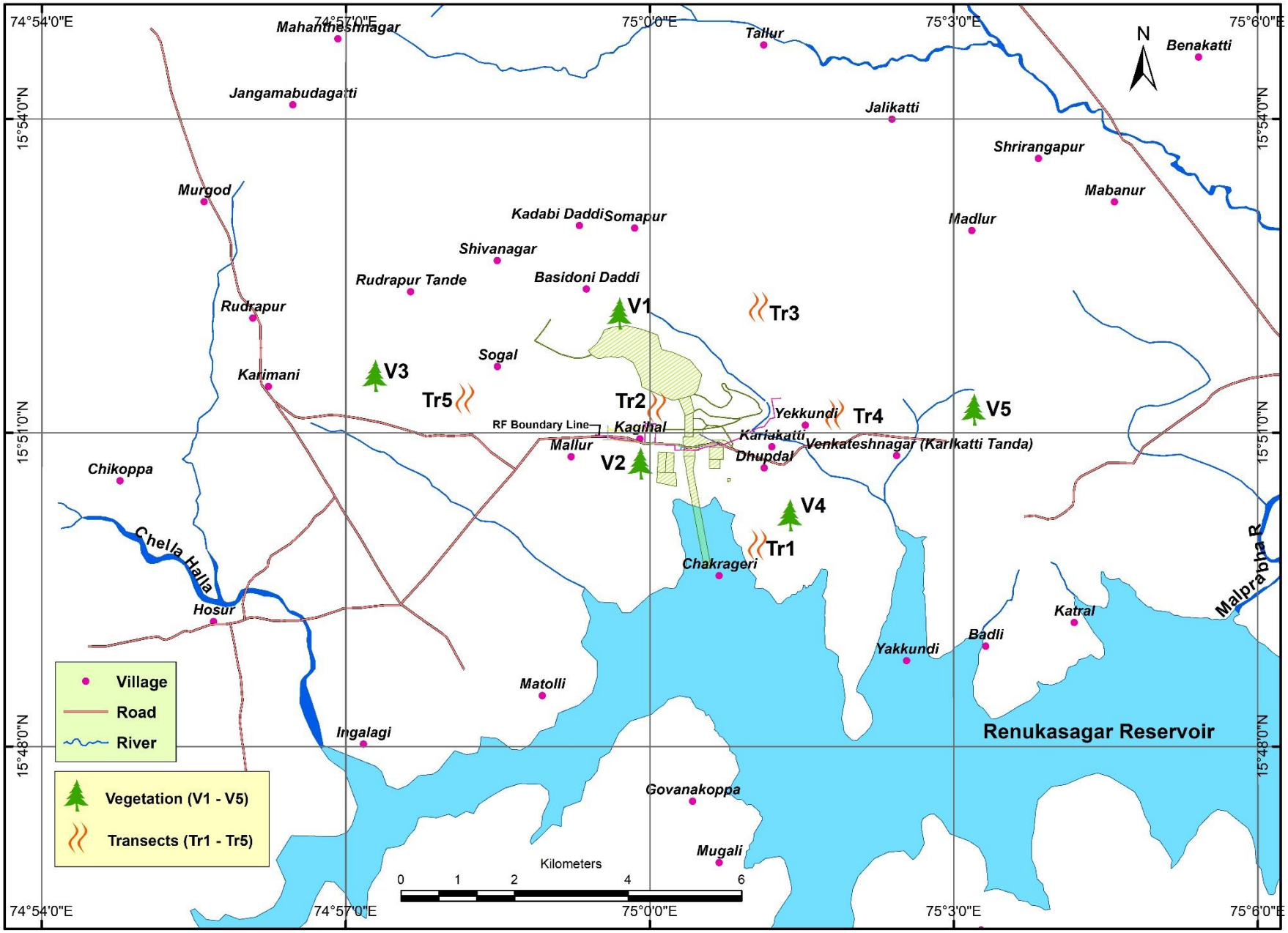


Figure 3.33: Location of Biological Sampling Sites in the study area (Additional Study)

PHOTOGRAPH-AVIFAUNA

Indian Roller (*Coracias benghalensis)*

Blue chacked bee eater (*Merops persicus*)

Black-Headed Bunting (*Emberiza melanocephala*)

Scaly-Breasted Munia (*Lonchura punctulata*)

Black Drongo (*Dicrurus macrocercus*)

Common Babbler (*Argya caudata*)

Rufous fronted prinia (*Prinia buchanani*)

Red-Rumped Swallow (*Cecropis daurica*)

Long tailed shrike (*Lanius schach*)

Red-Wattled Lapwing (*Vanellus indicus*)

Indian Pond Heron (*Ardeola grayii*)

Brahminy Starling (*Sturnia pagodarum*)

Herpetofauna

Herpetofauna sighted during field survey are listed below in **Table 3.67**. Only four species of amphibians are sighted during field survey.

Table 3.67: Herpetofaunal composition of the Study area

S.No	Scientific Name	Common Name	Local Name
1	*Sitana ponticeriana*	Fan throated Lizard	
2	*Calotes versicolor*	Garden lizard	Tonda
3	*Chamaeleo xeylanicus*	Indian Chameleon	Uservavilli
4	*Mabuya corinata*	Common skink	Raktapinjari

Conservation Status of Fauna

As per IUCN Red list of Threatened Species Version 2020.1 all the mammalian and avifaunal species sighted during field survey are under Least Concern (LC) category. As per WPA (1972) all species sighted during field survey fall under Schedule IV or V.

CONCLUSIONS

i) Analysis of soil samples shows fertility status of the soil in project area is Low to medium category. There is no change observed in the soil fertility status during additional study and sample analysis.

ii) Ambient Air and Noise quality in the study area are found within the permissible limit as prescribed by CPCB.

iii) Water samples were collected for surface and ground water quality. According to BIS standards for Drinking Water (2012) all the ground water samples collected from the study area fall within permissible limits prescribed by CPCB.

iv) All the samples of surface water qualify for Class 'B' i.e. designated best use of outdoor bathing (organized) according to Water Quality Criteria of Central Pollution Control Board.

v) In addition to 170 species recorded during earlier survey 10 new species of flowering plants species were recorded from the study area.

vi) During additional study field survey *Semnopithecus entellus* (Grey Langur), *Macaca mulatta* (Rhesus macaque) *Funambulus palmarum* (Indian Palm Squirrel), *Herpestes auropunctatus* (Small Indian Mongoose) and *Lepus nigricollis* (Common hare) are the mammalian species sighted from the study area.

vii) In addition to 41 bird species recorded during earlier survey 16 new species were sighted during additional study field survey for the study area.

viii) As per IUCN Red list of Threatened Species. Version 2020.1 all species reported during additional study are under Least Concern (LC) category of IUCN Red list of Threatened species. According to IWPA 1972 all species recorded from the study area are under Schedule IV and V.

3.2.6 Data Comparison

3.2.6.1 Soil

Soil samples were evaluated to access the change in soil fertility status collected at a 0–0.15 m depth from six different locations during July 2018 and December 2019.

Comparison of chemical parameters like pH, EC, Mg, Alkalinity, Ca, Na, P, and Fe, in soil samples exhibited low variability. While, results for parameters like Organic carbon (OC), Nitrogen (N), Phosphorus (P) and Potassium (K) show moderate variability.

Concentration of nitrogen (N) and potassium (K) varies from 325 kg/ha to 382 kg/ha and 140 kg/ha to 159 kg/ha respectively, whereas the concentration of phosphorus ranges between 23.2 kg/ha and 24.7 kg/ha. Result of December 2019 Nitrogen concentration varies from 290 kg/ha to 332 kg/ha, whereas the concentration of phosphorus and potassium ranges between 23.2 kg/ha and 24.7 kg/ha and 116 kg/ha to 129 kg/ha respectively.

The season of sampling cause the variation in the concentration of NPK in soil samples. Crop management practices, land use pattern and climate (rainfall, temperature & humidity) had significant effect on the soil chemical measurements. Sugarcane, Cotton and vegetable are main crops grown observed in agricultural fields. In the study area farmers use farm yard manure and fertilizers for higher yield. Due to use of manure and fertilizers the concentration of NPK were observed higher during Monsoon season (July 2018) sampling.

3.2.6.2 Ambient Air Quality

Ambient air quality monitoring was carried out for Sulphur dioxides (SO_2), nitrogen oxides (NO_X), PM_{10} and $PM_{2.5}$. The air environment around project site is free from any significant pollution source. The sources of air pollution in the study area are vehicular traffic and dust arising from fallow lands & unpaved village roads.

No significant changes observed in the Ambient Air quality status during comparison of additional data collected during December 2019 and January 2018. At monitoring site located in Chakrageri, Karlakatti Tand & Basidoni Daddi village's concentration of SO_2 and NO_X were found below detectable limit, while the concentration of PM10 and PM2.5 were below the permissible limits specified for industrial, residential, rural and other areas by CPCB.

3.2.6.3 Ambient Noise Level

For monitoring of Ambient Noise level, monitoring locations were selected keeping in view the project activity area along the roadside and the location of receptors. Hourly monitoring was carried out at 6 locations. Monitoring results observed during January 2018 and December 2019. Results show no significant changes in ambient noise level at the selected monitoring locations. Main source of noise pollution in the study area is vehicular movement; there is no change in road network or population pattern; no new industry or any such major change has taken place in last one year; therefore, no change observed on this parameter.

3.2.6.4 Traffic Analysis

Traffic density data was recorded by physically counting the number of different types of vehicles passing through a particular point in a fixed time interval at same location selected for Noise level monitoring. Maximum traffic was observed at same sites where the traffic density was recorded higher in earlier monitoring. The traffic load at Chakrageri and Hosur village was more due to the state highway. At monitoring location located near Sogal village maximum traffic density was recorded because of Sogal deer park and famous Shri Sogal Someshwar temple. As the population pattern and road infrastructure has not change dover the period of one year, no significant change was observed in traffic pattern.

3.2.6.5 Water Quality

Ground Water: Ground Water sampling was carried out at 6 different locations. Sampling result shows the quality of sample collected during January 2018 and December 2019 are well within permissible limits as per BIS standards for drinking water.
The Water Quality Index for both earlier and present study was compared and no significant changes were observed among the quality of water.

Ground Water Quality Index

Sampling Period	GW1	GW2	GW3	GW4	GW5	GW6
January 2018	23.39	23.79	25.64	24.41	24.41	24.46
December 2019	24.20	23.33	23.58	23.96	23.48	25.89

Surface water: For analysis of surface water quality samples were collected from three sites: Renukasagar reservoir, Malaparbha River and one from Sogal village waterfall (Pond). Comparing the results of surface water quality, no changes was observed between sample collected during January 2018 and December 2019.
All the samples of surface water collected during January 2018 and December 2019 qualify for Class 'B' i.e. designated best use of outdoor bathing (organized) according to Water Quality Criteria of Central Pollution Control Board.

According to WQI values obtained for different samples surface water quality in general is in Good category throughout the study area.

Water quality index*

Sampling Period	SW1	SW2	SW3
January 2018	74.38	72.79	71.21
December 2019	71.63	70.81	73.21

Water Quality Index *	
Range	**Quality**
90-100	Excellent
70-90	Good
50-70	Medium
25-50	Bad
0-25	Very bad

3.2.6.6 Floristic Diversity

Based upon earlier field surveys an inventory of 170 flowering plant species belonging to 51 families was prepared. This list includes 65 species of trees, 35 species of shrubs and 70 herbaceous species.

During additional study survey 66 species of trees, 25 species of shrubs and 51 herbaceous species were recorded from the study area (refer **Table 3.65)**. In addition to 170 species recorded during earlier survey 10 new species (1 tree, 3 shrubs and 6 herbs) viz; *Macaranga peltata, Cassia auriculata, Randia dumetorum, Wattakaka volubilis, Vernonia cinerea, Mimosa pudica, Erianthus munja, Setaria glauca, Thysanolaena agrostis* and *Hedyotis puberula* were observed in the study area. All the species recorded during additional study survey are under least concern category of IUCN Redlist 2020.1.

3.2.6.7 Faunal Diversity

Mammals: During additional study field survey *Semnopithecus entellus* (Grey Langur), *Macaca mulatta* (Rhesus macaque) *Funambulus palmarum* (Indian Palm Squirrel), *Herpestes auropunctatus* (Small Indian Mongoose) and *Lepus nigricollis* (Common hare) are the mammalian species sighted from the study area. All these species are common in study area and also sighted during earlier survey carryout out in study area.

Avifauna: A total of 41 species of bird species belonging to 28 families were reported based on three season survey in the study area. During addition study survey 32 bird species were sighted from the study area. Among these 32 bird species 16 species were sighted only during additional study survey (**refer Table 3.68**).

As per IUCN Red list of Threatened Species. Version 2020.1 all species reported during additional study are under Least Concern (LC) category of IUCN Redlist of Threatened species. According to IWPA 1972 all species recorded from the study area are under Schedule IV and V.

Table 3.68: List of avifauna sighted during additional study survey with their conservation status

S.No.	Family	Common Name	Scientific Name	Conservation Status	
				IUCN 2020.1	IWPA 1972
	Order: Bucerotiformes				
1	Upupidae	Eurasian Hoopoe	*Upupa epops*	LC	Ap.I

S.No.	Family	Common Name	Scientific Name	Conservation Status	
				IUCN 2020.1	IWPA 1972
	Order: Caprimulgiformes				
2	Apodidae	House Swift	*Apus nipalensis*	LC	Ap. I
	Order: Coraciiformes				
3	Meropidae	Blue- chacked Bee Eater	*Merops persicus*	LC	IV
4	Alcedinidae	White-Throated Kingfisher	*Halcyon smyrnensis*	LC	IV
	Order: Passeriformes				
5	Sturnidae	Brahminy Starling	*Sturnia pagodarum*	LC	
6	Hirundinidae	Red-rumped Swallow	*Cecropis daurica*	LC	
7	Emberizidae	Black-Headed Bunting	*Emberiza melanocephala*	LC	
8	Muscicapidae	Blue-fronted Robin	*Cinclidium frontale*	LC	
9	Cisicolidae	Rufous-fronted Prinia	*Prinia buchanani*	LC	
10	Laniidae	Long- Tailed Shrike	*Lanius schach*	LC	
11	Monarchidae	Fly Catcher	*Terpsiphone purasidisi*		
12	Estrildidae	Scaly-breasted Munia	*Lonchura punctulata*	LC	IV
13	Muscicapidae	Pied Bushchchat	*Sxicola caprata*	LC	
14	Motacillidae	White-Browed Wagtail	*Motacilla madaraspatensis*	LC	
15	Timaliidae	Jungle Babbler	*Turdoides striata*	LC	IV
	Order: Pelecaniformes				
16	Ardeidae	Indian Pond Heron	*Ardeola grayii*	LC	IV

LC- Least Concern; Ap. I (Appendix I)- Bird families that do not appear either in Schedule-I (Part-III) or Schedule-IV (No.11) of the Wildlife (Protection) Act, 1972 but should be included in the future amendments.

3.3 BASE MAPS OF ALL ENVIRONMENTAL COMPONENTS

Study area of the project covers the project area or the direct impact area within 10 km radius of the main project components like, Pump house, Power House, Balancing reservoirs and approach road etc. Base maps based on study area for all environmental components are prepared and given in respective sections above.

Chapter 4 ANTICIPATED ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

4.1 DETAILS OF INVESTIGATED ENVIRONMENTAL IMPACTS

Assessment of environmental impacts of any development activity is the key component of EIA process. Environmental impacts are assessed based on understanding of the project features/activities, environmental setting in the area and interaction of project activities with environmental components leading to prediction of likely impacts due to development of project in a particular area/region. The present pumped storage scheme as part of integrated renewable energy project, is a location specific project, therefore, impact assessment is carried out by establishing site-specific environmental settings through baseline data collection and defining project components from detailed project information. Baseline environmental status in the project area is established through field studies in different seasons and also by referring to various secondary data sources as discussed in earlier chapters. Project related information is sourced from Project Report (PR) of the project to carry out the impact assessment for project construction and operation phase.

Anticipated environmental impacts during construction phase consist of activities such as drilling and blasting, excavation, concreting, dumping of muck generated from various project activities, transportation of material, material handling and storage, waste generation from labour colonies, operation of construction machinery/equipment, etc. Additionally, large-scale labour migration to the area, during the construction period, may create additional stress on the receiving environment. EIA helps in identification and quantification of such impacts so that appropriate and adequate mitigation/management measures can be planned and implemented for mitigation and minimizing such impacts.

Operation phase of pump storage projects is much cleaner and will have minimum environmental impacts.

All the likely impacts have been considered for various aspects of environment, including physico-chemical, ecological and socio-economic aspects. Invariably there are two types of impacts that occur due to construction and operation of projects viz. permanent which generally lead to loss of plant species, change of land-use, etc.; which can be compensated/managed and temporary which can be minimized and mitigated.

Based on the project details and the baseline environmental status, potential impacts as a result of the construction and operation of the proposed Standalone Pumped Storage component of Saundatti IRE Project have been identified. Wherever possible, the impacts have been quantified and otherwise, qualitative assessment has been undertaken. Environmental protection measures can be best enforced through inclusion of relevant clauses in the contract not only for the main contractors but also for sub-contractors as most of activities are undertaken through various contractors.

This Chapter deals with the anticipated positive as well as negative impacts during the construction as well as operation phase of the proposed project.

4.1.1 Impacts on Air Quality

4.1.1.1 Construction Phase Impacts

The sources and activities that might affect air quality in the project area are vehicular traffic, dust arising from unpaved village roads and domestic fuel burning. The air environment around project site is free from any significant pollution source. Therefore, ambient air quality is quite good in and around the project area.

Vehicles and stationary equipment will impact air quality at the construction site through emissions from the engines and equipment, fugitive emissions due to material handling, etc. Additionally, construction activities including operation of crushers, concrete batch plants, construction work and movement of vehicles along unpaved road will generate dust & gaseous emission and impact air quality. The burning of waste will also affect air quality. In absence of proper fuel, construction workers at the project site may use wood for fuel burning. This will impact air quality.

4.1.1.2 Pollution due to fuel combustion in various equipment

The operation of various construction equipment requires combustion of fuel. Normally, diesel is used in such equipment. The major pollutant which gets emitted as a result of combustion of diesel is SO_2. The particulate matter emissions are minimal due to low ash content in diesel. Depending upon the fuel quality and quantity and rating of DG sets and other equipment, it is important to provide adequate stack height for emission to be dispersed in the atmosphere to have minimum increase in Ground Level Concentrations (GLCs).

4.1.1.3 Emissions from various crushers and other construction plants

The operation of the crusher and other construction plants during the construction phase is likely to generate fugitive emissions, which can impact plant area and surrounding area as well, depending on wind direction. Such fugitive emissions comprising mainly of the particulate matter, will be generated. Various measures have been recommended to control such emissions and further reduce their impacts on workers and locals in the EMP.

4.1.1.4 Fugitive Emissions from material handling and transportation

During construction phase, there will be increased vehicular movement. Lot of construction material like sand, fine aggregate is stored at various sites, during the project construction phase. Normally, due to blowing of winds, especially when the environment is dry, some of the stored material can get entrained in the atmosphere. Although it is very difficult to completely eliminate such impact, it is possible to reduce its intensity by implementing various measures as recommended in the EMP.

4.1.1.5 Operation Phase Impacts

In hydropower project, air pollution occurs mainly during project construction phase. During operation phase, no major impacts are envisaged on air environment.

4.1.2 Impact on Noise Environment

Sources of noise will be the vehicles and equipment for excavation and stationary equipment, including concrete batch plant located at the construction sites. Other sources of noise will be the use of explosives for blasting purposes for construction activities, drilling machines and quarrying and crushing activities.

4.1.2.1 Construction Phase Impacts

a) Noise due to Construction Equipment

Under the worst case scenario, considered for prediction of noise levels during construction phase, it has been assumed that all these equipment generate noise from a common point. The noise levels due to operation of the different construction equipment are given in **Table 4.1**.

Table 4.1: Equivalent Noise Levels due to Operation of Construction Equipment

Equipment	Noise level dB(A)	Equipment	Noise level dB(A)
Earth Moving		**Material Handling**	
Compactors	70-72	Concrete mixers	75-85
Front loaders	72-82	Movable cranes	82-84
Backhoes	70-92		
Tractors	76-90		
Scrappers, graders	82-90		
Truck	84-90		
Others			
Vibrators	69-81	Saws	74-81

Noise level of about 80 dB(A) at 1m from the source will reduce significantly with distance and can be calculated with the following formula at any location:

$$N2 = N1\text{-}20 \log_{10}(r2/r1) - A_f \quad \text{dBA}$$

Where, N2 = Sound level at any location at a distance r2 from the source
N1 = Sound level at any location at a distance r1 from the source

The decrease in sound level of 80 dB(A) at 100m from the source with distance is given in **Table 4.2**. In the absence of details of attenuation factors, they have assumed zero, whereas in actual practice attenuation factors such as vegetation, barricades, etc. will reduce the sound level significantly.

Table 4.2: Decrease in Sound Levels with Distance from Source*

Distance from Source (m)	Corresponding Sound levels dB(A)
100	40.0
200	34.0
500	26.0
1000	20.0
1500	16.5
2000	14.0
2500	12.0
3000	10.5

* Source sound is 80 dB(A) at a distance of 1m

Walls of houses attenuates at least 30 dB(A) of noise. In addition, there is attenuation due to air absorption, atmospheric in homogeneities, vegetal cover, etc. Thus, no increase in noise levels is anticipated beyond 100m from source during the project construction phase. However, it can be a cause of concern from workers working in proximity to machines generating noise.

b) Noise due to increased vehicular movement

During construction phase, there will be significant increase in vehicular movement for transportation of construction material. At present, there is no significant vehicular movement in the area. During construction phase, the increase in vehicular movement is expected to increase by 4 to 5 trucks/hour. The impact on noise level due to increased vehicular movement cannot be quantified as it will depend upon various factors such as vehicle condition, road condition, idling time, traffic condition, etc.

c) Noise Generated due to Blasting

Noise generated by blasting is instantaneous in nature. Noise generated due to blasting is site specific and depends on type, quantity of explosives, dimension of drill hole, degree of compaction of explosives in the hole and rock. Noise levels generated due to blasting have been monitored at various sites and the results have been summarized in **Table 4.3**.

Table 4.3: Noise generated due to blasting

No. of holes	Total charge (kg)	Maximum charge/delay (kg)	Distance (m)	Noise level dB(A)
15	1500	100	250	76-85
17	1700	100	250	76-86
18	1800	100	250	74-85
19	1900	100	400	70-75
20	2000	100	100	76-80

It can be observed from **Table 4.3** that noise level due to blasting operations are expected to be of the order of 75-85 dB(A) at a distance of about 250m; which will be reduced to 35-45 dB(A) in another 100m. External attenuation factor will reduce it further. As the blasting is likely to last for 4 to 5 seconds depending on the charge, noise levels over this time would be instantaneous and short in duration. Considering attenuation due to various sources, even the instantaneous increase in noise level is not expected to be significant especially during day time. Hence, noise level due to blasting is not expected to cause any significant adverse impact.

e) Impacts due to Ground Vibrations

The explosive energy generated during blasting sets up a seismic wave within the surface, which may affect the structures and cause discomfort to human population. When an explosive charge is fired in a hole, stress waves traverse in various directions, causing the rock particles to oscillate. Blasting also generates ground vibrations and instantaneous noise. Various measures have been recommended to minimize the adverse impacts due to blasting:

- Proper design of blast hole to be developed.
- Use of noiseless trunk delays to minimize the noise due to air blast.
- Use of non-electric system of blasting for true bottom-hole initiation.

- Use of muffling mats to arrest the dust and fly rock.

Noise in and around the construction site may affect the wildlife and residents in the nearby areas. Wildlife in the area will likely to move away from the noise and eventually return to the area when construction is complete. However, there is no major wildlife observed in and around the construction site and hence this may not be a significant issue.

f) Impacts on Labour

The effect of high noise levels on the operating personnel has to be considered as this may be particularly harmful. It is known that continuous exposures to high noise levels above 90 dB(A) affects the hearing ability of the workers/operators and hence, should be avoided. To prevent these effects, it has been recommended by Occupational Safety and Health Administration (OSHA) that the exposure period of affected persons be limited as in **Table 4.4**.

Table 4.4: Maximum Exposure Periods Specified by OSHA

Maximum equivalent continuous noise level dB(A)	Unprotected exposure period per day for 8 hrs/day and 5 days/week
90	8
95	4
100	2
110	½
120	¼

4.1.2.2 Operation Phase Impacts

No major impacts are envisaged on noise environment during project operation phase.

4.1.3 Water Environment

Various sources of water pollution in the project area during the construction phase include disposal of effluents with high turbidity from crushers commissioned at various sites, sewage disposal from labour camp, blasting and other land clearing activities, washing of oil, grease and other chemicals from diesel generator sets, vehicles and other machinery etc.

4.1.3.1 Impacts of water pollution

Water pollution is harmful and is considered to be a serious health hazard. It has far-reaching consequences and effects on human beings and animals also. The effect can be felt not only in the surface water bodies but also the ground water source in the area. The affect may be of temporary or permanent nature. The major impacts of water pollution are given as under:

- The construction of civil and allied structures could lead to stockpiling and excavation activity on site, thereby exposing the base soil to erosion. The runoff from this site and also from muck disposal sites may contain high quantity of Suspended Solids which shall add to the inorganic load of water bodies and drainages in the area. However, the impact of runoff may not be very significant except during rainy season.
- During construction phase, waste water, sewage etc. shall be generated from the labour camp and workshops. If disposed untreated, this would substantially deteriorate the surface and ground water quality in the area.

- The oil and grease released from the project related activities may also change the physico-chemical characteristics of water.

4.1.3.2 Construction Phase Impacts

The major sources of water pollution during project construction phase are as follows:

- Sewage from Construction work camps/colonies
- Effluent from Construction Plants and Workshops
- Disposal of muck

Sewage from Construction worker Camps

The project construction is likely to last for a period of 3 years. As mentioned earlier, about 1900 semi-skilled/unskilled, skilled and supervisory staff are likely to work during project construction phase. Most of the employees/ workers during construction phase are likely to be employed from outside the project area. The construction phase, also leads to mushrooming of various allied activities to meet the demand of immigrant construction workers in the project area. Additionally drivers and labour associated with transportation of material will also stay in the area on temporary basis.

The domestic water requirement for the construction worker and the technical staff migrating into the project area is of the order of 190 cum/day @ 100 lpcd. Adding other requirement from fluctuating population, it can go up to 200 cum/day. With 80% of this quantum to be generated as wastewater, the quantity of 160 cum/day is considered significant and require planned disposal otherwise it will lead to water pollution, resulting in increase in coliforms and other pathogens, which can lead to incidence of water borne diseases. Therefore, project authorities would be taking appropriate measures to check such disposal into the natural water bodies. In order to avoid any deterioration in water quality due to disposal of untreated wastewater from labour camps, appropriate sewage treatment facilities will be commissioned in the labour camps.

Effluent from Construction Plants and Workshops

As discussed earlier, construction plants viz. aggregate processing and concrete mixing and workshops will be established. Water is used in these construction plants and wastewater generated with high suspended solids. Similarly from workshops, major pollutant will be oil and grease. Discharge of untreated wastewater will adversely affect the surface and ground water quality. To minimize the impact, such effluent needs to be treated in situ before discharge to any water body or for land application.

Disposal of Muck

The major impact on the water quality arises when the muck is disposed along the water bodies and natural drainage system. The unsorted waste going into the channels/ water bodies will greatly contribute to the turbidity of water continuously for long time periods. The high turbidity is known to reduce the photosynthetic efficiency of primary producers in the water bodies and as a result, the biological productivity will be greatly reduced. Therefore, the prolonged turbid conditions would have negative impact on the water quality. Therefore, muck disposal has to be done in line with the Muck Disposal Plan given in EMP to avoid any negative impact.

4.1.3.3 Operation Phase Impacts

Proposed pumped storage component of Saundatti IRE project is not planned on any natural water body/river; the project will create artificial upper reservoir and water will remain in circulation from existing Renuka Sagar reservoir to upper reservoir during power generation and vice versa during non-generation hours on daily basis. Therefore, no direct impact on natural water bodies during operation is envisaged.

During the operation phase, due to absence of any large-scale construction activity, the cause and source of water pollution will be much different. Since, only a small number of O&M staff will reside in the area in a well-designed colony with sewage treatment plant and other infrastructural facilities, the problems of water pollution due to disposal of sewage are not anticipated. The treated sewage will be reused for gardening and green belt around the colony.

4.1.4 Land Environment

Construction Phase Impacts

For the development of Standalone Pumped Storage component of Saundatti IREP, land would be acquired for construction of project components, reservoir area, muck dumping, quarrying, construction camps and colony, etc. Based on the final project layout, land requirement has been finalized as **213.70 Ha (Table 4.5).**

Table 4.5: Land Requirement

S.No.	Components	Forest Area (Ha)		Non-forest Area (Ha)		Total Area (Ha)
		Surface	Underground	Pvt.	Govt.	
1	Upper Reservoir	128.58	0.00	0.00	0.00	128.58
2	Penstock	5.79	0.00	0.00	0.00	5.79
3	Pressure Shaft	0.00	5.84	0.00	0.00	5.84
4	Power House, Switch Yard & Tail Race Outfall including Permanent access road to Power House	12.93	0.00	2.31	0.00	15.24
5	Adit to Pressure shaft	0.10	0.63	0.00	0.00	0.73
6	Approach Road to all other Project Components	6.53	0.00	0.62	0.00	7.15
7	Contractor facilities, Cement and E&M stores, Temporary Colony area	0.00	0.00	10.00	0.00	10.00
8	Muck Disposal area (1 & 2)	0.00	0.00	10.00	0.00	10.00
9	Tail Race Channel	0.00	0.00	6.16	18.66	24.82
10	Magazine	0.00	0.00	0.25	0.00	0.25
11	Job Facility Yard & others	0.00	0.00	5.30	0.00	5.30
Total		**153.93**	**6.47**	**34.64**	**18.66**	**213.70**

Source: PR of Standalone Pumped storage component of Saundatti IREP

Major impact of land acquisition is permanent change of land use, which is unavoidable. Land acquisition has impacts on local population by way of loss of their agriculture land and hence livelihood. Land acquisition also lead to loss of flora and fauna by way of loss of forest land and clearing of vegetation on acquired land. These impacts can be mitigated to a large extent by providing adequate compensation to private land owners and by compensatory afforestation in lieu of loss of forest land.

4.1.4.1 Impact due to Land Requirement and change in land-use

Major impact of land acquisition is permanent change of land use, which is irreversible impact. Based on the final project layout, land requirement has been finalized as 213.70 ha; out of which 34.64 ha is private land, 18.66 ha is government land and 160.40 ha is forest land. Additionally, land acquisition has impacts on local population by way of loss of their agriculture land and hence livelihood and also impact on flora and fauna by way of loss of forest land and clearing of vegetation on acquired land. These impacts cannot be mitigated; however, compensation in terms of implementation of Compensatory Afforestation Plan, Biodiversity Conservation Plan and R&R Plan will help in managing and reducing the magnitude of such impacts.

4.1.4.2 Impacts Due to Muck Generation

The construction would involve about 7.21 Mcum of soil and rock excavation. About 5.33 Mcum of excavated muck is expected to be utilized for rockfill and aggregate for construction and about 1.00 Mcum is utilized for leveling of reservoir bed level. Total quantity of muck proposed to be disposed in designated muck disposal area, after considering 40% swelling factor would be 1.64 Mcum. This muck would requires disposal, with minimum environment impacts. Muck, if not securely transported and dumped at pre-designated sites, can have serious environmental impacts, such as:

- Can be washed away into the natural water bodies which can cause negative impacts on surface and ground water quality.
- Can lead to impacts on various aspects of environment. Normally, the land is cleared before muck disposal. During clearing operations, trees are cut, and undergrowth perishes as a result of muck disposal.
- In many of the sites, muck is stacked without adequate stabilisation measures. In such a scenario, the muck moves along with runoff and creates soil erosion like situations.
- Normally muck disposal is done at low lying areas, which get filled up due to stacking of muck. This can sometimes affect the natural drainage pattern of the area leading to accumulation of water or partial flooding of some area which can provide ideal breeding habitat for mosquitoes.

Muck disposal needs to be carefully planned else it becomes a major impact from construction of project. The plan should focus on reuse of the muck as far as possible and dump of the surplus muck at pre-designated sites with well-designed retention structures.

4.1.4.3 Impacts Due to Waste Generation

The construction of the proposed Pumped Storage component of the Project will involve different categories of manpower like labour, technical, other officials and service providers. Most of these technical and non- technical workers will be temporary and will leave the region as soon as the construction phase of the project is over, which is estimated as 4 years. Some of the workers will be accompanied by their families. The total migrant population of workers and their families has been estimated as 1400 persons during peak construction time. These people will be living in temporary and permanent colonies/ settlements. The main sources of waste generation can be categorized as:

- Municipal waste (includes commercial and residential wastes generated in either solid or semi-solid form excluding industrial hazardous wastes and bio-medical wastes)
- Construction and demolition debris (C&D waste)
- Bio-medical waste
- Hazardous waste (generated from construction machinery and equipment)
- e-Waste (computer parts, Printer cartridges, electronic parts, etc.,).

Solid waste generated from temporary and permanent colonies in construction as well as operation phase requires special management to dispose off as warranted under the Solid Wastes Management Rules (SWM) 2016. For that an efficient waste management system will be required to put in place to keep the environment of the region clean and healthy.

These colonies and temporary settlements will also require adequate water supply for drinking and cleaning.

The project authorities will ensure sewage generated from labour colonies and site office is treated and disposed as per the SPCB guidelines. It's proposed to provide adequate septic tanks with soak pits for treatment and disposal of sewage.

4.1.4.4 Impacts Due to Road Construction

A network of roads would be required to approach various project components for construction, operation and maintenance. It has been assessed that about 5.07 km length of new road is required to be constructed to access the access the Dam Site from the Power House. The total land required for the construction of new road is 7.15 ha.

The major impacts likely to accrue as a result of construction of the roads are:

- Loss of forest and vegetation by cutting of trees
- Geological disturbance due to blasting, excavation, etc.
- Soil erosion as the slope cutting operation disturbs the natural slope.
- Interruption of drainage and change in drainage pattern
- Disturbance of water resources with blasting and discriminate disposal of fuel and lubricants from road construction machinery
- Siltation of water channels/ reservoirs from excavated debris
- Effects on flora and fauna
- Air pollution due to dust from debris, road construction machinery, etc.
- Noise generation due to construction activities.

4.1.5 Impacts on Forests and Forest Land

The total land required for the construction of proposed project activities is approximately 2**13.70 ha** with **160.40 ha** of forestland. This shall lead to loss of some of the plant species used for various economic purposes because of creation of reservoir on forested areas. This impact is partially mitigated by implementation of Compensatory Afforestation Plan as well as Biodiversity Management Plan.

4.1.6 Flora and Fauna

4.1.6.1 Construction Phase

Impact on Terrestrial Flora

The direct impact of construction activity is generally limited in the vicinity of the construction sites only. As mentioned earlier, a large population (1900) including technical staff, workers and other group of people are likely to congregate in the area during peak project construction phase. It can be assumed that the technical staff will be of higher economic status and will live in a more urbanized habitat, and will not use wood as fuel, if adequate alternate sources of fuel are provided. However, workers and other population groups residing in the area may use fuel wood, if no alternate fuel is provided. Hence, to minimize such impacts, it is proposed to provide alternate fuel for cooking e.g. LPG/kerosene to the construction workers. The other alternative is to provide community kitchens on a cooperative basis by the contractor. The details of the same have been covered in Environmental Management Plan.

Other major impact on the flora in and around the project area would be due to increased level of human interferences. The workers may also cut trees to meet their requirements for construction of houses, furniture. Normally in such situations, lot of indiscriminate use or wastage of wood is also observed, especially in remote or inaccessible areas. Thus, it is necessary to implement adequate surveillance to mitigate the adverse impacts on terrestrial flora during project construction phase.

Impact on Terrestrial Fauna

a) Disturbance to Wildlife

During the construction period, large number of machinery and construction workers shall be mobilized, which may create disturbance to wildlife population in the vicinity of project area. The operation of various equipment will generate significant noise, especially during blasting which will have adverse impact on fauna of the area. The noise may scare the fauna and force them to migrate to other areas. Likewise siting of construction plants, workshops, stores, labour camps etc. could also lead to adverse impact on fauna of the area. During the construction phase, accessibility to area will lead to influx of workers and the people associated with the allied activities from outside will also increase. Increase in human interference could have an impact on terrestrial ecosystem.

The other major impact will be the blasting to be carried out during construction phase. This impact needs to be mitigated by adopting controlled blasting and strict surveillance regime and the same is proposed to be used in the project. This will reduce the noise level and vibrations due to blasting to a great extent.

Forest cover in the vicinity of proposed project working sites and their immediate vicinity is comprised of scrub forest with agriculture as second pre-dominant land use type. However, due to anthropogenic pressure in the area stray incidents of wildlife are reported from these areas. Therefore, adequate measures will be required during the construction phase not to cause any adverse impact on terrestrial and avi-faunal population. Blasting during construction may cause adverse impacts. Hence it is recommended that delayed blasting

techniques as already stated above would be utilized to minimize the impact, as a result of noise and vibration generated due to blasting.

4.1.6.2 Operation Phase Impacts

On completion of the construction of the project, the land used for construction activities will be restored. Construction workers who have resided in that area will move to another project site. By ensuring all the mitigation and management measures, as planned for this project, are implemented to minimize the impact of construction phase, large part of the area will go back to its original form. However, there will be some permanent changes such as reservoir formation, powerhouse and project colony. The project is planned as a clean source of renewable energy as there are no significant pollution generation during project operation. There is no air and water pollution from the project operation. Similarly generation of solid and hazardous waste is also insignificant.

Other impacts of the construction phase include formation of reservoir impacting the water quality, pollution generation from colony and plant along with positive as well as negative impacts on socio-economic environment mainly due to improved infrastructure in the area.

Proposed pumped storage component of Saundatti IRE project is not planned on any natural water body/river; the project will create artificial upper reservoir and water will remain in circulation from existing Renuka Sagar reservoir to upper reservoir during power generation and vice versa during non-generation hours on daily basis. Therefore, no direct impact on natural water bodies during operation is envisaged.

During the operation phase, due to absence of any large-scale construction activity, the cause and source of water pollution will be much different. Since, only a small number of O&M staff will reside in the area in a well-designed colony with sewage treatment plant and other infrastructural facilities, the problems of water pollution due to disposal of sewage are not anticipated. The treated sewage will be reused for gardening and green belt around the colony.

4.1.7 Impacts on Socio-economic Environment

A project of this magnitude is likely to entail both positive as well as negative impacts on the socio-cultural fabric of area.

a) Positive Impacts on Socio-Economic Environment

The following positive impacts are anticipated on the socio-economic environment of the local people of villages of project area during the project construction and operation phases:

i) A number of marginal activities and jobs would be available to the locals during construction phase.
ii) Developer bringing large scale investment to the area will also invest in local area development and benefit will be reaped by locals. Education, medical, transportation, road network and other infrastructure will improve.
iii) The availability of alternative resources provided by developer in the rural areas will reduce the dependence of the locals on natural resources such as forest.

b) Negative Impacts on Socio-Economic Environment

Such projects, in addition, to positive impact on socio-economic environment may also bring certain negative impact due to influx of outside population. Workforce will reside in that area for around three years and also there will be influx of drivers and other workers on temporary basis. This influx of people in otherwise isolated area may lead to various social and cultural conflicts during the construction stage. Developers need to take help of local leaders, Panchayat and NGOs to ensure minimum impact on this count.

c) Increased incidence of Diseases

Large scale activity in the area due to the proposed project may become a cause of spread different types of diseases in the project area due to following reasons:

- Project requires long-term input of labour from outside the area.
- Project requires that significant numbers of project employees be separated from their families for long periods of time.
- Project involves the creation of large, temporary construction camp(s).
- Increases mobility of people in and out of the area (job seekers, formal and informal service providers).
- Requires participation / resettlement of the local population.

4.2 MEASURES FOR MINIMIZING/OFFSETTING ADVERSE IMPACTS

Pollution generation mainly during construction phase will be in the form of air, water and noise pollution; which will be mitigated by adopting various mitigation measures during construction activities as discussed in later section under the head, “Mitigation Measures”.

Impacts of projects such as muck generation, quarrying, worker’s health and safety, waste generation from labour colonies, impact on workers’ health, impact of tree cutting for fuel etc. will be minimized by implementing various management plans. Environmental Management Plans viz. Compensatory Afforestation Plan, Green Belt Development Plan, Landscaping & Restoration Plan, Muck Management Plan, Dam Break Modeling & Disaster Management Plan, Public Health Delivery Plan, Sanitation and Solid Waste Management Plan, Energy Conservation Measures and Biodiversity Management & Wildlife Conservation Plan have been prepared to address these specific impacts with a view to minimize adverse impacts. Detailed Management Plans are discussed in Chapter 10.

4.3 IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF ENVIRONMENTAL COMPONENTS

The proposed Scheme will involve construction of Rockfill embankment of height 43m for creation of Saundatti IREP Upper reservoir of 1.03 TMC gross capacity. Intake structure and trash rack for five numbers of independent penstocks in which one penstock will be bifurcated in to two penstocks as hydraulic short circuit to connect two units will be taking off from Saundatti IREP Upper reservoir. Surface Power House will be located at about 776m from the intake structure and shall be equipped with four vertical-axis reversible Francis type units composed each of a generator/motor and a pump/turbine having generating/pumping capacity of 252MW/303MW and two units of 126MW/170MW respectively.

Irreversible environment components or resources are those, whose use limit the future use options and Irretrievable components are those whose use eliminate the future use options. Typically, in the context of infrastructure project, Irreversible and Irretrievable commitments of environmental components are due to use of non-renewable resources in project construction and operation.

During the construction stage of the project, raw material will be consumed as resources, which are in abundant supply. No impact is identified on any of the flora or fauna species which will make them extinct by the project. Land required for the project will undergo permanent change of land use. Forest land will be compensated by compensatory afforestation and private land will be compensated as per the law. No displacement of population is involved. During the project operation, water will be the main raw material for power generation. There is no consumptive use of water. 1.0 TMC of water will be sourced from Renuka Sagar reservoir for one time filling. Only evaporation losses will be added on annual basis. Therefore, project does not have any significant irreversible and irretrievable impacts on environmental components.

4.4 ASSESSMENT OF SIGNIFICANCE OF IMPACTS

Impacts, as discussed above, along with the mitigation measures have been summarized in the form of matrix and subjected to categorization in the form of magnitude, significance and duration of impact. Categorization is largely judgement based as assessed by experts who were involved in carrying out the study. Impact assessment matrix is given at **Table 4.6**.

Table 4.6: Impact Assessment Matrix

Sl. No.	Environmental attribute	Potential impacts	Nature of impact	Phase	Magnitude of impacts			Significance		Long Term/Short Term	
					Low	Medium	High	Significant	Insignificant	Permanent	Temporary
A.	**Physical Resources**										
1.	Land use and Topography	Change in the surface features and present aesthetics due to the construction of the project Muck disposal	Direct/Local/ irreversible	Before construction phase		X		X		X	
B.	**Environmental Resources**										
1.	Air Quality	Project will have marginal impact on air quality during the construction period due to increase in the dust emission, fuel combustion in various equipment, crushers and other construction plants & Emissions from material handling and transportation	Direct/Local/ reversible	During construction activity		X		X			X
2.	Noise	Noise due to general construction activities and equipment, increased vehicular traffic, blasting etc.	Direct/Local/ reversible	During construction activity		X		X			X
3.	Surface and Ground Water quality	Waste from construction labor camps, effluent from	Direct/Local/ reversible	Before and during construction activity		X		X			X

Sl. No.	Environmental attribute	Potential impacts	Nature of impact	Phase	Magnitude of impacts			Significance		Long Term/Short Term	
					Low	Medium	High	Significant	Insignificant	Permanent	Temporary
		construction plants and workshops Runoff from the construction site and its disposal									
		Domestic wastewater from construction sites	Direct/Local/ reversible	During construction and operation	X				X		X
4.	Soils	Soil erosion due to excavation, muck generation, construction activities and clearing of vegetation and access roads. Muck disposal	Direct/Local/ reversible	During and after the construction activity			X	X		X	
C.	**Ecological Resources**										
1.	Terrestrial Flora	Loss of vegetation	Direct/Local/ irreversible	Before the construction phase			X	X		X	

Sl. No.	Environmental attribute	Potential impacts	Nature of impact	Phase	Magnitude of impacts			Significance		Long Term/Short Term	
					Low	Medium	High	Significant	Insignificant	Permanent	Temporary
2.	Terrestrial Fauna	Disturbance to the local fauna during construction	Direct/Local/ reversible	Before, during and after construction phase	X				X		X
3.	Aquatic Ecology	Disturbance to the aquatic fauna after construction	Direct/Local/ reversible	Before, during and after the construction phase	X				X		X
D.	**Human Environment**										
1.	Health and Safety	Increased incidence of Diseases Fires, explosion and other accidents at construction sites	Direct/Local/ Continuous	Before and after the construction phase.	X			X			
2.	Agriculture	Impact envisaged as there is private land involved	Direct/Local/ reversible			X		X		X	
3.	Socio-economics	Positive and negative impacts on socio-economic environment Job opportunities during construction phase.	Direct/regional/Continuous	During operational phase		X		X			
4.	Resettlement	Impact envisaged as there is private land or displacement involved	Direct/Local/ reversible			X		X			X

Sl. No.	Environmental attribute	Potential impacts	Nature of impact	Phase	Magnitude of impacts			Significance		Long Term/Short Term	
					Low	Medium	High	Significant	Insignificant	Permanent	Temporary
5.	Historical and archaeological sites	No archaeological, historical or cultural important sites are affected by the construction.	Direct/Local/ reversible		X				X		X
6.	Traffic and Transportation	Traffic congestion due to movement of construction vehicles	Direct/Local/ reversible	During construction phase		X		X			X
7.	Solid Waste Generation	Probability of Surface and ground water pollution	Indirect/Local / reversible	During operation phase	X				X		X

4.5 MITIGATION MEASURES

Mitigation of construction-related impacts would be the responsibility of the project proponent (through its contractors). Air and water are two major environmental factors that are directly affected by any kind of construction activity. Different anthropogenic activities especially the developmental works add suspended particulate matter and obnoxious gaseous pollutants to air. During construction period generation and release of effluents from construction site, workshops, sewage disposal from labour camp, blasting and other land clearing activities, washing of oil, grease and other chemical from diesel generator sets, vehicles and other machinery etc. cause water pollution and affect the quality of surface as well ground water.

The major air pollutants, which could be generally, released during various construction activities and vehicular movements are Particulate Matter (PM), SOx and NO_X. In addition to these construction activities also generate noise due to the use of heavy machinery, heavy vehicles, blasting, etc. which has serious impacts on humans as well as the wildlife of the area.

4.5.1 Air Pollution

The various sources causing air pollution during the construction phase are as follows.

- **Particulate Matter (PM):** Various activities such as blasting, crushing, transportation of material in open trucks, open dumping in muck disposal sites, vehicle movements, operation of Diesel Generator Sets, etc.

- **Oxides of Sulphur (SOx):** SOx is released into the air from vehicular exhaust, Diesel Generator Sets, coal burning chulas etc.

- **Oxides of Nitrogen (NO_x):** Motor vehicles and fuel burning are generally responsible for the release of oxides of nitrogen into the ambient air.

4.5.1.1 Impacts of Air Pollution

The various impacts of air pollution associated with PM, SO_x and NO_x are as under:

- **Impacts of PM:** High quantities of PM in the ambient air can cause emphysema, bronchial asthma and eye-irritation which in some cases can also result in cancer. PM containing lead particles (emitted from automobiles) is considered responsible for anemia as it affects hemoglobin formation. Lead is also a proven carcinogen. Dust coating on leaves of plants reduces photosynthesis and reduces plant growth.

- **Impacts of SOx:** The oxides of Sulphur causes irritation of mucous membranes of the respiratory tract. Higher concentrations may cause bronchitis. Plants are particularly sensitive to high concentrations of SO_2 and suffer from chlorosis, metabolic inhibition, plasmolysis and even death.

- **Impacts of NO_x:** Oxides of nitrogen can combine with hemoglobin to reduce the oxygen carrying capacity of the blood. This can cause irritation of alveoli of the lungs and high concentrations may even cause acute bronchitis.

4.5.1.2 Control of Air Pollution

For the control of air pollution during construction phase of the project, it is suggested that it should be made mandatory for the contractor/s engaged in the construction works to ensure the following conditions:

- The crushers should be provided with Wet-scrubbers, so as to minimize the release of PM into the atmosphere.
- The chimneys of the Diesel Generator Sets should be kept at appreciable height (as per the laid down rules). The DG sets should be properly maintained.
- Regular water sprays at the crushing sites, dumping sites as well as on roads should be ensured. Necessary clause shall be incorporated in the contractor's agreement.
- Masks should be provided to the workers and staff.
- Proper ventilation facilities shall be provided inside the tunnel and at all the residential complexes of the staff and labour.
- Ambient Air quality shall be monitored seasonally during the construction phase at different locations with the help of any reputed agencies.
- Controlled blasting during construction activities will be ensured.

4.5.2 Noise Pollution

Various sources of noise pollution in the project area during the construction phase include vehicular movement, operation of heavy machinery, blasting, crushing, aggregate processing plants, diesel generator sets, etc.

4.5.2.1 Impacts of Noise Pollution

Noise is generally harmful and is considered to be a serious health hazard. It has far-reaching consequences and has many physical, physiological as well as psychological effects on human beings and animals. Continuous exposure to noise may result in temporary or permanent shifting of the hearing threshold depending upon the level and duration of exposure. The immediate and acute effect of noise causes impairment of hearing (total deafness). The major impacts of noise pollution are given as under:

- It causes headache and increased heart beat
- It causes anxiety, eye-strain, memory loss and muscular strain
- It also causes fatigue, loss of sleep and emotional disturbance
- In case of wild animals, the noise pollution has been observed to interfere with their breeding efficiencies

4.5.2.2 Control of Noise Pollution

Since continuous exposure to noise is lethal, it is essential to control the noise pollution. Various measures for control of noise pollution in the project area are suggested below:

- Diesel Generator sets are to be placed in acoustic enclosures to reduce the noise.
- Ear protection aids such as ear plugs, earmuffs, noise helmets, etc., must be provided to the workers who have to work in the noise prone area.

- Proper and regular maintenance/lubrication of machines should be done.
- Noise producing still machines (such as crushers, aggregate processing plants, etc.) should be provided with sound barriers.
- Quieter machines and vehicles with high quality silencers should be used.
- Afforestation around the residential colonies and office complexes should be done as proposed under the Afforestation Programmes.
- Ambient noise should be estimated periodically at different locations.

4.5.3 Water Pollution

Various sources of water pollution in the project area during the construction phase include disposal of effluents with high turbidity from crushers commissioned at various sites, sewage disposal from labour camp, blasting and other land clearing activities, washing of oil, grease and other chemicals from diesel generator sets, vehicles and other machinery etc.

4.5.3.1 Impacts of water pollution

Water pollution is harmful and is considered to be a serious health hazard. It has far-reaching consequences and effects on human beings and animals also. The effect can be felt not only in the surface water bodies but also the ground water source in the area. The affect may be of temporary or permanent nature. The major impacts of water pollution are given as under:

- The construction of civil and allied structures could lead to stockpiling and excavation activity on site, thereby exposing the base soil to erosion. The runoff from this site and also from muck disposal sites may contain high quantity of Suspended Solids which shall add to the inorganic load of water bodies and drainages in the area. However, the impact of runoff may not be very significant except during rainy season.
- During construction phase, waste water, sewage etc. shall be generated from the labour camp and workshops. If disposed untreated, this would substantially deteriorate the surface and ground water quality in the area.
- The oil and grease released from the project related activities may also change the physico-chemical characteristics of water.

4.5.3.2 Control of water pollution

To avoid deterioration of water quality of the receiving water body following measures are suggested

- During Construction phase provision of septic tank/ soak pit of adequate capacity for labour camp so that it can function properly for the entire duration of construction phase
- Construction of settling tank to settle the suspended impurities from various sources i.e. HMP/ crushers, labour camps, etc. before discharging into the main stream
- During Operation, Commission of suitable treatment facilities to treat the sewage generated from the colony

- Provision of sedimentation cum grease traps at the outer mouth of drains located along workshops, fuel filling stations, diesel generator rooms etc. so as to prevent entry of contaminants to the water bodies.
- Oil interceptors shall be provided for refueling areas, vehicle parking, washing areas etc. All spills and collected petroleum products will be disposed off in accordance with SPCB guidelines.

The cost for Air, Water & Noise management plan has been considered under Environmental Monitoring of the Project.

chapter 5 ANALYSIS OF ALTERNATIVES

5.1 DESCRIPTION OF EACH ALTERNATIVES

Following alternatives of project layout have been studied based on the topographical and Geological parameters;

Alternative – 1: Upper reservoir is located on moderately flat land on top of hill and this scheme comprises of Intake Structure, Top Inclined Pressure Shaft / VPS/ Bottom Horizontal Pressure Shaft, Power House, TRT, Tail Race Outlet and Tail Race Channel

Alternative -2: Upper reservoir is located on the natural depression and this scheme comprises of Intake Structure, Penstock/Pressure Shaft, Underground Power House, Underground Transformer Cavern, Draft Tube Tunnels, Tail Race Surge Chamber, Tail Race Tunnels, Tail Race Outlet and Tail Race Channel

5.2 SUMMARY OF ADVERSE IMPACTS AND MITIGATION MEASURES FOR EACH ALTERNATIVE

Alternative-1

In Alternative -1, the Upper reservoir is proposed to be located on the flat / gradually sloping land wherein on one side a small hillock portion is existing which has to be excavated up to the desired level. Considering this location, the area capacity calculation has been carried out and found that the location is suitable for creating the gross storage capacity of 1.03 TMC in which live storage capacity is 1 TMC and dead storage capacity is 0.03 TMC by keeping FRL and MDDL at EL 855.00m & EL 825.00m respectively. For creating this storage, it is proposed to construct rockfill embankment with maximum height of 43 for the length of 5776m. This layout of the scheme comprises the following components:

- Intake Structure
- Top Inclined Pressure Shaft / VPS/ Bottom Horizontal Pressure Shaft
- Power House
- Tail Race Tunnels
- Tail Race Outlet
- Tail Race Channel

With respect to the existing Renuka Sagar Lower reservoir FRL of EL 693.83m & MDDL of EL 623.93m, the rated head is arrived to 206.82m after considering the hydraulic losses. Accordingly, the installed capacity was arrived to 1260 MW with the storage capacity of 14616 MWH for 11.6 hours.

Alternative - 2

In Alternative -2, the Upper reservoir is proposed to be located on the natural depression. Considering this location, the area capacity calculation has been carried out and found that the location is suitable for creating the storage. The gross storage capacity is worked out to be 1.03 TMC in which the dead storage capacity is 0.03 TMC and the live storage capacity requirement is 1.0 TMC by keeping the FRL and MDDL same as alternative-1. The Dam &

intake structure remain same as proposed in alternative-. This layout of the scheme comprises the following components:

- Intake Structure
- Buried Penstock/Pressure Shaft
- Underground Powerhouse
- Transformer Cavern
- Draft Tube Tunnels
- TRT Surge Chamber
- Tail Race Tunnels
- Tail Race Outlet
- Tail Race Channel

With respect to the existing Renuka Sagar Lower reservoir FRL of EL 693.83m & MDDL of EL 623.93m, the rated head is arrived to 206.82m after considering the hydraulic losses. Accordingly, the installed capacity was arrived to 1260 MW with the storage capacity of 14616MWH for 11.6 hours.

Impacts and Mitigation Measures – Comparison of Alternative 1 and 2

Alternative 1 was identified during detailed survey and investigation. Both the alternatives were compared for project optimization, impact assessment of each alternative and proposed mitigation measures. Following is the outcome of comparison:

- An increase in MWH from earlier **8.0 hr to 11.6 hr** with the same quantity of water.
- The Gross Storage capacity has been optimized from 1.75 TMC to 1.03 TMC.
- Dead Storage reduces from 0.494 TMC to 0.03 TMC
- Storage Capacity Increased from 11340 MWH to 14616 MWH
- Apart from increase in MWH, civil structures like HRT and Surge Shaft had been eliminated reducing the overall length of water conductor system and reduced muck generation
- The total land requirement has been reduced from 228.97 ha to 213.70 Ha
- Forest land has been reduced from 169.97 ha to 160.40 ha.
- Private land requirement reduced to 34.64 ha from earlier estimate of 37.34 ha.
- The density of Forest land also changes from Medium Dense Forest Type to Open forest type.

5.3 SELECTION OF ALTERNATIVE

Considering the above comparison, Alternative -1 has been finalized.

Chapter 6 ENVIRONMENTAL MONITORING PLAN

6.1 TECHNICAL ASPECTS OF MONITORING THE EFFECTIVIENESS OF MITIGATION MEASURES

Environmental monitoring provides feedback about the actual environmental impacts of a project after implementation of mitigation and management measures. Monitoring results help judge the success of mitigation measures in protecting the environment. They are also used to ensure compliance with environmental standards and to facilitate any needed project design or operational changes.

Monitoring shall be performed during all stages of the project (namely: construction and operation) to ensure that the impacts are no greater than predicted, and to verify the impact predictions. The monitoring program will indicate where changes to procedures or operations are required, in order to reduce impacts on the environment or local population. The monitoring program for the proposed project will be undertaken to meet the following objectives:

- To monitor the environmental conditions of the project area and nearby villages;
- To check on whether mitigation and benefit enhancement measures have actually been adopted and are proving effective in practice;

To provide information on the actual nature and extent of key impacts and the effectiveness of mitigation and benefit enhancement measures which, through a feedback mechanism, can improve the planning and execution of future, similar projects.

6.1.1 Water Quality

Construction Phase

The water quality (surface and ground) monitoring should be carried out in seasonal intervals i.e. three times in a year for entre duration of 3 years of construction period. 10 samples will be taken – 2 for surface water (Malaprabha River and Sogal Waterfall) and 8 ground water from project surrounding villages. Budget proposed is worked based on Rs. 5,000.00 per sample i.e. Rs. 1.5 lakh per year.

Operation phase

Based on the result of analysis of ground and surface water samples during construction period, operation phase monitoring can continue at same location for another year and then the locations can be changed or reduced as required.

6.1.2 Air Quality

Construction Phase

The ambient air quality monitoring during construction phase will be carried out as per the requirement of State Pollution Control Board. Every year monitoring is proposed to be done for the following three seasons;

- Winter

- Pre - monsoon
- Post – monsoon

The frequency of monitoring shall be twice a week for four consecutive weeks at each station for each season. The parameters to be monitored are PM_{10}, $PM_{2.5}$, Sulphurdioxide (SO_2) and Nitrogen Oxides (NOx). Every year, ambient air quality is to be monitored for (6 stations x 2 days/week x 4 weeks x 3 seasons) 144 days. A total cost of **Rs. 10.80 lakhs/year** has been earmarked for this purpose.

Operation Phase

Same schedule, as followed during construction phase, should be continued for operation phase as well and budget can be extended.

6.1.3 Noise

Construction Phase

Noise emissions from vehicular movement, operation of various construction equipments may be monitored during construction phase at major construction sites. The frequency of monitoring could be once in a month. For monitoring of noise generators, two Integrating Sound Level Meter will be required for which an amount of **Rs. 4.00 lakh** per year has been earmarked for entire construction period of 3 years.

Operation Phase

Same schedule, as followed during construction phase, should be continued for operation phase as well and budget can be extended.

6.1.4 Ecological Monitoring

The monitoring of various activities suggested under Biodiversity & Wildlife Management and Conservation, etc. like ecological surveys for composition of flora and fauna, Survey & observation, Survival rate of species planted, and Status/ Survival rate of bio-engineering and engineering structures for controlling soil erosion. For this an amount of **Rs. 9.00 Lakhs** per year has been earmarked. Under this programme, the survival rate and recruitment of the seedlings planted in the plots taken up afforestation programme would be monitored through annual sampling either by belt transect method or circular plot method. Not only the survival and recruitment percentage but their height and other growth parameters would also be monitored on annual basis.

6.1.5 Financial Requirement

A sum of **Rs. 88.90 lakh** have been allocated to implement various activities and programmes envisaged under EMP, the details are given in **Table 6.1**.

Table 6.1: Cost Estimates for Environmental Monitoring Programme

S. No.	Activities	Units (samples x season x year)	Price per unit (Rs)	Cost (Rs. lakhs)
1	Water quality - surface and ground water	10x3x3	5000.00	4.50
2	Air quality	48x3x3	7500.00	32.40

3	Noise	lumpsum		4.00
4	Ecological Studies/ monitoring	3 lakh per season for 3 seasons per year for 3 years		27.00
5	Awareness programme	2 lakh per year for 3 years		6.00
6	Documentation & Reporting- Six monthly reporting	5 lakh per year for 3 years		15.00
	TOTAL (1-6)			**88.90**

Chapter 7 ADDITIONAL STUDIES

As per the scope of work issued by MoEF&CC, and Generic Structure of EIA Document as per Appendix III of EIA Notification, following are covered under the Additional Studies:

a) **R&R Plan** – Process of land acquisition of private land.

b) **Public Consultation** – On completion of draft EIA report and its executive summary in English and vernacular language (Kannada), report was submitted to Karnataka State Pollution Control Board (KSPCB) to initiate the process of Environmental Public Hearing (EPH). As such, the EPH was held on 07th January, 2019 adjacent to Mallur Electrical Sub-station, Karlakatti village, Yakkundi Panchayat, Saundatti taluka, District Belagavi, Karnataka. Major issues raised during Public Consultation process and response has been covered in this section.

c) **Corporate Environment Responsibility (CER)** –It deals with the provisions being made by project proponent under Corporate Environmental Responsibility Policy as directed by MoEF & CC vide their OM dated May 01, 2018. The cost of CER Plan is in addition to the cost envisaged for the implementation of EIA/EMP

Chapter 7.1 REHABILITATION & RESETTLEMENT PLAN

7.1.1 INTRODUCTION

Proposed Standalone Pumped storage component of Saundatti Integrated Renewable Energy Project (IREP) is located in Belagavi District of Karnataka. This scheme envisages non-consumptive re-utilization of 1 TMC of water of the Renuka Sagar reservoir by recirculation. The water in the Renuka Sagar reservoir (existing lower reservoir) will be pumped up and stored in the proposed Pumped Storage component of Saundatti IREP reservoir (upper Reservoir) and will be utilized for power generation.

The construction of Standalone Pumped storage component due to fixed location of project, will result in land acquisition. Among other land some private land will also come under the total land acquisition for the standalone component. The present chapter provides the details of the land requirement, process of procurement of the private land and the mitigation of any impacts arising out of the private land procurement through appropriate Rehabilitation & Resettlement measures.

7.1.2 LAND REQUIREMENT

The total land requirement for proposed project is **213.70 ha**; out of which **160.40 ha** is forest land and remaining **53.30 ha** is non-forest area. Out of non-forest area, **34.64 ha** is private land and **18.66 ha** is government land. The details are given in **Table 7.1**.

Out of the total private land required, about **2.31 ha** of land would be required for construction of power House, Switch Yard, tail race outfall including permanent access road to power house; **10 ha** for contractor's facilities including stores and colonies; **24.82 ha** for muck disposal and **5.55 ha** for job facilities, magazine and others.

Table 7.1: Details of Land Requirement

S.No	Components	Forest Area (Ha)		Non-forest Area (Ha)		Total Area (Ha)
		Surface	Underground	Pvt.	Govt.	
1	Upper Reservoir	128.58	0.00	0.00	0.00	128.58
2	Penstock	5.79	0.00	0.00	0.00	5.79
3	Pressure Shaft	0.00	5.84	0.00	0.00	5.84
4	Power House, Switch Yard & Tail Race Outfall including Permanent access road to Power House	12.93	0.00	2.31	0.00	15.24
5	Adit to Pressure shaft	0.10	0.63	0.00	0.00	0.73
6	Approach Road to all other Project Components	6.53	0.00	0.62	0.00	7.15
7	Contractor facilities, Cement and E&M stores, Temporary Colony area	0.00	0.00	10.00	0.00	10.00
8	Muck Disposal area (1 & 2)	0.00	0.00	10.00	0.00	10.00
9	Tail Race Channel	0.00	0.00	6.16	18.66	24.82
10	Magazine	0.00	0.00	0.25	0.00	0.25
11	Job Facility Yard & others	0.00	0.00	5.30	0.00	5.30
Total		**153.93**	**6.47**	**34.64**	**18.66**	**213.70**

From the above table, it may be noted that out of **34.64 ha** of private land, a significant area of about **15.55 ha** is used for Temporary facilities to be used as Contractor facilities, Cement and E&M stores, Temporary Colony area, Job facility yard, Magazine area etc. Therefore, the actual total private land that will be utilized for construction of the project components and used on a permanent basis is **19.09** ha only.

Of the total land required for the project, forest land of about **160.40 ha** shall be diverted as per the guidelines issued under the Forest (Conservation) Act, 1980 and Government land will be transferred to the project from the competent authority as per the laid-out process. The private land identified for the project will be purchased directly from respective land owners through private negotiations on land price and completed on a mutual agreement.

PURCHASE OF PRIVATE LAND

The private land required for the project is proposed to be purchased through a voluntary sale with a willing buyer and willing seller process. The process is undertaken through direct negotiations between land owners and Project Proponent with no obligation on the seller. The land owners are informed in advance, and each land owner negotiated on the price of land as part of land take.

The some of the steps in the land procurement process included the following:

- Identification of land required for the project and due diligence of land through verification of Revenue Records.
- Undertake consultation and negotiations with the land owners about the project and private land requirement.
- After negotiations on all aspects of purchase the voluntary sale of land is completed through a registered sale agreement.

7.1.3 PROJECT AFFECTED VILLAGES AND LAND OWNER FAMILIES

The private land identified for the project falls in two revenue villages viz. Chakrageri and Karlakatti under Savadatti Tehsil. The village Chakrageri is un-inhabitated and the owners of the identified land reside in Karlakatti Village. The private land proposed for procurement belongs to a total of 85 land owners and are termed as affected Land Owner families. Of the total 22 families own land in Chakrageri village and 63 own land in Karlakatti village.

All the 85 families will be losing part of their total agricultural land only and none of the families will be losing any house or any other assets. None of them is getting displaced due to the project from the above land procurement. The private land to be procured is agriculture land. List of identified land owners is attached as **Appendix I** at the end of plan.

7.1.4 APPLICABILITY OF REHABILITATION AND RESETTLEMENT

With reference to the private land purchase through private negotiations and the application of the provisions relating to rehabilitation and resettlement for the Project as per the **Section 2 (3) (a)** of The Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act (RFCTLARR), 2013, following provisions shall apply in case:

(a) ***a private company purchases land, equal to or more than such limits in rural areas or***

urban areas, as may be prescribed by the appropriate Government, *through private negotiations with the owner of the land in accordance with the provisions of section 46; (RFCTLARR 2013 attached).*

With reference to the above section the relevant limits on extent of land under Section 2(3)(a) are prescribed by the Government of Karnataka under **Section 31** of The Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement (Karnataka) Rules, 2015. As per the said rules:

31. Purchases by Person other than Specified Person:-*(1) The provisions of section 46 of the Act, relating to rehabilitation and resettlement shall apply in the rural areas or urban areas, in the cases where any person 'other than specified person' purchase land through private negotiations with the owners of the land;*
*(a) to an extent extending more than **500** acres of dry land and/or **50** acres of irrigated land in rural areas and 100 acres of dry land and 10 acres of irrigated land in urban areas for industrial purpose and infrastructural purpose projects*
*(b) to an extent extending more than **100** acres of dry land in rural or urban area for purpose of housing, education or any other purposes. Subject to any further revision as may be notified by the State Government (GoK Rules 2015 attached)*

In view of the above, it is noted that the total private land proposed to be purchased through private negotiations for the above Project is about 85.60 acres. The proposed land falls in rural areas and nature of the land is irrigated agricultural land. As the total private land required exceeds the above specified limits by the relevant rules notified by the Government of Karnataka, the provisions related to rehabilitation and resettlement under RFCTLARR, 2013 shall apply for the proposed Project.

7.1.5 REHABILITATION AND RESETTLEMENT MEASURES FOR AFFECTED FAMILIES

As discussed in above sections, the land owner family is losing only partial land holding and none of the land owners is losing any house or any other assets such as borewell, Cattle shed, trees etc. None of the land owner family is displaced due to the proposed land purchase and hence no resettlement.

The land value for the private land purchased is paid to the land owners based on direct negotiations and on mutually agreed terms. The Rehabilitation and Resettlement benefits to be given to the various types of project affected and displaced families are provided under Schedule II of RFCTLARR 2013. Considering the proposed private land purchase and the resultant impact discussed above, a brief analysis of the elements of Rehabilitation and Resettlement entitlement as provided under Schedule II of RFCTLARR 2013 and their applicability for the proposed project is presented in the following **Table 7.2** below:

Table 7.2: Elements of Rehabilitation and Resettlement

Sl. No.	Elements of Rehabilitation and Resettlement Entitlements	Entitlement/ provision	Applicability for the Proposed Project
1.	Provisions of housing units in case of displacement	(1) If a house is lost in rural areas, a constructed house shall be provided as per the Indira Awas Yojana	**Not Applicable** as there is no displacement or

Sl. No.	Elements of Rehabilitation and Resettlement Entitlements	Entitlement/ provision	Applicability for the Proposed Project
		specifications. If a house is lost in urban areas, a constructed house shall be provided, which will be not less than 50 sq mtrs in plinth area. (2) The benefits listed above shall also be extended to any affected family which is without homestead land and which has been residing in the area continuously for a period of not less than three years preceding the date of notification of the affected area and which has been involuntarily displaced from such area: Provided that any such family in urban areas which opts not to take the house offered, shall get a one-time financial assistance for house construction, which shall not be less than one lakh fifty thousand rupees: Provided further that if any affected family in rural areas so prefers, the equivalent cost of the house may be offered in lieu of the constructed house: Provided also that no family affected by acquisition shall be given more than one house under the provisions of this Act. Explanation- The houses in urban areas may, if necessary, be provided in multi-storied building complexes.	such impact.
2.	Land for Land	In the case of irrigation project, as far as possible and in lieu of compensation to be paid for the land acquired, each affected family owning agricultural land in the affected area and whose land has been acquired or lost, or who has, as a consequence of the acquisition or loss of land, been reduced to the status of a marginal farmer or landless, shall be allotted, in the name of each person included in the records of rights with regard to the affected family, a minimum of one acre of land in the command area of the project for which the land is acquired: *Provided that in every project those persons losing land and belonging to the Scheduled Castes or the Scheduled Tribes will be provided land equivalent to land acquired or two and a one-half acres, whichever is lower.*	**Not Applicable** as the proposed project is not an irrigation project.
3	Offer for Developed Land	In case the land is acquired for urbanization purposes, twenty per cent of the developed land will be reserved and offered to land owning project affected families, in proportion to the area of their land acquired and at a price equal to the cost of acquisition	**Not Applicable** as the land procured is not for urbanization purpose.

Sl. No.	Elements of Rehabilitation and Resettlement Entitlements	Entitlement/ provision	Applicability for the Proposed Project
		and the cost of development. Provided that in case the land owning project affected family wishes to avail of this offer, an equivalent amount will be deducted from the land acquisition compensation package payable to it.	
4	Choice of Annuity or Employment	The appropriate Government shall ensure that the affected families are provided with the following options: (a) Where jobs are created through the project, after providing suitable training and skill development in the required field, make provision for employment at a rate not lower than the minimum wages provided for in any other law for the time being in force, to at least one member per affected family in the project or arrange for a job in such other project as may be required; or (b) One time payment of 5 lakh rupees per affected family; or (c) Annuity policies that shall pay not less than 2000 rupees per month per family for 20 years, with appropriate indexation to the consumer price index for agricultural labourers	**Applicable.**
5	Subsistence grant for displaced families for a period of one year	Each affected family which is displaced from the land acquired shall be given a monthly subsistence allowance equivalent to 3000 rupees per month for a period of one year from the date of award. In addition to this amount, the schedule castes and the scheduled tribes displaced from scheduled areas shall receive and amount equivalent to 50000 rupees. In cases of displacement from the scheduled areas, as far as possible, the affected families shall be relocated in a similar ecological zone, so as to preserve the economic opportunities, language, culture and community life of the tribal communities.	**Not Applicable** as there is no displacement or such impact.
6	Transportation cost for displace families	Each affected family which is displaced shall get a one time financial assistance of 50000 rupees as transportation cost for shifting of the family, building materials, belongings and cattle.	**Not Applicable** as there is no displacement or such impact.
7	Cattle shed / Petty shops cost	Each affected family having cattle or having a petty shop shall get one time financial assistance of such amount as the appropriate Government may, by notification, specify subject to a minimum of 25000 rupees for construction of cattle shed or petty shop as the case may be.	**Not Applicable** as there is no such impact.

Sl. No.	Elements of Rehabilitation and Resettlement Entitlements	Entitlement/ provision	Applicability for the Proposed Project
8	One-time grant to artisan, small traders and certain others	Each affected family of an artisan, small traders or self-employed person or an affected family which owned nonagricultural land or commercial, industrial or institutional structure in the affected area, and which has been involuntarily displaced from the affected area due to land acquisition , shall get one time assistance of such amount as the appropriate Government may, by notification, specify subject to a minimum of 25000 rupees	**Not Applicable** as there is no displacement or such impact.
9	Fishing rights	In cases of irrigation or hydel projects, the affected families may be allowed fishing rights in the reservoirs, in such manner as may be prescribed by the appropriate Government	**Not Applicable** as the proposed project is not an irrigation project. Although the proposed project is a Hydel Project the water stored in upper reservoir is continually recirculated for energy generation and scope for fishing is limited.
10	One time Resettlement Allowance	Each affected family shall be given a onetime "Resettlement Allowance" of 50000 rupees only	**Applicable.**
11	Stamp duty and registration fee	(1) The stamp duty and other fees payable for registration of the land or house allotted to the affected families shall be borne by the Requiring Body. (2) The land for house allotted to the affected families shall be free from all encumbrances. (3) The land or house allotted may be in the joint names of wife and husband of the affected family.	**Not Applicable** as there is no displacement or such impact and requirement.

Based on the above analysis the Rehabilitation and Resettlement measures applicable for Project Affected Land Owner Families of Saundatti IREP Project is given at **Table 7.3** below**.**

Table 7.3: Applicable Rehabilitation & Resettlement Measures for affected families

Sl No as per Schedule II	Entitlement/ provision	R&R Assistance Considered
4	**Choice of Annuity or Employment** The appropriate Government shall ensure that the affected families are provided with the following options: (A) where jobs are created through the project, after providing suitable training and skill development in the required field, make provision for employment at a rate not lower than the minimum wages provided for in any other law for the time being in force, to at least one member per affected family in the project or arrange for a job in such other project as may be required;	As the project is expected to generate economic opportunities including direct and indirect employment opportunity based on the willingness of the affected land

Sl No as per Schedule II	Entitlement/ provision	R&R Assistance Considered
	or (B) one-time payment of five lakhs rupees per affected family; or (C) annuity policies that shall pay not less than two thousand rupees per month per family for twenty years, with appropriate indexation to the Consumer Price Index for Agricultural Labourers.	owner family priority is given to Option A and Option B respectively.
10	**One-time Resettlement Allowance** Each affected family shall be given a onetime "Resettlement Allowance" of 50,000 rupees only	Although there is no displacement for immediate needs a Resettlement Allowance of Rs. 50,000 for each affected land owner family will be provided.

R&R BUDGET

As mentioned in **Table 7.3** above as part of economic rehabilitation and livelihood restoration measures based on the willingness of the land owner family, priority will be given to providing employment opportunity after suitable training and skill development in the required field to at least one member per affected family in the project or arrange for a job in such other project as may be required. However, in case a significant number of affected family prefer for one-time rehabilitation grant instead of employment opportunity a suitable provision is made as part of the R&R Budget given below. The total provisional budget allocated for implementing the various measures for the project affected family is given in **Table 7.4** below.

The provisions relating to rehabilitation and resettlement measures will be implemented during the land procurement process. Appropriate implementation and monitoring of the above measures will be undertaken in coordination with the competent authority.

Table 7.4: Rehabilitation & Resettlement package for affected families

Clause No. as per II Schedule	Provision as per " LA, R&R Act, 2013"	No. of Eligible Nuclear Families	Rate as per " LA, R&R Act, 2013"	Cost, in Rs (for eligible families) as per the ACT
4	**Choice of Annuity or Employment***			
	The appropriate Government shall ensure that the affected families are provided with the following options: (a) where jobs are created through the project, after providing suitable training and skill development in the required field, make provision for employment at a rate not lower than the minimum wages provided for in any other law for the time being in force, to at least one member per affected family in the project or arrange for a job in such other project as may be required; or (**b) one time payment of five lakhs rupees per affected family; or**	85	Rs 500,000.00 one time payment per family (option B)	4,25,00,000.00

Clause No. as per II Schedule	Provision as per " LA, R&R Act, 2013"	No. of Eligible Nuclear Families	Rate as per " LA, R&R Act, 2013"	Cost, in Rs (for eligible families) as per the ACT
	(c) annuity policies that shall pay not less than two thousand rupees per month per family for twenty years, with appropriate indexation to the Consumer Price Index for Agricultural Labourers.			
10	**One-time Resettlement Allowance**			
	Each affected family shall be given a onetime "Resettlement Allowance" of 50,000 rupees only	85	Rs. 50,000.00 per family	42,50,000.00
Total				**4,67,50,000.00**

***Will be provided only in case the affected family opts for rehabilitation grant in lieu of employment opportunity**

7.1.5.1 Post-Project Monitoring

It is suggested that the monitoring be conducted by an independent agency not connected with the project. Therefore, an independent consultant having experience in R&R studies in similar areas, i.e. central states and not connected with the project can be appointed for monitoring the project.

7.1.5.2 Participation of PAFs

Involvement of affected communities in planning and implementation of rehabilitation programmes according to their needs and socio-economic conditions is of vital importance. To obtain co-operation, participation and feedback, PAFs need to be systematically informed and consulted during preparation and implementation of R&R plan about their options and rights. In the proposed project, co-operation and participation of PAFs in this process could be ensured through their involvement in each of the following stages.

As a part of participatory planning, community meetings should be held on a routine basis to explain about the project and the benefits of the project. Direct communication with the PAFs will negate the politicization of the R&R Process. The communication with the PAFs can be through the Village Level Committee.

The Consultant/Expert Agency will review the rehabilitation and resettlement programme every year till the completion of the project. A total provision of **Rs. 50.00 lakhs** have been kept in the cost estimate for this purpose.

7.1.6 FINANCIAL PACKAGE

The summary of the financial requirement for implementation of the Rehabilitation and Resettlement plan and Economic Development Package is **Rs. 517.50 lakhs** as per the summary given below at **Table 7.5**.

Table 7.5: Summary of Budgetary Estimates

S. No.	R&R Components	Cost (Rs in Lakhs)
1	Rehabilitation Grant	467.50
2	Monitoring and Evaluation	50.00
	Total	**517.50**

*Cost of land as per market value including assets and solatium is in addition to the above budget and will be assessed by Commissioner.

Appendix I

S. No	Village	Name		S. No	Village	Name		S. No	Village	Name
1	Chakrageri, Kalrakatti Village, Yakundi Gram panchayat	Fakirappa Sannafakirappa Bhajantri		23	Kalrakatti	Hanamantappa Phakirappa Koujalagi		47	Kalrakatti	Arjun Mallappa Huli
2		Mavappa Naduvinahalli		24	Kalrakatti	Bhimappa Fakirappa Koujalagi		48	Kalrakatti	Gopal Basappa Huli
3		Shankar Basappa Lamani & Others		25	Kalrakatti	Gangappa Mallappa Budshetti		49	Kalrakatti	Padeppa Vannur
4		Bhimappa Manappa lamani & Others		26	Kalrakatti	mallappa chanabasappa budshetti		50	Kalrakatti	Mahmadaali gorinayak
5		Somappa Pandappa Lamani		27	Kalrakatti	Chandrakant pattanshetti		51	Kalrakatti	Allabaksh Gorinayak
6		Shetteppa Pandappa Lamani		28	Kalrakatti	Shrikant Pattanshetti		52	Kalrakatti	Alisab Gorinayak
7		Bhama tavareppa lamani		29	Kalrakatti	Shinayak patil URF madlur		53	Kalrakatti	Yallavva Pakkirappa Vannur
8		Ishwar Mahadev Yaragatti		30	Kalrakatti	Basavanneppa sunagar		54	Kalrakatti	Rudrappa Shiddappa vannur
9		Khanappa Somappa Hittanagi & Others		31	Kalrakatti	Bheemappa Yalappa Hulli		55	Kalrakatti	Yallappa Kenchappa Vannur
10		Basavaraj Shedeppa Hittanagi & Others		32	Kalrakatti	Mohan Yallapa Hulli		56	Kalrakatti	Mallavva Vannur (otheres)
11		Yallappa Shivappa Hittanagi		33	Kalrakatti	Pakkirappa hittunagi		57	Kalrakatti	Kenchappa Vannur
12		Basappa Shivappa Hittanagi		34	Kalrakatti	Yallappa Enchladavar		58	Kalrakatti	Gouravva Vannur
13		Basappa Fakirappa Hittanagi		35	Kalrakatti	Ningappa Enchladavar		59	Kalrakatti	Pakkirapa vannur
14		Yallappa Basappa Hittanagi		36	Kalrakatti	Somappa Bsappa Huli		60	Kalrakatti	Mallapa Vannur
15		Basappa Gangappa Hittanagi		37	Kalrakatti	Khanappa basappa huli		61	Kalrakatti	Yallappa Vannur
16		Nagappa Sannatammappa Naduvinahalli		38	Kalrakatti	Mohan Hulli		62	Kalrakatti	Hanamath Sabanna Madlur
17		Shivappa Balappa Bhajantri		39	Kalrakatti	Guravva Vannur		63	Kalrakatti	Balappa Mayappa Madar
18		Ramanagouda Babanagouda pakir gowda		40	Kalrakatti	Bheemappa Hulli		64	Kalrakatti	Fakirappa Basappa Benakatti
19		Kallappa Siddappa hakki & Others		41	Kalrakatti	Pakkirappa Hulli		65	Kalrakatti	Prabhu Bhimappa Inchal
20		Nagappa phakirappa Hittanagi & Others		42	Kalrakatti	Yallappa Hulli		66	Kalrakatti	Nagappa Kallappa Pujer
21		Ramappa Mahadevappa Bhajantri		43	Kalrakatti	Basappa Hulli		67	Kalrakatti	Rudrappa Ningappa Sangate

22		Phakirappa gadigeppa bhajantri		44	Kalrakatti	Somappa Hulli		68	Kalrakatti	Suresh Ningappa Sungate
				45	Kalrakatti	Khanappa huli		69	Kalrakatti	Sahebee kutubuddien Mulla
				46	Kalrakatti	Fakirappa Mallappa Huli		70	Kalrakatti	Dilwarasab Hanifsab Mulla
71	Kalrakatti	Yallavva Kenchappa Naikar								
72	Kalrakatti	Ratnavva Somaningappa bhajantri								
73	Kalrakatti	Basavva Hanumantappa honnainnavar & Others								
74	Kalrakatti	Pakir gowda patil , Parvath gowda patil& family								
75	Kalrakatti	Malapurappa Badiger & Sonsmalapurappa Badigere & Sons								
76	Kalrakatti	Vittal Walekar & Sons								
77	Kalrakatti	Hassensab Mujewar & Sons								
78	Kalrakatti	Imamsab husainasab Immannavar & sons								
79	Kalrakatti	Mayappa Nadavinahalli & Sons								
80	Kalrakatti	Mukthum Mujawar								
81	Kalrakatti	Hassensab Mujewar Petrol Bunk(30 guntas)								
82	Kalrakatti	Mehaboob Mujawar & sons								
83	Kalrakatti	Dilawarasab Gorisab Dindimani & Sons								
84	Kalrakatti	Virupaksha Heramath & Sons								
85	Kalrakatti	Kanappa Somapur								

Chapter 7.2 PUBLIC CONSULTATION

7.2.1 PUBLIC HEARING

Public Hearing for the Standalone Pumped Storage Component of Saundatti IRE Project was conducted by Karnataka State Pollution Control Board (KSPCB) on 7th January 2019 adjacent to Mallur Electrical Sub-station, Karlakatti village, Yakkundi Panchayat, Saundatti taluka, District Belagavi, Karnataka. Meeting was chaired by District Collector, Belagavi District. Many other government officials of the various government departments attended the public hearing meeting. Advertisements and Proceedings of the Public Hearing has been prepared by KSPCB and is enclosed as **Annexure VI**. Major issues raised by the local people during the meetings have been tabulated below for ready reference.

Publications of notice for public hearing were given in state level English and Kannada newspaper "Vijaya Vani" and "Indian Express" dated 05.12.2018 and in District level Kannada newspaper "Kandamma" dated 06.12.2018.

SUGGESTIONS/ COMMENTS GIVEN BY STAKEHOLDERS

S No	Suggestions/ Comments/ Observations	Clarification given by project proponent
1	What are the mitigation measures proposed for control of underground work and dust pollution.	In order to reduce impact of dust pollution water sprinklers will be used in the project construction area. For tunneling and other underground work developer use new technologies and equipment's. For example the construction of Bangalore Metro involving tunnel construction with latest technologies to avoid any adverse impact of tunneling on buildings.
2	Consuming 1.75 TMC of water on continuous basis from Renukasagar reservoir will create water shortage for irrigation purposes.	Live storage of Renukasagar reservoir is 34.346 TMC i.e. below the intake sill level, and only 1.0 TMC of water on non-consumptive basis is required for proposed pumped storage project. Further, 1.0 TMC of water will be lifted only once during monsoon season, which will be the live storage of proposed PSP. The PP assures that water lifted from Renukasagar reservoir will neither be stored nor consumed. As such, there will be no shortage of water for irrigation purposes. The dead storage requirement of 0.75 TMC in Upper reservoir, will be met through rain water harvesting.
3	Utilising dead storage of Renukasagar reservoir will cause shortage of water for drinking water purposes during the	Water lifted one time from Renukasagar reservoir on non-consumptive basis will neither be stored nor consumed.

	lean season.	Therefore, shortage of water for drinking water purposes during the lean season is not envisaged
4	Utilising water for power generation, water will become less productive, like the cream is taken out of milk and the water will not be suitable for drinking or agriculture.	There is no scientific evidence to support this argument.
5	Acquisition of thousands of acres of private agricultural land for the proposed project will lead to displacement of families.	Around 85.60 acres (34.64 Ha) of private land will be required for the proposed PSP. This land will be directly purchased from private land owners on "willing seller - willing buyer policy" and no displacement is envisaged in construction of upper reservoir. Private land acquisition will be as per the provisions of RFCTLARR, 2013 and RFCTLARR issued by the Government of Karnataka vide **Notification RD 152 AQB 2013, dated 17-10-2015**.
6	Due to creation of upper reservoir, lands in lower reservoir will become saline which in turn will be unsuitable for agriculture.	PP assures that all measures to prevent seepage will be implemented and the ingress of water will be prevented through grouting, sealing etc.
7	Compensation for land acquired for construction of the Malaprabha Dam/ Renukasagar reservoir is not completed and people will again become landless, poor and will not get compensation.	The issue raised during public hearing related to L.A. is w.r.t. development of Renukasagar Reservoir and not w.r.t. to proposed PSP. This matter is almost 40 years old and the DC as well as the local MLA have assured to look into this issue. Further, as mentioned previously, land for the proposed PSP will be purchased directly from private land owners on "willing seller - willing buyer policy".
8	The GoK has approached the Honourable Supreme Court demanding more share of water from Malaprabha Basin (Mahadayi Inter-State Water Dispute). The matter is sub judice and allocating 1.0 TMC of water for the said project will weaken the stand of GoK in Supreme Court.	Pumped Storage Project are different from conventional Hydro power project. This being a closed-looped development, water will be recycled between upper and lower reservoirs. Therefore, allocation of 1 TMC of water for proposed PSP on non-consumptive basis will not impact existing water allocation of the State.

Chapter 7.3 CORPORATE ENVIRONMENT RESPONSIBILITY PLAN

7.3.1 INTRODUCTION

Greenko Group as part of its overall business operations is addressing many important aspects of local sustainable development like Social, Economic and Environment development and specifically issues associated with Climate Change, Local and Regional Environmental Degradation, Powering the Economy, Generating Wealth and Employment, Technology Innovation and Inclusive Development. It is addressing these issues through its Corporate Social and Environment Policy initiatives. In line with the above policy this section presents the details of the Corporate Environment Responsibility (CER) Plan for the proposed Project.

7.3.2 CORPORATE SOCIAL AND ENVIRONMENT POLICY

Greenko Group is committed to sustainable development at all its facilities and work to the satisfaction of all stakeholders while fulfilling its social, economic and environmental responsibilities. Social Responsibility being one of its core values, it aligns its community development activities through regular stakeholder engagements resulting in inclusive growth.

7.3.2.1 Vision

Greenko Group aims to improve the quality of life of our neighborhood communities through equitable and proactive smart initiatives in spheres of education, health, rural development, environment and livelihoods resulting in improvement of the overall local social, economic and environmental conditions. The Group aims to achieve its vision through an effective institutional setup with a dedicated team and a well-designed program-based approach, management systems, stakeholder engagements, monitoring and impact assessments.

7.3.2.2 Policy Principles

Some of the Social and Environment Policy guiding principles for achieving the above sustainable development vision include to ensure that all Group level activities at both operations and projects:

- Are environmentally and socially sustainable
- Are compliant with applicable environmental and social regulations in the host country and the commitments of the country to international laws/ agreements
- Are compliant with the applicable green or clean energy guidelines
- Anticipate environment and social impact of its projects through environmental and social impact assessment
- Continually monitor their environmental and social impact – and take appropriate measures for remedying or correcting or avoiding in future
- Pursue fair labour and safe working conditions, promote equal opportunity, work-life balance and respect human rights of employees and community.
- Anticipate and avoid adverse impacts on the health, safety and security of the employees and community.
- Anticipate and avoid or minimize adverse social and economic impacts.

- Pursue resource efficiency, pollution prevention and minimize waste generation.
- Protect and conserve biodiversity and practice sustainable management.
- Avoid negative impact on cultural heritage and indigenous peoples' rights
- Ensure that all personnel working for Greenko are aware of the environmental and social requirements relevant to their area of work
- Continually build capacity, through training or other means, to identify environmental and social risks as well as to identify mitigating measures

7.3.2.3 Policy Thrust Areas and Objectives

At the Group level Greenko has identified five critical areas to focus for its Corporate Social and Environment Responsibility initiatives. The focus areas and the broad objectives under the identified thrust areas which are in line with the relevant United Nations Sustainable Development Goals include the following.

- ✓ **Education** – To ensure access to equitable and quality primary and secondary education leading to relevant and effective learning outcomes in rural communities.
- ✓ **Healthcare** – To provide access to quality healthcare to our workforce and the rural communities close to our operations.
- ✓ **Rural Development** – To improve the living standards of rural people in an equitable and sustainable manner through creation of community services and facilities.
- ✓ **Livelihoods & Skill Development** - To ensure access to skill training for the local people leading to relevant and sustainable livelihoods for rural communities.
- ✓ **Environment** - To protect and manage the living natural resources within its project vicinity and promote the conservation of biodiversity.

7.3.3 PROVISIONS UNDER CER

In order to have transparency and uniformity while recommending CER by Expert Appraisal Committee (EAC)/ State Level Expert Appraisal Committee (SEAC)/ District Level Expert Appraisal Committee (DEAC), the following guidelines are issued:

i. The cost of CER is to be in addition to the cost envisaged for the implementation of the EIA/EMP which includes the measures for the pollution control, environmental protection & conservation, R&R, Wildlife and forest conservation/ protection measures including the NPV and Compensatory Afforestation, required, if any and any other activities, to be derived as part of the EIA Process.

ii. The fund allocation of the CER shall be deliberated in the EAC or SEAC or DEAC, as the case may be with a due diligence subject to maximum percentage as prescribed below for different cases:

S. No.	Capital Investment /Additional Capital Investment (in Rs.)	Greenfield Project - % of the Capital Investment	Brownfield Project - % of the Capital Investment
1	≤ 100 Crores	2.0%	1.0%
2	>100 Crores to ≤500 Crores	1.5%	0.75%
3	>500 Crores to ≤1000 Crores	1.0%	0.5%
4	From 1000 Crores to ≤10000 Crores	0.5%	0.25%
5	>10000 Crores	0.25%	0.125%

iii. The activities proposed under CER shall be worked out based on the issues raised during the Public Hearing, social need assessment, R&R Plan, EMP etc.
iv. The proposed activities shall be restricted to the affected area around the project.
v. Some of the activities which can be carried out in CER, are infrastructure creation for drinking water supply, sanitation, health, education, skill development, roads, cross drains, electrification including solar power, solid waste management facilities, scientific support and awareness to local farmers to increase yield and fodder, rain water harvesting, soil moisture conservation works, avenue plantation, plantation in community areas, etc.
vi. The entire activities proposed under the CER shall be treated as project and shall be monitored. The monitoring report shall be submitted to the District Collector. It should be posted on the website of the project proponent.
vii. The District Collector may add or delete the activities as per the requirement of the District.
viii. The EAC can vary the above percentage of the CER subject to proper diligence, qualification and justification. The EAC based on appraisal should be clearly suggest the activities to be carried out under CER.
ix. The CER is not applicable in name change, transfer and amendment involving no additional project investment. In case of amendment in EC involving additional expenditure, CER will be applicable only on the additional expenditure as per column IV of the above given table.

7.3.4 AFFECTED AREA FOR CER ACTIVITY

The proposed Project is located near Karlakatti Village under Yakkundi Gram Panchayat, Saundatti Taluk, Belagavi District of Karnataka State. The Project affected District, Tehsils and Villages is presented in **Table 7.6** below.

Table 7.6: Affected Area around the Project

District	Mandal	Gram Panchayat	Name of Village /Hamlet
Belagavi	Saundatti (Parasgad)	Yakkundi,	Karlakatti, Dhupdal, Yakkundi

Among the affected villages Karlakatti, Dhupdal, Yakkundi Villages under Yakkundi Gram Panchayat are in close vicinity of the Project and are affected due to the Project activities. Basidoni Daddi Village under Somapur Gram Panchayat may partially affect by the Project activity. Mallur and Kagihal Tande under Mallur Gram Panchayat are in project neighborhood and partially influenced by the project activity. The socio-economic and demographic profile of the project affected villages including the Project District and Mandals is already presented in the Chapter 4 of the EIA Report. A total of 13 villages will be directly or indirectly affected by the project activities of proposed Stanalone Pumped Storage component of Saundatti IREP. Therefore, these 13 affected villages are considered as affected area for CER activities.

7.3.5 FOCUS AREAS FOR CER ACTIVITY

Based on the public hearing and local consultations in project affected villages the following focus areas covering many important components of the sustainable development such as social, economic, livelihoods and environment are identified and set

of development activities proposed under each focus area for the benefit of the local people under the Project. The **Table 7.7** below presents the thrust area and the nature of activity proposed as part of the CER Plan.

In additional, based on the concerns discussed in Public Hearing, it was deduced that locals expect improvement of local infrastructure along with religious and community center. The Table below presents the thrust area and the nature of activity proposed as part of the CER Plan.

Table 7.7: Focus Area and Nature of CER Activity

Focus Area	Nature of Activity
Education	• Need based infrastructure support for existing Schools • Support for basic amenities in existing Schools • Support for teaching and learning materials • Support for improving quality of education • Support for meritorious students
Health Care	• Support or general and specialized health camps • Support to existing health facility • Support through mobile health care services • Support for emergency health care services • Awareness on Health and Hygiene
Infrastructure Development	• Support for strengthening existing roads • Support for existing transportation services • Support for Drinking Water facilities • Support in garbage collection/disposal • Support for Street Lighting facilities • Support for Community Toilet facilities
Skill Development and Training	• Skill Training of local youth for Job skills • Support for Vocational Training in market trades • Support for capacity building of local Teachers
Common Interest Activity	• Support for Community Infrastructure • Promoting local culture and traditions • Support for protection of local art forms • Support for protection of local heritage

7.3.6 CER BUDGET

The total budget allocated for implementing the various activity and program envisaged under CER in affected area around the project is given in **Table 7.8** below. CER budget will be allocated in the project cost and activities will be undertaken for implementation immediately after the start of construction work at site.

Table 7.8: Budget for CER Plan

Focus Area	Nature of Activity	Unit Cost/ Lump Sum Cost (Rs.)	Amount (Rs. in lakhs)
	Infrastructure support for existing Schools (25) - 13 primary schools; 7 middle schools, 5 secondary/Senior secondary schools	Primary schools @ Rs 100,000 per school; middle school @ Rs. 200,000 per school; secondary schools @ Rs. 500,000 per school	52.00
	Support for teaching and learning materials	Primary schools @ Rs 50,000 per school; middle	23.50

Focus Area	Nature of Activity	Unit Cost/ Lump Sum Cost (Rs.)	Amount (Rs. in lakhs)
Education		school @ Rs. 100,000 per school; secondary schools @ Rs. 200,000 per school	
	Support for meritorious students - 10 student (out of 13 affected villages) per year for technical education (full 4 years) after senior secondary school	10 students @ Rs 6.0 lakh per scholarship; the scheme will run for five years and if the budget is not exhausted will be extended further	300.00
Health Care	Specialized health camps	13 camps per year to cover 13 villages @ Rs. 2 lakh each camp; the scheme will run for five years	130.00
	Infrastructure support to improve health care facility - presently there is only one PHC and one PHSC in 13 villages; these need upgrading and more PHCs need to be established. A lump amount is suggested to be used judiciously with other funds available to ensure improvement in medical infrastructure.	Rs. 10 lakh per existing PHC/PHSCs plus Rs. 500 lakh for establishment of new infrastructure	520.00
	Awareness on Health and Hygiene	Awareness program to cover all 13 villages @ Rs. 100,000 per village per annum for 5 years	65.00
Infra-structure Development	Support for strengthening existing roads	lump sum	100.00
	Support for existing transportation services for infrastructure improvement	lump sum	52.00
	Support for improving drinking water facilities	lump sum	50.00
	Support in garbage collection/disposal	lump sum	75.00
	Support for Solar Street Lighting facilities	lump sum	50.00
	Support for Community Toilet facilities	lump sum	75.00
Skill Development and Training	Skill Training of local youth for Job skills - establishment of one skill development centre where preference will be given to PAFs; this can be established in existing school/college/ITI and additional funding support will be sourced under Skill India Initiative of Government of India. PPP model can also be explored and fund provided by project will ensure preference to eligible candidates from Project Affected Villages	Lump sum	1000.00

Focus Area	Nature of Activity	Unit Cost/ Lump Sum Cost (Rs.)	Amount (Rs. in lakhs)
	Support for Vocational Training in market trades - establishment of 4 vocational centres	2 vocational training centres @ Rs. 50 lakhs per centre	100.00
	Support for Vocational Training in market trades - establishment of 4 vocational centres	2 vocational training centres @ Rs. 50 lakhs per centre	100.00
Common Interest Activity	Support for community infrastructure	@ Rs. 20.00 lakh per village for 13 affected villages	260.00
	Support for protection of local culture and heritage value	@ Rs. 5.00 lakh per village for 13 affected villages	130.00
TOTAL			**2982.50**

chapter 8 PROJECT BENEFITS

Power sector is a critical infrastructure element required for the smooth functioning of the economy of the Nation. An efficient, resilient and financially healthy power sector is essential for growth and poverty reduction. The availability of reliable, quality and affordable power helps in the rapid agriculture, industrial and overall economic development of the state.

Today, Wind & Solar, are the lowest cost source of new energy, however their inherent infirm nature & non-schedulability presents a huge challenge for integrating large RE capacities, while maintaining grid stability.

Wind-Solar-Storage Hybrid Projects present a viable solution to the problem at hand and for future wherein large RE capacities are being planned to be added to National grid. While battery storage solutions are still evolving, integrating Wind & Solar with time tested and proven Pumped Storage solutions presents an optimal, economically viable & scalable solution to supply Schedulable Power On-Demand (SPOD) with both base load and peak load capabilities.

Pumped Storage solutions provide the necessary scale (large volume of energy storage) and have a long life-cycle resulting in lowest cost of delivered SPOD energy over the life of the projects. Developing such integrated projects in Wind-Solar resource rich locations along with standalone Pumped Storage capacities independently, without impacting the existing natural water systems / irrigation systems is necessary to sustainably power the future needs of our country while maintaining grid stability.

Greenko Group has been in the process of evaluating suitable locations for such integrated projects for over 1 year and has identified Saundatti (Near Karlakatti Village), Belagavi District, Karnataka as possible location for the proposed Saundatti Integrated Renewable Energy Project (IREP). Saundatti IREP has been conceived as the World's First & Largest Gigawatt Scale integrated project with solar, wind and pumped storage components that can supply Schedulable Power on Demand (SPOD) which is Dispatchable & Schedulable Renewable Energy for the first time to consumers across India. Saundatti IREP is envisaged as a 4.8 GW project i.e. 2.4 GW of Solar Project and 2.4 GW of wind project with storage capacity of 1260/10080 MWH.

With this in view, Greenko Group has undertaken feasibility studies to harness the wind and solar potential within the state of Karnataka and has approached the state government to establish Integrated Renewable Energy Project (IREP) encompassing development of 600 MW Pumped Storage Energy, 1000 MW Solar Power and 400 MW Wind Power Project to be developed in Saundatti Taluk of Belagavi District. After evaluating the said proposal in the 51st SHLCC meting dtd. 02.03.2018, the Government of Karnataka, vide G.O. No. CI 83 SPI 2018, dtd. 08.03.2018 has accorded in-principle approval for the said project along with in-principal approval for lifting 1.0 TMC of non-consumptive water from Renuka Sagar reservoir by re-circulation.

All three components of Saundatti IREP (wind, solar & pumped storage) are in close vicinity of each other and therefore power from all three components will be pooled into common pooling station and will be connected to PGCIL/CTU sub-station at Dharwad for further supply into the National Grid. The IREP Project is a self-identified project and first of its kind and is intended to cater the dynamic needs of DISCOMs/STUs, through:

1. 24 Hours Round the Clock (RTC) Base Load Energy
2. 18 Hours Base Load Energy as per Demand
3. 12 Hour Peak Load Energy (6 hours + 6 hours)
4. Energy Storage Service, Grid Management, Frequency Management & Ancillary Services

Employment Generation

Typically, like all infrastructure projects, Saundatti IREP will generate employment during construction phase as well as operation phase. Overall IREP, which includes wind and solar components as well, would lead to creation of direct and indirect employment opportunities as new factories would come up in and around the IREP due to reliable power supply/availability, contract works for the locals etc. for about 5000-8000 persons during construction and 1000-2000 persons after construction. Manpower requirement for Pump Storage component has been worked out separately also.

At the time of peak construction work in the pump storage component, around 1900 persons will be engaged, Out of 1900 the majority of about 1100 nos (800 - labour and 300 - Technical) will be from the local population/surrounding Villages and balance about 800 (600 - labour and 200 - technical) will migrate from outside. During project operation, about 350 persons will be engaged permanently.

chapter 9 ENVIRONMENTAL COST BENEFIT ANALYSIS

As this was not recommended at scoping stage; this aspect was not covered as part of EIA study.

chapter 10 ENVIRONMENT MANAGEMENT PLAN

10.1 IMPLEMENTATION OF EMP

This chapter deals with the description of the administrative aspects of ensuring that mitigation measures are implemented and their effectiveness monitored. Greenko is the project proponent/implementing agency for design and execution of the work including its operation post commissioning. Institutional arrangement for planning and implementing various mitigation and management measures along with carrying out environment monitoring are given at **Table 10.1.**

Greenko is committed to ensure that all possible impacts are mitigated and shall ensure compliance to the national and state level regulatory requirements with a view to mitigate potential adverse environmental impacts resulting from the proposed project activities. The proposed EMP aims at ensuring the implementation of proposed mitigation and monitoring measures along with the responsible agency for implementation.

EIA process has evaluated various impacts due to the proposed project and the proposed mitigation measures which have been suggested along with various management plans; will further reduce the severity of identified adverse impacts on environment due to the proposed activities.

The overall responsibility for implementation of the EMP measures rests with Greenko through their contractors. Environment Manager of Greenko reporting directly to the project head shall ensure coordination and implementation of the EMP measures. He will be responsible for progress monitoring of environmental and social safeguards during project construction and execution stage and submission of monitoring and compliance report to the authority.

The roles and responsibilities of Greenko shall be:

1. Review contract documents to ensure that EMP provisions related to works are included in the contract documents.

2. Participate in and facilitate consultations with stakeholders.

3. Participate in project meetings and report on the issues related to environmental management and social safeguards to provide for any mid-course corrections that may be required based on situation on the ground.

4. Assist Project Affected Persons (PAPs) to resolve their grievances.

5. Liaison with state administration for land acquisition and provision of adequate compensation.

6. Develop rapport with PAFs and between PAFs and project.

7. Carry out other responsibilities as required from time to time.

8. Coordinate on the training of locals and capacity building initiatives.

9. Ensuring the implementation of all the planned mitigation and management measures

10. Review the monitoring report and assess the effectiveness of mitigation and management measures.

11. Take preventive and corrective actions as and when required.

12. Oversee and report implementation of EMP provisions included in the works contract.

Table 10.1: EMP Implementation

Sl. No.	Activities	Implementing Agency	Monitoring/ Supervising/ Approving Agency
1	Muck Management	Contractor	Greenko/Forest Department
2	Sanitation and Solid Waste Management	Contractor	Greenko/Pollution Control Board
3	Public Health Delivery System	Contractor	Greenko/Health Department
4	Energy Conservation Measures	Contractor	Greenko
5	Control of Air Pollution	Contractor	Greenko/Pollution Control Board
6	Control of Noise Pollution	Contractor	Greenko/Pollution Control Board
7	Control of Water Pollution	Contractor	Greenko/Pollution Control Board
8	Waste Management at Sites	Contractor	Greenko/Pollution Control Board
9	Biodiversity Conservation and Management	Greenko	Forest Department
10	Compensatory Afforestation Programme	Greenko	Forest Department
11	Rehabilitation and Resettlement Plan	Greenko	District Administration
12	Disaster Management	Greenko	District Administration (DDMA)
13	CER	Greenko	MoEF&CC
14	Environmental Monitoring	Greenko	Pollution Control Board

10.2 COMPONENTS OF EMP

As per the Standard TOR, various plans need to be prepared as part of EIA study to ensure mitigation and management of identified impacts. This being an off-stream Pump storage scheme, some of the standard TOR Plans are not applicable. The matter was discussed in Expert Appraisal Committee (EAC) meeting and the requirement of following plans was removed from the amended TOR issued by MoEF&CC vide letter dated September 25, 2018.

- Catchment Area Treatment Plan
- Command Area Development Plan
- Fisheries Development Plan

In addition, Water, air and noise management, environment safeguards during construction activities including road construction and labour management have been covered under chapter 4; under mitigation measures. Corporate Environment Responsibly and Resettlement and Rehabilitation Plans are covered under Chapter 7 and Environment Monitoring at Chapter 6 as per generic structure of EIA. Other EMP components are discussed in ensuing text.

10.3 COMPENSATORY AFFORESTATION PLAN

The Standalone Pumped Storage component of Saundatti IRE Project is being constructed in the jurisdiction of Gokak Forest Division in Belagavi district, Karnataka. The total land required for the construction of proposed project activities is approximately 213.70 ha with 160.40 ha of forestland (153.93 ha surface land and 6.47 ha underground area), 18.66 ha of government land and 34.64 ha of private land (**Table 10.2**).

Table 10.2: Details of the Land to be acquired for Standalone Pumped Storage component of Saundatti IRE Project

S. No	Land Type	Area (ha)	
1	Forest Land	Surface area 153.93	Underground area 6.47
	Total Forest land	**160.40**	
2	Government land	**18.66**	
3	Private land	34.64	
Total		**213.70**	

10.3.1 Compensatory Afforestation Programme

The objective of the compensatory afforestation programme will be to develop natural areas in which ecological functions could be maintained on sustainable basis. Therefore, planting of economic important indigenous species would be undertaken. The compensatory afforestation is proposed to be done mainly in those forest blocks where degraded land and forest blanks are available for planting. The plantations in the above forests will be restricted to the areas which lie close to barrage site and colony area of the project. Suitable sites, depressions and sites along streams will planted up with appropriate species.

The Forest Conservation Act, 1980 stipulates strict forest protection measures and procedures (Guide Line 1/08-1 (ii)) for compensatory afforestation on acceptance of diversion of forestland for non-forestry purposes.

i. If non-forest land is not available, compensatory plantation is to be raised on degraded forest land to the extent of twice the affected or lost forest area, and
ii. If non-forest land is available, the extent of compensatory plantation will be equivalent of the affected or lost forest area.

As per the above guidelines, plantations are to be taken up in equal extent of Non-forest land of forest land diversion **[160.40 ha]**, it is also proposed to have avenue plantation along the proposed roads with iron guard fencing work around the new plantation with angle iron in the diverted land to maintain the ecological balance of the areas.

The compensatory afforestation is proposed to be undertaken on Non-forest land identified in consultation with the State Forest Department and District administration. The estimated cost of Compensatory Afforestation programme with cost of non-forest land acquired for afforestation programme is **Rs. 2561.40 lakhs**. The actual cost will be determined by the forest department during FC process.

Table 10.3: Cost estimates of Compensatory Afforestation Plan

Particulars	Area (ha)	Rate Rs-Lakh /ha	Amount (Rs. lakhs)
Total area for compensatory afforestation as per the notification	160.40	3.50	**561.40**
Cost of Non-Forest land	200.00	10.00	**2000.00**
Total			**2561.40**

10.3.2 Net Present Value (NPV)

The Hon'ble Supreme Court of India has made it mandatory vide its order dated 28.03.2008 for the user agency to compensate for the diversion of forest land for non-forest use for developmental activities on the recommendations of Central Empowered Committee (CEC) to make payment of Net Present Value (NPV) of such diverted land so as to utilize this for getting back in the long run which are lost by such diversion.

For this purpose, CEC has classified the forest taking in view the ecological role and value of the forest and the purpose of the report, 16 major forest types have been further grouped into 6 ecological classes depending upon their ecological functions.

1	**Eco-Class I**	Consisting of Tropical Wet Evergreen Forests, Tropical Semi Evergreen Forests and Tropical Moist Deciduous Forests
2	**Eco-Class II**	Consisting of Littoral and Swamp Forests
3	**Eco-Class III**	Consisting of Tropical Dry Deciduous Forests
4	**Eco-Class IV**	Consisting of Tropical Thorn Forests and Tropical Dry Evergreen Forests
5	**Eco-Class V**	Consisting of Sub-tropical Board Leaved Hill Forests, Sub-Tropical Pine Forests and Sub Tropical Dry Evergreen Forests
6	**Eco-Class VI**	Consisting of Montane Wet Temperate Forests, Himalayan Moist Temperate Forests, Himalayan Dry Temperate Forests, Sub Alpine Forest, Moist Alpine Scrub and Dry Alpine Scrub

The net present value per hectare of forest has been fixed based on this data.

Based on this, the NPV was fixed and the following recommendations have been made:
For non-forestry use/diversion of forest land, the NPV may be directed to be deposited in the Compensatory Afforestation Fund as per the rates given below **(in Rs.).**

Eco-Value class	Very Dense Forest	Dense Forest	Open Forest
Class I	10,43,000	9,39,000	7,30,000
Class II	10,43,000	9,39,000	7,30,000
Class III	8,87,000	8,03,000	6,26,000
Class IV	6,26,000	5,63,000	4,38,000
Class V	9,39,000	8,45,000	6,57,000
Class VI	9,91,000	8,97,000	6,99,000

Total forest land requirement for diversion for non-forest use i.e. for the construction of Saundatti IRE Project activities is **160.40 ha** (**Refer Table 10.4**). As the forest in the project area fall in the **Eco Class IV** as being of type Tropical Dry Deciduous Forests therefore NPV @ Rs. 6.26 lakhs/ha would be required to be deposited in the Compensatory Afforestation Fund. The total cost of NPV has been computed as under.

Table 10.4: Cost estimates of NPV

Particulars	
Forest Land to be Diverted (ha)	**160.40**
Eco Class	**IV**
Total NPV to be deposited @Rs. 6.26 lakhs per ha	**Rs. 1004.104**

10.3.3 Abstract of Cost

The total cost of the compensatory afforestation plan, NPV, compensation of trees and cost of damage to fence and infrastructure is estimated as **Rs. 3565.50 lakhs**. The details are given in **Table 10.5.** ***The actual cost will be as assessed under the FC proposal.***

Table 10.5: Total Cost

Sl. No.	**Particulars**	**Amount (Rs. in lakhs)**
1	Compensatory Afforestation	2561.400
2	Net Present Value (NPV)	1004.104
Total		**3565.504**

* Cost of trees will be additional as per actual assessment

10.4 GREEN BELT DEVELOPMENT PLAN

Green belt development will comprise of plantations at various places like periphery of Reservoir, alongside roads and at different project offices and colonies.

10.4.1 Roadside Plantation

In Standalone pumped storage component of Saundatti IRE Project area construction of about 4.0 kms of new roads is proposed. The cost of the plantation has been calculated as per the existing labour charges, material cost (plants, FYM, tree guards, etc.) and the total area of plantation. The spacing for trees is proposed 3 m while 2 m for shrubs. The pit size has been recommended as 45 cm x 45 cm x 5 cm for trees and 30 cm x 30 cm x 30 cm for shrubs. Plantation along roads must take into account visibility aspects on curves so as to ensure safe driving.

10.4.2 Green Belt around Reservoir, Powerhouse and Office Complex

Plantation around the project colony, Reservoir and office complexes is proposed to be done, so that, greenery is developed. Precaution should be exercised by not planting large size trees around buildings and other similar structures as during winter the sun rays are obstructed by them invariably and much wanted sunshine is impaired. Besides this, it is also proposed to develop green belt around the working areas for trapping the dust and noise. Plantation of avenue, with native, ornamental and fruit trees are proposed in these areas along with the area around office complex. The ornamental, fruit plants will be procured from the horticulture department and local market while the avenue plants will be raised in the project nursery. For protection of trees from cattle iron tree guards shall be required.

Table 10.6: Tree species suggested for Landscaping, Roadside and Avenue Plantation

S. No	**Scientific Name**	**Common Name**
1	*Alistonia scholaris*	Blackboard Tree (Saptaparni)
2	*Anthocephalus cadamba*	Kadamba

S. No	Scientific Name	Common Name
3	*Brassia actinophylla*	Umbrella Tree
4	*Callistemon lanceolatus*	Bottle brush
5	*Ceasalpinia pulcherrima*	Peacock flower (Guletura),
6	*Cordia sebestena*	Geiger Tree
7	*Dalbergia sissoo*	Shisham
8	*Delonix regia*	Gul mohur (Flame Tree)
9	*Dolichandrone spathacea*	Mangrove Trumpet Tree
10	*Ficus bengalensis*	Banyan
11	*Ficus religiosa*	Peepal
12	*Filicium decipiens*	Tree fern
13	*Grevilea robusta*	Silver Oak
14	*Melaleuca bracteata*	Golden Bottle Brush
15	*Peltophorum ferrugenium*	Rusty shield bearer
16	*Polyalthia longifolia*	Mast tree (Ashok)
17	*Pongamia glabra*	Indian Beech (Karanj, Kanuga)
18	*Pterospermum acerifolium*	Kanaka champa, Matsa kanda, Karnikara. Bayur tree
19	*Samania saman*	Rain Tree
20	*Saraka indica*	True Ashok (Seetha Ashok)
21	*Swietenia mahagoni*	Mahogany
22	*Tabebuia avellandae*	Pink trumpet tree
23	*Tabebuia rosea*	Rosy trumpet tree, Pink tecoma tree
24	*Terminalia catappa*	Tropical almond, Country Badam

For raising green belt in colonies, around working areas, a budget of **Rs. 42.50 lakhs** have been allocated.

Table 10.7: Cost estimates for Green Belt Development

S. No.	Green Belt Development	Cost (Rs. in lakhs)
1	Roadside/ Avenue plantation (@ Rs. 3.50/ha in 5 ha)	17.50
2	Green belt around powerhouse, Colony and other areas	25.00
	Total	**42.50**

10.5 LANDSCAPING AND RESTORATION OF CONSTRUCTION SITES

Various engineering and biological measures have been suggested for the restoration of proposed project affected areas.

Setting up of infrastructure for construction including colonies for labor will lead to clearing of vegetation and forests. The forest land at these sites will be cleared for the movement of heavy equipments required for different project related activities which would lead to the fragmentation and destruction of the habitats at these sites.

Following measures would be adopted at for the rehabilitation and landscaping of colony areas and construction sites.

- Proper roads and lanes would be provided inside the colony area. The open area will be covered with the vegetation. Preferably native ornamental plants and trees will be planted in rows along the roads and lanes.
- Proper channels would be provided inside the colony to drain out the rain/ domestic water. Retaining walls will be built to avoid the landslides and slips.

- Parks and play grounds for staff and children would be developed in colony of project area.

The estimated cost of restoration of construction is **107.00 lakhs (see Table 10.8).**

Table 10.8: Cost estimates for engineering and biological measures for construction areas

S. No.	Item of work	Quantity	Rate/ unit (in Rs.)	Amount Rs. (In lakhs)
1	Leveling and development of the area	10 ha	200000/ha	20.00
2	Covering the slopes with geo-textiles like coir, etc.	10000 sqm	100/sqm	10.00
3	Grass seeding	Lump sum		2.00
4	Plantation	10 ha	3.5 lakh/ha	35.00
5	Fencing	Lump sum		5.00
5	Maintenance for 7 years (from 4^{th} to 10^{th}) 5 Lakh/Year	7 Years	500000/Year	35.00
Total				**107.00**

10.6 MUCK MANAGEMENT PLAN

Proposed Scheme will involve construction of embankment of 43 m height for creation of Standalone Pumped storage component of Saundatti Integrated Renewable Energy Project reservoir. Water is proposed to be diverted through four numbers of independent penstocks and one number of independent penstocks bifurcated into two from Power block of Saundatti IREP reservoir. A surface Power House will be located on the downstream of the power block and shall be equipped with four turbines and a pump/turbine having generating/pumping capacity of 252MW and two units of 126MW, respectively. The layout map of the project showing main construction sites and water conductor system is given at **Figure 10.1**.

10.6.1 Quantity of Material to be excavated

The construction activities would generate muck from excavation for various project structures. The total quantity of muck generated from soil and rock excavation is about **7.21 Mcum.** Of the total muck generated, about **5.33 Mcum** is expected to be utilized for Rockfill and as aggregate for construction. It is also proposed to dispose 1.00 Mcum for leveling of the Reservoir bed. Total quantity of muck proposed to be disposed in designated muck disposal area, after considering 40% swelling factor would be **1.64 Mcum**. The entire excavated material is proposed to be dumped at two locations identified specifically for this purpose.

Table 10.9: **Muck to be generated from various components of the project**

S. No.	Project Component	Total Quantity of Muck to be generated (Cum)
1	Head Race Channel	817625
2	Surge	495420
3	Pressure Shaft	99428
4	Power House	2868004
5	HRT	312646
6	TRC	2621852
	Total	**72,14,975**

Table 10.10: **Quantity of muck to be disposed**

S. No.	Description	Quantity in M Cum
1	Total quantum of muck generated from the project	7.21

2	Total quantity of aggregate requirement	5.33
3	Quantity of muck to be disposed (1-2)	1.88
4	Applying Swelling factor of 40 % on the muck to be disposed	0.752
5	Total quantity of muck to be disposed (3+4)	2.64
6	Muck Proposed to be disposed in Reservoir	**1.00**
7	Muck Proposed to be disposed in MD Area (5-6)	**1.64**

10.6.2 Muck Disposal Site

For the disposal of 1.64 MCum of muck, 2 sites have been identified with total area of 10 Ha with details given in **Tables 10.11** & **10.12**. The disposal site was identified taking into consideration above mentioned criteria are represented in **Figure 10.2**.

10.6.3 Criteria for Selection of Dumping Site

The following points were considered and followed as guidelines for finalization of the areas to be used as dumping sites:

i) The dumping sites have been selected as close as possible to the project area to avoid long distance transport of muck.
ii) The site is free from any landslides or creep and care has been taken that the sites do not have a possibility of toe erosion and slope instability.
iv) There is no active channel or stream flowing through the dumping sites.
v) The site is away from human settlement areas.

Table 10.11: **Details of muck disposal site No-1 (7 Ha)**

S. No.	Chainage (m)	Area (Sq. m)	Capacity in Cum
1	0	2634	0
2	172	3987	570382
3	300	4797	688258
	Total Capacity		**12,58,640**

Table 10.12: Details of muck disposal site No-2 (3 Ha)

S. No.	Chainage (m)	Area (Sq. m)	Capacity in Cum
1	0	2438	0
2	104	2605	262220
3	194	2383	224455
	Total Capacity		**4,86,675**

Total Capacity of the Muck Disposal Areas (MD-1 & MD-2) = 1.75 Mcum

10.6.4 Methodology of Dumping

The muck that needs disposal would be piled at Ø (angle of repose) maximum of 30° at the proposed dumping site. The description regarding stabilization of stacked material along with the proposed roads has been discussed in the following paragraphs.

The options like dumping muck in stages and allowing it to consolidate/settle throughout the monsoon season, compacting dumped muck with Bulldozer movement, zoning of dump judiciously to ensure stability of 30° slope under all superimposed conditions will be explored and utilized. The plan and cross-sections of the proposed muck dumping site is given at **Figure 10.3a** & **10.3b**.

The main objectives of process of muck dumping and restoration of these muck disposal sites are:

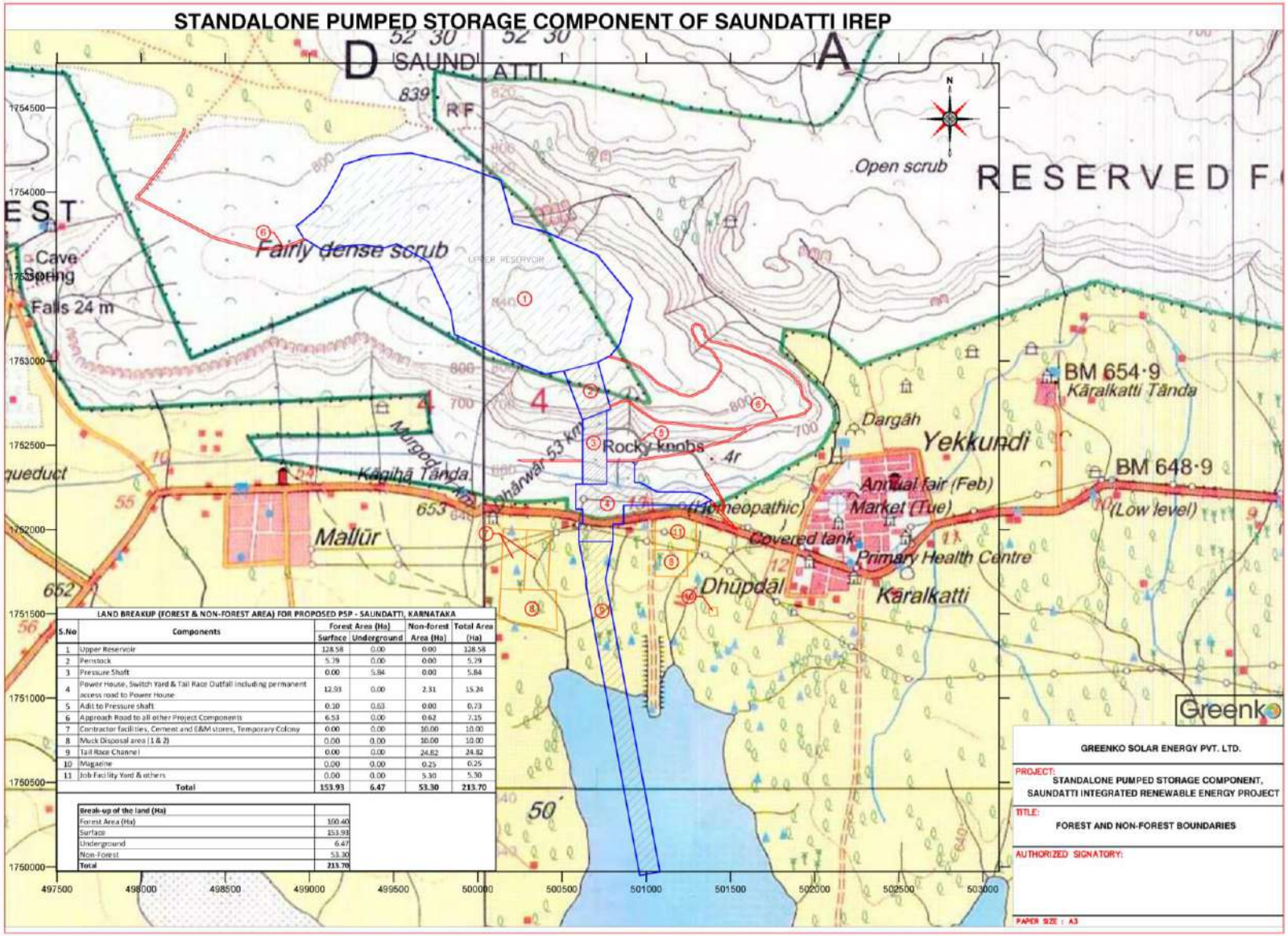
- to protect and control soil erosion;
- to create greenery in muck disposal area;
- to improve and develop sites into recreational site;
- to ensure maximum utilization of muck for construction purpose;
- to develop muck disposal site/ dumping yard to blend with the surrounding landscape; and
- to minimize damages due to spoilage of muck in project area.

In Standalone Pumped storage component of Saundatti Integrated Renewable Energy Project a scientific approach and methodology was followed for identification of the dumping site. All possible alternate sites were inspected and examined before rejecting or selecting any site. The dumping site is characterized by:

i) no forest cover,
ii) populated /settlement areas are located away from dumping site to reduce impact on human settlements, and
iii) identified muck site is close to the area of generation to avoid hazards related to transport of muck for long distances and avoid traffic problems.

The generated muck will be carried in dumper trucks, covered properly, in line with international best practices. All precautionary measures will be followed during dumping of muck. Proper precautions will be taken to ensure the dumpers are not over loaded. The transportation routes will be periodically sprinkled to reduce fugitive emission churned the mechanical disturbance caused by vehicular movement. Further, care will take to avoid dumping during windy conditions to avoid reculation of fine particulates and reduce the impacts of wind-blown dust. As a standard practice, all drivers will be instructed to maintain vehicular speed ≤ 20 km/hr.

The capacity/volume of the muck dumping sites is more than the volume of the muck to be disposed i.e. for 1.64 Mcum of muck required to be disposed, a capacity of 1.75 Mcum has been created (**see Table 10.10**). The spare capacity has been earmarked for temporary storage of usable muck, traffic movement of dumpers and lifters. The spoil from various construction sites would be disposed of at designated dumping sites. All measures would be adopted to ensure that dumping of muck does not cause injury or inconvenience to the people or the property around the area. The general topography of the disposal area has a very mild slope. The spillage of muck will be prevented by erecting concrete retaining walls and to retain piled muck. The top surface would be leveled and graded after the capacity of dumping site is exhausted. The top surface will be covered with soil and grass seeding will be ensured to promote vegetation cover.

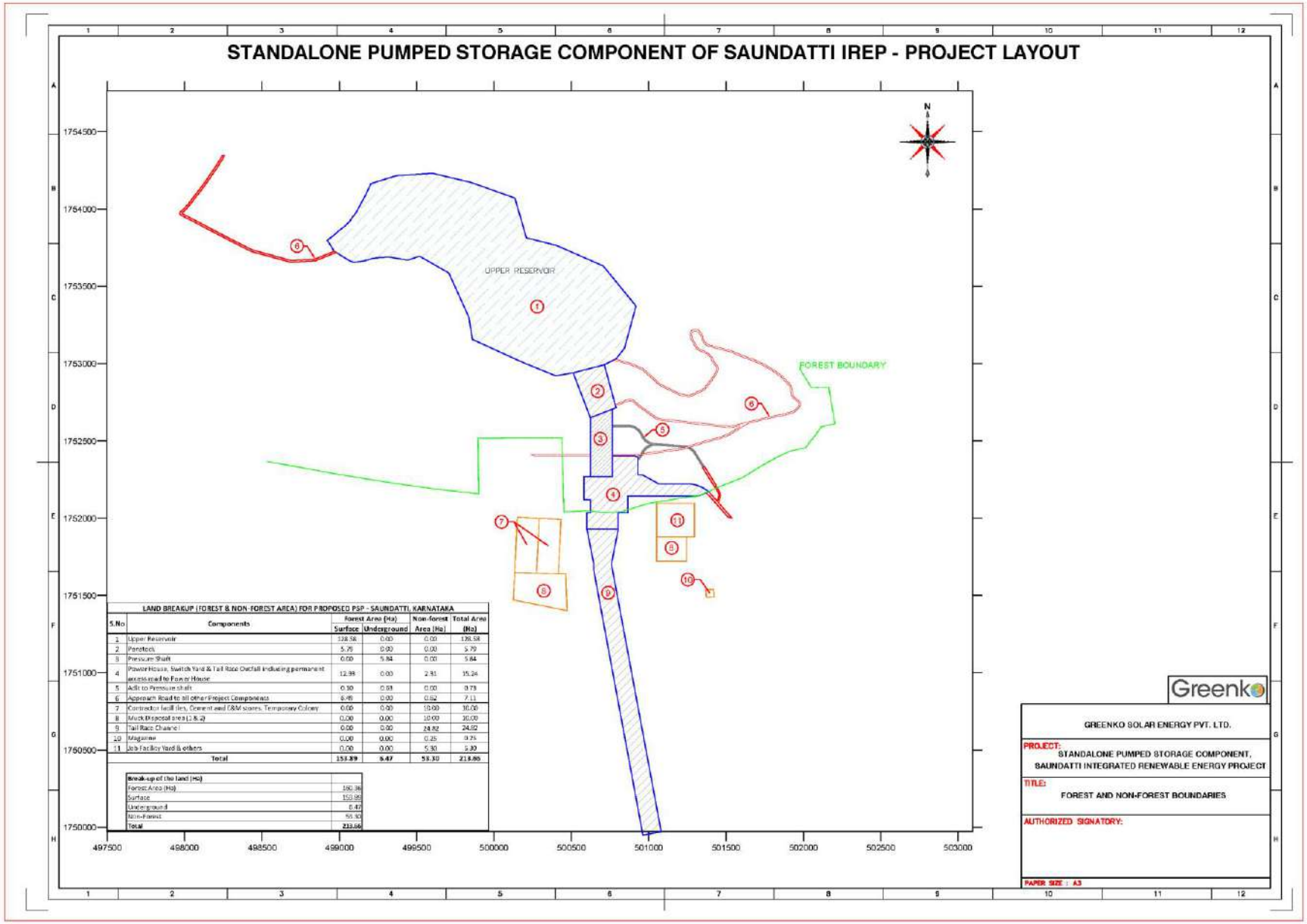


LAND BREAKUP (FOREST & NON-FOREST AREA) FOR PROPOSED PSP - SAUNDATTI, KARNATAKA

S.No	Components	Forest Area (Ha)		Non-forest Area (Ha)	Total Area (Ha)
		Surface	Underground		
1	Upper Reservoir	128.58	0.00	0.00	128.58
2	Penstock	5.79	0.00	0.00	5.79
3	Pressure Shaft	0.00	5.84	0.00	5.84
4	Power House, Switch Yard & Tail Race Outfall including permanent access road to Power House	12.93	0.00	2.31	15.24
5	Adit to Pressure shaft	0.10	0.63	0.00	0.73
6	Approach Road to all other Project Components	6.53	0.00	0.62	7.15
7	Contractor facilities, Cement and E&M stores, Temporary Colony	0.00	0.00	10.00	10.00
8	Muck Disposal area (1 & 2)	0.00	0.00	10.00	10.00
9	Tail Race Channel	0.00	0.00	24.82	24.82
10	Magazine	0.00	0.00	0.25	0.25
11	Job Facility Yard & others	0.00	0.00	5.30	5.30
	Total	153.93	6.47	53.30	213.70

Break-up of the land (Ha)	
Forest Area (Ha)	160.40
Surface	153.93
Underground	6.47
Non-Forest	53.30
Total	213.70

Figure 10.1: Layout Plan of Pumped Storage component of Saundatti IREP showing location of muck disposal sites


STANDALONE PUMPED STORAGE COMPONENT OF SAUNDATTI IREP - PROJECT LAYOUT
UPPER RESERVOIR
FOREST BOUNDARY
N
1754500
1754000
1753500
1753000
1752500
1752000
1751500
1751000
1750500
1750000
497500
498000
498500
499000
499500
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501500
502000
502500
503000
LAND BREAKUP (FOREST & NON-FOREST AREA) FOR PROPOSED PSP - SAUNDATTI, KARNATAKA
S.No | Components | Forest Area (Ha) Surface | Forest Area (Ha) Underground | Non-forest Area (Ha) | Total Area (Ha)
1 | Upper Reservoir | 128.58 | 0.00 | 0.00 | 128.58
2 | Penstock | 5.75 | 0.00 | 0.00 | 5.79
3 | Pressure Shaft | 0.00 | 5.84 | 0.00 | 5.84
4 | Power House, Switch Yard & Tail Race Outfall including permanent access road to Power House | 12.98 | 0.00 | 2.91 | 15.24
5 | Adit to Pressure shaft | 0.30 | 0.03 | 0.00 | 0.73
6 | Approach Road to all other Project Components | 6.45 | 0.00 | 0.62 | 7.11
7 | Contractor facilities, Cement and O&M stores, Temporary Colony | 0.00 | 0.00 | 10.00 | 10.00
8 | Muck Disposal area (1 & 2) | 0.00 | 0.00 | 10.00 | 10.00
9 | Tail Race Channel | 0.00 | 0.00 | 24.82 | 24.82
10 | Magazine | 0.00 | 0.00 | 0.25 | 0.25
11 | Job Facility Yard & others | 0.00 | 0.00 | 5.30 | 5.30
Total | | 153.89 | 5.87 | 55.90 | 213.86
Break-up of the land (Ha)
Forest Area (Ha) 159.76
Surface 153.89
Underground 5.87
Non-Forest 55.90
Total 213.66
Greenko
GREENKO SOLAR ENERGY PVT. LTD.
PROJECT:
STANDALONE PUMPED STORAGE COMPONENT, SAUNDATTI INTEGRATED RENEWABLE ENERGY PROJECT
TITLE:
FOREST AND NON-FOREST BOUNDARIES
AUTHORIZED SIGNATORY:
PAPER SIZE : A3

Suitable retaining walls shall be constructed prior to dumping of muck, and terraces would be developed to support the muck on vertical slope and for optimum space utilization. Loose muck would be compacted layer-wise. The compacted muck will be ultimately covered with fertile soil, and suitable plants will be planted adopting suitable bio-technological measures (**see Figure 10.2**).

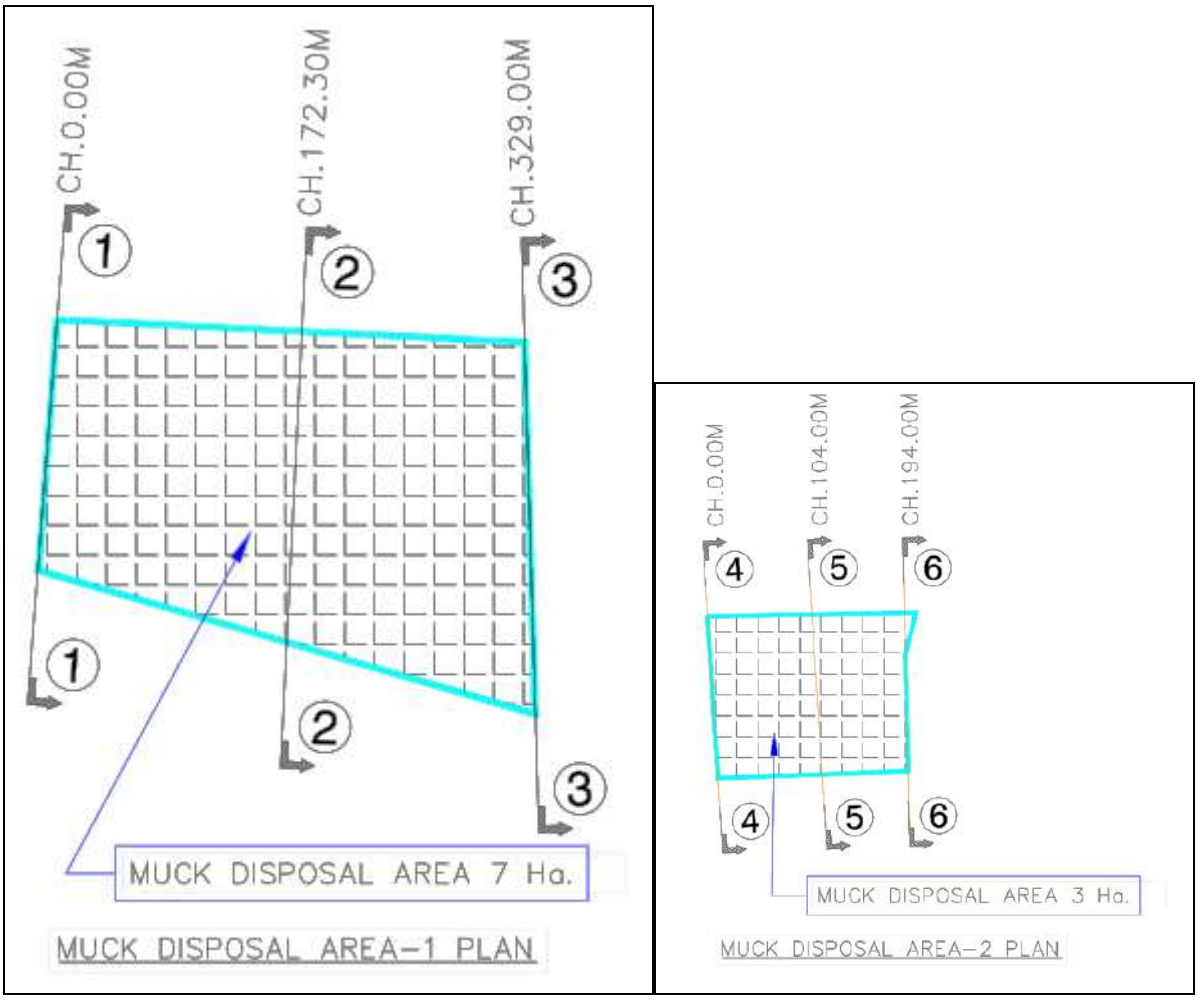


Figure 10.2: Plan of Muck Dumping Sites

10.6.5 Rehabilitation of Muck Disposal Site

The Rehabilitation plan of muck dumping site includes engineering and biological measures. The project authorities would ensure that dumping yards' blend with natural landscape are developed with patches of greenery in and around it. The site can also be developed later as recreational park or any other purpose with sufficient greenery by planting ornamental plants with a view to develop bio-diversity park.

The following engineering and biological measures have been proposed for the development of spoiled areas.

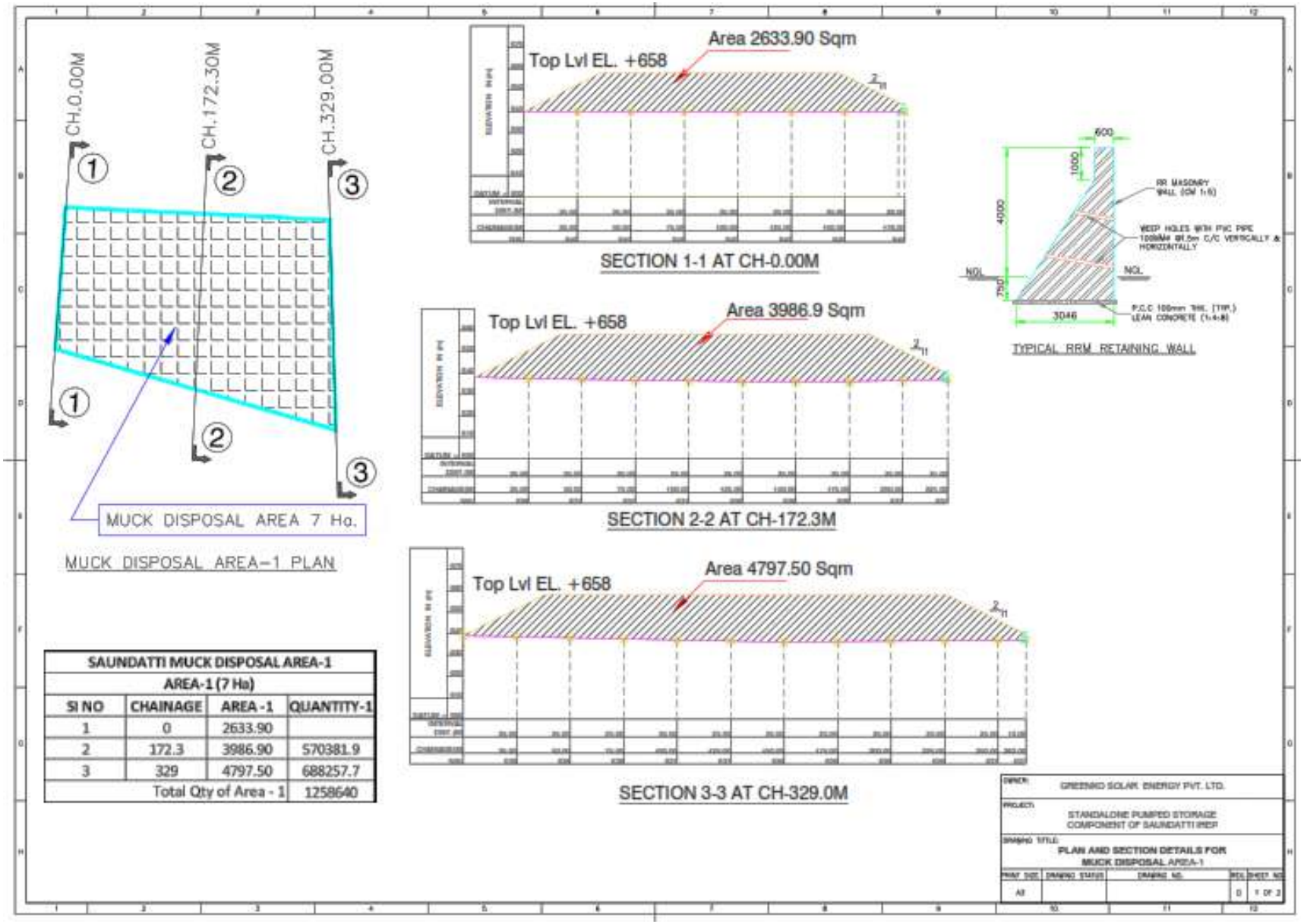
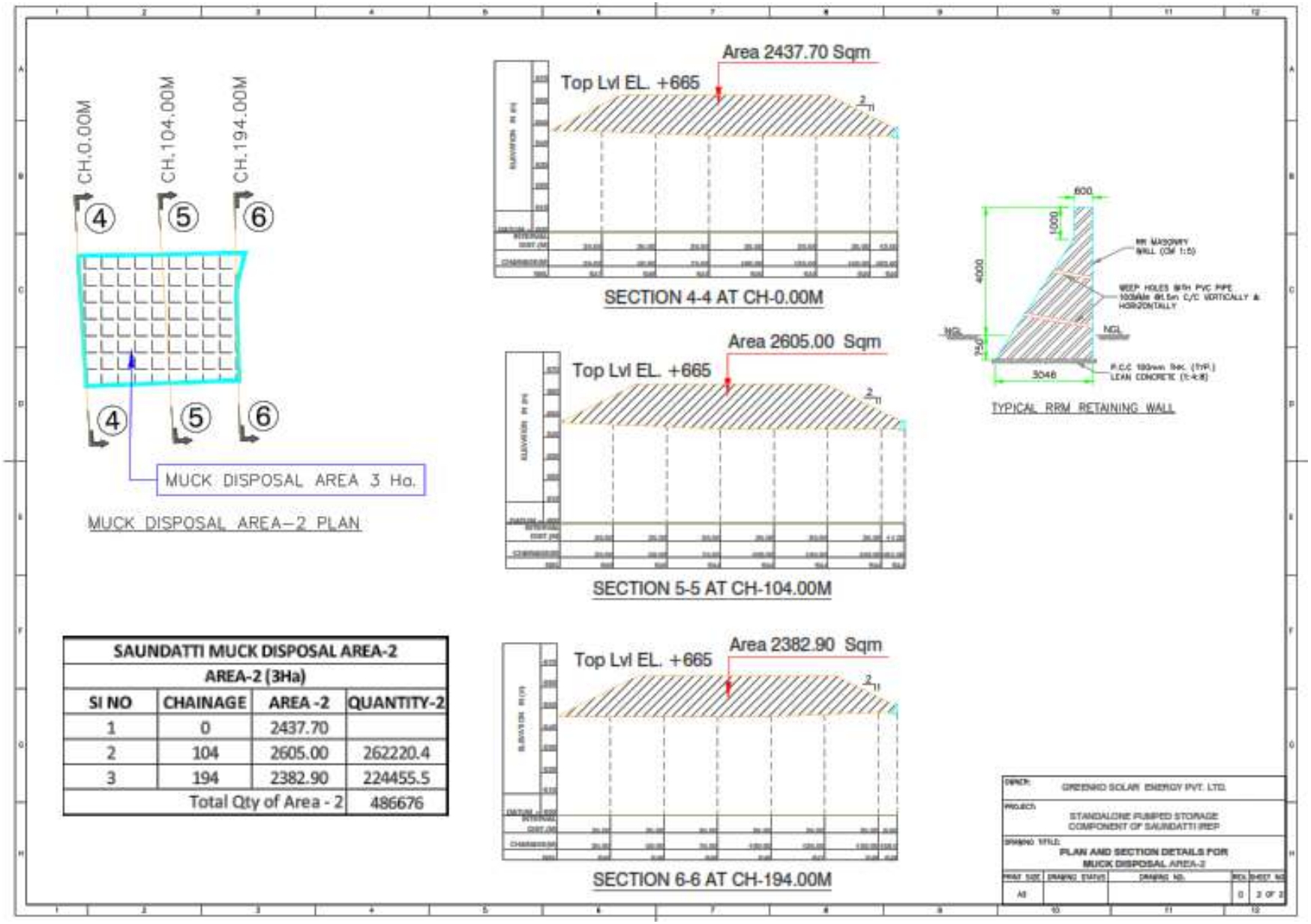


Figure 10.3a : Cross-sections of Muck Dumping Site-1



SAUNDATTI MUCK DISPOSAL AREA-2			
AREA-2 (3Ha)			
SI NO	CHAINAGE	AREA -2	QUANTITY-2
1	0	2437.70	
2	104	2605.00	262220.4
3	194	2382.90	224455.5
Total Qty of Area - 2			486676

Figure 10.3b : Cross-sections of Muck Dumping Site-2

a) Engineering Measures

For stacking of dumped material, concrete reinforced retaining wall is proposed to be built before dumping of any material on the pre-identified muck dumping sites (refer **Figure 10.2**). The total length of retaining wall at MD 1 is 803 m and 512m at MD 2, respectively and height of retaining walls is proposed to be 4m (**see Figures 10.3a & 10.3b**). The retaining wall shall have RCC base of 100mm thick and a width of about 3.0 m. The masonry wall is proposed with weeping pipes with PVC pipes of 100mm for drainage. The leveling & Sloping would be done after dumping the material after every cycle and simultaneously improving the drainage of the disposal site.

All the approach road to various project structures will be constructed with minimal environmental damage. The methodology consists in developing the formation width is half cutting and half filling, so that the materials obtained from cutting are utilized in filling. The excavation on hill side will be done to get a stable slope for the materials encountered. At places breast wall, gabion walls shall be erected on natural slope to retain filled material, particularly where there is problem of retaining the slope. Total financial outlay for the engineering measures comprising of retaining walls, compaction, fencing is **Rs. 325.28** lakhs, and breakup is given in **Table 10.13**.

i) Retaining Wall

Total area for the dumping of muck is 10.00 ha which can accommodate more than **1.75 Mcum** though the estimated muck to be disposed is **1.64 Mcum**. The height of the retaining wall will be approximately 4 m. A typical sketch of the retaining wall is given at **Figures 10.3a** & **10.3b**.

ii) Compaction

Compaction is an engineering measure, which would reduce bulk density of muck thereby optimizing the use of muck disposal area and would make it suitable for plantation and other biological measures. Top surface would be levelled and graded and muck will be spread in layers of 500-700mm thick layers.

iii) Fencing

After rehabilitation of muck, dumping area needs protection for some time from any disturbance from human and domestic animals. For this reason, fencing around the muck deposited is required. Barbed wire strands with two diagonal strands, clamped to wooden/ concrete posts placed at 3 m distance are proposed around dumping piles. Project authorities will establish temporary wind barriers around 3 sides of dumps in close of settlement area.

Table 10.13: Estimated Cost of Engineering Measures

S. No.	Particular	Volume (cum)	Rate in Rs./cum	Cost in Rs. Lakhs
1	Earthwork for foundation	3630	140	5.08
2	PCC 100 mm Thick M10 Grade Concrete	427	3500	14.95
3	R.R. Masonry	9783	2450	239.68
4	Weep Holes with PVC Pipe 100 mmØ @1.5m C/C Vertically & Horizontally	4285	150	5.57
5	Fencing	LS	LS	10.00

S. No.	Particular	Volume (cum)	Rate in Rs./cum	Cost in Rs. Lakhs
6	Compacting and land leveling, etc.	LS	LS	50.00
	Total			**325.28**

b) Biological Measures

Vegetation cover controls the hydrological and mechanical effects on soils and slopes and helps to stabilize the loose soil. Accordingly, the muck disposal sites after proposed engineering measures as mentioned above, shall be treated with biological measures for the purpose of plantation. To implement the biological measures in dumping area, the following activities would be taken into account. The biological measures include the following:

i) Soil treatment

Muck dumped at various sites is not considered to be nutrient rich as it is excavated from tunnels and other structures. In order to make it suitable for the plantation it will be provided bio treatment.

ii) Plantation

After the process of compaction and soil treatment, the dumping site will be available for the plantation. Appropriate local/native species shall be selected in consultation with the horticultural department as well as forest department. For Plantation, 1-2 years old saplings would be used. Grasses and herbaceous species would also be used in the inter space of tree and shrub species. They will help in providing the continuous chain of support in retaining debris, reinforcing soil and increasing the infiltration capacity of the area.

The afforestation with indigenous plant species of high ecological and economic value which can adapt to local habitat will be undertaken with 400-600 plants per hectare depending upon the canopy cover required. Major tree species which would be planted are listed in table below.

Family	Name of Species	Habitat
Acanthaceae	*Justicia adhatoda*	Shrub
Anacardiaceae	*Mangifera indica*	Tree
Anacardiaceae	*Semecarpus anacardium*	Tree
Anonaceae	*Polyalthia longifolia*	Tree
Apocyanaceae	*Wrightia tinctoria*	Tree
Apocynaceae	*Nerium indicum*	Shrub
Bignoniaceae	*Jacaranda mimosifolia*	Tree
Combretaceae	*Terminalia catappa*	Tree
Euphorbiaceae	*Jatropha curcas*	Shrub
Fabaceae	*Albizia lebbeck*	Tree
Fabaceae	*Bauhinia racemosa*	Tree
Fabaceae	*Cassia fistula*	Tree
Fabaceae	*Dalbergia paniculata*	Tree
Meliaceae	*Azadirachta indica*	Tree
Moringaceae	*Moringa concanensis*	Tree
Rutaceae	*Aegle marmelos*	Tree
Verbenaceae	*Vitex negundo*	Shrub

The estimated cost of these measures would be **Rs. 60.00 lakhs**. This cost includes the cost

of turfing of slopes, preparation of ground, spreading of manure, etc., providing 5 cm of soil cover and transportation and carriage. It also includes the cost of fencing, irrigation, watch and ward, etc. (**see Table 10.14**).

Table 10.14: Total financial outlay for the biological measures at dumping sites

S. No.	Particulars	Quantity	Rate (in Rs.)	Amount (Rs. in lakhs)
1	Rolling of Muck	1.64 Mcum	-	Included in Engineering measures
2	Pitting (size: 0.45 m x 0.45 m x 0.45 m)	20000	75.00	15.00
3	Manure and soil filling in pits including transportation	-	Lumpsum	10.00
4	Raising of plants (including nursery cost, manure, transport, etc.)	-	Lumpsum	25.00
5	Fencing, maintenance, watering, transport, etc.	-	Lumpsum	10.00
	Total			**60.00**

10.6.6 Monitoring & Compliance

Muck shall be dumped from bottom in layers of 500-700mm depending on size of boulders.

i) Each layer shall be rolled compacted.
ii) A layer of soil shall be spread on top of it to make it suitable for plantation.
iii) Prescribed norms of SPCB shall be followed.
iv) All norms of Forest department, SPCB and MoEF&CC and their acts related to muck disposal shall be complied with.
v) Design consultant shall be engaged for designing of retaining structures.
vi) Plantation shall be done on the reclaimed land and native variety of plants and trees shall be planted.

10.6.7 Financial Requirement

The estimated cost of the relocation and rehabilitation of excavated material is given in **Table 10.15**. The total cost of these measures will be **Rs. 385.28 lakhs.**

Table 10.15: Financial requirements for implementation of Muck Disposal Plan

S. No.	Item	Amount (Rs.in lakhs)
1.	Engineering measures	325.28
2.	Biological measures	60.00
	Total	**385.28**

10.7 DAM BREAK MODELING AND DISASTER MANAGEMENT PLAN

Dam break may be summarized as the partial or catastrophic failure of a dam leading to the uncontrolled release of water. Such an event can have a major impact on the land and communities downstream of the breached structure. A dam break may result in a flood wave up to tens of meters deep travelling along a valley at quite high speeds. The impact of such a wave on developed areas can be sufficient to completely destroy infrastructure.

With such destructive force comes an inevitable loss of life, if advance warning and evacuation was not possible.

10.7.1 Need For Dam Break Modeling

The extreme nature of dam break floods means that flow conditions will far exceed the magnitude of most natural flood events. Under these conditions, flow will behave differently to conditions assumed for normal flow modeling and areas will be inundated, that are not normally considered. This makes dam break modeling a separate study for the risk management and emergency action plan.

The objective of dam break modeling or flood routing is to simulate the movement of a dam break flood wave along a valley or indeed any area downstream that would flood as a result of dam failure. The key information required at any point of interest within this flood zone is generally:

- Travel time of flood water
- Peak water level – extent of inundation
- Peak discharge
- Duration of flooding

The nature, accuracy and format of information produced from a dam break analysis will be influenced by the end application of the data.

Emergency Planning

To reasonably prepare an emergency plan, it will be necessary for the dam break analysis to provide:

- Inundation maps at a scale sufficient to determine the extent of and duration of flooding
- Timing of the arrival and peak of the flood wave

Development Control

Development control will focus mainly on the extent of possible inundation resulting from different failure scenarios. Consideration may also be given to the characteristics of the population at risk.

10.7.2 Present Dam Break Modeling Scenarios

The present study for Saundatti Project comprises of the following hydrodynamic simulation:

- Embankment (dam) break with initial reservoir level at FRL

However, two scenarios have been studied in the present study based on the vulnerability assessment carried out using Google Earth, Surveyed layouts and topographical maps.

Both the scenarios have been shown on the **Figure 10.4** below and upstream elevation information of both scenarios has been depicted as **Figure 10.5A** and **10.5B**.

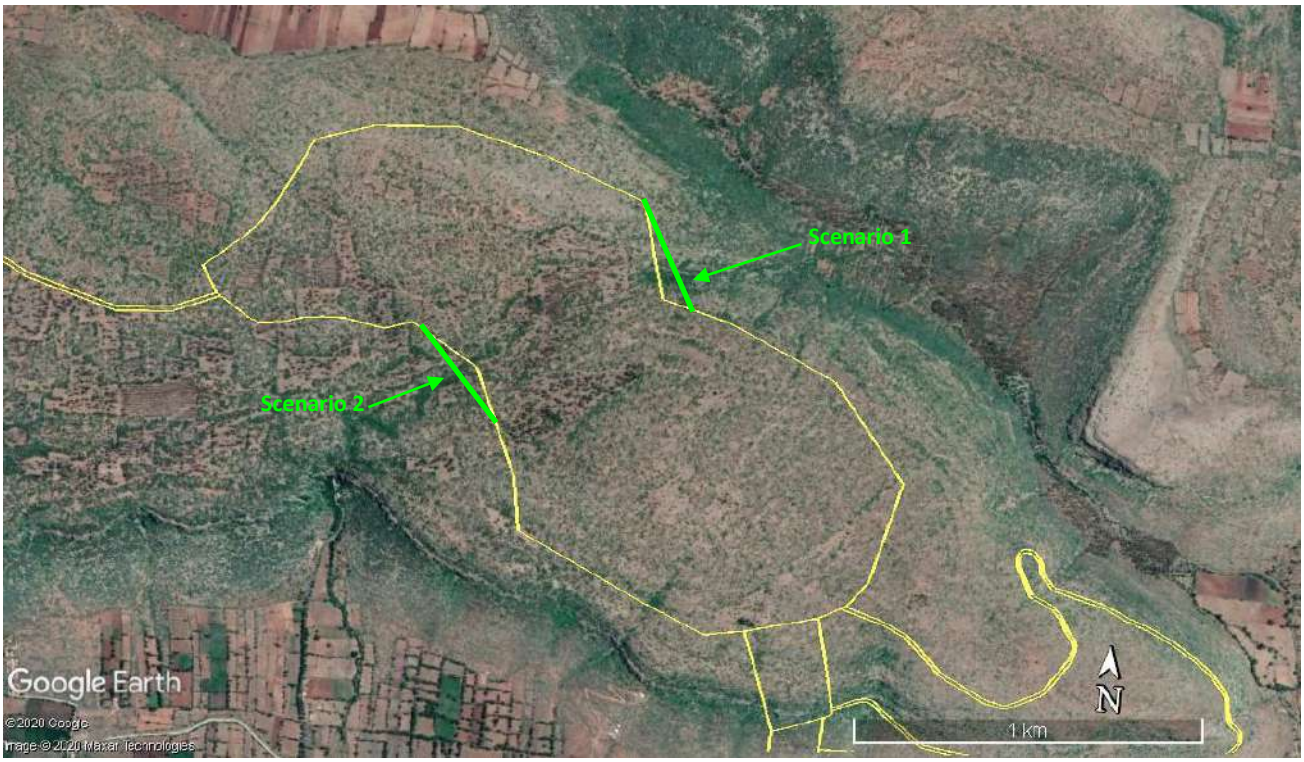


Figure 10.4: Embankment & reservoir – Saundatti project

Saundatti reservoir involves earthen embankments as dam on hill top which forms reservoir. Manmade earthen embankment (dam) could be vulnerable which has been assessed for probable dam break scenarios.

The study comprises of:

1. Prediction of outflow hydrograph due to dam breach
2. Routing of dam breach flood hydrograph through the downstream valley to get the maximum water level and discharge along with time of travel at different locations of the river downstream of the dam

10.7.3 Introduction to Dam Break Modeling

Generally, dam break modeling can be carried out by either i) scaled physical hydraulic models, or ii) mathematical simulation using computer. A modern tool to deal with this problem is the mathematical model, which is most cost effective and reasonably solves the governing flow equations of continuity and momentum by computer simulation.

Mathematical modeling of dam breach floods can be carried out by either one dimensional analysis or two dimensional analysis. In one dimensional analysis, the information about the magnitude of flood, i.e., discharge and water levels, variation of these with time and velocity of flow through breach can be had in the direction of flow. In the case of two dimensional analysis, the additional information about the inundated area, variation of surface elevation and velocities in two dimensions can also be assessed.

One dimensional analysis is generally accepted, when valley is long and the flood wave characteristics over a large distance from the dam are of main interest. In the instant case,

as these valleys are long and the flood wave characteristics over a large distance from the dam are of main interest, one dimensional modeling was adopted.

10.7.4 Hydrodynamic Modeling

The essence of dam break modeling is hydrodynamic modeling, which involves finding solution of two partial differential equations originally derived by Barre De Saint Venant in 1871. The equations are:

i. **Conservation of mass (continuity) equation**

$(\partial Q/\partial X) + \partial(A + A_0) / \partial t - q = 0$

ii. **Conservation of momentum equation**

$(\partial Q/\partial t) + \{ \partial(Q^2/A)/\partial X \} + g A ((\partial h/\partial X) + S_f + S_c) = 0$

where, Q = discharge;
A = active flow area;
A_0 = inactive storage area;
h = water surface elevation;
q= lateral outflow;
x = distance along waterway;
t = time;
S_f = friction slope;
S_c = expansion contraction slope and
g = gravitational acceleration.

10.7.5 Selection of Model

Selection of an appropriate model to undertake dam break flood routing is essential to ensure the right balance between modeling accuracy and cost (both in terms of software cost and time spent in developing & running the model). In the instant case, MIKE 11 model developed by Danish Hydraulic Institute has been selected for the present study because of its wide acceptability in India and abroad.

10.7.6 Mike 11 Model

The core of the MIKE 11 system consists of the HD (hydrodynamic) module, which is capable of simulating unsteady flows in a network of open channels. The results of a HD simulation consist of time series of water levels and discharges. MIKE 11 hydrodynamic module is an implicit, finite difference model for unsteady flow computation. The model can describe sub-critical as well as supercritical flow conditions through a numerical description, which is altered according to the local flow conditions in time and space.

Advanced computational modules are included for description of flow over hydraulic structures, including possibilities to describe structure operation. The formulations can be applied for looped networks and quasi two-dimensional flow simulation on flood plains. The computational scheme is applicable for vertically homogeneous flow conditions extending from steep river flows to tidal influenced tributaries.

The following three approaches simulate branches as well as looped systems.

i) **Kinematic wave approach**: The flow is calculated from the assumption of balance between the friction and gravity forces. The simplification implies that the Kinematic wave approach cannot simulate backwater effects.

ii) **Diffusive wave approach**: In addition to the friction and gravity forces, the hydrostatic gradient is included in this description. This allows the user to take downstream boundaries into account, and thus, simulate backwater effects.

iii) **Dynamic wave approach**: Using the full momentum equation, including acceleration forces, the user is able to simulate fast transients, tidal flows, etc., in the system.

Depending on the type of problem, the appropriate description can be chosen. The dynamic and diffusive wave descriptions differ from kinematic wave description by being capable of calculating backwater effects. The solution algorithm for the different flow descriptions is identical in the inner programme structure, implying that the user does not have to distinguish between the different computational levels, when running the program. In the instant case, dynamic wave approach was adopted for a better simulation.

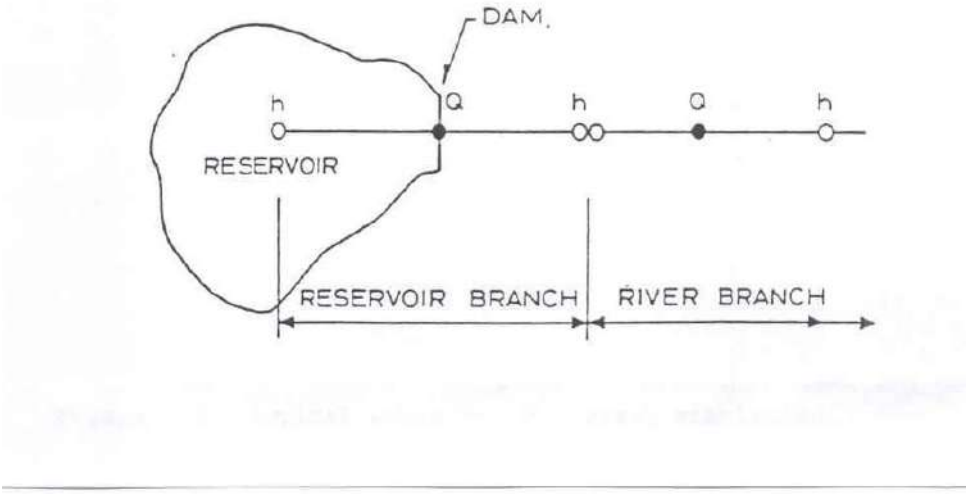
Hydrodynamic module utilizes a space staggered grid consisting of alternating **h** and **Q** points, i.e., points where water levels (**h**) and discharges (**Q**) are computed sequentially. Topographic data are entered at the **h** points, and discharge relations are evaluated at **Q** points. During simulations, the complete non-linear equations of open channel flow are solved numerically at the grid points at specified time intervals for the given boundary conditions.

10.7.7 Mike 11 Model Set-Up

The Dam Break Module in MIKE 11 simulates the outflow hydrograph resulting from the failure of a dam. The model set-up consists of a single or several channels, reservoirs, dam break structures and other auxiliary dam structures such as spillways, bottom outlets etc. As the flood propagation due to the dam break will be of highly unsteady nature, the river course needs to be described accurately through the use of as many cross-sections as possible, particularly where the cross-section is changing rapidly. Further, the cross-sections should extend as far as possible to cover the highest modelled water level, which normally will be in excess of the highest recorded flood level. If the modelled water level exceeds the highest level in the cross-section for a particular location, MIKE 11 will extrapolate the processed Data as a vertical wall, and this will give conservative results.

10.7.7.1 River channel set-up

The river channel set-up for dam break modeling is the same as for the HD model except that the dam break structure is located in a separate reservoir branch, which contains 3 calculation points, i.e., two h-points and one Q-point. If a spillway is added to the dam, it can be described as a separate branch with 3 calculation points. The dam and spillways are located at a Q-point. The river set-up with a dam and, with dam and spillway are shown in **Figure 10.5** and **10.6** respectively.



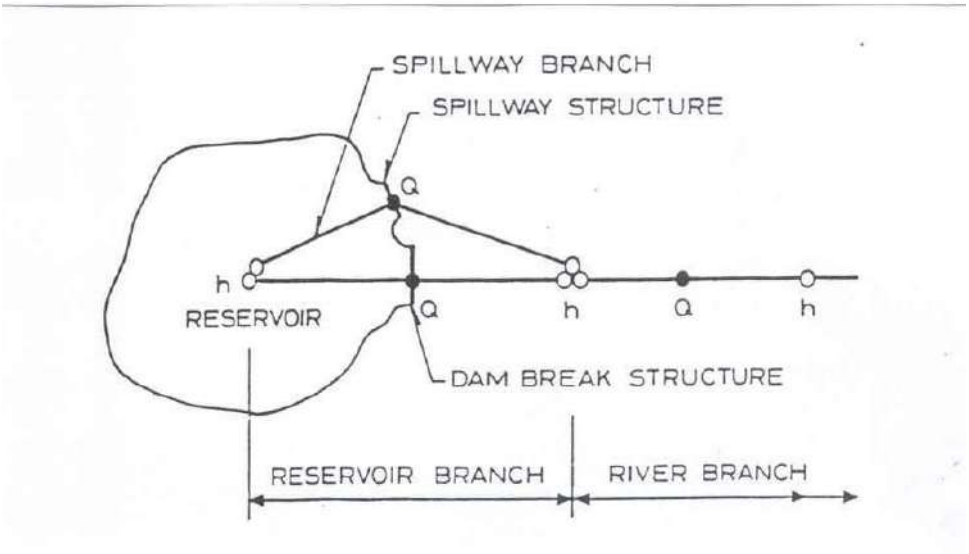


Figure 10.5 & 10.6: River set up with dam and spillway

10.7.7.2 Description of reservoir and appurtenant structures

Reservoir

To obtain an accurate description of the reservoir storage characteristics, the reservoir is normally modelled as a single **h**-point in the model. This will usually correspond to the upstream boundary of the model, where also the inflow hydrograph is also specified. In present case, since reservoir in on top of hill with virtually on no catchment; a notional negligible value has been considered in model as as constant.

The description of the reservoir storage is entered in the processed data. The surface storage area of the dam is described as a function of the water level and it is entered as additional flooded area. The lowest water level given for the reservoir should be somewhere below the final breach elevation of the dam.

The cross-sectional area is set to a large finite value and is used only for calculating the inflow head loss into the breach. The inflow head loss can be calculated as:

$$\Delta H = (V_s^2 / 2g)\, C_i\, [1-(A_s / A_{res})]$$

Where, V_s = Velocity through the breach

C_i = Inflow head loss coefficient

A_s = Flow area through the breach, and

A_{res} = Cross-sectional area of the reservoir

In order to obtain a reasonable head loss description, it is only necessary that $A_{res} >> A_s$ so that $[1-(A_s/A_{res})] = 1$. The hydraulic radius is set to any non-zero value.

The total surface area of the reservoir is calculated as:

A_{total} = b.2Δx + Additional flooded area

Since the total surface area is already described by the additional flooded area, the first term should be equal to zero. Therefore, the width b should be set to zero.

Dam

At the **Q** point, where the dam break structure is located, the momentum equation is replaced by an equation which describes the flow through the structure. As the momentum equation is not used at the **Q** point, the Δx – step is of no relevance. The maximum Δx for the river branch, where the dam is to be placed, should therefore be greater than the distance between two cross-sections in the reservoir branch. So, no cross-section is interpolated between the actual cross-sections.

Spillways and other structures

At the node, where two branches meet the surface flooded area is taken as the sum of the individual flooded areas specified at the **h**-points. Therefore, if the reservoir storage has already been specified at the reservoir **h**-point, the spillway **h**-point should not contain any flooded areas. Both the width b, and the "additional flooded area" should be set to zero and other parameters such as the cross-sectional area and hydraulic radius should be the same as for the reservoir.

Though, in present case there is no spillway.

10.7.7.3 Boundary conditions for dam break modeling

The boundary conditions must be specified at both upstream and downstream limits of the model. The upstream boundary will generally be an inflow into the reservoir at the first reservoir **h**-point. The downstream boundary will generally be a stage-discharge relationship at the last cross section of the set up.

10.7.8 Specifications Of Dam Break Structures

The following information relating to dam break structures need to be specified:

(i) Geometrical specifications
(ii) Breach characteristics
(iii) Failure moment, and
(iv) Failure mode

10.7.8.1 Breach development

Earth and Rockfill dams usually do not collapse instantaneously, but they develop breaches, which increase gradually. The failure time may vary between a few minutes up to a few hours, depending on amongst other, the dam geometry and the construction

material. The development of the breach determines the breach outflow hydrograph, and an accurate description of the breach development is, therefore, required in "near field" dam breach studies. In the "far-field" studies, an accurate flood routing procedure is of more importance, because the outflow variation is rapidly damped out as the flood propagates downstream.

Failure modes

The dam break module of MIKE 11 allows selection of one of various breach development modes. Either linear failure mechanism or an erosion based formulation may be selected. The linear failure mode assumes a linear increase in the breach dimensions in time between specified limits. In the erosion based mode, the increase in breach dimensions is calculated from the prevailing hydraulic conditions in the breach, and from the given geometrical data. For both modes, limits of the final breach width and level are specified. These may be determined, for example, by the original valley embankments.

a) Linear failure modes

The necessary data required to fully specify a linear dam failure are shown in **Figure 10.7**. In addition, the user specifies the duration of the breach development and whether the failure is to commence at a given time, or is initiated by overtopping of the dam. This facility has applications in simulating the cascading failure of several dams located on the same river.

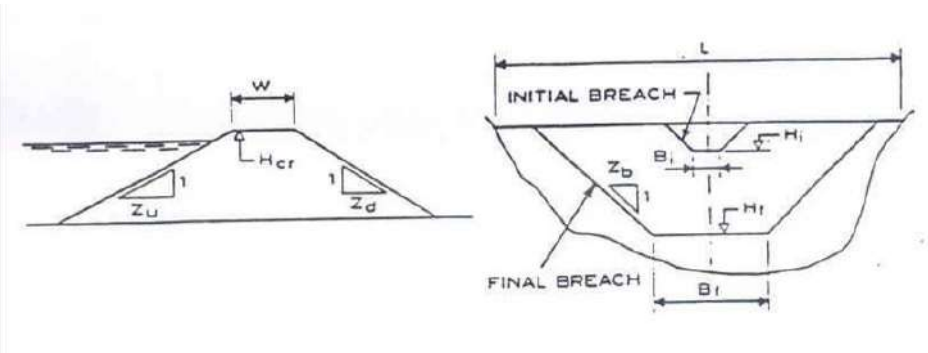


Figure 10.7: Breach parameters for linear mode

b) Erosion based failure

The enlargement of the breach in earth fill dams from erosion of the dam core material may also be determined from sediment transport considerations. Erosion based breach formulations are based on sediment continuity equation for the breach. Numerous sediment transport formulae are available, of which two have been implemented in the breach formulation, being those of Engelund-Hansen (1967), and Meyer-Peter and Muller (1947). Modeling of the variation of the width of the breach is more difficult to relate to the classical theories of sediment transport. Due to the development of a wall boundary layer along the often very steep side walls of the breach, the theories for bed load and suspended load do not apply. As an approximation, the sediment transport at the sloping walls is assumed to be proportional to that in the central part of the breach. The coefficient of proportionality (side erosion index) is of the order of 0.5 – 1.0.

10.7.9 Initial Conditions

Though in many cases, dam failure may occur on a dry river bed downstream of the dam, but such conditions are not possible in MIKE 11, which require a finite depth of water, in order to ensure "the continuity" of the finite difference algorithm. Therefore, before a dam break is actually simulated, it is necessary to create a steady state "hot-start" file, which can be used for all subsequent dam break simulation. This file is created by:

(i) Giving a lateral inflow at the first **h**-point in the river
(ii) Setting the inflow into the reservoir to zero, and
(iii) Specifying the dam break structure to fail by overtopping, ensuring that the dam crest level is greater than the specified reservoir level.

Initial conditions (water level and discharge) must be specified in HD parameter file, including the reservoir level, at which the dam break simulation should commence. The set-up should be run until a steady state condition is reached (i.e., Q=constant=lateral inflow up to the downstream boundary).

10.7.10 Dam Break Simulations

The dam break simulation may be carried out using the hotstart file generated as mentioned above. The time step depends upon the slope of the river bed and should be selected of the order of 0.5 to 5 minutes according to the slope.

10.7.11 Input Data Requirement

Dam break flood analysis requires a range of data to depict accurately to the extent possible the topography and hydraulic conditions of the river course and dam break phenomenon. The important data required in the present case are;

(i) Cross sections of the river from dam site and up to location downstream of the dam to which the study is required
(ii) Elevation-surface area relationship of the reservoir
(iii) Salient features of the all hydraulic structures at the dam site and also in the study reach of the river
(iv) Stage-discharge relationship at the last river cross section of the study area
(v) Manning's roughness coefficient for different reaches of the river under study

For the present study, the following data supplied has been used;

10.7.11.1 River cross sections

For dam break studies of Saundatti Project, in SCENARIO 1, the river for a length of about 9465 m downstream of the dam upto downstream renuka reservoir site has been represented in the model by numerous cross sections taken at a suitable interval. While in SCENARIO 2, a reach of about 5715 m length downstream of the dam on the opposite side has been represented in the model by numerous cross sections taken at a suitable interval. Manning's roughness coefficient for the entire study reach in both SCENARIOS has been taken as 0.025.

Reservoir and dam

The reservoir has been represented in the model by a separate reservoir branch and its elevation-surface area relation, which has been specified at Chainage "0" km of the

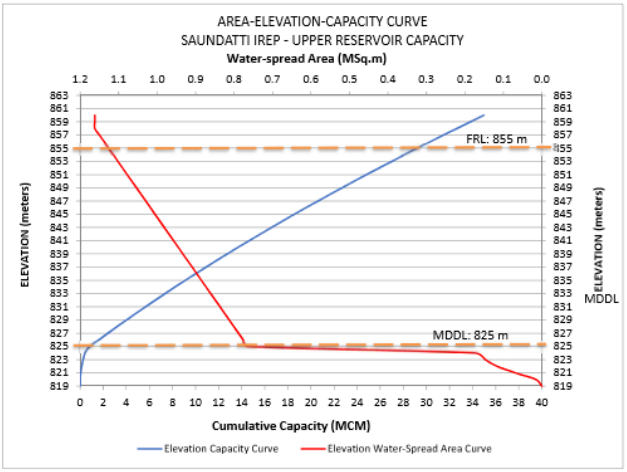
reservoir branch. The dam has been placed at Chainage 500 m of the reservoir branch and dam breach parameters specified therein**.**

Reservoir elevation table is presented below in **Table 10.16**.

Table 10.16: Reservoir Area Capacity Table

AREA CAPACITY TABLE

ELEVATION (m)	Depth (m)	AREA (M.sq.m)	Sqrt Area	Sqrt(A1 * A2)	Capacity (MCM)	Cum.capacity (MCM)	Cum.capacity (TMC)
819	0	0.000000	0.0000	0.0000	0.0000	0.0000	0.00
820	1	0.015993	0.1265	0.0000	0.0053	0.0053	0.00
821	1	0.069302	0.2633	0.0333	0.0395	0.0449	0.00
822	1	0.116691	0.3416	0.0899	0.0920	0.1368	0.00
823	1	0.147237	0.3837	0.1311	0.1317	0.2685	0.01
824	1	0.173432	0.4165	0.1598	0.1602	0.4287	0.02
825	1	0.764342	0.8743	0.3641	0.4340	0.8626	0.03
826	1	0.776391	0.8811	0.7703	0.7704	1.6330	0.06
827	1	0.788440	0.8879	0.7824	0.7824	2.4154	0.09
828	1	0.800489	0.8947	0.7944	0.7945	3.2098	0.11
829	1	0.812537	0.9014	0.8065	0.8065	4.0163	0.14
830	1	0.824586	0.9081	0.8185	0.8186	4.8349	0.17
831	1	0.836635	0.9147	0.8306	0.8306	5.6655	0.20
832	1	0.848684	0.9212	0.8426	0.8427	6.5082	0.23
833	1	0.860733	0.9278	0.8547	0.8547	7.3629	0.26
834	1	0.872782	0.9342	0.8667	0.8668	8.2296	0.29
835	1	0.884831	0.9407	0.8788	0.8788	9.1084	0.32
836	1	0.896879	0.9470	0.8908	0.8908	9.9993	0.35
837	1	0.908928	0.9534	0.9029	0.9029	10.9021	0.39
838	1	0.920977	0.9597	0.9149	0.9149	11.8171	0.42
839	1	0.933026	0.9659	0.9270	0.9270	12.7441	0.45
840	1	0.945075	0.9721	0.9390	0.9390	13.6831	0.48
841	1	0.957124	0.9783	0.9511	0.9511	14.6342	0.52
842	1	0.969173	0.9845	0.9631	0.9631	15.5974	0.55
843	1	0.981221	0.9906	0.9752	0.9752	16.5726	0.59
844	1	0.993270	0.9966	0.9872	0.9872	17.5598	0.62
845	1	1.005319	1.0027	0.9993	0.9993	18.5591	0.66
846	1	1.017368	1.0086	1.0113	1.0113	19.5704	0.69
847	1	1.029417	1.0146	1.0234	1.0234	20.5938	0.73
848	1	1.041466	1.0205	1.0354	1.0354	21.6292	0.76
849	1	1.053515	1.0264	1.0475	1.0475	22.6767	0.80
850	1	1.065563	1.0323	1.0595	1.0595	23.7363	0.84
851	1	1.077612	1.0381	1.0716	1.0716	24.8078	0.88
852	1	1.089661	1.0439	1.0836	1.0836	25.8915	0.91
853	1	1.101710	1.0496	1.0957	1.0957	26.9872	0.95
854	1	1.113759	1.0553	1.1077	1.1077	28.0949	0.99
855	1	1.125808	1.0610	1.1198	1.1198	29.2147	1.03
856	1	1.137857	1.0667	1.1318	1.1318	30.3465	1.07
857	1	1.149905	1.0723	1.1439	1.1439	31.4904	1.11
858	1	1.161954	1.0779	1.1559	1.1559	32.6463	1.15
859	1	1.161954	1.0779	1.1620	1.1620	33.8082	1.19
860	1	1.161954	1.0779	1.1620	1.1620	34.9702	1.23



10.7.11.2 Upstream Elevation Views

Upstream elevation views considered in both the SCENARIOS are presented below in **Figure 10.8A and Figure 10.8B.**

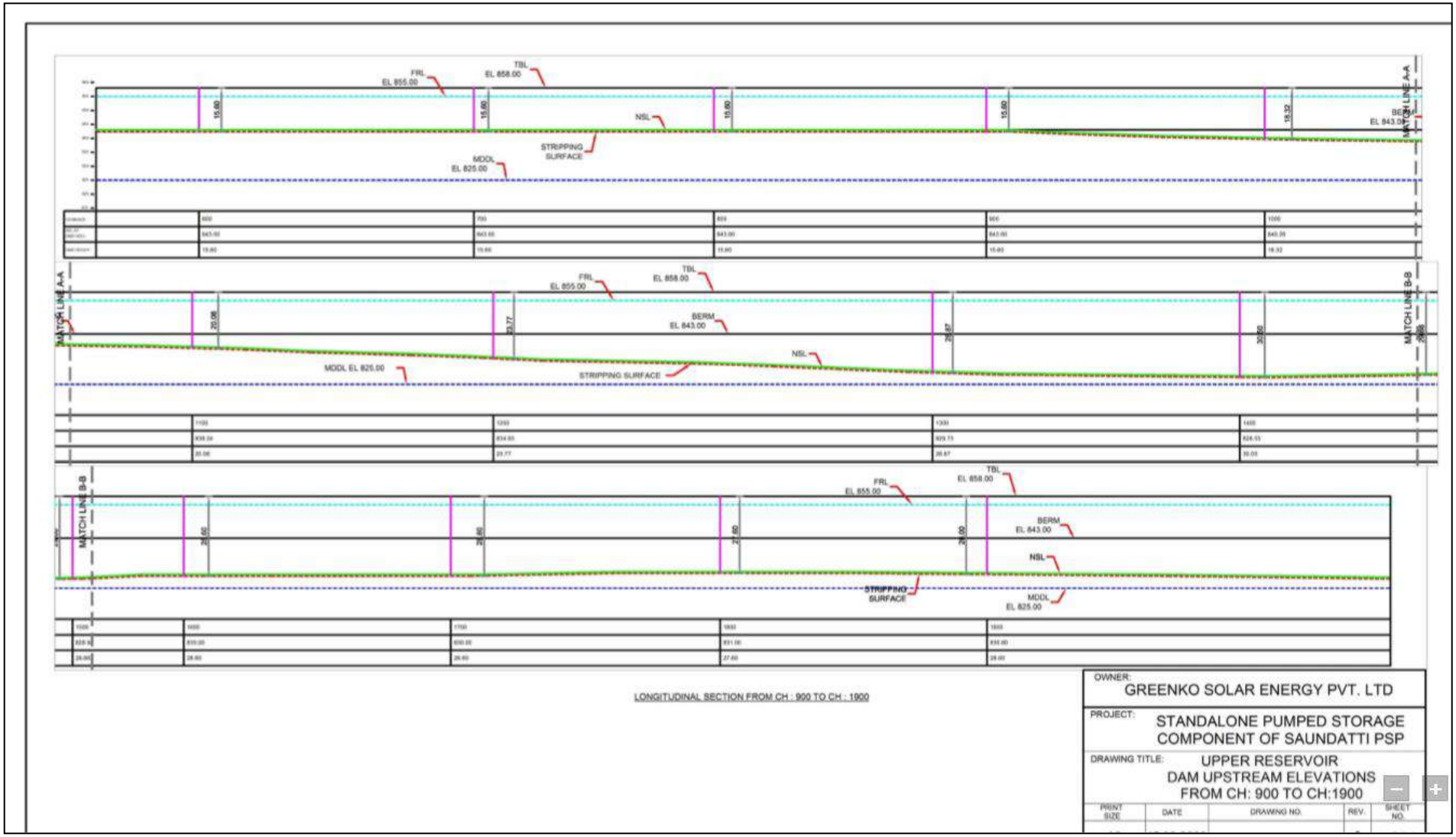


Figure 10.8A: Upstream Elevation view of dam /embankment (SCENARIO 1)

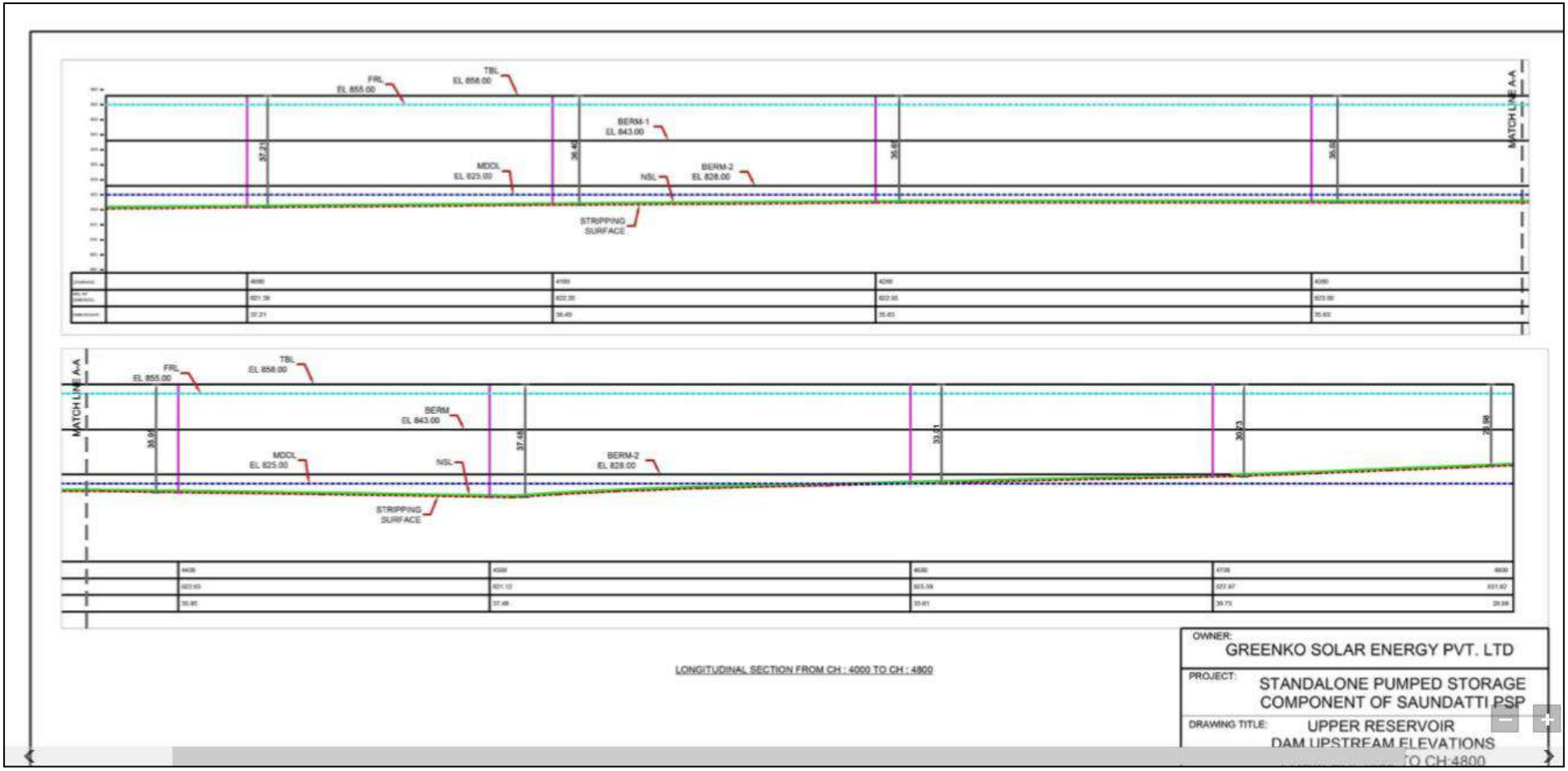


Figure 10.8B: Upstream Elevation view of dam /embankment (SCENARIO 2)

10.7.11.3 Downstream boundary

In order to avoid its influence in the study reach normally the downstream boundary should be applied at a distant location from the last river cross section of study reach. The same has been worked out using Manning's equation and applied at a location 9465 m and 5715 m downstream for dam site for both SCENARIO 1 and SCENARIO 2 respectively, as given in **Table 10.17**.

Table 10.17: Stage-discharge relationship - downstream boundary of MIKE11 model set up

A. SCENARIO 1

Stage (m)	Discharge (cumec)
621.00	0
621.05	4
621.54	210
622.59	1375
623.64	3325
624.69	5989
625.74	9339
626.06	10497
626.38	11729
627.12	14892
627.85	18540
628.03	19492
628.17	20272
628.24	20676
628.52	22308
628.80	24055
629.16	26485
629.52	29102
629.67	30288
630.37	36100
631.07	42676
631.54	47493
631.83	50736
632.27	55744
632.40	57375
632.48	58388
632.84	62976
633.20	67880
633.34	69857
633.91	78580
634.48	88171
634.93	96429
635.73	112108
636.01	118091
636.51	128984
637.00	140522

B. SCENARIO 2

Stage (m)	Discharge (cumec)
619.00	0
619.05	46
619.14	256
619.57	2742
620.00	7134

620.05	7753
620.07	8008
620.20	9769
620.52	14892
620.54	15249
620.75	19267
620.80	20293
620.87	21779
621.48	36887
622.09	55578
622.69	77555
623.30	102679
623.35	104882
623.87	129129
624.37	154860
625.23	204692
625.30	209043
626.44	286313
626.94	323897
627.44	363787
627.46	365432
627.55	372873
627.70	385459
628.28	436231
628.86	490594
629.43	548506
630.01	609931
630.28	639821
630.30	642062
630.37	649936
630.90	711518
631.14	740470
631.71	811963
631.99	848461

10.7.12 Selection Of Dam Breach Parameters

Estimation of the dam break flood will depend on time of failure, extent of overtopping before failure, size, shape and time of the breach formation, etc., which are called dam breach parameters. The breach characteristics that are needed as input to the existing dam break models are i) Initial and final breach width; ii) Shape of the breach; iii) Time duration of breach development, and iv) Reservoir level at time of start of breach. The predominant mechanism of breach formation is, to a large extent, dependent on the type of dam and the cause due to which the dam failed.

A study of the different dam failures indicates that earthen or rockfill dams never collapse instantaneously as concrete dams which breach by sudden collapse. Earthen or rockfill dams develop breaches which increase gradually. The breaching time may vary from a few minutes to a few hours, depending on amongst other the dam geometry and the construction material. The development of the breach largely determines the reservoir outflow hydrograph, and a reasonable description of the breach development is therefore required in near field dam break models. In far field models a reasonable flood routing procedure is of more importance, because the outflow variation is rapidly damped out as the flood wave propagates downstream.

The way earthen or rockfill dam starts to breach can be specified as one of the following failure modes:

- Linear failure, i.e. the increase in breach dimensions is assumed to occur linearly over a given time (the time of breach development)
- Erosion based failure, i.e. the increase in the breach depth is calculated from a classical sediment transport formula. The increase in breach width is calculated as the increase in breach depth multiplied by side index.

In present case, linear based failure has been considered with the following parameters:

SCENARIO 1

Linear failure has been adopted in the present case; breach of trapezoidal shape has been considered with a side slope of 1 V: 1.5 H. End shape of the breach should reflect the bounds imposed by the valley bathymetry accordingly the value has been taken. Breach starts from top of dam when water is at FRL i.e. 855 m and reaches level of 828.55 (bottom of embankment) in two hour developing breach in trapezoidal form and with initial breach width of 29.45 m.

Accordingly, the breach parameter given in **Table 10.18A** has been selected for the dam break study.

Table 10.18A: Breach Parameters (SCENARIO 1)

Breach Level (m)		Initial Breach Width (m)	Breach Slope	Breach Development Time (Minutes)	Remarks
Initial	Final				
858	828.55	29.45	1 V: 1.5 H	120	The final breach level at El 828.55 m has been taken as bottom level of embankment

SCENARIO 2

Linear failure has been adopted in the present case; breach of trapezoidal shape has been considered with a side slope of 1 V: 1.5 H. End shape of the breach should reflect the bounds imposed by the valley bathymetry accordingly the value has been taken. Breach starts from top of dam when water is at FRL ie 855 m and reaches level of 821.12 (bottom of embankment) in two hour developing breach in trapezoidal form and with initial breach width of 36.88 m.

Accordingly, the breach parameter given in **Table 10.18B** has been selected for the dam break study.

Table 10.18B: Breach Parameters (SCENARIO 2)

Breach Level (m)		Initial Breach Width (m)	Breach Slope	Breach Development Time (Minutes)	Remarks
Initial	Final				
858	821.12	36.88	1 V: 1.5 H	120	The final breach level at El 821.12 m has been taken as bottom level of embankment

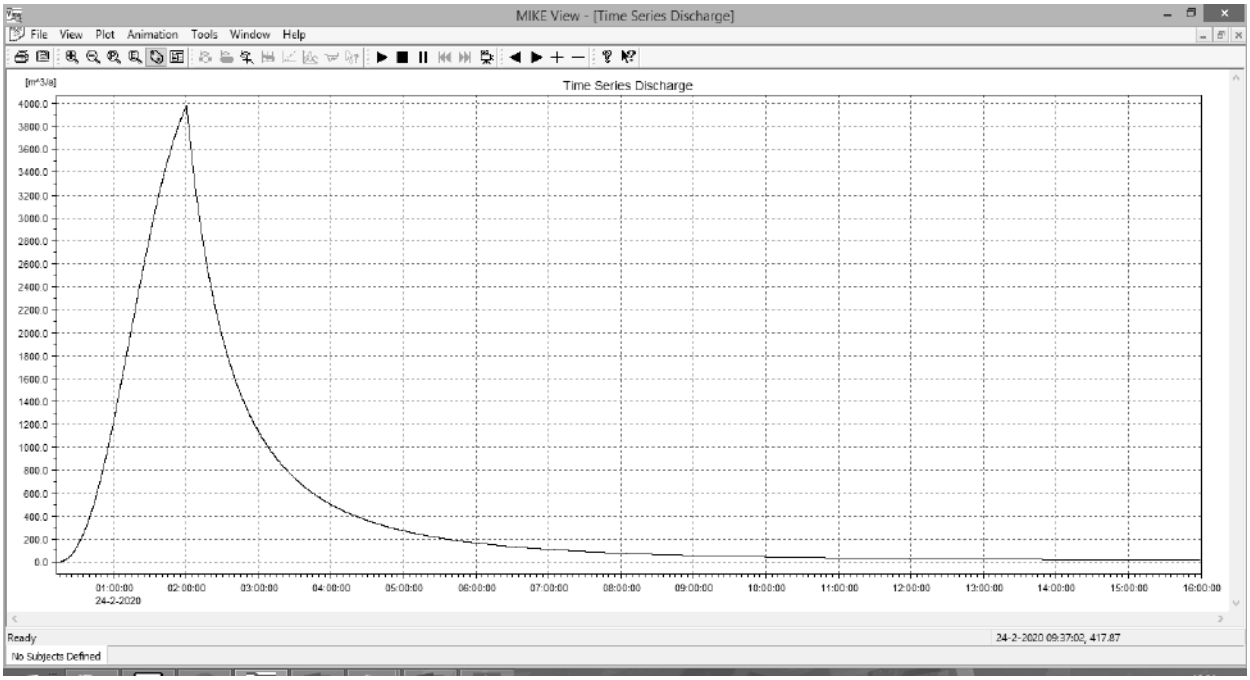
10.7.13 Critical Conditions For Dam Break Study

The critical condition for a Dam break study is when the reservoir is at FRL and design flood hydrograph is impinged which is not applicable in present case. Hence for the hypothetical case of Dam break simulation and also to get the maximum Dam breach flood peak it would be appropriate to assume the starting of the breach, when the reservoir level is at FRL.

10.7.14 Dam Break Stimulation

SCENARIO 1

Taking the above breach parameter and critical condition of para 3.13 the dam break condition has been simulated. In the simulation the dam has been assumed to breach when the water level in the reservoir is at FRL i.e. EL 855 m. The dam breach flood hydrograph just downstream of the dam is given in **Figure 10.9**.



SCENARIO 2

Taking the above breach parameter and critical condition of para 3.13 the dam break condition has been simulated. In the simulation the dam has been assumed to breach when the water level in the reservoir is at FRL i.e. EL 855 m. The dam breach flood hydrograph just downstream of the dam is given in **Figure 10.9**.

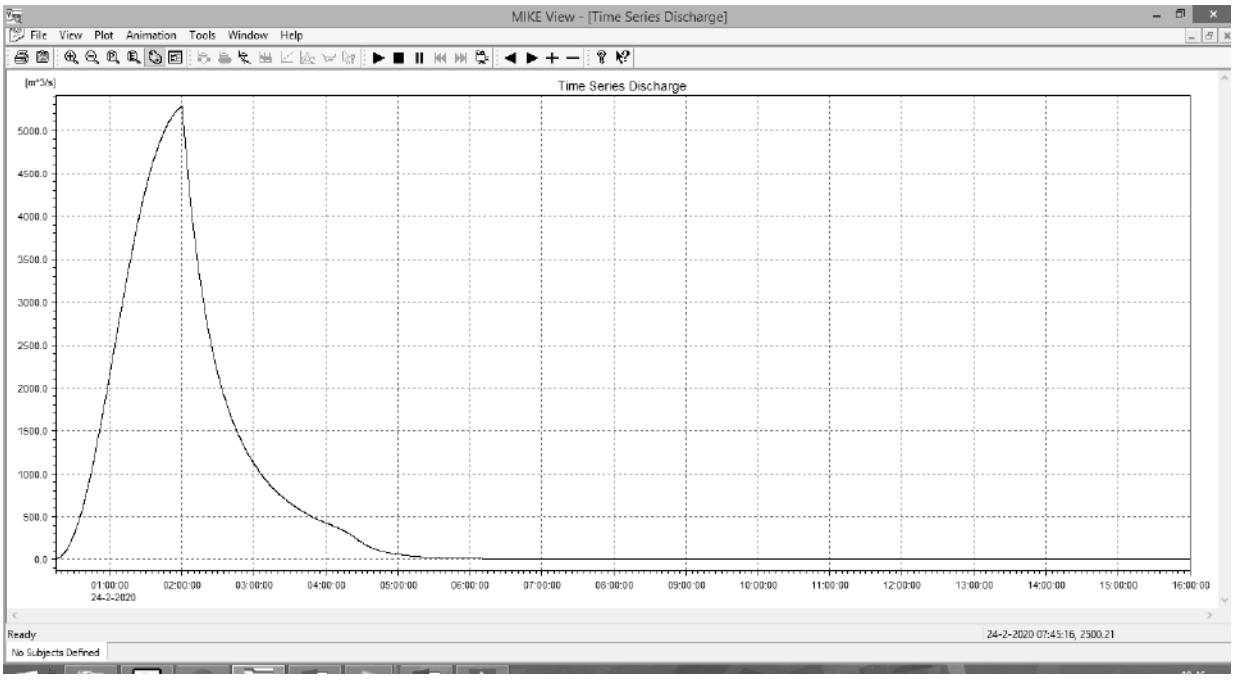


Figure 10.9: Dam breach flood hydrographs in both scenarios

SCENARIO 1

The peak of the dam breach flood just downstream of the dam is 3976 cumec. The maximum discharge, water level and their time of occurrence at different locations of the River downstream of the dam are given in **Table 7.19A and 7.20A** respectively.

Table 10.19A: Maximum discharge due to dam breach flood

The breach has been assumed to start on 24-02-2020 00:00:00 hours		
Chainage (m) d/s of dam	*Maximum discharge (cumec)*	*Time of occurrence (Date:hours:Minutes:Seconds)*
SAUNDATTI 82.50	3976	24-02-2020 02:00:10
SAUNDATTI 290.00	3976	24-02-2020 02:00:10
SAUNDATTI 540.00	3978	24-02-2020 02:00:35
SAUNDATTI 790.00	3980	24-02-2020 02:00:55
SAUNDATTI 1040.00	3980	24-02-2020 02:01:14
SAUNDATTI 1290.00	3982	24-02-2020 02:01:34
SAUNDATTI 1540.00	3985	24-02-2020 02:02:05
SAUNDATTI 1790.00	3989	24-02-2020 02:02:34
SAUNDATTI 1989.00	3992	24-02-2020 02:02:49
SAUNDATTI 2164.50	3994	24-02-2020 02:03:05
SAUNDATTI 2395.50	3995	24-02-2020 02:03:20
SAUNDATTI 2640.50	3998	24-02-2020 02:03:40
SAUNDATTI 2921.50	3999	24-02-2020 02:03:59
SAUNDATTI 3265.50	3997	24-02-2020 02:04:34
SAUNDATTI 3605.50	3995	24-02-2020 02:04:59
SAUNDATTI 3896.00	3993	24-02-2020 02:05:50
SAUNDATTI 4235.00	3991	24-02-2020 02:06:19
SAUNDATTI 4780.00	3982	24-02-2020 02:07:05
SAUNDATTI 5275.00	3974	24-02-2020 02:08:00
SAUNDATTI 5865.00	3966	24-02-2020 02:09:09
SAUNDATTI 6455.00	3954	24-02-2020 02:10:25
SAUNDATTI 6780.00	3953	24-02-2020 02:11:00
SAUNDATTI 7430.00	3943	24-02-2020 02:12:19
SAUNDATTI 8115.00	3940	24-02-2020 02:13:55
SAUNDATTI 8500.00	3939	24-02-2020 02:14:39
SAUNDATTI 8825.00	3942	24-02-2020 02:15:24
SAUNDATTI 9215.00	3942	24-02-2020 02:16:24

Table 10.20A: Maximum water level due to dam breach flood

The breach has been assumed to start on 24-02-2020 00:00:00 hours			
Chainage (m) d/s of dam	*Bed Level (m)*	*Maximum water level (m)*	*Time of occurrence (Date:hours:Minutes:Seconds)*
SAUNDATTI 0.00	815.05	817.93	24-02-2020 02:00:00
SAUNDATTI 165.00	789.49	792.83	24-02-2020 02:00:10
SAUNDATTI 415.00	717.00	723.76	24-02-2020 02:00:20
SAUNDATTI 665.00	717.05	721.72	24-02-2020 02:00:39
SAUNDATTI 915.00	709.48	713.89	24-02-2020 02:00:59
SAUNDATTI 1165.00	698.68	706.55	24-02-2020 02:01:20
SAUNDATTI 1415.00	696.40	704.40	24-02-2020 02:01:45
SAUNDATTI 1665.00	696.85	703.23	24-02-2020 02:02:10

SAUNDATTI 1915.00	696.12	701.83	24-02-2020 02:02:30
SAUNDATTI 2063.00	695.00	699.71	24-02-2020 02:02:45
SAUNDATTI 2266.00	690.30	694.67	24-02-2020 02:03:05
SAUNDATTI 2525.00	683.26	687.70	24-02-2020 02:03:20
SAUNDATTI 2756.00	680.90	684.57	24-02-2020 02:03:49
SAUNDATTI 3087.00	673.00	676.31	24-02-2020 02:04:15
SAUNDATTI 3444.00	668.00	670.55	24-02-2020 02:04:44
SAUNDATTI 3767.00	660.40	665.26	24-02-2020 02:05:24
SAUNDATTI 4025.00	660.63	664.04	24-02-2020 02:06:05
SAUNDATTI 4445.00	653.00	655.31	24-02-2020 02:06:44
SAUNDATTI 5115.00	642.24	646.69	24-02-2020 02:07:40
SAUNDATTI 5435.00	638.28	644.18	24-02-2020 02:08:40
SAUNDATTI 6295.00	635.88	639.92	24-02-2020 02:09:54
SAUNDATTI 6615.00	634.60	638.44	24-02-2020 02:10:39
SAUNDATTI 6945.00	631.10	635.45	24-02-2020 02:11:50
SAUNDATTI 7915.00	625.87	631.50	24-02-2020 02:13:04
SAUNDATTI 8315.00	626.66	630.95	24-02-2020 02:14:14
SAUNDATTI 8685.00	623.00	627.87	24-02-2020 02:14:49
SAUNDATTI 8965.00	623.22	627.12	24-02-2020 02:15:55
SAUNDATTI 9465.00	621.00	623.88	24-02-2020 02:16:39

From the **Table 10.19A** it can be seen that the rise in water level along the reach of the river is about 2.3 m to 8 m.

SCENARIO 2

The peak of the dam breach flood just downstream of the dam is 5280 cumec. The maximum discharge, water level and their time of occurrence at different locations of the valley downstream of the dam are given in **Table 10.19B and 10.20B** respectively.

Table 10.19B: Maximum discharge due to dam breach flood

The breach has been assumed to start on 24-02-2020 00:00:00 hours		
Chainage (m) d/s of dam	*Maximum discharge (cumec)*	*Time of occurrence (Date:hours:Minutes:Seconds)*
SAUNDATTI 107.50	5280	24-02-2020 02:00:04
SAUNDATTI 465.00	5280	24-02-2020 02:00:14
SAUNDATTI 1215.00	5279	24-02-2020 02:00:35
SAUNDATTI 1965.00	5274	24-02-2020 02:01:04
SAUNDATTI 2430.00	5268	24-02-2020 02:01:49
SAUNDATTI 2930.00	5267	24-02-2020 02:02:45
SAUNDATTI 3465.00	5263	24-02-2020 02:03:40
SAUNDATTI 3965.00	5257	24-02-2020 02:04:24
SAUNDATTI 4465.00	5231	24-02-2020 02:05:44
SAUNDATTI 4965.00	5220	24-02-2020 02:07:15
SAUNDATTI 5465.00	5221	24-02-2020 02:08:44

Table 10.20B: Maximum water level due to dam breach flood

The breach has been assumed to start on 24-02-2020 00:00:00 hours			
Chainage (m) d/s of dam	*Bed Level (m)*	*Maximum water level (m)*	*Time of occurrence (Date:hours:Minutes:Seconds)*
SAUNDATTI 0.00	815.48	818.22	24-02-2020 02:00:00
SAUNDATTI 215.00	807.31	809.58	24-02-2020 02:00:10
SAUNDATTI 715.00	675.94	683.03	24-02-2020 02:00:24
SAUNDATTI 1715.00	645.00	648.05	24-02-2020 02:00:55
SAUNDATTI 2215.00	635.00	638.67	24-02-2020 02:01:30
SAUNDATTI 2645.00	629.00	633.78	24-02-2020 02:02:14
SAUNDATTI 3215.00	629.00	631.45	24-02-2020 02:03:14
SAUNDATTI 3715.00	624.00	627.45	24-02-2020 02:04:09
SAUNDATTI 4215.00	619.00	622.09	24-02-2020 02:05:34
SAUNDATTI 4715.00	619.00	621.73	24-02-2020 02:06:44
SAUNDATTI 5215.00	619.00	620.94	24-02-2020 02:07:50
SAUNDATTI 5715.00	619.00	619.81	24-02-2020 02:08:54

From the **Table 10.20B** it can be seen that the rise in water level along the reach of the river is about 0.81 m to 7.09 m.

10.7.15 Dam Breach Flood Hydrograph

SCENARIO 1

The dam breach flood hydrograph of **Figure 10.9** has been reproduced in the tabular form and the same are given in **Table 10.21A.** The peak of the hydrograph is 3976 cumec.

Table 10.21A: Dam breach Flood hydrograph just d/s of dam (SCENARIO 1)

Time (Date: hours: minutes: seconds)	Discharge (cumec)
24-02-2020 00:00:00	0
24-02-2020 00:30:00	141
24-02-2020 01:00:00	1235
24-02-2020 01:30:00	2851
24-02-2020 02:00:00	3974
24-02-2020 02:00:10	3976
24-02-2020 02:30:00	1952
24-02-2020 03:00:00	1135
24-02-2020 03:30:00	728
24-02-2020 04:00:00	501
24-02-2020 04:30:00	362
24-02-2020 05:00:00	272
24-02-2020 05:30:00	210
24-02-2020 06:00:00	166
24-02-2020 06:30:00	134
24-02-2020 07:00:00	111
24-02-2020 07:30:00	92
24-02-2020 08:00:00	78
24-02-2020 08:30:00	67
24-02-2020 09:00:00	57
24-02-2020 09:30:00	50
24-02-2020 10:00:00	44
24-02-2020 10:30:00	39

Time (Date: hours: minutes: seconds)	Discharge (cumec)
24-02-2020 11:00:00	35
24-02-2020 11:30:00	31
24-02-2020 12:00:00	28
24-02-2020 12:30:00	26
24-02-2020 13:00:00	23
24-02-2020 13:30:00	21
24-02-2020 14:00:00	20
24-02-2020 14:30:00	18
24-02-2020 15:00:00	17
24-02-2020 15:30:00	16
24-02-2020 16:00:00	15

SCENARIO 2

The dam breach flood hydrograph of **Figure 10.9** has been reproduced in the tabular form and the same are given in table below**.** The peak of the hydrograph is 5280 cumec.

Table 10.21B: Dam breach Flood hydrograph just d/s of dam (SCENARIO 2)

Time (Date: hours: minutes: seconds)	Discharge (cumec)
24-02-2020 00:00:00	0
24-02-2020 00:30:00	285
24-02-2020 01:00:00	2155
24-02-2020 01:30:00	4326
24-02-2020 02:00:00	5280
24-02-2020 02:00:04	5280
24-02-2020 02:30:00	2170
24-02-2020 03:00:00	1116
24-02-2020 03:30:00	659
24-02-2020 04:00:00	426
24-02-2020 04:30:00	196
24-02-2020 05:00:00	58
24-02-2020 05:30:00	23
24-02-2020 06:00:00	12
24-02-2020 06:30:00	8
24-02-2020 07:00:00	6
24-02-2020 07:30:00	6
24-02-2020 08:00:00	5
24-02-2020 08:30:00	5
24-02-2020 09:00:00	5
24-02-2020 09:30:00	5
24-02-2020 10:00:00	5
24-02-2020 10:30:00	5
24-02-2020 11:00:00	5
24-02-2020 11:30:00	5
24-02-2020 12:00:00	5

10.7.16 Preparation of Inundation Map

Inundation map (**Figures 10.10 and 10.11**) is a map depicting the d/s areas vulnerable to inundation by the Dam break flood. The MIKE11 model computes maximum flood elevation at each original or interpolated cross-section.

In present case, two scenarios have been studied. Scenario 1 covers reach upto downstream reservoir for which the cross-sections are available up to 9465 m d/s of Dam while Scenario 2 covers reach upto downstream reservoir for which the cross-sections are available up to 5715 m d/s of Dam. The profile of water levels below the Dam at all cross-sections is given as **Table 10.20A and Table 10.20B**. From these profiles, at locations below the Dam & their subsequent markings on the topographic maps, it can be seen which areas are likely to be submerged in case of Dam break.

From the **Table 10.20A** Scenario 1, it can be seen that the rise in water level along the reach of the river is about 2.3 m to 8 m.

From the **Table 10.20B** Scenario 2**,** it can be seen that the rise in water level along the reach of the river is about 0.81 m to 7.09 m.

It is clear from the inundation map that in case of Dam break scenario, following villages are likely to be affected :

Villages affected in Scenario 1
1.Yekkundi
2. Karlakatti
3. Venkateshnagar (Karlakatti Tanda)

Village affected in Scenario 2
1.Mallur

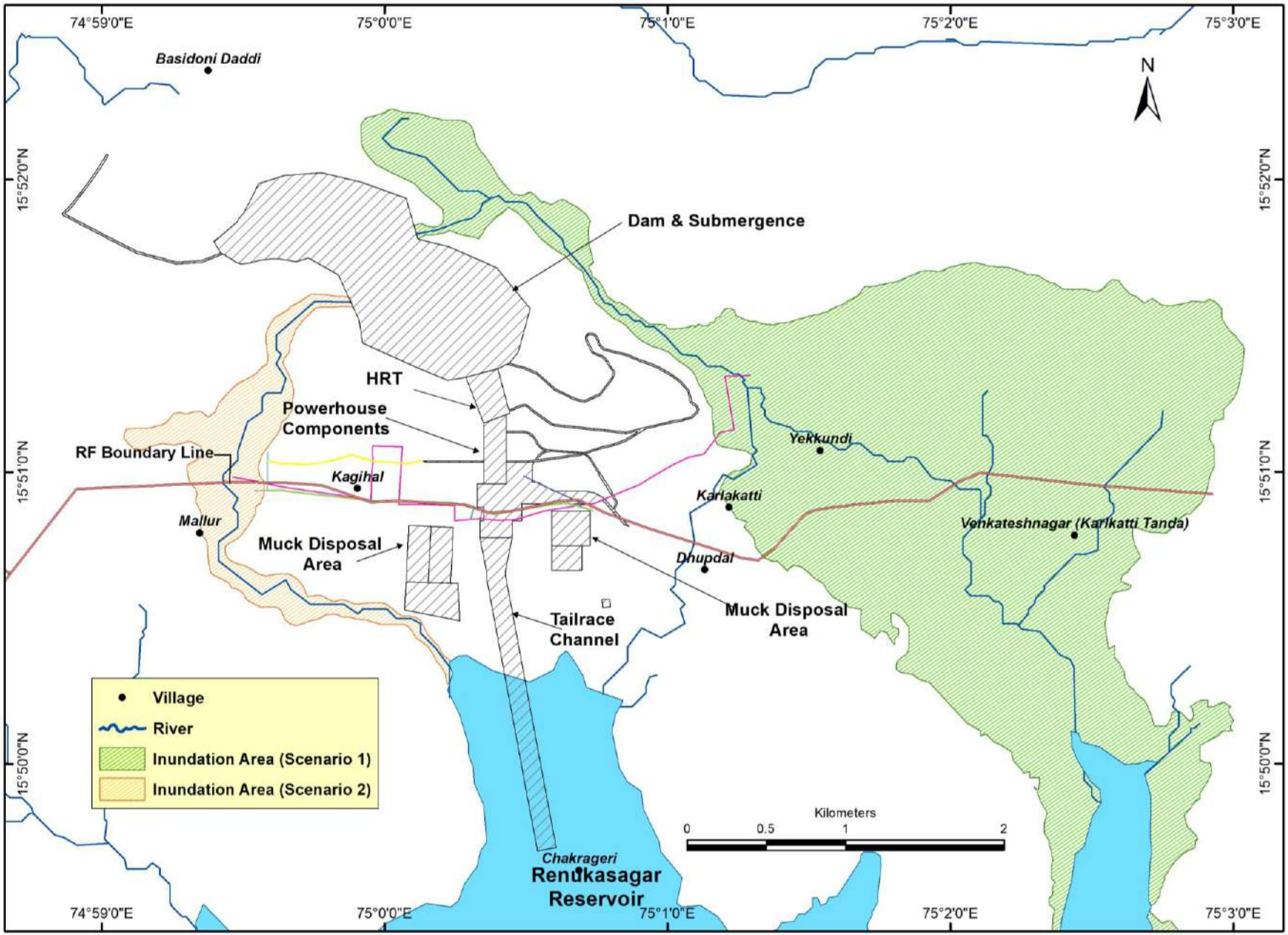


Figure 10.10: Inundation Map (SCENARIO 1 & SCENARIO 2)

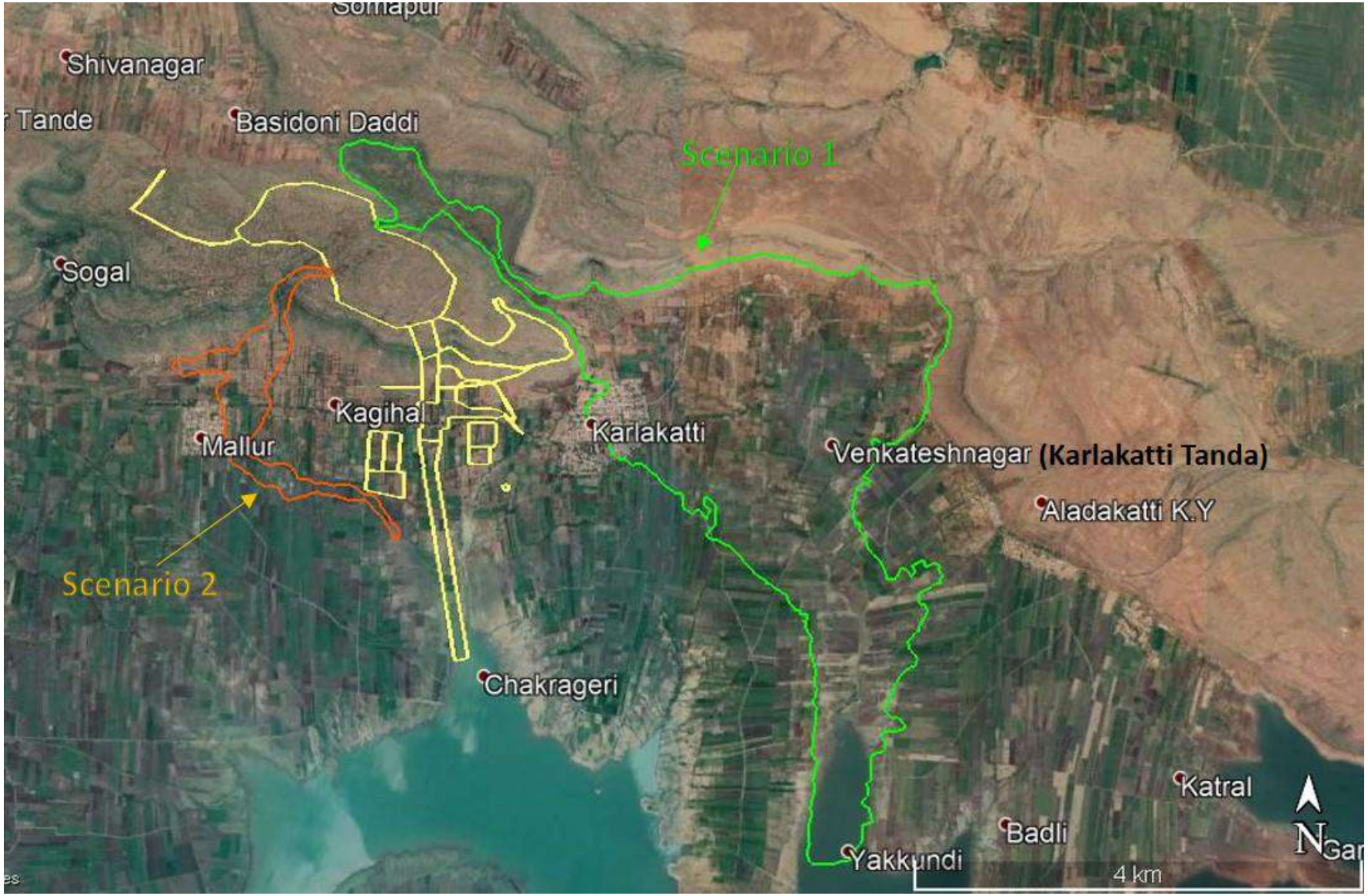


Figure 10.11: Inundation Map superimposed over Google Earth map (SCENARIO 1 & SCENARIO 2)

10.7.17 Disaster Management Plan

10.7.17.1 Vulnerability Assessment

From the result of Dam Break Modeling it is evident that up to about 9465 m d/s of the Dam in Scenario 1 and up to about 5715 m d/s of the Dam in Scenario 2, time required in reaching the flood wave elevation to the maximum is about 2.15 to 2.30 hour. Since the time available is very short, the Disaster Management Plan should concentrate on preventive actions. Also as evident from the inundation map, that in case of Dam break scenarios, villages Yekkundi, Karlakatti, and Venkateshnagar (Karlakatti Tanda) are likely to be affected in Scenario 1 and village Mallur is likely to be affected in Scenario 2, Disaster Management Plan is more of a precautionary measure.

10.7.17.2 Surveillance & Monitoring

The surveillance and monitoring programs are required to be implemented during design and investigation, construction, early operation period and operation and maintenance phases of the life cycle of the Dam. An affective flood forecasting system is required by establishing hourly gauge reading at suitable upstream locations with real time communication at the top. An effective Dam safety surveillance, monitoring and observation along with periodic inspection, safety reviews and evaluation must be put in place. These programs will be implemented in five phases in the life cycle of Dam/embankment *viz*.

i) Design and investigation phase,
ii) Construction phase,
iii) First reservoir filling,
iv) Early operation period, and
v) Operation and maintenance phase.

Surveillance and monitoring programmes are required to be implemented during design and investigation, construction, first reservoir filling, early operation period and operation & maintenance phases of the life cycle of Dam/embankment.

10.7.17.3 Disaster Management Plan (DMP) for Project

A Disaster Management Plan essentially consists of Disaster Response Plan, Contingency Plans and Standard Operating Procedures (SOPs). A well-coordinated Disaster Response Plan, which makes best use of the organization's combined expertise and resources, is essential for efficient and successful disaster response. During an actual emergency, rapid and effective action is required. For this to happen, disaster response and contingency plans must be in place before a disaster strikes along with the necessary resources. If appropriate action is not taken or if the response is delayed, lives may be needlessly lost.

A detailed comprehensive Disaster Management Plan would need to be prepared which would need to be dove tailed with the state disaster management plan for which adequate provision has been kept in cost estimates. Broadly it should consist of following:

- ·Disaster Response Plan
- Contingency Plan

- Awareness and Emergency Preparedness
- Emergency Action Plan (EAP)
- Communication System
- Emergency Alert System
- Emergency Warning and Control System
- Health & Medical Response System
- Training
- Mock Drills & Exercises
- Public Information System
- Information Dissemination and Safety Procedures & Plan
- Safety Procedures & Plan
- Evacuation Plans
- Notifications

10.7.18 Cost Estimates For Disaster Management

The estimated total cost of execution of disaster management plan including the equipment would be **Rs. 275.00 lakh** and the breakup of the same is given at **Table 10.22**.

Table 10.22: Estimated cost of Disaster Management Plan

S. No.	Particulars	Amount Rs. in Lakh
A.	**Capital Expenditure**	
1	Preparation of compressive Disaster Management Plan	**110.00**
2	Setting up of communication system	**40.00**
3	Setting up of Emergency Response Organisation	**25.00**
4	Public Information System	**25.00**
	Total - A	**200.00**
B.	**Recurring Expenditure**	
5	Training & Miscellaneous	**25.00**
6	Maintenance of alert systems and other equipment	**50.00**
	Total - B	**75.00**
	Grand Total A+B	**275.00**

10.8 PUBLIC HEALTH DELIVERY PLAN

10.8.1 Threats to Public Health

Project construction and operation will bring about several changes in the socio-economic environment of the area including increased threats to health of the community. Possible threats to public health are briefly discussed below along with the management measures.

i. New Diseases due to Migratory Population

During the project construction period, there will be further increase in the population of this region, particularly around the project area. The peak migratory labour force during the construction period is estimated to be around 1400. These migrant workers and their family members may be the potential carriers of new diseases hitherto unknown/unreported from the project area. Diseases like VDs, gastroenteritis, etc. are some of the potential risks to human inhabitants of this area. The present available health services in the area would be insufficient to cater to such a vast influx of outside population in this area. Therefore, it would be obvious for the project authorities and their contractors

to have all the labourers including their family members registered, quarantined and vaccinated against common diseases like malaria, etc. The project authorities will hold screening camps for the labourers, where rapid blood tests will be conducted for diseases like, TB, etc. and health card will be issued. Only after valid certification a labour or his family members will be registered with the contractor. The project authorities would ensure that the contractors follow this strict quarantine procedure and this clause would be included in the award of the contract/works. Adequate medical facilities will be provided by the project authorities for this purpose in addition to strengthening the existing medical facilities in the area.

ii. **Chances of increase in water borne diseases as malaria, and dengue are high** if there is a stagnant water body in the vicinity. The project is a pumped storage scheme which will create one new reservoir and water will remain in circulation on daily basis from upper (already existing reservoir) to lower and vice versa. Stagnation of water and multiplication of mosquitoes and other vectors is not anticipated, however, monitoring and preventive measures are recommended to prevent outbreak of water-borne diseases.

iii. **Chances of increase in respiratory troubles due to increase in suspended particles during the construction phase.** Mainly a cause of concern for construction workers who are likely to be exposed to dust for long hours. PPEs, such as dust masks, are recommended to mitigate such impacts.

iv. **Chances of occurrence of gastroenteritis, cholera and typhoid in the labour camps.** The project should make proper arrangements for maintaining high hygienic conditions in the colonies and labour camps, by providing good sanitation and drinking water facilities. Medicines would be distributed free of cost to the labour during construction period as and when required.

10.8.2 Medical Facilities

A migratory population of about 1400 persons is expected to be present during construction phase, spread along construction sites in labour colonies. One part of impact is on local population due to migrant population and second part is medical needs of migrant population putting stress on existing limited medical resources in the area. Another dimension which needs to be kept in mind while planning medical services from project side is the risk of accidents during project construction and emergency medical services to respond to such incidents. Working at heights, underground operations, blasting using explosives, use of heavy machinery and equipment with moving parts, movement of large number of vehicles carrying men and material, etc. increase the risk of accidents at work place. Despite training and use of safety gears, possibilities of accidents at work place cannot be ruled out and require preparedness.

It is recommended that the developer would provide the following medical facility, directly or through contractor, to ensure safe and healthy operations during the entire construction phase. This also helps in minimizing dependence of labour population on the existing medical facility.

- Two fully equipped ambulance needs to be procured to provide pre-hospital care to accident victims. The ambulances should always be stationed near major construction sites or the sites where risky operations are taking place. Typically, the ambulance should have equipments such as Fornoflex Chair/COT, Ventilator, Vacuum Splint Kit (Adult), Scoops Stretcher, Oxygen Cylinder with accessories, Resuscitation Bag (Adult), Suction Pump, Spine Board, siren/beacon, Emergency Light with public address system, Wireless equipments, additional battery, First Aid bag, BP instrument, stethoscope, etc and with trained manpower.
- Two first-aid posts need to be established - near proposed construction sites and colony areas to take care of basic medical needs of the workers at major construction site.
- The first aid posts will have essential medicines including dressing materials, stretcher, wheel chair, ORS packets, etc. The first aid post can be housed in temporarily erected structure and should be managed by one Health Assistant and assisted by one dresser/first aid attendant. Visiting doctors can attend First Aid post regularly every day at a fixed time.
- As the existing medical facilities in the area are not adequate, budget provisions have been made for strengthening existing PHCs at Karlakatti in the project area.

10.8.3 Health Extension Activities

The health extension activities will have to be carried out in the villages situated within the study area. It is important to inculcate hygienic sanitary habits especially with respect to water pollution by domestic wastes.

A medico needs to be engaged to make regular visits to these villages and organize health promotional activities with the active participation of the local village leaders, NGOs and available local health functionaries. The health functionaries would undertake the following tasks as a part of health promotional activities:

- Organize awareness programs and medical camps to make people aware about the common diseases in the region. This should include poster campaign, awareness camps, medical camps for health check-ups and vaccination/ treatment, etc.
- Collect water samples to ascertain the potability of water from different sources so as to monitor regular disinfection of drinking water sources.
- Maintain close surveillance on incidence of communicable diseases in villages.
- Maintain close liaison with the community leaders and health functionaries of different departments, so that they can be mobilized in case of an emergency.
- Close interaction to be maintained with health department functionaries of the state government.
- In case of verifiable health problem arising due to blasting activities of the project, necessary health care facilities shall be provided.

10.8.4 Cost Estimates

Budgetary estimates for public health delivery system have been worked out as **Rs. 147.00 lakhs**, as per the break up given at **Table 10.23**.

Table 10.23: Budgetary estimates for developing health care facilities

Sl. No.	Particulars	Amount (Rs. lakhs)
1	Ambulance: 2 no. with all the basic Medicare facilities and small DG set, etc. in the project area	25.00
2	Budget for running the ambulances including driver, fuel and maintenance for 3 years @ 5 lakhs per ambulance per annum	30.00
3	Two first aid posts including sheds, furniture and basic equipment	15.00
4	Budget for running the first aid post @ Rs.8 lakhs per post per annum including cost of medico, para-medico/Nurses and attendant, consumables, etc. for 3 years	48.00
5	Budget for strengthening existing medical facilities	20.00
6	Budget for Health Awareness/ Vaccination Camps @ Rs. 3.00 lakhs per annum for 3 years	9.00
	Total (Rs. lakhs)	**147.00**

10.9 SANITATION AND SOLID WASTE MANAGEMENT PLAN

Solid waste generated from temporary and permanent colonies in construction as well as operation phase requires special management to dispose off as warranted under the Solid Wastes Management Rules (SWM) 2016. For that an efficient waste management system will be required to put in place to keep the environment of the region clean and healthy. These colonies and temporary settlements will also require adequate water supply for drinking and cleaning.

The project authorities will ensure sewage generated from labour colonies and site office is treated and disposed as per the SPCB guidelines. It's proposed to provide adequate septic tanks with soak pits for treatment and disposal of sewage.

Waste generation rate in Indian cities ranges between 200 - 870 grams/capita/day, depending upon the region's lifestyle and the size of the city. The per capita waste generation is increasing by about 1.3% per year in India (*Annepu, 2012*). State-wise data show that Belagavi district of Karnataka average is about 395 gm/capita/day. It is assumed for the estimation of quantum of waste generation, for the purpose of preparation of solid waste management plan, that migrant labour population will follow the local pattern. Therefore, when project will go for construction, about 450 grams/capita/day is expected to be generated. Further, the peak labour population is estimated to be 1400 persons and it's also expected that locals in the proximity will also use solid waste management facilities; keeping this in view, the plan is prepared for about 2500 persons.

For 2500 persons an estimated amount of about 410 tons/annum (0.45 kg x 2600 individuals x 365 days = 410 ton) of solid waste will be generated. A figure of 450 tonnes per annum has been taken to prepare the solid waste management plan. This waste will be collected, segregated and disposed off in line with the provisions laid down in Solid Waste Management Rules, 2016.

10.9.1 Management of Solid Waste

The project authority shall, within the territorial area of the project complex/ colony, be responsible for the implementation of the provision of Solid Wastes Management.

Adequate facilities for collection, transportation and disposal of solid waste will be developed. Any solid waste generated in the project complex/ project colony/ labour colony, shall be managed and handled appropriately. Various aspects of solid waste management include:

- Reuse/Recycling
- Storage/Segregation
- Collection and Transportation
- Disposal

i) Reuse/Recycling

Project proponent will explore opportunity to recycle the waste generated at the project site, in this context project will identify authorized vendors for recycling or disposal of used batteries, used oil and used oil filters (as these are hazardous waste).

Bio-degradable waste will be treated in Organic Waste Composter (OWC) and the manure generated will be distributed to local villagers.

ii) Storage and Segregation

In the labour colony, provisions shall be made to separately store the degradable and non-degradable solid waste. Two different coloured bins will be supplied to each labour family, who will segregate the waste generated in their household. Green and Biodegradable waste is to be deposited in one container and non-biodegradable waste in another container. In case of canteens and community kitchens also, two different coloured dust bins will be used for separately storing the biodegradable and non-biodegradable waste generated. A sustained awareness programme will be conducted to educate workers about the segregation of degradable and biodegradable wastes.

iii) Collection and Transportation

The project authorities shall prohibit littering of solid wastes in the area under their control by resorting to following collection practices:

- Organizing house-to-house collection of solid waste on regular pre-informed timing by using tractor mounted trolley.
- Collected waste from residential areas shall be transferred to community bin by hand-driven containerized carts or another small vehicle
- Collection of wastes from office complexes and commercial areas
- Construction / demolition wastes or debris shall be separately collected and disposed off
- Wastes from vegetable and fruit shops and meat shops shall be separately collected

Solid waste collected shall be disposed-off at a common storage point. Three trucks will be commissioned to collect the solid waste and dispose the same at sites designated for disposal of solid waste.

iv) Disposal

The solid waste will be transported for disposal at the designated landfill sites. The landfill shall have impervious clay at the bottom most layers. The second layer shall be impervious liner (Geo membrane), third layer will be of sand, after that well compacted solid waste is

to be put over the sand, then again, a layer of clay, finally a layer of soil. Vegetation shall be grown on the topmost layers. It will give a good aesthetic view of landfill.

10.9.2 Degradable component

The bio degradable portion of the solid waste would be disposed off by composting. The degradable portion is expected to be about 50% i.e. about 600 kg/day of degradable portion of solid waste will be generated. Composting process takes around 45 days to mature.

A pit of 2m x 2m x 1m deep (effective depth for waste disposal is considered 50 cm, after keeping provision of bottom layer and free board) size can take 2.0 m^3 (around 600 Kg) of compostable waste. Therefore, 45 pits would be needed to store the biodegradable waste with 45 days retention time, however, a provision of 50 pits should be kept. The total area required would be almost two times the pit area as some area in between pits will be required for transportation and stacking of waste. Hence, total area required will be 400m^2. The pits will be covered with GI sheets. Additional 400m^2 would be kept for storage for compost plus screening and other activities.

The pits to be constructed will have around 25 cm of bottom lining consisting of about 5 cm thick stone grit over which 15 cm thick coarse sand followed by 15 cm thick earth lining will be done. The refuse along with animal dung will have to be laid in layers of 5 to 10 cm thickness. The pit will be then watered on alternate days. There after waste is laid in 5 to 10 cm thick layers twice in a week till the whole pits filled up. Every week the waste will need to be turned up and water will have to be sprinkled every day to keep adequate moisture. The process will take around 45 days where after the composted waste from the pits taken out and after drying it is screened with screens having 2 mm dia. holes. The screened compost would be filled in plastic bags and used as good manure especially for cultivation of vegetables and flowers.

10.9.3 Non-Degradable component

The non-degradable portion (about 225 tons /annum) such as plastic bottles, cans, etc. shall be segregated and transported to disposed at designated sites. The details of land fill site are given as below:

Waste Generation:	225 tons per annum
Design Life:	3 years (construction phase)
Total Waste Generation in 3 Years:	675 tons
Volume of waste:	794.12 m^3 (assumed density =0.85 tonnes/m^3)
Provision of daily cover, liner, etc:	158.82 m^3 (20% approx.)
Total Volume:	952.94 m^3 say (953 m^3)
Pits of Size (LxWxD):	150m x 25m x 3m (effective depth 2.7 m)

A provision of additional 50% of the total area, for accommodating infrastructure facilities will be included while working out requirement of space. The liner system will comprise of the following layers below the waste:

- 0.30m thick drainage layer comprising of coarse sand or gravel
- 0.2m thick protective layer of sandy silt

- 1.50mm thick HDPE geo-membrane
- 1m thick clay layer/amended soil layer, comprising of local soil

10.9.4 Bio-medical Wastes

Biomedical waste is expected to be generated during the diagnosis, treatment or immunization of human beings. It may include waste like scrap, anatomical waste, culture media, discarded medicines, chemical waste, syringes, swabs, bandages, body fluids, human excreta, etc. This waste is highly infectious and can be serious threat to human health if not managed in a scientific and discriminate manner. In proposed project, biomedical waste will be generated from first aid posts and other medical establishments in the area. As the quantity of biomedical waste generated is not expected to be very significant requiring separate incineration, it is proposed to have a tie-up with district hospital or private hospital in Belagavi to treat/ dispose-off biomedical waste generated from project activities in their facility. Provision has been made under CER Plan to upgrade medical facilities in the area; handling of biomedical waste generated from such facilities will also be included as part of upgrading component as the existing facilities are not in place.

10.9.5 Financial Requirement

The total budget in order to manage the solid waste generated from this population, has been proposed as **Rs. 186.16 lakhs** (**Table 10.24**).

Table 10.24: Cost Estimate for Solid Waste Management Plan

S. No.	Item	Cost (Rs. lakhs)
1	Construction at composting site and land fill site - digging of pits, construction of pits, boundary wall, drainage, lining, etc.	45.00
2	Reclamation and stabilization of land fill and composting site	15.00
3	Two covered trucks for conveyance of solid waste to landfill site @ Rs. 15.00 lakh per truck	30.00
4	Manpower cost for 3 persons @ Rs. 12000 per person per month for 3 years	12.96
5	Two tractors with trolleys @ Rs. 10.00 lakh per tractor with trolley	20.00
6	Running, operation and maintenance of trucks and trolleys including driver's salaries @ Rs. 30000 per vehicle per month for 4 vehicles for 3 years	43.20
7	Awareness Programme/ Periodical Training	10.00
8	Tools & Implements	10.00
Total Cost (Rs. lakh)		**186.16**

10.10 ENERGY CONSERVATION MEASURES

As discussed previously, the proposed project would remain under construction for about 3 years and it is estimated that migrant population during peak construction phase will be of the order of 1400 persons. It is the general tendency of the migrant laborers to use forest wood for the fuel and other domestic uses, especially when it is easily available. This would create serious biotic pressure on the nearby forest. To mitigate such impacts, various management measures need to be put in place and strictly implemented.

Energy Conservation Measure (ECM) are to be planned and implemented during construction phase either directly by developer or through contractor to reduce the pressure on natural resources in the project area and minimize impacts on this count. These measures can affect a variety of resources mainly forest, from negative impact of fuel wood collection by stakeholders as well as by labors during construction period. To mitigate such impacts, feasible measures will be adopted to help minimize pressure on forest. These are briefly discussed in the ensuing text.

10.10.1 Energy Conservation Measures

Renewable natural resources like Forests should be protected/ cared to enhance quality of life and can also be used and replenished for future use. In study area, supply of cooking gas and kerosene is available in all villages, but fuel wood is the dominant source of energy due to its easy availability; therefore, there is need to reduce the pressure on natural forests for wood. With an estimated migrant population of 1400 persons in the area, the existing facilities will become insufficient for supply of kitchen fuel for the migrant population during the construction of the project. Fuel for cooking is an essential requirement and in the absence of adequate fuel availability they will resort to tree cutting for use of fuel wood. The project authorities would need to make adequate arrangements for supply of fuel for domestic use.

Provisions for Kitchen Fuel

The demand for kitchen fuel will increase due to the population coming from outside for the construction and other related work of the project. Project authority should provide kitchen fuel and make arrangement for community kitchen, canteen and efficient cooking facilities, as briefly discussed below.

Community kitchen: The project developer would make sufficient arrangement for the establishment of at least two community kitchens. These will be established near the project colonies. The kitchen should provide food to the labour at subsidized rates. The facility should maintain proper hygiene while preparing and supplying food, with adequate arrangement for waste collection and disposal. In addition, three canteens are also proposed for labour near major construction sites to provide tea/snacks at subsidized rates.

Kitchen fuel: During the construction period of the project, many families may prefer cooking on their own instead of using community kitchen. In absence of fuel for cooking, they would resort to tree cutting and using wood as fuel. To avoid such situations, the project authority should make LPG and/or kerosene available to these migrant workers. The supply of LPG and kerosene can be ensured on regular basis at subsidized rates.

It is estimated that about 50% of married labour families and all the technical and supervisory staff would prefer doing their own cooking. Additional connections would be needed for community kitchens, Project Affected Families and other interested local families. Based on this, it is estimated that a total of 300 LPG connections would be needed for locals, labour and community kitchen. Therefore, developer will coordinate with the LPG storage depot/ Kerosene depot to ensure regular supply of LPG cylinders/ Kerosene in the project area during construction period.

Efficient cooking facilities: Project authority should also take measures for reducing the fuel consumption. The authority should provide solar cookers and pressure cookers to the families of migrant workers as well to local villagers. Accordingly, budget has been allocated for the supply of cookers. This facility will also increase work efficiency of migrant workers and they will also get proper daily diet.

Solar Lantern: Provision of solar lantern has also been made in the project budget and these will be distributed free of cost to labor camps and villagers for use.

Awareness Programmes on Energy Conservation: Special awareness programmes against tree cutting should be held, which should concentrate on the awareness of labor families and villagers on environment conservation and sustainable development for the future generations. Thus, issues like saving trees, electricity and water should be covered in such programmes.

10.10.2 Cost Estimates

A total grant of **Rs. 185.00 lakhs** have been assigned towards the provision of kitchen fuel, and other facilities including establishment of community kitchen or canteens for the migrant workers (**Table 10.25**).

Table 10.25 : Financial Provision for Energy Conservation Measures

Sl. No.	Particulars	Amount (Rs. In lakhs)
1	Upgradation of LPG	8.00
2	Connection cost of 300 connections @ Rs. 5000.00 per connection	15.00
3	Distribution of Pressure Cooker and Solar Lantern	25.00
4	Community Kitchen (2 No.) – capital cost (Rs. 3.00 lakhs per kitchen) and running cost for 3 years @ Rs. 15 lakh per kitchen per annum	96.00
5	Canteen (3 No.) – capital cost (Rs. 2.00 lakh per canteen) and running cost @ Rs. 5.0 lakh per canteen per annum for 3 years	36.00
6	Community Awareness Programme	5.00
	Total (Rs. lakhs)	**185.00**

10.11 BIODIVERSITY MANAGEMENT AND WILDLIFE CONSERVATION PLAN

Habitat degradation, land use /land cover changes, hunting and poaching, invasiveness of exotic species are main threats to biodiversity and wildlife. Keeping in view of the anticipated impacts, the main objectives of biodiversity conservation and wildlife management plan are as follows:

i. Wildlife Habitat Preservation & Improvement
ii. Conservation Plan for Schedule I species
iii. Establishment of Eco Park
iv. Development of Grass land
v. Biodiversity monitoring
vi. Awareness promotion
vii. Strengthening of Infrastructural Facilities of Forest Department

viii. Biodiversity Management Committee (BMC)

One schedule I species viz. peafowl was spotted during field study. In compliance with the regulatory requirement, separate conservation plan has been prepared and submitted to the office of Chief Wildlife Warden for approval and implementation.

The estimated cost of implementation of various activities envisaged in the Biodiversity Conservation and Management Plan including conservation of schedule I species is **Rs. 280.00 lakh**.

Complete Biodiversity Conservation Plan prepared by Centre for Inter-Disciplinary Studies of Mountain & Hill Environment (CISMHE) University of Delhi is enclosed as **Appendix I**.

APPENDIX - I

Biodiversity Management & Wildlife Conservation Plan

Prepared by

Centre for Inter-Disciplinary Studies of Mountain & Hill Environment (CISMHE), University of Delhi

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1.1 INTRODUCTION

Over a series of years, changes in land use, especially types of forest management and their spatial pattern due to human activities have resulted in less diversified and more fragmented landscape worldwide (Urban *et al.* 1987; Delcourt and Delcourt, 1988; Rescia *et al,* 1994). Since prime landscapes have been significantly changed due to destructive human activities, tree plantation has become predominant land use and people are meeting their diverse biomass needs from trees in cultivated lands. Several researchers have studied the influence of landscape characteristics influencing woody plant diversity (Noss, 1983, 1990; Rescia et al, 1994).

In the recent past, management of forests has largely suffered in Deccan plateau due to pressure on land, exploitation of forest for timber and NTFP resources in the wild. Therefore, a diverse agro-ecosystem may help people to meet their varied needs and maintaining biodiversity in forest ecosystems.

1.2 BIODIVERSITY STUDY TASKS

The detailed account of Biodiversity study has been described based on primary surveys and are supplemented with the Forest Working Plans and records of Belagavi Forest Division. Surveys were carried out to understand the vegetation patterns along altitudinal gradient in pumped storage component of Saundatti IREP for classification of forest types and preparing checklist of flora focusing on lower (existing) Renukasagar reservoir as well as proposed upper reservoir area (Saundatti) including power house and adjoining area (Karlakatti Village) within 10 km radius. The documentation of biodiversity assessment in the study area is based on

- Primary survey of forest flora and adjoining agriculture and scrub land;
- Documentation and conservation status of terrestrial threatened plants along with listing of rare, endemic, threatened plants; and
- Main anthropogenic impacts on forest areas of proposed project.

- Inputs of three seasons studies carried out for EIA studies is also included for this present study.

1.3 FOREST TYPES

The State of Karnataka, situated in south-western part of India and on the western edge of Deccan Plateau, has a geographic area of 191,791 sq km. The reported forest area is 36,421 sq km which constitutes 18.99% of the geographic area and consist of very dense to moderately dense and open forest based on tree canopy density (FSI, 2017). The five forest types found in the state are Tropical Wet Evergreen, Tropical Semi Evergreen, Tropical Dry Evergreen, Tropical Dry Deciduous and tropical Thorn forests and the catchment area of standalone pumped storage component of Saundatti IREP project comprises of a mix of these forests. However, project area which we are directly concerned is stretched around 4 km along Malaprabha river (north of Karnataka), towards the upstream of Renukasagar Reservoir and mostly consists of Southern dry mixed deciduous and Southern thorn forests.

Malaprabha is important tributary of Krishna river in north Karnataka. The vegetation within 10 km radius start from the bank of Renukasagar Reservoir on Malaprabha river up to Karlakatti village, and Chakrageri village comprises much disturbed and degraded thorn forest along the edges of agricultural fields and fallow lands. Degraded Southern Thorn forest with many planted Eucalyptus trees are found in hillocks areas near reservoir area (Saundatti), while mixed dry teak bearing deciduous forest occurs in plantation area and adjoining Dharwad Taluka area. The forests present in the study area have been grouped into different forest types following the Revised Survey of forest Types of India by Champion and Seth (1968), Negi (1989, 1996), Singh (1988), Mudgal and Hajra (1999) and Singh et al (1999). The important forest types found in and around the project area are discussed below.

5A Southern Tropical Dry Deciduous Forests

This is a dry deciduous forest made up of a mixture of various species all of which remain devoid of leaves during the dry season. The forest of this subgroup can further be classified as:

5A/ C1b *Dry Teak Forest*

This is a mixed dry deciduous forest with teak (*Tectona grandis*) accounting for a major proportion. Important associates of teak are *Anogeissus latifolia, Dalbergia latifolia, Terminalia*

tomentosa, Mitragyna parviflora, Hardwickia binata, Grewia tiliifolia, Lagerstroemia lanceolata, Lannea coromandelica, Pterocarpus marsupium, Diospyros melanoxylon, Xylia xylocarpa, Buchnania lanzan, and *Wrightia tinctoria.* Undergrowth is comprised of bamboos (*Bambusa arundinacea* and *Dendrocalamus strictus*) with other shrubs like *Gymnosporea montana, Dodonaea viscosa, Helicteres isora, Lantana camara, Senna auriculata* and *S. tora*. This type of forest occurs in the plantation areas near Chakrageri and Karlakatti villages and adjoining Dharwad Taluk area. Few dry habitat specific grasses are seen on the forest floor viz., *Chloris barbata, Cymbopogon citratus, Eragrostis viscosa, Heteropogon contortus*, etc.

5A/C3 *Southern Mixed Deciduous forest*

Main species found are *Acacia auriculiformis, A. nilotica, Aegle marmelos, Albizia amara, Anogeissus latifolia, Azadirachta indica, Cassia fistula, Chloroxylon swietenia, Corymbia citriodora, Eucalyptus grandis, Hardwickia binata, Terminalia tomentosa*, etc. Understorey comprises few shrubs; bamboos are not common. *Abutilon indicum, Bambusa arundinacea*, *Calotropis gigantea, Capparis divaricata, Lantana camara, Senna auriculata, S. tora* and *Tamiladia ulginosa*. Climbers are few such as *Coculus hirsutus, Coccinia grandis, Hemidesmus indicus, Ipomoea purpurea*, etc. This type of forest is observed in upper reaches of surrounding hillocks of Saundatti and adjoining localities. Grasses are few with some herbs. The common grasses are *Chloris barbata, Cymbopogon citratus, Dichanthium annulatum, Eragrostis viscosa, Heteropogon contotus* and *Saccharum officinarum*.

6A Southern Tropical Thorn Forests

These are low open forests in which thorny and woody species predominate. Grass growth is thin and appears during the short moist season. Climbers are few and show xerophytic adaptations. The forests of this sub-group belong to following types:

6A/C1 *Southern Thorn Forest*

This is an open mixed dry deciduous forest in which thorny tree species are scattered. These forests occur in the dry tracts of central and south India. The main species in the forest are *Acacia nilotica, A. ferruginea, A. leucophloea, Aegle marmelos, Albizia amara, Balanites roxburghii, Dichrostachys cinerea, Euphorbia tirucalli, Phoenix sylvestris, Prosopis juliflora, Ziziphus jujuba*, etc. This is a most widely distributed forest type and observed throughout the project as well as in adjoining dry tracts of project study area. Among understorey, thorny and

bushy shrubs are *Agave americana*, *Capparis divaricata, Dodonaea viscosa, Lantana camara, Opuntia dillenii, Senna auriculata,* etc.

6A/DS1 *Southern thorn scrub*

This is a degradation forest which is formed due to heavy biotic pressure on vegetation. The main species are *Albizia amara, Azadirachta indica, Chloroxylon swietenia* and *Wrightia tinctoria*. Understorey is composed of *Acacia pennata, Capparis divaricata, Dichrostachys cinerea, Flacourtia indica, Tamilnadia ulginosa, Ziziphus jujuba*, etc.

1.4 VEGETATION PROFILE IN THE STUDY AREA

The description of vegetation of the project area has been presented in terms of zones which correspond to topographic/elevational class within the study area of the project. These are as follows:

i) Area between Chakrageri village and Karlakatti Village
i) Area between Karlakatti and Basidoni Daddi village
ii) Area beyond Basidoni Daddi and its environs.

i) Area between Chakrageri village and Karlakatti Village

This area is characterised by sparse distribution of trees interspersed with agricultural fields and many coconut orchards. Around Chakrageri village, some large tree species like *Acacia nilotica, Azadirachta indica, Bauhinia purpurea, Cassia fistula, Cocos nucifera, Corymbia citriodora, Eucalyptus grandis, Hardwickia binata, Tamarindus indica,* etc. are seen especially on bunds and edges of agricultural fields **(Plate 1.1a)**. Cotton and sugarcane cultivation can be seen throughout the region. Besides these cash crops, vegetables and maize are the other main crops. Because of large scale human interference and grazing, the growth of shrubs, climbers and herbs is very limited in the area especially near project (water conducting system). *Abutilon indicum, Capparis divaricata, Catunaregam spinosa, Euphorbia tirucalli, Lantana camara, Ziziphus jujuba,* etc. are some of the shrubs found in project area. Among twiners are *Cardiospermum helicacabum, Coccinia grandis, Cocculus hirsutus* and *Leptadenia reticulata.* Due to high disturbance weeds like *Argemone mexicana, Lantana indica* and *Parthenium hysterophorus* have invaded the agricultural and barren areas and are responsible for gradually driving out the indigenous species. Apart from the biological invasions, the forests of

Malaprabha river Basin in Gokak Forest Division are under severe biotic pressure due to large scale sugarcane cultivation and Eucalyptus plantation activities.

ii) **Area between Karlakatti and Basidoni Daddi village**

This area harbours degraded southern thorn forest at the foot of forested hills or hillocks. The common trees occur in the surrounding area are *Acacia auriculiformis, A. nilotica, A. leucophloea, Albizia amara, Azadirachta indica, Balanites roxburghii, Chloroxylon swietenia, Prosopis juliflora* and *Wrightia tinctoria* **(Plate 1.1b)**. The predominant shrub species include *Abutilon indicum*, *Calotropis gigantea, Capparis divaricata, Ipomoea carnea, Lantana camara, Senna auriculata* and *Ziziphus jujuba*. Climbers are rarely seen. Some twining species in the forest and agricultural field edges include *Coccinia grandis, Cocculus hirsutus, Leptadenia reticulata, Rivea hypocrateriformis,* etc. At few places, especially along the agricultural fields, plantation of *Corymbia citriodora, Cocus nucifera, Eucalyptus grandis, Tectona grandis*, etc. can be seen in this area. Because of large scale cultivation of cotton, maize and vegetables, spread of herbs are limited in the area. Barren fields and forest floor are covered with some weeds and grass species like *Achyranthes aspera, Cynodon dactylon, Dichanthium annulatum, Heteropogon contortus, Parthenium hysterophorus, Sida rhombifolia, Tridax procumbens,* etc.

iii) **Area beyond Basidoni Daddi and its environs**

Mixed southern dry deciduous forest, thorny scrub and mixed plantations of eucalyptus are found above Basidoni Daddi area. Important tree species found in the surrounding forest area include *Acacia leucophloea, A. ferruginea, A. nilotica, Balanites roxurghii, Bauhinia purpurea, Cassia fistula, Eucalyptis grandis, Hardwickia binata, Mangifera indica, Phyllanthus emblica, Prosopis juliflora* and *Wrightea tinctoria* (**Plate 1.1c)**. Other important small trees in the area includes *Acacia suma, Holoptelea integrifolia, Morinda tinctoria, Phyllanthus reticulatus, Pongamia pinnata, Simarouba amara, Ziziphus jujuba*, etc. Undergrowth is poor and is represented by few spreading shrubs like *Bambusa arundinacea, Carissa spinarum, Catunaregam spinosa, Dendrocalamus strictus, Dodonaea viscosa, Lantana camara, Senna auriculata, S. tora, Tamilandia ulginosa,* etc.

The vegetation in upper reaches of Malaprabha river catchment consists of some compact patches of forest interspersed with grassy vegetation. However, thorny vegetation composed of

scattered trees and many medicinally important shrubby plant species occur on the middle hillocks and in the adjoining area of Saunadatti upper reservoir area. Important medicinal plant species of the hillocks and adjoining area include *Balanites roxburghii, Calotropis gigantea, Ipomoea carnea, Morinda tinctoria, Phoenix sylvestris, Simarouba amara* and *Ziziphus jujuba*.

As these forest areas harbours rich varieties of food, medicinal plants and other important economic plants. More priority should be given for the preservation and conservation of medicinal plants especially those which are collected from the wild.

1.5 FLORISTICS OF PROJECT AREA

The present Biodiversity study in the project area of standalone pumped storage component of Saundatti IREP, was undertaken with the objectives of preparing a checklist of flora in the Lower reservoir (existing Renukasagar reservoir), upper reservoir and power house site are proposed; listing of rare/endangered, economically important and medicinal plant species also.

1.5.1 Vegetation around existing Lower Reservoir (Renukasagar reservoir)

The existing Lower reservoir is located near Chakrageri village in Belagavi District of Karnataka. At right bank of Renuka sagar reservoir, much disturbed and degraded vegetation occurs especially along the bunds of agricultural farms. Sugarcane and vegetables are major cash crops in the adjoining area (**Plate 1.2a**). Some trees viz., *Azadirachta indica, Cassia fistula, Cocos nucifera, Eucalyptus* spp. and *Mangifera indica* are seen planted on the edges of agricultural lands. Other tree species occur in the fragmented forest patches include *Acacia nilotica, A. ferruginea, A. polyacantha, Bauhinia purpurea, Hardwickia binata, Tamarindus indica, Tectona grandis,* etc. Undergrowth is thin and patchy consists of few spreading shrubs like *Abutilon indicum, Asparagus racemosus*, *Calotropis gigantea, Capparis divaricata, Euphorbia tirucalli, Lantana camara, Phyllanthus reticulatus* and *Ziziphus jujuba*. Climbers are few such as *Cardiospermum helicacabum*, *Cocculus hirsutus, Coccinea grandis, Leptadanea reticulata*, etc. Ground floor is disturbed and show gaps covered with weeds, herbs and few grasses. The common herbs are *Achyranthes aspera, Acalypha indica, Cynodon dactylon, Euphorbia hirta, Parthenium hysterophorus, Sida cordata, Tridex procumbens,* etc. A total of 55 species of angiosperms including trees, shrubs, climbers and herbs are recorded around the Lower reservoir area during primary survey (Table 1.1).

Table 1.1 List of flowering plant species recorded in and around the existing Lower Reservoir Area (Renuka sagar reservoir)

Sl. No.	Botanical Name	Ver./Local Name	Family	Uses
	Trees			
1	*Acacia auriculiformis*	Acacia	Fabaceae	Timber
2	*A. ferruginea*	Banni	Fabaceae	Ornamental
3	*A. leucophloea*	Bilijali	Fabaceae	Medicinal
4	*Acacia nilotica*	Karijali	Fabaceae	Timber
5	*A. polyacntha*	Mugali	Fabaceae	Cultural
6	*Azadirachta indica*	Bevu	Meliaceae	Medicinal
7	*Bauhinia purpurea*	Basavanapada	Fabaceae	Ornamental
8	*Cassia fistula*	Rela	Fabaceae	Medicinal
9	*C. leptophylla*	Gold Medallion	Fabaceae	Ornamental
10	*Corymbia citriodora*	Lemon Eucalyptus	Myrtaceae	Timber
11	*Cocos nucifera*	Thengu	Arecaceae	Medicinal
12	*Eucalyptus grandis*	Neelagiri	Myrtaceae	Timber
13	*Hardwickia binata*	Kamara	Fabaceae	Fodder
14	*Mangifera indica*	Mavu	Anacardiaceae	Medicinal; Timber
15	*Melia azedarach*	Hebbevu	Meliaceae	Medicinal; Timber
16	*Morinda coreia*	Maddi	Rubiaceae	Medicinal
17	*Phoenix sylvestris*	Echaclu	Arecaceae	Medicinal
18	*Pongamia pinnata*	Honge	Fabaceae	Ornamental
19	*Tamarindus indica*	Hunase	Fabaceae	Fruits
20	*Tectona grandis*	Tega	Verbenaceae	Timber
	Shrubs			
1	*Abutilon indicum*	Aphra	Malvaceae	Medicinal
2	*Asparagus racemosus*	Satavar	Asparagaceae	Medicinal
3	*Calotropis gigantea*	Ekka	Apocynaceae	Medicinal
4	*Canthium coromandelicum*	Billudu	Rubiaceae	Fuel-wood
5	*Capparis divaricata*	Wagti	Capparaceae	-
6	*Catunaregam spinosa*	-	Rubiaceae	Fruits
7	*Dodonaea viscosa*	Bandarike	Sapindaceae	Fuel-wood

Sl. No.	Botanical Name	Ver./Local Name	Family	Uses
8	*Euphorbia tirucalli*	Kolu Kalli	Euphorbiaceae	Medicinal
9	*Lantana camara*	Lantana	Verbenaceae	Fuel-wood
10	*Phyllanthus reticulatus*	Hooli	Euphorbiaceae	Medicinal
11	*Senna auriculata*	Avram	Fabaceae	Medicinal
12	*Ziziphus jujuba*	Bore	Rhamnaceae	Fruits
	Climbers			
1	*Cardiospermum helicacabum*	Ballon vine	Sapindaceae	Medicinal
2	*Coccinia grandis*	-	Cucurbitaceae	-
3	*Cocculus hirsutus*	-	Cucurbitaceae	-
4	*Hemidesmus indicus*	Sarsparila	Apocynaceae	Medicinal
5	*Leptadenia reticulata*	-	Apocynaceae	-
	Herbs			
1	*Acalypha indica*	Kuppaimeni	Euphorbiaceae	Medicinal
2	*Argemone mexicana*	Datturi	Papaveraceae	-
3	*Celosia argentea*	Hanne gida	Amaranthaceae	-
4	*Chloris barbata*	-	Poaceae	-
5	*Croton bonplandianus*	-	Euphorbiaceae	-
6	*Cymbopogon citratus*	Majjige hullu	Poaceae	Aromatic
7	*Cynodon dactylon*	Durba	Cyperaceae	Medicinal
8	*Cyperus corymbosus*	Bhadre hullu	Cyperaceae	-
9	*Cyperus rotundus*	Konnari gedde	Cyperaceae	Medicinal
10	*Dichanthium annulatum*	Kanda Bathada hullu	Poaceae	-
11	*Eragrostis viscosa*	-	Poaceae	-
12	*Euphorbia hirta*	Dudhi	Euphorbiaceae	Medicinal
13	*Parthenium hysterophorus*	Congress Gida	Asteraceae	-
14	*Sida cordta*	-	Malvaceae	Medicinal
15	*Sorghastrum nutans*	Kalda	Poaceae	-
16	*Tribulus terrestris*	Niranji	Zygophyllaceae	Medicinal
17	*Tridax procumbens*	Shavanthi	Asteraceae	Medicinal
18	*Typha angustifolia*	Naribala	Typhaceae	-

1.5.2 Vegetation around the proposed Power house area

The power house area is situated in Karlakatti village area near proposed Upper reservoir area in Belagavi District. The area near project area is comprised of open southern thorn forest interspersed with agricultural fields. The common wild as well as planted tree species in the area are *Acacia leucophloea, A. nilotica, Albizia amara, Azadirachta indica, Balanites roxburghii, Cassia fistula, Eucalyptus grandis, Prosopis juliflora, Tectona grandis* and *Wrightia tinctoria* (**Plate 1.2b**). Shrubby elements consist of species such as *Calotropis gigantea, Capparis divaricata, Canthium coromandelicum, Catunarenga spinosa, Lantana indica* and *Ziziphus jujuba.* Ground floor consists of few herbaceous species and weeds like *Achyranthes aspera, Acalypha indica, Argemone mexicana, Brachiaria reptans, Cymbopogon citratus, Cyperus corymbosus, Eragrostis viscosa, Gomphrena globosa, Parthenium hysterophorus, Sida cordata,* etc. A total of 44 species of flowering plants including trees, shrubs, climbers and herbs are recorded in and around the power house area during primary survey (**Table 1.2**).

Table 1.2 List of flowering plant species recorded in and around the Power house

Sl. No.	Botanical Name	Ver./Local Name	Family	Uses
	Trees			
1	*Acacia leucophloea*	Bilijali	Fabaceae	Medicinal
2	*Acacia nilotica*	Karijali	Fabaceae	Timber
3	*A. polyacantha*	Mugali	Fabaceae	Cultural
4	*Albizia amara*	Chikreni	Fabaceae	Ornamental
5	*Azadirachta indica*	Bevu	Meliaceae	Medicinal
6	*Balanites roxburghii*	Hingu	Zygophyllaceae	Medicinal
7	*Cassia fistula*	Rela	Fabaceae	Medicinal
8	*Chloroxylon swietenia*	Hurgalu	Meliaceae	Medicinal
9	*Corymbia citriodora*	Lemon Eucalyptus	Myrtaceae	Timber
10	*Cocos nucifera*	Thengu	Arecaceae	Medicinal
11	*Eucalyptus grandis*	Neelagiri	Myrtaceae	Timber
12	*Phyllanthus emblica*	Aonla	Euphorbiaceae	Medicinal
13	*Prosopis juliflora*	Prosopis juliflora	Fabaceae	Fuel-wood
14	*Tectona grandis*	Tega	Verbenaceae	Timber
15	*Wrightia tinctoria*	Neila palei	Apocynaceae	Medicinal
	Shrubs			

Sl. No.	Botanical Name	Ver./Local Name	Family	Uses
1	*Abutilon indicum*	Aphra	Malvaceae	Medicinal
2	*Calotropis gigantea*	Ekka	Apocynaceae	Medicinal
3	*Canthium coromandelicum*	Billudu	Rubiaceae	Fuel-wood
4	*Capparis divaricata*	Wagti	Capparaceae	-
5	*Catunaregam spinosa*	Mainphal	Rubiaceae	Fruits
6	*Dodonaea viscosa*	Bandarike	Sapindaceae	Fuel-wood
7	*Gymnosporia montana*	Tandrasi	Celastraceae	Medicinal
8	*Lantana camara*	Lantana	Verbenaceae	Fuel-wood
9	*Senna auriculata*	Avram	Fabaceae	Medicinal
10	*Ziziphus jujuba*	Bore	Rhamnaceae	Fruits
	Climbers			
1	*Coccinia grandis*	-	Cucurbitaceae	-
2	*Cocculus hirsutus*	-	Cucurbitaceae	-
3	*Hemidesmus indicus*	Sarsparila	Apocynaceae	Medicinal
4	*Ipomoea purpurea*	-	Convolvulaceae	-
5	*Rivea hypocrateriformis*	Dhak Ki Bel	Convolvulaceae	-
	Herbs			
1	*Acalypha indica*	Kuppaimeni	Euphorbiaceae	Medicinal
2	*Achyranthes aspera*	Chirchita	Amaranthaceae	Medicinal
3	*Argemone mexicana*	Datturi	Papaveraceae	-
4	*Brachiaria reptans*	-	Poaceae	-
5	*Cymbopogon citratus*	Majjige hullu	Poaceae	Aromatic
6	*Cynodon dactylon*	Durba	Cyperaceae	Medicinal
7	*Cyperus corymbosus*	Bhadre hullu	Cyperaceae	-
8	*Cyperus rotundus*	Konnari gedde	Cyperaceae	Medicinal
9	*Dichanthium annulatum*	Kanda Bathada hullu	Poaceae	-
10	*Eragrostis viscosa*	-	Poaceae	-
11	*Gomphrena globosa*	-	Amaranthaceae	-
12	*Parthenium hysterophorus*	Congress Gida	Asteraceae	-
13	*Sida cordta*	-	Malvaceae	Medicinal
14	*Tridax procumbens*	Shavanthi	Asteraceae	Medicinal

1.5.3 Vegetation around upper reservoir area

The upper reservoir (Saundatti reservoir) is proposed near Basidoni village. The vegetation near project is comprised of patchy southern thorn forest with some planted exotic tree species like *Acacia auriculiformis* and dense patches of planted *Eucalyptus* spp. (**Plate 1.2c**). The main trees species in the project area are *Acacia leucophloea, A. nilotica, A. polyacantha, Albizia amara, Balanites roxburghii, Cassia fistula, Prosopis juliflora, Simarouba amara* and *Wrightia tinctoria.* Understorey is also open and patchy composed of few spreading shrubs and climbers. The common shrub species includes *Abutilon indicum, Capparis divaricata, Catunaregam spinosa, Calotropis gigantea, Lantana camara, Senna auriculata, Ziziphus jujuba*. Ground floor is disturbed and is dominated by few herbaceous weeds and grasses like *Argemone mexicana, Brachiaria reptans, Cyperus corymbosus, Eragrostis viscosa, Gomphrena globosa, Parthenium hysterophorus, Senna tora,* etc. A total of 42 species of flowering plants including trees, shrubs and herbs are recorded in and around the Upper reservoir area during primary survey (Table 1.3).

Table 1.3 List of flowering plant species recorded in and around the Upper Reservoir Area (proposed Saundatti Reservoir)

Sl. No.	Botanical Name	Ver./Local Name	Family	Uses
	Trees			
1	*Acacia auriculiformis*	Acacia	Fabaceae	Ornamental
2	*Acacia nilotica*	Karijali	Fabaceae	Timber
2	*A. leucophloea*	Bilijali	Fabaceae	Medicinal
3	*A. polyacantha*	Mugali	Fabaceae	Cultural
4	*Albizia amara*	Chikreni	Fabaceae	Ornamental
5	*Azadirachta indica*	Bevu	Meliaceae	Medicinal
6	*Balanites roxburghii*	Hingu	Zygophyllaceae	Medicinal
7	*Cassia fistula*	Rela	Fabaceae	Medicinal
8	*Corymbia citriodora*	Lemon Eucalyptus	Myrtaceae	Timber
9	*Eucalyptus grandis*	Neelagiri	Myrtaceae	Timber
10	*Prosopis juliflora*	Kabuli Kikar	Fabaceae	Fuel-wood
11	*Simarouba amara*	Paradise Tree	Simaroubaceae	Medicinal
12	*Wrightia tinctoria*	Neila palei	Apocynaceae	Medicinal

Sl. No.	Botanical Name	Ver./Local Name	Family	Uses
	Shrubs			
1	*Abutilon indicum*	Aphra	Malvaceae	Medicinal
2	*Asparagus racemosus*	Satavar	Asparagaceae	Medicinal
3	*Bambusa arundinacea*	Baans	Poaceae	Medicinal
4	*Calotropis gigantea*	Ekka	Apocynaceae	Medicinal
5	*Canthium coromandelicum*	Billudu	Rubiaceae	Fuel-wood
6	*Capparis divaricata*	Wagti	Capparaceae	-
7	*Catunaregam spinosa*	-	Rubiaceae	Fruits
8	*Lantana camara*	Lantana	Verbenaceae	Fuel-wood
9	*Murraya koenigii*	Kare-pata	Rutaceae	Medicinal
10	*Senna auriculata*	Avram	Fabaceae	Medicinal
11	*Ziziphus jujuba*	Bore	Rhamnaceae	Fruits
	Climbers			
1	*Cocculus hirsutus*	-	Cucurbitaceae	-
2	*Hemidesmus indicus*	Sarsparila	Apocynaceae	Medicinal
3	*Leptadenia reticulata*	-	Apocynaceae	-
4	*Ventilago bombaiensis*	Popli	Rhamnaceae	-
	Herbs			
1	*Achyranthes aspera*	Chirchita	Amaranthaceae	Medicinal
2	*Apluda aristata*	-	Poaceae	Fodder
3	*Argemone mexicana*	Datturi	Papaveraceae	-
4	*Brachiaria reptans*	-	Poaceae	-
5	*Corchorus olitorius*	-	Malvaceae	-
6	*Cymbopogon citratus*	Majjige hullu	Poaceae	Aromatic
7	*Cynodon dactylon*	Durba	Cyperaceae	Medicinal
8	*Cyperus corymbosus*	Bhadre hullu	Cyperaceae	-
9	*Dichanthium annulatum*	Kanda Bathada hullu	Poaceae	-
10	*Eragrostis viscosa*	-	Poaceae	-
11	*Euphorbia hirta*	Dudhi	Euphorbiaceae	Medicinal
12	*Heteropogon contortus*	-	Poaceae	-
13	*Parthenium hysterophorus*	Congress Gida	Asteraceae	-
14	*Senna tora*	-	Fabaceae	Medicinal

Sl. No.	Botanical Name	Ver./Local Name	Family	Uses
15	*Tribulus terrestris*	Niranji	Zygophyllaceae	Medicinal

1.6 RET SPECIES

Significant damage has been done to the natural flora of Chakrageri village and adjoining hilly tracts of Belagavi District, due to various ongoing developmental activities in the area viz., large scale removal of timber species for preparation of agricultural fields, road construction, Renewable Energy Projects and mining activities, etc.

As per the primary survey carried out in the Saundatti IREP project area, no rare and endemic species were observed in the study area and the same is evident based on the Red Data Book of India, (Nayar and Sastry, 1987, 1988 and 1990). As per IUCN Red List of threatened plant species *Chloroxylon swietenia* (**Plate 1.3**) is listed in Vulnerable category, while *Azadirachta indica, Cyperus rotundus, Euphorbia tirucalli* and *Tamarindus indica* are listed in Least Concern category from the project as well study area of this project.

1.7 ECONOMICALLY IMPORTANT PLANTS

The diverse climatic conditions and topography of the area support many flowering plants which are useful for the local people. The local people consume these plants in crude form as medicine, food, timber, fibre, etc. Some of the important groups of wild useful plants are**:**

i) Medicinal Plants

The entire project area of Saundatti project falls in degraded southern thorn forest category. Some of the known threats affecting the flora include heavy deforestation or illegal felling of trees for preparation of agricultural fields, forest fire, unsustainable harvesting of NTFP, grazing, mining and hydro power project construction activities. In addition, there are cash crops like cotton, sugar cane, coco nut, vegetables, etc are widely cultivated in Northern Karnataka districts. The demand of cultivation of these crops are continuously increasing day by day thereby resulting in depletion of native species. Moreover, some medicinal plant species like *Cardiospermum helicacacbum, Chloroxylon swietenia, Morinda tinctoria, Murraya koenigii, Senna auriculata, Wrightia tinctoria*, etc. (**Plate 1.4 a & b**) are being harvested by local people from hilly localities for curing their various diseases and ailments. Therefore, considering the

current rate of deforestation, there is an urgent need for accurate documentation of traditional knowledge and folklore of medicine to cure various diseases and ailments. Some of studies related to ethnomedicinal survey in adjoining districts of Belagavi District have been reported from the state (Harsha et al, 2005, Hegde et al, 2007, Shiddamallayya et al, 2008). Some of the important medicinal and aromatic plants of the project area are given in Table 1.4 (**Plate 1.4a & b**).

Table 1.4 Some of the medicinal plants recorded in the Study area of Saundatti IREP

Botanical Name	Vern./Local Name	Family	Parts Used
Abutilon indicum	Aphra	Malvaceae	Roots
Acacia leucophloea	Bilijali	Fabaceae	Pods
Acalypha indica	Kupai	Euphorbiaceae	Leaves
Azadirachta indica	Bevu	Meliaceae	Twigs, Fruits
Balanites roxburghii	Ingalara	Zygophyllaceae	Fruits
Calotropis procera	Ekka	Asclepiadaceae	Roots, Latex
Chloroxylon swietenia	Hurgalo	Meliaceae	Leaves
Cardiospermum helicacabum	Ballon vine	Sapindaceae	Roots
Cassia fistula	Rela	Fabaceae	Pods
Cocos nucifera	Thengu	Arecaceae	Fruits
Cymbopogon citratus	Majjige hullu	Poaceae	Leaves
Cyperus rotundus	Konnari gedde	Cyperaceae	Roots
Euphorbia tirucalli	Kolu Kalli	Euphorbiaceae	Stem
Hemidesmus indicus	Sarsparila	Apocynaceae	roots
Morinda tinctoria	Maddi	Rubiaceae	Fruits
Murraya koenigii	Kari Pata	Rutaceae	Leaves
Phoenix sylvestris	Echaclu	Arecaceae	Fruits
Phyllanthus reticulatus	Hooli	Euphorbiaceae	Leaves
Senna auriculata	Avarike	Fabaceae	Leaves
Simarouba amara	Laxmi Taru	Simaroubaceae	Leaves
Tamarindus indica	Hunase	Fabaceae	Fruits
Tridax procumbens	Shavanthi	Asteraceae	Leaves

Botanical Name	Vern./Local Name	Family	Parts Used
Tribulus terrestris	Niranji	Zygophyllaceae	Roots
Wrightia tinctoria	Neila Palei	Apocynaceae	Follicles
Ziziphus jujuba	Bore	Rhamnaceae	Fruits

ii) Food Plants

Many wild plants commonly consumed by locals include fruits of *Phyllanthus emblica* (Tasha)*, Phoenix sylvestris* (Echaclu)*, Tamarindus indica* (Hunase), *Ziziphus jujuba* (Bore), etc. Further, leaves of some wild plant species provide good source of minerals in the diet include *Acalypha indica, Amaranthus viridis*, *Murraya koenigii, Simarouba amara,* etc. are important plant source of minerals.

iii) Fiber yielding

Some fiber yielding plant species include *Abutilon indicum, Grewia tiliifolia, Sida rhombifolia,* etc. in the project as well as study area.

iv) Plywood and Paper pulp Industry

Some important plywood and pulp yielding species in the project study area are *Eucalyptus* spp., *Tectona grandis* (Tega) and *Mangifera indica* (Mavu).

Plate 1.1a View of *Cocos nucifera* with other trees in Chakrageri area

Plate 1.1b view of forest vegetation near Karlakatti village area

Plate 1.1c. View of forest vegetation near Baisdoni Daddi

Plate 1.2a Vegetation around existing lower reservoir area

Plate 1.2b Forest vegetation view near power house area (Karlakatti)

Plate 1.2c Forest view near Upper reservoir area (Saundatti)

Plate 1.3 *Chloroxylon swietenia* near Upper reservoir

Plate 1.4a Medicinal shrubby species (*Murraya koenigii*) in Upper reservoir

Plate 1.4b Medicinal shrubby species (*Senna auriculata*) in Upper reservoir

2
Fauna

2.1 INTRODUCTION

Standalone Pumped Storage component of Saundatti IRE Project is located on the Eastern plains area of Karnataka. The vegetation of this region falls under Southern tropical dry deciduous and Southern tropical thorn forests.

Present study area falls in Belagavi district in north Karnataka. The major land use/land cover of the study area of proposed project is characterised by agricultural land use with thorny scrubs and very small patches of fragmented forests. The baseline data on terrestrial fauna was collected with respect to assess the impacts of and to formulate a sound biodiversity management and conservation plan of Saundatti IRE storage project.

2.2 STUDY AREA AND METHODOLOGY

The Project envisages creation of a reservoir across a Jagavalla Halla depression which is flowing NW – SE direction, joining the Malaprabha reservoir near Yekkundi village. The proposed reservoir is located between 15° 51' 36.83" N Latitude and 75° 00' 42.57" E longitude while existing reservoir is situated between 15° 49' 17.15" N Latitude and 75° 05' 48.23" E Longitude. The project envisages construction of a dam to form reservoir, an Intake Structure, Head Race Tunnel, Surge Chamber, Penstock tunnel and a surface Power House. Storage Capacity of the Project is proposed as 10080 MWH.

To prepare biodiversity profile, likely impacts of proposed project and to formulate a biodiversity management plan, data on different aspects of biodiversity was collected from the study area comprising 10 km radius of project components. Faunal elements comprise mammals, avifauna, herpetofauna, butterflies and other invertebrates. The profile also includes baseline data collected during EIA study of the project, and secondary literature. Secondary literature primarily included Forest Working Plan of the region, published literature like Kumar and Singh (2007), Patter et al. (2010), Menasagi and Kotika (2011), Jadesh et al. (2014), Prajapati (2016), Umapati et al. (2016), Praveen et al. (2016), Ramakrishna (2018) and many anonymous sources like https://ebird.org/region/IN-KA?yr=cur and EIA report of other projects

in the same area. Secondary data also included adjoining areas of study sites with similar climatic conditions. After preparation of inventory of species, each species was subjected to the assessment for its conservation status using criteria of IUCN (2018-2) and IWPA (1972).

2.3 DIVERSITY AND DISTRIBUTION

2.3.1 Mammals

Deccan plateau forms two-third of the total geographic area of Karnataka and characterised by low rainfall, high temperature and rocky topography. Thus, such types of land use/ land covers do not support high richness especially of large mammals. The present study area is part of Deccan peninsular plateau as it is dominated by Deccan elements. In the study area, a total of 31 species of mammals from 18 families was recorded (Table 2.1).

In general, all these species are widely distributed in Deccan Plateau region; however, they differ in their abundance. In the study area, the most common species are *Macaca radiata* (Bonnet Macaque), *Semnopithecus entellus* (Common Langur), *Herpestes edwardsii* (Common Mongoose), *Herpestes smithii* (Ruddy Mongoose), *Funambulus tristriatus* (Jungle Palm Squirrel) and species belonging to Muridae family. They are found near settlement areas, open forests, and other common places like roads etc. They are frequently spotted by local people in the surveyed areas.

The species like *Prionailurus bengalensis* (Leopard Cat), *Felis chaus* (Jungle Cat), *Canis lupus* (Wolf), *Canis aureus* (Jackal), *Vulpes bengalensis* (Indian Fox), *Hyaena hyaena* (Hyena), and a few species of bats are found in scrubs and grasslands, in general; they are nocturnal and roam around settlement areas at night. Except *Felis chaus* (Jungle Cat), they are not common in occurrence in the study area.

Viverricula indica (Small Indian Civet), *Paradoxurus hermaphrodites* (Asian Palm Civet), *Manis crassicaudata* (Pangolin) and *Mellivora capensis* (Honey Badger) inhabit inner part of forests, which are in scattered forms in the study area. They are rarely sighted by local people. These species are more vulnerable to human activities.

Sus scrofa (Wild Boar), *Lepus rigricolis* (Indian Hare) and *Hystrix indica* (Indian Porcupine) are common species of the area. Sometimes, they are reported to invade agricultural crops and become main cause of man-animal conflict.

Table 2.1: Species composition of mammals in the study area of proposed Pumped storage component of Saundatti IRE Project

Family	Scientific Name	Common Name	Conservation Status	
			IUCN 2018-2	IWPA 1972
Cercopitheciadae	*Macaca radiata*	Bonnet Macaque	LC	II
Cercopitheciadae	*Semnopithecus entellus*	Common Langur	LC	II
Felidae	*Prionailurus bengalensis*	Leopard cat	LC	I
Felidae	*Felis chaus*	Jungle cat	LC	II
Canidae	*Canis lupus*	Wolf	LC	I
Canidae	*Canis aureus*	Jackal	LC	II
Canidae	*Vulpes bengalensis*	Indian Fox	LC	II
Hyanidae	*Hyaena hyaena*	Striped Hyena	NT	III
Viverridae	*Viverricula indica*	Small Indian Civet	LC	II
Viverridae	*Paradoxurus hermaphroditus*	Asian Palm Civet	LC	II
Herpestidae	*Herpestes edwardsii*	Common Mongoose	LC	IV
Herpestidae	*Herpestes smithii*	Ruddy Mongoose	LC	IV
Herpestidae	*Herpestes vitticollis*	Stripe-Necked Mongoose	LC	IV
Mustelidae	*Mellivora capensis*	Honey Badger	LC	I
Suidae	*Sus scrofa*	Wild Boar	LC	III
Leporidae	*Lepus rigricolis*	Indian Hare	LC	IV
Hystricidae	*Hystrix indica*	Indian Porcupine	LC	IV
Sciuridae	*Funambulus tristriatus*	Jungle Palm Squirrel	LC	IV
Muridae	*Rattus rattus*	House Rat	LC	V
Muridae	*Mus booduga*	Field Mouse	LC	V
Muridae	*Mus musculus*	House Mouse	LC	V
Platacanthomyidae	*Platacanthomys lasiurus*	Malabar Spiny Dormouse	VU	-
Pteropodidae	*Cynopterus sphinx*	The Greater Short-Nosed Fruit Bat	LC	-
Pteropodidae	*Pteropus leschenaultii*	Leschenault's Rousette	LC	-
Megadermatidae	*Megaderma spasma*	Lesser False Vampire Bat	LC	-
Emballonuridae	*Taphozous theobaldi*	Theobald's Tomb Bat	LC	-

Family	Scientific Name	Common Name	Conservation Status	
			IUCN 2018-2	IWPA 1972
Vespertilionidae	*Pipistrellus javanicus*	Vesper Bat	LC	-
Vespertilionidae	*Tylonycteris pachypus*	Club Footed Bat	LC	-
Vespertilionidae	*Myotis horsfieldii*	Common Asian Myotis	LC	-
Vespertilionidae	*Kerivoula picta*	Painted Bat	LC	-

LC = Least Concern, NT = Near Threatened; VU = Vulnerable, EN = Endangered

Conservation Profile: Majority of the species mentioned in **Table 1** is included under 'Least Concern' category of IUCN redlist (2018-2). *Hyaena hyaena* is 'Near Threatened' species while *Platacanthomys lasiurus* (Malabar Spiny Dormouse) is categorised as 'Vulnerable' species. Malabar Spiny Dormouse in the study area is rarely sighted. In the Schedule list of IWPA (1972), a total of 3 species viz; Leopard Cat, Wolf and Honey Badger are categorised as Schedule I species.

2.3.2 Avifauna

In the study area, the presence of a total of 96 species grouped under 44 families could be confirmed from different sources, however, the presence of more species cannot be ruled out in the study area (**Table 2.2**). *Pelecanus onocrotalus* (Great White Pelican), *Pelecanus philippensis* (Spot-Billed Pelican), *Ciconia ciconia* (Europian White Stork), *Threskiornis melanocephala* (White Ibis), *Sterna aurantia* (River Tern), *Phylacrocorox niger* (Little Cormorant), *Ardea intermedia* (Intermediate Egret), *Ardeola alba* (Large Egret), *Ardeola grayii* (Pond Heron), *Bubulcus ibis* (Cattle Egret), *Vanellus indicus* (Red Wattled Lapwing), *Milvus migrans* (Black Kite), *Halcyon smyrnensis* (White-Throated Kingfisher), *Coracias benghalensis* (Indian Roller), *Francolinus pondicerianus* (Grey Partridge), *Centropus sinensis* (Greater Coucal), *Columba livia* (Blue Rock Pigeon), *Streptopelia senegalensis* (Laughing Dove), *Corvus splendens* (House Crow), *Delichon urbicum* (Northern House Martin), *Acridotheres fuscus* (Jungle Myna), *Acridotheres tristis* (Common Myna), *Passer domesticus* (House Sparrow), *Motacilla cinerea* (Gray Wagtail), etc. are common species of the study area.

Majority of the species (about 87%) found in the study area are breeding residents while remaining are seasonal migrants and winter visitors.

Table 2.2: Species composition of avifauna in the study area of proposed pumped storage component of Saundatti IRE Project

Family	Scientific Name	Common Name	Conservation Status		Habit
			IUCN 2018-2	IWPA 1972	
Anatidae	*Anas platyrhynchos*	Mallard	LC	IV	R
Anatidae	*Aythya nyroca*	Ferruginous Duck	NT	IV	R
Anatidae	*Spatula clypeata*	Northern Shoveler	LC	IV	R
Anhingidae	*Anhinga rufa*	Darter	LC	IV	R
Ciconiidae	*Pelecanus onocrotalus*	Great White Pelican	LC	IV	R
Ciconiidae	*Pelecanus philippensis*	Spot-Billed Pelican	NT	IV	R
Ciconiidae	*Anastomus oscitans*	Open Billed Stork	LC	IV	R
Ciconiidae	*Ciconia ciconia*	Europian White Storks	LC	IV	W
Ciconiidae	*Ciconia episcopus*	White Necked Stork	VU	IV	R
Threskiornithidae	*Platalea leucorodia*	Spoon Bill	LC	IV	RW
Threskiornithidae	*Threskiornis melanocephala*	White Ibis	NT	IV	R
Ralidae	*Zapornia akool*	Brown Crake	LC	IV	R
Rallidae	*Lewinia striata*	Slaty-Breasted Rail	LC	IV	R
Rallidae	*Porzana porzana*	Spotted Crake	LC	IV	R
Gruidae	*Anthropoides virgo*	Demoiselle Crane	LC	IV	R
Laridae	*Larus fuscus*	Lesser Black-backed Gull	LC	IV	R
Laridae	*Sterna aurantia*	River Tern	NT	IV	R
Phalacrocoracidae	*Phylacrocorox niger*	Little Cormorant	LC	IV	R
Ardeidae	*Ardea intermedia*	Intermediate Egret	LC	IV	R
Ardeidae	*Ardeola alba*	Large Egret	LC	IV	R
Ardeidae	*Ardeola grayii*	Pond Heron	LC	IV	R
Ardeidae	*Bubulcus ibis*	Cattle Egret	LC	IV	R
Ardeidae	*Butorides striata*	Striated Heron	LC	IV	R
Ardeidae	*Egretta garzetta*	Little Egret	LC	IV	R
Apodidae	*Apus affinis*	Indian House Swift	LC	IV	R
Charadridae	*Vanellus indicus*	Red Wattled Lapwing	LC	IV	R
Burhiniade	*Burhinus indicus*	Indian Thick-Knee	LC	IV	R
Glareolidae	*Cursorius coromandelicus*	Indian Courser	LC	IV	R

Family	Scientific Name	Common Name	Conservation Status		Habit
			IUCN 2018-2	IWPA 1972	
Accipitridae	*Aquila heliaca*	Eastern Imperial Eagle	VU	IV	R
Accipitridae	*Circus melanoleucos*	Pied Harrier	LC	I	R
Accipitridae	*Haliastur indus*	Brahminy Kite	LC	IV	R
Accipitridae	*Milvus migrans*	Black Kite	LC	IV	RW
Falconidae	*Falco amurensis*	Amur Falcon	LC	IV	R
Falconidae	*Falco subbuteo*	Eurasian Hobby	LC	IV	R
Bucerotidae	*Anthracoceros coronatus*	Malabar Pied-Hornbill	NT	I	R
Alcedinidae	*Alcedo atthis*	White Breasted Kingfisher	LC	IV	R
Alcedinidae	*Halcyon pileata*	Black Capped King Fisher	LC	IV	R
Alcedinidae	*Halcyon smyrnensis*	White-Throated Kingfisher	LC	IV	R
Alcedinidae	*Pelargopsis capensis*	Stork-billed Kingfisher	LC	IV	R
Psittaculidae	*Psittacula krameri*	Rose-Ringed Parakeet	LC	IV	R
Psittaculidae	*Psittaculo eupatria*	Large Indian Parakeet	LC	IV	R
Strigidae	*Ketupa zeylonensis*	Fish Owl	LC	IV	R
Strigidae	*Otus brucei*	Pallid Scops Owl	LC	IV	R
Coraciidae	*Coracias benghalensis*	Indian Roller	LC	IV	R
Upupiade	*Upupa epops*	Hoopoe	LC	IV	R
Meropidae	*Merops leschenaulti*	Chestnut- Headed Bee Eater	LC	IV	R
Meropidae	*Merops orientalis*	Green Bee-Eater	LC	IV	R
Phasianidae	*Galloperdix lunulata*	Painted Spurfowl	LC	IV	R
Phasianidae	*Galloperdix spadicea*	Red Spurfowl	LC	IV	R
Phasianidae	*Coturnix coromandelica*	Rain Quail	LC	IV	SM
Phasianidae	*Francolinus pondicerianus*	Grey Partridge	LC	IV	R
Phasianidae	*Pavo cristatus*	Peacock	LC	I	R
Cuculidae	*Centropus sinensis*	Greater Coucal	LC	IV	R
Cuculidae	*Cuculus canorus*	Common Cuckoo	LC	IV	R
Cuculidae	*Eudynamys scolopaceus*	Asian Koel	LC	IV	R

Family	Scientific Name	Common Name	Conservation Status		Habit
			IUCN 2018-2	IWPA 1972	
Cuculidae	*Hierococcyx varius*	Common Hawk-cuckoo	LC	IV	R
Columbidae	*Columba livia*	Blue Rock Pigeon	LC	IV	R
Columbidae	*Streptopelia decaocto*	Eurasian Collared-Dove	LC	IV	R
Columbidae	*Streptopelia senegalensis*	Laughing Dove	LC	IV	R
Campephagidae	*Pericrocotus erythropygius*	White-Bellied Minivet	LC	IV	R
Corvidae	*Corvus macrorhynchos*	Jungle Crow	LC	IV	R
Corvidae	*Corvus splendens*	House Crow	LC	IV	R
Dicruridae	*Dicrurus adsimilis*	Fork-tailed Drongo	LC	IV	
Dicruridae	*Dicrurus macrocercus*	Black Drongo	LC	IV	SM
Hirundinidae	*Cecropis daurica*	Red-rumped Swallow	LC	IV	R
Hirundinidae	*Delichon urbicum*	Northern House Martin	LC	IV	R
Lanidae	*Lanius cristatus*	Brown Shrike	LC	IV	W
Lanidae	*Lanius schach*	Long-Tailed Shrike	LC	IV	R
Lanidae	*Lanius vittatus*	Bay-Backed Shrike	LC	IV	R
Pycnonotidae	*Pycnonotus cafer*	Red-Vented Bulbul	LC	IV	R
Sturnidae	*Acridotheres fuscus*	Jungle Myna	LC	IV	R
Sturnidae	*Acridotheres tristis*	Common Myna	LC	IV	R
Sturnidae	*Sturnia pagodarum*	Brahminy Starling	LC	IV	R
Muscicapidae	*Copsychus fulicatus*	Indian Robin	LC	IV	R
Muscicapidae	*Saxicola caprata*	Pied Bushchat	LC	IV	R
Muscicapiodae	*Euodice malabarica*	Indian Silverbill	LC	IV	R
Muscicapiodae	*Ficedula parva*	Red-breasted Flycatcher	LC	IV	W
Muscicapiodae	*Ficedula superciliaris*	Ultramarine Flycatcher	LC	IV	R
Muscipacidae	*Monticola cinclorhyncha*	Blue Headed Rock Thrush	LC	IV	R
Muscipacidae	*Muscicapa dauurica*	Asian Brown Flycatcher	LC	IV	RW
Phylloscopidae	*Phylloscopus humei*	Hume's Leaf Warbler	LC	IV	R
Locustellidae	*Chaetornis striata*	Bristled Grass-Warbler	VU	IV	R
Leiothrichidae	*Turdoides malcolmi*	Large Gray Babbler	LC	IV	R
Timaaliade	*Dumetia hyperythra*	Rufous Bellied Babbler	LC	IV	R

Family	Scientific Name	Common Name	Conservation Status		Habit
			IUCN 2018-2	IWPA 1972	
Turdidae	*Turdus obscurus*	Eyebrowed Thrush	LC	IV	R
Turdidae	*Turdus unicolor*	Tickell's Thrush	LC	IV	R
Cisticolidae	*Prinia socialis*	Ashy Prinia	LC	IV	R
Passeridae	*Passer domesticus*	House Sparrow	LC	IV	R
Motacillidae	*Motacilla cinerea*	Gray Wagtail	LC	IV	RW
Motacillidae	*Motacilla maderaspatensis*	Large Pied Wagtail	LC	IV	R
Nectarniidae	*Leptocoma zeylonica*	Purple-rumped Sun Bird	LC	IV	R
Ploceidae	*Ploceus philippinus*	Baya Weaver Bird	LC	IV	R
Alaudidae	*Alauda gulgula*	Eastern Skylark	LC	IV	R
Estrildidae	*Lonchura punctulata*	Scaly-Breasted Munia	LC	IV	R
Estrildidae	*Lonchura malacca*	Black-Headed Munia	LC	IV	
Estrildidae	*Lonchura striata*	White Rumped Munia	LC	IV	R

LC = Least Concern, NT = Near Threatened; VU = Vulnerable, EN = Endangered; R = Resident, W = winter visitor; SM = seasonal migrant

Conservation Profile: Nearly 90% of the total species reported from study area are included under 'Least Concern' category of IUCN redlist (2018-2). A total of 5 species namely *Aythya nyroca* (Ferruginous Duck), *Pelecanus philippensis* (Spot-Billed Pelican), *Threskiornis melanocephala* (White Ibis), *Sterna aurantia* (River Tern), *Anthracoceros coronatus* (Malabar Pied-Hornbill) are categorised under 'Near Threatened' category. Except Malabar Pied Hornbill, all species inhabit wetlands of the region. *Ciconia episcopus* (White Necked Stork), *Aquila heliaca* (Eastern Imperial Eagle) and *Chaetornis striata* (Bristled Grass-Warbler) are categorised as 'vulnerable' species. White Necked Stork inhabits wetlands like ponds, lakes and reservoir while Eastern Imperial Eagle has wide range of distribution. Bristled Grass-Warbler is found in the scrub forests of the area.

In the Schedule list of IWPA, only three species are listed under Schedule I, of which *Pavo cristatus* (Peacock) is commonly found in the study area. Majority of the species of birds is listed as Schedule IV (Table 2.2).

2.3.3 Herpetofauna

Secondary data on Herpetofauna, specific to the study area and its environs is scanty, therefore, data from adjacent areas with similar climatic and topographic conditions were used to prepare an inventory of Herpetofauna. A total of 27 species of Herpetofauna has been reported from the study area (**Table 2.3**). Out of 27 species, 10 belong to amphibia while remaining species are reptiles. Majority of the species are well distributed in Indian sub-continent while a few, viz. *Uperodon taprobanica* (Indian Painted Frog), *Uperodon variegata* (Pug-snout Frog), *Duttaphrynus scaber* (Dwarf Toad), and *Psammophilus dorsalis* (Peninsular Rock Agma) are generally confined to the Peninsular region of sub-continent. Except *Calotes versicolor* (Garden Lizard) and *Hemidactylus flaviviridis* (Northern House Gecko), none of the species was recorded during the surveys. However, local inhabitants revealed the presence of *Varanus bengalensis* (Monitor Lizard), Naja kaouthia (Cobra) and *Python molurus* (Python) in the study area.

Table 2.3: Species composition of Herpetofauna in the study area of proposed pumped storage component of Saundatti IRE Project

Family	Scientific Name	Common Name	Conservation Status	
			IUCN 2018-2	IWPA 1972
Bufonidae	*Duttaphrynus melanostictus*	Common Toad	LC	-
Bufonidae	*Duttaphrynus scaber*	Dwarf Toad	LC	-
Dicroglossidae	*Hoplobatrachus tigerinus*	Indian Bull Frog	LC	IV
Microhylidae	*Uperodon taprobanica*	Indian Painted Frog	LC	IV
Microhylidae	*Uperodon variegata*	Pug-snout Frog	LC	IV
Microhylidae	*Microhyla ornata*	Black-throated Frog	LC	IV
Microhylidae	*Microhyla rubra*	Narrow Mouth Frog	LC	IV
Dicroglossidae	*Euphlyctis cyanophlyctis*	Common Skittering Frog	LC	IV
Dicroglossidae	*Fejervarya* limnocharis	Asian Grass Frog	LC	IV
Rhacophoridae	*Polypedates maculatus*	Himalayan Tree Frog	LC	IV
Agamidae	*Calotes versicolor*	Garden Lizard	NE	-
Agamidae	*Sitana ponticeriana*	Fan-throated Frog	LC	-
Agamidae	*Psammophilus dorsalis*	Rock Agma	LC	-
Gekkonidae	*Hemidactylus flaviviridis*	Northern House Gecko	NE	-
Varanidae	*Varanus bengalensis*	Monitor Lizard	NE	II
Scincidae	*Eutropis carinata*	Grass Skink	LC	-

Family	Scientific Name	Common Name	Conservation Status	
			IUCN 2018-2	IWPA 1972
Boidae	*Eryx johnii*	Indian Sand Boa	NE	-
Pythonidae	*Python molurus*	Python	VU	I
Colubridae	*Ahaetulla nasuta*	Green Vine Snake	NE	-
Colubridae	*Coelognathus helena*	Montane Trinket Snake	NE	-
Colubridae	*Lycodon striatus*	Northern Wolf Snake	NE	-
Colubridae	*Oligodon arnensis*	Banded Kukri Snake	NE	-
Colubridae	*Ptyas mucosus*	Rat Snake	NE	II
Colubridae	*Amphiesma monticola*	The Hill Keelback	LC	-
Elapidae	*Bungarus caeruleus*	Common Krait	NE	-
Elapidae	*Naja kaouthia*	Indian Cobra	LC	II
Viperidae	*Daboia russelii*	Eastern Russell's Viper	LC	II

NE = not evaluated, LC = Least Concern; VU = Vulnerable

Conservation Profile: In the amphibian fauna reported from the study area, all species assessed under 'least concern' category of IUCN redlist (2018-2) while none of the species is under Schedule I of IWPA (1972). All species are widely distributed in the Deccan Plateau region. In reptilian fauna, most of the species are not evaluated for their conservation status or categorised under 'least concern' category of IUCN red list (2018). Similarly, in the schedule list of IWPA (1972), except *Python molurus*, none of the species is listed under Schedule I. Only *Python molurus* is included under 'vulnerable' category and Schedule I of respective criteria. A total of four species like Monitor Lizard, Rat Snake, Indian Cobra and Eastern Russell's Viper are listed under Schedule II of IWPA (1972).

2.3.4 Butterflies

The secondary data on butterfly fauna is not available from the defined study area. Therefore, secondary data was collected from Bagalkot and Dharwad area of Karnataka, located on northeast and southeast to the study area and fall into similar climatic conditions. The common species inhabiting these both regions are assumed to inhabit the study area. A total of 39 species of 5 families were recorded from the study area from primary as well as secondary sources (**Table 2.4**).

Table 2.4: Species composition of butterflies in the study area of proposed pumped storage component of Saundatti IRE Project

Family	Scientific Name	Common Name	Conservation Status	
			IUCN 2018-2	IWPA 1972
Papilionidae	*Papilio demoleus*	Lime Butterfly	NE	-
Papilionidae	*Papilio polytes*	Common Mormon	NE	-
Papilionidae	*Graphium doson*	Common Jay	NE	-
Papilionidae	*Graphium gamemnon*	Tailed Jay	NE	-
Papilionidae	*Pathysa nomius nomius*	Spotted Swordtail	NE	-
Papilionidae	*Pachiliopta hector*	Crimson Rose	NE	I
Papilionidae	*Atrophaneure aristolochia*	Crimson Rose	NE	-
Pieridae	*Eurema hecabe*	Common Grass Yellow	NE	-
Pieridae	*Eurema brigitta*	Small Grass Yellow	NE	-
Pieridae	*Cepora nerissa*	Common Gull	NE	II
Pieridae	*Catopsilia pyraithe*	Mottled Emigrant	NE	-
Pieridae	*Catopsilia pomona*	Common Emigrant	NE	-
Pieridae	*Colotis eucharis*	Plain Orange Tip	NE	-
Pieridae	*Appias albina*	Albatross	NE	II
Pieridae	*Delias eucharis*	Common Jezebel	NE	-
Nymphalidae	*Ariadne merione*	Common Castor	NE	-
Nymphalidae	*Acraea terspicore*	Tawny Castor	NE	-
Nymphalidae	*Tirumala limniace*	Blue Tiger	NE	-
Nymphalidae	*Danaus chrysippus*	Plain Tiger	NE	-
Nymphalidae	*Euploea klugii*	Brown King Crow	NE	-
Nymphalidae	*Euploea core*	Common Crow	LC	IV
Nymphalidae	*Phalanta phalantha*	Common Leopard	NE	-
Nymphalidae	*Neptis hylas*	Common Sailor	NE	-
Nymphalidae	*Junonia hierta*	Yellow Pansy	LC	-
Nymphalidae	*Junonia lemonias*	Lemon Pansy	NE	-
Nymphalidae	*Precis iphita*	Chocolate Pansy	NE	-
Nymphalidae	*Precis orithya*	Blue Pansy	NE	-
Nymphalidae	*Hypolimnas misippus*	Danaid Egg Fly	NE	I
Nymphalidae	*Euthalia nais*	Baronet	NE	-

Family	Scientific Name	Common Name	Conservation Status	
			IUCN 2018-2	IWPA 1972
Nymphalidae	*Vanessa canace*	Blue Admiral	NE	-
Nymphalidae	*Vanessa indica*	Red Admiral	NE	-
Nymphalidae	*Ypthima hubneri*	Common Four Ring	NE	-
Nymphalidae	*Melanitis leda*	Common Evening Brown	NE	-
Lycaenidae	*Leptotes plinius*	Zebras Blue	NE	-
Lycaenidae	*Talicada nyseus*	Red Pierrot	NE	-
Lycaenidae	*Euchrysops cnejus*	Gram Blue	NE	-
Lycaenidae	*Pseudozizeeria maha*	Pale Grass Blue	NE	-
Hesperiidae	*Spialia galba*	Indian Skipper	NE	-
Hesperiidae	*Lambrix salsala*	Chestnut Bob	NE	-

NE = not evaluated; LC = least concern

Conservation Profile: Most of the species of butterflies have not been assessed for their conservation categories under IUCN redlist (2018-2). Only two species, namely *Euploea core* (Common Crow) and *Junonia hierta* (Yellow Pansy) are included under 'least concern' category. In the Schedule list of Wildlife Protection Act (1972), only a few species are listed. Out of five, two species namely *Pachiliopta hector* (Crimson Rose) and *Hypolimnas misippus* (Danaid Egg Fly) are listed under Schedule I.

2.3.5 Other Invertebrates

In addition to butterflies, Lepidopteran fauna comprises *Lymantria dispar* (Gypsy Moth), *Eudocima phalonia* (Fruit Piercing Moth), *Orgyia antiqua* (Live Oak Tussock Moth), *Arctia caja* (Garden Tiger Moth), *Polytella gloriosae* (Lily Moth), *Plutella xylostella* (Diamond Back Moth), *Acherontia atropos* (Death's Head Hawk Moth), *Ceratomia undulosa* (Waved Sphinx Moth), etc. All species of moth are commonly found in the region and none of them are threatened under IUCN redlist. Freshwater crabs are represented by *Barytetphusa guerini*, *Spiralothelphusa hydrodroma*, *Travancoriana schirnerae*, etc which are widely distributed in the state of Karnataka and are assessed under 'least concern' category of IUCN redlist. Common spiders reported from the landscape are *Hippasa greenalliae*, *Pardosa sumatrana, Paradosa pseudoannulata, Myrmarachne orientales, Cyrtarachne keralayensis*. In addition, insect fauna includes beetles,

cadisflies, mayflies, many species of dragonflies (*Gomphus* spp., *Burmagomphus* spp., *Davidioides* spp., *Lamelligomphus* spp., *Mcirogomphus* spp., *Gynacantha* spp.). Widely distributed species of earthworm are *Eudrilus eugeniae*, *Perionyx excavatus*, *Perionyx sansibaricus*, etc. Most common species of molluscs comprise *Bellamya bengalensis*, *Lymnaea luteola*, *Thiara tuberculata*, *Gabbia stenothyroides, Lamellidens marginalis, Corbicula striatella*, etc.

2.4 CONCLUSION

Study area is characterised by the climatic and topographic features of Deccan Plateau. Nearly 70% area falls under agricultural land use and the remaining areas is covered with southern thorny forests with patchy distribution, fallow lands and small patches of grasslands. Due to degraded habitats, the area is relatively poor in biodiversity richness. All faunal species listed above are well distributed in Deccan Plateau and Indian sub-continent. The area is also known for a few migratory bird species, which are known to invade and destroy the agricultural crops, which in turn, results in man – animal conflicts. Though, hunting and poaching are not reported from the area; the adverse impacts on the biodiversity of proposed project are not anticipated.

3

Biodiversity Management and Wildlife Conservation Plan

3.1 INTRODUCTION

The area of study lies in the semi-arid tract of Indian sub-continent and characterised by low and erratic rainfall with high variation in temperature regime. The major land use/land cover profile of Belagavi district falls into agricultural practices. The available forest is dominated by southern thorn forests with patchy distribution. Thus, zone of influence of the proposed project is not anticipated to harbour high floral and faunal species richness. In view of the proposed project, the biodiversity Management strategies effectively rely on the biodiversity profile in the area including richness of threatened species and endemic species, the existing threats to the biodiversity in the region, and extent of the likely impacts of proposed project. These characteristics of the study area are described below.

3.2 PROJECT ACTIVITIES AND LIKELY IMPACTS

Standalone Pumped Storage Component of Saundatti IRE Project is in Belagavi district of Karnataka. It envisages creation of a reservoir in natural depression of Karlakatti forest area near Yekkundi and Karlakatti villages. In addition, construction activities include roads, workers' colonies, powerhouse, HRT, TRT, Magazine, dumping areas, etc. For construction activities, total requirement of land is 228.97 ha, of which forest land is 167.65 ha (including surface and underground land). Major land requirement (nearly 49%) belongs to the creation of new reservoir, followed by muck dumping areas and power house components. Construction activities are anticipated to lead various primary and secondary impacts on air quality, water quality, noise level, human health, biodiversity and wildlife. Also, such activities require a reasonable labour force, which are also foreseen to affect the socio-economic and biological environment in the project area.

3.3 BIODIVERSITY AND VULNERABILITY

Study area is characterised by the climatic and topographic features of Deccan Plateau. Nearly 70% area falls into agricultural land use and the remaining areas is covered with southern

thorny forests with patchy distribution, fallow lands and small patches of grasslands. Due to degraded habitats, the area is relatively poor in biodiversity richness, however, inhabited by a few threatened species. In the mammalian fauna, the species like Striped Hyena, Wolf, Leopard Cat, Honey Badger, Malabar Spiny Dormouse are categorised under one of the threatened categories and/or under Schedule I. However, in the study area of the proposed project, Wolf and Leopard Cat are sometimes spotted by local people.

In the threatened and schedule species of avifauna, Ferruginous Duck, Spot-Billed Pelican, Peacock are more affected as compared to other species. Peacock is more common species in the study area while other species are found in the close vicinity of water bodies. In the Herpetofauna Python, Monitor Lizard, Russell's Viper and Cobra are common species of the study area; they are anticipated to be affected by project activities.

As far as existing threats to biodiversity concerns, no animal hunting and poaching was reported from this area during survey. Forest Working Plan of Belagavi district reported habitat degradation due to different linear projects like road, transmission lines, canals, etc. Such types of activities were reported to affect the hinter lands and wild animal habitats adversely. Due to gradual loss of fallow lands, and lack of adequate community lands, grazing was also recorded to lead immense pressure on the forest lands and which in turn affects the natural regeneration adversely. Incidence of forest fire in summer season is also common in this area. In order to clear the ground for new grasses, people kindle the fire in forest areas.

3.4 CONCERNS OF LOCAL PEOPLE

Man-animal conflicts is one of the major concerns in this area, however, such conflicts are rare. Livestock is one of the sources of livelihood in the study area. Wolf preying on the cattle is one of the reasons of man-animal conflicts. In addition, migratory birds are also reported to damage the agricultural crops in the region.

3.5 PLAN OF ACTION

Biodiversity Management and Wildlife Conservation Plan has been aimed to minimize the likely impacts of Standalone Pumped Storage Component of Saundatti IRE Project on the biodiversity, to address the concerns of local people, to protect the vulnerable and susceptible species in the

area and to strengthen the infrastructure facilities in the forest areas. Following measures are proposed for the present plan of action.

3.5.1 Awareness Programme

The effectiveness of Biodiversity Management Plan largely depends on the participation and cooperation of local inhabitants. To promote the involvement of local people, an awareness programme is warranted in the surrounding areas. The forest areas are generally repository of varieties of plant species having medicinal importance, food and fodder values ecological significance and many other ecosystem services. Making people realise the importance of environment education cannot happen in one day. It is a long process and an on-going process. People in areas who are in direct contact with natural resources are much easier to be taught about environment and they can easily relate to the aspects of nature. Making the best and optimum use of natural resources should be taught to them. The awareness programme would be helpful in creating awareness on the significance of ecosystem services, disadvantages of forest fire, value of conservation of biodiversity and wildlife and to prevent the man-animal conflicts.

The plant species like *Chloroxylon swietenia, Azadirachta indica, Tamarindus indica, Euphorbia tirucalli, Balanites roxburghii, Wrightia tinctoria* (Tree), *Asparagus racemosus, Bambusa arundinacea, Gymnosporia montana, Senna auriculata* (shrub), *Cardiospermum helicacabum, Chlorophytum* spp. *Achyranthes aspera, Cymbopogon citratus*, *C. martini*, *Hemidesmus indicus* (herb), etc. are suggested to be taken up for plantation in the project area especially areas which shall be affected by the construction activities. The plantation of host plants of butterflies like *Ficus indica*¸ *Ficus hispida*, *Asteracantha longifolia*, *Ricinus communis*, *Zizyphus jujuba*, *Pongamia glabra*, *Citrus* spp. are also recommended.

Periodical environmental awareness programmes and workshops may be held there to promote conservation efforts of the project proponent and propagate importance of conservation of biodiversity in the area.

Under the awareness programme, bird watching need to be encouraged among the local people, project staff and youngsters in the area as the number of Schedule I bird species are

reported from the project area. Black shouldered kite, Pied Harrier and Peafowl are some of the important birds in the area. Periodic census of some of these species should be taken up in consultation with the Department of Forests, Karnataka. Such efforts can help in checking hunting of these birds.

To implement various activities under the overall awareness programme, government agencies like Forest Department, Information Department, renowned NGO(s) and project authorities can be involved. For the purpose, publicity materials like brochures, posters, sign and caution boards, pamphlets etc can be prepared and distributed freely among the tourists, public, school children and the people of surrounding villages. Total budget estimated for awareness programme is **Rs.50,00,000** (Rupees Fifty lacs) only.

3.5.2 Development of Community Pasture Lands

Grazing pressure on the forest land is one of the concerns in this area, which is vulnerable to regenerating plant species. To reduce grazing pressures from the forest areas, pasture lands in a few selected villages, especially project affected villages can be developed in non-forest areas. Fodder plant species including grasses and trees would be grown in these community lands. The village communities would be involved in implementation of this plan; thus, it would be a joint exercise of villagers, project developers and State Forest Department. A survey will be conducted by project developers with the help of villagers and NGO to identify such villages requiring such grazing and pasture lands. This plan would be helpful in reducing not only the grazing pressure from the forest areas but would prevent the man-animal conflicts in the region. Villagers would provide labourers for development of pasture land, while State Forest Department would facilitate technical support. The funds for other works like fencing, if required, seeds/seedlings of fodder plants, etc. would be provided by project developers. The size of pasture land would depend of the livestock population of different villages. Total budget allocated for this plan would be **Rs. 50,00,000** (Rupees Fifty lacs) only.

3.5.3 Fire Protection Measures

Forest areas are highly prone to fire in this area, where fire is kindled for new growth of grasses. Forest fire damages not only palatable grasses, seedlings and other plants but damages the nests and eggs of birds and reptiles. Fire control measures are a good strategy to conserve the

biodiversity. To implement fire protection measures, important forest patches would be identified in the zone of influence by the State Forest Department. The area would be divided into different compartments and each compartment would be facilitated by fire lines. State Forest Department shall implement this plan. Total financial outlay under this head is **Rs. 20,00,000** (Rupees Twenty lacs) only.

3.5.4 Infrastructure Development

Improvement in the infrastructure facilities in the zone of influence is expected to play an important role in biodiversity protection. In this plan project authorities would assist State Forest Department in strengthening the infrastructures, so that State Forest Department can contribute to the biodiversity protection of this area. It includes construction of patrolling paths, construction of watch towers, check posts and provision of equipment like cameras, binoculars, sleeping bags, search lights, health kits, wireless communication system, etc. Such strengthening measures are foreseen to enhance the vigilance capacity, monitoring of wildlife movement, checking and poaching. The plan would be implemented by the State Forest Department and funds would be borne by the project developers. Total financial outlay for this plan would be **Rs. 50,00,000** (Rupees Fifty lacs) only.

In addition to infrastructure development, project proponent proposes to build nature trails in wilderness area in the project area. These shall be managed by eco-development team at the project level and arranging different eco-development programmes for which funding shall be provided by the project. For all these lumpsum amount of Rs.100.00 lakhs has been earmarked which shall be utilised during construction and operation phase as well.

3.5.5 Good Practices

Good practices are precautionary measures, which are not expensive but play an important role in protecting biodiversity if put up with strategically. A list of good practice to be implemented in the surrounding areas of the proposed project is given below:

i) Project authorities would organise a comprehensive training programme to their workers of all levels. The training programme would address the issues of significance and conservation of biodiversity, the activities related to endangerment of plant and animal

species, knowledge about Schedule, threatened, medicinal, alien and invasive plant species, and legal consequences of poaching and hunting.

ii) All workers will be provided with identity cards and would not be allowed to enter in forest areas and villages without a valid permission. The exploitation of forest produce including fuel wood and plant species would be prohibited.

iii) The workers will be discouraged to plant any alien species in colony areas.

iv) Workers will be encouraged to remove alien and invasive plant species from the colony areas and other working sites.

v) Project authorities will be bound by rules and regulation of Wildlife (Protection) Act, 1972 of India and any others rule and guidelines, stipulated by the state Government.

vi) A sound waste management plan and eco-friendly disposal of solid waste will be followed by the workers.

vii) The use of plastic carry bags by workers will be discouraged.

viii) Restriction shall be imposed on the disposal of any types of pesticide, poisonous and other toxic material in the forest areas.

ix) Considering the movement of wild animals at night, project authorities shall adopt a controlled blasting mechanism

Total Financial outlay for the implementation of good practice would be **Rs. 5,00,000** (Rupees Five lacs) only.

3.5.6 Conservation Plan for Schedule I Species

As already discussed one Schedule-I bird species is found in the project area. Therefore, species specific conservation plan for Peafowl has been prepared with financial assistance of Rs. 40.00 lakh and submitted for approval to Chief Conservator od Forests (Wildlife) Bengluru, Karnataka vide letter no. FEPL/2019-20/CLW/191009 dated 9th October 2019. Copy of letter along with Conservation Plan is attached as Appendix – I of this report.

3.6 BIODIVERSITY MANAGEMENT COMMITTEE

The success of Biodiversity Management and Wildlife Conservation plan depends on the regular monitoring and audits of functioning. For this purpose, a biodiversity management committee (BMC) would be constituted for the project. The committee shall follow the guidelines of National

Biodiversity Authority, State Biodiversity Board and State Forest Department. The Biodiversity Management Committee of Pumped Storage Component of Saundatti IRE Project comprises the following members:

Chief Wildlife Warden/his/her representative	Chairman
Project Director /his/her representative	Member Secretary
Divisional Forest Officer	Member
Chief (Environment), Project	Member
Renowned wildlife expert (1 or 2 Nos)	Member(s)
Local Body's Representatives from at least 3 villages	Member(s)
Representative of a well-known local NGO	Member

Chairman man will have the right to assign different tasks to different members for proper functioning of plan. Also, the number of members of committee mentioned above may be increased or decreased or changed as per need. Project authorities would provide funds and facilities for the functioning of committee. Total financial outlay for the functioning of BMC is **Rs. 5,00,000** (Rupees Five lacs) only.

3.7 SUMMARY OF BUDGET

Total budget allocated for the Biodiversity Management and Wildlife Conservation Plan for Pumped Storage Component of Saundatti IRE Project would be **Rs**. **280,00,000** (Two hundred and eighty lakhs) only. Break-up of the budget is given in **Table 3.1**.

Table 3.1: Break-up of the Biodiversity Management and Wildlife Conservation Plan

Sl. No.	Particulars	Total Budget (in Lakhs)
1	Awareness Programme	10.00
2	Development of Community Pasture Lands	48.00
3	Fire Protection Measures	20.00
4	Infrastructure Development	50.00
5	Monitoring of populations of Schedule I species in and around project area, Checking and monitoring of hunting	2.00
6	Good Practices	5.00
7	Budget for Development and maintenance of nature trails and eco-development programmes	100.00
8	Biodiversity Management Committee	5.00
9	Conservation Plan for Peafowl	40.00
	Total Budget	**2,80.00**

REFERENCES

Bhat, P., Hegde, G. and Hegde, G. R. (2012). Ethnomedicinal practices in different communities of Uttara Kannada district of Karnataka for treatment of wounds. Journal of Ethnopharmacology, 143: 501–514.

Champion, H.G. and Seth, S.K. (1968). A revised survey of the forest types of India. Department of Forest, Govt. of India publication.

Delcourt, H. and Delcourt, P. (1988). Quaternary landscape ecology: relevant scales in space and time. Landscape Ecol., 2: 23-44.

FSI (2017). State of Forest Report. Forest Survey of India, Dehradun, pp. 182.

Harsha, V.H., Shripathi, V., Hegde, G.R. (2005). Ethnoveterinary practices in Uttara Kannada district of Karnataka. Indian Journal of Traditional Knowledge, 4: 252–258.

Hegde, H.V., Hegde, G.R., Kholkute, S.D. (2007). Herbal care for reproductive health: ethnomedicobotany from Uttara Kannada district in Karnataka, India. Complementary Therapies in Clinical Practice 13: 38–45.

IUCN (2018-2). Red List of Threatened Species (online). www.iucn redlist.org

Jadesh, M., Kamble, P., Manjunath, K., Ravikiran, K. and Padashetty, S. (2014). A preliminary survey of amphibians and reptiles in around Gulbarga University Campus, Karnataka, India. International Letters of Natural Sciences, 27:67-71.

Kumar, H.N and Singh, M. (2007). Small carnivores of Karnataka: distribution and sight records. Journal of the Bombay Natural History Society, 104:155-162.

Menasagi, J.B and Kotika, Y.K (2011). Studies on butterfly fauna of Bagalkot district (Karnataka-India). Karnataka Journal of Agricultural Science, 24 (4):538-539.

Mudgal, V. and Hajra, P.K. (1999). Floristic Diversity and Conservation Strategies in India. Botanical Survey of India, Kolkata.

Nayar, M.P. and Sastry, A.R.K. (1987). Red Data Book of Indian Plants, Vio.I. Botanical Survey of India, Howrah.

Nayar, M.P. and Sastry, A.R.K. (1988). Red Data of Indian Plants, Vol.II. Botanical Survey of India, Howrah.

Nayar, M.P. and Sastry, A.R.K. (1990): Red Data of Indian Plants, Vol. III. Botanical Survey of India, Howrah.

Negi, S.S. (1989). Forest types of India, Nepal and Bhutan. Periodical experts book Agency, Delhi.

Negi, S.S. (1996). Forest types of India. In S.S. Negi (ed.) Manual of Indian Forestry, Vol I., pp.180-243. Bishen singh Mahendra Pal singh, Dehra Dun.

Noss, R.F. (1983). A regional landscape approach to maintain diversity. BioScience, 33: 700-706.

Noss, R.F. (1990). Indicators for monitoring biodiversity: a hierarchical approach. Conserv. Biol., 4: 355-364.

Pattar, R.M., Kudari, V.A. and Kanamadi, R.D. (2010) Anuran amphibian diversity, distribution and habitat use in Dharwad. In: Lake 2010: Wetlands, Biodiversity and Climate Change.

Prajapati, R.C. (2010). Biodiversity of Karnataka at a glance. Karnataka Biodiversity Board. Government of Karnataka.

Praveen, J., Subramanya, S. and Raj, V.M. (2016). A checklist of the birds of Karnataka. Indian Birds, 12:89-118.

Ramakrishna (2018). Checklist of Mammals of Karnataka. Government of Karnataka. http://www.karnataka.gov.in/kbb/Pages/Mammals-of-Karnataka.aspx.

Rescia, A.J., Schmitz, M.F., Martín de Agar, P., de Pablo, C.L., Atauri, J.A. and Pineda, F.D. **(**1994). Influence of landscape complexity and land management on woody plant diversity in northern Spain. Journal of Vegetation Science, 5: 505-516.

Shiddamallayya, N., Yasmeen, A. and Gopakumar, K. (2008). Hundred common medicinal plants of Karnataka in primary healthcare. Ind. J. traditional Knowledge, 9(1): 91-95.

Singh, N.P. (1988). Flora of Eastern Karnataka. Mittal Publications, Delhi.

Singh, N.P., Prasanna, P.V. and Kulkarni, B.G. (1999). Floristics Diversity of Karnataka. In: Mudgal & Hajra (eds) Floristic Diversity and Conservation Strategies in India. Botanical Survey of India, Kolkata.

Umapati, Y., Usha, D.N., Vedavati, G.N., Girimalleshwar, B., Veeranagoudar, D.K. and Pulikeshi, M.B. (2016). Butterfly Diversity of Karnatak University Campus, Dharwad. IOSR Journal of Environmental Science, Toxicology and Food Technology, 10:77-83.

Urban, D.L., Neill, R.V. and Shugart, H.H., Jr. (1987). Landscape ecology: a hierarchical perspective can help scientists understand spatial patterns. BioScience, 37: 119-127.

No. J-11011/1/2013-IA-I
Government of India
Ministry of Environment & Forests
IA-I Division

Paryavaran Bhawan,
CGO Complex, New Delhi

Dated: 3rd December, 2013

Office Memorandum

Sub:- Streamlining of process of Environment Clearance (EC) and Forest Clearance (FC) cases by Expert Appraisal Committee (EAC) & Forest Advisory Committee (FAC) respectively for Hydropower and River Valley Projects (HEP&RVP)-Names of Institutes capable for conducting studies.

This Ministry had reviewed the issues which are normally considered by both the EAC and FAC while examining the EC and FC cases respectively in respect of hydropower and river valley projects (HEPs & RVPs) with a view to streamlining the processes and avoiding duplication of efforts by the two Committees. Accordingly, an OM of even number dated 28.5.2013 was issued on the captioned subject.

2. Vide Para 3(ii) of the above OM, a list of Institutes for conducting Bio-diversity studies by the Project Proponents under EIA of HEP &RVP was required to be published.

3. ICFRE and WII, Dehradun have provided names of the potential Institutes in this regard, which is enclosed for information and further necessary action.

(B. B. Barman)
Director
Telefax: 24362434

To,

1. PS to Minister (E&F)
2. PPS to Secretary (E&F)/DG(Forests)/ JS (AT)/JS(MS)/IG(F)
3. Chief Secretaries of all States
4. Additional Secretary, Ministry of Power, Shram Shakti Bhawan, New Delhi. Fax 23350780
5. Environment & Forest Secretaries/Principal Secretaries of all States
6. Joint Secretary, Ministry of Power, Shram Shakti Bhawan, New Delhi. Fax 23350780
7. All the Officers of IA Division
8. Chairpersons / Member Secretaries of all the SEIAAs/SEACs
9. Chairman, CPCB
10. Chairpersons / Member Secretaries of all SPCBs/UTPCC
11. Website of the MoEF through NIC
12. Guard File

13. Indian Council of Forestry Research and Education (ICFRE)
P.O. New Forest
Dehradun 248006

14. Zoological Survey of India
M Block, New Alipore
Kolkata 700 053
Telefax: 033 24008595
Email: zsikolkata@gmail.com

15. Botanical Survey of India,
P-8, Brabourne Road,
Calcutta – West Bengal

16. Salim Ali Center for Ornithology and Natural History (SACON)
Anaikatty P.O.,
Coimbatore 641 108 (Tamil Nadu)

17. National Institute of Oceanography (NIO)
Dona Paula-Goa, 403 004

18. National Environmental Engineering Research Institute (NEERI)
Nehru Marg,
Nagpur 440020

19. Centre for Ecological Science
Indian Institute of Science
Bangalore 560 012

20. Central Arid Zone Research Institute (CAZRI)
Near Industrial Training Institute (ITI)
Light Industrial Area
Jodhpur - 342 003 (Rajasthan)

21. Indian Institute of Forest Management (IIFM)
Nehru Nagar, PO Box # 3577
Bhopal 462 003

22 Indian Institute of Remote Sensing (IIRS),
4, Kalidas Road,
Dehradun.

23 G.B. Pant Institute of Himalayan Environment and
Development (GBPIHED)
Kosi-Katarmal, Almora-263 643

24 North Eastern Regional Institute of Science and Technology (NERIST)
Nirjuli (Itanagar) - 791109
Arunachal Pradesh

25 Environment Protection Training and Research Institute (EPTRI)
91/4, Gachibowli, Hyderabad - 500 032
Andhra Pradesh

Universities

26 University of Delhi,
Delhi 110 007

27 H.N.B.Garhwal University
Srinagar –
Dist.Pauri Garhwal
Uttarakhand – 246174

28 Bharati Vidyapeeth Institute of Environment Education & Research
(Bhartiya Vidyapeeth Deemed University)
Katraj-Dhankawadi,
Pune 411 043

29 Manipal University
Manipal 576104,
Karnataka

30 Anna University
Sardar Patel Road
Chennai-600 025
Tamil Nadu

Greenko Solar Energy Private Limited
(CIN: U40108TG2010PTC067974)
Site Office: 4043, 6th Cross Road, Basavanagar, Baihongal, Belagavi Dist, Karnataka-591102
ADMIN OFFICE: Suite no.701-702, Prestige Meridian-II, No.30, M.G.Road, Bangalore, Ph.: +91 (08)25584567

Ref. No: GEPL/2019-20/CLW/191009

Appendix I

09-10-2019

To

Principal Chief Conservator of Forests (Wild life)
Aranya Bhawan,
Sankey Tank, Chowdaiah Rd,
National Highway 4, Kodandarampura,
Malleshwaram, Bengaluru, Karnataka 560012

Sub: **1260 MW Saundatti HEP (Integrated Renewable Energy with Pumped Storage Project) near Village Karlakatti, Tehsil Saundatti in Belagavi District of Karnataka by M/s Greenko Solar Energy Private Limited-Submission of Wildlife Conservation Plan for Peafowl-Approval-reg**

Sir,

M/s Greenko Solar Energy Private Limited (GSEPL) is in process of developing 1260 MW Stand alone Pumped Storage Project near Village Karlakatti, Tehsil Saundatti in Belagavi District of Karnataka. Ministry of Environment, Forest and Climate Change (MoEF & CC) while recommending the Project for Environmental Clearance has *inter-alia* directed to submit approved conservation plan for Schedule I species i.e. Peafowl reported in the study area as part of Environmental Impact Assessment (EIA) Studies as approved by MoEF & CC.

In pursuant to the said directions, the Wildlife Conservation Plan for Peafowl is herewith submitted for your kind approval**(Annexure-I)**.The plan has been prepared for Peafowl conservation with a budget of Rs. 40.00 lakhs to be allocated specifically for this work, out of total budget of Rs. 280 lakhs allocated for Biodiversity Conservation and Wildlife Management Plan in EIA report as approved by MoEF & CC.

You are requested to kindly approve the said Wildlife Conservation Plan for Peafowl at the earliest.

Thanking you
Your sincerely
M/s Greenko Solar Energy Private Limited

Authorised Signatory

Encl: As above

Greenko Solar Energy Pvt. Ltd. Bangalore

CONSERVATION PLAN FOR PEAFOWL

***Prepared For*:**

STANDALONE PUMPED STORAGE COMPONENT (1260 MW) OF SAUNDATTI INTEGRATED RENEWABLE ENERGY PROJECT

Greenko

GREENKO SOLAR ENERGY PRIVATE LIMITED, HYDERABAD

Prepared by:

RSET Environmental Consulting

R. S. Envirolink Technologies Pvt. Ltd.

402, Bestech Chambers Commercial Plaza, B-Block, Sushant Lok-I, Gurgaon

Phone: +91-124-4295383: www.rstechnologies.co.in

1. INTRODUCTION

Proposed Standalone Pumped storage component of Saundatti Integrated Renewable Energy Project (IREP) is located in Belagavi District of Karnataka. It envisages creation of reservoir near village Karlakatti under Yakkundi Gram Panchayat, Saundatti Taluk about 80 Kms from Belagavi. The Saundatti IREP is proposed in between two reservoirs i.e. Saundatti IREP Reservoir as Upper reservoir (to be constructed newly) and the existing Renuka Sagar (Malaprabha) Reservoir as Lower reservoir.

This scheme envisages non-consumptive re-utilization of 1 TMC of water of the Renuka Sagar reservoir by recirculation. The water in the Renuka Sagar reservoir (existing lower reservoir) will be pumped up and stored in the proposed Saundatti IREP reservoir (Upper Reservoir) and will be utilized for power generation. The Geographical co - ordinates of the proposed Saundatti IREP reservoir are at longitude 75° 00' 19.50" East and latitude is 15° 51' 21.84" North and that of Renuka Sagar reservoir (existing) are 15° 49' 17.15" N and 75° 05' 48.23" E. Proposed Rating of the Saundatti IREP Pump storage project is 1260 MW.

2. OBJECTIVE

Environment Impact Assessment (EIA) study of Standalone Pumped Storage Component (1260 MW) of Saundatti Integrated Renewable Energy Project has been carried out with a view to assess the impacts of project on the surrounding area so as to suggest mitigation and management measures to minimize such impacts. EIA study for such projects is mandatory as per EIA Notification of September 2006, which describes the environment clearance procedure.

While carrying out the baseline data collection as part of EIA study of Standalone Pumped Storage Component (1260 MW) of Saundatti Integrated Renewable Energy Project, peafowl have been sighted reported near the human dominated and associated surrounding habitats like agricultural fields, fellow and scrub land in the study area. According to the villagers, during day time they temporally move towards the surrounding areas like agricultural fields or water bodies for feeding while during night time roosts on the trees present in vicinity of the human settlement and also road side trees.

Since Peafowl is a Schedule-I species therefore to mitigate the impacts of various activities to be undertaken, a separate Conservation Plan has been prepared.

3. INDIA PEAFOWL

An Indian Peafowl or Peacock (*Pavo cristatus*) is a large pheasant and has been an integral part of Indians and their culture, religion and mythology for centuries. The Indian Peafowl is well recognized for its ecological and aesthetical value, and therefore, justifiably declared as the National Bird of India in the year 1963. It's a spectacularly beautiful magical looking creature and resident in India. It is widely distributed in the Indian Subcontinent (Ali & Ripley 1987). Peafowl do not migrate or travel widely. They are most common in deciduous open forest habitats.

Classification of the Species

Kingdom	*Animalia*
Phylum	*Chordata*
Class	*Aves*
Order	Galliformes
Family	Phasianidae
Genus	Pavo
Species	*Pavo cristatus*
Vernacular name	Indian Peafowl

1.3.1 Appearance

Male peacock has a spectacular glossy green long tail feathers that may be more than 60% of the total body length. These feathers have blue, golden green and copper colored eyes. The long tail feathers are used for mating rituals like courtship displays. The feathers are arched into a magnificent fan shaped from across the back of the bird and almost touching the found on both sides. Female do not have these graceful tail feathers. They have to fan like crest with whites face and throat, chestnut brown crown and hind neck, metallic green upper breast and mantle, white belly and brown back rump and tail. Their primaries are dark brown.

1.3.2 Food and Feeding Habitats

Peafowls are omnivorous; they consume insects, worms, lizards, frogs and other arthropods, reptiles and amphibians. They also feed on plant parts, flower petals, seed heads, grains, grasses and bamboo shoots. In the study area tree canopy, scrub forest, agricultural farms and grasslands supports good insect diversity which is very common food for peafowls.

1.3.3 Breeding

The female called Peahen breeds in the month of May to September. It lays 8 to 12 eggs in the bushes of *Ziziphus spp.* & other thorny species surroundings. Female hatch the eggs and hatching period is 25 to 27 days.

1.3.4 Conservation Status

In India, it is given the utmost protection by inclusion in Schedule 1 of The Wildlife (Protection) Act, 1972 (2016). Being a wide spread species, apart from the various urban habitats, it is also found in agriculture field, along stream with good vegetation and close to human habitation in semi – feral conditions. However, as per IUCN Red List, Indian Peafowl is listed under Least Concern category.

4. SIGHTING IN STUDY AREA

The data on environmental parameters was collected from the study area marked for EIA study. The Study Area for assessment of environmental baseline status was delineated as the area within 10 km radius of the main project components.

While carrying out field surveys for the collection of baseline data on various environmental parameters peafowl have been sighted near the human dominated and associated surrounding habitats like agricultural fields, fellow and scrub land. However, presence of peafowl could not be established near the core zone of the project i.e. areas where major construction activities are proposed.


Peafowl sighted during field survey

5. THREATS

Threats to the peacock are:

- Habitat loss, specially the shortage of tall trees in and around the villages for roosting and for providing shade during hot summer months.
- Shortage of drinking water for the birds during the hot summer days.
- Conflict with farmers during cropping season.
- Casualties caused by eating chemically treated agricultural crop seeds.

- Illegal hunting to meet the demand for feathers and wild meat.
- Predators: Foxes, Dogs, Snakes, Monitor Lizards, Jungle Cat and Jackals
- No direct impact on the Peafowl will be done due to the proposed project as their presence has not been established near the proposed construction site i.e. dam site.

6. CONSERVATION MEASURES

1. Peafowl prefers tall trees with dense foliage or thorny trees for roosting and prefer open scrub vegetation for foraging. Therefore, increasing the tree cover in the area for shelter and roosting of pea fowls is necessary. This will be achieved by planting of tree groves. Species like *Azadirachta indica* (Neem), *Madhuca longifolia* (Mahuwa), *Mangifera indica* (Aam), *Albizia sp.* (Siris), *Cassia fistula* (Amaltash), *Dalbergia sissoo* (Shesham), *Butea monosperma* (Dhak), *Acacia catechu* (Khair), *Acacia nilotica* (Babool), *Prosopis juliflora* (Kikar), trees etc. will be planted.

2. Water hole will be constructed at the area where "Peacocks" generally (nearby habitat). Location of water holes will be suggested by the forest department. Water will be supplied during summer seasons through tankers in the village to fill the ponds or water holes.

3. Plantations to be carried out near the water bodies/ water hole for habitation and water availability.

4. Development of Green belt all around the periphery of project site to control fugitive emission from the construction activity and vehicular movement. A separate green belt development plan has already been prepared and budgeted under Environmental Management Plan (EMP) of the Environmental report.

5. Small Grove of Trees to be planted in the school compounds in the villages. The groves will be protected by fencing and will be provided with one water hole as well as food for the bird.

6. Community participation by the means of organizing Seminars, Focus Group Discussion (FGD), plays, poster presentation at various levels such as school and gram panchayat. Community participation will protect the bird from

killings, predators, poaching for meat, eggs and feather etc.

7. Training to the staff & laborers in the project construction activities and make them aware of Indian Peafowl's status as National Bird of India and Schedule-I species protected under The Wildlife (Protection) Act, 1972 and related knowledge.

8. Wildlife Signage containing information about environment, wildlife, forest conservation about wildlife animals along with photographs to be displayed in and around project area.

9. Close collation from forest department for construction of infrastructure, veterinary care and cages for injured or sick deformed birds and for conservation of wildlife.

10. By conducting/ observing/ celebrating World Environment Day and Wildlife Week every year to create awareness among the locals for the conservation of Peafowl.

11. Encourage local farmers to use bio-pesticides, bio-fertilizer and vermi-composting in agriculture practices.

Further suggestion/ recommendation: -

- Restricted uses of pollutants in their habitat.
- Stopping the increased vehicle pollution, wildlife road fatalities and damaged to habitat by people to start movement towards these areas.
- To carry out census to population status of the species and know the potential threats.

7. BUDGET FOR CONSERVATION PLAN

The total budget allocated for implementation of conservation plan is **Rs. 40 lakh** out of total budget of Rs. 280 lakhs allocated for Biodiversity Conservation and Wildlife Management Plan in EIA report approved by MoEF & CC.

The said budget is divided into different activities as given in **Table 1**. The year wise expenditure of the budget is given in **Table 2**.

Table 1: Budget for Conservation Plan for Peafowl

S. No.	Conservation Activities	Expenditure (Rs. in Lakh)
1	Construction of 30 small grove of trees in different habitation area with planting of 50 sapling of tree species in each grove @ Rs. 200 per plant in consultation with forest department (6 groves per year for 5 years)	2.00
2	Maintenance of plants (watering facility, weeding etc.) @ Rs. 100 per plant per year for 5 years	4.50
3	Casualty replacement (20% of total plant species) @ Rs. 200 per plant per year	1.80
4	Construction and Deepening of 5 water holes/ natural ponds (50 x 50 m) per year in the vicinity of villages @ 0.50 lakh per water hole/ natural pond per year for 5 years	12.50
5	Awareness programme (Minimum 2 camps per year for Organization of the awareness camps, organizing play, posters, quiz competition, brochures etc.) for conservation of peafowl (Rs. 15,000 per camp per year for 10 year)	3.00
6	Close collation from forest department for construction of infrastructure, veterinary fund, ambulance with cages, rescue center, tube wells etc. for conservation of wildlife	15.20
	TOTAL	**40.00**

Table 2: Year Wise Expenditure of Conservation Plan for Peafowl

Year	Construction of 20 small tree groves in different habitation area with plantation	Maintenance of Plants	Casualty Replacement of Sapling	Construction and Deepening of Water holes/ Natural ponds	Awareness Programme	Close collation from forest department for construction of infrastructure, veterinary fund, ambulance with cages, rescue center, tube wells etc. for conservation of wildlife	Total (Rs. in Lakh)
I	0.60			2.50	0.30	1.52	4.92
II	0.60	0.30	0.12	2.50	0.30	1.52	5.34
III	0.60	0.60	0.24	2.50	0.30	1.52	5.76
IV	0.60	0.90	0.36	2.50	0.30	1.52	6.18
V	0.60	1.20	0.48	2.50	0.30	1.52	6.60
VI		1.50	0.60		0.30	1.52	3.92
VII					0.30	1.52	1.82
VIII					0.30	1.52	1.82
IX					0.30	1.52	1.82
X					0.30	1.52	1.82
TOTAL	**3.00**	**4.50**	**1.80**	**12.50**	**3.00**	**15.20**	**40.00**

Chapter 11 SUMMARY AND CONCLUSION

11.1 PROJECT DESCRIPTION

The Standalone Pumped Storage Component of Saundatti IREP envisages construction of upper reservoir (proposed) located in Saundatti Taluk of Belagavi District. The Renuka Sagar reservoir (Existing) is under operation with a live storage capacity of 29.34 TMC and Saundatti IREP reservoir is proposed for the live storage capacity of 1.00 TMC.

Proposed Scheme will involve construction of rockfill embankment with height of 43m for the length of 5776m for creation of Saundatti IREP upper reservoir of 1.03 TMC gross capacity. Intake structure and trash rack for five numbers of independent penstocks in which one penstock will be bifurcated in to two penstocks as hydraulic short circuit to connect two units will be taking off from Saundatti IREP upper reservoir. Surface Power House will be located at about 824.12 m from the intake structure and shall be equipped with four vertical-axis reversible Francis type units composed each of a generator/motor and a turbine/pump having generating/pumping capacity of 252MW/297MW and two units of 126MW/170MW respectively.

The Standalone Pumped Storage Component of Saundatti IREP envisages construction of:

- 43Maximum height of Rockfill Embankment for creation of Saundatti IREP Upper reservoir of 1.03 TMC gross storage capacity
- Power Intake Structure
- 5 nos. of each1023.46 m long and 6.0m dia surface steel lined Penstock/ Pressure Shaft in which 4 nos. will feed 4 units each of 252 MW and 1 no. will get bifurcated in to two near to power house to feed 2 units each of 126 MW
- A surface Power house having an installation of four nos. reversible Francis turbine each of 252 MW capacity and two nos. reversible Francis turbine each of 126 MW capacity operating under a rated head of 206.82 m in generating mode and 216.12 m in pumping mode.
- Tailrace Outlet Structure
- 45m wide and FSD of 6.0m Tail race channel 1749 m long connecting to the Existing Renuka Sagar reservoir.

For the development of **Standalone Pumped Storage component of Saundatti IREP**, land would be acquired for construction of project components, reservoir area, muck dumping, quarrying, construction camps and colony, etc. Based on the final project layout, land requirement has been finalized as **213.70 Ha** – 18.66 ha government land; 34.64 ha private land and 160.40 ha forest land.

11.2 DESCRIPTION OF THE ENVIRONMENT

Data on the existing environmental parameters in the study area delineated as per the approved Terms of Reference (TOR) for EIA studies by Ministry of Environment, Forests & Climate Chang (MoEF&CC), Government of India was collected to understand the present setting of the environment at the project site. The base line status is described briefly in

the following sections:

11.2.1 Physiography

The study area of the proposed project is comprised of moderately sloping, exposed rocks, and scrub vegetation. Elevation in the study area ranges from El. 550 to 850 m above MSL. The denudation landforms are visible in the form of scree slope, scarps ridges valleys, etc.

The slope in the area falling under various slope categories, nearly 63.54 % of the study area is under moderately sloping followed by the area under Gently Sloping category with 21.57% of the total area.

11.2.2 Land Use/ Land Cover

The land use/ land cover pattern of the study was interpreted from latest satellite data and the classified land use/ land cover categories interpreted. 61.95 % of the study area is comprised of agricultural fields and settlements. Forests constitute 12.66% of the area and 16.02% of the area is under waterbodies.

11.2.3 Geology & Seismicity

Detailed geological mapping (1:1000 scale) of the project area located to the northwest of Yekundi/Karlakatti suggests that the proposed layout spreads across the southern margin of the Kaladgi basin into the northern margin of Western Dharwad Craton**.**

Detailed geological mapping (1:1000 scale) with total station and reflector targets, the reservoir and its surrounding areas was carried out over 7.50 Sq. Km area to delineate rock outcrops, litho-contacts, attitude of discontinuities & to record geotechnical parameters of the rock mass, and also delineate overburden and record its geotechnical characteristics. The top layer/venier of overburden comprises of rock fragments and interspaces occupied by admixture of light brown clay-silt - sand.

In the surveyed areas, the thickness of overburden varies from 0.50m to +3.0m, at places above quartzite which is hard and massive and pinkish to whitish in colour and having colour bending structures due to mineral composition which is reflecting of bedding direction of deposition.

As the project area falls in low seismic zone-II, therefore, appropriate coefficients together with suitable safety factors would be used in the design of the major project components.

11.2.4 Meteorology

The study area of the proposed project lies in Belagavi district, located east of the Western Ghats and is situated in the northwestern part of Karnataka state. The area lies in the tropical climate zone and can be termed as semi-arid. The climate in the area is governed mainly by southwest monsoon and the year can be divided into three seasons; (i) Monsoon (mid-June to mid-October), (ii) Winter (mid-October to February) and (iii) Summer season (March to mid-June).

11.2.5 Soil

Clayey Loamy soils are predominant in the study area. The soil fertility in general varies from Low to Medium category. Based upon Nutrient Index in terms of NPK in case of Nitrogen and Potassium is Medium (2.00), in case of and Phosphorus is Low i.e. NI is 1.00. Sugarcane, cotton and vegetables are the major crops in the area.

11.2.6 Ambient Air and Noise Quality

The Ambient Air Quality monitoring was carried out conforming to the National Ambient Air Quality Standards for Industrial Residential, Rural & Other Areas and Ecologically Sensitive Areas. The concentrations of PM2.5, PM10, SO_2 and NO_X at all the sites were well within the Residential & Rural area permissible limits prescribed by National Ambient Air Quality Standard 2009 notified by CPCB.

Ambient Noise Levels were compared with the Ambient Air Quality Standard in respect of noise and results shows that the ambient noise level in the study area also well within permissible limits as per CPCB standards.

11.2.7 Water Quality

The data on water quality has been collected to evaluate surface water (reservoir and pond) and ground water quality (tube-wells, hand pumps, wells, etc.) in study area. The water quality in the study area in general is good. Except for agricultural activities there are no sources of pollution of water bodies in the area.

According to BIS standards for Drinking Water (2012) all the ground water samples collected from the study area fall within permissible limits of the same. The Water Quality Index of all the ground water samples fall in excellent ground water quality class.

All the samples of surface water qualify for **Class 'B'** i.e. designated best use of outdoor bathing (organized) according to Water Quality Criteria of Central Pollution Control Board. According to WQI surface water quality in general is in Good category throughout the study area.

11.2.8 Floristic Diversity

Agriculture is dominant land use pattern in the study area, cotton, sugarcane, maize and vegetables are the main crop in the area. The factors responsible for degradation of forests are anthropogenic activities. Forest land in the area was encroached by villagers resettled due Renuka Sagar reservoir (Malaprabha Dam) for farming. There are small patches of forests mostly secondary in nature are dominating by *Corymbia citriodora* (Eucalyptus) species associated with *Acacia auriculiformis, Acacia nilotica, Ziziphus jujuba, Azadirachta indica, Lannea coromandelica, Bauhinia racemosa.* According to 'A Revised Survey of the Forest Types of India' by Champion and Seth (1968) the forests types are under Tropical Dry Deciduous Forest and Tropical Thorn Forest.

According to Rodgers & Panwar (1988) biogeographic classification the regions falls in Biogeographic zone (6) Deccan Peninsula; Deccan South (6E) biotic province.

Based upon earlier field surveys an inventory of 170 flowering plant species belonging to 51 families was prepared. This list includes 65 species of trees, 35 species of shrubs and 70 herbaceous species.

During additional study survey 66 species of trees, 25 species of shrubs and 51 herbaceous species were recorded from the study area (refer **Table 3.65)**. In addition to 170 species recorded during earlier survey 10 new species (1 tree, 3 shrubs and 6 herbs) viz; *Macaranga peltata, Cassia auriculata, Randia dumetorum, Wattakaka volubilis, Vernonia cinerea, Mimosa pudica, Erianthus munja, Setaria glauca, Thysanolaena agrostis* and *Hedyotis puberula* were observed in the study area. All the species recorded during additional study survey are under least concern category of IUCN Redlist 2020.1.

11.2.9 Faunal Diversity

Mammals: During additional study field survey *Semnopithecus entellus* (Grey Langur), *Macaca mulatta* (Rhesus macaque) *Funambulus palmarum* (Indian Palm Squirrel), *Herpestes auropunctatus* (Small Indian Mongoose) and *Lepus nigricollis* (Common hare) are the mammalian species sighted from the study area. All these species are common in study area and also sighted during earlier survey carryout out in study area.

Avifauna: A total of 41 species of bird species belonging to 28 families were reported based on three season survey in the study area. During addition study survey 32 bird species were sighted from the study area. Among these 32 bird species 16 species were sighted only during additional study survey.

As per IUCN Red list of Threatened Species. Version 2020.1 all species reported during additional study are under Least Concern (LC) category of IUCN Redlist of Threatened species. According to IWPA 1972 all species recorded from the study area are under Schedule IV and V, only one bird species falls under Schedule I i.e. *Pavo cristatus* (Indian Peafowl).

11.2.10 Proximity to Protected Area

Ghataprabha Bird Sanctuary is about 38.40 kms aerial distance from the proposed project reservoir area of the Standalone Pumped Storage Component of Saundatti IRE Project.

11.2.11 Social Environment

The Study Area for the collection of data on socio-economic status has been delineated as the area within 10 kms radius of the main project components like proposed reservoir area, powerhouse, tailrace channel, muck dumping site etc. All project components as well as entire study area falls under Saundatti taluka (Parasgad) in Belagavi district. Socio-economic profile of the study area covering aspects like demography, occupational pattern, literacy rate and other important socio-economic indicators of the villages. The baseline socio-economic profile is based on field survey and Census of India 2011.

Due to project construction, only one Village i.e. Karlakatti is directly affected by the project due to acquisition of land. A total of 13 villages will be directly or indirectly affected by the project activities of proposed Stanalone Pumped Storage component of Saundatti IREP.

The study area villages have 6365 households with a total population of 32726, of which the males 16645 and females 16081. The sex ratio is 966 females per thousand males. Murgod is the largest village with maximum number of households (2312) with a population of 11551 whereas Mallur is smallest with 70 households and a population of only 326 persons. The population of Scheduled Castes and Scheduled Tribes in the study area villages is 18.74% and 18.25 %, respectively. The male and female literate population is 10738 and 7525 respectively, which implies that the literacy rate of the affected villages is 58.4 %of which the male 58.8% while the female 41.2 %. Murgod village has the highest literacy rate (64.7 %) while Sompura Village has the least literacy rate of 30.8 %.

In the study area villages education facilities are good upto middle school for secondary and senior secondary education students travel upto 2 to 5 kms and for higher education. Basic amenities in terms of electricity and driniking water facilities, Fair price shop is available in all the villages. Road & transporation facility in the area is good. All villages in the project area are well contacted with State Highway through metallic road. Banking and Postal services are not adequate in all the villages. For banking facility villagers depend on the only bank located at Yaragatti. The telecommunication facilities are good in the area. The mobile cellular network is also available in the study area.

Medical facilities in the area are also poor, villagers depend on Primary Health Center at Karlakatti or district Hospital at Belagavi.

11.3 ANTICIPATED ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

11.3.1 Ambient Air Quality

Construction Phase Impacts: The air environment around project site is free from any significant pollution source at present. Vehicles and stationary equipment will impact air quality at the construction site through emissions from the engines and equipment, fugitive emissions due to material handling, etc. Additionally, construction activities including operation of crushers, concrete batch plants, construction work and movement of vehicles along unpaved road will generate dust & gaseous emission and impact air quality. In absence of proper fuel, construction workers at the project site may use wood for fuel burning and space heating. This will also impact air quality.

Operation Phase Impacts: In hydropower project, air pollution occurs mainly during project construction phase. During operation phase, no impacts are envisaged on air environment.

11.3.2 Noise Environment

Construction Phase Impacts: Sources of noise will be the vehicles and equipment for excavation and stationary equipment, including concrete batch plant located at the construction sites. Other sources of noise will be the use of explosives for blasting purposes for construction activities, drilling machines and quarrying and crushing activities.

Operation Phase Impacts: No major impacts are envisaged on noise environment during

project operation phase.

11.3.3 Water Environment

Construction Phase Impacts: The major sources of water pollution during project construction phase are as follows:

- Sewage from Construction work camps/colonies
- Effluent from Construction Plants and Workshops
- Disposal of muck

Operation Phase Impacts: Proposed pumped storage component of Pinnapuram IRE project is not planned on any natural water body/river. Reservoir water requirement will be met once and thereafter only small quantity will be added to compensate for evaporation losses/leakages. Therefore, no direct impacts on natural water bodies during operation are envisaged.

11.3.4 Land Environment

Construction Phase: The following positive impacts are anticipated on Land environment during construction phase

- **Impact due to Land Requirement and change in land-use:** Major impact of land acquisition is permanent change of land use, which is irreversible impact. These impacts cannot be mitigated; however, providing adequate compensation to private land owners, compensation in terms of implementation of Compensatory Afforestation Plan, Biodiversity Conservation Plan will help in managing and reducing the magnitude of such impacts.

- **Impact Due to Muck Generation:** Muck generation, transportation and disposal can significantly impact the land environment, if not managed properly.

- **Impact due to Waste Generation**: The main sources of waste generation can be categorized as:
  - Municipal waste (includes commercial and residential wastes generated in either solid or semi-solid form excluding industrial hazardous wastes and bio-medical wastes)
  - Construction and demolition debris (C&D waste)
  - Bio-medical waste
  - Hazardous waste (generated from construction machinery and equipment)
  - e-Waste (computer parts, Printer cartridges, electronic parts, etc.,).

- **Impact on Forests and Forest Land**: The total land required for the construction of proposed project activities is approximately 2**13.70 ha** with **160.40 ha** of forestland. This shall lead to loss of some of the plant species used for various economic purposes because of creation of reservoir on forested areas. This impact is partially mitigated by implementation of Compensatory Afforestation Plan as well as Biodiversity Management Plan.

Operation Phase: On completion of the construction of the project, the land used for construction activities will be restored and creation of green belt around the project site

provide suitable habitat for the wildlife in the area.

11.3.5 Flora and Fauna

The construction of proposed project require acquisition of **160.40 ha** forest land. This may impact the floral and faunal diversity of the area. Following impacts are anticipated on flora and fauna during construction of proposed project:

Impact on Terrestrial Flora: The direct impact of construction activity is generally limited in the vicinity of the construction sites only. A large population including technical staff and workers are likely to congregate in the area during construction phase. Workers residing in the area may use fuel wood, if no alternate fuel is provided. Hence, to minimize such impacts, it is proposed to provide alternate to the construction workers.

Impact on Terrestrial Fauna: During the construction period, large number of machinery and construction workers shall be mobilized, which may create disturbance to wildlife population in the vicinity of project area. The operation of various equipment will generate significant noise, especially during blasting which will have adverse impact on fauna of the area. Likewise siting of construction plants, use of explosives, workshops, stores, labour camps etc. could also lead to adverse impact on fauna of the area. These impacts cannot be mitigated, however, compensation in terms of implementation of Compensatory Afforestation Plan and Biodiversity Conservation Plan will help in managing and reducing the magnitude of such impacts.

Operation Phase: On completion of the construction of the project, the land used for construction activities will be restored. Construction workers who have resided in that area will move to another project site. Creation of green belt around the project site provide suitable habitat for the wildlife in the area.

11.3.6 Socio-Economic Environment

A project of this magnitude is likely to entail both positive as well as negative impacts on the socio-cultural fabric of area.

a) Positive Impacts on Socio-Economic Environment

The following positive impacts are anticipated on the socio-economic environment during the project construction and operation phases:

i) A number of marginal activities and jobs would be available to the locals during construction phase.
ii) Developer bringing large scale investment for local area development. Education, medical, transportation, road network and other infrastructure will improve.
iii) The availability of alternative resources provided by developer in the rural areas will reduce the dependence of the locals on natural resources such as forest.

b) Negative Impacts on Socio-Economic Environment

i). Impact due to influx of outside population may lead to various social and cultural conflicts during the construction stage.
ii). Increased incidence of Diseases

11.4 ENVIRONMENTAL MONITORING PLAN

Monitoring shall be performed during all stages of the project (namely: construction and operation) to ensure that the impacts are no greater than predicted, and to verify the impact predictions. The monitoring program will indicate where changes to procedures or operations are required, in order to reduce impacts on the environment or local population. The monitoring program for the proposed project will be undertaken to meet the following objectives:

- To monitor the environmental conditions of the project area and nearby villages;
- To check on whether mitigation and benefit enhancement measures have actually been adopted and are proving effective in practice;

11.5 ADDITIONAL STUDIES

11.5.1 Rehabilitation and Resettlement Plan

This section discusses the process of land acquisition of private land. The total private land for various construction activities is about 34.64 ha. The private land required for the project is proposed to be purchased through a voluntary sale with a willing buyer and seller process.

In this context it is to be noted that the total private land proposed to be purchased through private negotiations for the Standalone Pumped storage component of Saundatti IRE Project is about 34.64 ha (85.60 acres). The proposed land falls in rural areas and nature of the land is irrigated agricultural land. As the total private land required exceeds the above specified limits by the relevant rules notified by the Government of Karnataka, the provisions related to rehabilitation and resettlement under RFCTLARR, 2013 shall apply for the proposed Project.

11.5.2 Public Consultation

On completion of draft EIA report and executive summary in English and local language (Kannad), report was submitted to Karnataka State Pollution Control Board (APPCB) to initiate the process of public consultation. Public hearing was held 7th January 2019 adjacent to Mallur Electrical Sub-station, Karlakatti village, Yakkundi Panchayat, Saundatti taluka, District Belagavi, Karnataka. The outcome of the Public Consultation process in the form of report detailing the proceedings and video of the entire event is submitted to MoEF&CC by Karnataka State Pollution Control Board.

11.5.3 Corporate Environment Responsibility (CER)

Greenko Group is committed to sustainable development at all its facilities and work to the satisfaction of all stakeholders through Corporate Environment Responsibility (CER) Policy. The aim of CER Plan is to improve the quality of life of our neighborhood communities through equitable and proactive smart initiatives in spheres of education, health, rural development, environment and livelihoods resulting in improvement of the overall local social, economic and environmental conditions. CER plan has been developed keeping in view the inputs received during public hearing and specifically addresses the needs of project affected villages.

11.6 PROJECT BENEFITS

Pumped-storage hydroelectricity allows energy from intermittent sources (such as solar, wind) and other renewables, or excess electricity from continuous base-load sources (such as coal or nuclear) to be saved for periods of higher demand. The reservoirs used with pumped storage are quite small when compared to conventional hydroelectric dams of similar power capacity, and generating periods are often less than half a day. Along with energy management, pumped storage systems are also helpful in controlling electrical network frequency and provide reserve energy.

Greenko Group has been in the process of evaluating suitable locations for such integrated projects for over an year and has identified Saundatti (Near Karlakatti Village), Belagavi District, Karnataka as possible location for the proposed Saundatti Integrated Renewable Energy Project (IREP). Saundatti IREP is envisaged as a 4.7 GW project i.e. 2.4 GW of Solar Project and 2.4 GW of wind project with storage capacity of 1260/14616 MWH.

With this in view, Greenko Group has undertaken feasibility studies to harness the wind and solar potential within the state of Karnataka and has approached the state government to establish Integrated Renewable Energy Project (IREP) encompassing development of 600 MW Pumped Storage Energy, 1000 MW Solar Power and 400 MW Wind Power Project to be developed in Saundatti Taluk of Belgavi District. After evaluating the said proposal in the 51st SHLCC meting dtd. 02.03.2018, the Government of Karnataka, vide G.O. No. CI 83 SPI 2018, dtd. 08.03.2018 has accorded in-principle approval for the said project along with in-principal approval for lifting 1.0 TMC of non-consumptive water from Renuka Sagar reservoir by re-circulation. However, taking into consideration the requirements and demands from various State DISCOMs/STU and other consumers, Greenko Group intended to augment this capacity subsequently to develop 2400 MW Solar, 2400 MW Wind & 1260 MW Standalone Pumped Storage depending on technical feasibility and site suitability. Even though the capacity is envisaged to be augmented, particularly for the Pumped Storage component, the feasibility carried out by PP indicate that 1.0 TMC of water will suffice the purpose for establishing 1260 MW Pumped Storage with 11.60-hour storage capacity.

Further, all three components of Saundatti IREP (wind, solar & pumped storage) are in close vicinity of each other and therefore power from all three components will be pooled into common pooling station and will be connected to PGCIL/CTU sub-station at Dharwad for further supply into the National Grid. The IREP Project is a self-identified project and first of its kind and is intended to cater the dynamic needs of DISCOMs/STUs, through:

1. 24 Hours Round the Clock (RTC) Base Load Energy
2. 18 Hours Base Load Energy as per Demand
3. 12 Hour Peak Load Energy (6 hours + 6 hours)
4. Energy Storage Service, Grid Management, Frequency Management & Ancillary Services

11.7 ENVIRONMENT MANAGEMENT PLAN

Pollution generation mainly during construction phase will be in the form of air, water and noise pollution; which will be mitigated by adopting various mitigation measures and implementation of environment management plans.

11.7.1 Muck Management Plan

The construction activities would generate muck from excavation for various project structures. The total quantity of muck generated from soil and rock excavation is about **7.21 Mcum.** Of the total muck generated, about **5.33 Mcum** is expected to be utilized for Rockfill and as aggregate for construction. It is also proposed to dispose 1.00 Mcum for leveling of the Reservoir bed. Total quantity of muck proposed to be disposed in designated muck disposal area, after considering 40% swelling factor would be **1.64 Mcum**. The entire excavated material is proposed to be dumped at two locations identified specifically for this purpose.

The estimated cost of the relocation and rehabilitation of excavated material will be **Rs.385.28 lakh.**

11.7.2 Landscaping and Restoration of Construction Sites

The proposed project would involve construction of project roads, power house, tailrace channel, residential and staff colonies, roads, etc. These activities will result in modification of the existing landscape of the area. It is therefore imperative that after the project work and related activities are over, restoration works should be carried out in these areas to bring them back to their similar or near-similar pre-construction conditions and land use.

The estimated cost of restoration of construction is **107.00 lakhs.**

11.7.3 Public Health Delivery System

Project construction and operation will bring about several changes in the socio-economic environment of the area including increased threats to health of the community.

i. New Diseases due to Migratory Population
ii. Chances of increase in water borne diseases as malaria, and dengue are high
iii. Chances of increase in respiratory troubles due to increase in suspended particles during the construction phase.
iv. Chances of occurrence of gastroenteritis, cholera and typhoid in the labour camps.

Medical services at secondary level play a vital and complimentary role to the tertiary and primary health care systems and together form a comprehensive district based health care system. Following activities are proposed:

- Ambulance: 2 no. with all the basic Medicare facilities and small DG set, etc. to cater for villages in the project area.
- Budget for running the ambulances including driver, fuel and maintenance for 3 years.
- First aid posts including sheds, furniture and basic equipment.
- Budget for running the first aid post including cost of medico, para-medico/Nurses and attendant, consumables, etc. for 3 years.

- Budget for strengthening existing medical facilities.
- Budget for Health Awareness/ Vaccination Camps for 3 years.

Budgetary estimates for public health delivery system to be implemented have been worked out as **Rs. 147.00 lakh.**

11.7.4 Sanitation and Solid Waste Management

Solid waste generated from temporary and permanent colonies in construction as well as operation phase requires special management for disposal. The project authorities will ensure sewage generated from labour colonies and site office is treated and disposed as per the SPCB guidelines. Various aspects of solid waste management include:

- Reuse/Recycling
- Storage/Segregation
- Collection and Transportation
- Disposal

It is proposed to provide adequate septic tanks with soak pits for treatment and disposal of sewage. This waste will be collected, segregated and disposed off in line with the provisions laid down in Solid Waste Management Rules, 2016. The total budget in order to manage the solid waste generated from this population, provisions for community toilets for labours and nearby villagers as well as septic tanks and soak pits, has been proposed as **Rs. 186.16 lakh**

11.7.5 Energy Conservation Measures

The existing facilities will become insufficient for supply of kitchen fuel for the migrant population during the construction of the project. Therefore, the project authorities would make adequate arrangements such as Community kitchen, Supply of Kitchen fuel, efficient cooking facilities and solar lantern either directly by developer or through contractor to reduce the pressure on natural resources in the project area and minimize impacts on this count. A total budget of **Rs. 185.00 lakhs** have been proposed under Energy Conservation Plan.

11.7.6 Mitigation Measures for air, water and noise pollution

Saundatti IREP Standalone Pump Storage Project involves construction of reservoir other associated infrastructure, and construction period is planned for 36 months. Major construction activities have serious potential of pollution generation and impacts all components of environment as discussed above. Impacts arising out of construction activities can be mitigated significantly by taking appropriate mitigation measures, as discussed below.

11.7.6.1 Air Pollution

The various sources causing air pollution during the construction phase are crushing, transportation of material in open trucks, open dumping in muck disposal sites, vehicle movements, operation of Diesel Generator Sets, etc.

Control of Air Pollution: For the control of air pollution during construction phase of the project, it is suggested that it should be made mandatory for the contractor/s engaged in the construction works to ensure the implementation of pollution control measures as per CPCB guidelines with regular monitoring of ambient air quality in the project area. Necessary clause shall be incorporated in the contractor's agreement.

11.7.6.2 Noise Pollution

Various sources of noise pollution in the project area during the construction phase include vehicular movement, operation of heavy machinery, crushing, aggregate processing plants, diesel generator sets, etc.

Control of Noise Pollution: Various measures for control of noise pollution in the project area are suggested below:

- Diesel Generator sets are to be placed in acoustic enclosures to reduce the noise.
- Ear protection aids such as ear plugs, earmuffs, etc., must be provided to the workers who have to work in the noise prone area.
- Proper and regular maintenance/lubrication of machines should be done.
- Noise producing machines (such as crushers, aggregate processing plants, etc.) should be provided with sound barriers.
- Quieter machines and vehicles with high quality silencers should be used.
- Afforestation around the residential colonies and office complexes should be done as proposed under the Afforestation Programmes.
- Ambient noise should be monitored periodically at different locations.

11.7.6.3 Water pollution

Various sources of water pollution in the project area during the construction phase include disposal of effluents with high turbidity from crushers commissioned at project site and effluents from construction sites.

Control of Water Pollution: To avoid deterioration of water quality of the receiving water body following measures are suggested

- Provision of septic tank/ soak pit of adequate capacity for labour camp.
- Construction of settling tank to settle the suspended impurities from various sources i.e. HMP/ crushers, labour camps, etc. before discharging into the main stream
- Commission of suitable treatment facilities to treat the sewage generated from the colony
- Provision of sedimentation cum grease traps to prevent entry of contaminants to the water bodies.
- Oil interceptors shall be provided and residue of petroleum products will be disposed off in accordance with PCB guidelines.

11.7.7 Biodiversity Conservation & Wildlife Management Plan

Habitat degradation, land use /land cover changes, hunting and poaching, invasiveness of exotic species are main threats to biodiversity and wildlife. Keeping in view of the anticipated impacts, the main objectives of biodiversity conservation and wildlife management plan are as follows:

i. Wildlife Habitat Preservation & Improvement
ii. Conservation Plan for Schedule I species
iii. Establishment of Eco Park
iv. Development of Grass land
v. Biodiversity monitoring
vi. Awareness promotion
vii. Strengthening of Infrastructural Facilities of Forest Department
viii. Biodiversity Management Committee (BMC)

The estimated cost of implementation of various activities envisaged in the Biodiversity Conservation and Management Plan would be **Rs. 280.00 lakh**.

11.7.8 Green Belt Development Plan

Green belt development will comprise of plantations at various places like periphery of Reservoir, alongside roads and at different project offices and colonies. The green belt helps to provide habitat for faunal species and capture the fugitive emission and to attenuate the noise generated apart from improving the aesthetics environment in the area. The estimated cost for the plantations and creation of green belt around colony and working sites would be **Rs. 42.50 lakh.**

11.7.9 Compensatory Afforestation Plan

The Standalone Pumped Storage component of Saundatti IRE Project is being constructed in the jurisdiction of Gokak Forest Division in Belagavi district, Karnataka. The total forest land required for the construction of proposed project activities **160.40 ha**.

The compensatory afforestation is proposed to be undertaken on Non-forest land identified in consultation with the State Forest Department and District administration. The estimated cost of Compensatory Afforestation programme with cost of non-forest land acquired for afforestation programme is **Rs. 2561.40** lakh.

Forest in the project area fall in the Eco Class IV as being of type Consisting of Tropical Thorn Forests and Tropical Dry Evergreen Forests therefore NPV @ Rs. 6.26 lakhs/ha would be required to be deposited in the Compensatory Afforestation Fund. The total cost of NPV has been computed as **Rs. 1004.104** lakh.

The total cost of the compensatory afforestation plan, NPV, compensation of trees and cost of damage to fence and infrastructure is **Rs. 3565.504 lakh**.

11.8 SUMMARY OF COST

The costs involved for implementation of Environmental Management Plan and Corporate Environment Responsibility Plan for Standalone Pumped Storage Component of Saundatti IRE Project are summarized in the table given below. The total expenditure on Environmental Management Plan and Corporate Environment Responsibility Plan will be about **Rs**. **8762.34 lakh (Table 11.1)**

Table 11.1: Cost for Implementing Environmental Management Plan & CER Activities

Sl. No	Component of EMP	Capital Cost (Rs. In lakh)	Recurring Cost (Rs. In lakh)			Total Cost (Rs. In lakh)
			Year 1	Year 2	Year 3	
1	Biodiversity Conservation & Wildlife Management Plan	280.00	-	-	-	**280.00**
2	Muck Dumping and Management Plan	-	162.64	162.64	60.00	**385.28**
3	Solid Waste Management Plan	115.00	23.72	23.72	23.72	**186.16**
4	Public Health Delivery System	60.00	29.00	29.00	29.00	**147.00**
5	Energy Conservation Measures	65.00	40.00	40.00	40.00	**185.00**
6	Landscaping, Restoration and Green Belt Development Plan	17.50	0.00	0.00	132.00	**149.50**
7	Environmental Monitoring Program	4.00	28.30	28.30	28.30	**88.90**
8	Rehabilitation and Resettlement Plan	517.50	-	-	-	**517.50**
9	Disaster Management Plan		25.00	25.00	225.00	**275.00**
	Total	**1059.00**	**308.66**	**308.66**	**538.02**	**2214.34**
Other Costs						
11	Compensatory Afforestation (estimated cost)	**3565.50**				**3565.50**
12	CER Budget	-	995.00	995.00	992.50	2982.50
Total		**4624.50**	**1303.66**	**1303.66**	**1530.52**	**8762.34**

*****_Cost of Air, Water & Noise Management Plan is considered in Environmental Monitoring Plan_

**Actual cost of Compensatory Afforestation will be finalized by forest Department.

Chapter 12 DISCLOSURE BY THE CONSULTANT

12.1 DISCLOSURE BY THE CONSULTANT

Final EIA report of Standalone Pumped Storage Component of Saundatti IREP has been prepared by M/s RS Envirolink Technologies Pvt. Ltd., (RSET) Gurgaon which is a QCI-NABET accredited company to undertake River Valley, Hydroelectric, Drainage and Irrigation Projects (Category 'A') according to the TOR approved by MoEF&CC. Certification and contact details are:

Certificate No : NABET/EIA/1922/RA 0152
Validity : August 14, 2022
Contact Person : Mr. Ravinder Bhatia
Name of Sector : River Valley and Hydroelectric Projects
Category : A
MoEF Schedule : I(C)
Address : 403, Bestech Chambers, Block-B, Sushant Lok Phase I, Sector 43, Gurugram, Haryana - 122009.
E-mail : ravi@rstechnologies.co.in
Land Line : (0124) 4295383
Cellular : (+91) 9810136853

A copy of the Accreditation certificate along with the list of experts involved is appended at the beginning of the report.

R S Envirolink Technologies Pvt. Ltd (RSET) is a multi-disciplinary environmental consulting company with special focus on River Valley, Hydel, Drainage and Irrigation projects. RSET was established in 2007 as a specialized consulting Service Company, focused to provide entire gamut of environmental services for water resource development projects. We have in-house expertise and have a compact team of consulting professionals providing comprehensive, responsive and high-quality services primarily in the field of natural resources management, environment, environmental audits and due diligence, environmental impact assessment, environmental management plan, environmental modeling, environmental monitoring and compliance status evaluation, hydrology, geology, Remote Sensing & GIS and modeling using these latest tools, techniques and technologies with projects extending across the Himalaya and hilly and mountainous regions of India. Various studies, we undertake, include:

- Environmental Impact Assessment
- Environmental Management Planning and Implementation
- River Basin/Carrying Capacity Studies
- Ecological Studies including Aquatic Ecology
- Biodiversity Conservation and Management Planning
- Assessment of Ecological Flow Requirement
- Glacial Lake Outburst Flood (GLOF) Modeling

- Dam Break Modeling and Disaster Management Plan; Hydrological and Hydro-dynamic modelling
- Catchment Area Treatment (CAT) Plan, Watershed modelling, Watershed Analysis, Rehabilitation, Inventories and Management Planning
- Remote Sensing and GIS: All aspects related to applications of Remote Sensing and GIS especially in the field of natural resources management.
- Socio-economic studies
- Surface Water Hydrology, Water Quality, and Erosion Control
- Environmental Monitoring

RSET is on the list of Consultants who are permitted to appear before Expert Appraisal Committee (EAC) and State Expert Appraisal Committee (SEAC) and can certify various documents including Environment Impact Assessment (EIA)/ Environment Management Plan (EMP) reports under the accreditation scheme for EIA consultants with Quality Council of India (QCI)/National Accreditation Board for Education and Training (NABET). Environment Impact Assessment (EIA) Consultant Accreditation Scheme has been developed which has been adapted as minimum requirement by Ministry of Environment, Forest & Climate Change (MoEF&CC), Government of India.

We would like to mention that RSET has significant experience of working on environmental impact assessment studies. We have successfully completed and got environmental clearances from MoEF&CC/SEIAA for 42 River Valley, Hydel, Drainage and Irrigation projects. Presently we are involved with around 10 similar studies which are at various stages of progress.

RSET's core competence includes **Environment & Social Impact Assessment (ESIA)** of hydro power, solar power, drinking water supply and transmission & distribution projects according to **World Bank, IFC's performance standards, NDB and Equator principles**.

ANNEXURES

Annexure - Ia

No. J-12011/11/2018-IA.I(R)
Ministry of Environment, Forest & Climate Change
Government of India

Indira Paryavaran Bhawan
3rd Floor, Vayu Wing
Jor Bagh Road
New Delhi-110 003.

Date: 18th May, 2018

To,

The Authorised Signatory
M/s Greenko Energies Private Limited
Plot no.1071, Road No.44,
Jubilee Hills, Hyderabad-500033, Telangana.

Sub: 1200 MW Saundatti HEP (Integrated Renewable Energy with Pumped Storage Project) near Village and Tehsil Suandatti in Belagavi District of Karnataka by M/s Greenko Energies Private Limited.– reg. Terms of Reference (ToR).

Sir,

This has reference to online application no. IA/KA/RIV/74600/2018 dated 16.4.2018 on the above mentioned subject.

2. It has been noted that Proposed Saundatti Integrated Renewable Energy with Storage Project (IRESP) located in Belagavi District of Karnataka which will have a 4.8 GW project i.e. 2.4 GW of Solar Project and 2.4 GW of wind project with storage capacity of 1200/ 9600 MWH. Saundatti IRESP- Storage Project will comprise of two reservoirs i.e. Renuka Sagar Reservoir (already existing) and Saundatti IRESP Reservoir (to be constructed in natural depression). This project is a one of its kind because the proposed reservoir is not located on any river course and the existing Renuka Sagar reservoir is located across river Malaprabha which is a tributary of River Krishna. The proposed Saundatti IRESP reservoir is in a natural depression and it is far away from any river course.

3. It has been informed that the Pumped Storage Scheme stores energy in the form of gravitational potential energy of water, pumped from a lower elevation reservoir to a higher elevation. Low-cost surplus off-peak electric power generated from wind energy and solar energy is typically used to run the pumps. During periods of high electrical demand, the stored water is released through turbines to produce electric power. Although the losses of the pumping process make the plant a net consumer of energy overall, the system increases revenue by selling more electricity during periods of peak demand, when electricity prices are highest which will supply firm dispatchable renewable power to the grid for 24 hrs.

4. The scheme envisages non-consumptive re-utilization of 1 TMC of water of the Renuka Sagar reservoir by recirculation. The water in the Renuka Sagar reservoir (lower reservoir) will be pumped up and stored in the proposed Saundatti IRESP reservoir (upper Reservoir) and will be utilized for power generation. The Proposed Rating of the Saundatti Pump storage project is 1200 MWH by utilizing a design discharge of 925.68 Cumec and rated head of 149.82 m. The Saundatti IRESP will utilize 1360 MW to pump 1.0 TMC of water to the upper reservoir in 9.2 hours.

5. The Salient Features of the Project are as below:

1	**Saundatti IRESP Upper Reservoir (Now Proposed)**	
	Catchment Area	0.386 sq. km
	Live Storage	1.01 TMC
	Dead Storage	0.74 TMC
	Gross Storage	1.75 TMC
	Full Reservoir level (FRL)	EL +793.00 m
	Dimensions of earthen dam (Length x Height x Width)	435.0 m x 96.0 m x 6.0 m
2	**Renuka Sagar Lower Reservoir (Existing)**	
	Catchment Area	2176 sq. km
	Live Storage	34.346 TMC (972.56 Mcum)
	Dead Storage	3.385 TMC (95.85 Mcum)
	Gross Storage	37.731 TMC (1108.41 Mcum)
	Full Reservoir level (FRL)	EL +633.832 m
3	**Power Intake**	
	Type	Open Semi Circular
	Elevation of Intake center line	EL +745.26 m
4	**Head Race Tunnel**	**Concrete lined**
	No. and Dimensions	2 nos. and 817m x 12.0m dia
5	**Tail Race Tunnel**	**Concrete Lined**
	Type of tunnel	Trapezoidal
	Width & Length of each Tunnel	55.0 m & 2390 m
6	**Powerhouse**	
	Type	Surface Power House
	Dimensions	L 200.0 m x B 24.0 m x H 56.50 m
7	**Parameters of Storage Plant**	
	Storage Capacity	9600 MWH
	Rating	1200 MWH
	No. of Units	7 (5 x 200 MW + 2 x 100 MW)
	Turbine Capacity	200 MW / 100 MW
	Total Design Discharge	925.68 Cumec
	Rated Head in Turbine mode	149.82 m
	Pump Capacity	230 MW / 105 MW

6. Total land required for the construction of various components is about 259.03 Ha. About 172.48 Ha out of 259.03 is part of Kagehala forest under Savadati Range. Application for diversion of forest land is yet to be submitted. There are no wildlife sanctuaries, national parks and other protected areas within 10 km radius of proposed project.

7. By constructing a 817 m long twin tunnel and Power house complex, Surge chamber, Tailrace Channel, etc., the quantity of muck to be generated is estimated to be about 72.15 lakh Cum. It is expected that about 57.90 lakh Cum of this will be used for making aggregates which will be used in construction of various roads and buildings. The remaining quantity will be disposed-off in a planned manner. It is proposed to dump about 10.00 Lakh Cum of muck in the reservoir bed as there is no water course is existing and the remaining quantity of muck is proposed to dump in 3 different locations of dumping sites and they are to be identified at suitable places.

8. The Suandatti IRESP is envisaged to be completed in a period of 3.0 years. The project cost works out to Rs. 4,985.80 Crores. About 400 workers and 100 technical staff are likely to work during the peak construction phase in the project area.

9. The above proposal was appraised by the Expert Appraisal Committee (EAC) for River Valley & Hydroelectric Power Projects (RV & HEP) in its 13th meeting held on 27.4.2018. The comments and observations of EAC may be seen in the Minutes of the meeting that are available on the Ministry's website.

10. In view of the recommendations made by the EAC (RV&HEP) in its 13th meeting held on 27.4.2018 and the information/clarifications submitted by you with regard to the above-mentioned project proposal, **the Ministry hereby accords a fresh clearance for pre-construction activities at the proposed site along with the following Terms of Reference (ToR) for the proposed project under Schedule 1(c) of the EIA Notification, 2006 and its amendments issued time to time, for the preparation of EIA/ EMP report**:

a) The EIA/EMP report should contain the information in accordance with provisions & stipulations as given in the ***Annexure-I***.
b) The consultant engaged for preparation of EIA/EMP report has to be registered with Quality Council of India (QCI/ NABET under the scheme of Accreditation & Registration of MoEF. This is a pre-requisite.
c) Consultant shall include a "Certificate" in EIA/EMP report regarding portion of EIA/EMP prepared by them and data provided by other organisation(s)/ laboratories including status of approval of such laboratories.
d) The draft EIAA/EMP report prepared as per ***Annexure-I*** should be submitted to the State Pollution Control Board Committee concerned for conducting Public Consultation as per the provisions stipulated in EIA Notification of 2006. Public Hearing, which is a component of Public Consultation, shall be held district wise at the site or in its close proximity as prescribed in Appendix (IV) of EIA Notification, 2006. The draft EIA/EMP report is to be submitted to SPCB etc. sufficiently before the expiry of the ToR validity so that necessary amendments in EIA/EMP can be undertaken based on public hearing and the same is submitted to MoEF&CC before expiry of validity.
e) All issues discussed in the Public Hearing / Consultations should be addressed and incorporated in the EIA/EMP report. Final EIA/EMP report should be submitted to the Ministry for Environmental Clearance only after incorporating these issues before the expiry of validity of ToR.
f) The ToR will remain valid for a period of 4 years from the date of issue of this letter for submission of EIA/EMP report along with public consultation. The ToR will stand lapsed on completion of 4 years in case final EIA/EMP is not submitted and the validity is not extended.
g) In case of any change in the scope of the project such as capacity enhancement, change in submergence, etc., fresh scoping clearance has to be obtained by the project proponent.
h) The PP should submit a copy of TEC of the DPR along with EIA/EMP report.
i) Information pertaining to Corporate Environmental Responsibility and Environmental Policy shall be provided in the EIA/EMP Report as per this Ministry's OM No. 22-65/2017-IA.III dated 1.8.2018 (Reference as ***Annexure-II***)
j) The EIA/ EMP report must contain an Index showing details of compliance of all TOR conditions. the Index will comprise of page no. etc., vide which compliance of a specific ToR is available. It may be noted that without this index, EIA/ EMP report will not be accepted.

k) In case the validity is to be extended, necessary application is to be submitted to Regulatory Authority before expiry of validity period together with an updated Form-I based on proper justification.

This has approval of the Competent Authority.

Yours faithfully,

(Dr. S. Kerketta)
Director, IA.I

Copy to:

1. The Secretary, Ministry of Power, Shram Shakti Bhawan, Rafi Marg, New Delhi 110001.
2. The Secretary, Ministry of Water Resources, Shram Shakti Bhawan, Rafi Marg, New Delhi – 1.
3. The Chairman, Central Electricity Authority, Sewa Bhawan, R.K. Puram, New Delhi-110066.
4. The Chief Engineer, Project Appraisal Directorate, Central Water Commission, Sewa Bhawan, R. K. Puram, New Delhi – 110 066.
5. The Chairman, Central Pollution Control Board, Parivesh Bhawan, CBD-cum-Office Complex, East Arjun Nagar, Delhi-110032.
6. The Additional Principal Chief Conservator of Forests (C), Ministry of Environment, Forest and Climate Change, Regional Office (SZ), Kendriya Sadan, 4th Floor, E&F Wings, 17th Main Road, Koramangala II Block, Bangalore – 560034
7. The Principal Secretary Environment, Department of Ecology & Environment, 708, M S Building, 7th Floor, Near-Vidhana Soudha, Ambedkar Veedhi, Bengaluru, Karnataka 560001.
8. The Chairman, Karnataka State Pollution Control Board, Parisara Bhavan, #49, 4th & 5th Floor, Church Street, Bangalore-560001.
9. The District Collector, Belgaum District, Commissioner, DC Compound, Main Road, Belgaum Ho, Belgaum-590001.
10. Guard file/Monitoring file.
11. Website of MoEF&CC.

(Dr. S. Kerketta)
Director, IA.I

Annexure-1

TERMS OF REFERENCE FOR CONDUCTING ENVIRONMENT IMPACT ASSESSMENT STUDY FOR 'A' CATEGORY RIVER VALLEY PROJECTS AND INFORMATION TO BE INCLUDED IN EIA/EMP REPORT

(1) Scope of EIA Studies

The EIA Report should identify the relevant environmental concerns and focus on potential impacts that may change due to the construction of proposed project. Based on the baseline data collected for three (3) seasons (Pre-monsoon, Monsoon and Winter seasons), the status of the existing environment in the area and capacity to bear the impact on this should be analyzed. Based on this analysis, the mitigation measures for minimizing the impact shall be suggested in the EIA/EMP study.

(2) Details of the Project and Site

- General introduction about the proposed project.
- Details of project and site giving L-sections of all U/S and D/S projects of River with all relevant maps and figures. Connect such information as to establish the total length of interference of Natural River and the committed unrestricted release from the site of diversion into the main river.
- A map of boundary of the project site giving details of protected areas in the vicinity of project location.
- Location details on a map of the project area with contours indicating main project features. The project layout shall be superimposed on a contour map of ground elevation showing main project features (viz. location of dam, Head works, main canal, branch canals, quarrying etc.) shall be depicted in a scaled map.
- Layout details and map of the project along with contours with project components clearly marked with proper scale maps of at least a 1:50,000 scale and printed at least on A3 scale for clarity.
- Existence of National Park, Sanctuary, Biosphere Reserve etc. in the study area, if any, should be detailed and presented on a map with distinct distances from the project components.
- Drainage pattern and map of the river catchment up to the proposed project site.
- Delineation of critically degraded areas in the directly draining catchment on the basis of silt Yield Index as per the methodology of All India Soil and Land Use Survey of India.
- Soil characteristics and map of the project area.
- Geological and seismo-tectonic details and maps of the area surrounding the proposed project site showing location of dam site and powerhouse site.
- Remote Sensing studies, interpretation of satellite imagery, topographic sheets along with ground verification shall be used to

develop the land use/land cover pattern of the study using overlaying mapping techniques viz. Geographic Information System (GIS), False Color composite (FCC) generated from satellite data of project area.

- Land details including forests, private and other land.
- Demarcation of snow fed and rain fed areas for a realistic estimate of the water availability.

(3) Description of Environment and Baseline Data

To know the present status of environment in the area, baseline data with respect to environmental components air, water, noise, soil, land and biology & biodiversity (flora & fauna), wildlife, socio-economic status etc. should be collected with 10 km radius of the main components of the project/site i.e. dam site and power house site. The air quality and noise are to be monitored at such locations which are environmentally & ecologically more sensitive in the study area. The baseline data should be collected for 3 seasons (Pre-Monsoon, Monsoon and Post Monsoon). Flora -Fauna in the Catchment and command area should be documented. The study area should comprise of the following:

- Catchment area up-to the dam site.
- Submergence Area
- Project area or the direct impact area should comprise of area falling within 10 km radius from the periphery of reservoir, land coming under submergence and area downstream of dam upto the point where Tail Race Tunnel (TRT) meets the river.

(4) Details of the Methodology

- The methodology followed for collection of base line data along with details of number of samples and their locations in the map should be included.
- Study area should be demarcated properly on the appropriate scale map.
- Sampling sites should be depicted on map for each parameter with proper legends.
- For forest classification, Champion and Seth (1968) classification should be followed.

(5) Methodology for collection of Biodiversity Data

- The number of sampling locations should be adequate to get a reasonable idea of the diversity and other attributes of flora and fauna. The guiding principles should be the size of the study area (larger area should have larger number of sampling locations) and inherent diversity at the location, as known from secondary sources (e.g. eastern Himalayan and low altitude sites should have a larger number of sampling locations owing to higher diversity).

- The entire area should be divided in grids of 5km X 5km preferably on a GIS domain. There after 25% of the grids should be randomly selected for sampling of which half should be in the directly affected area (grids including project components such as reservoir, dam, powerhouse, tunnel, canal etc.) and the remaining in the rest of the area (areas of influence in 10 km radius form project components). At such chosen location, the size and number of sampling units (e.g. quadrats in case of flora/transects in case of fauna) must be decided by species area curves and the details of the same (graphs and cumulative number of species in a tabulated form) should be provided in the EIA report. Some of the grids on the edges may not be completely overlapping with the study area boundaries. However, these should be counted and considered for selecting 25% of the grids. The number of grids to be surveyed may come out as a decimal number (i.e. it has an integral and a fractional part) which should be rounded to the next whole number.

- The conventional sampling is likely to miss the presence of rare, endangered and threatened (R.E.T.) species since they often occur in low densities and in case of faunal species are usually secretive in behaviour. Reaching the conclusion about the absence of such species in the study area based on such methodology is misleading. It is very important to document the status of such species owing to their high conservation value. Hence likely presence of such species should be ascertained from secondary sources by a proper literature survey for the said area including referring to field guides which are now available for many taxonomic groups in India. Even literature from studies/surveys in the larger landscapes which include the study area for the concerned project must be referred to since most species from adjoining catchments is likely to be present in the catchments in question. In fact such literature form the entire state can be referred to. Once a listing of possible R.E.T. species form the said area is developed, species specific methodologies should be adopted to ascertain their presence in the study area which would be far more conclusive as compared to the conventional sampling. If the need be, modern methods like camera trapping can be resorted to, particularly for areas in the eastern Himalayas and for secretive/nocturnal species. A detailed listing of the literature referred to, for developing lists of R.E.T. species should be provided in the EIA reports.

- The R.E.T. species referred to in this point should include species listed in Schedule I and II of Wildlife (Protection) Act, 1972 and those listed in the red data books (BSI, ZSI and IUCN).

(6) Components of the EIA Study

Various aspects to be studied and provided in the EIA/EMP report are as follows:

A. Physical and Chemical Environment

(i) Geological & Geophysical Aspects and Seismo – Tectonics:

- Physical geography, Topography, Regional Geological aspects and structure of the Catchment.
- Tectonics, seismicity and history of past earthquakes in the area. A site specific study of the earthquake parameters will be done. The results of the site specific earthquake design shall be sent for approval of the NCSDP (National committee of Seismic Design Parameters, Central water commission, New Delhi for large dams.
- Landslide zone or area prone to landslide existing in the study area should be examined.
- Presence of important economic mineral deposit, if any.
- Justification for location & execution of the project in relation to structural components (dam height).
- Impact of project on geological environment.

(ii) Meteorology, Air and Noise:

- Meteorology (viz. Temperature, Relative humidity, wind speed/direction etc.) to be collected from nearest IMD station.
- Ambient Air Quality with parameters viz. Suspended Particulate Matter (SPM), Respirable Suspended Particulate Matter (RSPM) i.e. suspended particulate materials <10 microns, Sulphur Dioxide (SO_2) and Oxides of Nitrogen (NOx) in the study area at 6 locations.
- Existing noise levels and traffic density in the study area at 6 locations.

(iii) Soil Characteristics

- Soil classification, physical parameters (viz., texture, porosity, bulk density and water holding capacity) and chemical parameters (viz. pH, electrical conductivity, magnesium, calcium, total alkalinity, chlorides, sodium, potassium, organic carbon, available potassium, available phosphorus, SAR, nitrogen and salinity, etc.) (6 locations).

(iv) Remote sensing and GIS Studies

- Generation of thematic maps viz., slope map, drainage map, soil map, land use and land cover map, etc. Based on these, thematic maps, an erosion intensity map should be prepared.
- New configuration map to be given in the EIA Report.

(v) Water Quality

- History of the ground water table fluctuation in the study area.
- Water quality for both surface water and ground water for (i) Physical parameters (pH, temperature, electrical conductivity,

TSS); (ii) Chemical parameters (Alkalinity, Hardness, BOD, COD, NO_2, PO_4, Cl, SO_4, Na, K, Ca, Mg, Silica, Oil & Grease, phenolic compounds, residual sodium carbonate); (iii) Bacteriological parameter (MPN, Total coliform) and (iv) Heavy Metals (Pb, As, Hg, Cd, Cr-6, total Cr, Cu, Zn, Fe) (10 locations).

- Delineation of sub and micro-watersheds, their locations and extent based on the All India Soil and Land Use Survey of India (AISLUS), Department of Agriculture, Government of India. Erosion levels in each micro-watershed and prioritization of micro-watershed through silt yield index (SYI) method of AISLUS.

B. Water Environment & Hydrology

- Hydro-Meteorology of the project viz. precipitation (snowfall, rainfall), temperature, relative humidity, etc. Hydro-meteorological studies in the catchment area should be established along-with real time telemetry and data acquisition system for inflows monitoring.
- Run off, discharge, water availability for the project, sedimentation rate, etc.
- Basin characteristics
- Catastrophic events like cloud bursts and flash floods, if any, should be documented.
- For estimation of Sedimentation Rate, direct sampling of river flow is to be done during the EIA study. The study should be conducted for minimum one year. Actual silt flow rate to be expressed in ha-m km^2 year-1.
- Sedimentation data available with CWC may be used to find out the loss in storage over the years.
- Set up a G&D monitoring station and a few rain gauge stations in the catchment area for collecting data during the investigation.
- Flow series, 10 daily with 90%, 75% and 50% dependable years discharges.
- A table of 10-daily water discharges corresponding to 90% dependable year showing the intercepted discharge at the barrage, the environmental flow to be released and the other flow releases downstream of the barrage and spills to be provided in hydrology section of EIA.
- Norms for release of Environmental flows, i.e. 30% in monsoon season, 20% in lean season and 25% in non-monsoon & non-lean season to be followed corresponding to 90% dependable year. A site specific study on minimum environment flow should be carried out.
- Hydrological studies/data as approved by CWC shall be utilized in the preparation of EIA/EMP report. Actual hydrological annual yield may also be given in the report.

- A minimum of 1 km distance from the tip of the reservoir to the tail race tunnel should be maintained between upstream and downstream projects.

C. Biological Environment

Besides primary studies, review of secondary data/literature published for project area on flora & fauna including RET species shall be reported in EIA/EMP report.

(i) Flora

- Characterization of forest types (as per Champion and Seth method) in the study area and extent of each forest type as per the Forest Working Plan.
- Documentation of all plant species i.e. Angiosperm, Gymnosperm, Pteriodophytes, Bryophytes, Lichens (all groups). All species list may be provided.
- General vegetation profile and floral diversity covering all groups of flora including lichens and orchids. A species wise list may be provided.
- Assessment of plant species with respect to dominance, density, frequency, abundance, diversity index, similarity index, importance value index (IVI) , Shannon Weiner index etc. of the species to be provided. Methodology used for calculating various diversity indices along with details of locations of quadrates, size of quadrates etc. to be reported within the study area in different ecosystems.
- Existence of National park, Sanctuary, Biosphere Reserve etc in the study area, if any, should be detailed.
- Economically important species like medicinal plants, timber, fuel wood etc.
- Details of endemic species found in the project area.
- Flora under RET categories should be documented using International Union for the Conservation of Nature and Natural Resources (IUCN) criteria and Botanical Survey of India's Red Data list along-with economic significance. Species diversity curve for RET species should be given.
- Biodiversity study, a sub-component of EIA study, is to be carried-out by associating a reputed organisation/institution as recommended by WII, Dehradun or by ICFRE, Dehradun. A list of such institutes is available on MoEF"s website.
- Cropping pattern and Horticultural Practices in the study area.

(ii) Fauna

- Fauna study and inventorisation should be carried out for all groups of animals in the study area. Their present status along-with Schedule of the species.

- Documentation of fauna plankton (phyto and zooplankton), periphyton, benthos and fish should be done and analysed.
- Information (authenticated) on Avi-fauna and wildlife in the study area.
- Status of avifauna their resident/ migratory/ passage migrants etc.
- Documentation of butterflies, if any, found in the area.
- Details of endemic species found in the project area.
- RET species-voucher specimens should be collected along-with GPS readings to facilitate rehabilitation. RET faunal species to be classified as per IUCN Red Data list and as per different schedule of Indian Wildlife (Protection) Act, 1972.
- Existence of barriers and corridors, if any, for wild animals.
- Compensatory afforestation to compensate the green belt area that will be removed, if any, as part of the proposed project development and loss of biodiversity.
- Collection of primary data on agricultural activity, crop and their productivity and irrigation facilities components.

D Aquatic Ecology

- Documentation of aquatic fauna like macro-invertebrates, zooplankton, phytoplantktons, benthos etc.
- Fish and fisheries, their migration and breeding grounds.
- Fish diversity composition and maximum length & weight of the measured populations to be studies for estimation of environmental flow.
- Conservation status of aquatic fauna.

E Socio-Economic

- Collection of baseline data on human settlements, health status of the community and existing infrastructure facilities for social welfare including sources of livelihood, job opportunities and safety and security of workers and surroundings population.
- Collection of information with respect to social awareness about the developmental activity in the area and social welfare measures existing and proposed by project proponent.
- Collection of information on sensitive habitat of historical, cultural and religious and ecological importance.
- The socio-economic survey/ profile within 10 km of the study area for demographic profile; Economic Structure; Developmental Profile; Agricultural Practices; Infrastructure, education facilities; health and sanitation facilities; available communication network etc.
- Documentation of demographic, Ethnographic, Economic Structure and development profile of the area.
- Information on Agricultural Practices, Cultural and aesthetic sites, Infrastructure facilities etc.

- Information on the dependence of the local people on minor forest produce and their cattle grazing rights in the forest land.
- List of all the Project Affected Families with their name, age, educational qualification, family size, sex, religion, caste, sources of income, land & house holdings, other properties, occupation, source of income, house/land to be acquired for the project and house/land left with the family, any other property, possession of cattle, type of house etc.
- In addition to socio-economic aspects of the study area, a separate chapter on socio-cultural aspects based upon study on Ethnography of the area should be provided.

(7) Impact Prediction and Mitigation Measures

The adverse impact due to the proposed project should be assessed and effective mitigation steps to abate these impacts should be described.

(i) Air Environment

- Changes in ambient and ground level concentrations due to total emissions from point, line and area sources.
- Effect on soil, material, vegetation and human health.
- Impact of emissions from DG set used for power during the construction, if any, on air environment.
- Pollution due to fuel combustion in equipments and vehicles
- Fugitive emissions from various sources
- Impact on micro-climate

(ii) Water Environment

- Changes in surface and ground water quality
- Steps to develop pisci-culture and recreational facilities
- Changes in hydraulic regime and downstream flow.
- Water pollution due to disposal of sewage
- Water pollution from labour colonies/ camps and washing equipment.

(iii) Land Environment

- Adverse impact on land stability, catchment of soil erosion, reservoir sedimentation and spring flow (if any) (a) due to considerable road construction / widening activity (b) interference of reservoir with the inflowing stream (c) blasting for commissioning of HRT, TRT and some other structures.
- Changes in land use / land cover and drainage pattern.
- Immigration of labour population.
- Quarrying operation and muck disposal.
- Changes in land quality including effects of waste disposal.
- River bank and their stability.
- Impact due to submergence.

(iv) Biological Environment

- Impact on forests, flora, fauna including wildlife, migratory avi-fauna, rare and endangered species, medicinal plants etc.
- Pressure on existing natural resources.
- Deforestation and disturbance to wildlife, habitat fragmentation and wild animal's migratory corridors.
- Compensatory afforestation-identification of suitable native tree species for compensatory afforestation and green belt.
- Impact on fish migration and habitat degradation due to decreased flow of water.
- Impact on breeding and nesting grounds of animals and fish.

(v) Socio-economic aspects

- Impact on local community including demographic profile.
- Impact on socio-economic status.
- Impact on economic status.
- Impact on human health due to water / vector borne disease
- Impact on increase traffic.
- Impact on Holy Places and Tourism.
- Impacts of blasting activity during project construction which generally destabilize the land mass and leads to landslides, damage to properties and drying up of natural springs and cause noise population will be studies. Proper record shall be maintained of the baseline information in the post project period.
- Positive and negative impacts likely to be accrued due to the project are listed.

(8) Environmental Management Plans

- **Catchment Area Treatment (CAT) Plan** should be prepared micro-watershed wise. Identification of free draining/ directly draining catchment based upon Remote Sensing and Geographical Information System (GIS) methodology and Sediment Yield Index (SYI) method of AISLUS, Deptt. of Agriculture, Govt. of India coupled with ground survey. Areas or watersheds falling under 'very severe' and 'severe' erosion categories should be provided and required to be treated. Both biological as well as engineering measures should be proposed in consultation with State Forest Department for areas requiring treatment. Year-wise schedule of work and monetary allocation should be provided. Mitigation measures to check shifting cultivation in the catchment area with provision for alternative and better agricultural practices should be included.

- **Command Area Development (CAD) Plan** giving details of implementation schedule with a sample CAD plan.

- **Compensatory Afforestation** shall be prepared by the State Forest Department in lieu of the forest land proposed to be diverted for construction of the project as per the Forest (Conservation) Act, 1980.

Choice of plants for afforestation should include native and RET species, if any.

- **Biodiversity and Wildlife Conservation and Management Plan** for the conservation and preservation of rare, endangered or endemic floral/ faunal species or some National Park/Sanctuary/ Biosphere Reserve or other protected area is going to get affected directly or indirectly by construction of the project, then suitable conservation measures should be prepared in consultation with the State Forest Department.

- **Fisheries Conservation and Management Plan –** a specific fisheries management measures should be prepared for river and reservoir. If the construction of fish ladder/ fish-way etc. is not feasible then measures for reservoir fisheries will be proposed. The plan will detail out the number of hatcheries, nurseries, rearing ponds etc. proposed under the plan with proper drawings. If any migratory fish species is getting affected then the migratory routes, time/season of upstream and downstream migration, spawning grounds etc will be discussed in details.

- **Resettlement and Rehabilitation Plan** needed to be prepared on the basis of findings of the socio-economic survey coupled with the outcome of public consultation held. The R&R package shall be prepared after consultation with the representatives of the project affected families and the State Government. Detailed budgetary estimates are to be provided. Resettlements site should be identified. The plan will also incorporate community development strategies. *R&R Plan is to be formulated as per Land Acquisition, Rehabilitation and Resettlement Act, 2013 which came into force w.e.f. 1.1.2014.*

- **Green Belt Development Plan** along the periphery of the reservoir, approach roads around the colonies and other project components, local plant species must be suggested with physical and financial details. Local plant species suitable for greenbelt should be selected.

- **Reservoir Rim Treatment Plan** for stabilization of land slide/ land slip zones, if any, around the reservoir periphery is to be prepared based on detailed survey of geology of the reservoir rim area. Suitable engineering and biological measures for treatment of identified slip zones to be suggested with physical and financial schedule.

- **Muck Disposal Plan** suitable sites for dumping of excavated materials should be identified in consultation with State Pollution Control Board and State Forest Department. All muck disposal sites should be minimum 30 in away from the HFL of river. Plan for rehabilitation of muck disposal sites should also be given. The L-section/cross section of muck disposal sites and approach roads should be given. The plan shall have physical and financial details of the measures proposed.

- **Restoration Plan for Quarry Sites and landscaping** of colony areas, working areas, roads etc. Details of the coarse/fine aggregate/clay etc. required for construction of the project and the rock/clay quarries/river shoal sites identified for the project should be discussed along-with the Engineering and Biological measures proposed for their restoration with physical and financial details. Layout map showing quarry sites vis-à-vis other project components, should be prepared.
- **Study of Design Earthquake Parameters:** A site specific study of earthquake parameters should be done. Results of the site specific earthquake design parameters should be approved by National Committee of Seismic Design Parameters, Central Water Commission (NCSDP), New Delhi.
- **Dam Break Analysis and Disaster Management Plan** The outputs of dam break model should be illustrated with appropriate graphs and maps clearly bringing out the impact of Dam Break scenario. The action plan will include Emergency Action and Management plan including measures like preventive action notification, warning procedure and action plan for co-ordination with various authorities.
- **Water, Air and Noise Management Plans** to be implemented during construction and post-construction periods.
- Mitigating measures for **impacts due to Blasting** on the structures in the vicinity.
- **Ground Water Management Plan.**
- **Public Health Delivery Plan** including the provisions of drinking water supply for local community.
- **Labour Management Plan** for their Health and Safety.
- **Sanitation and Solid waste Management plan** for domestic waste from colonies and labour camps etc.
- **Local Area Development Plan** to be formulated in consultation with the Revenue Officials and Village Pancahayats. Local skill development schemes should br given. Details of various activities to be undertaken along with its financial out lay should be provided.
- Environmental safeguards during construction including Road Construction.
- **Energy Conservation Measures.**
- **Environmental Monitoring Programme** with physical & financial details covering all the aspects of EMP. A summary of Cost Estimates for all the plans, **c**ost for implementing all the Environmental Management Plans.

(9) In the EMP, a sample CAD plan for a distributary outlet command is also included. Such a plan is to show the alignment of irrigation and

drainage channels. The components of the On Farm Development (OFD) works to be undertaken may be clearly mentioned along with a time schedule for their completion vis-&-vis the progress of irrigation development.

(10) Additional ToR

i. Three (3) season's data should be collected for the entire project.
ii. Land acquired for the project shall be suitably compensated in accordance with the law of the land with the prevailing guidelines. Private land shall be acquired as per provision of Right to Fair Compensation and Transparency in Land acquisition, Rehabilitation and Resettlement Act, 2013.
iii. The project involves about 172.48 ha of forest land. Forest clearance should be obtained as per the prevailing norms of FC Act, 1980.

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F.No.22-65/2017-IA.III

Government of India

Ministry of Environment, Forest and Climate Change

Impact Assessment Division

*****

Indira Paryavaran Bhawan
Jor Bagh Road, Aliganj
New Delhi – 110003

Dated: 1st May, 2018

Office Memorandum

Sub: Corporate Environment Responsibility (CER) – reg.

The Environment Impact Assessment (EIA) Notification, 2006, issued under the Environment (Protection) Act, 1986, as amended from time to time, prescribes the process for granting prior environment clearance (EC) in respect of certain development projects/activities listed out in the Schedule to the Notification.

2. Sustainable development has many important facets/components like social, economic, environmental, etc. All these components are closely inter-related and mutually re-enforcing. Therefore, the general structure of EIA document, under Appendix-III to the notification, prescribes inter-alia public consultation, social impact assessment and R&R action plan besides environment management plan (EMP).

3. Section 135 of the Companies Act, 2013 deals with Corporate Social Responsibility (CSR) and Schedule-VII of the Act lists out the activities which may be included by companies in their CSR Policies. The concept of CSR as provided for in the Companies Act, 2013 and covered under the Companies (Corporate Social Responsibility Policy) Rules, 2014 comes into effect only in case of companies having operating projects and making net profit as also subject to other stipulations contained in the aforesaid Act and Rules. The environment clearance given to a project may involve a situation where the concerned company is yet to make any net profit and\or is not covered under the purview of the aforesaid Act and Rules. In such cases, the provisions of aforesaid act and Rules will not apply.

4. In the past, it has been observed that different Expert Appraisal Committees / State Expert Appraisal Committees (EACs/SEACs) have been prescribing different formulation of the Corporate Environment Responsibility (CER) and no common principles are followed. Several suggestions have also been received in this regard which inter-alia states that Greenfield projects and Brownfield projects should be treated differently; no CER should be prescribed whereas there is no increase in air pollution load, R&R, etc., besides streamlining percentage of CER.

5. The Ministry has carried out a detailed stakeholder consultation which inter-alia included meeting with Ministry of Petroleum & Natural Gas, Ministry of Power, Chairmen EACs, FICCI, ASSOCHAM, Gujarat Chamber of Commerce and Industry amongst others.

6. In order to have transparency and uniformity while recommending CER by Expert Appraisal Committee (EAC) / State level Expert Appraisal Committee (SEAC) / District level Expert Appraisal Committee (DEAC), the following guidelines are issued:

(I) The cost of CER is to be in addition to the cost envisaged for the implementation of the EIA/EMP which includes the measures for the pollution control, environmental protection and conservation, R&R, wildlife and forest conservation/protection measures including the NPV and Compensatory Aforestation, required, if any, and any other activities, to be derived as part of the EIA process.

(II) The fund allocation for the CER shall be deliberated in the EAC or SEAC or DEAC, as the case may be, with a due diligence subject to **maximum percentage** as prescribed below for different cases:

S.No	Capital Investment / Additional Capital Investment (in Rs)	Greenfield Project – % of Capital Investment	Brownfield Project – % of Additional Capital Investment
I	II	III	IV
1.	≤ 100 crores	2.0%	1.0%
2.	> 100 crores to ≤ 500 crores	1.5%	0.75%
3.	> 500 crores to ≤ 1000 crores	1.0%	0.50%
4.	> From 1000 crores to ≤10000 crores	0.5%	0.25%
5.	> 10000 crores	0.25%	0.125%

(III) The activities proposed under CER shall be worked out based on the issues raised during the public hearing, social need assessment, R&R plan, EMP, etc.

(IV) The proposed activities shall be restricted to the affected area around the project.

(V) Some of the activities which can be carried out in CER, are infrastructure creation for drinking water supply, sanitation, health, education, skill development, roads, cross drains, electrification including solar power, solid waste management facilities, scientific support and awareness to local farmers to increase yield of crop and fodder, rain water harvesting, soil moisture conservation works, avenue plantation, plantation in community areas, etc.

(VI) The entire activities proposed under the CER shall be treated as project and shall be monitored. The monitoring report shall be submitted to the regional office as a part of half-yearly compliance report, and to the District Collector. It should be posted on the website of the project proponent.

(VII) The District Collector may add or delete the activities as per the requirement of the District.

(VIII) The EAC can vary the above percentage of CER subject to proper diligence, quantification and justification. The EAC based on appraisal, should clearly suggest the activities to be carried out under CER.

(IX) This CER is not applicable in name change, transfer and amendment involving no additional project investment. In case of amendment in EC involving additional expenditure, CER will be applicable only on the additional expenditure as per column-IV of the table given in para 6(II) above.

7. This issues in supersession of all earlier OMs and guidelines issued in this regard.

8. This issues with the approval of competent authority.

(Sharath Kumar Pallerla)
Director (IA-III-Policy)

1. Chairman, CPCB
2. Chairmen of all the Expert Appraisal Committees
3. Chairperson/Member Secretaries of all the SEIAA/SEACs
4. Chairpersons/Member Secretaries of all SPCBs/UTPCCs
5. All the officers of IA Division

Copy for information to:

1. PS to Minister for Environment, Forest and Climate Change
2. PS to MoS (EF&CC)
3. PPS to Secretary (EF&CC)
4. PPS to AS(AKJ) / AS(AKM)
5. PPS to JS(GB) / JS(JT)
6. Website, MoEF&CC
7. Guard File.

Annexure - Ib

No. J-12011/11/2018-IA.I(R)
Ministry of Environment, Forest & Climate Change
Government of India
(IA-I Division)

Indira Paryavaran Bhawan
3rd Floor, Vayu Wing
Jor Bagh Road
New Delhi-110 003
Date: 25th September, 2018

To,

Shri. Gopi Krushna
Assistant General Manager
M/s Greenko Energies Private Limited
Plot no.1071, Road No.44,
Jubilee Hills,
Hyderabad-500033 (Telangana)

Subject: Saundatti IREP (1260 MW) - Pumped Storage Project in Belgavi District of Karnataka by M/s Greenko Solar Energy Pvt. Ltd – Amendment in TOR- regarding.

Sir,

This is with reference to your online application no. IREP-Saundatti/MoEF & CC/TOR Amendment/20180810 dated 13.8.2018, 14.8.2018 and 15.9.2018 on the above mentioned subject. The Terms of Reference (TOR) for Saundatti IREP (1200 MW) in Belgavi District of Karnataka was accorded on 18.5.2018 for 4 years. Your request for approval for change of scope in the project and enhancement of capacity of the project from 1200 MW to 1260 MW has been examined by the Expert Appraisal Committee (EAC) for River Valley & Hydroelectric Projects in its meeting held on 27.8.2018.

2. The EAC duly considered the relevant documents submitted by you and have recommended the enhancement of capacity of the project from 1200 MW to 1260 MW and agreed for minor changes in the project. Accordingly, the Ministry hereby accords amendment ToR for enhancement of capacity from 1200 MW to 1260 MW in respect of Saundatti IREP (1260 MW) in Belgavi District of Karnataka with the same TOR as communicated vide letter dated 18.5.2018 with the following corrections:

i. The committee noted the minor changes in project, capacity increased from 1200 MW to 1260 MW. The comparative statement with reference to earlier proposal and revised proposal are presented below:

S.No.	Details	Original	Revised
1	Capacity	1200 MW	1260 MW
2	Rated Pumping Head	156.92 m	157.38 m
3	Pump Capacity	230 MW	240 MW
4	Turbine Design Discharge	77.14 cumec for each unit	81.13 cumec for each unit

5	Structure	400 KV Multi circuit Towers	400 KV Double circuit Towers with Moose Conducter
6	Number of units	7 Units (5 x 200 MW + 2 x 100 MW)	7 Units (5 x 210 MW + 2 x 105 MW)
7	Terminating at	One double circuit connected to PGCIL Narendra 400 KV substation at Dharwad and other double circuit connected to IRESP CPSS	One line will be connected to PGCIL Narendra 400 KV substation at Dharwad and other line will connected to IREP CPSS

3. You have requested EAC that this being a pump storage scheme & not typically river valley project as this is not located on any river course, some of the standard TOR conditions are not applicable and delete from the earlier TOR dated 18.5.2018. The EAC agreed on the suggestion and the following items are deleted from the TOR in the present case:

S. No.	TOR conditions
1	• Para Nos. 2 – (ii), (vii), (viii) & (xiii) (related to river, drainage and catchment delineation)
2	• Para No.6 (b) related to hydrology studies approved by CWC, Flow series of 90%, 75% and 50% dependable years discharge, Minimum of 1 km distance from tip of the reservoir, norms for release of e-flows, etc.
3	• Para No.6 (d) related to (ii) & (iii) related to fish, their migration and conservation
4	• Para No. 8 related to CAT Plan
5	• Para No.9 related to CAD
6	• Para No. 10 related to Fisheries Conservation and Management
7	• Para No. 11 related to CAD Plans for distributary outlet

4. All other terms and conditions of the Scoping/TOR clearance stipulated in letter No. J-12011/11/2018-IA-I (R) dated 18.5.2018 and 6.7.2018 shall remain unchanged.

5. This issues with the approval of the Competent Authority.

Yours faithfully,

(Dr. S. Kerketta)
Director

Copy to:

1. The Secretary, Ministry of Power, Shram Shakti Bhawan, Rafi Marg, New Delhi 110001.
2. The Secretary, Ministry of Water Resources, Shram Shakti Bhawan, Rafi Marg, New Delhi – 1.

3. The Chairman, Central Electricity Authority, Sewa Bhawan, R.K. Puram, New Delhi-110066.
4. The Chief Engineer, Project Appraisal Directorate, Central Water Commission, Sewa Bhawan, R. K. Puram, New Delhi – 110 066.
5. The Additional Principal Chief Conservator of Forests (C), Regional Office (SZ), Ministry of Environment, Forest and Climate Change, Kendriya Sadan, 4th Floor, R & F Wings, 17th Main Road, Block-II, Koramangala, Bangalore – 560 034
6. The Secretary, Department of Forest, Ecology & Environment, Government of Karnataka, M.S. Building, Ambedkar Veedhi, Banglore -
7. The Member - Secretary, Karnataka State Pollution Control Board, 5th Floor, Parisara Bhavan, # 49, Church Street, Off MG Road, Bangalore – 560 001
8. Guard file.

(Dr. S. Kerketta)
Director

COMPLIANCE TO TOR SAUNDATTI PUMPED STORAGE PROJECT (1260 MW)

MoEF&CC Letter no. F No.J-12011/11/2018-IA-I dated 18.05.2018 & 25.09.2018

S.No.	Scope of work	Compliance
1.	Scope of EIA Studies	EIA Chapter 1, Introduction 1.4
2.	Details of the Project and Site,	EIA Chapter 2, Project Description
i	Details of project with Layout Plan and site giving L-sections of all U/S and D/S project with all relevant maps and Figures. Connect such information as to establish the total length of interference of natural river, total length of tunneling of the river and the committed unrestricted release from the site of diversion in to the main river.	Not Applicable
ii	A map of boundary of the project site giving details of protected areas in the vicinity of project location	EIA Chapter 3, Description of Environment: Section 3.2.3 & Figure 3.30
iii	Location details on a map of the project area with counters indicating main project features. The project layout shall be superimposed on a contour map of ground elevation showing main project features (viz. Location of dam, Head works, main canal, branch canals, quarrying etc.) shall be depicted in a scaled map.	EIA Chapter 2, Project Description, Figure. 2.1 & Figure 2.2.
iv	Layout details and map of the project area with contours with project component clearly marked with proper scale map of at least a 1:50,000 scale and printed at least on A3 scale for clarity.	EIA Chapter 2, Project Description, Figure. 2.2
v	Existence of National Park, Sanctuary, Biosphere Reserve etc.in the study area, if any should be detailed and presented on a map with distinct distance from the project components.	EIA Chapter 3, Description of Environment: Section 3.2.3 & Figure 3.30
vi	Drainage pattern and map of the river catchment up to the proposed project site.	Not Applicable
vii	Delineation of critically degraded areas in the directly draining catchment on the basis of Silt Yield Index as per the methodology of All India Soil and Land Use Survey of India.	Not Applicable
viii	Soil characteristics and map of the project area.	EIA Chapter 3, Environmental Baseline, Section 3.2.1.4, Table 3.3 Figure Figure 3.26 Soil map.
ix	Geological and seismo-tectonic details and map of the area surrounding the proposed project site showing location of dam site and powerhouse site.	EIA Chapter 3, Description of Environment, Section 3.2.1.2
x	Remote sensing studies, interpretation of satellite imagery, topographic sheets along with ground verification shall be used to develop the land use/land cover pattern of the study using overlaying mapping techniques viz. Geographic Information System (GIS), False Colour Composite (FCC) generated from satellite data of project area.	EIA Chapter 3, Description of Environment, Figure. 3.27 & 3.28
xi	Land details including forests, private and other land.	EIA Chapter 2, Project Description, Section 2.7.2.2 Table 2.2
3.	**Description of Environment and Baseline data**	
A	Project area or the direct impact area should comprise of the area within 10 km radius of the main project component; Reservoir and powerhouse etc. The baseline studies should be collected for 3 seasons	EIA Chapter 3, Description of Environment, Section. 3.1, Figure. 3.1 EIA Chapter 3, Description of Environment, Section. 3.2.1
4.	**Details of the Methodology**	EIA Chapter 3, Description of Environment
	The methodology followed for collection of baseline data	EIA Chapter 3, Description of Environment

A	along with details of number of samples and their locations in the map	Figure 3.25 and Figure 3.29
	For forest classification, Champion and Seth (1968) classification should be followed	EIA Chapter 3, Description of Environment, 3.2.2.1
5.	**Method for collection of Biodiversity Data**	
	Methodology for Collection of Biodiversity Data The entire area should be divided in grids of 5km* 5km preferably on a GIS domain. Thereafter 25% of the grids should be randomly selected for sampling of which half should be in the directly affected area (grids including project components such as reservoir, dam powerhouse, tunnel, canal, etc.) and the remaining in the rest of the area (area of influence in 10 km radius from project components).	EIA Chapter 3, Description of Environment Section 3.2.2.1 Figure 3.29 & 3.33
	A detailed listing of the literature referred to, for developing lists of R.E.T. species should be provided in the EIA reports.	EIA Chapter 3, Description of Environment, 3.2.2.1
6.	**Component of the EIA study**	
A	**Physical and Chemical Environment**	
i.	**Geological and Geophysical Aspects and Seismo-Tectonics**	
	Physical geography, Topography, Regional Geological aspects.	EIA Chapter 3, Description of Environment, Section 3.2.1.1 & Section 3.2.1.2
	Tectonics, seismicity and history of past earthquakes in the area. A site-specific study of the earthquake parameters will be done. The results of the site-specific earthquake design shall be sent for the approval of the NCSDP (National Committee of Seismic Design Parameters, Central Water Commission, New Delhi for large dams.	EIA Chapter 3, Description of Environment, Section 3.2.1.2
	Landslide zone or area prone to landslide existing in the area should be examined.	NA
	Justification for location & execution of the project in relation to the structural components (dam/barrage height).	EIA Chapter 5 Analysis of Alternatives
	Impact of project on geological environment.	EIA Chapter 4 Assessment of Impact & Mitigation Measures
ii.	**Meteorology, Air and Noise**	
	Meteorology (viz. Temperature, Relative humidity, wind speed/direction etc.) to be collected from nearest IMD station.	EIA Chapter 3. Description of Environment Section 3.2.1.3
	Ambient air quality with parameters viz. Suspended particulate matter (SPM), Respirable suspended particulate matter (RSPM) i.e. suspended particulate materials less than 10 microns, Sulphur dioxide (SO2) and Oxides of Nitrogen (NOx) in the study area. (5Locations)	EIA Chapter 3, Description of Environment, Section. 3.2.1.5 Table 3.8. Figure 3.25
	Existing Noise Levels and traffic density in the study area. (5 Locations)	EIA Chapter 3, Description of Environment, Section. 3.2.1.6 Table 3.10 Figure 3.25
iii.	**Soil Characteristics**	
	Soil classification, physical parameters (viz.,texture, Porosity, Bulk Density and water holding capacity) and chemical parameters (viz. pH, electrical conductivity, magnesium, calcium, total alkalinity, chlorides, sodium, potassium, organic carbon, available potassium, available phosphorus, SAR, nitrogen and salinity, etc) (5 Locations).	EIA Chapter 3, Description of Environment, Section 3.2.1.4, Table 3.3 & 3.5
iv.	**Remote Sensing and GIS studies**	
	Generation of thematic maps viz. slope map, drainage map, soil map, land use and land cover map, etc. Based on these, thematic maps, an erosion intensity map should be	EIA Chapter 3, Description of Environment Figure 3.3, 3.2, 3.3, 3.27 & 3.28

	prepared.	
v.	**Water quality**	
	Water quality for both surface and ground water for 6 Locations.	EIA Chapter 3, Description of Environment Section 3.2.1.7, Table 3.12 to 3.17
	Delineation of sub and micro watersheds, their locations and extent based on the Soil and Land Use Survey of India (SLUSOI), Department of Agriculture, Government of India. Erosion levels in each micro- watershed and prioritization of micro- watershed through Silt Yield Index (SYI) method of SLUSOI.	Not Applicable
B	**Water Environment and Hydrology**	
	Hydro metrology of the project viz. precipitation (snowfall, rainfall), temperature, relative humidity, etc. Hydro-metrological studies in the catchment area should be established along with real time telemetry and data acquisition system for inflow monitoring. Basin Characteristics, Runoff, discharge, water availability for the project, sedimentation rate etc.	Not Applicable
	Catastrophic events live cloud bursts and flash flood, if any should be documented	Not Applicable
	For estimation of sedimentation rate, direct sampling of river flow is to be done during the EIA study. The study should be conducted for minimum 1 year.	Not Applicable
	Flow series, 10 daily with 90%, 75% and 50% dependable years discharges.	Not Applicable
	Environmental flow release should be 20% of the average of the 4 lean months of 90%dependable year and 30% of monsoon flow.	Not Applicable
	A site specific study on minimum environmental flow should be carried out.	Not Applicable
C.	**Biological Environment**	
i.	**Flora**	
	Forest and Forest types	EIA Chapter 3. Description of Environment Section. 3.2.2.1
	Vegetation profile and floral diversity. A species wise list may be provided.	EIA Chapter 3. Description of Environment Section. 3.2.2.2 Annexure V
	Assessment of plant species with respect to dominance, density, frequency, abundance, diversity index, similarity index, importance value index (IVI), Shannon Weiner Index etc. of the species to be provided.	EIA Chapter 3. Description of Environment Section. 3.2.2.2 Table 3.42, 3.43 &3.44
	Economically important species like medicinal plants, timber, fuel wood etc.	EIA Chapter 3. Description of Environment Section. 3.2.2.2
	Flora under RET categories should be documented using International Union for the conservation of Nature and Natural Resources(IUCN) criteria and Botanical Survey of India Red data list along with economic significance. Details of endemic species found in the project area.	EIA Chapter 3. Description of Environment Section. 3.2.2.2 Table 3.23
	Biodiversity study, a sub-component of EIA study, is to be carried— out by associating a reputed organisation/institution as recommended by WII, Dehradun or by ICFRE, Dehradun. A list of such institutes is available on MoEF"s website.	EIA Chapter 4 Anticipated Environmental Impacts & Mitigation Measures
ii.	**Fauna**	
	Fauna study and inventorisation. Their present status along with schedule of the species. Information (authenticated) on Avi-fauna, butterflies and wildlife in the study area. Details of endemic species found in the project area. RET faunal species to be classified as per IUCN Red Data list and as per different schedule of Indian Wildlife (protection)	EIA Chapter 3 Description of Environment Section. 3.2.2.3 Table 3.46, 3.47, 3.48 & 3.49

	Act, 1972.	
	Existence of barrier and corridors, if any, for wild animals.	Not Applicable
	Compensatory afforestation to compensate the green belt area that will be removed, if any, as part of the proposed project development and loss of biodiversity.	EIA Chapter 10, Environment Management Plan, Section. 10.3
D.	**Aquatic ecology**	
	Documentation of aquatic fauna like macro-invertebrates, zooplankton, phytoplankton, benthos etc.	Not Applicable
	Fish and fisheries, their migration, breeding grounds and conservation status. Fish diversity composition and maximum length & weight of the measured populations to be studies for estimation of environmental flow.	Not Applicable
E.	**Socio-economic**	
	Collection of baseline data on human settlements, health status of the community and existing infrastructure facilities for social welfare including sources of livelihood, job opportunities and safety and securities of workers and surroundings population.	EIA Chapter 3 Description of Environment, Section 3.2.4
	Collection of information with respect to social awareness about the developmental activity in the area and social welfare measures existing and proposed by project proponent.	EIA Chapter Description of Environment Section 3.2.4
	The socio-economic survey/profile within 10 km radius of the study area for the demographic profile; Economic structure; Developmental profile; Agricultural practices; Infrastructure, education facilities; health and sanitation facilities; available communication network etc.	EIA Chapter Description of Environment Section 3.24
	List of all project affected families with their names, educational qualification, land holdings, other properties, occupation, source of income, land and other properties to be acquired, etc.	EIA Chapter 7 Additional Studies Section 7.1.1
7	**Impact prediction and Mitigation Measures**	
A.	Air Environment ▪ Changes in ambient and GLC concentration due to total emissions from point, line and area sources ▪ Effect on soil, material, vegetation and human health ▪ Impact of emission from DG sets used for power during the construction, if any, on air environment. ▪ Pollution due to fuel combustion in equipment & vehicles ▪ Fugitive emissions from various sources. ▪ Impact on micro climate	EIA Chapter 4, Assessment of Impact & Mitigation Measures, Section. 4.1.1 & 4.5.1.1
B.	Water Environment ▪ Changes in surface & ground water quality. ▪ Steps to develop pisci-culture and recreational facilities. ▪ Changes in hydraulic regime and down stream flow. ▪ Water pollution due to disposal of sewage. ▪ Water pollution from Labour colony/camps and washing equipment.	EIA Chapter 4, Assessment of Impact & Mitigation Measures, Section. 4.1.3 & 4.5.3.2
C.	Land Environment ▪ Adverse impact on land stability, catchment of soil erosion, reservoir sedimentation and spring flow (if any) a) due to considerable road construction/widening activity (b) interference of reservoir with the inflowing streams (c) blasting for commissioning of HRT, TRT and some other structures ▪ Changes in land use/ land cover and drainage pattern	EIA Chapter 4, Assessment of Impact & Mitigation Measures, Section. 4.1.4

	▪ Immigration of labour population ▪ Quarrying operation and muck disposal ▪ Changes in land quality including effects of waste disposal	
D.	Biological Environment ▪ Impacts on forests, flora, fauna including wildlife, migratory avi-fauna, rare and endangered species, medicinal plants etc. ▪ Pressure on existing natural resources ▪ Deforestation and disturbance to wildlife, habitat fragmentation and wild animals migratory corridors ▪ Impact on fish migration and habitat degradation due to decreased flow of water ▪ Impact on breeding and nesting grounds of animals and fish	EIA Chapter 4, Assessment of Impact & Mitigation Measures, Section. 4.1.6
E.	Socio economic Aspects ▪ Impact on local community including demographic profile. ▪ Impact on socio-economic status. ▪ Impact on human health due to water/ vector borne disease ▪ Impact on increase traffic ▪ Impact on holy places and tourism. ▪ Impact of blasting activities ▪ Positive as well as negative impacts likely to be accrued due to the project are to be listed.	EIA Chapter 4, Assessment of Impact & Mitigation Measures, Section. 4.1.7
8	**Environment management Plan (EMP)**	
A	Catchment area treatment plan should be prepared micro-watershed wise. Identification of area for treatment and Silt Yield Index (SYI) method of SLUSOI coupled with ground survey. Areas/ watershed falling under very severe and severe, erosion categories. Both biological and engineering measures should be proposed in consultation with State Forest Department.	Not Applicable
	Command Area Development (CAD) Plan giving details of implementation schedule with a sample CAD plan	Not Applicable
B	Compensatory Afforestation	EIA Chapter 10, Environment Management Plan, Section. 10.3
C	Biodiversity & Wildlife Conservation and Management Plan for conservation and preservation of endemic, rare and endangered species of flora and fauna to be prepared in consultation with State Forest Department.	EIA Chapter 10, Environment Management Plan, Section. 10.11
D	Fisheries Conservation and Management Plan	Not Applicable
E	Resettlement & Rehabilitation (R&R) Plan	EIA Chapter 7, Additional Studies, Section. 7.1
F	Green Belt Development Plan along the periphery of the reservoir, colonies, approach road, canals etc.	EIA Chapter 10, Environment Management Plan, Section. 10.4
G	Reservoir Rim Treatment Plan for stabilization of land slide/ land slip zones.	Not Applicable
H	Plan for Land Restoration and Landscaping of project site.	EIA Chapter 10, Environment Management Plan, Section. 10.5
I	Muck disposal Plan- suitable sites for dumping of excavated material should be identified in consultation with the State Pollution Control Board and Forest Department.	EIA Chapter 10, Environment Management Plan, Section. 10.6
J	Plan for Restoration of quarry sites and landscaping of colony areas, working areas, roads, etc.	EIA Chapter 10, Environment Management Plan, Section. 10.5
K	Study of Design Earthquake Parameters: A site specific study of earthquake parameters should be done. The	Design Earthquake Parameters study is under progress.

	results of the site-specific earthquake design parameters should be approval by National Committee of Seismic design Parameters, Central Water Commission (NCSDP), New Delhi.	
L	Dam Break Analysis and Disaster Management Plan: The output of the dam break model should be illustrated with appropriate graphs and maps clearly bringing out the impact of Dam break scenario.	EIA Chapter 10, Environment Management Plan, Section. 10.7
M	Water, Air and Noise Management Plans to be implemented during construction and post- construction periods. Mitigating measures for impacts due to blasting on the structures in the vicinity.	EIA Chapter 6 Environment Monitoring Programme
N	Public Health Delivery Plan including the provisions for drinking water facility for the local community.	EIA Chapter 10, Environment Management Plan, Section. 10.8
O	Labour Management Plan for their health and safety.	EIA Chapter 10, Environment Management Plan
P	Sanitation and Solid waste management plan for domestic waste from colonies and labour camps etc.	EIA Chapter 10, Environment Management Plan, Section. 10.9
Q	Local area development plan. Details of various activities to be undertaken along with its financial out lay should be provided.	EIA Chapter 7, Additional Studies, Section. 7.3 Corporate Environment Responsibility
R	Environmental safeguard during construction activities including road construction.	EIA Chapter 10, Environment Management Plan EIA Chapter 6 Environment Monitoring Programme
S	Energy conservation measures	EIA Chapter 10, Environment Management Plan, Section. 10.10
T	Environmental Monitoring Programme with physical and financial details covering all the aspects of EMP.	EIA Chapter 6, Environment Monitoring Programme
U	A summary of cost estimate for all the plans, cost for implementing all environmental Management Plans including the cost for implementing environmental monitoring programme should be given. Provision for an Environmental Management Cell should be made.	EIA Chapter 11, Summary and Conclusion, Section 11.3 Table 11.1.
9	Public Hearing as per EIA notification 2006	EIA Chapter 7, Additional Studies, Section 7.2 Public Consultation
10	Corporate Environment Social Responsibility Plan	EIA Chapter 7, Additional Studies, Section. 7.3 Corporate Environment Responsibility

Surya Prakash D

From: Gopi Krushna Nikku
Sent: 28 January 2020 11:23
To: Surya Prakash D
Cc: Surya Prakash K
Subject: FW: Email Alert From System Administrator of Online Submission and Monitoring of Forests Clearances Proposal(OSMFCP) portal

Thanks & Regards
Gopi Krushna Nikku | DGM – EHS EQHS/GIMS | Extn 1333 | M +91 99596 66709

From: monitoring-fc@nic.in <monitoring-fc@nic.in>
Sent: 28 January 2020 10:53
To: envifor.irepka@greenkoenergyprojects.com
Cc: monitoring-fc@nic.in; monitoring-fc@nic.in
Subject: Email Alert From System Administrator of Online Submission and Monitoring of Forests Clearances Proposal(OSMFCP) portal

This is to acknowledge that a proposal seeking prior approval of Central Government under the Forest (Conservation) Act 1980 as per the details given below has been successfully reuploaded on the portal of the Ministry of Environment, Forest and Climate Change Government of India.

1. Proposal No. : FP/KA/HYD/37723/2018
2. Proposal Name : Standalone Pumped Storage Component of Saundatti IREP
3. Category of the Proposal : Hydel
4. Date of Submission : 18/12/2018
5. Name of the Applicant with Contact Details

Name : Gopikrushna
Mobile No. : 9959666709
State : Telangana
District : Hyderabad
Pincode : 500033

6. Area Applied (ha.) : 160.4

The same has been forwarded to DFO for the processing.

(System Administrator)

*** This is a system generated email, please do not reply. ***

FORM - A

Form for seeking prior approval of Central Government under section 2 of the Forest(Conservation) Act,1980 for Diversion of fresh forest area

PART - I

(To be filled up by User Agency)

A. General Details

A-1. Project Details

(i). Proposal No. : FP/KA/HYD/37723/2018

(ii). Name of Project for which Forest Land is required : Standalone Pumped Storage Component of Saundatti IREP

(iii). Short narrative of the proposal and Project/scheme for which the forest land is required : India is leading the world's renewable energy revolution and is on track to achieve 175 GW of RE capacity by 2022. Today, Wind & Solar, are the lowest cost source of new energy, however their inherent infirm nature & non-schedulability presents a huge challenge for integrating large RE capacities.

(iv). State : Karnataka

(v). Category of the Project : Hydel

(vi). Shape of forest land proposed to be diverted : Non Linear

(vii). Estimated cost of the Project(Rupees in lacs) : 606325

(viii). Total Area of Forest Land proposed for diversion(in ha.): 160.4

(ix). Non-Forest Land required for this project(in ha.): 53.3

(x). Total period for which the forest land is proposed to be diverted(in years): 100

A-2. Details of User Agency

(i). Name : GREENKO SOLAR ENERGY PVT LTD

(ii). Address1 : Plot No-8-2-293/82/A/1131A, Road No-36, Jubilee Hills, Hyderabad

(iii). Address2 : NIL

(iv). State : Telangana

(v). District : Hyderabad

(vi). Pin : 500033

(vii). Landmark : Peddamma Talli Temple

(viii). Email address : envifor.irepka@greenkoenergyprojects.com

(ix). Landline Telephone No. : 40-40301333

(x). Fax No. : 40-40301101

(xi). Mobile No. : 9959666709

(xii). Website (if any) : NIL

(xiii). Legal status of User Agency : Private

A-3. Details of Person Making Application

(i). First Name: Gopikrushna

(ii). Middle Name: NIL

(iii). Last Name: Nikku

(iv). Gender: Male

(v). Designation: AGM

(vi). Address 1: Plot No-8-2-293/82/A/1131A, Road No-36, Jubilee Hills, Hyderabad-33

(vii). Address 2: NIL

(viii). State: Telangana

(ix). District: Hyderabad

(x). Tehsil: Khairatabad

(xi). Pin: 500033

(xii). Landmark: Peddamma Talli Temple

(xiii). Email Address: envifor.irepka@greenkoenergyprojects.com

(xiv). Landline Telephone No.: 40-40301333

(xv). Fax No.: 04040301101

(xvi). Mobile No.: 9959666709

(xvii). Copy of documents in support of the competence/authority of the person making this application to make application on behalf of the User Agency:

B. Details of land required for the Project

B-1. Details of proposal seeking prior approval of Central Government under the Act for diversion of forest land for the Project already submitted in the past

List of proposal submitted in Past							
S.no	**Proposal Status.**	**Proposal No.**	**Moef File No.**	**Area Proposed for Diversion(Ha.)**	**Area Diverted(Ha.)**	**Date of In-Principle Approval**	**Date of Final Approval**
NIL							

B-2. Details of forest land proposed to be diverted

B-2.1 Details of Divisions involved

Details of Divisions involved			
S.no	**Division Name**	**Forest Land(ha.)**	**Non-Forest Land(ha.)**
1.	Gokak	160.4	53.3

B-2.2 Details of Districts involved

District wise breakup			
S.no	**District Name**	**Forest Land(ha.)**	**Non-Forest Land(ha.)**
1.	Belgaum	160.4	53.3

B-2.3 Village wise breakup

Villages wise breakup			
S.no	**Village**	**Forest Land(ha.)**	**Non-Forest Land(ha.)**
1	Karlakatti	63.12	20.02
2	Chakrageri	46.33	33.28
3	Kagihal	50.95	0

B-2.4 Component wise breakup

Component wise breakup			
S.no	**Component**	**Forest Land(ha.)**	**Non-Forest Land(ha.)**
1	Upper Reservoir	128.58	0
2	Penstock	5.79	0
3	Pressure Shaft	5.84	0
4	Power House, Switch yard & Tail race Outfall inclu	12.93	2.31
5	Adit to Pressure Shaft	0.73	0

6	Approach Road to all Other Project Components	6.53	0.62
7	Contractor facilities, Cement, E & M Stores, Tempo	0	10
8	Muck Disposal Area (1 & 2)	0	10
9	Tail Race Channel	0	24.82
10	Magazine	0	0.25
11	Job facility Yard and Others	0	5.3

C. Maps of forest land proposed to be diverted

Division 1. : Gokak

(i). Area of forest land proposed to be diverted(in ha.) : 160.4

(ii). : Non Linear

(a). No. of patches : Six

Patch wise details		
Patch No.	**Area of Patch(in ha.)**	**Kml File of Patches**
1.	6.53	View File
2.	0.73	View File
3.	12.93	View File
4.	5.84	View File
5.	5.79	View File
6.	128.58	View File

(iii). Copy of Survey of India Toposheet indicating boundary of forest land proposed to be diverted: Map

(iv). Scanned copy of the Geo-referenced map of the forest land proposed to be diverted prepared by using GPS or Total Station: Map

D. Justification for locating the Project in forest land and details of alternatives examined:

(i). Copy of note containing justification for locating the Project in forest land:

E. Employment likely to be generated

(i). Whether the Project is likely to generate employment ?: Yes

(ii). Permanent/Regular Employment(Number of persons): 400

(iii). Temporary Employment(Number of person-days): 2080500

F. Displacement of People due to the Project, if any

(i). Whether Project involves displacement?: No

G. Details of Cost-Benefit analysis for the Project

(i). Whether the Project requires Cost-Benefit analysis?: Yes

(a). Copy of Cost-Benefit analysis:

H. Status of Environmental Clearance

(i). Whether the Project requires Clearance under the Environment (Protection) Act 1986 ? : Yes

(a). Status of the Environmental Clearance to the Project: EC under process

(ii). Environmental Clearance File No.: J-12011/11/2018-IA.I(R)

I. Status of Wildelife Clearance

(i). Whether the Project or a part thereof is located in any Protected Area or their Eco sensitive zone? : No

J. Applicability of special provisions governing Scheduled Areas

(i).Whether the Project or a part thereof is located in a Scheduled Area? : No

K. Status of settlement of rights under the Forest Rights Act,2006 on the forest land proposed to be diverted

(i). Whether the process for settlement of Rights under the Forest Rights Acts 2006 on the forest land proposed to be diverted has been completed? : No

L. Details of land identified for Compensatory Afforestation

(i). Whether non-forest or Revenue forest land is required to be provided by User Agency?: Yes

(ii). Whether the area of non-forest land or Revenue forest land required to be provided by User Agency for raising Compensatory Afforestation is less than area of forest land proposed to be diverted ?: No

(iii). No. of districts involved for raising Compensatory Afforestation: 1

(iv). No. of patches: One

District 1. : Bidar
(a). Village: Dabka and Chimagaon **(b). Area(in ha.):** 161

(c). Copy of KML file of the patch: View File

(d). Khasra details:
136,116,117,124,125,126,123,127,128,129,130,131,134,135,148,149

(e). Present owner: Others

(f). Copy of ownership proof:

(g). Copy of Mou/agreement executed between the Present owner and the User Agency:

(h). Copy of non encumberence certificate for the forest land:

(v). Scanned copy of the map of the land identified for creation of Compensatory Afforestation prepared by using GPS ot Total Station:

(vi). Copy of Survey of India Toposheet in 1:50,000 scale indicating location of the land identified for creation of Compensatory Afforestation:

M. Hydel/Irrigation/Multipurpose Project

(i). Installed power generation capacity of the Project(in MW): 1260

(ii). Total command area of the Project(in ha.): 0

(a). Copy of the approval of competent authority to the Catchment Area Treatment Plan (CAT Plan):

(b). Copy of the approved CAT plan:

Additional information Details

Documents		
S.No	**Documents**	**Remarks**
1		Terms of reference
2		CA Land RTC
3		CA Land RTC
4		CA Land RTC
5		CA Land RTC
6		CA Land RTC
7		CA Land Non Encumbrance Certificate

8		CA Land Non Encumbrance Certificate
9		Covering Letter
10		Project Report
11		Karnataka Govt Order
12		CA Land Suitability is applied and Report is Under Scrutiny
13		CA Land Non Encumbrance Certificate
14		Authorization
15		Reply to EDS 03-10-2019
16		Total Land (Forest & Non Forest) Break Up as per Survey no wise
17		GPS Co-ordinates of the Proposed Forest Land
18		Abstract of CA Land GPS Co-ordinates
19		Geo Referred Map of Project with differentiation of forest & non forest land in two different colours
20		Break-up of Total Land
21		Project Layout (Total) Map
22		Undertakings
23		Abstract of Sy No Wise CA Land Owners
24		Forest Compartment & Village Wise Sy No Wise Map
25		Reply to EDS 19-12-2019
26		EAC Recommendations for EC
27		FRA Undertaking

Print page

Annexure-IV

Mean Monthly Maximum Temperature and Minimum Temperature (°C)
(Reference years 2013-2017), District Belgavi

Month	2013		2014		2015		2016		2017	
	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min
January	31	18	32	18	31	17	32	19	33	17
February	32	21	34	19	34	20	36	22	36	20
March	34	23	37	23	36	24	39	25	38	22
April	37	24	40	26	38	25	41	27	40	24
May	40	25	39	26	39	26	39	26	36	25
June	39	23	35	25	31	24	32	23	29	23
July	29	22	29	23	31	24	29	22	30	23
August	26	22	30	23	31	22	29	22	30	23
September	29	22	31	21	33	22	29	21	29	22
October	31	21	32	20	33	22	32	19	30	22
November	31	18	32	18	31	21	32	17	30	20
December	31	16	31	17	32	19	31	17	29	19

Mean Monthly Average Rainfall (mm) and Numbers of Rainy Days
(Reference years 2013-2017), District Belgavi.

Month	2013		2014		2015		2016		2017	
	A	B	A	B	A	B	A	B	A	B
January	2.11	1	8.99	4	1.57	1	1.21	2	0.6	1
February	1.49	2	18	7	0.2	1	0	0	0	0
March	1	2	17.2	6	17.8	11	7.41	7	1.3	2
April	6	3	8.29	3	31.27	11	2.9	4	4	5
May	19.2	7	76.53	18	41.08	20	12.93	15	30.1	13
June	141.96	29	60.12	22	125.07	29	271.71	27	152.8	30
July	250.94	31	113.38	31	34.92	27	93.86	31	103.5	29
August	66.01	30	172.29	31	58.04	30	54.71	31	145.1	31
September	203.12	29	112.57	30	148.43	26	190.34	29	389.5	27
October	85.09	21	90.58	24	145.97	15	32.79	13	124.8	17
November	5.31	5	16.81	6	34.4	14	24.1	3	14.6	3
December	7.5	2	28.44	6	19.62	8	3.2	2	6.5	3
Annual Rainfall	**789.73**	**162**	**723.2**	**188**	**658.37**	**193**	**695.16**	**164**	**972.8**	**161**

Note:-A-Rainfall(mm), B-Number of Rainy Days.

Mean Monthly Maximum Wind Speed (kmph)
(Reference years 2013-17), District Belgavi.

Months	2013	2014	2015	2016	2017	Average
January	11.9	15.1	16.6	16.9	15.8	**15.26**
February	14.4	16.2	18.4	17.3	17.6	**16.78**
March	16.9	14	19.1	20.5	18	**17.7**
April	20.2	17.6	21.6	25.6	23	**21.6**
May	23.4	19.8	25.2	25.6	23.4	**23.48**
June	24.8	25.2	28.8	25.6	25.6	**26**
July	26.3	27	32.4	27.7	32.4	**29.16**
August	23.8	20.2	27.7	27.4	28.8	**25.58**
September	17.6	18.7	19.1	21.2	20.2	**19.36**
October	15.5	14	16.2	15.5	16.9	**15.62**
November	14	14.8	20.5	15.1	16.9	**16.26**
December	14	13.3	17.6	16.2	19.4	**16.1**

Mean Monthly Humidity (%)
(Reference years 2013-2017), District Belgavi.

Months	2013	2014	2015	2016	2017	Average
January	42	49	43	42	41	**43**
February	38	42	31	37	31	**36**
March	32	35	38	33	33	**34**
April	37	37	41	34	37	**37**
May	50	50	50	47	56	**51**
June	76	65	70	74	78	**73**
July	84	77	69	80	72	**76**
August	80	82	74	80	76	**78**
September	82	79	74	82	77	**79**
October	76	67	63	65	67	**68**
November	59	51	62	47	48	**53**
December	46	51	53	45	47	**48**

Annexure-V

LIST OF PLANT SPECIES

1. Tree Species

S. No.	Family	Name of Species
1	Alangiaceae	*Alangium salvifolium*
2	Anacardiaceae	*Buchanania lanzan*
3	Anacardiaceae	*Lannea coromandelica*
4	Anacardiaceae	*Mangifera indica*
5	Anacardiaceae	*Semecarpus anacardium*
6	Anonaceae	*Polyalthia longifolia*
7	Apocyanaceae	*Wrightia tinctoria*
8	Arecaceae	*Borassus flabellifer*
9	Arecaceae	*Cocos nucifera*
10	Arecaceae	*Phoenix sylvestris*
11	Bignoniaceae	*Dolichandrone atrovirens*
12	Bignoniaceae	*Jacaranda mimosifolia*
13	Bignoniaceae	*Millingtonia hortensis*
14	Bombacaceae	*Bombax ceiba*
15	Boraginaceae	*Cordia dichotoma*
16	Burseraceae	*Commiphora caudata*
17	Casuarinaceae	*Casuarina equisetifolia*
18	Combretaceae	*Terminalia catappa*
19	Combretaceae	*Terminalia chebula*
20	Combretaceae	*Terminalia tomentosa*
21	Erythroxylaceae	*Erythroxylum monogynum*
22	Euphorbiaceae	*Macaranga peltata*
23	Euphorbiaceae	*Sapium insigne*
24	Fabaceae	*Acacia auriculiformis*
25	Fabaceae	*Acacia ferruginea*
26	Fabaceae	*Acacia leucophloea*
27	Fabaceae	*Acacia nilotica*
28	Fabaceae	*Albizia lebbeck*
29	Fabaceae	*Albizia procera*
30	Fabaceae	*Bauhinia purpurea*
31	Fabaceae	*Butea monosperma*
32	Fabaceae	*Cassia fistula*
33	Fabaceae	*Dalbergia latifolia*

S. No.	Family	Name of Species
34	Fabaceae	*Hardwickia binata*
35	Fabaceae	*Leucaena leucocephala*
36	Fabaceae	*Pongamia pinnata*
37	Fabaceae	*Prosopis juliflora*
38	Fabaceae	*Pterocarpus marsupium*
39	Fabaceae	*Tamarindus indica*
40	Fabaceae	*Xylia xylocarpa*
41	Hernandiaceae	*Gyrocarpus americanus*
42	Lamiaceae	*Gmelina arborea*
43	Lamiaceae	*Tectona grandis*
44	Loganiaceae	*Strychnos potatorum*
45	Malvaceae	*Guazuma ulmifolia*
46	Malvaceae	*Thespesia populnea*
47	Meliaceae	*Azadirachta indica*
48	Meliaceae	*Melia azedarach*
49	Meliaceae	*Soymida febrifuga*
50	Moraceae	*Ficus hispida*
51	Moraceae	*Ficus racemosa*
52	Moraceae	*Ficus religiosa*
53	Moringaceae	*Moringa concanensis*
54	Phyllanthaceae	*Phyllanthus emblica*
55	Rhamnaceae	*Ziziphus jujuba*
56	Rubiaceae	*Catunaregam spinosa*
57	Rubiaceae	*Gardenia gummifera*
58	Rubiaceae	*Morinda coreia*
59	Rubiaceae	*Neolamarckia cadamba*
60	Rutaceae	*Aegle marmelos*
61	Rutaceae	*Chloroxylon swietenia*
62	Rutaceae	*Toddalia asiatica*
63	Sapotaceae	*Madhuca longifolia*
64	Simaroubaceae	*Simarouba glauca*
65	Ulmaceae	*Holoptelea integrifolia*
66	Zygophyllaceae	*Balanites roxburghii*

2. Shrub Species

S. No.	Family	Name of Species
1	Acanthaceae	*Justicia adhatoda*
2	Amaranthaceae	*Aerva javanica*
3	Annonaceae	*Annona reticulata*
4	Apocynaceae	*Calotropis procera*
5	Apocynaceae	*Carissa carandas*
6	Apocynaceae	*Holarrhena pubescens*
7	Apocynaceae	*Nerium indicum*
8	Apocynaceae	*Wattakaka volubilis*
9	Bignoniaceae	*Tecoma stans*
10	Capparaceae	*Capparis divaricata*
11	Convolvulaceae	*Ipomoea carnea*
12	Euphorbiaceae	*Croton bonplandianus*
13	Euphorbiaceae	*Euphorbia caducifolia*
14	Euphorbiaceae	*Euphorbia tirucalli*
15	Euphorbiaceae	*Jatropha curcas*
16	Fabaceae	*Abrus precatorius*
17	Fabaceae	*Cassia auriculata*
18	Fabaceae	*Mundulea sericea*
19	Fabaceae	*Senna auriculata*
20	Lamiaceae	*Gmelina asiatica*

S. No.	Family	Name of Species
21	Lamiaceae	*Leonotis nepetifolia*
22	Lamiaceae	*Vitex negundo*
23	Malvaceae	*Abutilon crispum*
24	Malvaceae	*Corchorus olitorius*
25	Malvaceae	*Grewia flavescens*
26	Malvaceae	*Helicteres isora*
27	Malvaceae	*Hibiscus micranthus*
28	Malvaceae	*Triumfetta rhomboidea*
29	Malvaceae	*Urena lobata*
30	Phyllanthaceae	*Phyllanthus reticulatus*
31	Poaceae	*Pseudoxytenanthera stocksii*
32	Rhamnaceae	*Ziziphus xylopyrus*
33	Rubiaceae	*Canthium coromandelicum*
34	Rubiaceae	*Morinda pubescens*
35	Rubiaceae	*Pavetta tomentosa*
36	Rubiaceae	*Randia dumetorum*
37	Sapindaceae	*Dodonaea viscosa*
38	Verbenaceae	*Lantana camara*

3. Herb Species

S. No.	Family	Name of Species
1	Acanthaceae	*Lepidagathis cristata*
2	Amaranthaceae	*Achyranthes aspera*
3	Amaranthaceae	*Gomphrena globosa*
4	Apocynaceae	*Dregea volubilis*
5	Apocynaceae	*Hemidesmus indicus*
6	Asteraceae	*Acanthospermum hispidum*
7	Asteraceae	*Ageratum conyzoides*
8	Asteraceae	*Cyanthillium cinereum*
9	Asteraceae	*Echinops echinatus*
10	Asteraceae	*Eclipta prostrata*
11	Asteraceae	*Parthenium hysterophorus*
12	Asteraceae	*Sonchus oleraceus*
13	Asteraceae	*Sphaeranthus indicus*
14	Asteraceae	*Tagetes erecta*
15	Asteraceae	*Vernonia cinerea*
16	Asteraceae	*Xanthium strumarium*
17	Capparaceae	*Cadaba fruticosa*
18	Caryophyllaceae	*Polycarpaea corymbosa*
19	Celastraceae	*Celastrus paniculatus*

S. No.	Family	Name of Species
20	Combretaceae	*Combretum albidum*
21	Euphorbiaceae	*Euphorbia hirta*
22	Euphorbiaceae	*Tragia involucrata*
23	Fabaceae	*Alysicarpus longifolius*
24	Fabaceae	*Crotalaria medicaginea*
25	Fabaceae	*Mimosa pudica*
26	Fabaceae	*Rhynchosia minima*
27	Fabaceae	*Senna tora*
28	Fabaceae	*Stylosanthes scabra*
29	Fabaceae	*Tephrosia purpurea*
30	Lamiaceae	*Anisomeles indica*
31	Lamiaceae	*Anisomeles malabarica*
32	Lythraceae	*Ammannia baccifera*
33	Malvaceae	*Byttneria herbacea*
34	Malvaceae	*Corchorus trilocularis*
35	Malvaceae	*Grewia hirsuta*
36	Malvaceae	*Pavonia zeylanica*
37	Malvaceae	*Sida acuta*
38	Malvaceae	*Sida cordata*

S. No.	Family	Name of Species
39	Malvaceae	*Sida cordifolia*
40	Malvaceae	*Waltheria indica*
41	Menispermaceae	*Cocculus hirsutus*
42	Menispermaceae	*Tiliacora racemosa*
43	Menispermaceae	*Tinospora sinensis*
44	Nyctaginaceae	*Bougainvillea spectabilis*
45	Oxalidaceae	*Biophytum sensitivum*
46	Oxalidaceae	*Oxalis latifolia*
47	Papaveraceae	*Argemone mexicana*
48	Poaceae	*Apluda mutica*
49	Poaceae	*Brachiaria eruciformis*
50	Poaceae	*Cenchrus ciliaris*
51	Poaceae	*Cymbopogon martini*
52	Poaceae	*Cynodon dactylon*
53	Poaceae	*Digitaria ciliaris*
54	Poaceae	*Eragrostis amabilis*
55	Poaceae	*Erianthus munja*
56	Poaceae	*Heteropogon contortus*
57	Poaceae	*Imperata cylindrica*

S. No.	Family	Name of Species
58	Poaceae	*Pennisetum glaucum*
59	Poaceae	*Porteresia coarctata*
60	Poaceae	*Saccharum bengalense*
61	Poaceae	*Saccharum officinarum*
62	Poaceae	*Setaria glauca*
63	Poaceae	*Sorghum halepense*
64	Poaceae	*Themeda caudata*
65	Poaceae	*Thysanolaena agrostis*
66	Poaceae	*Thysanolaena latifolia*
67	Rubiaceae	*Hedyotis puberula*
68	Rubiaceae	*Oldenlandia umbellata*
69	Solanaceae	*Datura metel*
70	Solanaceae	*Physalis minima*
71	Urticaceae	*Pouzolzia zeylanica*
72	Violaceae	*Hybanthus enneaspermus*
73	Vitaceae	*Ampelocissus latifolia*
74	Vitaceae	*Cissus quadrangularis*
75	Vitaceae	*Cissus vitiginea*
76	Zygophyllaceae	*Tribulus terrestris*

4. Pteridophytes

S. No.	Family	Name of Species
1	Dennstaedtiaceae	*Pteridium aquilinum*
2	Dryopteridaceae	*Dryopteris cochleata*
3	Lycopodiaceae	*Lycopodiella cernua*
4	Marsileaceae	*Marsilea minuta*
5	Pteridaceae	*Adiantum capillus-veneris*
6	Pteridaceae	*Adiantum caudatum*
7	Pteridaceae	*Pteris biaurita*
8	Pteridaceae	*Pteris ensiformis*
9	Salviniaceae	*Azolla pinnata*
10	Selaginellaceae	*Selaginella monospora*

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Annexure VI

TUMKUR CO-OPERATIVE MILK PRODUCERS SOCITIES UNION LTD.,

N.H.-206, B.H. ROAD, MALLASANDRA, TUMKUR-572107
Phone: 0816-2206297/1424490/464, Email: tmupur123@gmail.com Fax:0816-2206760

INVITATION FOR TENDERS (Tender Notification only through E-procurement)

Tumkur Co-operative Milk Producers Societies Union Ltd, Tumkur invites E-Procurement tenders two cover system (Technical & Financial bid) from eligible tenderers for the supply of the materials listed below:

Sl. No.	E-PROCURMENT TENDER NO. & Date	MATERIALS DETAILS	EMD Amount Rs.
1	KMF/TCMU/PUR/2018-19/ IND6072 Dt: 27-11-2018	Supply of Milko Screen – 04 Nos.	40,000-00
2	KMF/TCMU/PUR/2018-19/ IND6073 Dt: 27-11-2018	Supply of Caustic Soda In Liquid Form (Lye) on ARC basis – 50,000 Kgs.	50,000-00
3	KMF/TCMU/PUR/2018-19/ IND6074 Dt: 27-11-2018	Supply of Lactovit – Vitamin 'A' & 'D' Premix – 300 Kgs.	11,500-00
4	TMU/MIS/M.S.OFFICE/ 2018-19 Dt: 27-11-2018	Supply of M.S. Office Paper License, Part Code: 021-10609 Product Description-OfficeStd 2019 SNGL OLP NL – 10 Nos.	5,000-00

1) Tender Schedule Downloading Date: From **06-12-2018 to 05-01-2019 / 2.00 P.M.** 2) Last Date For Submission Of Tender: **05-01-2019 / 2.00 P.M.** 3) Time & Date of Opening of Technical Tender Bid (Cover-1): **07-01-2019 / 2.30 P.M.** 4) Web Site Address For E-tender: **www.eproc.karnataka.gov.in**

Sd/-
For Tumkur Co-operative Milk Union Ltd.
MANAGING DIRECTOR

CSIR-Indian Institute of Petroleum

(Council of Scientific & Industrial Research)
P.O.I.I.P., MOHKAMPUR, DEHRADUN – 248005 (UK) INDIA
Ph.0135-2525945, Fax. 0135-2660072, 2660202-203
E-Mail- rawats@iip.res.in Web: www.iip.res.in

TENDER NOTICE 2018-2019

E-Bids (Online tenders) under two bids system (part-I Technical bid along with EMD and Part-II Price bid) are invited through Central Public Procurement (CPP) portal **(https://www.etenders.gov.in)**. Only online quotations will be entertained from the registered bidders of CPP Portal.

Sl. No	File No.	Description	Qty	EMD (In Indian Rupees)
1.	PUR/1/18-19/667/ LR/AFLAD/PO	A Multi-channel Power Analyzer	One Set	Rs. 54,000.00 (Rs. Fifty Four Thousand only)
2.	PUR/1/18-19/618/ LR/AFLAD/PO	Electronic Control Unit Development System for Electric Vehicle	One	Rs. 84,000.00 (Rs Eighty Four Thousand Only)

The last date of submission of bids is on or before **26.12.2018** upto **15:00 hours (IST)** and shall be opened on **27.12.2018 at 15:00 hours (IST).**
Please visit our website **www.iip.res.in** for further details for Standard Bid Documents.

(S.O. Stores & Purchase)

KIDWAI CANCER INSTITUTE

Government of Karnataka Autonomous Institution
Dr. Marigowda Road, Bengaluru - 560029.

SHORT TERM e-PROCUREMENT TENDER NOTIFICATION

Tenders are invited in TWO Bid System for the supply of following Equipments.

Sl. No.	Tender Notification No. & Date	Particulars	No. of Calls
01	No. KCI /SME(1)/ TENDER/OUT SOURCE/99/2018-19 Dt. 30.11.2018	Out Source of Group 'D' Employees to KCI., Bengaluru	2nd Call
02	No. KMIO/SME(1)/ Tender/M. Equip/ 91/2018-19 Dt. 30.11.2018	Supply & Installation of Laundry Machine, Demineralization Plant & Supply of Mobile Cancer Screening & Detection Bus	2nd Call
03	No KCI/MNT/Tender/ Condemned Things/ 02/2018-19 dt. 30.11.2018	Disposal of Released Unservicable/ Scrap Materials godown at KCI.,	2nd Call
04	No KCI/MNT/Vehicle Parking/09/2018-19 dt. 30.11.2018	Maintenance of Vehicle Parking Stand at KCI., Bengaluru	2nd Call

The Bid Document will be available in online from 06.12.2018 to 19.12.2018. Bidders can view and download the Bid Document from the Website https://eproc.karnataka.gov.in Bids have to be submitted through e-Procurement Portal and Rs. 500-00 as e-procurement Portal fees The last date and time of Receipt of Bid through e-Procurement Portal is 19.12.2018 at 3-00 P.M. Tender Accepting Authority reserves the right to accept/ reject/ cancel the tender without assigning any reason thereof.

Sd/-
Director

DIPR/DDU/1582/2018-19

KARNATAKA STATE POLLUTION CONTROL BOARD

No.49, "Parisara Bhavana", 1st to 5th Floor, Church Street,
Bengaluru - 560 001, Karnataka, INDIA.
Ph: 25581383, 25589112, 25586520 Fax: 080-25586321
E-mail: ho@kspcb.gov.in Website : http://kspcb.gov.in

PCB/462/17cat /EPH/HPI/2018-19/4510 Date:-04/12/2018

ENVIRONMENTAL PUBLIC HEARING NOTIFICATION

M/s Greenko Solar Energy Private Limited, has proposed to establish Stand alone pumped storage project of 1260MW under Saundatti Integrated Renewable Energy Project(IREP) near Karalakatti village, Yakkundi Panchayat, Saundatti Hobli and Taluk, Belagavi District, Karnataka State.

As per Environment Impact Assessment Notification dated: 14.09.2006 and its amendment dated: 01.12.2009, the project has to obtain prior Environmental Clearance from the Ministry of Environment, Forest and Climate Change, Government of India and is required to go through Environmental Public Hearing process. As per the Terms of Reference letter No.J-12011/11/2018-IA-I(R), dated:18.05.2018 & amendment letter dated:25.09.2018 of Ministry of Environment, Forest and Climate Change, Government of India and request letter of the project proponent dated: 23.11.2018, the Environmental Public Hearing is being conducted by the Board.

The details of the project are as follows:

1. Name of the Company & Address : **M/s Greenko Solar Energy Private Limited**, Admin Office: Suite No.701-702, Prestige Meridian-II, No.30, M.G. Road, Bengaluru-5600001, Karnataka State.

2. Proposed location of the project : **M/s Greenko Solar Energy Private Limited**, near Karalakatti village, Yakkundi Panchayat, Saundatti Hobli and Taluk, Belagavi District, Karnataka State.

3. Details of activity : Proposed to establish Stand alone pumped storage project of 1260MW under Saundatti Integrated Renewable Energy Project (IREP)

4. Date, time and venue of Public Hearing : **07.01.2019(Monday) at 11.00A.M.** at Project site (adjacent Maliur Electrical substation), Karalakatti village, Yakkundi Panchayat, Saundatti Hobli and Taluk, Belagavi District.

5. **Places of availability of project documents as per EIA Notification, which is kept open to public are:** (a) Office of the Deputy Commissioner, Belagavi District, Belagavi. (b) Chief Executive Officer, Zilla Panchayat, Belagavi District. (c) District Industries Centre, Belagavi District. (d) Office of the Regional Officer, Regional Office- Karnataka State Pollution Control Board, Belagavi. (e) Gram Panchayath Yakkundi panchayat. (f) Office of the Ministry of Environment & Forest & CC, South Zone Office, E-3/240, Kendriya Sadan, 4th Floor, E&F Wings, 17th Main Road, 2nd Block, Koramangala, Bengaluru – 560 034. (g) HELP DESK, Karnataka State Pollution Control Board, Ground Floor, No.49, Parisara Bhavan, Church Street, Bengaluru – 560 001.

NOTE: Suggestions, views, comments and objections of interested bonafide residents, environmental groups and others located at project site and likely to be affected by the proposed project are invited within 30 days from the date of publication of this Notification to make oral/ written / E-Mail suggestions to the Karnataka State Pollution Control Board/Chairman, Environmental Public Hearing Committee (Deputy Commissioner Belagavi District), Belagavi. Interested public can participate in the Environmental Public Hearing at the above place. For details please visit our **Website: http://kspcb.gov.in.**

Sd/-
Member Secretary

"AVOID USE OF PLASTICS - BE 'ECO' FRIENDLY"

VISAYAVANI - DT:- 05-12-2018. 6.

ಮಹಾರಾಷ್ಟ್ರ ಹಿರಿಯೂರಿನಲ್ಲಿ ನೋಟಾವನ್ನು ಒಂದು ಅಭ್ಯರ್ಥಿಯಾಗಿ ಪರಿಗಣಿಸಲಾಗಿದೆ. ಒಂದು ವೇಳೆ ನೋಟಾ ಉಳಿದ ಅಭ್ಯರ್ಥಿಗಳಿಗಿಂತ ಹೆಚ್ಚಿನ ಮತ ಪಡೆದರೆ ಉತ್ಪಾದನೆಯಾಗುವ ವಿದ್ಯುತ್ ಅನ್ನು ಮುಂದಿನ ಚುನಾವಣೆಗಳಲ್ಲೂ ಬಳಕೆ ಮಾಡಲಾಗುವುದು ಎಂದು ಸಮ್ಮೇಳನಾಧ್ಯಕ್ಷ ಪರಶುರಾಮ್ ತಿಳಿಸಿದ್ದಾರೆ.

ಮಾಡದಿದ್ದರೆ ಡಿ. 26ರಂದು ಮತ್ತೆ ಆಯೋಗಕ್ಕೆ ಭೇ ವಿಚಾರಿಸುವುದಾಗಿ ಸುರೇಶ್ ಕುಮಾರ್ ತಿಳಿಸಿದರು.

ಎಲ್ಲರಿಗೂ ವೇದವಿ

ಉಡುಪಿ: ಹಿಂದು ಧರ್ಮದ ಮೂಲ ವೇದ. ವೇದಗಳ ಅರಿವಿಲ್ಲದ ಬದುಕು ಶೂನ್ಯ. ಹೀಗಾಗಿ ಎಲ್ಲರಿಗೂ ವೇದ ವಿದ್ಯೆಯ ಜ್ಞಾನ ಅವಶ್ಯ ಎಂದು ಪೇಜಾವರ ಮಠದ ಶ್ರೀವಿಶ್ವೇಶತೀರ್ಥ ಸ್ವಾಮೀಜಿ ಹೇಳಿದರು.

ವೇದಗಳ ಅರಿವಿಲ್ಲದ ಬದುಕು ಶೂನ್ಯ

ಉಜ್ಜಯಿನಿಯ ಮಹರ್ಷಿ ಸಾಂದೀಪನಿ ರಾಷ್ಟ್ರೀಯ ವೇದವಿದ್ಯಾ ಪ್ರತಿಷ್ಠಾನದಿಂದ ಪರ್ಯಾಯ ಪಲಿಮಾರು ಮಠ ಶ್ರೀಕೃಷ್ಣ ಮಠ, ಉಡುಪಿಯ ಎಸ್‌ಎಂಎಸ್‌ಪಿ ಸಂಸ್ಕೃತ ಮಹಾವಿದ್ಯಾಲಯ ಮತ್ತು ಬೆಂಗಳೂರಿನ ಪೂರ್ಣಪ್ರಜ್ಞ ಸಂಶೋಧನಾ ಮಂದಿರ ಸಹಭಾಗಿತ್ವದಲ್ಲಿ ಡಿ. 4ರಿಂದ

ವೇದ ಸಮ್ಮೇಳನಕ್ಕೆ

ಕರ್ನಾಟಕ ರಾಜ್ಯ ಮಾಲಿನ್ಯ ನಿಯಂತ್ರಣ ಮಂಡಳಿ

ನಂ.49, "ಪರಿಸರ ಭವನ", 1 ರಿಂದ 5ನೇ ಅಂತಸ್ತು ಚರ್ಚ್ ಸ್ಟ್ರೀಟ್,
ಬೆಂಗಳೂರು-560 001, ಕರ್ನಾಟಕ, ಭಾರತ
ಫೋನ್: 25581383, 25589112, 25586520, ಫ್ಯಾಕ್ಸ್: 080-25586321
ಈ-ಮೇಲ್: ho@kspcb.gov.in ವೆಬ್‌ಸೈಟ್ : http://kspcb.gov.in

ಸಂಖ್ಯೆ: ಮಾನಿಮಂ/462/17ನೇ ಪ್ರವರ್ಗ/ಹೆಚ್‌ಪಿಐ/2018-19/4510 ದಿನಾಂಕ: 04/12/2018

ಪರಿಸರ ಸಾರ್ವಜನಿಕ ಸಭೆಗಾಗಿ ಸೂಚನೆ

ಮೆ: ಗ್ರೀನ್‌ಕೋ ಸೋಲಾರ್ ಎನರ್ಜಿ ಪ್ರೈವೇಟ್ ಲಿಮಿಟೆಡ್, ಕಂಪನಿಯವರು ಕರ್ನಾಟಕ್ಕಾಗ್ರಾಮದ ಹತ್ತಿರ, ಯಕುಂಡಿ ಪಂಚಾಯತ್, ಸೌಂದತ್ತಿ ಹೋಬಳಿ ಮತ್ತು ತಾಲ್ಲೂಕು, ಬೆಳಗಾವಿ ಜಿಲ್ಲೆಯಲ್ಲಿ ಸೌಂದತ್ತಿ ಇಂಟಿಗೇಟೆಡ್ ರಿನ್ಯೂವಬಲ್ ಎನರ್ಜಿ ಪ್ರಾಜೆಕ್ಟ್ (ಐಆರ್‌ಇಪಿ) ಯೋಜನೆ ಅಡಿಯಲ್ಲಿ ಹೊಸದಾಗಿ 1260MW ಸಾಮರ್ಥ್ಯವನ್ನು ಸ್ವತಂತ್ರ ಪಂಪ್ಡ್ ಶೇಖರಣಾ ಘಟಕವನ್ನು (Stand alone pumped storage project 1260 MW) ಸ್ಥಾಪಿಸಲು ಉದ್ದೇಶಿಸಿರುತ್ತಾರೆ.

ಸದರಿ ಯೋಜನೆಯ ಪ್ರವರ್ತಕರು ಪರಿಸರ ಅಘಾತ ಅಧ್ಯಯನದ ಅಧಿಸೂಚನೆ ದಿನಾಂಕ 14.9.2006ರ (ತಿದ್ದುಪಡಿ ದಿನಾಂಕ 1.12.2009) ಪ್ರಕಾರ **ಪರಿಸರ ಮತ್ತು** ಅರಣ್ಯ ಮಂತ್ರಾಲಯ, ಭಾರತ ಸರ್ಕಾರ, ಇವರಿಂದ ಪರಿಸರ **ವಿಮೋಚನಾ** ಪತ್ರವನ್ನು ಪಡೆಯಬೇಕಾಗಿರುತ್ತದೆ ಮತ್ತು ಪರಿಸರ ಸಾರ್ವಜನಿಕ **ಆಲಿಕೆಯನ್ನು** ನಡೆಸಬೇಕಾಗಿರುತ್ತದೆ. ಪರಿಸರ, ಅರಣ್ಯ ಮತ್ತು ಹವಾಗುಣ ಬದಲಾವಣೆ ಮಂತ್ರಾಲಯ, ಭಾರತ ಸರ್ಕಾರ, ನವ ದೆಹಲಿ ಇವರ **Terms of Reference** ಪತ್ರ ಸಂಖ್ಯೆ: No.J-12011/11/2018-IA-I(R)ದಿನಾಂಕ :18.05.2018 & ತಿದ್ದುಪಡಿ ಪತ್ರದ ದಿನಾಂಕ :28.09.2018 ರಂತೆ ಹಾಗೂ ಉದ್ದಿಮೆ ನಿವೇದನೆ ಪತ್ರ ದಿನಾಂಕ: 23.11.2018ರ ಪ್ರಕಾರ ಪರಿಸರ ಸಾರ್ವಜನಿಕ **ಆಲಿಕೆ ಸಭೆಯನ್ನು ಮಂಡಳಿಯ ವತಿಯಿಂದ ನಡೆಸಲಾಗುತ್ತಿದೆ.**

ಯೋಜನೆಯ ವಿವರಗಳು ಕೆಳಕಂಡಂತಿವೆ.

1. ಕಂಪನಿಯ ಹೆಸರು ಮತ್ತು ವಿಳಾಸ : **ಮೆ: ಗ್ರೀನ್‌ಕೋ ಸೋಲಾರ್ ಎನರ್ಜಿ ಪ್ರೈವೇಟ್ ಲಿಮಿಟೆಡ್**, ಆಡಳಿತ ಕಛೇರಿ: ಸೂಟ್ ನಂ.701-702, ಪ್ರೆಸ್ಟೀಜ್ ಮೆರಿಡಿಯನ್-II, ನಂ.30, ಎಮ್.ಜಿ.ರೋಡ್, ಬೆಂಗಳೂರು-5600001.

2. **ಉದ್ದೇಶಿತ ಯೋಜನೆಯ ಸ್ಥಳ : ಮೆ: ಗ್ರೀನ್‌ಕೋ ಸೋಲಾರ್ ಎನರ್ಜಿ ಪ್ರೈವೇಟ್ ಲಿಮಿಟೆಡ್**, ಕರ್ನಾಟಕ್ಕಾಗ್ರಾಮದ ಹತ್ತಿರ, ಯಕುಂಡಿ ಪಂಚಾಯತ್, ಸೌಂದತ್ತಿ ಹೋಬಳಿ ಮತ್ತು ತಾಲ್ಲೂಕು, ಬೆಳಗಾವಿ ಜಿಲ್ಲೆ, ಕರ್ನಾಟಕ ರಾಜ್ಯ.

3. **ಯೋಜನೆಯ ಕಾರ್ಯಚಟುವಟಿಕೆ** : ಸೌಂದತ್ತಿ ಇಂಟಿಗೇಟೆಡ್ ರಿನ್ಯೂವಬಲ್ ಎನರ್ಜಿ ಪ್ರಾಜೆಕ್ಟ್ (ಐಆರ್‌ಇಪಿ) ಯೋಜನೆ ಅಡಿಯಲ್ಲಿ ಹೊಸದಾಗಿ 1260MW ಸಾಮರ್ಥ್ಯವನ್ನು ಸ್ವತಂತ್ರ ಪಂಪ್ಡ್ ಶೇಖರಣಾ ಘಟಕವನ್ನು (Stand alone pumped storage project 1260MW) ಸ್ಥಾಪಿಸಲು ಉದ್ದೇಶಿಸಿರುತ್ತಾರೆ.

4. **ಪರಿಸರ ಸಾರ್ವಜನಿಕ ಸಭೆಯ ಸ್ಥಳ, ದಿನಾಂಕ ಮತ್ತು ಸಮಯ: ದಿನಾಂಕ: 07.01.2019** (ಸೋಮವಾರ) ರಂದು **ಸಮಯ: ಬೆಳಿಗ್ಗೆ 11.00 ಘಂಟೆ. ಸ್ಥಳ: ಯೋಜನಾ** ಪ್ರದೇಶ, (ಮಾಲೂರು ವಿದ್ಯುತ್ ವಿಸ್ತರಣಾ ಕೇಂದ್ರದ ಪಕ್ಕ) ಕರ್ನಾಟ್ಕಿ ಗ್ರಾಮ, ಯಕುಂಡಿ ಪಂಚಾಯತ್, ಸೌಂದತ್ತಿ ಹೋಬಳಿ ಮತ್ತು ತಾಲ್ಲೂಕು, ಬೆಳಗಾವಿ ಜಿಲ್ಲೆ.

6. ಯೋಜನೆಯ ಕಾರ್ಯಕಾರಿ ಸಾರಾಂಶ ಸಾರ್ವಜನಿಕ ಪರಾಮರ್ಶೆಗೆ ಇಡುವ ಸ್ಥಳ : (ಅ) ಜಿಲ್ಲಾಧಿಕಾರಿಗಳ ಕಛೇರಿ, ಬೆಳಗಾವಿ ಜಿಲ್ಲೆ, ಬೆಳಗಾವಿ. (ಆ) ಮುಖ್ಯ ಕಾರ್ಯನಿರ್ವಹಕ ಅಧಿಕಾರಿಗಳ ಕಛೇರಿ, ಜಿಲ್ಲಾಪಂಚಾಯತ್, ಬೆಳಗಾವಿ. (ಇ) ಜಿಲ್ಲಾ ಸೈಕೈಗಾರಿಕಾ ಕೇಂದ್ರ, ಬೆಳಗಾವಿ. (ಈ) ಗ್ರಾಮ ಪಂಚಾಯತ್ ಕಾರ್ಯಾಲಯ, ಯಕುಂಡಿ ಪಂಚಾಯತ್. (ಉ) ಪ್ರಾದೇಶಿಕ ಕಛೇರಿ, ಕರ್ನಾಟಕ ರಾಜ್ಯ ಮಾಲಿನ್ಯ ನಿಯಂತ್ರಣ ಮಂಡಳಿ, ಬೆಳಗಾವಿ. (ಊ) ಕೇಂದ್ರ ಅರಣ್ಯ, ಪರಿಸರ & ಹವಾಗುಣ ಬದಲಾವಣೆ, ಮಂತ್ರಾಲಯ, ದಕ್ಷಿಣ ವಲಯ ಕಛೇರಿ,ನಂ.ಇ-3/240, ಕೇಂದ್ರೀಯ ಸದನ, 4ನೇ ಮಹಡಿ, ಇ ಮತ್ತು ಎಫ್ ವಿಂಗ್ಸ್, 17ನೇ ಮುಖ್ಯ ರಸ್ತೆ, 2ನೇ ಬ್ಲಾಕ್, ಕೋರಮಂಗಲ, ಬೆಂಗಳೂರು-560034. (ಋ) ಸಹಾಯಕ ಕೇಂದ್ರ, ಕರ್ನಾಟಕ ರಾಜ್ಯ ಮಾಲಿನ್ಯ ನಿಯಂತ್ರಣ ಮಂಡಳಿ,ನೆಲ ಅಂತಸ್ತು, ನಂ.49, ಪರಿಸರ ಭವನ, ಚರ್ಚ್ ಸ್ಟ್ರೀಟ್, ಬೆಂಗಳೂರು-560001.

ಸೂಚನೆ: ಯೋಜನಾ ಸ್ಥಳದಲ್ಲಿ ವಾಸವಾಗಿರುವ ಆಸಕ್ತ ನಿವಾಸಿಗಳು, ಪರಿಸರಾಸಕ್ತ ಗುಂಪುಗಳು ಮತ್ತು ಈ ಯೋಜನೆಯಿಂದ ತೊಂದರೆಗೊಳಗಾಗಬಹುದಾದ ಸಾರ್ವಜನಿಕರು ತಮ್ಮ ಸಲಹೆಗಳು, ಅನಿಸಿಕೆಗಳು, ಟೀಕೆ-ಟಿಪ್ಪಣಿಗಳು ಹಾಗು ಅಹವಾಲುಗಳನ್ನು ಮೌಖಿಕ/ಲಿಖಿತ/ಇ-ಮೇಲ್ ಮೂಲಕ ಕರ್ನಾಟಕ ರಾಜ್ಯ ಮಾಲಿನ್ಯ ನಿಯಂತ್ರಣ ಮಂಡಳಿ/ಅಧ್ಯಕ್ಷರು, ಪರಿಸರ ಸಾರ್ವಜನಿಕ ಸಮಿತಿ (ಜಿಲ್ಲಾಧಿಕಾರಿಗಳು, ಬೆಳಗಾವಿ ಜಿಲ್ಲೆ, ಬೆಳಗಾವಿ) ಇವರಿಗೆ ಈ ಅಧಿಸೂಚನೆ ಪ್ರಕಟವಾದ 30 ದಿನಗಳ ಒಳಗೆ ಸಲ್ಲಿಸತಕ್ಕದ್ದು. ಇಚ್ಛೆಯುಳ್ಳ ಸಾರ್ವಜನಿಕರು ಮೇಲೆ ತಿಳಿಸಿರುವ ದಿನದಂದು ಪರಿಸರ ಸಾರ್ವಜನಿಕ ಆಲಿಕೆ ಸಭೆಯಲ್ಲಿ ಪಾಲ್ಗೊಳ್ಳಬಹುದಾಗಿದೆ. ಹೆಚ್ಚಿನ ವಿವರಗಳನ್ನು ಮಂಡಳಿಯ ವೆಬ್‌ಸೈಟ್ : **http://kspcb.gov.in** ನಲ್ಲಿ ಪಡೆಯಬಹುದು

ಸಹಿ/-
ಸದಸ್ಯ ಕಾರ್ಯದರ್ಶಿ

"ಪ್ಲಾಸ್ಟಿಕ್ ಬಳಕೆ ನಿಲ್ಲಿಸಿ, ಪರಿಸರ ಹಾನಿ ತಪ್ಪಿಸಿ"

Deputy Director
SOCIAL WELFARE DEPARTMENT
Raichur District, Raichur

DDSwd Rcr/Act/FoodTender/CR/2018-19 Dated: 03 /12/2018

SHORT TERM TENDER NOTIFICATION (2- Call)

FOR SUPPLY OF FOOD MATERIALS AND OTHER MATERIALS (GROUP-A TO GROUP-D) TO PRE-METRIC, POST METRIC HOSTELS / RESIDENTIAL SCHOOLS WOKING UNDER SOCIAL WELFARE DEPARTMENT RAICHUR DISTRICT FOR THE YEAR 2018-19.

Deputy Director Social Welfare Department Raichur District, Here by invites Technical & financial Bids from officially registered, eligible suppliers, Non-governmental organization who are registered under law, co-operative societies who are registered under society act to Supply food materials for all institutions spread over Raichur District as described in the schedule of requirements.

(1) Tender Reference No and date : ddswd Rcr / Act / FoodTender / CR / 2018-19, Dated : 03/ 12 / 2018 **(2)** Amount put to Tender : **Rs.1159,96,000/- (3)** Pre-Bid Meeting Date, Place and Time : Dated : **07/12/2018 Time. 11.00 A.M** (In this office) **(4)** Demonstration / submission of samples of food & miscellaneous articles (A,B,&D), Dated: **11 / 12/2018 Time. 11.00 A.M,** (In this office) **(5)** Last date & Time for submission of Tender Dated : **15 /12 /2018 Time. 4.00 P.M (6)** Date & Time of opening of Technical bid Dated : **19/12/2018 Time. 11.00 A.M** At: Office of the Deputy Commissioner Raichur **(7)** Date & Time of opening of Financial Bid Dated: **22/12/2018 Time. 11.00 AM** At: Office of the Deputy Commissioner Raichur **(8)** EMD Amount **Rs. 29,00,000/- (9)** Venue of opening of tenders & address for communication : The Deputy Director Social Welfare Department Raichur District Behind Hotel Priya, Station Road, Azad Nagar. Raichur Phone No. 08352-231091

Interested eligible Registered in e-procurement portal bidders can down load the bid documents with visiting the web site **http://e-proc.karnataka.gov.in**

Sd/-
Deputy Director ,
Social Welfare Department Raichur

DIPR/RAICHUR/KAVITA/01/2018-19

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PROCEEDINGS OF THE ENVIRONMENTAL PUBLIC HEARING OF M/s. GREENKO SOLAR ENERGY PRIVATE LIMITED FOR THE ESTABLISHMENT OF 1260 MW STANDALONE PUMPED STORAGE PROJECT OF SAUNDATTI INTEGRATED RENEWABLE ENERGY PROJECT (IREP) HELD ON 07.01.2019 AT 11.00 A.M. AT THE CHAIMANSHIP OF DEPUTY COMMISSIONER, BFELAGAVI, KARNATAKA STATE.

Venue: **AT THE PROJECT SITE (ADJACENT TO MALLUR ELECTRICAL SUBSTATION), KARLAKATTI VILLAGE, YAKKUNDI PANCHAYAT, SAUNDATTI HOBLI AND TALUK, BELAGAVI DISTRICT.**

Details of the present Officials	:	Annexure 1
Officials representing the Project	:	Annexure 2
Details of the public participants	:	Annexure 3
Project Report presented by the company	:	Annexure 4
Representation received in writing	:	Annexure 5
Clarification given by Project Proponent	:	Annexure 6

Preamble:

M/S Greenko Solar Energy Private Ltd, Karlakatti Village, Yakkundi Village Panchayath, Saundatti Taluka, Belagavi District have applied for Environmental clearance to the MOEF and CC, Government of India to establish a new Standalone Pumped Storage component of 1260 MW as part of the Integrated Renewable Energy Project. The Project Proponent need to obtain the Environment Clearance from Ministry of Environment, Forest and Climate Change, Government of India as per Environment Impact Assessment notification dated 14.09.2006 (Amended date 01.12.2009). It is informed by the Planning Advisor that as per the Terms of Reference (TOR) of Ministry of Environment, Forest and Climate Change letter No.J-12011/11/2018-IA-I(R) date: 18.05.2018 and project proponent's request letter dated: 23.11.2018, the Karnataka State Pollution Control Board (KSPCB) is to conduct Public Hearing meeting. The Draft Report on Environmental Impact Assessment (EIA) Study of the proposed project is submitted to the Board in English and Kannada and it is requested as per the EIA notification, 2006 to conduct Public Hearing.

In this regard a Public Hearing has been conducted at Project Area (near Mallur Power Sub Station) in Karlakatti Village, Yakkundi Village Panchayath, Saundatti Taluka, Belagavi District on 07.01.2019 at 11:00 am.

In the said matter the Karnataka Pollution Control Board had published a Notice stating about the Environmental public hearing in State Level English and Kannada newspaper "Vijaya Vani" and "Indian Express" dated 05.12.2018 respectively and in District Level Kannada newspaper "Kandamma" dated 06.12.2018 asking for the residing public, environmental interested people and expected affecting people by the project to inform about their feelings, suggestion, advantages and disadvantages and any memorandums verbal/written/email to Karnataka State Pollution control board, Committee of Environment (Belagavi District Commissioner) within 30 days from the newspaper publication. The Environment Impact Assessment Report and Execution Summary report has been made available at The DC Office Belagavi, CEO Zillah Panchayath Belagavi, DIC Belagavi, Office of Village Panchayath Yakkundi, Regional Office KSPCB Belagavi – 1, Ministry of Environment, Forest and Climate Change Bangalore and Help Desk KSPCB Bangalore for the purpose of public discussion.

On 07.01.2019 the Public Hearing was conducted at Yakkundi Village Panchayath (near Mallur Power Sub Station) in Karlakatti Village, Yakkundi Village Panchayath, Saundatti Taluka, Belagavi District. Smt. Rajashree. J. Kulli Deputy Environment Officer, Regional Office, KSPCB, Belagavi – 1 welcomed Dr. S.B.Bommanahalli, DC Belagavi(President of Environmental Committee) and Shri. Vijaykumar T. Kadakbhavi, Sr. Environment Officer, KSPCB Dharwad, Shri. Mahantesh Koujalgi, MLA Bailhongal and all the officers, public, farmers, media friends and Project officials. The procedure of conducting public hearing as per Ministry of Environment, Forest and Climate Change Notification-2006 was explained and the said project comes under Environment Impact Assessment (EIA) 2006 notification and also explained purpose of public hearing. She requested the DC Belagavi to preside this meeting.

Shri. Balaram G V, Project Director, M/s Greenko Solar Energy Private Limited :- He greeted The Deputy Commissioner, Belagavi District, Poojya Swamiji, Senior Environment Officer, KSPCB, Environment Officer, KSPCB and Tehsildar, Saundatti, and Villagers of Project Affected Area, farmers of the local area, NGO's, Print & Electronic media and other District Officials.

He informed that the M/s Greenko is a renewable energy company and proposes to establish Saundatti Integrated Renewable Energy Project

constituting three components i.e Solar, Wind and Pumped Storage Components. He briefly described about the proposed Pumped Storage Project features and said that the Project constitutes Upper reservoir located near to Karlakatti Village under Yakkundi Gram Panchayath, a water conductor system, a surface powerhouse and a tail race channel connecting to the existing Renuka Sagar Reservoir. The live storage capacity of the proposed Upper reservoir is 1.01 TMC. He said that the water is pumped from the existing Renuka Sagar Reservoir to the proposed upper reservoir utilizing the energy generated during the day time from the other two components i.e., Solar and Wind of the total Integrated Project. He further informed that the energy is generated from the Proposed Pumped Storage Project by utilization of the 1 TMC water through recirculation where water is circulated between the proposed upper reservoir and existing Renuka Sagar reservoir. The Power House will be a surface power house. The energy is generated by using 2 turbines of 126 MW capacity and 4 turbines of 252 MW capacities. The total project cost of Pumped Storage Component is Rs 5535.22 Crores including cost towards civil, electro mechanical works and cost incurred towards interest during Construction etc., On land requirement for the Proposed Pumped Storage Project he said that the total land required is 228.14 Ha, out of which 167.51 Ha is forest land, 37.34 Ha private land and 23.29 Ha of Government/PWD.

He also informed that M/s Greenko Solar Energy Private Limited has engaged R S Envirolink Technologies Pvt. Ltd. Gurgaon, a reputed Environmental Consultant for undertaking the EIA & EMP study of the proposed Standalone Pumped Storage Project. He informed that the baseline studies are conducted by the consultant for three seasons including winter, summer and Monsoon seasons. He explained the study approach and methodology and stated that the study covered assessment of physical, biological and socio-economic environment in the 10 Kms radius of the Proposed Pumped Storage Project and anticipated impacts on the above environment from the construction activity of the Project.

He presented the anticipated environmental impacts from the Project such as impacts on air, noise and water quality from the construction activity, the influx of migrant labor and its resultant impact on local socio-cultural environment, the forest land usage and it impact on flora and fauna and others. On private land requirement for the proposed Pumped Storage Project, he informed that the total private land required will be obtained through direct purchase from the land owners. He detailed the steps in the process of land purchase and stated that appropriate due diligence of

revenue records of the identified land will be undertaken, then undertake consultations and negotiations with the identified land owners and finally based on their willingness the land will be purchased and registered. He informed the benefits arising out of the proposed Project and listed the benefits including a large number of employment opportunity, work contract opportunity, indirect economic opportunity and basic infrastructure development and local Village Development activity mainly in health, education and communication sectors. He also stated that for employment and other opportunity arising out of the Project the first priority will be given to the local people of the affected villages.

He informed on the mitigation measures proposed under the Environment Management Plan (EMP) for addressing the anticipated impacts from the Project and briefed the measures proposed and budgets allocated for various management plans including Biodiversity Conservation & Management Plan, Muck Dumping and Management Plan, Solid Waste Management Plan, Public Health Delivery System, Energy Conservation Measures, Landscaping, Restoration and Green Belt Development Plan, Compensatory Afforestation Plan, Air, Water and Noise Management Plan Environment Monitoring Program and Corporate Environment Responsibility (CER) Plan. He informed that for the above Plans under EMP a total budget of Rs 70.60 Crores is provided. The details of the presentation is enclosed vide Annexure -4.

Dr. S. B. Bommanahalli, The Deputy Commissioner, Belagavi District :- During the end of the presentation on the EIA and EMP The DC, Belagavi District asked the company representative if you have done any studies on the effects on the environment due to this project. He asked in what way this affect local environment and that too have to be identified whether any major damages would happen due to the proposed Project.

Shri. Balaram G V, Project Director, M/s Greenko Solar Energy Private Limited :- In reply, he informed that as you all know that the proposed Project is a green energy project and it doesn't adversely affect the local environment. He also said that while constructing the project some amount of dust pollution may occur and in order to reduce such impact we will be using water sprinkler and use the new latest technologies and state of the art equipment for example during the construction of Bangalore metro involving tunnel construction latest technologies were used and tunnels were constructed below the existing buildings. We would like to clarify that even after completion of the project there won't be any adverse impact.

Dr. S. B. Bommanahalli, The Deputy Commissioner, Belagavi District :- The Honorable Deputy Commissioner while welcoming again Poojya Swamiji and the Hon'ble Member of Legislative Assembly (MLA), Bailhongal, has informed that the Greenko Energy Company has proposed to establish 1260 MW of an Integrated Renewable Energy project covering Wind, Solar and Hydro components in this region. This project is being implemented at Cost of rupees more than Rs 5000 Crores and envisaged procurement of 226 ha of land. He said that out of the total land this company is purchasing only 36-37 ha of private land from local farmers.

As you all know I would like to inform that Govt. and public have the intention to protect the renewable energy, because the power generated by using Coal, Diesel, Petrol, Kerosene will not be available for a longer time. If at all, if we have to give gift to our future generation we need to protect the natural resources by using renewable energy. With this intention Govt. is encouraging renewable energy as it doesn't adversely effect the environment. Studies have been conducted by experts for this project to find out the effects on the Environment. They have found out that there won't be adverse effect on public, animals, birds and environment from this project. They have also found out that there would be some amount of dust while constructing buildings, tunnels and roads. They have explained that there won't be adverse effect on the public health as they are taking preventive measures. The administrative and technical permissions and Noc's would be given after consulting various Govt. departments as per the norms and this will be a separate procedure. This public hearing is organized on this day by inviting you all to discuss the adverse effects on the environment from this project and to express your views and doubts or if you know anything and find out a solution. The company has allocated Rs. 70 Crores to mitigate the adverse impacts, if any. The company is ready to allocate more funds for the health of public or development or to mitigate adverse effect. At this stage he invited the local people to express their views, doubts, suggestions if they have any regarding the project and the details presented for which this hearing is arranged.

Shri. Gopal Krishna B Sanatangi, Environmental Officer, Karnataka State Pollution Control Board, Belagavi-1 :- He requested the local villagers, farmers, public at large, the Public Representative, NGO's etc., to elicit their views, suggestions and objections if any; on the proposed project and informed that each and every person gathered at the venue would be granted an opportunity to express their views, suggestions, objections etc.,

on the proposed project. He invited the public and informed that they can come one by one to the podium and express their views starting by telling their names, villages and give their opinion.

Views, Suggestions & Objections raised by the Public:

Shri. Prakash Mugabasav, Village Hosur, Saundatti Taluka, Belagavi District :- He has expressed his greetings to the Officials and people gathered for the Public Hearing and informed that the details of the project have been explained. At this juncture we have some problem. Personally, and on the half of the villagers I would like to make representation as follows. Especially, we are facing shortage of water on the both banks of the river during the month of Feb, March, April and May. The surrounding villagers will face shortage of water for Cattle. In such situation the company utilizes this water, farmer, public and animals will face problems. Already we have faced problems during construction of Navilitheertha Dam and become homeless. We are earning our livelihoods by depending on the lands where in we have river on one side and hills on other side. We have taken loans depending on our crops. If the company utilizes this water the scarcity will extend from existing 3 months to 6 months. Please don't allow to utilize this water. He said that in view of the above difficulties the DC and MLA will have to take serious note of this and requested the authorities to not allow the utilization of the Reservoir water for the proposed Project. He has also submitted a Memorandum to DC.

Shri Basavangouda Nagangouda Patil, Village Yakkundi Tal: Saundatti Dist: Belagavi:- He has informed that he has understood the proposed project and its activities that will be taken up by Greenko company. He said that in 1972 they have lost 1 TMC water and if the proposed project stores 1.7 TMC on the hills there is a chance of salinity in this region and during monsoon it is likely to result in developing of huge cracks leading to land slide. He said that in view of the above chances of facing dangerous situation for people living below he requested the DC to take precautionary measures.

Shri. H.Y. Kittur, Village: Mallur Tal: Saundatti Dist: Belagavi :- He gave a written representation to The Deputy Commissioner.

Shri. Ganesh Hurakaldi and People of Village: Hosur Tal: Saundatti Dist: Belagavi :- He gave a written representation to The Deputy Commissioner.

Shri. Ramesh Parandi, Village: Anigol (Gram Panchayat President) Tal: Bailhongal, Dist: Belagavi :- He has informed that the Malaprabha River Dam is constructed for the benefit of the people of this region and during the construction they have lost vast area of their lands. It is beneficial only to the people reside downstream. He said that even after 35-40 years they have not got proper compensation for their lost lands and lift Irrigation is not completed. He said that around 30-40 Villages of Saundatti area and Bailhongal area are in pathetic condition. He observed that they gave their lands believing the assurances that the remaining lands will be irrigated and even now we are experiencing the difficulties. He requested the Hon'ble MLA to improve the lift irrigation facility. He said that they don't want any buildings and stated this as his personal and collective opinion of his village and submitted a memorandum to the DC.

Shri. Abdul Khadar Jailani Barigidad, Village: Yakkundi (Gram Panchayat Present) Tal: Saundatti Dist: Belagavi :- He gave a written representation to The Deputy Commissioner.

Shri. Vijayakumar Khadakbhavi, Sr. Environmental Officer, KSPCB, Dharwad:- He has informed to the gathering to ask questions related to Environment apart from the topics already spoken.

Shri. Husainsab Hassansab, Mujavar Village: Dhupadal Tal: Saundatti Dist: Belagavi :- He said that due to the project construction there will be salinity in their Yakkundi and surrounding Village and gave a written representation to The Deputy Commissioner.

Shri. Basavaraj Hongal, Village: Yakkundi, Tal: Saundatti , Dist: Belagavi. :- He expressed his greetings to Officials and people gathered for the public hearing and informed to the gathering that if the proposed project will utilize 1.0 TMC of water continuously it will result in water deficit. Instead of continuous utilization the 1.0 TMC should be used in recycling process and again let out into the river. He said that this method should be adopted as the Malaprabha river will not have water in all seasons affecting the local farmers. He informed that the use water in circulation method should not impact the farmers. He said that due to the upper reservoir there is a chance of salinity formation and possibility of cracks in the proposed dam and view of this he requested the Hon'ble MLA and Hon'ble DC to examine and give proper direction.

Shri. Mohanrao Desai, Village: Dhupadal, Tal: Saundatti Dist: Belagavi :- He gave a written representation to The Deputy Commissioner.

Shri. Bandayya Hiremath, Village : Karlakatti, Tal: Saundatti, Dist: Belagavi :- He gave a written representation to The Deputy Commissioner.

Shri. F.S. Siddangoudar, Village: Hosur Tal: Saundatti, Dist: Belagavi:- He has introduced himself and greeted everyone and said several people have expressed their views and informed that it is necessary to obtain opinion of the farmers and villagers before taking up any project by utilizing the local resources. He said that a lot of Wind Energy generation projects have been given to Saundatti Taluk and there is no objection in any manner for these types of projects and that there is cooperation from the local people for wind energy projects. He said that 1.7 TMC of water will be utilized for this project that too for storing on the hills and observed that for generation of power it is ridiculous to take water from one place to another place affecting the environment. He said that just by constructing a tank in our field it will lead to salinity within two days and in 2006-2007 due to continuous rains for 7-8 days many water falls were created, which we have all witnessed. He further said just because of rain water which will be about 10-20 cusecs we have witnessed these falls and you can imagine the status when more than 1.7 TMC of water is stored in the hills. If 1.7 TMC water is stored in the hill the entire region will lead to salinity. We have the right to ask the concerned authorities about this. He said that it is foolishness to believe that there won't be any adverse effect due to storage of this water in the hills and even if DC or the state government supports them, we have right to question them. This is our intention. Speaking on the effects of rain water and river water he said that during construction of the existing Renukasagar Dam, certain rules were formed and till now there is no amendment on this even though we are eligible for utilizing 4-5 feet stored water in the Dam. The laws laid down during construction of the dam which says that they are eligible to utilize the upstream water. But whether it is adequate is not answered.

He said that it is not important whether development works worth of rupees one crore or two crore is happening in our area and quoted a story where one person was sent to a village to capture monkeys by paying rupees one thousand for each monkey and after some time he announced rupees two thousand for a monkey and the villagers brought all the monkeys and then

he announced rupees five thousand for each monkey but they could not get even one monkey and the person who bought the monkey sold it for rupees three thousand to the villagers and the person who was supposed to buy monkeys left the place. Farmers should understand that in this case in reality the farmers received only Rs 1000 and rest is only inflated value. He said the program is going on here simultaneously protest is going on elsewhere because it is not only about the problems of farmers who are selling 30-40 acres but also if the water stagnation happens in the hill entire area will become saline and we will lose our lands and homes. He said the locals don't have any objection for wind projects and they oppose the proposed Hydraulic project and request the DC not to favor the company but to resolve the problems by approaching them and announcing compensation. He said for example, in Hosur for obtaining 2 acres of land for KEB station out of 58 acres of Govt. land the DC, RC, and Govt. rejected stating that this land is reserved for Cattles grassland and if they give 2 acres out of 58 acres they say environment will spoil. Now, they should tell what will happen if they give 700 acres to company. He requested the authorities to consider these issues and help and respond to the farmer's problems in the same way you are supporting the companies for Industries. He said to see the roads in these areas which are bad in condition even after representing on the subject many times. He expressed his support for project coming up in the area by Greenko entered into Karnataka in 2016 keeping in mind the local interest and requested Greenko Company to withdraw the proposed hydraulic project and instead take up wind project so that this region will get enough power. He also said that even though a large number of people have gathered here, still there are many people who are protesting and the DC should understand the problem.

He said that they will welcome projects in their area which are beneficial to the people and not harmful to them and companies also should grow, and it is not one sided. He once again requested to not to approve the proposed project involving storing of water in the hills as it will not be successful and in case an attempt is made it will spoil the farmers of this region and create drinking water scarcity. He informed that the local MLA has plans of constructing a bridge between Hittanigi and Baatoli and let this bridge come up. He then requested the DC to not to continue with the plans of acquiring the lands from the farmers.

Shri. Veerayya Sorabarmath President Raith Sangh and Smt. Jayashri V.J. Women Raitha Sangh :- He appealed to the protesting the farmers to maintain peacefulness. We should protect the law and you

should understand that. I request the youth that you have to decide whether we need this project or not and we have come for this purpose and the DC has told us that he has come here to hear us.

Farmer leaders : Request all my brothers to keep calm as we have come to express our opinions and the DC has to come to know about it.

The Deputy Commissioner, Belagavi District: Please sit down as we have organized this program to discuss the effects on the environment from this project. 1 or 2 leaders can give details about this.

Smt. Jayashree V G, Womens Raitha Sangha – President, Dist: Belagavi :- Please be calm and first of all you understand that this solar plant will not be implemented. They will not oppose your views and hence maintain peace. As we have told that we do not need this project, there is no need to show the details of the project and DC will not go against the wishes of us and he will take care of us. He will not give consent unless you all agree. He knows that you are opposing the project, then why you are making noise and don't get tired. He has understood that the entire village have come here to oppose the project and he will listen to your grievances.

Shri. Goolappa Bhavikatti, Secretary Raitha Sangha, Dist: Belagavi :- Farmers of Yekkundi, Dupdal and surrounding Villages please listen and understand that the court has come to you and by shouting slogans you don't get solutions. Today not only the DC but the district magistrate has come to Yekkundi village. This problem is larger and already you are homeless and lost your land and this is an attempt to vacate you from your place, we don't want this. Being a judge, the DC has to enquire. Malaprabha Dam was constructed not for power project but for drinking water. After laying foundation in 1960, this Dam has been filled only five times. Till now we couldn't give water to our farms. 8 TMC of water is allocated in Mahadayi for power project and if they want to let them do the project there. We do not require this power project at any cost which displaces our people. It is not required to do the project here by showing theory and practical and fooling the public. We do not want project but we want lives and we want to protect our land which has been cultivated since our ancestors. We have not go compensation and now you don't conduct programs which give pain over pain. Those who are opposing the project please raise your hands and Sir; please see the no of people who are opposing the project.

The Hon'ble DC, Belagavi: Informed that gathered farmer leaders are here to express your opinions on behalf of you so listen to them. As they have come to represent you allow them to speak and senior persons have told that you do not need this project. You should bring to our notice that why you do not need the project.

Farmer leader: The points raised by the DC will be addressed seriously by our local farmer Mr. Hussain. The reason we have come here is to support our cause and to inform the consequences of this project and the DC has already come to know that thousands of farmers are against this. If 5% of farmers agree, it will not happen, because you are the people who are going to give land, the Raitha Sangha will support you and you need not worry.

Shri. Hussain Immannavar, Village: Dhupdal Tal: Saundatti, Dist: Belagavi:- He has informed that the people of Yakkundi, Dupdal, Karlakatti, Karlakatti Tanda, Katral, Badli, Mallur have assembled to oppose the project of Greenko company and many people have gathered because during the year 1972 they have lost thousands of acres during construction of Navilatheertha Dam across Malaprabha. He said that now proposed project is planning to utilize their share of water of 1.7 TMC to store it in the hills which will destroy their village and not agreeable to the locals. He said that they don't need this project because it will make them homeless again. He said that since last 40-45 years they have been living on their own without having benefits from the Govt. and now the project people are coming and telling us that they will get economic opportunity and jobs which they don't require. He also said that they have the ability to work in their fields and earn their livelihood and don't want anybody's courtesy.

He said that the Britishers who came to India for doing cardamom business ruled us for 400 years but we did not ask them as that is our nature and we didn't ask the company to construct Toilets, Roads, Bus shelters etc. He said they have already given representation to the authorities and the Panchayath development officer not to issue NOC to the company for which they have not responded and today they have come here for public hearing to discuss on the environment issue but not on the problems faced by the farmers. He said that Greenko Company is arranged meeting here but they have not conducted booth wise meeting in the village. He expressed his concern that after the proposed project where will they go and settle once they lose their lands. He said he has only 2 acres of land in which his parents, himself and his family are depending on and today they might be given 1 Cr or 2 Cr. He said that in 1972 their elders were used to get many

things with 10 paisa but now even they are carrying Rs.1 lakh in their hand, they are unable to get bagful and what they should we do with the 2 Cr rupees for the future generation, nothing we can do. He said out of 133 acres land, if there is any farmer who is willing to give lands he can be summoned and not even a single farmer will give his land and farmers need land not money. He continued on farmers and stated that one farmer will fulfill the hunger of 10000 people, is there any businessman who can fulfill the hunger of 10000 people? And it is only in books they say, "Farmers are back bone of our country". He observed that they have to fight for their rights and authorities should give justice to them. He requested all the farmers not to sell their lands. After concluding his address he said they will submit memorandum on behalf of the villagers to stop the project and even we had given memorandum to Hon'ble MLA, Koujalagi for which we didn't get any response. He questioned and said are we not the children of this village? And tomorrow if something happens to any one of this village, we will only help them, Greenko will not help them and if anybody has to support a farmer it has to be only another farmer and not anybody else. He concluded his speech by thanking one and all.

Shri. Veerayya Sobaradmath, President Raith Sangh, Belagavi District :- He has greeted all the dignitaries on the stage and people attending the public hearing program and informed that Malaprabha dam was constructed by relocating 36 villages and the project was undertaken for agriculture and utilizing $1/4^{th}$ of the water for drinking water purpose. He informed that the canals from the Reservoir pass through 4 Districts and 9 Talukas covering a length of 350 Km. There are 4 dams in our state Kaveri, Tundabhadra, Krishna and Malaprabha. Water from the three dam's, flows to other states. As per water policy expert there is 210 TMC of water He said that the Mahadayi River mainly flows in their area and balance it flows in the state of Goa and of the total available water from this river 45 TMC of water belongs to them and 150 TMC of water belongs to Goa and rest flows to Maharashtra as per the report tells it is 210 TMC and another report says it is 200 TMC. We have fought in the supreme court too under the leadership of Vijay Kulkarni we are demanding the state and central Govt. also He said that for this issue we are fighting in Supreme Court and we are demanding the three Judge bench court for allocating 7 TMC of water for drinking water and 8 TMC for agricultural purpose and 14 TMC for power projects, 5 TMC for Kali river and 1.5 TMC from Mahadayi basin, 20 TMC for other purpose totaling 36 TMC. He said that their elders have done this project for the advantages it will provide for the future generation and not for any disadvantages. He said that as per tribunal order

they have been allotted only 4-5 TMC for drinking water, 8 TMC of water for power projects and if they give 1.7 TMC for your project, in future during their appeal in the Supreme court they will be questioned stating that when you require water for drinking purpose how you can release water for the proposed project. He noted that it will be difficult for them to reply to such kind of questions. He informed that the Renukasagar reservoir was filled only four times since its construction and in such a scenario why water should be released for the proposed project? He said that in general a lot of people are fighting for their rights on water and as still a lot of time is there we are not against your project. When we approach the three bench Supreme Court they will ask that when there is shortage for drinking water, then how can you give 1.7 TMC of water for Hydro Power. The 34 TMC capacity Dam has been filled only for 4 times till now. He said that 8 TMC water is reserved for hydroelectric projects and the proposed project can utilize water from this. He also said that 10,000 MW of excess power is available in their state and what is the need for the proposed power project? He said that they do not require this project and in the case of Mahadayi issue they have already approached the tribunal and at this stage if the company is given the water for which we are eligible, then where we are supposed to go and what we should do. He informed that there is a survey stating that because of these types of companies in India 2 Lakhs Ha land has been converted from green belt to red belt and hence this project should not be allowed. He said that at any cost they will not back track. He stated that expressing the facts, they are telling water will be left to the reservoir after generation, but nobody is understanding that there won't be any energy in the water after power generation for which there is a scientific reason and in spite of all this if the project is taken up, no doubt we will further protest. He requested the Hon'ble DC and other competent authorities such as the Hon'ble Chief Minister, Irrigation Minister, Hon'ble DC , Hon'ble SP, Hon'ble Tahasildar to not to allow the project without their consent. He said that this project should be closed as there is opposition from the public and the DC has to pass the resolution in this regards and submit report to State and Central govt.

Shri. Choolappa Pujeri , Village: Gokak, Dist: Belagavi :- He has informed that this project is against farmers and they don't see any benefits from this project. He said that a large number of people are opposing this project and believe that administration will not give permission for this project without their consent. He said that their agricultural activities will get spoiled because of this project and in spite of this if the project is taken

up they will protest further. He requested the authorities not to give scope for such events to happen.

Shri. Vijay Kulkarni, President of Kalasa Banduri Horata, Dist: Belagavi :- He has informed that the main purpose of constructing Navilatheertha dam/Renukasagar dam is to provide drinking water efficiently, and there is no instructions to give water for power generation. He requested the Hon'ble MLA to first fill the reservoir with 37.7 TMC of water in the dam as there is no 37.7 TMC of water available in the dam instead of thinking of utilizing water for power project. By giving 1.5 TMC water to the company, you are spending the stored water instead of filling the Dam. He questioned the MLA as to why he is not thinking of filling the reservoir. He informed that although this reservoir is constructed since many years ago it was filled up only 5 times because there is no water resource and there is no ground water resource and if it rains only water is available and if doesn't rain there won't be any water. He said in view of this situation lifting 1.75 TMC and generating power is irrational. We know to utilize the water and you should take action to complete in filling 37.70 TMC of water and then only to take up this type of work. He also questioned that when there is authority to give water from the reservoir, don't they have the authority to fill up the reservoir and what is the point in encouraging this project and making the farmers protest. He said they will unitedly oppose this project which proposes to utilize water from Malaprabha Dam.

Shri Mahantesh Koujalagi, MLA, Bailahongal, Belagavi District, Karnataka State :- The opinion of the people who have spoken till now has been recorded and others should be allowed to speak.

Shri. Hussain Immannavar, Village: Dhupadal, Tal: Savadatti Dist: Belagavi :- He was speaking for the second time and informed that they have given representation to the local MLA 4 times and wished to know as to why any action was not taken? He reiterated that even though they have given representation to Hon'ble DC, Hon'ble AC, Bailhongal no action has been taken. He said that earlier when people from Bhagili and Karlakatti tanda were cultivating land on the hillock the forest officials shifted them citing that the forest will get destroyed but now the forest department are giving the land and wished to know if there is any loss to the forest now and forest department has to give reply. He said that this is totally injustice and stated that instead of giving 200 Ha to company, if the same land is given to them they will grow crops and earn double the amount

of that. He also said that farmers will never like to be beggars, but they are always *annadata* i.e who provides food to the people.

Hon'ble DC, Belagavi: I request all of you that you allow others to speak, if there are any other issues and unnecessarily do not confuse the farmers. Please tell if you have any other issues apart from the issues already discussed.

Shri, Jagadish Totagi, Village: Asundi (Members Of Gram Panchayat), Tal: Savadatti Dist: Belagavi:- He has expressed his greetings to Hon'ble DC, Tashildar, Hon'ble MLA and local farmers and introduced himself as a farmer from Asundi Village who has lost 30 acres of his land in the Malaprabha Dam. He said before the Dam they use to grow sugarcane in 30 acres and since their land is lost in submergence he along with his other brothers have taken up growing dry crops in the remaining land holdings of four to five acres each one of them holding. He said that as they are not getting proper monsoon they are facing lot of problems and the existing canals are not being cleared properly and hence we are not getting water in the canal. They used to grow cotton and Jowar as their land was near canals but now a days the concerned officers are not letting water in the canals as there is water storage and hence we can leave water only one or two months. He requested to give water from Kalasa Bhanduri Project and complete the Kalasa Bhanduri and Mahadayi project and till that time they are not ready to give water from Malaprabha River for any projects. He said that farmers from rural areas have lost lands in 33 villages and presently if they dig bore wells in Asundi, Suddgatti and Hittanagi they are not getting water. He noted that earlier before construction of Dam their villages like Kadakoda, Chandragiri there were no crops like Sugar cane and there use to be no water to drink and nobody used to get their daughters married to those areas and after construction of Dam they are getting 5 to 6 inches of water at a depth of 80 feet. He further said that he is taking loan of Rs 10 lakhs for laying pipeline for two acres and one can imagine that how much you can earn in two acres and requested the DC to consider these facts before giving permission for the project. He also informed that as a member of Asundi gram Panchayath they bring JCB in the month of April & May and dig ponds in the river for supplying drinking water for their village as the river will be completely dried during the month of April and May. He said that authorities give water to Hubli-Dharward but those people don't come and fight for Mahadayi issue and only farmers from Savadatti, Nargund and Navalgund fight for this issue. He requested all those people who are connected with this issue to fight for the issue and thanked the organizers of

the public hearing for giving him an opportunity to speak. He ended his address by saying Jai Hind and Jai Karnataka.

Shri. Jayashree V J, Women Raitha Sangha President Dist: Belagavi :- She has praised the farmers and said that the farmers are the backbone of our country and recited a small poem of a local farmer stating *"Attangamaadi Sattagabandhu maali haakudaatha"*. She said that one has to be mindful that water is dear to farmers like mother and not a saleable commodity. She also questioned the necessity of the project which is not required for the people and said nobody will come here without any intention. She expressed her doubts on intention of the proposed project and alleged that attempts are being made to impress the local people.

She said that the authorities should understand and respond to the problems of the people as many of them have told that they have lost everything many years ago and their lives are improving only recently. She said that the proposed project will destabilize them again and this is being done for some benefits. She wanted the authorities to understand her pain and not her anger and that her conscious says that she visualizes many problems in front of her and hence she requested people sitting on the dais to provide Mahadayi water for the local people instead of giving water to the proposed project and depriving the farmers of the water. She wanted to know whether this kind of treatment is mentioned in the constitution and informed that as per 74th amendment in the constitution everybody got equal rights towards the water.

She has said that taking away the lands of the farmers and want them to be happy is not real democracy and the democracy as we understand is different from what you know. She further said that the assurance that project will have social responsibility but many companies having social responsibilities have come and they couldn't even provide drinking water. She referred to a local "Indal" factory in her region and said that they are not providing water. She said that she believes that Honorable D.C and Honorable MLA will not go against the wishes of the people and brothers and sisters of this place and allow this Greenko Company to do the project. She requested the authorities to not compel them to protest against the project by allowing the project against the wishes of the people. She humbly requested the MLA and DC not to allow this project at any cost.

Shri. Raghavendra Nayak, Farmer leader, Tal: Raibag, Dist: Belagavi:- He has started by saying that in the meeting we are discussing only about 3 villages and the Greenko company should do not undertake any activity in these villages and in the presence of media, panchayat members, Taluk panchayat members, Zilla Panchayat members, Hon'ble MLA and Hon'ble DC and through the media he wished to inform that hence forth outside companies should not come here. He also said that many companies have come and spoiled the culture of India and people like Mallappa Shetty will be born again. He said that people who are supporting the project whether panchayat members, taluk Panchayath members and others should not allow the company to do this type of programs and should not call the farmers and ask if they are willing to sell their land. He said that the DC knows that in our country solar plants are constructed in dry lands and not in irrigated lands and tomorrow onwards this type of programs should not be conducted, and this message has to reach the CM through the media and tomorrow onwards there should not be any discussions regarding this project. Finally, he said that in presence of Swamiji, he requests the local public to stop supporting this project and incase if it is taken up they are going to undertake further protest.

Shri. Jagadish Channappa Budhihal, Taluk Panchayat Member, Hosur:- He began his views by expressed his greetings to farmers, Swamiji, people on the dais and elected representative in this programme. He asked for excuse if people are not satisfied with his opinions which he is going to present. He said everyone spoke about Malaprabha back water issue and about 1.5 TMC water for which he is also opposing and don't have any objections for the solar and wind projects, because we need infrastructure and power. He requested the Govt. to not approve the project involving back water but asked to take up solar and wind project under the condition that power supply should be given to farmers for Ten hours at discounted rates instead of Six to Eight hours. He said that there is six hundred acres in Yakkundi panchayat and if it is only private land we can oppose, but if they give Govt. land we can't do anything, and we can't question anyone, please understand. He also said that Govt. should not take any decision against the wishes of the farmers and the Govt has to listen whatever the farmers say.

Shri. F.S. Siddangoudar, Village : Hosur Tal: Saundatti, Dist: Belagavi:- This is not only connected to 3 villages. The Hydraulic Project on the back waters of Kalasa bandori project and Malaprabha river is creating the problem all across the state because there is 1.70 TMC will be taken. It

will adversely affect SLP filed in supreme court and the entire state will be disturbed. Hence the problem is not confined only to Karlakatti, Yakkundi and Dhupdal but also across the state and it will come up with at a higher level. I will conclude on behalf of Karlakatti, Yakkundi and Dhupdal people stating that Hydraulic should not be done.

Shri. Goolappa Bhavikatti, President Of Raitha Sangha Dist: Belagavi :- He said that authorities should distribute the land for the land losers of Malaprabha instead of giving to company and if you do this Karnataka Rajya Raitha Sanga will be standing as a back bone of the farmers. He made it clear to the Company that they will not given water from Malaprabha River.

Hon'ble Deputy Commissioner, Belagavi:- The DC requested the Hon'ble MLA to tell few words.

Shri Mahantesh Koujalagi, Member of Legislative Assembly (MLA), Bailahongal, Belagavi District, Karnataka State :-

The Hon'ble MLA informed the gathering that the local people should not be under an impression that the administration has given permission for this project, and presently only the survey work and studying the advantages and disadvantages of this project is taken up. He also informed that as part of this process and to obtain the opinion of the people this public hearing program has been organized under the chairmen ship of The Deputy Commissioner (DC). He said that the DC has organized this program to seek opinion of the public of this region and submit the report to State Government and the Central Government and if anyone has documents stating that permission has been given to the company, they may produce it accordingly. He reiterated that as per his knowledge nobody has been given permission to start this project and while taking up any project one has to do the survey work and study the advantages and disadvantages of the project and it is in this regard the Govt. is doing the survey work. He said that currently they have problems like providing continuous power supply for the farmers for 24 hours for which the Govt. is planning these types of projects however, one has to understand that they are not doing this project against the people's wishes and it is with people support only that the project work will commence.

He while replying to one of the earlier speaker said that they have given representation and asked the status of it and said that when some of the farmers approached him and gave representation he has forwarded the same to the concerned departments. He informed that Yekkundi Panchayat is an elected and independent body and he has advised accordingly and cannot oppose the decisions taken by the Panchayat. He also said Yekkundi panchayat is not the only body to give permission for lifting water from Malaprabha River but also all the people who are using water starting from Kanakumbi, Nargund, Navalgund, Badami who have stakes in this project. He said one has to take the opinion of all the people and then only start the project and it is in this context the Public Hearing program is conducted. He said people need 24 Hours Power without which we can't survive, and farmers also require 24 Hours power for lifting water and it is in this context Govt. is proposing these types of Projects.

He informed that when the Project Proponents approached him to provide details of the Project he has clearly expressed his views that if Solar and Wind Projects are coming up he does not have any objections, because the State need power without which we can't live, however for taking water from Malaprabha river one has to seek opinion from the people of this region as it is a sensitive issue and in this regard lot of farmers have represented him about the problems and the pending Mahadayi Case in the Supreme Court, which is also sensitive, and this aspect was also clearly shared with the Project Proponents. He said that the Govt. while giving permission has to consider all the problems that will be faced in future and expressed objection for utilization of water from Malaprabha River which can impact thousands of people but can only benefit few hundred people with jobs. He informed that he being an elected representative was very clear on this aspect and has prepared a memorandum which he will read it out before submitting it to the DC. He requested to the gathering that everyone should be given opportunity to express their opinion and people should have patience to listen to others.

Memorandum of Shri Mahantesh Koujalagi, Member of Legislative Assembly (MLA), Bailahongal, Belagavi District, Karnataka State

He has read out his prepared memorandum to the DC and began by stating that the memorandum is regarding objection for implementation of power project by Greenko Solar Energy Private Limited in Yekkaundi and Karlakatti Villages of Bailahongal assembly constituency and said that while constructing the Dam across Malaprabha River near Navilitheertha in Savadatti Taluk, lot of Villages of Bailahongal and Savadatti taluk got

submerged. He informed that 42 villages of his constituency have been completely submerged and the people have been rehabilitated and new villages have been formed. Malaprabha River is the life line for the people of this region. He said that all of you know that thousands of families are depending on Malaprabha river for their livelihood and Bailahongal town and 75 villages of Bailahongal Taluk and other larger towns are wholly dependent on Malaprabha River for their drinking water needs. He noted that drinking water shortage is seen in the Month of February, March, April and May since many years and the DC has observed that in some of the years there was acute shortage of water for even few drops of water was not available. He further said that for addressing the drinking water problem during summer they were using sand bags in the river storing water, and were supplying drinking water to nearby towns.

He informed that Greenko Solar Energy Private Limited Company has proposed to implement an integrated renewable energy power project including pumped storage project by utilizing water from Malaparbha River and said that he believes that the local people will co-operate to implement solar and wind projects. In this regard he has specified few points and stated that the local people will not have any objections to implement solar and wind projects but have apprehension regarding implementation of hydro project by lifting water from Malaprabha river. He has read out the following specific points for Project Proponent to provide an appropriate response and clarifications on behalf of the people and as an elected representative.

a) They should clarify that there won't be any problem for drinking water for the nearby towns.
b) While lifting water they should clarify that there will not be any problem for anyone.
c) They should clarify that there won't be any problem for the surrounding Environment.
d) The people of this region are dependent only on Malaprabha River and hence they should clarify that there won't be any problem for the Villages and towns who are dependent on Malaprabha River.

He informed that being an elected representative, it was his responsibility to provide all the basic facilities for Industries coming up in in his region and while providing basic facilities few hundred people might get jobs, but it is also his responsibility to see to it that the farmers of his region are not affected and considering the above facts, he requested the concerned to not to give any immediate consent for the project being implemented in

Yakkundi, Karlakatti Villages by Greenko Solar Company Pvt. Ltd. He as part of his closing remarks and on the behalf of the people of this region submitted the representation along with photographs which shows the problems faced by the farmers for lifting water from Malaprabha River by using diesel motors to pump water through jackwells etc.

Dr. S. B. Bommanahalli, The Deputy Commissioner, Belagavi District :- The Deputy Commissioner has offered his salutations and thanked Poojya Swamiji, the Hon'ble MLA, the Environment officers present in the program, farmer leaders participating in the public hearing, farmers, brothers and sisters and people of the surrounding villages for participating in the program. He has reiterated to the gathering that the public hearing meeting was arranged to seek their opinion on the possible impacts, specifically related to the impact on the environment from the proposed Project to be implemented by Greenko company. He has informed that the Govt. before giving any final approval has to look into the advantages and disadvantages, problems faced by the public and should consider and seek opinion of the public before taking any further decision and it is in this context we have assembled to hear your views on advantages and disadvantages of the project. He has said that many farmers, farmer leaders, presidents of different organizations, public representatives of different stages, land owners and villagers have expressed their views. He also informed that most of them have raised their apprehensions about salinity by storing of water in the proposed upper reservoir and expressed their concerns on chances of breaching of the reservoir and resultant serious impacts in future. He said most importantly people have expressed their reservations regarding lifting of water from Navilatheertha Dam for Hydro Electric Project and summarized their concerns raised including that the water in the Reservoir is meant for agriculture purpose for farmers and drinking water which is not sufficient as of now, and since construction of Navilatheertha Dam only four times it was full and during other years the farmers could not get enough water, and there was shortage of water for drinking purpose for locals and livestock and hence you have said not to give water for this hydroelectric project.

He has informed and brought to the notice of the gathering that the competent authorities so far are yet to give necessary permission for utilization of the water and this permission will be given by Water Resources Department (WRD), that too only after considering all the relevant facts. He assured the people that he will definitely forward all the views, objections, demands and opinions put forth by the participants to WRD, Principle

Secretary of the WRD and to the concerned Government authorities who are responsible on this subject. He informed that for the proposed Project the private land requirement is estimated to be 37 ha and in total 226 ha including Govt. land is required and on this issue also few of them have raised their objections stating that you are not giving your lands and this also will be brought to the notice of the concerned Govt. authorities. He further assured the people that any permission will be given without troubling the farmers and it is duty of the Govt. to safeguard the interests of the farmers. He has reiterated that considering all the facts he will inform the peoples opinion to the WRD, concerned other departments and that local farmers should not get panicky and assured them that all measures will be taken without giving any trouble to them. Further he said keeping in mind their concerns, feelings, problems and based on the facts the Government will decide further course of action. The Deputy Commissioner has concluded his address by thanking all the participants who have gathered in large numbers and expressed their opinions and feelings on the proposed project and the Project Proponent submitted the written clarification on the issues raised by the public present during the hearing.

17/1/2019

DEPUTY COMMISSINER,
BELAGAVI
AND CHAIR PERSON OF THE
ENVIRONMENTAL PUBLIC HEARING.

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☎ 080-25581383, 25589112
080-25589113, 25589114

Annexure VII

ಕರ್ನಾಟಕ ರಾಜ್ಯ ಮಾಲಿನ್ಯ ನಿಯಂತ್ರಣ ಮಂಡಳಿ
Karnataka State Pollution Control Board
"ಪರಿಸರ ಭವನ", 1 ರಿಂದ 5ನೇ ಮಹಡಿಗಳು, ನಂ. 49, ಚರ್ಚ್ ಸ್ಟ್ರೀಟ್, ಬೆಂಗಳೂರು - 560 001, ಕರ್ನಾಟಕ ರಾಜ್ಯ, ಭಾರತ
"Parisara Bhavan", 1st to 5th Floor, # 49, Church Street, Bangalore - 560 001, Karnataka State, India

PCB/462/17 Cat/EPH-HPI/GreenKo Solar Energy Ltd/2020-21/ 1879 Dated: 27 AUG 2020

ರವಾನಿಸಲಾಗಿದೆ

To,
The Director,
MOEF, Indira Paryavana Bhavan,
3rd Floor, Vayu Wing,
Jor Bhag Road,
New Delhi -110003

Sir,

Sub: Issue of conformation letter with respect to uploading of modified EIA/EMP report for public comments in respect of project implemented by GreenKO Solar Energy Ltd.

Ref: 1. MOEF &CC letter No. F. No. J-12011/11/2018IA.I(R) Dated 25.02.2020
2. Letter from GreenKo Solar Energy Pvt. Ltd. Dated 11.06.2020.
3. Internal letter Dated 11.06.2020 for uploading the modified EIA/EMP report
4. Proceedings from Government of Karnataka Dated 16.06.2020
5. Industry letter Dated 11.06.2020

*****

Inviting your attention to the above cited letter at ref (1) directing the industry to request KSPCB for uploading the modified EIA/EMP report incorporating the compliances on the comments /suggestions received.

Accordingly industry authorities have revised the EIA/EMP report and submitted to the Board and requesting the Board to upload the same in KSPCB website.

Accordingly the information was uploaded on 26.06.2020 for the period of 30days for public display to submit their comments/suggestion on the revised EMP/EIA report of the proposed project.

Now the industry authorities have submitted a letter with the screenshot of email displaying the comments and suggestions received during the said period, it is observed from the information

given by the industry that, no comments /suggestions are received from the public on the above report.

This is for your kind information and for your needful action

Yours Faithfully
Sd/-
Member Secretary

Copy to:

1. The Occupier, M/s. Greemnko Solar Energy Pvt Limited, Ground Floor, Prestige Koday Tower, No:5, Raj Bhavan Road, Bangalore -560 001 for information
2. The Regional Officer, Belagavi, KSPCB for information.
3. Case File

CHIEF ENVIRONMENTAL OFFICER