ENVIRONMENTAL IMPACT ASSESSMENT STUDY FOR STANDALONE PUMPED STORAGE COMPONENT (1200 MW) OF PINNAPURAM INTEGRATED RENEWABLE ENERGY PROJECT



NOVEMBER 2018

Prepared for:



GREENKO ENERGIES PRIVATE LIMITED, HYDERABAD

Prepared by:



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The Accreditation shall remain in force subject to continued compliance to the terms and conditions mentioned in NABET's letter of accreditation bearing no. QCI/NABET/ENV/ACO/17/0393 dated Sep 5, 2017. The accreditation needs to be renewed before the expiry date by R.S.Envirolink Technologies Pvt. Ltd., following due process of assessment.

Director I NABET Dated: Sep 5, 2017

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August 14, 2018

QCI/NABET/EIA/ACO/18/00731 R. S. Envirolinks Technologies Pvt. Ltd. 402, Radisson Suites Commercial Plaza, B Block, Sushant Lok 1, Gurgaon – 122009 (Kind Attention: Sh. Ravinder Bhatia)

Sub: Validity of Accreditation as EIA Consultant organization- R. S. Envirolinks Technologies Pvt. Ltd.

Dear Sir,

This has reference to the accreditation of your organization under QCI-NABET EIA Scheme, the validity of R. S. Envirolinks Technologies Pvt. Ltd. is hereby extended till November 14, 2018 or completion of assessment process, whichever is earlier.

The above extension is subject to the submission of required information/documents related to assessment on time to NABET.

You are requested not to use this letter after expiry of the above stated date.

With best regards,

A.K Jha Senior Director | NABET

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List '1' - Accredited EIA Consultant Organizations (ACOs) - as on October 11, 2018#

		Scope of Ac	creditation		
		As per NAB	ET Scheme	Project or Activity as	
5. No.	Consultant Organization	Sector Number	Name of Sector	Category	per Schedule of MoEFCC Notification dated September 14, 2006 and subsequent Amendments
	Aadhi Boomi Mining and Enviro Tech Private Limited (formerly known as Suriya Mining	1	Mining of minerals – opencast only	A	1 (a) (i)
	Services) Address:3/216, K.S.V.Nagar, Narasothipatti, Salem- 636004	3	River Valley Projects	A	1 (c)
		7	Mineral beneficiation	A	2 (b)
		9	Cement Plants	A	3 (b)
1		34	Highways	в	7 (f)
1224	Email: <u>surivakumarsemban@gmail.com</u> Tel.:09842729655, 09443290855 Conditions apply	38	Building and construction projects	В	8(a)
				·	
2	Aakhivi Consultants	1	Mining of minerals - opencast only	A**	1 (a) (i)
	Noida, UP - 201 308	4	Thermal power plants	A**	1 (d)
L					





2		Scope of Accreditation				
		As per NABET Scheme			Project or Activity as	
S. No.	Consultant Organization	Sector Number	Name of Sector	Category	per Schedule of MoEFCC Notification dated September 14, 2006 and subsequent Amendments	
	P. S. Envirolinks Technologies Dat 11d	1	Mining of minerals- opencast	A	1 (a) (i)	
	A. S. CHVITOINKS TECHNOlogies PVL Ltd.	3	River Valley projects	A	1(c)	
123	Address: 402, Radisson Suites Commercial Plaza, B Block, Sushant Lok 1, Gurgaon – 122009 e. mail: ravi@rstechnologies.co.in Tel.: 0124 – 4295383 09810136853 Conditions apply	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	В	7 (e)	
		34	Highways	A	7 (f)	
		40 (i)	Automobile and Auto Components	3		
			1			
	Ramans Enviro Services Pvt. Ltd.	4	Thermal power plants	A	1 (d)	
124	Address: SF 23 & 24, Camps Corner, Nr. AUDA Garden, Prahladnagar, Ahmedabad – 380015 e. mail: ramans.consultancy@gmail.com samirchoksi88@yahoo.com	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)	
	Tel.: 079 – 26937472, 26937411	28	Isolated storage & handling of	В	6 (b)	

List of Accredited Consultant Organizations (Alphabetically) Rev. 70, October 11, 2018

Final EIA Report Pinnapuram IRE Project

Greenko Energies Pvt. Ltd.

Declaration by Experts contributing to the EIA/EMP Report of Pinnapuram 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:

Period of Involvement: May 2018 - November 2018

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 	S/11/2018
2	WP	Ravinder P S Bhatia	 Baseline Data Review and Analysis –Water Quality Impact Assessment and Management Plan 	Ud-12-1019
3	SHW	Ravinder P S Bhatia	 Impact Assessment Preparation of Waste Management Plan Public Health Delivery System Muck generation analysis and Dumping Plan 	Ust 22 5/11/2018
4	SE	Zahoor A Wani	 Social Data Collection and Interpretation Social Impact Assessment Preparation of R&R Plan 	2 Arwand stulaoro
5	EB	Arun Bhaskar	 Impact Assessment Preparation of Biodiversity Management Plan Compensatory Afforestation Plan 	An 5/11/2018
		Vivek Jhaldiyal	Baseline Data Collection, Analysis and Interpretation	g/14/15/11/2018
6	sc	Arun Bhaskar	Baseline Data Review and Analysis	Que 5/11/2018

RS Envirolink Technologies Pvt. Ltd.

Date-05/11/2018

Greenko Energies Pvt. Ltd.

Final EIA Report Pinnapuram IRE Project

			Impact Assessment	
		Vivek Jhaldiyal	 Sampling and Interpretation 	Shall all port
7	AQ.	Ravinder P S Bhatia	Impact Assessment of Air and Water Environment	Uston 25111 hours
8	NV	Ravinder P S Bhatia	 Baseline Data Review and Analysis – Sound levels, Impact Assessment and Mitigation Plan 	Ust 22
9	HG	Vimal Garg	Impact Assessment	& SINTER
10	LU	Vimal Garg	Impact Assessment Data Review and Analysis	S-T-SJUIDAVE
		Dimple Razdan	Preparation of Thematic maps	15-14- TI1/2018
11	RH	Harsh Pandya	Risk Assessment	bitty spint and
12	GEO	Trilochan Singh Kaith	Geological & Geotechnical Investigations	Jen L

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 Pinnapuram IRE project. I also confirm that the consultant organization shall be fully accountable for any mis-leading information in this statement.

Signature:

5/11/2018 april

Name: Dr. Arun Bhaskar

Designation: Managing Director

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

RS Envirolink Technologies Pvt. Ltd.

Greenko Energies Pvt. Ltd.

NABET Certificate No. & Issue Date: NABET/EIA/1518/SA042, 05th September 2017 &

Validity Extension letter No. QCI/NABET/EIA/ACO/18/00731 dt. August 14, 2018

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
б	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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- Annexure Ib: Amendment to Scoping clearance for the Pinnapuram IREP (1200 MW) accorded by MoEF&CC vide letter no. J-12011/12/2018-IA. I(R), dated: 25.09.2018
- Annexure II: Compliance to TOR
- Annexure III: Meteorological data of Kurnool district (2009-2017)
- Annexure IV: List of plant species recorded from the study area
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Chapter



INTRODUCTION

1.1 GENERAL

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 with ever changing dynamic demand curves capacities coupled 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 also 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 to the Nation. 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. 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 policy of Andhra Pradesh (AP) government is to provide 24 hours power supply to all industries. Government of India & Government of AP have taken joint initiative to provide uninterrupted 24x7 power in the state of AP.

The requirement of electricity, i.e. both energy and peak demand are expected to increase significantly in Andhra Pradesh from the present level of demand 54,301MU & 7,969 MW to 82,392 MU and 13,436 MW respectively by FY 2018-19 due to:

- 1. Natural Load Growth.
- 2. 24x7 power supply to all consumers
- 3. Increase in electrification of households

- 4. 9 hours supply to agricultural consumers
- 5. Additional energy requirement for upcoming capital city and associated investments
- 6. New Industrial corridors
- 7. New Lift Irrigation schemes.

Andhra Pradesh is one of the largest hydro power potential among all the states in southern region. 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. 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 makes 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. 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 1 year and has identified Pinnapuram, Kurnool District, Andhra Pradesh for the proposed **Pinnapuram Integrated Renewable Energy Project (IREP)**. Pinnapuram 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.

After evaluating the site for over 1 year, assessing the Wind & Solar resources, Greenko Group has approached the Government of Andhra Pradesh (GoAP) for necessary permissions and approvals for the proposed Project. Presently, GoAP has approved the project with **1000 MW Solar, 550 MW Wind & 1200 MW** of Standalone Pumped Storage capacities to be developed in Phase I with possibility to enhance capacities in subsequent stages to 3000 MW Solar, 2000 MW Wind & 2400 MW Standalone Pumped Storage depending on technical feasibility, site suitability and associated requirements and demand from various State DISCOMs/STUs and other consumers. GoAP has also allocated 1 TMC of water for establishing the 1200 MW Pumped Storage component and process has been initiated to increase the allocation to 1.2 TMC for facilitating 8 hour storage capacity.

All three components of Pinnapuram IREP 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 Orvakallu for further supply into the National Grid. The IREP Project is a self-identified project and first of its kind in the world and our country which can meet 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.

1.2 STANDALONE PUMPED STORAGE COMPONENT OF PINNAPURAM IREP

'Standalone pumped Storage component of Pinnapuram IREP' is located in Kurnool district of Andhra Pradesh. It envisages creation of 2 new off-stream reservoirs near Pinnapuram village. The scheme will involve construction of 45.0m high Concrete Gravity Intake structure for 200m long and non-over flow rock fill embankment of average height around 12m to 14m and with maximum height of 35m for short reach for formation of upper reservoir of 1.37 TMC gross capacity. The lower reservoir is formed with rock fill embankment of average height around 12m to 14m with maximum height of 33m for short reach of 1.42 TMC gross capacity. The Standalone pumped Storage component of Pinnapuram IREP is proposed in between these two reservoirs i.e. Pinnapuram Upper & Lower Reservoirs (both to be constructed newly). Water will be pumped from existing Gorakallu Reservoir to fill up the Upper reservoir. The total design discharge for the proposed scheme is 1162.85 cumecs with the rated head of 119.27 m. The location of the project is shown in **Figure 1.1**.

1.2.1 Purpose of the Study

An **Environmental Impact Assessment** (EIA) is a process 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) provides 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.

The purpose of the assessment is to ensure that decision makers consider the environmental impacts when deciding whether or not to proceed with a project.

1.2.2 Scope of the Study

The general scope of this EIA study is as follows:

- Assessment of the existing condition of ecological, physico-chemical and socioeconomic aspects of environment;
- Identification of potential impacts on various environmental components due to activities envisaged during construction and operational phases of the proposed pumping storage project.
- Prediction of significant impacts on major environmental components;
- Preparation of Environmental Management Plan (EMP) outlining measures to minimize adverse impacts during construction and operational phases of the proposed project. This includes components like Green Belt Development Plan, conservation/management plan, Muck Disposal Plan etc;
- Formulation of environmental monitoring plan for construction and operation phases;
- Estimation of Cost for implementation of Environmental Management Plan and Environmental Monitoring Programme.



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

1.3 STUDY OF ALTERNATIVES

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

- Alternative-1: Formation of upper & lower reservoir with 1050.0m steel lined penstock and surface powerhouse downstream of upper reservoir.
- Alternative-2: Formation of upper & lower reservoir with 350.0m steel lined pressure shaft and underground powerhouse, tail race tunnel of 485.0m with D/s surge shaft.
- Alternative-3: Formation of upper & lower reservoir with 760.0m steel lined penstock and surface powerhouse downstream of upper reservoir.

Three alternatives for the project layout have been studied based on topographical and geological parameters in which two alternatives are with surface power house option and one alternative with underground power house option as follows. However, for all three alternatives, both upper and lower reservoir locations are same since these are the only possible site is available in and around that area. The upper reservoir is formed with rock fill embankment of average height of around 12m to 14m with maximum height of 35m for short reach. Similarly, the lower reservoir is formed with rock fill embankment of average height of around height of 33m for short reach. The detailed description of all three alternatives are as follows:

Alternative-1: Surface Power house Option - An RCC Intake structure comprising of 6 power intakes provided in the block with six independent steel lined pressure penstocks of 1050.00m long and 7m dia. to convey water to the surface power house. Tail race channel of 70m width and 125m long has been provided after power house to be suitably connected to the lower reservoir. Five penstocks will be feeding 5 units of 200 MW and one penstock bifurcated in to two will be feeding 2 units of 100 MW each.

The L/H ratio of the proposed alignment is 8.75 which will require surge shaft. The average ground level for proposing surge shaft is EL+ 420.0m. Considering the FRL of upper reservoir and the Upsurge requirements, the top level of surge shaft is at EL+475.0m. This requires formation of huge height of surge tank above the average ground level which is not suitable as per topographic condition. The Power House will have to be located in the sloped terrain requiring deep excavation of about requiring 100m deep excavation. Stabilizing these slopes may require deep rock bolts and shotcrete with wire mesh and sufficient drainage. Construction of any structure in the steep hill slopes is not a safe structure. Considering the above difficulties, this option is not technically feasible.

Alternative-2: Underground Power House option - The location of RCC intake structure is same as in case of Alternative-1. The RCC Intake structure comprising of 6 power intakes provided in the block with six independent steel lined pressure penstocks of 350.00m long and 7m dia. to convey water to the underground power house. Six nos. of draft tube tunnel coming out of power house is to be suitably connected to downstream surge shaft. Downstream of this surge chamber will be joined to two nos. of 12.00m dia main Tail race tunnel. Total length of each Tail race tunnel has been proposed as 485m. The flows from

the tail race tunnel shall be carried through a tail race channel of 440m long. Five penstocks will be feeding 5 units of 200 MW and one penstock bifurcated in to two will be feeding 2 units of 100 MW each.

The proposed layout requires housing of underground powerhouse, requiring long MAT and other Adits to reach the project components, excavation of which will take longer duration to reach the Power House and start works at Power House. In case of underground system in pump storage project, power house is not a single cavern alone, it consists of a set of three to four caverns thus increasing the vulnerability of underground complex which in turn impacts the construction time of the project. The total construction time for the project is 54 months which is more compared to other alternatives because of long construction period required for underground works (due to long MAT) and much long geological investigations (Drifts for ascertaining the suitability of underground locations of caverns). The construction duration of the scheme is very important as this being a integrated project, construction duration of IREP (Solar, Wind & PSP) impacts the overall viability of the project.

Considering the complexity of underground structures, construction time and the economics of cost, this alternative is not considered for further studies.

Alternative-3: Surface Power House option - An RCC Intake structure comprising of 6 power intakes provided in the Dam block with six independent steel lined pressure penstocks of 760.00m long and 7m dia. to convey water to the surface power house. Tail race channel of 70m width and 1300m long has been provided after power house to be suitably connected to the lower reservoir. Five penstocks will be feeding 5 units of 200 MW and one penstock bifurcated in to two will be feeding 2 units of 100 MW each.

The L/H ratio of the proposed alignment is 6.3 and no separate surge shaft is provided in this layout. The water after power generation will be conveyed through 1300m long Tail Race Channel to discharge water in to Lower reservoir.

After considering the above factors, **Alternative – 3** is found to be technically feasible and the **same is adopted.** The main consideration for selection of Alternative-3 included the following.

- It is easier and faster to construct at lesser cost.
- The sites are suitable for formation of reservoir.
- The length of the pressure shaft is short in this case.
- A surface powerhouse can be suitably located.
- All the project components are easily accessible.

As the proposed project is a part of Integrated renewable energy scheme, the construction time for the project shall be in line with the solar and wind power developments. Considering the economics of the cost for the integrated project, the scheme under alternative – 3 is more viable.

1.4 POLICY LEGAL AND ADMINISTRATIVE FRAMEWORK

In the emerging scenario of rapid economic growth, sustainability of existing resources for the present and future generations requires an integrated approach so that, the existing resources are optimally utilized without causing undue damage to the environment. To achieve this objective, the Ministry of Environment, Forest and Climate Change (MoEF&CC), Government of India has enacted Acts, Legislations, Guidelines and Standards to ensure sustainable development and conserve the environment. These are required to be compiled by the Project proponents while executing the development of Project. The Project proponent thus prepares the EIA report, incorporating management plans to mitigate the adverse impacts (if any) for perusal of the MoEF&CC. The MoEF&CC in turn evaluates the proposal and suggests stipulations for mitigation of adverse impacts while granting the clearance for execution of the Project. The important Environmental legislations laid down for conservation of environment are presented in **Table 1.1**.

Name	Scope and Objective	Key Areas	Operational Agencies/ Key Players
Water (prevention and Control of Pollution) Act, 1974, 1988	To provide for the prevention and control of water pollution and enhancing the quality of water	Controls sewage and industrial effluent discharges	Central and State Pollution Control Boards
Air (Prevention and Control of Pollution) Act 1981, 1987	To provide for the prevention and control of air pollution	Controls emissions of air pollutants	Central and State Pollution Control Boards
Forest (Conservation) Act,1980, 1988	To consolidate acquisition of common property such as forests; halt India's rapid deforestation and resulting Environmental degradation	Regulates access to natural resources, state has a monopoly right over land; Restriction on de-reservation and using forest for non- forest purpose	State Government and Central Government
Wildlife (Protection) Act, 1972,1993	To protect wildlife	Creates protected areas (National Parks/ sanctuaries) categories of wildlife which are protected	Wildlife Advisory Boards; Central Zoo Authorities
Environment (Protection) Act, 1986	To provide for the protection and improvement of Environment	An umbrella legislation; supplements pollution laws	Central Government nodal agency MoEF&CC can delegate powers to state departments of Environments
The Right of Fair Compensation and Transparency in Land Acquisition, Resettlement and Resettlement Act 2013;	Resettlement and Rehabilitation of Project affected people	Social issues	Central Government
EIA Notification, 2006	Environmental Impact Assessment	Environmental Protection	Project Developer, State and Central government

Table 1.1: Key Environmental Legislations in India

(Source: Government of India Publications)

Like many other developmental activities, the proposed Project, while providing planned power generation could also lead to a variety of adverse environmental impacts. However, by proper planning at the inception stage and by incorporating appropriate mitigation measures in the planning, design, construction and operation phases, the adverse impacts can be minimized to a large extent, whereas the beneficial impacts could be maximized. The main objective of the EIA study is to assess the positive and negative impacts likely to accrue as a result of the construction and operation of the proposed Project and to suggest suitable Environmental Management Plans (EMP) to ameliorate the adverse impacts, if any. A well-designed environmental monitoring programme covering various critical parameters to be covered in the Project construction and operation phase would also be required. The present EIA for Pinnapuram IRE project has been prepared based on the analysis of baseline data and accordingly Environment Management Plan has been prepared for seeking Environment Clearance.

The principal Environmental Regulatory Agency in India is the Ministry of Environment, Forest and Climate Change (MoEF&CC). MoEF&CC formulates environmental policies and accords environmental and Forest clearance for the projects. The State Pollution Control Board (SPCB) conducts Public hearing and accords Consent to establish and operate for the project.

1.5 EIA NOTIFICATION, 2006

Standalone Pumped storage component (1200 MW) of Pinnapuram IRE Project is a Category A projects (>50 MW), as per item 1 (c) of Schedule attached to EIA notification of September, 2006 and require environmental appraisal from the Ministry of Environment Forests and Climate Change (MoEF&CC), Government of India. The environmental clearance process involves three stages:

- Scoping
- Public Consultation
- Appraisal

As per MoEF&CC, EIA Notification, dated 14th September 2006 (and amendments thereafter), under Activity 1(c) - River Valley projects; if, the capacity of power generation for any HEP will more than 50 MW, the project falls under Category A. Comprehensive EIA study needs to be undertaken and environmental clearance to be obtained from MoEF&CC before start of any construction activity.

Scoping: Scoping clearance of Pinnapuram IREP of 1000 MW project was accorded by Ministry of Environment Forests and Climate Change (MoEF&CC), Government of India vide letter no. J-12011/12/2018-IA. I(R), dated: 17.05.2018. (**Refer Annexure Ia**). Subsequently, Amendment to Scoping Clearance for Standalone Pumped storage component (1200 MW) of Pinnapuram IRE Project received from MoEF&CC for change in installed capacity, location, land etc., of the proposed project vide letter no. J-12011/12/2018-IA. I (R) dated **Sept 25th 2018** (**Refer Annexure-Ib**). Compliance to TOR is given at **Annexure II**.

Public Consultation: On completion of draft EIA report and its executive summary in English and local language (Telugu), report was submitted to Andhra Pradesh Pollution Control Board (APPCB) to initiate the process of public consultation. Public hearing was held on 2nd November 2018 near Mandal Parishad Upper Primary School, Pinnapuram, Panyam Mandal, Kurnool District, Andhra Pradesh. The proceedings of the same have been appended as a separate document. 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 Andhra Pradesh Pollution Control Board. Major issues raised during Public Consultation process and response is given at Chapter 11 of EMP.

Environmental Clearance:

The final EIA report prepared as per the approved TOR after incorporating the concerns and suggestions made during the Public Hearing, shall be submitted to the concerned regulatory authority i.e. MoEF&CC for appraisal and grant of Environment Clearance.

1.6 FOREST CLEARANCE

Forest Clearance under the **Forest (Conservation) Act 1980** from Ministry of Environment, Forests & Climate Change, Government of India is one of major step in project development as the project requires to divert **365.66 Ha** of forest land for non-forestry purposes i.e. for the purpose of construction of various project components. In compliance with the prescribed procedures for the forest clearance, the online application for diversion of the above said forest land has been submitted vide proposal no. FP/AP/HYD/35371/2018; dated 28/08/2018.

1.7 DISCLOSURE BY THE CONSULTANT

M/s RS Envirolink Technologies Pvt. Ltd., (RSET) Gurgaon is a QCI-NABET accredited company and is qualified to undertake preparation of the EIA and EMP reports of the project according to the approved ToR issued by EAC, MoEF&CC for River Valley, Hydroelectric, Drainage and Irrigation Projects (Category A);

1.8 OUTLINE OF THE REPORT

The Comprehensive EIA for the proposed IRE Project has been presented in two parts -First part presents the findings of EIA study and the second part includes various mitigation measures under the Environmental Management Plan.

The contents of Part - I of the document are organized as follows:

PART – I: Environmental Impact Assessment (EIA) Report

Chapter-1: Introduction: The Chapter gives brief of the project. The Environmental Clearance procedure and the related policies, legal and administrative framework for the same have been summarized in this chapter. The objectives and need for EIA study too have been covered. Brief description of the proposed project with alternative studies is also given.

Chapter-2: Project Description & Infrastructure: It gives the salient features of the project and also the brief of major components of the project. In addition, the details of various infrastructural facilities including land requirement for different components of the project and equipment to be deployed for construction has been covered.

Chapter-3: Methodology: It includes the methodology adopted for conducting the Comprehensive EIA study. The details of selected sampling sites and specific methodology adopted for each environmental parameter have been given.

Chapter-4: Environmental Baseline Status: Biological and Physico-chemical Parameters: Presents Baseline status of Biological and Physico-chemical aspects of environment. The study is based on collection of primary data as well as data from various secondary data sources. As a part of the Comprehensive EIA study, detailed monitoring and survey for air, noise and traffic density was conducted for various seasons. Samples were also collected for analyzing the physico chemical properties of soil in the study area. Similarly, detailed survey was conducted to collect the data of terrestrial ecological for various seasons. The findings of the study were analyzed and physical and biological characteristics of the study area have been described in this Chapter.

Chapter-5: Description of the Socio Environment: It includes the details of social, and demography status of the study area and Project affected area.

Chapter-6: Assessment of Impacts: It describes the anticipated positive and negative impacts as a result of the construction and operation of the proposed project. It is essentially a process to forecast the future environmental conditions of the project area that might be expected to occur as a result of the construction and operation of the proposed project. An attempt was made to forecast future environmental conditions quantitatively to the extent possible. But for certain parameters, which cannot be quantified, the general approach has been to discuss such intangible impacts in qualitative terms so that planners and decision makers are aware of their existence as well as their possible implications.

The contents of Part - II of the document are organized as follows:

PART – II: Environmental Management Plan (EMP) Report

The Part-II of the report deals with different Environmental Management Plans prepared to mitigate the adverse environmental impacts. The contents of the Part-II are organized as follows:

Chapter-1: Biodiversity Conservation & Management Plan: It delineates the plan for mitigation of anticipated adverse impacts likely to accrue as a result of the proposed project on the biodiversity of the area. The approach for formulation of Biodiversity Conservation Plan is to maximize the positive environmental impacts and minimize the negative ones. After suggesting environmental mitigation measures, the cost required for implementation of various measures is also estimated.

Chapter-2: Muck Disposal Plan: It deals with the rehabilitation of muck that is likely to be generated during the construction of various project components and also suggests measures for both engineering and biological measures for restoration of muck disposal sites in environmentally sustainable manner.

Chapter-3: Solid Waste Management Plan: This chapter describes issues related to solid waste disposal that are likely to accrue during the construction period and also the formulation of management plan for the same.

Chapter-4: Public Health Delivery System: This chapter deals with the basic health care facilities available in the area and setting up of new infrastructure as well as improvement of existing infrastructure along with the cost estimates.

Chapter-5: Energy Conservation Measures: It deals with the provisions being made for the reduction of pressure on the adjoining forest of the project area during the construction

period energy conservation measures like subsidy for fuel wood, etc. along with the cost of these measures.

Chapter-6: Landscaping & Restoration Plan: This chapter covers adverse impact of construction activities on the landscape and suggests measures for restoration of the disturbed area back to their similar or near-similar pre-construction conditions and land use. It also includes green belt to be created along reservoir periphery and around the colony areas.

Chapter-7: Compensatory Afforestation Programme: This Chapter discusses various aspects of Compensatory Afforestation Programme to be implemented by the State Forest Department.

Chapter-8: Air and Water Environment Management Plan: This chapter covers various environmental risks that are foreseen during the construction on air, water and noise environment in the project area and also deals with mitigation measures during the construction and operational phase.

Chapter-9: Environmental Monitoring Plan: This chapter deals with the issues of implementation of various mitigation measures and environmental management plans during project construction and operation phases. The environmental monitoring plan has been suggested to assess the adequacy of various environmental safeguards and to compare the predicted and actual scenario during construction and operation phases. This will help the project proponents to formulate remedial measures not foreseen during the planning stage but arising during these phases and to generate data for further use.

Chapter-10: Corporate Environment Responsibility Plan: It deals with the provisions being made by project proponent under Corporate Environmental Responsibility Policy. The cost of CER Plan is in addition to the cost envisaged for the implementation of EIA/EMP.

Chapter-11: Public Consultation Issues and Responses: This chapter covers issues raised during public hearing and reply given by project developer and district administration.

Chapter-12: Cost Estimates: It summarizes the cost to be incurred for implementation of the Environmental Management Plan (EMP) and the Environmental Monitoring Programme.

Chapter 2

PROJECT DESCRIPTION & INFRASTRUCTURE

2.1 PROJECT LOCATION & ACCESSIBILITY

Proposed Standalone Pumped storage component of Pinnapuram Integrated Renewable Energy Project (IREP) is located in Kurnool District of Andhra Pradesh. It envisages creation of two new reservoirs near Pinnapuram Village in Panyam Mandal, about 80 Km from Kurnool. This scheme envisages non-consumptive re-utilization of 1.20 TMC of water to be taken from existing Gorakallu reservoir to fill up Pinnapuram Upper reservoir. The Geographical coordinates of the proposed Pinnapuram upper reservoir are at longitude 78° 15' 13" East and latitude is 15° 36' 26" North and that of lower reservoir are 78° 15' 30" E and 15° 37' 26" N.

Pinnapuram village is located in Panyam Tehsil/Mandal of Kurnool district in Andhra Pradesh, India. It is situated 15km away from sub-district headquarter Panyam and 60km away from district headquarter Kurnool. The site is easily approachable by NH-18 from Kurnool. Nearest railway head is Kurnool from where project site is located at around 81km away.

2.2 SALIENT FEATURES OF THE PROJECT

The Standalone Pumped Storage Component of Pinnapuram IREP envisages construction of upper and lower reservoir near Pinnapuram village in Panyam Mandal of Kurnool District. The existing Gorakallu balancing reservoir is under operation with a live storage capacity of 12.44 TMC. The filling of the proposed Pinnapuram upper reservoir will be taken up from Gorakallu Reservoir.

Proposed Scheme will involve construction of Rock fill embankments of average height of around 12m to 14m with maximum of 33m height in lower reservoir and 35m in upper reservoir for very short reach for creation of Pinnapuram IREP reservoirs. Intake structure and trash rack for Five numbers of independent penstocks and one number of independent Penstock bifurcated into two will be taking off from Power block of Pinnapuram IREP upper reservoir. A surface Power House will be located on the downstream of the power block and shall be equipped with five vertical-axis reversible Francis type units composed each of a generator/motor and a pump/turbine having generating/pumping capacity of 200MW/244MW and two units of 100MW/130MW respectively.

The salient features of the project are given at **Table 2.1**. The layout map of the Pinnapuram Standalone pumped storage project is given at **Figure 2.1**.

Table 2.1: Salient features of the Standalone	Pumped Storage	component of Pinnapuram IR	EΡ
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1		Name of the Project	Standalone Pumped Storage Component of Pinnapuram IREP
2		Location	
	а	Country	India
	b	State	Andhra Pradesh
	С	District	Kurnool
	d	Village near Power House	Pinnapuram

3		Geographical Co-Ordinates	
		Standalone Pumped Storage	
	а	Component of Pinnapuram IREP	
		Reservoir - Upper (Now Proposed)	
		Latitude	15° 36' 26" N
		Longitude	78° 15' 13" E
		Standalone Pumped Storage	
	b	Component of Pinnapuram IREP	
		Reservoir - Lower (Now Proposed)	
		Latitude	15° 37' 26" N
		Longitude	78° 15' 30" E
4		Access To Project Site	
	а	Airport	Hyderabad
	b	Rail head	Kurnool – 81 Km
	С	Road	Gorakallu
	d	Port	Krishnapatnam
5		Project	·
	а	Туре	Pumped Storage Project
	b	Storage Capacity	9600 MWH
	С	Rating	1200 MWH
	d	Peak operation duration	8.00 Hours daily
6		Pinnapuram Reservoir - Upper	Upper Reservoir
	а	Live Storage	1.20 TMC
	b	Dead Storage	0.17 TMC
	C	Gross Storage	1.37 TMC
	d	Top of Dam	EL +466.00 m
	e	Full Reservoir level (FRL)	EL +463.00 m
	f	Min. Draw Down Level (MDDL)	EL +441.50m
	g	Height of RCC Intake Structure	45.0 m
	h	Max Height of Embankment	35.0m
	i	Top Width of Embankment	10.0 m
7		Pinnapuram Reservoir - Lower	Lower Reservoir
	а	Live Storage	1.20 TMC
	b	Dead Storage	0.22 TMC
	с	Gross Storage	1.42 TMC
	d	Top of Dam	EL +343.00 m
	е	Full Reservoir level (FRL)	EL +340.00 m
	f	Min. Draw Down Level (MDDL)	EL +321.00 m
	g	Max Height of Embankment	33.0 m
	h	Top Width of Embankment	10.0 m
8		RCC Intake Structure	
	а	Туре	Open Semi Circular
	b	Elevation of Intake center line	EL +429.24 m
	С	Elevation of bell mouth bottom	EL +423.71 m
9		Penstock /Pressure Shafts	
	а	Туре	steel lined - circular
	h	Number of Benstecks	5 Nos Independent Penstocks and 1 No: of
	U		Independent Penstock bifurcated in to 2
	С	Diameter of penstock	7.0 m
	d	Length of penstock	760.0 m each
10		Powerhouse	
	а	Туре	Surface Powerhouse
	b	Dimensions	L 240.00m x B 24.00 m x H 58.00 m
11		Tail Race Channel	Trapezoidal Channel - Lined
	а	Lenth of the channel	1300 m
	b	Bed Width	70 m
	С	Full supply depth	6.00 m
	d	Bed slope	1 in 5000
12		Tailrace Outlet	

	-	Turne	Onon Comi Circulor
	d		
	D	Elevation of outlet centre line	EL +305.70 m
13		Hydro-Mechanical Equipment	
	а	RCC Intake Structure	
		Trash Rack	
		No of bays in each trash rack	6 Nos – 21.0m high
		Intake Service Gate - 6 Nos	W5.77 m X H7.00 m (Vertical lift fixed wheel)
		Intake Stop log Gate - 6 Nos	W5.77 m X H7.00 m (Vertical lift fixed wheel)
	b	Draft Tube Gates	High pressure steel type slide gates
			2 per unit - W 6 5 m X H 7 0 m
		No of gates per unit	(Vertical lift fixed wheel type)
	<u>ر</u>	Tailrace Outlet Structure	(vertical intelliced wheel type)
	C	No. of bays in each trash rack	6 Noc 19 0m high
1.1		No. of Days III Each trasinack	0 NOS – 18.011 High
14		Electro Mechanical Equipment	Fuencie transmission laboft according to accord
		Pump Turbine	Francis type, vertical shaft reversible pump-
			turbine
		I otal No of units	7 no's (5 X 200MW & 2 X 100 MW)
		Total Design Discharge (Turbine	1162.85 Cumec
		Mode)	
		Rated Head in Turbine mode	119.27m
	а	200MW Turbines	
		Total No of units	5 Units (2 Nos with Variable speed & 3 Nos
			with Fixed Speed)
		Turbine Design Discharge	193.81 Cumec for each unit
		Pump Capacity	244 MW
		Rated Pumping Head	125.77 m
		Rated Pump Discharge	178 42 Cumers
		Synchronous speed	136 36 rnm
	i	Generator-Motor	190.50 (pm
			Three (2) phase alternating current
		Тура	synchronous generator motor semi umbrella
		Туре	type with vertical shaft
		Number of units	5 Units
		Number of units	Concretor 200NAWA
		Rated Capacity	$\frac{1}{2}$
		Datad \/altaga	
		Rated Voltage	18.0 KV
	11	Main Power Transformer	
		Τνρε	Indoor, 3-Ph transformers with Off-Circuit tap
			changer (OCIC)
		Number of units	5 Units
		Rated Capacity of each unit	280 MVA
			Primary – 18.0 kV; Secondary - 400 kV
		Rated Voltage	adjustable range of the secondary voltage:
			-10% to +10%(3kV/tap)
	b	100MW Turbines	
		Total No of units	2 Units (1 Nos with Variable speed & 1 Nos
			with Fixed Speed)
		Turbine Design Discharge	96.90 Cumec for each unit
		Pump Capacity	130 MW
		Rated Pumping Head	125.77 m
		Rated Pump Discharge	94.37 Cumec for each unit
		Synchronous speed	187.5 rpm
	i	Generator-Motor	
			Three (3) phase alternating current
		Туре	synchronous generator motor somi umbrolla
		i ype	type with vertical chaft
		Number of units	cype with vertical slidit
			2 UTILS
		Rated Capacity	Generator – 100IVIW;
└── ┤		n - 1	Pump Input - 130MW
		Rated Voltage	18.0 kV

	ii	Main Power Transformer	
		Туре	Indoor, 3-Ph transformers with Off-Circuit tap changer (OCTC)
		Number of units	2 Units
		Rated Capacity of each unit	150 MVA
		Rated Voltage	Primary – 18.0 kV; Secondary - 400 kV adjustable range of the secondary voltage: -10% to +10%(3kV/tap)
17		420KV Gas Insulated Switchgear	(GIS)
	1	Type of GIS	Indoor Type
	2	No. of GIS units	One No.
	3	Location	Inside GIS Building above ground
	4	Scheme	Double Busbar Arrangement with bus sectionalise
18		POWER EVACUATION	
	а	Voltage Level (KV)	400 KV
	b	No. of Transmission lines	Two Nos for each connecting point
	е	Conductor	Moose
	h	Total Length	Line 2: 20 Km to PGCIL 765/400 KV SS near Orvakallu
	i		6 Km up to Central Pooling Substation of IREP
19		Estimated Cost	
	а	Civil Works & Other works	2258.27 Cr.
	b	E & M Works incl transmission	1920.00 Cr.
	С	I DC & Others	1289.75 Cr.
		Total Project Cost With IDC	5468.03 Cr.

Source: PR of Standalone Pumped storage component of Pinnapuram IREP

2.3 PROJECT COMPONENTS

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

- Rock fill embankments of average height of around 12m to 14m with maximum of 33m height in lower reservoir and 35m in upper reservoir for very short reach for creation of Pinnapuram PSP upper & lower reservoir with 1.20 TMC live storage capacity.
- 45m high RCC Intake structure.
- 5 nos. of 760 m long and 7.0m dia. inclined circular steel lined Penstock / Pressure Shaft each for each unit of 200 MW.
- 1 no 760m long and 7.0m dia inclined circular steel lined Penstock / Pressure shaft bifurcated into 2 penstocks to feed 2 units of 100 MW.
- A surface Power house having an installation of five nos. reversible Francis turbine each of 200 MW capacity (3 units of fixed speed and 2 units of variable speed turbines) and two nos. reversible Francis turbine each of 100 MW capacity (1 unit of fixed speed and 1 unit of variable speed turbines) operating under a rated head of 119.27 m in generating mode and 125.77 m in pumping mode.
- 70m wide concrete lined Tail race channel with FSD of 6.00m and 1300 m long connecting Tail race channel to the lower reservoir.

2.4 GORAKALLU RESERVOIR

The water from the Gorakallu (existing reservoir) will be pumped up initially for nonconsumptive use during suitable season and stored in the proposed Pinnapuram Upper reservoir and will be utilized for power generation. Further any shortfall, if any is proposed to be replenished from Gorakallu Reservoir during suitable season. The source of water to the scheme is River Krishna tapped from foreshore of Srisailam reservoir (now named as Neelam Sanjeev Reddy Sagar Project). Water will be drawn from reservoir through Pothidreddy padu head regulator with an approach channel of 3.40km long inside the reservoir and from the head regulator.

The Srisailam Right main canal is aligned cutting across the Mittakandala ridge up to Banakacherla village to enter the Kundu sub-valley. At Banakacherla, a cross regulator complex is constructed and from this point the main canal i.e., SRMC branches into three canals. The right-side canal taking off to feed SRBC scheme with a capacity of 5,000 Cusecs, left canal taking off to feed the TGP and the middle escape channel to feed K. C. Canal. Thus, SRBC starts from Banakacherla cross regulator complex and runs for a length of 198.00 Km and joins in Pennar river duly filling two balancing reservoirs one at Goralkallu village and another at Owk village. The length of canal in Kurnool district is 141 km.

This S.R.B.C Scheme was formulated to irrigate an Ayacut of 1,90,000 Acres to benefit the chronic drought prone areas in 82 villages of Nandyal, Panyam, Banaganapalli, Owk, Koilakuntla, Vuyyalwada and Sanjamala mandals of Kurnool district (1,57,422 Acres) and 18 villages of Jammalamadugu mandal of Kadapa district (32,578 Acres).

2.5 INFRASTRUCTURE FACILITIES

This part outlines the preliminary planning of infrastructure facilities.

2.5.1 Approach to the Project

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

2.5.1.1 Transportation by air

The nearest airport is at Hyderabad which is about 270 km from Pinnapuram village.

2.5.1.2 Transportation by Railway

Project site is accessible by railway up to Kurnool railway station about 80km from project site. The transportation of project cargo by railway is possible up to Kurnool.

2.5.1.3 Transportation by road

The project site is 15km away from sub-district headquarter Panyam and about 80km away from district headquarters Kurnool. The site is easily approachable by NH-18 from Kurnool.

2.5.2 Land Requirement

For the development of Standalone Pumped Storage component of Pinnapuram 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 (Fig 2.1), land requirement has been finalized as **713.65ha** (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.



Figure 2.1: Layout map Showing Standalone Pumped storage component of Pinnapuram Integrated Renewable Energy Project (IREP)

EIA Report Standalone Pumped Storage Component of Pinnapuram IREP
cl		Tatal		Non-Forest Land Area (Ha)	
si. no.	Components	Area (Ha)	rea (Ha) Area (Ha)		Govt/Assigned land
1	Upper Reservoir	280.17	0	107.00	173.17
2	Intake Structure	10.61	8.02	0.00	2.59
3	Penstock	6.96	6.96	0.00	0.00
4	Power House & TRC Outlet	22.50	22.50	0.00	0.00
5	Tail Race Channel	16.83	2.43	0.48	13.92
6	Lower Reservoir	319.02	319.02	0.00	0.00
7	Pot Head Yard	0.25	0	0.00	0.25
8	Proposed roads: from Lower Reservoir to Power House (PH), PH to Upper Reservoir	10.76	6.73	0.00	4.03
9	Contractor facilities, cement and E&M stores, Temporary colony area.	10.50	0.00	4.93	5.57
10	Muck disposal areas	21.00	0.00	7.24	13.76
11	Pumping & Other facilities	15.00	0.00	0.00	15.00
12	Magazine	0.05	0.00	0.00	0.05
	TOTAL	713.65	365.66	119.65	228.34

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

Source: PR of Standalone Pumped storage component of Pinnapuram IREP

2.5.2.1 Private Land

As stated above the total private land for various construction activities is about **119.65 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.

With regard to 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, 2013" the Act and its provisions applies in case:

(a) <u>a private company purchases land, equal to or more than such limits in rural areas or</u> <u>urban areas, as may be prescribed by the appropriate Government,</u> 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 under **Chapter 4 Section 29** of Andhra Pradesh Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Rules, 2014. As per the rules:

"The limits on extent of land beyond which provisions of Rehabilitation and Resettlement under the Act apply, in Cases of purchase by a private company through Private Negotiation with the owner of the land <u>shall be five thousand acres of dry land or</u> <u>equivalent extent of Irrigated Dry or Wet lands in rural areas</u> subject to any further notification as may be notified by Government. However, the provisions of Rehabilitation and Resettlement shall be applicable wherever any habitation is part of such land". (Rules issued through the G.O.MS.No. 389 dated 20-11-2014 attached)

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 Pinnapuram IRE Project is about 120 ha (297 acres) which is well within the prescribed limits as specified above. Further the land procured for the Project does not involve any habitation. Based on the provisions of RFCTLARR, 2013 and Rules issued by the Government of Andhra Pradesh as specified above the provisions relating to Rehabilitation and Resettlement are not applicable for the proposed Project.

2.5.3 Project Roads

It has been assessed that about 7.2 km length of new road is required to be constructed to access the power house from the lower reservoir and Upper reservoir (**Table 2.3**). The total land required for the construction of new road is 10.76 ha.

S.No.	Road Description	Area (ha)	Length (km)
1	Proposed road from Power House to	- 10	4.75
_	Lower Reservoir & pothead	7.16	
2	Proposed road from Power House		2.26
2	Upper Reservoir	3.6	2.50

 Table 2.3: Description of Road to be constructed for Pinnapuram IREP

Source: PR Standalone Pumped storage component of Pinnapuram IREP

2.5.4 Temporary Project Colonies, Contractor facilities & 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 10.50 ha of land near proposed upper reservoir area.

2.5.5 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 2.4**.

Table 2.4: Size and location of a	aggregate processing	and batching plants
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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 Pinnapuram IREP

2.5.6 Construction Material Requirement

For the construction of various project components approximately 5,80,000 m³ of coarse aggregate 3,80,000 m³ fine aggregate and 68,80,000 m³ for Rockfill are required (Table 2.5)

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.

Construction Material Requirement	Quantity	Unit
Aggregates	580000	Cum
Sand	380000	Cum
Cement	4100000	Bags
Steel	10500	MT
Structure Steel	822	MT
Steel Liners	25340	MT
Rockfill material	6880000	Cum
Soil / Clay	1880000	Cum

Table 2.5: Total requirement of Construction materials for the Project

2.5.7 Muck Disposal Areas

The total quantity of muck generated from soil and rock excavation is about **9.73 Mcum.** About **7.61 Mcum** of excavated muck are expected to be utilized for Rockfill and aggregate for construction. Total quantity of muck proposed to be disposed in designated muck disposal area, after considering 40% swelling factor would be **2.12 Mcum**. (Table 2.6).

Table 2.6: Quantity of muck to be generated from different project construction activities and
quantity required to be disposed off

SI		As per revised layout		
No.	No. Description		Unit	
1	Total quantum of muck generated from the project	9.73	Mcum	
2	Total quantity of aggregate requirement	0.58	Mcum	
3	Total quantity of Rockfill	7.03	MCum	
4	Quantity of muck to be disposed	2.12	MCum	
5	Swelling factor for loose muck	40.00	%	
6	Total quantity of muck to be disposed	2.97	MCum	
7	Dump height of materials	15.00	m	
8	Total area required for dumping - in sqm	197908.54	Sqm	
	Area in hectares	19.79	Ha	

Net Quantity of Muck to be rehabilitated/disposed off is estimated as 2.12 Mcum (approx.). Keeping the above requirement and vicinity of the excavation sites in view, one muck disposal area has been identified. Total area of this site is 21 Ha.

2.5.8 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.

2.5.9 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 Panyam/ Kaluvabugga 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

2.5.10 Tele-Communication and Other Facilities

Presently, the project site is connected with mobile networks from various service providers. In order to boost mobile connectivity, it is proposed to one number mobile network tower.

2.6 PROXIMITY TO PROTECTED AREA

Rollapadu Wildlife Sanctuary is about 11.50 km from the Lower Reservoir area of the Pinnapuram IRE Project. The location of Rollapadu Wildlife Sanctuary in relation to Pinnapuram IRE Project is shown in **Figure 2.2**.



Figure 2.2: Map showing distance of Rollapadu Wildlife Sanctuary from Standalone Pumped storage component of Pinnapuram IRE Project

Chapter 3

METHODOLGY

3.1 INTRODUCTION

Environmental Impact Assessment (EIA) is a location specific study; with a common basic structure of understanding the baseline status of relevant environmental components and impact prediction due to proposed development. EIA studies need a significant amount of primary and secondary environmental data. The primary data are those which need to be collected in the field to define the status of environment (like ambient air quality data, water quality data, etc.). The secondary data are those data which have been collected over the years and can be used to understand the existing environmental scenario of the study area. The EIA studies are conducted over a short period of time and therefore, understanding the environmental trends based on few months of primary data has its own limitations. Ideally, the primary data must be considered along with the secondary data for complete understanding of the existing environmental status of the area.

The baseline data for EIA studies is collected according to the Terms of Reference (ToR) approved by the Expert Appraisal Committee (EAC) of the Ministry of Environment and Forests (MoEF&CC), Government of India.

3.2 METHODOLOGY

A brief account of the methodology followed in the present study is given below under different headings. The methods are structured for collection and organization of environmental baseline data and identification of environmental impacts. The information, thus, gathered was analyzed and presented in form of maps for easy interpretation and decision-making.

3.2.1 Study Area

Study area for environmental study has been delineated as:

• 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.

A map of the study area prepared based on the above criteria is given at **Figure 3.1**. The study area was further demarcated into Direct Impact Zone and Indirect Impact Zone as follows:

Direct Impact Zone

The Direct Impact Zone (DIZ) is defined as all areas which are directly affected by the project works, such as the canal, power house, balancing reservoir, project access roads and areas affected by any construction work on the ground (proposed dumping sites, working areas, etc.). New road alignments necessitated by the siting of project structures as they also will have a direct impact and have been considered as part of the direct impact zone.

The sampling for generation of field data was primarily concentrated around project works in the DIZ.

Indirect Impact Zone

The Indirect Impact Zone (INDIZ) covers a larger area not directly affected, but where the project nevertheless has significant impacts on people and biodiversity.

3.2.2 Scoping Matrix

Scoping is a tool which gives direction for selection of impacts due to the project activities on the environment. As part of the study, scoping exercise was conducted selecting various types of impacts which can accrue due to Pumped storage project. Based on the project features, site conditions, the scope of studies were approved by MoEF&CC (**Refer Annexure – Ia & Ib**). The approved Terms of Reference (TOR) specified for various parameters to be covered during the EIA study.

Based on the Scoping matrix (**Table 3.1**), the environmental baseline data have been collected and the project details superimposed on environmental baseline conditions to understand the beneficial and deleterious impacts due to the construction and operation of the proposed project.

3.2.3 Baseline Status Primary Data Collection

The data on baseline status of various environmental parameters in the study area was collected through primary surveys for three seasons as specified in the approved TOR for the Standalone pumped storage component of Pinnapurum IREP.

3.2.4 Secondary Data

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, Kurnool 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 Quality Criteria. 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, Satellite data of Sentinel-2 MSI of European Space Agency was used
- Soil map of the study area was prepared using Soil Map prepared by Atlas of Andhra Pradesh 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.





Table 3.1: Scoping matrix for EIA study of Standalone Pumped storage component of Pinnanuram IRE Project

Parameters	Sampling locations	Frequency		
Soil (Soil Type and Physico chemical properties)	Soil samples collected from various sites of the proposed project study area viz. lower reservoir, upper reservoir, and surrounding villages – 6 locations	Once during study period		
Air environment ($PM_{2.5}$, PM_{10} , So _x and NO_x	Near proposed working areas and nearby villages – 6 locations	Three seasons (Winter, Pre-monsoon and Monsoon)		
Noise & Traffic (hourly monitoring during day time)	Near proposed working areas, highway and nearby villages – 6 locations.	Three seasons (Winter, Pre-monsoon and Monsoon)		
Vegetation sampling	Sampling for vegetation was carried out in direct impact zone as well influence area as per methodology described in ToR issued by MoEF&CC.– 7 locations	Three seasons (Winter, Pre-monsoon and Monsoon)		
Faunal surveys	8 number of Transects surveyed in the study area – 6 locations	Three seasons (Winter, Pre-monsoon and Monsoon)		
Water Quality and Aquatic Ecology	Sampling for surface and ground water, near proposed construction area- 3 surface water and 5 ground water locations	Three seasons (Winter, Pre-monsoon and Monsoon)		
Socio-economic survey	Villages falling within the study area, project affected families due to proposed project	Once during the study period		

3.2.4.1 Physiography

The spatial database on physiographic features like drainage, roads, settlements and villages, etc. was created from maps of topographic sheets and satellite data followed by ground truth verification and data analysis with Geographic Information System (GIS) tools. Digital Elevation Model of Advanced Spaceborne 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. Percent area under various slope categories as per SLUSI namely gently sloping, moderately sloping, strongly sloping, moderately steep to steep, very steep and escarpments were also calculated for the entire study area.

GIS based maps have been provided for the following themes:

- General Features (Villages, roads, tributaries)
- Elevation profile
- Slope
- Land use in study area
- Villages in Study area

3.2.4.2 Geology

The regional geology around the project area highlighting geology, stratigraphy and structural features, based on the existing information on these aspects contained in Project Report. In addition, the important parameters of seismicity were assessed using published literature on seismic history and seismo-tectonic nature of the regional rock types in the area.

3.2.4.3 Meteorology

Meteorological factors like precipitation, temperature and evapo-transpiration are important, as they have a profound impact on the water availability, cropping pattern, irrigation and drainage practices, soil erosion, public health, etc. The meteorological data for Kurnool district was downloaded from online weather portal <u>https://www.weatheronline.in/</u> Monthly data for the years 2009-2017.

3.2.4.4 Forest Types & Forest Cover

The details on forest types and forest cover were based on field surveys in the area supplemented with the working plan of the forest division falling in the study area. Major forest types in the study area have been described based upon the classification of Champion and Seth (1968).

3.2.4.5 Infrastructure Facilities

The present status of infrastructure facilities, status and availability of electricity, drinking water, communication and mode of transportation, commercial, educational and health facilities, veterinary services, etc. were collected using secondary data from District Census Handbook published; Census of India 2011 and interactions with the locals.

3.2.5 Primary Data Collection - Field Surveys

The field surveys for the collection of primary data commenced from January 2018 up to August 2018 and were conducted in different seasons of the year i.e. winter, premonsoon/summer and monsoon to collect data/ information on terrestrial ecology and physical environment parameters as well as sociological aspects. 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 3.2**.

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.

···· · · · · · · · · · · · · · · · · ·			
Parameters	Winter	Summer	Monsoon
Soil sampling		July 2018	
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	August 2018
Noise & Traffic	January 2018	May 2018	August 2018
Socio-economic survey of Project affected and study area villages		July-August 202	18

Table 3.2: Sampling schedule for various Environmental Parameters

3.2.5.1 Soil

The soil taxonomic (family) classification map for study area of Standalone Pumped storage component of Pinnapuram IRE project was prepared as per the Soil Atlas of Andhra Pradesh 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**. The sampling for soil was done 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.

Site Code	Sampling Site
S1	Brahmanapalle Village
S2	Husenapurampuram Village
S3	Somayajulapalle Village
S4	Proposed Lower Reservoir area
S5	Proposed Upper Reservoir near Pinnapuram Village
S6	Gorakallu Village

Table	3.3:	Sampling	locations
TUDIC	3.3.	Jamping	locations

The following parameters were analyzed for soil quality.

Physical parameters included:

- Bulk density (gm/cc)
- Water holding capacity (%w/w)
- Porosity
- Soil texture
- Electrical conductivity (µmho/cm)

Chemical Parameters included:

- 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)

3.2.5.2 Ambient Air Quality

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 (NO_x), PM₁₀ 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 the 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 3.4**.

S. No.	Monitoring location
ANT1	Brahmanapalle Village
ANT 2	Kalava Village
ANT 3	Somayajulapalle Village
ANT 4	Pinnapuram Village
ANT 5	Undulla Village
ANT 6	Gorakallu Village

Table 3.4: Ambient air quality, monitoring locations

Sampling and Analysis

Sulphur dioxide (Modified West and Gaeke method (IS-5182 Part-II, 2001)

Placed 30 ml of absorbing solution in an impinger and sample for 24 hours at the flow rate of 1 L/min in Respirable Dust Sampler. After sampling measured the volume of sample and transferred to a sample storage bottle. Sulphur dioxide from air is absorbed in a solution of potassium tetrachloromercurate (TCM). A dichlorosulphitomercurate complex, which resists oxidation by the oxygen in the air, is formed, which is stable to strong oxidants such as ozone and oxides of nitrogen and therefore, the absorber solution was stored for some time prior to analysis. The complex was made to react with para-rosaniline and formaldehyde to form the intensely colored pararosaniline methylsulphonic acid. The absorbance of the solution was measured by means of a suitable spectrophotometer at 560 nm and SO₂ concentration was calculated using the standard calibration graph.

Nitrogen dioxide (Jacobs Hochheiser method (IS 5182 Part-VI, 2006)

Placed 30 ml of absorbing solution in an impinger and sample for 24 h at the flow rate of 0.2 to 1 L/min in Respirable Dust Sampler. After sampling measure the volume of sample and transfer to a sample storage bottle. Ambient nitrogen dioxide (NO₂) is collected by bubbling air through a solution of sodium hydroxide and sodium arsenite. The concentration of nitrite ion (NO₂) produced during sampling is determined calorimetrically by reacting the nitrite ion with phosphoric acid, sulfanilamide, and N-(1-naphthyl)-ethylenediamine di-hydrochloride (NEDA) and measuring the absorbance of the highly colored azo-dye at 540 nm using spectrophotometer and concentration is calculated using the standard calibration graph.

Particulate Matter (PM₁₀) - Gravimetric Method (IS 5182 Part-23, Reaffirmed-2012) Air is drawn through a size-selective inlet and through 8" X 10" filter at a flow rate, which is typically 1132 L/min using Respirable Dust Sampler for 24 h. Particles with aerodynamic diameter less than the cut-point of the inlet are collected, by the filter. The mass of these particles was determined by the difference in filter weights prior to and after sampling. The concentration of PM₁₀ in the designated size range was calculated by dividing the weight gain of the filter by the volume of air sampled.

Particulate Matter (PM_{2.5}) - Gravimetric Method (CPCB Guidelines National Ambient Air Quality Series: NAAQMS/36/2012-13)

An electrically powered air sampler draws ambient air at a constant volumetric flow rate (16.7 lpm) maintained by a mass flow / volumetric flow controller coupled to a microprocessor into specially designed inertial particle-size separator (i.e. cyclones or impactors) where the suspended particulate matter in the PM_{2.5} size ranges is separated for collection on a 47 mm polytetrafluoroethylene (PTFE) filter using Fine Particulate Sampler over a specified sampling period. Each filter is weighed before and after sample collection to determine the net gain due to the particulate matter. The mass concentration in the ambient air is computed as the total mass of collected particles in the PM_{2.5} size ranges divided by the actual volume of air sampled and is expressed in μ g/m³. The microprocessor reads averages and stores five-minute averages of ambient temperature, ambient pressure, filter temperature and volumetric flow rate.

3.2.5.3 Ambient Noise levels & Traffic Density

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 3.5**) where levels are recorded for 6-8 hours during the daytime. Night time readings are not taken keeping in view that there is no significant noise generating source at night time and the security at night time is always a cause of concern in remote areas. 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. From the recorded values, day time equivalent levels were calculated.

S. No.	Monitoring location
ANT1	Brahmanapalle Village
ANT2	Kalava Village
ANT3	Somayajulapalle Village
ANT4	Pinnapuram Village
ANT5	Undulla Village
ANT6	Gorakallu Village

Table 3.5: Ambient air quality, noise	and traffic density monitoring locations
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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. Following the IRC 64-1990 to know the level of service (LOS).

3.2.5.4 Land use / land cover

The objective of the study was to produce a detailed vegetation/ land use map using hybrid digital classification technique. The study also aims to produce land cover data set appropriate for applications like erosion mapping, etc.

In the present study, National Remote Sensing Centre (NRSC), Indian Space Research organization (ISRO) of Dept. of Space, Balanagar, Hyderabad, Telangana with A.P. State Remote Sensing Centre (APSRAC), as partner has been used for the classification of land use/land cover. For the description of various classes classified, Technical Document prepared by NRSC/ISRO has been referred to (http://bhuvan.nrsc.gov.in/gis/thematic/tools/document/2LULC/lulc1112.pdf). However, in order to visualise the general land use pattern in the study area False Color Composite (FCC) of the study area comprised Sentinel-2 MSI data of ESA was downloaded from https://earthexplorer.usgs.gov/.

3.2.5.5 Vegetation Community Structure/ Floristic Surveys

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 studies 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. Seven 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 already 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 3.6**.

Site	Sampling Location
V1	Near Brahmanapalle Village
V2	Proposed Lower Reservoir
V3	Near Kalava Village
V4	Near Somayajulapalle Village
VE	Proposed Upper Reservoir area near
٧٥	Pinnapuram village
V6	Near Undulla Village
V7	Near Gorakallu Reservoir

Sampling Methodology

Standard methodology of vegetation sampling was used for community structure. Nested quadrat sampling method was used for the study of community structure of the vegetation. Each sampling unit consisted of randomly placed quadrats of 10 x 10 m² for trees, $5 \times 5m^2$ for shrubs and $1 \times 1m^2$ for herbs. For sampling of vegetation, 10 numbers of quadrats were laid during seasonal surveys at each sampling site/ area depending upon the heterogeneity/ homogeneity of the vegetation encountered in a particular site/ area. At each site the quadrats were laid as such to ensuring maximum possible representative coverage of the vegetation of a particular sampling location. Each sampling location/ area was divided into grids vertically as well as horizontally along the slopes thereby capturing the maximum diversity of vegetation. In case of trees total basal area/cover per unit area 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 given in the following paragraphs.

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

The density was calculated as follows: Density = Total no. of individuals of a plant species recorded from all quadrats Total number of quadrats studies

Frequency (%) = Number of quadrats of occurrence of a species x 100 Total number of quadrats studied

For the calculation of dominance, the basal area was determined by using the data on *cbh* and using following formula.

Basal area = πr^2

Calculation of Dominance & Diversity Indicies

Based on the quadrat data, frequency, density and cover (basal area) of each species were calculated. The data on density and basal cover are presented on per ha basis.

The **Importance Value Index (IVI)** for different tree species was determined by adding up the Relative Density, Relative Frequency and Relative Dominance/ Cover values. The Relative Density and Relative Frequency values were used to calculate the IVI of shrubs and herbs.

Species diversity and evenness index was calculated by using the Shannon-Wiener Diversity Index (1963) and Evenness Index, respectively.

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 / In(S)

Where, H is Shannon Wiener Diversity index; *S* is number of species

3.2.5.6 Faunal Elements

The fauna of the study area has been compiled with the help of secondary sources supplemented with information provided by local people during field surveys in the study area. For the preparation of checklist of animals, Forest Working Plan of Kurnool Forest Division is considered. Birds were identified using the field guide of birds by Ali & Ripley (1983), Grimmett *et al.* (1998, 2011), Inskipp *et al.* (1999) and Kazmierczak (2000).

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 3.7**.

Transect	Location
Tr 1	Near Brahmanapalle Village
Tr 2	Near Proposed Lower Reservoir
Tr 3	Near Husenapuram Village
Tr 4	Proposed Upper Reservoir near Pinnapuram Village
Tr 5	Near Undulla Village
Tr 6	Surrounding of Gorakallu reservoir

Table 3.7: Transects and trails for faunal elements

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 performed 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 km 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 elicited from the locals were also noted for the presence or absence of wild animals in the area. These indirect evidences and information must be 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. The herpetofauna was also sampled along the same transects marked for mammals.

3.2.5.7 Water Quality

The data on water quality has been collected to evaluate surface water (reservoir and pond) and ground water quality (tubewells, handpumps, wells, etc.) in study area.

Selection of Sampling Sites

The sampling was carried out at 8 different locations (Surface water: 3 samples and ground water: 5 samples) during three seasons as described below in the table to study various physico-chemical and biological characteristics of surface and ground water (**Table 3.8**). Water samples were collected during each sampling season for physico-chemical parameters.

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.

Sites	Location	Remarks				
	Surface Water					
SW1	Proposed Lower Reservoir	Pond				
SW2	Near Kalava village	Pond				
SW3	Gorakallu Reservoir	Gorakallu Reservoir				
	Ground Water					
GW1	Brahmanapalle Village	Tubewell				
GW2	Husenapuram Village	Tubewell				
GW3	Panyam Village	Tubewell				
GW4	Pinnapuram Village	Well				
GW5	Gorakallu Village	Handpump				

Table	3.8:	Water	sampling	locations
- asic	0.0.	T a c c i	Samping	,

Some of the physico-chemical parameters of water necessary for the ecological studies 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 analysed 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.

3.2.5.8 Socio-economic Surveys

To assess the baseline socio-economic status of the study area Census, 2011 was used while for the status of affected villages' primary as well as secondary data was collected. For this the data was collected at village level.

The data for project affected villages was collected through questionnaire-based surveys as well as from District Census Handbook, Census of India 2011.

Source/s of Data

The details of source of different Environmental parameters are given at Table 3.9.

Aspect	Mode of Data collection	Parameters covered/ monitored	Frequency	Sources
Meteorology	Secondary	Temperature, Humidity, Rainfall	-	Project Report (PR)
Water Resources and Water Availability	Secondary	Flow, Design, and water availability	-	Project Report (PR)
Geology and seismo- tectonics	Secondary	Regional Geology, Tectonics and Earthquakes	-	Project Report (PR)
Land use	Primary and	Land use pattern	-	Field Survey, ground truthing
	secondary			Remote Sensing and GIS Studies
Ambient Air Quality	Primary	PM _{2.5} , PM ₁₀ , SO ₂ , NOx	Seasonal	On-site monitoring and analysis
Water Quality	Primary	Physico-chemical parameters	Seasonal	Sample collection and analysis
Ambient Noise Levels	Primary	Leq (Day only), and Mean noise level in dB (A)	Seasonal	On-site monitoring and analysis
Soil	Primary and Secondary	Soil Taxonomy and Physico-chemical parameters	Once during study period	Sample collection and analysis
Terrestrial Ecology	Primary and secondary	Floral and faunal diversity, density and species composition	Seasonal	On-site data collection, Forest Department, public consultation and Literature review
Socio-economic aspect	Primary and secondary	Demographic profile, Ethnographic profile, Economic structure, Literacy profile, Development profile, Agricultural practices, Infrastructure facilities: education, health and hygiene, communication network, etc., Impact on socio-cultural and ethnographic aspects due to dam building activity	-	Field Survey, District Census Handbook, Census of India 2011

Table 3.9: Source of data for various Environmental Parameters

3.3 IMPACT ASSESSMENT & MITIGATION MEASURES

Prediction is essentially a process to forecast the environmental conditions of the project area that might be expected to occur because of implementation of the project. Impacts of project activities have been predicted using overlay technique (super-imposition of activity on environmental parameter). For intangible impacts qualitative assessment has been done. The environmental impacts predicted are as follows:

- Loss of forests and cultivable land
- Impacts on land use pattern
- Impact on socio-economic aspects
- Displacement of population, due to acquisition of private and community properties
- Impacts on water quality
- Increase in incidence of water-related diseases including vector-borne diseases
- Increase in air pollution and noise level during project construction phase
- Impact due to sewage generation from construction works camps
- Impact due to acquisition of forest land
- Impacts on terrestrial ecology due to increased human interferences during project construction and operation phases
- Impact due to blasting

3.4 ENVIRONMENTAL MANAGEMENT PLAN

Based on the environmental baseline conditions and project inputs, the adverse impacts were identified and a set of measures have been suggested as a part of Environmental Management Plan (EMP) for their mitigation.

The management measures have been suggested for the following aspects:

- Biodiversity and Wildlife Conservation and Management Plan
- Solid Waste Management Plan
- Public Health Delivery System
- Energy Conservation Measures/ Forest Protection Plan
- Muck Disposal Plan
- Rehabilitation and Resettlement Plan
- Local Area Development Plan/CSR/CER (As per 01.05.2018)
- Greenbelt Development and Restoration of Working Areas
- Mitigation Measures for Air, Noise and Water Environment
- Compensatory Afforestation Plan
- Environmental Monitoring Plan
- The expenditure required for implementation of Biodiversity and Wildlife Conservation and Management Plan, Rehabilitation and Resettlement Plan and other components of EMP have been estimated and proposed as part of the study report.

3.5 ENVIRONMENTAL MONITORING PROGRAMME

It is necessary to continue monitoring of certain parameters to verify the adequacy of various measures outlined in the Environmental Management Plan (EMP) and to assess the implementation of mitigation measures. A comprehensive environmental monitoring programme including monitoring frequency for critical parameters has been suggested for implementation during project construction and operation phases. The staff, necessary equipments and agencies to be involved for implementation of the Environmental Monitoring Programme and costs have also been indicated.

Chapter

4

ENVIRONMENTAL BASELINE

4.1 INTRODUCTION

The Environmental Baseline chapter provides details of data collected for environmental parameters during different seasons i.e. winter season, pre-monsoon and monsoon in the project study area as specified in the approved Terms of Reference by MoEF&CC, Government of India. The details of collection of both primary and secondary data for pertinent environmental components have been given in Chapter-3 of the EIA report.

4.2 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.

4.2.1 Physiography

Physiography describes the landscape and terrain of the project study area. To understand this relief and slope maps of the study area were generated. For this Digital Elevation Model of Advanced Spaceborne 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 4.1**.

The study area of the proposed project is comprised of moderately sloping, exposed rocks, and scrub vegetation. The study area ranges from El. 200 to 500 m above msl. The denudation landforms are visible in the form of scree slope, scarps ridges valleys, etc.

The slope map of the study area is given at **Figure 4.2** and the area falling under various slope categories (as per SLUSI) has been tabulated below in **Table 4.1**. As seen from the map and table nearly 68% of the study area is under moderately sloping followed by the area under Strongly Sloping category with 16.15% and Gently Sloping with 10.33% of the total area (**Table 4.1**).

Slope Categories (Degrees)	Area (ha)	Area (%)	
Gently Sloping (Upto 2)	6982.62	10.33	
Moderately Sloping (2 - 8)	46185.05	68.33	
Strongly Sloping (8 - 15)	10912.42	16.15	
Moderately Steep (15 - 30)	3320.55	4.91	
Steep (Above 30)	187.60	0.28	
Total	67588.24	100.00	

Table 4.1: Areas falling under different slope categories in the study area



Figure 4.1: Digital Terrain Model (DTM) of the study area generated from ASTER GDEM data



Figure 4.2: Slope map of the study area generated from DEM

4.2.2 Geology

4.2.2.1 Regional Geology of Study Area

THE CUDDAPAH SUPER GROUP

The rocks of Cuddapah Super group mostly occupy the eastern part of the district, roughly 100 Km long in N-S (roughly) 50 Km wide extending westwards from Nallamalai range. The northern and eastern parts of Atmakur, eastern parts of Nandyal, and east of Allagadda are occupied by Cuddapah formations. They are concealed by the younger Kurnool formations.

THE KURNOOL GROUP

The Cuddapah super group has been divided into 6 groups, in which the Kurnool Group is the youngest. Kurnool Group is further sub divided in 4 formations namely Kundair formation, Paniam formation, Jammulamadugu formation and Banganapalli formation.

A complete succession of Kurnool group rocks is well exposed in lower reservoir, Upper Reservoir and Proposed surface power house area of Pinnapuram IREP.

4.2.2.2 General Geology of Proposed Upper & Lower Reservoir Areas

A. UPPER RESERVOIR

The upper level reservoir is proposed at about 80 kms from Kurnool, neighboring Pinnapuram village. It comprises of a 30-40m high embankment along the hills which will be made by rock fill or concrete faced methods around the outer periphery of proposed reservoir. The approximate lengths of embankment will be about 5-6 km. The height of embankment will vary at places because the ground levels are ranging between 430 to 465m. Towards south and south eastern margin of proposed reservoir, where it is terminated against a 15 to 20 m high sub-vertical to vertical rock edges, above and beyond of it a flat bench of in-situ bed rock covers all area and continue for considerable length towards south east & south west direction. The southern side of proposed reservoir, having natural depression which are acting as a seasonal stream of about 230-240 m wide are observed trending South-East to North-west direction.

It is revealed from the geological study of the upper reservoir area that the overall proposed reservoir area is located in a flat and rocky terrain.



Figure 4.3: A widespread view of proposed upper level reservoir, from southern margin



Figure 4.4: A flat bench of massive quartzite adjacent to Pinnapuram village.



Figure 4.5: Geological Plan of Upper Reservoir and Water conductor System including Surface PH showing proposed geotechnical Investigation Locations

In majority of cases in situ bed rock outcrops are exposed in & around the flat terrain located adjacent to Pinnapuram village (See figure-4.4), although thin layer of silty sand occurring over the in-situ rock mass in the center of the reservoir, where cultivated land is observed (see figure-4.3) and cone shaped sand deposition could also be observed adjacent to rock edge (see figure-4.6). The brown colored silty sand is predominantly consisting of sand sized quartz grains. The large size tilted/detached rock blocks of massive quartzite are laying along the 15m to 20m sub vertical to vertical high rock edges continuing for considerable length in east to west direction (see figure-4.6 & 4.7).

Geological mapping of the proposed reservoir revealed that the litho-units comprising of the rock masses in & around the Pinnapuram village is massive quartzite. At places pinnacle quartzite could also be noticed & recorded occurring along seasonal /periodic nallahs. It is anticipated that approximately 20-30m thick deposition of massive quartzite may underly the Shale & Limestone. However, during traverse along and around the periphery of the proposed reservoir area any contact of shale & quartzite could not be seen along peripheral area of proposed reservoir.



Figure 4.6: Cone/fan of sand deposited at base of vertical rock edge along southern margin of proposed upper level reservoir



Figure 4.7: Detached rock mass of quartzite at vertical rock edge along southern margin of proposed upper level reservoir

The exposed massive quartzite is, light grey to whitish coloured (see Figure 4.2), hard, very strong, medium grained with high strength. In general, the massive quartzite is fresh but surficial weathering/staining has been observed & recorded all over the area. In majority of cases, massive quartzite is medium grained, well sorted, composed of quartz grains (+90%) and feldspar grains as accessary mineral, the matrix of quartzite is siliceous and calcareous. Therefore, at many places solution cavities /holes could be found in quartzite forming circular and elongated shape.

During geological mapping it is revealed that the rock mass has been dissected by three major joints (S2, S3 & S4), in addition to bedding planes/joints (S0 & S1). In which S2 & S3 joints prominently show high to very high persistence and having space of 10-60cm and 60cm-150m. At the vertical edge along southern margin of reservoir S2 and S3 becomes opened and gapped enough, which is mainly responsible for the detached/tilted rock mass from the massive quartzite. S2 joints are controlling the all seasonal streams wherever observed.

The slopes within the reservoir are not likely to slide. Mineralization of economic importance could not be observed in the area likely to be submerged due to filling of reservoir area.

B. LOWER RESRVOIR

The proposed Lower reservoir area is located at about 80 kms from Kurnool district, which is approximately 3.5km long in East to West direction and 1.5km wide in North to South direction. It is shielded by isolated small ridges, except for few low-level areas where depressions act as seasonal streams. The slope of the proposed reservoir area gradually decreases from South to North direction. Towards South direction (from the center of proposed reservoir) there is a straight ridge continue for about 4km (See figure. 4.3) and afterwards it is separated by another ridge, which attains its direction NW to SE. Similarly, towards north-west and north east direction from the center of proposed reservoir area all isolated ridges maintain straight pattern for about 4 km surrounding the periphery of proposed reservoir.



Figure 4.8: Dense and rugged topography of proposed Reservoir area

The isolated ridge area was unapproachable during the field study. Access along the ridges was very difficult and hazardous due to presence of dense forest and rugged topography (Figure 4.8), however all efforts were made to access the bottom as well upper part of ridges which were in range of approach; from where adequate data was collected for analysis.

Towards the southern limit between embankment points 11 to 14 of the proposed reservoir, the slope of the ridge is moderate with flat bench at top of hill where the elevation is EL 440m, afterwards it becomes almost flat and maintain gentle to mid slope, whereas towards north western and north eastern limit embankment points 15 to 16 and 8 to 9 respectively, the slope of the ridge is moderate to gentle, extending up to its top level (EL 347m) except few areas where the natural depressions were noticed.

Small traverses have been taken along the center of proposed reservoir, along approach roads, nallahs and all accessible areas. It is was noticed that the area of the proposed reservoir comprises of multiple seasonal streams and drains. Two main seasonal streams have been observed which gather all the rainwater and pass it through valley towards north direction between embankments point Nos 8 to 9. Both streams flow between the isolated ridges separately from south to north and north-west direction, and several small seasonal drains connect from the southern margin of the proposed reservoir area. The minimum ground level ELs ranged between EL 293m & EL 297m as recorded with hand held GPS along the terminal area of streams and at the beginning of the streams elevation recorded between El 316m to EL 322m; indicating that the slope of reservoir is south to North.



Figure 4.9: Isolated ridges around the proposed Reservoir area and shale outcrops exposed along the center of reservoir

In general, the exposed rock mass of the area comprises of weak to medium strong, light brown to purpled colored shale which is underlain by grey colored limestone. Hard and massive quartzite is observed at the top of the ridges (up to a 15-30m thick). The shale which is found in reservoir area is ferruginous in nature (Figure 4.9). Few isolated outcrops of limestone are identified along the banks of streams, but continuity of limestone has not been established. The recorded limestone is fine grained whitish grey coloured, medium strong to weak in strength. At some places few isolated outcrops of basic sills/dykes are also noticed and recorded along the streams.

The outer periphery of the northern margin is associated by a vertical ridge of quartzite; the slope on either side of the ridge suddenly becomes low because of sudden lithological changes from quartzite to shale and limestone.



Figure 4.10: Exposure of ferruginous shale

At some places in reservoir area the exposed rock mass consists of shale having widely spaced thin bands of sandstone. The shale is khaki to purpled coloured, fine grained, weak to medium strong composed of mixed flakes of clay minerals and thin fragments of slit sized particles. It is easily broken along the thin laminae or parallel layering of bedding which is less than 2-4 cm in thickness. The 20 cm of thick bands of sandstones having light grey colour, fine to medium grained, strong and hard in nature and closely jointed. It predominantly consists of fine to medium sized grains of quartz, where bedding is identified on the basis of colour of lamination.

During traversing along the area, it is revealed that in the shale beds three major sets of joints (S2, S3 & S4) occur along with bedding plane, where S2 & S3 joints are more prominently show medium to high persistence with spacing of 1 - 8m and 10 - 100cmrespectively. The exposed quartzite rocks, towards the western margin of the reservoir, show moderate to high persistence (5 – 20m) and spacing of 20 to 50 cm. The exposed shale are slightly weathered to moderately weathered and the aperture of S1, S2 and S3 are tight to partly open.



Figure 4.11: Vertical ridge of the Quartzite at the northern periphery of Reservoir

General Geology of Penstock, Powerhouse and TRC 4.2.2.3

As per the details collected during surface geological mapping, it is found that the suitable location of surface power house is near the Gumantam Tanda (Brahamanapalle Village) just Upstream of Embankment No. 1. As per geological conditions and geological mapping done at 1:5000 Scale, the area is laid in a bed of basin, which is covered from 3 sides by hills. The power house location is covered with thick overburden material which will be delineated by bore hole drilling and exploratory pits covering the penstock, PH and TRC alignment.



Figure 4.12: Geological Plan & section of Proposed Penstock, PH and TRC alignment

The Rocks for underground penstocks are shale or basic intrusive sills of Kurnool formations, which are good tunneling media. Based on surface geological mapping, the average RMR recorded at places was 45-55, hence it is Class III rock and may require adequate supporting systems during execution. The average RQD recorded in shale was 25-40 which is slightly less. The tunneling media is good enough and may be categorized in Class III (Fair Rock Mass Class) to Poor rock Mass Class (IV).

4.2.2.4 Geology of Rim Area

Along the Proposed reservoir area all slopes were studied and were found suitable without any possibility of major slide failure. All the slopes are stable due to horizontal bedded, low dip angles of rock beds and vertical joints.

4.2.2.5 Seismicity of the Project Area

Andhra Pradesh and adjoining region is considered to be seismically stable unlike the Himalaya terrains, although the project area laid in high rifted zone of Cuddapah Super group, hence many fault zones may be found. The occurrence of earthquakes in the state is rare and directly relate to major tectonic activity.

4.2.2.6 Parameters for Earthquake Resistant Design

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.



Figure 4.13: Seismic Zone Map of India Updated on 2nd June 2014

4.2.3 Meteorology

The study area of the proposed project lies in Kurnool district of Rayalaseema region in Andhra Pradesh state. The area lies in the tropical climate zone. The climatic condition of the region can be divided into four seasons. The period from December to February is dry and cool. Summer spreads from March to May followed by south west-west monsoon from June to September. October and November contribute the post-monsoon or retreating monsoon season. The meteorological data for Kurnool district was downloaded from online weather portal <u>https://www.weatheronline.in/</u>. Monthly data for the years 2013-2017 is given in the **Annexure-III**.

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 & May and average minimum temperature of 18°C during the month of December & January (reference year 2013-17). The monthly variation of average maximum and minimum temperatures is shown in **Figure 4.14**.



Figure 4.14: Monthly Average (2009-2017) Max. and Min. Temperature (Distt- Kurnool)

b. Rainfall

The annual average rainfall of Kurnool district was recorded as 656.10 mm (based on data for a period of 2013-2017). Maximum Rainfall in the area was recorded during 2013 with annual rainfall of 1086.6 mm and 131 rainy days. Minimum annual rainfall was recorded during 2017 with annual average of 376.4mm (**Annexure-III**). The area receives maximum rainfall during south west monsoon i.e. between June and September, where about 65.0% of the annual average rainfall is received. 23.0 % of the annual average rainfall occurs between October and November during post-monsoon or retreating monsoon season (**Figure 4.15**).



Figure 4.15: Monthly Average Rainfall and Number of Rainy Days (Distt- Kurnool)

c. Relative Humidity

The Relative Humidity is generally high throughout the year, average relative humidity is close to 75% during September to November. Relative humidity is lowest during summer period and ranges from 40 to 45% (reference year 2013-2017). Average monthly variation in relative humidity is given at **Figure 4.16** and **Annexure-III**.



Figure 4.16: Monthly Variation in Average Relative Humidity, District- Kurnool

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 4.17 and Annexure-III**.



Figure 4.17: Monthly Variations in Wind Speed (2009-17) Distt. Kurnool

4.2.4 Soil

It is very essential to assess the soil quality of the project area for proper planning for agricultural activities or afforestation. The major soils of the Kurnool district are *in situ* soils, deep red sandy soils, shallow red sandy soils, black soil plains and alluvial soils. The *in-situ* soils are found in the ridge and valley topography of Nallamala hills and denuded hills of Erramala hills in the district. The black soil plains consisting of deep, sticky clayey soils are found in the western parts of the district and in the Kunderu valley. The shallow red sandy and red loamy soils are characteristic of the project area.

4.2.4.1 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 Andhra Pradesh by National Bureau of Soil Survey & Land Use Planning (NBSS & LUP). The dominant soil types in the district are black soils and red loamy soils (**see Figure 4.18**).

The majority of project study area i.e. more than 64% of soil is characterized by Red loamy soil (see Table 4.2 & Figure 4.18).

Soil Type	Area (sq km)	Area (%)
Deep calc. black soils	22054.48	32.63
Red calc. gravelly loam	1884.97	2.79
Red loamy soils	43648.79	64.58
	67588.24	100.00

|--|

Source: ICAR, Hyderabad Report 2012

4.2.4.2 Soil Fertility in the Study Area

To ascertain the fertility status of the soil in the area the soil samples were collected from different locations in the study area (Figure 4.18 & Table 4.3). The methodology and the analysis details have already been given in Chapter 3-Methodology. Among the physical parameters soil texture, bulk density, water holding capacity, pH and electrical conductivity

were analyzed while chemical characteristics included organic matter, sodium, phosphate, nitrate, magnesium and potassium were analyzed. 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 4.4**.

The bulk density of soil varied from 1.25 to 1.52 (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 (45.3) from the soil sample collected from sampling site S1 and lowest was from (22.4) sampling site S5. Electrical conductivity ranged between 300 μ mho/cm and 868 μ mho/cm. Soil pH is normal in nature with pH values ranging from 7.7 to 8.2 (**Table 4.4**).



Figure 4.18: Soil map of the Study Area

S. No.	Monitoring Code	Sampling Location	Site Description
1	S1	Brahmanapalle Village	Agriculture field
2	S2	Proposed Lower Reservoir	Forest
3	S3	Pinnapuram Village	Agriculture field
4	S4	Panyam Village	Orchard
5	S5	Upper Proposed Reservoir	Agriculture
6	S6	Near Gorakallu Village	Fellow Land

Table 4.3: Description sampling location of Soil in the Study Area



Figure 4.19: Map showing locations for collection of soil samples, air and noise monitoring and collection of surface and ground water samples in the study area

Parameters	S1	S2	S3	S4	S5	S6
Texture						
Sand (% w/w)	20	50	60	20	80	32
Silt (% w/w)	9	10	22	10	12	9
Clay (% w/w)	71	40	18	70	8	59
Porosity (% w/w)	38.8	46.6	48.3	37.6	54.1	44.7
Bulk Density (gm/cc)	1.52	1.38	1.32	1.5	1.25	1.43
Water Holding Capacity (%)	45.3	38.2	34.7	44.7	22.4	42.9
рН	7.84	8	8.2	7.7	7.7	7.79
Electrical Conductivity (µmho/cm)	320	420	300	440	420	868
Calcium (mg/kg)	34	42	28	60	50	632
Magnesium (mg/kg)	18	38	20	44	28	265
Alkalinity (mg/l)	38	50	45	52	56	46
Chloride Content (mg/kg)	38.6	44.3	39.7	42.4	55.2	65.8
Sodium (mg/kg)	70	73.8	82.2	74	82.4	155
Organic Carbon (%)	0.36	0.34	0.42	0.53	0.38	0.48
Available Phosphorus (kg/ha)	26.7	23.5	28	30.5	24.4	28.3
Available Nitrogen (kg/ha)	180	145	172	168	152	167
Available Potassium (kg/ha)	135	158	140	153	148	160
Salinity (ppt.)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01

Table 4.4: Physico-chemical Composition of Soil in the Study Area

Soil fertility status of the area was assessed based upon soil test results. Based upon Soil Fertility Rating given in Table 4.5 Organic matter an important indicator of soil health is in Low range with exception of soil sample collected from an orchard (Site S4) from Panyam village where it is in Medium range (0.53%). The soil fertility rating in terms of nitrogen concentration is in low range varies from 145 kg/ha to 180 kg/ha and the concentration of potassium is in medium range (135 kg/ha to 160 kg/ha), whereas the concentration of phosphorus ranges between 23.5 kg/ha and 30.5 kg/ha with fertility rating in low to medium range.

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

Table 4.5: Soil Fertility Rating as per Soil Fertility Book*

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

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 is Low (1.00), in case of Potassium and Phosphorus is Medium i.e. NI is 2.00 and 1.67, respectively.



SOIL SAMPLING

Lower Reservoir

Upper Reservoir



Panyam Village

Brahmanapalle Village

4.2.4.3 Conclusions

Red 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 is Low (1.00), in case of Potassium and Phosphorus is Medium i.e. NI is 2.00 and 1.67, respectively. Rice, jowar, bajra and ground nut are the major crops in the area.
4.2.5 Air Environment

The air pollutants present in atmosphere, in concentrations that disturbs its dynamic equilibrium and thereby, affect human and his environment. There are three potential air pollutants; sulphur dioxides (SO₂), nitrogen oxides (NO_x) and soot/dust technically known as particulate matter divided into PM₁₀ and PM_{2.5}. To evaluate and quantify the ambient air quality monitoring is carried out during winter, pre-monsoon and monsoon seasons at different locations in the study area (**Figure 4.18**).

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.

The National Ambient Air Quality Standard notified by CPCB is given in **Table 4.6**.

	Concentration in A						
Pollutant	Time Weighted Average	Industrial Residential, Rural & Other Areas	Ecologically Sensitive Area (Notified by Central Govt.)				
Sulphur Diovido (SQ.) ug/m2	Annual	50	20				
Sulphul Dioxide (SO ₂) µg/IIIS	24 hour	80	80				
Nitrogen Oxides (NO _x)	Annual	40	30				
μg/m3	24hour	80	80				
Particulate Matter (size less	Annual	60	60				
than 10μm or PM ₁₀) μg/m3	24 hour	100	100				
Particulate Matter (size less	Annual	40	40				
than 2.5μm or PM _{2.5}) μg/m3	24hour	60	60				

 Table 4.6: National Ambient Air Quality Standard by (CPCB)

4.2.5.1 Ambient Air Quality

The ambient air monitoring was carried out at six different locations in the study area for monitoring of PM_{2.5}, PM₁₀, SO₂ and NO_x. Map showing sampling locations for Air monitoring in the study area is given at **Figure 4.19**. During monitoring of ambient air quality at various location 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. However, the monitoring results shows that the level of pollutants in the study area much lower than the permissible limit as per National Ambient Air Quality Standards for Industrial Residential, Rural & Other Areas and Ecologically Sensitive Areas. Results of ambient air quality monitoring is given in **Table 4.7**.

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 Kalava village (B) with 35.3 µg/m³ during pre-monsoon season and minimum levels at Pinnapuram village (A) with 15.6 µg/m³ during monsoon season. The $PM_{2.5}$ levels at monitoring were below the permissible limits (60 µg/m³) specified for industrial, residential, rural and other areas.

b. PM₁₀ levels

The PM_{10.0} values ranged from minimum $50.2\mu g/m^3$ at Pinnapuram village (A) to $68.4 \mu g/m^3$ at Undulla village (B). The maximum PM₁₀ levels was observed during pre-monsoon season while minimum level of PM₁₀ was observed during monsoon season. The PM_{10.0} level observed at various sampling stations was much lower than the permissible limit of 100 $\mu g/m^3$ for industrial, residential and rural areas.

c. SO₂ levels and NOx levels

The SO₂ and NO_x levels observed during the study was much lower than the permissible limit of 80 μ g/m³ and for industrial, residential and rural areas. The SO₂ values ranged from 6.0 μ g/m³ to 8.4 μ g/m³ at various stations covered as a part of the ambient air quality monitoring study. Similarly, the NO_x values ranged from 5.8 μ g/m³ to 11.2 μ g/m³ at various stations covered as a part of the study.

Site Code	Monitoring location	S	eason*	PM _{2.5}	PM ₁₀	SO ₂	NOx
		\A/	Sample-A	25.6	58.6	7.7	7.8
		vv	Sample-B	28.3	60.4	7.2	8.2
ANT 1	Drohmononollo Villogo		Sample-A	30.4	62.6	7.8	9.3
ANTI	Branmanapane village	PIVI	Sample-B	32.4	68.4	8.4	10.2
		М	Sample-A	20.4	56.6	6.2	8.9
		Sai	Sample-B	23.5	54.4	6.4	9.2
		۱۸/	Sample-A	30.4	64.3	6.3	7.9
		vv	Sample-B	32.5	62.9	6.9	8.2
	Kalava Village	DM	Sample-A	34.5	67.4	7	8.8
ANTZ	Kalava village	PINI	Sample-B	35.3	68.4	7.4	9.4
		5.4	Sample-A	26.8	58.8	6.1	7.8
		141	Sample-B	28.2	56.2	6.2	8.4
	1Brahmanapalle Village2Kalava Village3Somayajulapalle Village4Pinnapuram Village5Undulla Village	۱۸/	Sample-A	24.5	58.9	6	7.9
		vv	Sample-B	27.9	60.4	6.8	8
		PM	Sample-A	26.4	60.8	7	8.4
AINT 5			Sample-B	28.8	62.4	7.4	8.9
		М	Sample-A	18.3	55.3	6.9	7.4
		IVI	Sample-B	20.5	58.6	7.4	7.8
		PM M W PM M PM PM PM PM PM PM	Sample-A	20.3	55.5	6	7
		vv	Sample-B	24.3	58.2	6.9	7.4
	Dinnanuram Villago		Sample-A	27.8	60.6	6.8	7.3
ANT 4		FIVI	Sample-B	30.4	63.4	7	8
		М	Sample-A	15.6	50.2	6.2	6.2
		IVI	Sample-B	16.3	54.3	6.8	5.8
		۱۸/	Sample-A	28.9	64.3	7.5	8.3
	Undulla Villago	VV	Sample-B	30	67.9	7.7	8.6
ANT 5	Undulla Village		Sample-A	30.4	64.8	7.9	10.2
		FIVI	Sample-B	32.4	68.4	7.4	11.2

Table 4.7: Air Quality Monitoring of the Study Area (unit: $\mu g/m^3$)

EIA Report of Pumped Storage Component of Pinnapuram IREP

Site Code	Monitoring location	S	eason*	PM _{2.5}	PM ₁₀	SO ₂	NOx
		54	Sample-A	26.4	60.9	6.6	9.4
		IVI	Sample-B	28	65.3	7.3	10.2
N/ N/	14/	Sample-A	32.9	58.9	6.7	8.2	
		vv	Sample-B	30.2	64.5	7	7.5
			Sample-A	32.4	66.6	7.3	9.9
ANIO	Gorakallu village	PIVI	Sample-B	34.5	68.4	7.5	10.5
			Sample-A	23.3	55.7	6.6	9.2
		M	Sample-B	25.8	62.4	6.5	9.4

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

4.2.5.2 Noise & Traffic Monitoring

i) Noise Levels

Unwanted sound that is loud and unpleasant or unexpected termed as noise pollution. It has adverse impact on the daily activities of the human being and animals. The adverse impact of the noise on human and animals also depends upon time, season and the quality of sound. Noise levels were monitored during the studies at various locations in the Direct Impact Area of the project (**Figure 4.19**). The Ambient noise standards and results of noise level monitoring in terms of equivalent sound levels are given in **Tables 4.8 & 4.9**, respectively.

Monitoring location ANT1 (Brahmanapalle Village near Kurnool Solar Park) and ANT6 (Gorakallu Village near Gorakallu reservoir area) lies under industrial area category, while rest of the monitoring location is in residential area category. Main source of noise pollution in the study area are regular vehicular movement.

The sound levels in the study area was observed well within the prescribed Ambient Noise Standards ranged from 48.9 to 56.7 dB(A) (day time observations).

Area Cada	Cotogomy of Area	Limits in dB(A)Leq			
Area Code	Category of Area	Day time	Night time		
Α.	Industrial Area	75	70		
В.	Commercial Area	65	55		
С.	Residential Area	55	45		
D.	Silence Zone	50	40		

Table 4.8: Ambient Noise Standards

Note:

1 Day time 6 AM to 10 PM

2 Night time is 10 PM to 6 AM

3 Silence zone is an area comprising not less than 100 meters around hospitals, educational institutions, courts, religious places or any other area which is declared as such by the competent authority

Site Code	Monitoring location	Winter	Pre-Monsoon	Monsoon
ANT1	Brahmanapalle Village	54.5	56.4	52.2
ANT2	Kalava Village	51.5	52.5	52.6
ANT 3	Somayajulapalle Village	52.5	54.6	53.4
ANT 4	Pinnapuram Village	48.9	50.5	50.4
ANT 5	Undulla Village	51.6	52.9	50.8
ANT 6	Gorakallu Village	54.3	56.7	55.2

Table 4.9: Equivalent Noise levels in study area during day time [Leq dB(A)]

ii) 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 Somayajulapalle Village along the NH18 (Kurnool-Chittoor highway) and Gorakallu village (near Gorakallu reservoir area). The traffic density recorded at different sites is presented in **Table 4.10**.

Site	Monitoring location	Winter Pre-monsoor			nsoon	Monsoon				
Code	wonitoring location	HV	LV	ΤW	HV	LV	ΤW	HV	LV	TW
ANT1	Brahmanapalle Village	3	8	12	2	7	10	2	6	12
ANT2	Kalava Village	2	8	10	2	7	10	3	6	8
ANT 3	Somayajulapalle Village	7	13	16	6	14	15	6	12	14
ANT 4	Pinnapuram Village	2	7	5	2	8	4	1	6	3
ANT 5	Undulla Village	1	5	3	1	5	2	1	7	4
ANT 6	Gorakallu Village	7	10	12	6	8	12	6	9	10

Table 4.10: Traffic density in the study area

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

4.2.5.3 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. This is mainly due to absence of any industrial establishment and traffic in the study area.

4.2.6 Water Quality

Water quality of both surface and ground water was assessed in the study area. Sampling locations for collection of water are shown in in **Figure 4.19**. The details of methodology for sampling and analysis have been given in Chapter 3 on Methodology.

4.2.6.1 Ground Water Quality

Ground Water samples were collected from hand pumps, dug well and tube wells in the study area. The location of sampling points has been shown in **Figure 4.19**. The results of physico-chemical analysis in different seasons along with BIS Standards for Drinking Water are given at **Tables 4.11 - 4.13**.

S. No.	Parameters	BIS Standards* Permissible Limits	GW1	GW2	GW3	GW4	GW5
1	Temperature (⁰ C)		22.6	23.7	22.9	22	22.4
2	рН	6.5-8.5	7.5	7.6	7.61	7.65	7.34
3	Electrical Conductivity (µS/cm)		890	1010	1080	1121	1222
4	Total Dissolved Solids (mg/l)	2000	542.9	616.1	658.8	683.8	745.4
5	Chloride (as Cl) (mg/l)	1000	78	75	72	76	68
6	Total Alkalinity (mg/l)	600	57	70	75	80	73
7	Total Hardness (as CaCO3) (mg/l)	600	150.44	161.26	157.9	167.33	158.23
8	Calcium (as Ca) (mg/l)	200	30	34	32	32	30
9	Magnesium (as Mg) (mg/l)	100	18.4	18.6	19	21.3	20.3
10	Sulphate (SO ₄) (mg/l)	400	65	61	58	59	55
11	Nitrate (NO₃) (mg/l)	45	15.3	16	17	20	16
12	Phosphate (as PO4) (mg/l)		0.02	0.01	0.01	0.03	0.01
13	Sodium (mg/l)		32	34	40	32	35
14	Potassium (mg/l)		0.23	0.22	0.21	0.12	0.34
15	Silicate (Si) (mg/l)		BDL	BDL	BDL	BDL	BDL
16	Salinity (mg/l)		<0.1	<0.1	<0.1	<0.1	<0.1
17	Phenolic Compounds (mg/l)	0.002	BDL	BDL	BDL	BDL	BDL
18	Oil & Grease (mg/l)	0.5	BDL	BDL	BDL	BDL	BDL
19	Residual Sodium Carbonate (mg/l)		1.2	1.4	1.21	1.2	1.12
20	Iron (Fe) (mg/l)	0.3	BDL	BDL	0.14	0.2	0.17
21	Cadmium (Cd) (mg/l)	0.003	BDL	BDL	BDL	BDL	BDL
22	Arsenic (As) (mg/l)	0.05	BDL	BDL	BDL	BDL	BDL
23	Mercury (Hg) (mg/l)	0.001	BDL	BDL	BDL	BDL	BDL
24	Copper (Cu) (mg/l)	1.5	BDL	BDL	BDL	BDL	BDL
25	Zinc (Zn) (mg/l)	15	BDL	BDL	BDL	BDL	BDL
26	Total Chromium (Cr) (mg/l)	0.05	BDL	BDL	BDL	BDL	BDL
27	Chromium-6 (Cr-6) (mg/l)		BDL	BDL	BDL	BDL	BDL
28	Manganese (Mn) (mg/l)	0.3	BDL	BDL	BDL	BDL	BDL
29	Lead (Pb) (mg/l)	0.01	BDL	BDL	BDL	BDL	BDL

Table 4.11: Physico-Chemical (Characteristics of Grou	und Water During Winter	Season
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*Indian Standard Drinking Water - Specification (Second Revision) Permissible Limits (IS: 10500:2012) GW1-GW5: Sampling sites: BDL: Below Detectable Limits

S. No.	Parameters	BIS Standards* Permissible Limits	GW1	GW2	GW3	GW4	GW5
1	Temperature (^o C)		28	28.6	29	29.3	28.7
2	рН	6.5-8.5	7.65	7.8	7.87	7.66	7.45
3	Electrical Conductivity (µS/cm)		1050	1232	990	1050	986
4	Total Dissolved Solids (mg/l)	2000	640.5	751.5	603.9	640.5	601.5
5	Chloride (as Cl) (mg/l)	1000	66	62	68	65	64
6	Total Alkalinity (mg/l)	600	90	94	66	57	60
7	Total Hardness (as CaCO3) (mg/l)	600	167	155.1	153	129.89	156.84
8	Calcium (as Ca) (mg/l)	200	34	31.7	28.4	26.7	34.2
9	Magnesium (as Mg) (mg/l)	100	20	18.5	20	15.4	17.4
10	Sulphate (SO ₄) (mg/l)	400	58	55	66	50	72
11	Nitrate (NO₃) (mg/l)	45	18	18	18.8	19	16.6
12	Phosphate (as PO4) (mg/l)		0.03	0.01	0.02	0.01	0.02

Table 4.12: Physico-Chemical Characteristics of Ground Water During Pre-Monsoon Season

S. No.	Parameters	BIS Standards* Permissible Limits	GW1	GW2	GW3	GW4	GW5
13	Sodium (mg/l)		29	30	32	28	26
14	Potassium (mg/l)		0.24	0.15	0.18	0.2	0.3
15	Silicate (Si) (mg/l)		BDL	BDL	BDL	BDL	BDL
16	Salinity (mg/l)		<0.1	<0.1	<0.1	<0.1	<0.1
17	Phenolic Compounds (mg/l)	0.002	BDL	BDL	BDL	BDL	BDL
18	Oil & Grease (mg/l)	0.5	BDL	BDL	BDL	BDL	BDL
19	Residual Sodium Carbonate (mg/l)		1.3	1.21	1.22	1.2	1.32
20	Iron (Fe) (mg/l)	0.3	0.23	0.23	BDL	BDL	0.21
21	Cadmium (Cd) (mg/l)	0.003	BDL	BDL	BDL	BDL	BDL
22	Arsenic (As) (mg/l)	0.05	BDL	BDL	BDL	BDL	BDL
23	Mercury (Hg) (mg/l)	0.001	BDL	BDL	BDL	BDL	BDL
24	Copper (Cu) (mg/l)	1.5	BDL	BDL	BDL	BDL	BDL
25	Zinc (Zn) (mg/l)	15	BDL	BDL	BDL	BDL	BDL
26	Total Chromium (Cr) (mg/l)	0.05	BDL	BDL	BDL	BDL	BDL
27	Chromium-6 (Cr-6) (mg/l)		BDL	BDL	BDL	BDL	BDL
28	Manganese (Mn) (mg/l)	0.3	BDL	BDL	BDL	BDL	BDL
29	Lead (Pb) (mg/l)	0.01	BDL	BDL	BDL	BDL	BDL

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

GW1-GW5: Sampling sites: BDL: Below Detectable Limits

Table 4.13: Physico-Chemical Characteristics of Ground Water During Monsoon Season

S. No.	Parameters	BIS Standards* Permissible Limits	GW1	GW2	GW3	GW4	GW5
1	Temperature (^o C)		25.5	26.9	25.4	25.3	25.8
2	рН	6.5-8.5	7.2	7.5	7.4	7.7	7.55
3	Electrical Conductivity (µS/cm)		1210	1100	1223	1334	1010
4	Total Dissolved Solids (mg/l)	2000	738.1	671.0	746.0	813.7	616.1
5	Chloride (as Cl) (mg/l)	1000	120	130	110	98	102
6	Total Alkalinity (mg/l)	600	98	86	80	95	110
7	Total Hardness (as CaCO3) (mg/l)	600	177.7	184.05	189.46	211.32	173.1
8	Calcium (as Ca) (mg/l)	200	35	40	42	43.2	38.9
9	Magnesium (as Mg) (mg/l)	100	22	20.5	20.6	25.2	18.5
10	Sulphate (SO4) (mg/l)	400	45	40	65.4	56.9	48.9
11	Nitrate (NO₃) (mg/l)	45	24	22	21	20	19
12	Phosphate (as PO4) (mg/l)		0.88	0.78	0.54	0.34	0.54
13	Sodium (mg/l)		58	62	41.4	49.5	53.3
14	Potassium (mg/l)		0.1	0.01	0.02	0.12	0.12
15	Silicate (Si) (mg/l)		BDL	BDL	BDL	BDL	BDL
16	Salinity (mg/l)		<0.1	<0.1	<0.1	<0.1	<0.1
17	Phenolic Compounds (mg/l)	0.002	BDL	BDL	BDL	BDL	BDL
18	Oil & Grease (mg/l)	0.5	BDL	BDL	BDL	BDL	BDL
19	Residual Sodium Carbonate (mg/l)		1.4	1.2	1.4	1.2	1.5
20	Iron (Fe) (mg/l)	0.3	0.2	0.2	0.12	0.15	0.12
21	Cadmium (Cd) (mg/l)	0.003	BDL	BDL	BDL	BDL	BDL
22	Arsenic (As) (mg/l)	0.05	BDL	BDL	BDL	BDL	BDL
23	Mercury (Hg) (mg/l)	0.001	BDL	BDL	BDL	BDL	BDL
24	Copper (Cu) (mg/l)	1.5	BDL	BDL	BDL	BDL	BDL
25	Zinc (Zn) (mg/l)	15	BDL	BDL	BDL	BDL	BDL
26	Total Chromium (Cr) (mg/l)	0.05	BDL	BDL	BDL	BDL	BDL

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S. No.	Parameters	BIS Standards* Permissible Limits	GW1	GW2	GW3	GW4	GW5	
27	Chromium-6 (Cr-6) (mg/l)		BDL	BDL	BDL	BDL	BDL	
28	Manganese (Mn) (mg/l)	0.3	BDL	BDL	BDL	BDL	BDL	
29	Lead (Pb) (mg/l)	0.01	BDL	BDL	BDL	BDL	BDL	

*Indian Standard Drinking Water - Specification (Second Revision) Permissible Limits (IS: 10500:2012) GW1-GW5: 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 Hussian (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.

Season	GW1	GW2	GW3	GW4	GW5
Winter	27.52	28.51	29.26	30.25	28.75
Pre-monsoon	28.98	29.64	29.53	28.26	28.07
Monsoon	32.95	32.58	32.19	33.23	30.57

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



GROUND WATER SAMPLING

4.2.6.2 Surface Water

For analysis of surface water quality samples were collected from three sites. Results of water samples taken from Ponds and Gorakallu reservoir in the study area are given in **Table 4.14**.

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 (<u>http://www.cpcb.nic.in/Water Quality Criteria.php</u>) (**Table 4.15**). 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.

S. No.	Test Parameters Units of Measurements	Winter			Pre	e-Monsoo	on	Monsoon		
	<u>.</u>	SW1	SW2	SW3	SW1	SW2	SW3	SW1	SW2	SW3
CHEN	/IICAL PARAMETRES									
1	Temperature (^o C)	22.2	23.2	22	28	28.9	27.3	25.6	26.3	26.4
2	рН	7.8	7.6	7.7	7.6	7.5	7.4	8.1	7.74	7.4
3	Dissolved Oxygen (mg/l)	7.2	7.43	7.7	6.8	6.38	7.5	6.6	7.26	7.5
4	Turbidity (NTU)	4	2.1	2.4	5.4	4	3.8	7.4	3.2	4.2
5	Total Suspended Solids (mg/l)	9.8	6	7	12	11	10	14	8.9	10.2
6	Electrical Conductivity μS/cm	323	320	290	346	441	398	500	623	512
7	Total Dissolved Solids (mg/l)	197.03	195.2	176.9	211.5	269.0	242.8	305.0	380.0	312.3
8	Chloride (as Cl) (mg/l)	98.7	94.4	88.9	95	50.65	65	140	73.4	104.4
9	Alkalinity (mg/l)	55	56	49	53	60	59	50	65	66
10	Total Hardness (mg/l)	149.9	144.2	139.45	150.64	110.91	121.21	147.7	103.73	120.84
11	Calcium (as Ca) (mg/l)	37	38	32	35	36	35.2	35.3	24.6	28
12	Magnesium (as Mg) (mg/l)	14	12	14.5	15.4	5.1	8.1	14.5	10.3	12.4
13	Nitrate (NO₃) (mg/l)	3.2	3.8	3.2	3	3.4	3.2	4.5	3.4	4.3
14	Phosphate (as PO ₄) (mg/l)	0.12	0.23	0.22	1.1	0.32	0.21	0.04	0.08	0.1
15	Sulphate (SO ₄) (mg/l)	18.8	32.2	22.4	22.3	24.3	25.5	14.4	20.5	22.45
16	Sodium (mg/l)	19.9	24.1	22	23.2	22.1	25.4	56	38	46
17	Sodium Adsorption Ratio meq/l	0.71	0.87	0.73	0.94	1.29	1.51	2.0	1.62	1.82
18	Potassium (mg/l)	1.5	1.2	1.5	1.2	1.6	1.6	1.5	1.65	1.2
19	Silicon Dioxide (mg/l)	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
20	Silicate (Si) (mg/l)	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
21	Phenolic Compounds (mg/l)	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
22	Oil & Grease (mg/l)	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
23	Iron (Fe) (mg/l)	0.2	0.1	0.25	0.24	0.29	0.27	0.24	0.12	0.1
24	Cadmium (Cd) (mg/l)	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
25	Arsenic (As) (mg/l)	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
26	Mercury (Hg) (mg/l)	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL

Table 4.14: Surface Water quality in the study area

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S. No.	Test Parameters Units of Measurements	Winter			Pre-Monsoon			Monsoon		
27	Copper (Cu) (mg/l)	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
28	Zinc (Zn) (mg/l)	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
29	Total Chromium (Total Cr) (mg/l)	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
30	Chromium-6 (Cr-6) (mg/l)	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
31	Manganese (Mn) (mg/l)	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
32	Lead (Pb) (mg/l)	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
33	Residual Sodium Carbonate (mg/l)	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
34	Biological Oxygen Demand (mg/l)	2.1	1.5	1.9	1.2	1.8	2.2	3	0.8	1.2
35	Chemical Oxygen Demand (mg/l)	13.4	6.9	8.2	7.5	9.6	10.4	10.5	3.3	6.2
36	Total Coliform MPN/100ml	389	220	212	387	232	233	358	110	170

Table 4.15: Water Quality Criteria for designated Best Use by CPCB, New Delhi

Designated-Best-Use	Class of water	Criteria
		Total Coliforms Organism MPN/100ml shall be 50 or less
Drinking Water Source without	۸	pH between 6.5 and 8.5
disinfection	A	Dissolved Oxygen 6mg/l or more
		Biochemical Oxygen Demand 5 days 20°C 2mg/l or less
Outdoor bathing (Organised)	В	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°C 3mg/l or less
Drinking water source after conventional treatment and	С	Total Coliforms Organism MPN/100ml shall be 5000 or less, pH between 6 and 9, Dissolved Oxygen 4mg/l or more
disinfection		Biochemical Oxygen Demand 5 days 20°C 3mg/l or less
Propagation of Wild life and	D	pH between 6.5 to 8.5, Dissolved Oxygen 4mg/l or more
Fisheries	D	Free Ammonia (as N) 1.2 mg/l or less
Irrigation, Industrial Cooling,		pH between 6.0 and 8.5
Controlled Waste disposal	с	Electrical Conductivity at 25°C micromhos/cm Max.2250
	E	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 290 μ S/cm and 623 μ S/cm while SAR varied from 0.71 to 2.00 (**Table 4.14**). 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 4.16**).

Table 4.16: 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) 1970 al. in by Brown et (www.waterresearch.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.

рН	Delta Temperature Change ⁰ C	Total Phosphates mg/L
Dissolved Oxygen	Total Coliforms	Nitrates
(DO) Saturation (%)	MPN/100ml	mg/l
Turbidity	Biochemical Oxygen Demand	Total Suspended Solids
NTU	(BOD) mg/l	(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	Winter			Р	Pre-Monsoon			Monsoon		
Site	SW1	SW2	SW3	SW1	SW2	SW3	SW1	SW2	SW3	
WQI	75.46	77.35	77.24	73.52	75.39	77.58	74.46	80.92	79.68	

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

4.2.6.3 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 category throughout the study area.

SURFACE WATER SAMPLING



Water Sampling Lower reservoir area



Surface Water Sampling Pinnapuram Village



Surface Water Sampling Gorakallu Reservoir

4.3 BIOLOGICAL ENVIRONMENT

4.3.1 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, Andhra Pradesh 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 Sentinel-2 Multi Spectral Instrument (MSI) data of European Space Agency (ESA) 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 4.18 & 4.19**. Nearly half of the area (48.97%) of the study area is comprised of agricultural fields and settlements. Forests constitute 12.47% of the area (**Table 4.17**).

S. No.	Land Use/ Land Cover	Area (Sq. km)	Area (%)
1	Forest	8425.54	12.47
2	Scrub	12646.73	18.71
3	Agriculture/ Fallow Land	33098.03	48.97
4	Settlement	356.77	0.53
5	Mining	514.05	0.76
6	Barren Rocky	9679.47	14.32
7	Waterbody	2867.65	4.24
	Total	67588.25	

 Table 4.17: Area under different Land use/ Land cover in the study area

4.3.2 Forest Types

The project area falls in Kurnool Forest Division of Kurnool Circle under Andhra Pradesh Forest Department. The forests occurring in the study area of Standalone pumped storage component of Pinnapuram IRE Project are classified as per classification given by Champion and Seth (1968). Forest types of study area are under Group 6 - Tropical Thorn Forest type and belong to Subgroup 6A/C1, 6A/DS1 and 6A/DS2.



Figure 4.20: False Color Composite of the Project Study Area



Figure 4.21: Land Use/ Land Cover Map of the Project Study Area



Lower Reservoir Area



Upper Reservoir



Pinnapuram village



Pinnapuram village



Brahmanapalle Village



Brahmanapalle Village



Gorakallu Village



Gorakallu Village

4.3.3 Floristics

4.3.3.1 Objectives

The main objectives of the floristic studies are as follows:

- To prepare inventory of plants belonging to different plant groups
- To assess the vegetation community structure in the study area
- To identify the dominant plant species occurring in the study area by calculating Importance Value Index
- To assess the Diversity of different tree, shrubs and herbaceous species by calculating the Shannon Wiener Diversity

The study area comprised of and area within 10 km radius of proposed reservoir area and power house site as per the TOR approved by MoEF&CC, GOI. As already described in the Methodology Chapter quadrat sampling was undertaken at 7 different locations for carrying out phytosociological surveys of the vegetation and in addition an inventory of various floristic elements was also prepared by walking different transects around these sampling sites.

In order to understand the composition of the vegetation, most of the plant species could be identified in the field itself whereas in case of the species that could not be identified a herbarium specimen of some flowers were collected without uprooting the plant itself and in addition their photographs were also taken for identification later with the help of available published literature and floras of the region.

4.3.3.2 Taxonomic Diversity

During the field surveys an inventory of 133 species of plants belonging to different plant groups was compiled. This list includes 50 species of trees, 28 species of shrubs and 55 herbaceous species. 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. wherever little moisture is available. Trees are found mainly as plantations in the forest area. Dominant families in the area are Fabaceae, Malvaceae and Asteraceae followed by Sterculiaceae, Rubiaceae and Verbenaceae. Distribution of plant species within families are summarized in **Table 4.18**. List of plant species recorded from the area is given in **Annexure-IV**.

S. No.	Vegetation Type	No. of Families	No. of Species
1	Trees	29	50
2	Shrubs	16	28
3	Herbs	26	55

 Table 4.18: Family wise details of plant species

Source: field survey RSET

4.3.3.3 Community Structure

Community structure of the vegetation was assessed by quadrat sampling method described in Chapter 3 on Methodology to evaluate various quantitive parameters at different sampling sites during three seasons and location of the sites is given at **Figure 4.19**.



Figure 4.22: Map Showing sampling location of terrestrial ecology and Water Sampling in the study area

Greenko Energies Pvt. Ltd.EIA Report Standalone Pumped Storage Component of Pinnapuram IREPThe 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. Pteridophytes are
very scarce. These are mainly species like Adiantum capillus-veneris, Adiantum caudatum,
Pteris biaurita and Dryopteris cocheiata. Among byryophytes 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: Near Brahmanapalle Village

The sampling site is V1 is located in the vicinity of Kurnool Solar Park near Brahmanapalle village. This area is characterized by scrub land with few agriculture farms and fallow land. Tree cover comprised of *Cassia fistula, Azadirachta indica* and *Acaica nilotica* as plantations occur along the road and near habitations. *Azadirachta indica, Bauhinia racemosa* and *Acacia nilotica* are the dominant tree species recorded from the area (**see Table 4.19**).

Shrub layer is dominated by weed species like *Lantana camara* followed by *Justicia* adathoda and *Dodonaea viscosa* (**Table 4.20**). Capparis divaricata, Morinda pubescens, Leonotis nepetifolia, Nerium indicum and Grewia flavescens are the other shrub species recorded from the sampling site.

Herbaceous flora in sampling site V1 is comprised of 12 species. At this site 8 species of herbs were found during winter, 10 in summer and 9 species in monsoon season sampling (**Table 4.21**). Ageratum conyzoides, Boerhavia diffusa, Cocculus hirsutus, Cocculus hirsutus, Datura metel, Echinops echinatus, Oxalis latifolia, Physalis minima, Sida cordifolia, Tagetes erecta, Tiliacora acuminata, Xanthium indicum are the common herbs of this area.

S. No.	Name of Species	Frequency (%)	Density (Indiv./ha)	Basal Area (sq m/ha)
1	Acacia nilotica	30	30	1.41
2	Bauhinia racemosa	30	40	0.43
3	Bombax ceiba	20	20	1.14
4	Cassia fistula	10	20	0.60
5	Azadirachta indica	20	30	2.96
	Total	-	140	-

Table 4.19: Community structure –Site: V1 (Trees)

Table 4.20:	Community	structure –Site:	V1	(Shrubs)
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S. No.	Name of Species	Frequency (%)	Density (Indiv./ha)
1	Capparis divaricata	40	360
2	Dodonaea viscosa	30	440
3	Grewia flavescens	30	240
4	Justicia adhatoda	50	440
5	Lantana camara	50	560
6	Leonotis nepetifolia	30	280
7	Morinda pubescens	30	280
8	Nerium indicum	20	240

S. No.	Name of Species	Frequency (%)	Density (Indiv./ha)				
	Winter						
1	Ageratum conyzoides	40	1600				
2	Boerhavia diffusa	30	1700				
3	Cocculus hirsutus	40	2700				
4	Datura metel	30	1800				
5	Echinops echinatus	50	2500				
6	Sida cordifolia	40	2400				
7	Tagetes erecta	50	3100				
8	Xanthium indicum	30	1000				
	Pre-M	onsoon					
1	Ageratum conyzoides	50	2700				
2	Boerhavia diffusa	20	1300				
3	Cocculus hirsutus	50	2800				
4	Corchorus trilocularis	20	800				
5	Datura metel	10	200				
6	Oxalis latifolia	40	2000				
7	Echinops echinatus	40	2300				
8	Physalis minima	40	3000				
9	Tagetes erecta	30	1500				
10	Tiliacora acuminata	50	4800				
Post-Mo	onsoon						
1	Ageratum conyzoides	50	3800				
2	Boerhavia diffusa	40	3100				
3	Cocculus hirsutus	30	3200				
4	Corchorus trilocularis	30	2100				
5	Datura metel	40	2400				
6	Oxalis latifolia	50	3200				
7	Physalis minima	30	1800				
8	Sida cordifolia	40	2700				
9	Tiliacora acuminata	40	3800				

Table 4.21: Community structure –Site: V1 (Herbs)

V2: Proposed Lower Reservoir Area

Sampling site V2 is located in the proposed lower reservoir area. The area is characterized by hillocks with open forest. *Holoptelia integrifolia* is the dominant tree species associated with *Acacia leucophloea, Azadirachta indica* and *Bauhinia racemosa* (**Table 4.22**). *Ziziphus mauritiana, Terminalia catappa* and *Gmelina arborea* are the other tree species recoded the sampling site.

In shrub layer 10 species were recorded from this location during sampling (**Table 4.23**). Shrub layer is represented mainly by *Lantana camara*, *Calotropis gigantea*, *Dodonaea viscosa*, *Corchorus olitorius*, *Ziziphus xylopyrus* and *Leonotis nepetifolia* was found along the approach road in the forest area. Other common shrubs found in the proposed lower reservoir area are *Grewia flavescens*, *Justicia adhatoda*, *Vitex negundo* and *Gmelina asiatica*.

The herbaceous layer is comprised of 14 species in this area. Maximum density of herb species was recorded during monsoon season. *Eclipta prostrata, Parthenium integrifolium* and *Sida acuta* are the most dominating species during post-monsoon sampling. *Ageratum conyzoides, Sida acuta, Tagetes erecta* and *Parthenium integrifolium* were the most dominant during pre-monsoon sampling while during winter were most common species

are Achyranthes aspera, Combretum albidum, Sida acuta and Datura metel (**Table 4.24**). Other most common species were Argemone mexicana, Boerhavia diffusa, Combretum albidum, Echinops echinatus, Hybanthus enneaspermus, Waltheria indica, and Xanthium indicum.

S. No.	Name of Species	Frequency (%)	Density (Indiv./ha)	Basal Area (sq m/ha)
1	Acacia leucophloea	50	60	0.73
2	Azadirachta indica	30	40	1.09
3	Bauhinia racemosa	30	30	0.54
4	Gmelina arborea	20	20	0.40
5	Holoptelia integrifolia	20	30	0.97
6	Terminalia catappa	20	20	0.87
7	Ziziphus mauritiana	30	30	0.60
	Total		230	

Table 4.22: Community structure –Site: V2 (Trees)

Table 4.23: Community structure –Site: V2 (Shrubs)

S. No.	Name of Species	Frequency (%)	Density (Indiv./ha)
1	Calotropis gigantea	30	400
2	Corchorus olitorius	30	320
3	Dodonaea viscosa	40	360
4	Gmelina asiatica	20	200
5	Grewia flavescens	30	280
6	Justicia adhatoda	30	240
7	Lantana camara	40	440
8	Leonotis nepetifolia	40	280
9	Vitex negundo	30	200
10	Ziziphus xylopyrus	30	240

Table 4.24: Community structure –Site: V2 (Herbs)

S. No.	Name of Species	Frequency (%)	Density (Indiv./ha)			
Winter						
1	Achyranthes aspera	50	4700			
2	Argemone mexicana	20	1700			
3	Combretum albidum	40	4300			
4	Datura metel	40	4000			
5	Eclipta prostrata	40	2000			
6	Parthenium integrifolium	40	3400			
7	Sida acuta	40	4100			
8	Xanthium indicum	30	1300			
Pre-Mo	onsoon					
1	Ageratum conyzoides	50	6800			
2	Argemone mexicana	10	500			
3	Boerhavia diffusa	40	3600			
4	Combretum albidum	10	1400			
5	Echinops echinatus	50	5000			
6	Hybanthus enneaspermus	30	1700			

S. No.	Name of Species	Frequency (%)	Density (Indiv./ha)
7	Parthenium integrifolium	50	5100
8	Sida acuta	40	5500
9	Tagetes erecta	50	5400
10	Waltheria indica	30	1400
11	Xanthium indicum	30	2800
Post-N	lonsoon		
1	Achyranthes aspera	40	5400
2	Combretum albidum	40	5200
3	Echinops echinatus	40	5500
4	Eclipta prostrata	50	7000
5	Parthenium integrifolium	30	6600
6	Sida acuta	50	6200
7	Tagetes erecta	30	3800
8	Xanthium indicum	60	3200

V3: Near Kalava Village

The sampling location is located between Kalava and Hussainapuram village. The area is characterized by agricultural as pre-dominant land use associated with scrub and barren land.

During the field surveys 8 species of trees were recorded at this site. Azadirachta indica, Ziziphus mauritiana and Dalbergia paniculata is the most dominant tree of this area (**Table 4.25**). Azadirachta indica and Dalbergia paniculata are the species commonly recorded near agricultural farms and settlements, while Ziziphus mauritiana and Acacia leucophloea are reported from scrub land. Other important constituents of tree layer are: Bauhinia racemosa, Holoptelia integrifolia, Gardenia gummifera and Sterculia urens.

Shrub layer is comprised of 9 species. *Justicia adhatoda, Lantana camara* and *Abutilon indicum* are the dominant shrub species in the area. *Calotropis gigantea, Morinda pubescens, Grewia flavescens, Helicteres isora, Tecoma stans* and *Leonotis nepetifolia* are other shrub species distributed in the site (**Table 4.26**).

Herbaceous flora at this location is comprised of 13 species. During winter sampling 7 species were recorded, 13 species during summer season and 10 during monsoon season (**Table 4.27**). Herbaceous layer was dominated by species like *Anisomeles indica*, *Argemone mexicana*, *Sida acuta* and *Xanthium indicum*. Other commonly found species in the area are *Boerhavia diffusa*, *Cocculus hirsutus*, *Echinops echinatus*, *Datura metel*, *Polycarpaea corymbosa* and *Tagetes erecta*.

S. No.	Name of Species	Frequency (%)	Density (Indiv./ha)	Basal Area (sq m/ha)
1	Acacia leucophloea	30	30	0.27
2	Azadirachta indica	30	40	1.04
3	Bauhinia racemosa	30	30	0.65
4	Holoptelia integrifolia	20	30	1.20
5	Ziziphus mauritiana	20	40	0.48
6	Dalbergia paniculata	30	40	0.96

Table 4.25: Community structure –Site: V3 (Trees)

S. No.	Name of Species	Frequency (%)	Density (Indiv./ha)	Basal Area (sq m/ha)
7	Gardenia gummifera	10	10	0.81
8	Sterculia urens	20	20	0.63
	Total		240	

Table 4.26: Community structure –Site: V3 (Shrubs)

S. No.	Name of Species	, Frequency (%)	Density (Indiv./ha)
1	Abutilon indicum	50	360
2	Calotropis gigantea	50	160
3	Grewia flavescens	50	200
4	Helicteres isora	60	200
5	Justicia adhatoda	60	400
6	Lantana camara	70	360
7	Leonotis nepetifolia	50	320
8	Morinda pubescens	60	160
9	Tecoma stans	70	240

Table 4.27: Community structure –Site: V3 (Herbs)

S. No.	Name of Species	Frequency (%)	Density (Indiv./ha)			
Winter						
1	Anisomeles indica	50	6300			
2	Argemone mexicana	40	3900			
3	Datura metel	20	3600			
4	Echinops echinatus	40	2700			
5	Parthenium integrifolium	40	4600			
6	Sida acuta	60	4400			
7	Xanthium indicum	40	3300			
Pre-Mo	onsoon					
1	Anisomeles indica	50	3900			
2	Argemone mexicana	50	4400			
3	Biophytum sensitivum	50	2800			
4	Boerhavia diffusa	50	3000			
5	Cocculus hirsutus	50	4300			
6	Datura metel	50	1900			
7	Echinops echinatus	50	4100			
8	Hedyotis puberula	50	1500			
9	Parthenium integrifolium	50	6700			
10	Polycarpaea corymbosa	50	3700			
11	Sida acuta	50	2000			
12	Tagetes erecta	50	2500			
13	Xanthium indicum	50	700			
Post-M	onsoon					
1	Anisomeles indica	50	4600			
2	Argemone mexicana	40	3900			
3	Boerhavia diffusa	40	4200			
4	Cocculus hirsutus	50	4100			
5	Datura metel	20	1900			
6	Echinops echinatus	40	5700			
7	Parthenium integrifolium	40	3900			
8	Sida acuta	60	7000			
9	Tagetes erecta	50	5300			
10	Xanthium indicum	40	6700			

V4: Near Somayajulapalle Village

Sampling site V4 site is located near Somayajulapalle village. The area is characterized by open canopy forest dominated by *Dalbergia paniculata* and *Holoptelia integrifolia*

<u>Greenko Energies Pvt. Ltd.</u> <u>EIA Report Standalone Pumped Storage Component of Pinnapuram IREP</u> associated with *Corymbia citriodora, Semecarpus anacardium* and *Mangifera indica* tree species. (Table 4.28).

Shrub layer is represented by 9 species (**Table 4.29**). On open places *Dodonaea viscosa* and *Jatropha curcas* are common. *Grewia flavescens and Ziziphus xylopyrus* was found dominant in scrub land. *Lantana camara and Corchorus olitorius* are the species distributed along the bunds of agricultural farms and edges of village road.

Herb layer was represented by 13 species. Maximum density of herbaceous species was recorded during Post-Monsoon season. During winter 7 species, 9 species in Pre-Monsoon and 8 species of herbs during Post-Monsoon were recorded (**Table 4.30**).

Herb were mostly recorded from the bunds of agricultural farms and barren land. The herbaceous layer mainly consists of Ageratum conyzoides, Argemone mexicana, Boerhavia diffusa, Echinops echinatus, Sida acuta, Tagetes erecta, Cocculus hirsutus and Sonchus oleraceus.

S. No.	Name of Species	Frequency (%)	Density (Indiv./ha)	Basal Area (sq m/ha)
1	Corymbia citriodora	10	10	0.77
2	Dalbergia paniculata	30	40	1.38
3	Holoptelia integrifolia	30	40	1.73
4	Mangifera indica	20	20	1.17
5	Semecarpus anacardium	30	30	0.81
	Total		140	

Table 4.28: Community structure –Site: V4 (Trees)

S. No.	Name of Species	Frequency (%)	Density (Indiv./ha)
1	Corchorus olitorius	70	280
2	Dodonaea viscosa	40	320
3	Grewia flavescens	50	320
4	Jatropha curcas	50	200
5	Justicia adhatoda	60	200
6	Lantana camara	40	280
7	Tecoma stans	60	200
8	Urena lobata	50	240
9	Ziziphus xylopyrus	50	240

Table 4.30: Community	structure –Site:	V4 (Herbs)
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S. No.	Name of Species	Frequency (%)	Density (Indiv./ha)	
Winter				
1	Ageratum conyzoides	50	3000	
2	Anisomeles indica	40	2000	
3	Argemone mexicana	60	3700	
4	Boerhavia diffusa	40	4000	
5	Echinops echinatus	30	3800	
6	Eclipta prostrata	50	2300	
7	Sida acuta	60	2800	
Pre-Mon	Pre-Monsoon			
1	Ageratum conyzoides	40	2800	
2	Argemone mexicana	60	4200	
3	Boerhavia diffusa	50	3200	

S. No.	Name of Species	Frequency (%)	Density (Indiv./ha)
4	Cocculus hirsutus	60	4700
5	Crotalaria medicaginea	40	2700
6	Lepidagathis cristata	40	2500
7	Rhynchosia minima	60	3000
8	Sonchus oleraceus	40	2800
9	Tagetes erecta	40	5100
Post-Mo	onsoon		
1	Ageratum conyzoides	40	2400
2	Anisomeles indica	40	2400
3	Argemone mexicana	60	4000
4	Boerhavia diffusa	40	4200
5	Cocculus hirsutus	50	4100
6	Eclipta prostrata	50	7000
7	Sida acuta	60	7000
8	Tagetes erecta	50	3800

V5: Pinnapuram village near proposed Upper Reservoir area

The sampling site V5 is located in Pinnapuram Village near proposed upper reservoir area. This area is characterized by scrub land with open rocky surface with thorny vegetation. Tree layer dominated by *Ziziphus mauritiana* and *Cassia fistula* (**Table 4.31**). Acacia nilotica, Prosopis juliflora and Toddalia asiatica are associated tree species.

The shrub layer is dominated by the *Aerva javanica, Lantana camara* and *Corchorus olitorius* which recorded near agricultural farms and along the road. *Ziziphus xylopyrus* and *Tecoma stans* are the species dominating the scrub and fallow/barren land. *Dodonaea viscosa, Calotropis gigantea* and *Capparis divaricata* are the other dominant shrubs (**Table 4.32**).

The herb layer was represented by 8 species in winter sampling, 12 species in premonsoon sampling and 10 species during post-monsoon (**Table 4.33**). The herbaceous species dominant in the area are *Argemone mexicana*, *Ampelocissus latifolia*, *Alysicarpus longifolius*, *Cocculus hirsutus*, *Tephrosia purpurea* and *Lepidagathis cristata*. *Eclipta prostrata*, *Lepidagathis cristata*, *Polycarpaea corymbosa*, *Polycarpaea corymbosa*, *Rhynchosia minima* and *Sida acuta* are the other common herb species recorded from this area.

S. No.	Name of Species	Frequency (%)	Density (Indiv./ha)	Basal Area (sq m/ha)	
1	Acacia nilotica	30	30	0.58	
2	Cassia fistula	30	40	1.73	
3	Prosopis juliflora	20	30	1.38	
4	Toddalia asiatica	40	40	1.41	
5	Ziziphus mauritiana	20	40	0.09	
	Total		180		

Table 4.31: Community structure –Site: V5 (Trees)

Table 4.32: Communit	y structure –Site: V5	(Shrubs)
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S. No.	Name of Species	Frequency (%)	Density (Indiv./ha)
1	Aerva javanica	50	400
2	Calotropis gigantea	40	320
3	Corchorus olitorius	40	360
4	Dodonaea viscosa	40	280

S. No.	Name of Species	Frequency (%)	Density (Indiv./ha)
5	Lantana camara	30	240
6	Tecoma stans	40	320
7	Ziziphus xylopyrus	30	240

S. No.	Name of Species	Frequency (%)	Density (Indiv./ha)
	Winter		
1	Alysicarpus longifolius	30	1400
2	Argemone mexicana	40	2100
3	Cocculus hirsutus	50	2800
4	Polycarpaea corymbosa	30	1500
5	Rhynchosia minima	50	1900
6	Sida acuta	50	2300
7	Tephrosia purpurea	50	3100
8	Tribulus terrestris	40	2000
Pre-Mo	nsoon		
1	Alysicarpus longifolius	50	5500
2	Ampelocissus latifolia	20	2600
3	Argemone mexicana	10	600
4	Cocculus hirsutus	40	4700
5	Eclipta prostrata	10	1300
6	Lepidagathis cristata	30	4500
7	Polycarpaea corymbosa	20	2800
8	Rhynchosia minima	20	800
9	Tephrosia purpurea	40	4600
10	Tribulus terrestris	20	2100
11	Vernonia cinerea	10	500
12	Xanthium indicum	30	1600
Post-M	onsoon		
1	Alysicarpus longifolius	40	3900
2	Ampelocissus latifolia	60	7000
3	Argemone mexicana	50	5300
4	Cocculus hirsutus	60	4000
5	Polycarpaea corymbosa	40	2400
6	Rhynchosia minima	40	5700
7	Sida acuta	40	2400
8	Tephrosia purpurea	60	3800
9	Tiliacora acuminata	60	3200
10	Tribulus terrestris	30	1800

Table 4.33: Community structure –Site: V5 (Herbs)

V6: Near Undulla Village

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

Tree canopy is represented by 6 species dominated by Ziziphus mauritiana (**Table 4.34**). The frequency of occurrence of Ziziphus mauritiana, Prosopis juliflora, Cassia fistula and Acacia nilotica was highest amongst all species. Other species recorded from the area are Holoptelea integrifolia and Bauhinia racemosa.

Shrub layer near Undulla village is comprised of species like *Calotropis gigantea, Ziziphus xylopyrus, Lantana camara, Urena lobata* and *Grewia flavescens. Ziziphus xylopyrus, Capparis divaricata* and *Lantana camara* were found dominant in fallow and scrub land. *Calotropis gigantea* and *Grewia flavescens* are the species found in the moist places (**Table 4.35**).

Herbaceous flora near Kanga village is comprised of 12 species (**Table 4.36**). At this site 7 species of herbs were found during winter, 8 in pre-monsoon and 6 species in post-monsoon season sampling (**Table 4.36**). Argemone mexicana, Cissus quadrangularis, Eclipta prostrata and Tiliacora acuminate are the most dominant species in the area. Other common herb species recorded from are the area are Ammannia baccifera, Grewia hirsuta, Pavonia zeylanica, Polycarpaea corymbosa, Sida acuta, Tephrosia purpurea and Waltheria indica.

S. No.	Name of Species	Frequency (%)	Density (Indiv./ha)	Basal Area (sq m/ha)
1	Acacia nilotica	30	40	0.73
2	Bauhinia racemosa	30	40	0.38
3	Cassia fistula	30	40	0.29
4	Holoptelia integrifolia	20	30	0.97
5	Prosopis juliflora	40	40	0.64
6	Ziziphus mauritiana	40	50	0.04
	Total		240	

Table 4.34: Community structure –Site: V6 (Trees)

Table 4.35: Community structure –Site: V6 (Shrubs)

S. No.	Name of Species	Frequency (%)	Density (Indiv./ha)
1	Calotropis gigantea	60	680
2	Capparis divaricata	70	360
3	Corchorus olitorius	50	240
4	Grewia flavescens	50	360
5	Lantana camara	60	520
6	Urena lobata	60	560
7	Ziziphus xylopyrus	80	520

Table 4.36: Communit	y structure –Site: V6 (Herbs
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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 acuminata	40	2300
7	Waltheria indica	40	2200
Pre-Mo	onsoon		
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-M	lonsoon		
1	Argemone mexicana	60	6700
2	Eclipta prostrata	50	6600
3	Polycarpaea corymbosa	40	2400
4	Sida acuta	40	2400
5	Tiliacora acuminata	60	4500
6	Waltheria indica	40	3800

V7: Near Gorakallu Reservoir

Sampling site V5 is located near the Gorakallu village along the Gorakallu reservoir area. This area is characterized by scrub land dominated by shrub species. Trees were sparsely distributed, represent by species like *Acacia leucophloea, Corymbia citriodora, Cassia fistula* and *Azadirachta indica* (**Table 4.37**).

The shrub layer is comprised of 6 species mainly represented by *Lantana camara*, *Jatropha curcas* and *Justicia adhatoda*, and at open places *Ziziphus xylopyrus* is frequently found species. *Ipomoea carnea* and *Calotropis gigantea* are the other common shrubs found at the moist places (**Table 4.38**).

The number of herbaceous species found during winter and pre-monsoon surveys were 7 and 8, respectively while 7 herb species were recorded during post-monsoon season (**Table 4.39**). Dominating herb species in this area are *Parthenium integrifolium, Argemone mexicana, Corchorus trilocularis, Xanthium indicum* and *Pouzolzia zeylanica. Ageratum conyzoides, Anisomeles indica,* are other herbs recorded near the Gorukallu reservoir. *Sida acuta, Oxalis latifolia* and *Physalis minima* are the species observed near agricultural fields.

S. No.	Name of Species	Frequency (%)	Density (Indiv./ha)	Basal Area (sq m/ha)
1	Acacia leucophloea	20	20	0.63
2	Azadirachta indica	10	20	1.78
3	Cassia fistula	40	40	0.48
4	Corymbia citriodora	30	40	1.43
	Total		120	

Table 4.37: Community structure –Site: V7 (Trees)

S. No.	Name of Species	Frequency (%)	Density (Indiv./ha)
1	Calotropis gigantea	40	400
2	Ipomoea carnea	30	200
3	Jatropha curcas	40	280
4	Justicia adhatoda	50	440
5	Lantana camara	20	200
6	Ziziphus xylopyrus	30	280

Table 4.38: Community structure –Site: V7 (Shrubs)

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S. No.	Name of Species	Frequency (%)	Density (Indiv./ha)
	Winter		
1	Ageratum conyzoides	20	1000
2	Argemone mexicana	50	2500
3	Corchorus trilocularis	40	1700
4	Parthenium integrifolium	40	2100
5	Physalis minima	40	1800
6	Pouzolzia zeylanica	50	2600
7	Xanthium indicum	30	1600
Pre-Mo	onsoon		
1	Ageratum conyzoides	40	2600
2	Anisomeles indica	30	1900
3	Argemone mexicana	70	5000
4	Corchorus trilocularis	40	2700
5	Oxalis latifolia	40	2300

6	Parthenium integrifolium	40	3100
7	Tiliacora acuminata	20	1200
8	Xanthium indicum	40	4000
Post-N	lonsoon		
1	Ageratum conyzoides	40	2400
2	Anisomeles indica	40	2400
3	Argemone mexicana	60	4000
4	Corchorus trilocularis	60	4200
5	Parthenium integrifolium	60	4700
6	Sida acuta	40	3700
7	Xanthium indicum	50	4000

4.3.3.4 Density, Dominance & Diversity

<u>i) Density</u>

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 120 number of trees/ha to maximum of 240 trees/ha (**Table 4.40**). Highest tree density was recorded at sampling site V3 located near proposed lower reservoir area, followed by sampling site V4; located near Somayajulapalle village and lowest was at sampling site V7 located near Gorakallu reservoir area.

The shrub layer was quite prominent at all sampling sites and the density of shrub layer varied from 1800 plants/ha to 3520 plants/ha, lowest density was found at sites located near Undulla village and highest at sampling site located near Gorakallu village (**Table 4.40**).

The density of herbaceous plant species varied from season to season amongst all sampling sites (**Table 4.40**). In winter season herb density is highest at sampling site located near Gorakallu Village (28800 plants/ha) and lowest at Sampling site located near Gorakallu Reservoir (13300 plants/ha). In Pre-Monsoon season, highest density was recorded from sampling site V1 (41500 plants/ha) located near Kalava village and lowest herb density (21400 plants/ha) was found near Brahmanapalle Village. In monsoon season maximum herb density was observed from sampling site located near Kalava village (47300 plants/ha). Lowest herb density during monsoon was recorded from the sampling site located near Gorakallu reservoir (25400 plants/ha).

Sampling	Trace	Chruha	Herbs		
Site	Trees	Surus	Winter	Summer	Monsoon
V1	140	2840	16800	21400	26100
V2	230	2960	25500	35600	42900
V3	240	2400	28800	41500	47300
V4	140	2280	21600	31000	38100
V5	180	2160	17100	31600	39500
V6	240	3240	15100	26600	26400
V7	120	1800	13300	22800	25400

Table 4.40: Density (plants per ha) of Trees, Shrubs and Herbs

ii) Dominance (IVI)

Based upon the Importance Value Index (IVI) the trees in the project area given in table below species like *Azadirachta indica, Bauhinia racemosa, Holoptelia integrifolia,* and *Ziziphus mauritiana* are most dominant trees in the project area. *Azadirachta indica* is generally found in association with *Bauhinia racemosa*.

S. No.	Name of Species	V1	V2	V3	V4	V5	V6	V7
1	Acacia leucophloea	-	65	33	-	-	-	51
2	Acacia nilotica	70		-	-	49	56	
3	Azadirachta indica	85	53	50	-	-	-	68
4	Bauhinia racemosa	62	38	39	-	-	45	-
5	Bombax ceiba	50	-	-	-	-	-	-
6	Cassia fistula	33	-	-		77	42	84
7	Corymbia citriodora	-	-	-	29	-	-	96
8	Dalbergia paniculata	-	-	48	77		-	-
9	Gardenia gummifera	-	-	23	-	-	-	-
10	Gmelina arborea	-	26	-	-	-	-	-
11	Holoptelia integrifolia	-	42	43	83	-	55	-
12	Mangifera indica	-	-	-	-	51	-	-
13	Prosopis juliflora	-	-	-	-	58	59	-
14	Semecarpus anacardium	-	-	-	60	-	-	-
15	Sterculia urens	-	-	29	-	-	-	-
16	Terminalia catappa	-	35		-	-	-	-
17	Toddalia asiatica	-	-	-	-	78	-	-
18	Ziziphus mauritiana	-	39	35	-	38	43	-

Table 4.41: Dominance of Tree Species

<u>iii)</u> <u>Diversity</u>

To understand the species diversity Shannon Weiner Diversity was calculated separately for trees, shrubs and herbs. Amongst the trees the diversity Index ranged from low of 1.33 at sampling site V7 (near Gorakallu village) to highest of 2.03 at sampling site V3 (near Kalava village) (**Table 4.42**).

Amongst shrubs the highest diversity was recorded at sampling site V2 (near proposed lower reservoir area) i.e. 2.27 and lowest at sampling site V7 located near Gorakallu village (1.75) (**Table 4.42**).

The species diversity in herbs was observed higher during pre-monsoon period and varied from 2.00 (site V2) to 2.75 (site V6) at different sampling location. During winter diversity index varied from low of 1.91 at Site-V7 to 2.05 at Site-V5. During monsoon highest diversity value 2.25 was recorded from site V3 and lowest 1.92 was recorded from site V7 (**Table 4.42**).

Sampling	Troop	Shruhe	Herbs		
Site	nees	Sillups	Winter	Summer	Monsoon
V1	1.57	2.03	2.03	2.12	2.17
V2	1.88	2.27	2.00	2.34	2.05
V3	2.02	2.14	1.91	2.45	2.25
V4	1.51	2.18	1.92	2.54	2.13
V5	1.60	1.93	2.05	2.26	2.23
V6	1.78	1.90	1.94	2.75	2.01
V7	1.33	1.75	1.91	2.00	1.92

Table 4.42: Shannon Weiner Diversity Index (H)

4.3.3.5 RET Species

The conservation status (Rare, Endangered and Threatened) of all 133 species of plants recorded from the study area was assessed. Their conservation status following IUCN Red list of Threatened Species Version 2018.1 downloaded from <u>www.iucnredlist.org</u> on 04 September 2018 is listed in table below. *Borassus flabellifer* is listed under Near Threatened (NT) category, *Chloroxylon swietenia* and *Jacaranda mimosifolia* in Vulnerable (VU) category, *Gardenia gummifera* and *Wrightia tinctoria* are under Low risk/least concern (LR/lc) category. 11 species reported from the area are under Least Concern (LC) category.

S. No.	Family	Scientific name	Conservation Status as per IUCN 2018.1
1	Anacardiaceae	Mangifera indica	DD
2	Apocyanaceae	Wrightia tinctoria	LR/Ic
3	Apocynaceae	Holarrhena pubescens	LC
4	Arecaceae	Borassus flabellifer	EN
5	Asteraceae	Eclipta prostrata	LC
6	Asteraceae	Sphaeranthus indicus	LC
7	Bignoniaceae	Jacaranda mimosifolia	VU
8	Fabaceae	Acacia nilotica	LC
9	Fabaceae	Rhynchosia minima	LC
10	Malvaceae	Thespesia populnea	LC
11	Meliaceae	Azadirachta indica	LC
12	Rubiaceae	Gardenia gummifera	LR/Ic
13	Rutaceae	Chloroxylon swietenia	VU
14	Solanaceae	Physalis minima	LC

Table 4.43: RET 9	Species reported	from study	v area

DD=Data Deficient; EN=Endangered; VU=Vulnerable; LR/lv=Low Risk/least concern; LC=Least Concern

4.3.4 Faunal Elements

The fauna in the study area is discussed based upon the data/ information collected through primary as well as secondary data available on the study area. Rollapadu wildlife sanctuary is located at an aerial distance of about 11.50 km from the nearest project component (refer Figure 2.2 of Chapter 2)

4.3.4.1 Mammals

According to Rodgers & Panwar (1988) biogeographic classification the regions falls in what is known as Deccan biogeographic zone (6) and Deccan Plateau South (6A) biotic province. To study the wild mammalian fauna of the study area, 2 - 5 km long transects and trails were walked at 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 walk in the transects. Total eight transects were followed in the study area and separate walks were done along the proposed Upper reservoir and lower reservoir area to collect information on wildlife presence in the area. Secondary data as well as information elicited 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 checked with the help of literature available.

During the surveys 4 mammalian species viz; *Lepus nigricollis* (Common Hare), *Herpestes auropunctatus* (Small Indian Mongoose), *Semnopithecus entellus* (Grey Langur) and *Macaca radiata* (Bonnet monkey) were sighted in the study area (**Table 4.44**). According to the list prepared based upon secondary data 21 species of mammals are reported from the area and the same is given at **Table 4.44**.

				Conservation Status	
S. No.	Family	Scientific Name	ne Common Name		IUCN
				1972	2018.1
1	Bovidae	Antilope cervicapra	Black buck	I	LC
	Canidae	Canis aureus naria	Asiatic Jackal	II	NA
2	Canidae	Cuon alpinus	Wild Dog	II	EN
3	Cercopithecidae	Macaca radiata	Bonnet monkey	II	LC
4	Cercopithecidae	Semnopithecus entellus	Grey Langur	II	LC
5	Emballonuridae	Taphozous longimanus	Long-armed Sheath tailed Bat	V	LC
6	Felidae	Viverricula indica	Small Indian Civet	П	LC
7	Herpestidae	Herpestes auropunctatus	Small Indian Mongoose	V	LC
8	Herpestidae	Herpestes edwardsii	Indian Grey Mongoose	II	LC
9	Hystricidae	Hystrix indica	Porcupine		LC
10	Leporidae	Lepus nigricollis	Common hare	IV	LC
11	Muridae	Bandicota indica	Large Bandicoot Rat	V	LC
12	Muridae	Mus booduga	Field Mouse	V	LC
13	Muridae	Mus musculus	House mouse	V	LC
14	Muridae	Rattus rattus	House rat	V	LC
15	Pteropodidae	Cynopterus sphinx	Short-nosed Fruit Bat	V	LC
16	Pteropodidae	Pteropus giganteus	Indian flying fox	V	LC
17	Sciuridae	Funambulus palmarum	Indian Palm Squirrel	IV	LC
18	Soricidae	Suncus murinus	House Shrew	V	LC
19	Suidae	Sus scrofa	Wild Boar	Ш	LC
20	Tupaiidae	Anathana ellioti	Madras Tree Shrew	V	LC
21	Vespertilionidae	Pipistrellus coromandra	Indian Pipistrelle	V	LC

Table 4.44: A list of Mammalian species reported from the study area

IUCN- International Union for Conservation of Nature; WPA – Wildlife (Protection) Act; EN – Endangered; LC - Least Concern; NE: Not Assessed.

4.3.4.2 Avifauna

As discussed in Methodology Chapter 3 of this report, 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, 23 species of birds were recorded. 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 47 species of bird species belonging to 16 Orders and 30 families was compiled based upon sighting as well as secondary data.

List of bird species composition and their conservation status has been described in **Table 4.45.**

Table 4.45: 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	Scientific Name	Common Name	IUCN	IWPA	
	i anny		Common Name	1	1972	
	Order: Accipitriform	ies				
1	Accipitridae	Elanus caeruleus	Black-shouldered Kite	LC	I	
	Order: Anseriformes					
2	Anatidae	Sarkidiornis melanotos	Comb Duck	LC	IV	
	Order: Caprimulgifo	ormes				
3	Apodidae	Apus affinis*	Little Swift	LC	Appendix I	
	Order: Charadriifori	nes				
4	Charadriidae	Charadrius hiaticula	Common Ringed Plover	LC	IV	
5	Charadriidae	Vanellus indicus*	Red Wattled Lapwing	LC	IV	
6	Charadriidae	Vanellus malarbaricus	Yellow-wattled Lapwing	LC	IV	
7	Recurvirostridae	Himantopus himantopus*	Black winged stilt	LC	IV	
	Order: Ciconiiforme	S				
8	Ciconiidae	Ephippiorhynchus asiaticus	Black-necked Stork	NT	IV	
	Order: Columbiform	nes				
9	Columbidae	Streptopelia decaocto*	Eurasian Collared-dove	LC	IV	
10	Columbidae	Streptopelia senegalensis*	Little Brown Dove	LC	IV	
	Order: Coraciiforme	S				
11	Coraciidae	Coracias benghalensis	Indian Roller	LC	IV	
12	Meropidae	Merops leschenaulti	Chestnut-headed Bee-eater	LC	Appendix I	
13	Meropidae	Merops orientalis*	Small Green Bee-eater	LC	Appendix I	
14	Meropidae	Merops philippinus	Blue-tailed Bee-eater	LC	Appendix I	
15	Alcedinidae	Ceryle rudis*	Pied Kingfisher	LC	IV	
16	Alcedinidae	Halcyon smyrnensis	White-breasted Kingfisher	LC	IV	
	Order: Cuculiforme	5				
17	Cuculidae	Centropus sinensis	Greater Coucal	LC	IV	
18	Cuculidae	Cuculus micropterus*	Indian Cuckoo	LC	IV	
19	Cuculidae	Eudynamys scolopacea	Asian Koel	LC	IV	
	Order: Galliformes					
20	Phasianidae	Francolinus pondicerianus	Grey Francolin	LC	IV	
21	Phasianidae	Pavo cristatus*	Indian Peafowl	LC	I	
	Order: Gruiformes					
22	Rallidae	Gallinula chloropus	Common Moorhen	LC	IV	
	Order: Passeriformes					
23	Alaudidae	Eremopterix grisea	Ashy Crowned Sparrow Lark	LC	IV	
24	Artamidae	Artamus fuscus	Ashy Woodswallow	LC	Appendix I	
25	Corvidae	Corvus macrorhynchos*	Indian Jungle Crow	LC	IV	
26	Corvidae	Corvus splendens*	House Crow	LC	V	
27	Dicruridae	Dicrurus macrocercus*	Black Drongo	LC	IV	

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S. No.	Family	Scientific Name	Common Name	IUCN 2018- 1	IWPA 1972	
28	Nectariniidae	Cinnyris asiaticus*	Purple Sunbird	LC	IV	
29	Passerinae	Passer domesticus*	House Sparrow	LC	IV	
30	Pittidae	Pitta brachyura	Indian Pitta	LC	IV	
31	Ploceinae	Ploceus philippinus	Baya Weaver	LC	IV	
32	Pycnonotidae	Pycnonotus cafer*	Red-vented Bulbul	LC	IV	
33	Sturnidae	Acridotheres tristis*	Common Myna	LC	IV	
34	Sturnidae	Sturnus agodarum	Brahminy Starling	LC	IV	
35	Timaliinae	Turdoides caudatus*	Common Babbler	LC	IV	
36	Timaliinae	Turdoides striatus*	Jungle Babbler	LC	IV	
37	Turdinae	Saxicoloides fulicatus	Indian Black Robin	LC	IV	
38	Turdinae	Copsychus saularis	Oriental Magpie-robin	LC	IV	
	Order: Pelecaniforn	nes				
39	Ardeidae	Ardea cinerea*	Grey Heron	LC	IV	
40	Ardeidae	Ardeola grayii	Indian Pond Heron	LC	IV	
41	Ardeidae	Bubulcus ibis*	Cattle Egret	LC	IV	
42	Ardeidae	Butorides striatus	Little Green Heron	LC	IV	
43	Ardeidae	Egretta garzetta*	Little Egret	LC	IV	
	Order: Podicipediformes					
44	Podicipedidae	Tachybaptus ruficollis	Little Grebe	LC	IV	
	Order: Psittaciformes					
45	Psittacidae	Psittacula krameri*	Rose-ringed Parakeet	LC	IV	
	Order: Strigiformes					
46	Tytonidae	Tyto alba	Common Barn-owl	LC	IV	
	Order: Suliformes					
47	Phalacrocoracidae	Phalacrocorax niger*	Little Cormorant	LC	IV	

*: Birds sighted during field survey

IUCN Red List of Threatened Species. Version 2018.1. www.iucnredlist.org>. Downloaded on 09 August 2018. IUCN- International Union for Conservation of Nature; NT- Near Threatened; LC - Least Concern; IWPA – Wildlife (Protection) Act, 1972

Appendix I: List of the bird families that do not appear either in Schedule-I or Schedule-IV of the Wildlife (Protection) Act, 1972 but should be included in the future amendments.

4.3.4.3 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 13 species of butterflies belonging to 5 families were recorded (**Table 4.46**) from the surroundings of proposed project area. Nymphalidae family was represented by 5 species followed by Lycaenidae, Libellulidae, Papilionidae and Pieridae respectively. Among the butterflies, Indian Large Cabbage White (*Pieris brassicae*), Plain Tiger (*Danaus chrysippus*) and Blue Pansy (*Precis orithya*) were most frequently sighted speices in the study area.

_					
S. No.	Scientific name	Common name			
	Libellulidae				
1	Orthetrum glaucaum	Blue Marsh Hawk			
2	Orthetrum triangulare	Blue Tailed Forest Hawk			
	Lycaenidae				
3	Acytolepis puspa	Common Hedge Blue			
4	Pseudozizeeria maha	Pale Grass Blue			
5	Heliophorous sena	Sorrel Sapphire			
	Nymphalidae				
6	Hipparchia parisatis	White edged Rockbrown			
7	Danaus chrysippus	Plain Tiger			
8	Callerebia ananda	Ringed Argus			
9	Precis orithya	Blue Pansy			
10	Aglais cachmirensis	Indian Tortoise shell			
	Papilionidae				
11	Papilio crino	Common Banded Peacock			
12	Papilio polytes	Common Mormon			
	Pieridae				
13	Pieris brassicae	Large Cabbage White			

4.3.4.4 Herpetofauna

Herpetofauna comprised of snakes and lizards is given in **Table 4.47**. Varanus, Garden lizard, Chameleons and skinks are commonly sighted species in the area.

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

Table 4.47: List of Herpetofauna found in the Study Area

4.3.4.5 Conservation Status of Fauna

Only two of the mammals in the study area fall under the category RET fauna. *Cuon alpinus* (Wild Dog) is falls under Endangered (EN) category as per IUCN Red list of Threatened Species. Version 2018.1.

According to WPA (1972) *Antilope cervicapra* (Black Buck) is Schedule-I species reported from the area. Six species fall under Schedule-II, and one species under Schedule-III. Among rest of the species two are under Schedule-IV and 11 under Schedule-V (**Table 4.44**).

Among the avifaunal species *Ephippiorhynchus asiaticus* is reported under Near Threatened (NT) category of IUCN Red list of Threatened Species. Version 2018.1, rest of the species fall under Least Concern category of IUCN (**Table 4.45**). As per the Wildlife

<u>Greenko Energies Pvt. Ltd.</u> <u>EIA Report Standalone Pumped Storage Component of Pinnapuram IREP</u> (Protection) Act 1972 two bird species falls under Schedule I viz. Black-shouldered Kite and Indian Peafowl (**see Table 4.45**).

4.3.4.6 Conclusions

The plant life in the project study area is in fairly degraded condition and its distribution is also very irregular with scattered patches. The major conclusions are as follows.

- i) Rollapadu Wildlife Sanctuary is the nearest notified Protected Area which is located at an aerial distance of about 12 km from the nearest project component.
- ii) There are small patches of forests which are in degraded condition.
- iii) According to 'A Revised Forest Types of India' by Champion and Seth (1968) the forests types are under Group 6A - Southern Tropical Thorn Forests and Subgroup 6A/C1/DS1/DS2).
- iv) According to Rodgers & Panwar (1988) biogeographic classification the regions falls in Biogeographic zone (6) and Deccan Plateau South (6A) biotic province.
- v) The factors responsible for degradation of forests are anthropogenic activities.
- vi) The most common tree species are Azadirachta indica, Ziziphus mauritiana, 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 133 including herbs (55), trees (50) and shrubs (28).
- viii) Lantana camara, Argemone mexicana, Parthenium integrifolium and Achyranthes aspera are the common invasive exotic species found in the area.
- ix) According to IUCN Redlist (Version 2018-1) Borassus flabellifer is listed under Near Threatened (NT), Chloroxylon swietenia and Jacaranda mimosifolia are listed in Vulnerable (VU) category.
- Mammals are represented by 21 species of which only 4 species viz. Lepus nigricollis (Common Hare), Herpestes auropunctatus (Samall Indian Mongoose), Semnopithecus entellus (Grey Langur) and Macaca radiata (Bonnet monkey) were sighted.
- xi) According to IWPA (1972) *Antilope cervicapra* (Black Buck) is Schedule-I species reported from the area.
- xii) Birds are represented by 47 species of which 23 were sighted during surveys.
- xiii) *Ephippiorhynchus asiaticus* is reported under Near Threatened (NT) category of IUCN Red list of Threatened Species. As per the Indian Wildlife (Protection) Act 1972 two bird species fall under Schedule I viz. Black-shouldered Kite and Indian Peafowl.
CHAPTER

5

DESCRIPTION OF THE SOCIAL ENVIRONMENT

5.1 SOCIO-ECONOMIC ENVIRONMENT

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.

Demographic Profile of Districts

The district of Kurnool occupies an area of approximately 17,658 sq.kms. is a part of Rayalseema region in Andhra Pradesh state. The city of Kurnool is the headquarter of the district. The district is located in the west-central part of the state and is boundard by Mahabubnagar district of Telangana in the north, Raichur district of Karnataka in northwest, Bellary district of Karnataka in the west, Ananthapur district in the south, YSR Kadapa district in the south east and Prakasham district in the east Kurnool district.

Accoding to census of India 2011, Kurnool district has 898 villages (870 habited and 28 uninhabited) spread over in three revenue divisions i.e. Nandyal, Kurnool and Adoni division and 54 Mandals. The district has five statutory towns (1 Municipal Corporation, 3 Municipalities and 1 Nagar Panchayat), 7 census towns.

5.2 THE STUDY AREA

The Study Area for the collection of data on socio-economic status has been delineated as the area within 10 km radius of the main project components like proposed reservoir area, powerhouse, muck dumping site etc.

A map of the study area is given at **Figure 5.1**.



Figure 5.1: Map showing villages in the Study Area

5.3 SOCIO ECONOMIC PROFILE OF THE STUDY AREA

Study area consists of 5 tehsils (Mandal), of which 2 are i.e. Midturu and Orvakallu of Kurnool division and remaning 3 are i.e. Panyam, Gadivemula and Banganapalle of Nandyal division of Kurnool 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.

5.3.1 Demographic Profile of Study Area

Total households in study area tehsil are 67815. The total population of study area is 295279, of which 148980 are male and 146299 are female. Sex ratio in study area is 982 female per 1000 males.

Demographic profile of study area shows that Banaganapalle is the largest tehsil with a total population of 100954, while, Midturu is the smallest tehsil with a total population of 41652. Panyam tehsil has the highest sex ratio (1007), while Orvakallu tehsil has the least (968). The Households, population details, and sex ratio in the study area are given in **Table 5.1**.

		House		Population	l	Sex
		Hold	Total	Male	Female	ratio
District	Kurnool	887652	4053463	2039227	2014236	988
	Gadivemula	9947	42810	21667	21143	976
Tabaila	Midturu	9665	41652	21099	20553	974
Tensiis	Panyam	11332	51426	25619	25807	1007
	Banaganapalle	23840	100954	50906	50048	983
	Orvakallu	13031	58437	29689	28748	968
Tot	Total (Tehsils)		295279	148980	146299	982

Table 5.1: Demographic Profile of study area

Source: Census of India: 2011

5.3.2 Social Category

As per Census of India, 2011, nearly 18.21% of the population of the Kurnool district area belongs to Scheduled Castes, while the population of Scheduled Tribes is only 2.04%. In study area, 18.4% and 3.4% of the total population belongs to Scheduled Castes and Scheduled Tribes, respectively **(Tables 5.2).**

		Sch	eduled Ca	iste	Scheduled Tribe			
		Total	Male	Female	Total	Male	Female	
District	Kurnool	737945	370215	367730	82831	42052	40779	
	Gadivemula	7954	4025	3929	1554	847	707	
	Midturu	9723	4936	4787	35	17	18	
Tehsil	Panyam	8489	4276	4213	3313	1247	2066	
	Banaganapalle	16736	8467	8269	3886	1985	1901	
	Orvakallu	12028	6141	5887	1261	662	599	
Total (Tehsil)		54930	27845	27085	10049	4758	5291	

Table 5.2: Social Category of villages in Study Area

Source: Census of India: 2011

5.3.3 Literacy

As per Census of India 2011, the literacy rate in Kurnool district is 60.4% of which 72.9% are males and 51.8% are females. The total literacy rate in the tehsils falling under study area is 62.4%, with 72.9% males and 51.8% females **(Table 5.3)**.

District /Tabail	То	tal populati	on	Lite	rate (Numb	er)	Liter	ate Rat	e (%)
District/Tensil	Т	М	F	Т	М	F	Т	М	F
Kurnool	4053463	2039227	2014236	2127161	1246369	880792	60.0	70.1	49.8
Gadivemula	42810	21667	21143	22818	13583	9235	60.5	71.5	49.4
Midturu	41652	21099	20553	23129	13611	9518	62.9	73.5	52.1
Panyam	51426	25619	25807	29876	17051	12825	65.3	75.2	55.6
Banaganapalle	100954	50906	50048	54145	31748	22397	61.0	71.3	50.7
Orvakallu	58437	29689	28748	32103	19083	13020	62.2	73.0	51.1
Total (Tehsils)	295279	148980	146299	162071	95076	66995	62.4	72.9	51.8

Table 5.3: Literacy Rate in Study Area

Source: Census of India: 2011

5.3.4 Occupation Pattern

As per census 2011, 51.4% of the total population of study area is working population. Of this working population 88.6% are main workers and 11.4% are marginal workers. 48.6% of the total population of the study area population is considered as non-workers. For classification of main workers **Refer Figure 5.2, Table 5.4.** Main worker 88.6%, of which 17.3% of cultivator, 59.4% Agriculture Labour, 1.4% Household Industry worker and 21.9% Other worker in the study area (**refer Figure 5.3, Table 5.5**).

The diagram below describes the categories of main workers:



The list of house-hold industries includes those engaged in house-hold manufacturing, processing, repairing, servicing, etc., and that of other workers includes factory workers, plantation workers, those in trade, commerce, business, transport, mining, construction, political or social work, all government servants, teachers, priests, artists, etc.

Tehsil	Total Total Worker		Non Worker		Main Worker			Marginal Worker					
Tensii	Population	т	м	F	т	м	F	т	м	F	т	м	F
Gadivemula	42810	24241	13029	11212	18569	8638	9931	20596	11649	8947	3645	1380	2265
Midturu	41652	22332	12473	9859	19320	8626	10694	20416	11910	8506	1916	563	1353
Panyam	51426	24228	13779	10449	27198	11840	15358	21056	12826	8230	3172	953	2219
Banaganapalle	100954	47739	29110	18629	53215	21796	31419	41074	26696	14378	6665	2414	4251
Orvakallu	58437	30582	16828	13754	27855	12861	14994	28612	16065	12547	1970	763	1207

Table 5.4: Occupational Pattern in Study Area (Kurnool District)

Source: Census of India: 2011; T-Total, M-Male, F-Female.



Figure 5.2: Occupational Pattern in study area

Tabail		Cu Main Warker	Cultivators Agr		Agricu	cultural labour		Househo	Household Industry Worker			ther Worker		
rensii		т	м	F	т	м	F	т	м	F	т	м	F	
Gadivemula	20596	4079	2729	1350	13354	6604	6750	293	188	105	2870	2128	742	
Midturu	20416	3422	2691	731	14293	7038	7255	205	128	77	2496	2053	443	
Panyam	21056	3886	2954	932	12790	6515	6275	276	169	107	4104	3188	916	
Banaganapalle	41074	6095	4587	1508	14910	7156	7754	765	408	357	19304	14545	4759	
Orvakallu	28612	4709	3196	1513	18641	8766	9875	422	216	206	4840	3887	953	

Table 5 5	· Main	Workers	Classifica	tion
I able 5.3). IVIAIII	VVUIKEIS	Classifica	uon

Source: Census of India: 2011; T-Total, M-Male, F-Female.



Figure 5.3: Main Workers Classification in study area

5.4 SOCIO-ECONOMIC PROFILE OF VILLAGES IN PROJECT AREA

Due to project only one Village i.e. Pinnapuram is directly affected by the project. However, the villages in the direct proximity of project construction area and the village where the families are residing whose land are likely to be affected by the proposed project activities, have been categorized as affected villages. A total of 7 villages will be directly or indirectly affected by the project activities of proposed Project. The socio- economic profile of these villages is discussed in the following text.

5.4.1 Demographic Profile

Demographic profile of the 8 villages in study area is given **Tables 5.6** below. The study area villages have 6621 households with a total population of 29918, of which the males 14754 and females 14164. The sex ratio is 960 females per thousand males. Panyam is the largest village with maximum number of households (3452) with a population of 14562 whereas Hussainapuram is smallest with 257 households and a population of only 1156 persons.

C No		Total		Population		Sex Ratio	
5.INO	village Name	Households	т	Μ	F	Sex Ratio	
	Tehsil-Orvakallu						
1	Brahmanapalle	351	1520	768	752	979	
2	Kalava	1067	5123	2798	2325	831	
3	Somayajulapalle	466	2063	1048	1015	969	
	Tehsil-Panyam						
4	Pinnapuram	279	1299	643	656	1020	
5	Gorakallu	749	3195	1617	1578	976	
6	Panyam	3452	14562	7291	7271	997	
	Tehsil-Gadivemula	a					
7	Chennakkapalle	528	2555	1325	1230	928	
	Tehsil-Banaganap	alle					
8	Hussainapuram	257	1156	589	567	963	
	Total	7149	31473	16079	15394	957	

 Table 5.6: Demographic Profile of the study Villages

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

5.4.2 Social Category

The population of Scheduled Castes and Scheduled Tribes in the study area villages is 8.99% and 14.37 %, respectively. The village-wise social category is presented in **Table 5.7**. **Table 5.7**: **Population structure of Project Affected Villages**

		Total Domulation	Sche	duled C	astes	Sche	duled T	ribes
5.INO	village Name	Total Population	Т	Μ	F	Т	Μ	F
	Tehsil-Orvakallu							
1	Brahmanapalle	1520	343	176	167	337	175	162
2	Kalava	5123	306	183	123	689	362	327
3	Somayajulapalle	2063	434	229	205	34	20	14
	Tehsil-Panyam							
4	Pinnapuram	1299	24	11	13	0	0	0
5	Gorakallu	3195	260	133	127	429	224	205
6	Panyam	14562	1201	608	593	1918	953	965
	Tehsil-Gadivemula							
7	Chennakkapalle	2555	247	127	120	1115	601	514
	Tehsil-Banaganapalle							
8	Hussainapuram	1156	14	8	6	0	0	0
	Total	31473	2829	1475	1354	4522	2335	2187

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

5.4.3 Literacy

The literacy profile of the project affected villages is given in **Table 5.8**. The male and female literate population in is 9933 and 6631, respectively, which implies that the literacy rate of the project study area is 52.63 % of which the male 59.97% while the female 40.03%. Panyam village has the highest literacy rate (64.30 %) while Pinnapuram Village has the least literacy rate of 36.5%. Highest female literacy rate (53.0 %) was recorded for Panyam village and Pinnapuram has the lowest female literacy rate of 27.5 %.

S No	Villago Namo	Literac	y popul	lation	Lite	rcy Rate	(%)
5.110	village Name	Т	Μ	F	Т	М	F
1	Brahmanapalle	751	448	303	57.30	68.90	45.90
2	Kalava	2766	1797	969	62.00	73.30	48.20
3	Somayajulapalle	998	614	384	54.60	66.50	42.50
4	Pinnapuram	404	250	154	36.50	45.50	27.50
5	Gorakallu	1624	977	647	58.00	69.30	46.60
6	Panyam	8273	4813	3460	64.30	75.00	53.70
7	Chennakkapalle	1134	690	444	51.50	60.50	41.80
8 Hussainapuram		614	344	270	60.30	67.30	53.30
Total		16564	9933	6631	52.63	59.97	40.03

 Table 5.8: Literacy Rate in project affected villages

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

5.4.4 Education Facilities

Educational facilities play an important role in the overall development of an area. These facilities enhance economic growth and employment. There are Primary Schools and Middle schools facilities available in all villages. Secondary School facilities are available at Kalava, Somyajulapalle, Panyam and Hussainapuram village and Secondary School facilities are available at Panyam and Hussainapuram villages (Table 5.9)

S.No	Village Name	PS	MS	SC	SSC
1	Brahmanapalle	Yes	No	No	No
2	Kalava	Yes	Yes	Yes	No
3	Somyajulapalle	Yes	Yes	Yes	No
4	Pinnapuram	Yes	Yes	No	No
5	Gorakallu	Yes	Yes	Yes	No
6	Panyam	Yes	Yes	Yes	Yes
7	Chennakkapalle	Yes	No	No	No
8	Hussainapuram	Yes	Yes	Yes	Yes

Table 5.9: Education facilities in the in the Project Affected Villages

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

5.4.5 Health Care Facilities

An available medical facility in study villages is given in **Table 5.10.** It has been found that the Pinnapuram and Gorakallu village have not any medical facility within the village, the nearest facility available is about 4 km and 9 km respectively. Availability of medical personnel and institutions the in the area is served by 1 community health centres (CHC), 1 Primary Health Centres and 4 Primary health sub centres. There are some private medical practitioners at Panyam and Hussainapuram villages. Community health Center is only in Panyam village.

S.No	Name	СНС	PHS	PHSC	Dispensary
1	Brahmanapalle			Yes	Yes
2	Kalava			Yes	
3	Somayajulapalle			Yes	
4	Pinnapuram				
5	Gorakallu				
6	Panyam	Yes			
7	Chennakkapalle			Yes	
8	Hussainapuram		Yes		Yes

 Table 5.10: Health Care facilities in the Project Affected Villages

CHC-Community Health Centre, PHC-Primary Health Centre, PHSC-Primary Health Sub Centre.

5.4.6 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, available only in Panyam and Hussainapuram Village. Electricity and drinking water facility is available in all the villages. The villages in the project area is not well connected by a network of banking facility, as show in **Table 5.11** banking facility is available only in Panyam village.

S.No	Villages	Bus Stop	Market	Ration Shop	Fair Price Shop	Bank	Post Office
1	Brahmanapalle	Yes	No	Yes	Yes	No	No
2	Kalava	Yes	Yes	Yes	Yes	No	No
3	Somayajulapalle	Yes	No	No	Yes	No	No
4	Pinnapuram	Yes	No	Yes	Yes	No	No
5	Gorakallu	Yes	Yes	Yes	Yes	No	No
6	Panyam	Yes	Yes	Yes	Yes	Yes	Yes
7	Chennakkapalle	Yes	Yes	Yes	Yes	No	No
8	Hussainapuram	Yes	Yes	Yes	Yes	No	Yes

Table 5.11: Nearest distance from village upto corresponding amenities

5.5 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 secondary education students travel upto 2 to 5 km and for higher education students move to Panayam or Kurnool.
- Medical facilities in the area are also poor, villagers depends on Primary Health Center at panyam or district Hospital at Kurnool.
- Basic amenities in terms of electricity and driniking water facilities, Fair price shop is available in all the villages.

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- Road & transporation facility in the area is good. The most important roads in this area are National Highway-18 passing through Husenapuram and Kalava village. All villages in the project area are well contacted with National 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 Panyam village. There are 2 post offices located in the area are in Panyam and Husenapuram villages.
- The telecommunication facilities are good in the area. The mobile cellular network is also available in the study area.

Chapter 6

ASSESSMENT OF IMPACTS

6.1 GENERAL

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 pump 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 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.

Environmental impacts are generated during construction phase owing to 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 impact the local inhabitants. 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 as far as pollution generation is concerned.

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 Pinnapuram IREP 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.

6.2 IMPACTS DURING CONSTRUCTION

Majority of the environmental impacts attributed to construction works are temporary in nature, lasting mainly during the construction phase and often do not extend much beyond the construction period. However, as the construction phase of Project extends up to three years, there is a need to minimize and mitigate the impacts. Even though the impacts due to construction are temporary in nature, they need to be reviewed closely as they could be significant due to the nature and intensity of the impacts.

Impacts can be discussed in terms of projects activities with their magnitude and potential impacts on environmental resources or alternatively resource wise in terms of impact on each environmental resource e.g. Ambient Air Quality and potential impact on this resource from various project activities. However, as some of the project activities are quite critical and it is important to understand them along with their impacts on environmental resources, therefore, they are briefly discussed below to be followed by impacts on resources.

6.2.1 Impacts due to immigration of Construction Workers

At the time of peak construction work in the project, around 2000 persons may be engaged, Out of 2000 the majority of about 1100 nos (800 - labour and 300 - Technical) will be from the local population/surrounding Villages and balance persons about 900 (600 - labour and 300 - technical) will migrate from other areas. All the local persons will up-down from their home. The migrate manpower only will stay at site camp.

Immigration of such a large population for such a duration in the project area can cause serious impact on various environmental resources including socio-economic profile of local population. The congregation of large number of construction workers during the peak construction phase is likely to create problems of sewage disposal, solid waste management, tree cutting to meet fuel requirement, etc. Appropriate mitigating measures have been suggested in EMP, which needs to be implemented to minimize such impacts.

Based on these assumptions the peak migrant population (who will stay at site) has been calculated as 1200 persons (**Table 6.1**). This population is expected to reside in the project area at any given time.

Α.	Migrant Population of Laborers	
	Total labor force	600
	Married laborers (20% of 600)	120
	Single laborers (80% of 600)	480
	Husband and wife both working Labour (90% of 120)	108
	Number of families where both husband and wife work (108/2)	54
	Number of families where only husband work (10% of 120)	12
	Total number of laborers families (54 +12)	66
	Total Migrant Population of Laborers (66 x 3)+480	678
в.	Migrant Population of Technical Staff	
	Total technical staff	300
	Married technical staff	60

Table 6.1: Calculation of Total Migratory Population

	Say	1200
	Total Migrant Population	1149
	Total migrant population of service providers (13x3+12)	51
	Single service providers	12
	Married service providers (50 % as assumed)	13
	Total service providers	25
C.	Service Providers	
	Migrant Workforce (Labor plus Technical)	1098
	Total migrant population of technical staff (60x2 + 240)	420
	Single technical staff	240

Separate accommodation and related facilities for semi-skilled/un-skilled workers, skilled workers and supervisory staff are to be arranged. Migration of 1200 persons during the peak construction period, in otherwise scarcely populated and pristine area, is likely to create problems of sewage disposal, solid waste management, tree cutting to meet fuel requirement, etc.

6.2.2 Construction of Main Project Components

Construction work is required for the construction of following main project components:

- Rockfill embankments varying from 12 to 14m with maximum of 33m height in lower reservoir and 35m height in upper reservoir for very short reach creation of Pinnapuram upper & lower reservoir with 1.20 TMC live storage capacity
- 45m RCC Intake structure. 56m high concrete power block
- Power Intake Structure
- 5 nos. of 760 m long and 7.0m dia. inclined circular steel lined Penstock tunnel /Pressure Shaft each for each unit of 200 MW
- 1 no 760m long and 7.0m dia. inclined circular steel lined Penstock tunnel/ Pressure shaft bifurcated to 2 penstocks to feed 2 units of 100 MW
- A surface Power house having an installation of five nos. reversible Francis turbine each of 200 MW capacity (2 units of fixed speed and 2 units of variable speed turbines) and two nos. reversible Francis turbine each of 100 MW capacity (1 unit of fixed speed and 1 unit of variable speed turbines) operating under a rated head of 119.27m in generating mode and 125.77m in pumping mode.
- 70m wide concrete lined Tail race channel with Full Supply Depth(FSD) of 6.00m and 1300m long connecting Tail race channel to the lower reservoir.

For construction of main project components major activities are excavation and concreting. Excavation will have impact in terms of muck generation. Excavation and concreting process will require use of various construction equipments such as batching plants, aggregate processing plants, dumper trucks, excavators, dozers, shotcrete machines, jack hammers, generators, pumps, etc leading to generation of pollution in terms of emissions, wastewater, noise and solid waste.

6.2.3 Operation of Construction Plant and Equipment

During the construction phase, various types of equipment will be brought to the site and construction plants and repair workshops will be set up. These include crushers, batching

plant, drillers, earth movers, etc. Aggregate Processing and Batching & Mixing Plants will be set up as per details below.

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

The siting of these construction plant/equipments would require clear piece of land. About 10.5 ha has been estimated for the contractors activities and colony. Proper siting of these facilities will reduce the impact due to their location. Their locations have been identified, keeping in view the technical and economic criteria; however, same can be further refined during set up, keeping in view:

- Proximity to the site of use
- Sensitivity of forests in the nearby areas
- Wildlife, if any, in the nearby area
- Proximity from habitations
- Predominant wind direction
- Natural slope and drainage

Such activities are planned on private and government land and completely avoiding the forest area; to minimize the impacts of tree cutting. Land will be restored once the project construction is complete.

Operation of construction plant and machinery, will have impact on ambient air quality due to fugitive emissions associated with material handling; emissions due to operation of DG sets to meet the power requirements and other equipment; impact on water quality due to wastewater generation and impact on soil due to solid and hazardous waste generation. Management of such impacts with operation control and appropriate pollution control equipment is essential to minimize their effect on surrounding environment including local population and wildlife and same is discussed in EMP.

6.2.4 Muck Disposal

The construction would involve about 9.73 Mcum of soil and rock excavation. About 7.61 Mcum of excavated muck is expected to be utilized for rockfill and aggregate for construction. Total quantity of muck proposed to be disposed in designated muck disposal area, after considering 40% swelling factor would be 2.97 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.

Therefore, at this stage only muck disposal sites have been identified, with proper design of retaining structures and budget thereof. Details of quantity of muck generated and disposal requirement is given in **Table 6.2** below:

cl		As per revised layout		
No.	Description	Quantity Details	Unit	
1	Total quantum of muck generated from the project	9.73	Mcum	
2	Total quantity of aggregate requirement	0.58	Mcum	
3	Total quantity of Rockfill	7.03	MCum	
4	Quantity of muck to be disposed	2.12	MCum	
5	Swelling factor for loose muck	40.00	%	
6	Total quantity of muck to be disposed	2.97	MCum	
7	Dump height of materials	15.00	m	
8	Total area required for dumping - in sqm	197908.54	Sqm	
	Area in hectares	19.79	На	

Table	6.2:	Muck	Ouantity	/ and	Dis	oosal	Area
TUNIC	0.2.	IT ACK	Quantity			505ui	Alcu

Keeping the above requirement and vicinity of the excavation sites in view, one muck disposal area has been identified. Muck management is discussed in detail in Environment Management Plan.

6.2.5 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 7.2 kms length of new road is required to be constructed to access the power house from the lower reservoir and Upper reservoir. The total land required for the construction of new road is 10.76 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 and leads to land slips and landslides.
- 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
- Effect on flora and fauna
- Air pollution due to dust from debris, road construction machinery, etc.
- Noise generation due to construction activities

6.2.6 Land Requirement

For the development of Standalone pumped Storage component of Pinnapuram IREP, land would be required for construction of project components, reservoir area, muck dumping,

quarrying, construction camps and colony, etc. Total land required for the construction of Project activities is approximately 713.65 ha **(Table 6.3).**

cl	Components	Total	Forest Land	Non-Forest Land Area (Ha)	
no.		Area (Ha)	Area (Ha)	Pvt	Govt/Assigned land
1	Upper Reservoir	280.17	0	107.00	173.17
2	Intake Structure	10.61	8.02	0.00	2.59
3	Penstock	6.96	6.96	0.00	0.00
4	Power House & TRC Outlet	22.50	22.50	0.00	0.00
5	Tail Race Channel	16.83	2.43	0.48	13.92
6	Lower Reservoir	319.02	319.02	0.00	0.00
7	Pot Head Yard	0.25	0	0.00	0.25
8	Proposed roads: from Lower Reservoir to Power House (PH), PH to Upper Reservoir	10.76	6.73	0.00	4.03
9	Contractor facilities, cement and E & M stores, Temporary colony area.	10.50	0.00	4.93	5.57
10	Muck disposal areas	21.00	0.00	7.24	13.76
11	Pumping & Other facilities	15.00	0.00	0.00	15.00
12	Magazine	0.05	0.00	0.00	0.05
	TOTAL	713.65	365.66	119.65	228.34

Table 6.3: Land Requirement

Major impact of land acquisition is permanent change of landuse, which is unavoidable. Land acquisition has impacts on local population by way of loss of their agriculture land and hence livelihood. Land aquistion 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 mitilagted to a large extent by provding adequate compnesation to private land owners and by compnesatory afforestation in lieu of loss of forest land.

Impact of various degrees on different environmental resources is discussed in ensuing paragraphs resource wise.

6.2.7 Impact on Water Quality

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

a) Sewage from Construction worker Camps

The project construction is likely to last for a period of 3 years. As mentioned earlier, about 2000 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 137.5 cum/day @ 110 lpcd. Adding other requirement from fluctuating population, it can go up to 150 cum/day. With 80% of this quantum to be generated as wastewater, the quanitity of 120 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.

b) 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.

c) 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.

6.2.8 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 (2000) 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.

6.2.9 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 dense 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.

6.2.10 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.

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 6.4**.

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	

Table 6.4: Noise L	evels due to O	peration of Construction	on Equipment

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:

$$N2 = N1-20log_{10}(r2/r1) - A_f$$
 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 1m from the source with distance is given in **Table 6.5**. 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.

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

Table 6.5: Decrease in Sound Levels with Distance from Source*

* 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 facotrs 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 6.6**.

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

Table 6.6: Noise generated due to blasting

It can be observed from **Table 6.6** 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 affect 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 6.7.

Table 6.7. Maximum exposure Perious 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	1/2		
120	1/4		

Table 6.7. Maximum Expansion Daviade Specified by OSUA

6.2.11 Impacts on Air Quality

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.

a) Pollution due to fuel combustion in various equipments

The operation of various construction equipments 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 SO₂. 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 equipments, 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).

b) 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.

Fugitive Emissions from material handling and transportation c)

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.

6.2.12 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.

6.3 IMPACTS DURING 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. 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 and positive as well negative impacts on socio-economic environment mainly due to improved infrastructure in the area.

Proposed pumped storage component of Pinnapuram IRE project is not planned on any natural water body/river; the project will create artificial upper and lower reservoirs and water will remain in circulation from upper to lower during power generation and vice versa during non-generation hours on daily basis. Reservoir water requirement will be met once and thereafter only small quantity will be added to compensate for evaporation losses/leakages. Therefore, no direct impact on natural water bodies during operation are 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.

Annexures

No. J-12011/12/2018-IA.I(R) Ministry of Environment, Forest & Climate Change Government of India (IA-1 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: Pinnapuram IREP (1200 MW) - Pumped Storage Project in Kurnool District of Andhra Pradesh by M/s Greenko Energies Pvt. Ltd - Amendment in TOR- regarding.

Sir,

This is with reference to your online application no. IREP-Pinnapuram/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 Pinnapuram IREP (1000 MW) in Kurnool District of Andhra Pradesh was accorded on 17.5.2018 for 4 years. Your request for approval for change of scope in the project and enhancement of capacity of the project from 1000 MW to 1200 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 1000 MW to 1200 MW and agreed for changes in the scope of the project. Accordingly, the Ministry hereby accords amendment ToR for enhancement of capacity from 1000 MW to 1200 MW in respect of Pinnapuram IREP (1200 MW) in Kurnool District of Andhra Pradesh with the same TOR as communicated vide letter dated 17.5.2018 with the following corrections:

 The committee noted the changes in project component locations, capacity increased from 1000 MW to 1200 MW. The comparative statement with reference to earlier proposal and revised proposal are presented below:

S.No.	Details	Original	Revised
1	Capacity	1000 MW	1200 MW
2	Project type	Pinnapuram IRESP - Storage Project	Standalone Pumped Storage Component of Pinnapuram IREP
в	Upper Reservoir	Pinnapuram IRESP	Pinnapuram IREP
ъ	Lower reservoir	Gorakallu Reservoir	Pinnapuram IREP

1

10	Live Storage	1.00 TMC	1.20 TMC
d	Dead Storage	0.32 TMC	0.17 TMC
e	Full Reservoir level (FRL) – Upper Reservoir	EL+392.00 m	EL +463.00 m
3	Powerhouse	Underground	Surface Powerhouse
4	Number of units	6 Units (4 x 200 MW + 2 x 100 MW)	7 Units (5 x 200 MW + 2 x 100 MW)
5	Turbine Design Discharge	86.25 current for each unit	96.9 curnet for each unit

ii. The land required for the proposed pumped storage project are as follows:

e 14	W2400E	Land requirement (ha)	
S. NO	Details	As per original	As per revised
1	Forest land	283.38	364.79
2	Non-Forest land	97.10	348,90
	Total	380.48	713.69

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 17.5.2018. 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 Fisherics Conservation and Management 	
7	 Para No. 11 related to CAD Plans for distributary outlet and Dam Break Analysis 	

 All other terms and conditions of the Scoping/TOR clearance stipulated in letter No. J-12011/12/2018-IA-I (R) dated 17.5.2018 and 6.7.2018 shall remain unchanged.

5. This issues with the approval of the Competent Authority.

Yours faithfully,

ELEVILLA R (Dr. S. Kerketta) Director

Copy to:

- The Secretary, Ministry of Power, Shram Shakti Bhawan, Rafi Marg, New Delhi 110001.
- The Secretary, Ministry of Water Resources, Shram Shakti Bhawan, Rafi Marg, New Delhi - 1.
- The Chairman, Central Electricity Authority, Sewa Bhawan, R.K. Puram, New Delhi-110066.
- The Chief Engineer, Project Appraisal Directorate, Central Water Commission, Sewa Bhawan, R. K. Puram, New Delhi – 110 066.
- The Additional Principal Chief Conservator of Forests (C), Ministry of Environment, Forest and Climate Change, Regional Office (SEZ), 1^m and 2nd Floor, Handloom Export Promotion Council, 34 Cathedral Garden Road, Numgambakkam, Chennal – 600 034.
- The Principal Secretary, Environment, Science & Technology, Government of Andhra Pradesh, Secretariat Office, 4th Block, Ground Floor, Room No. 187, Velagapudi, Amaravathi – 522–238, Andhra Pradesh.
- The Member Secretary, Andhra Pradesh State Pollution Control Board, D.No. 33-26-14 D/2, Near Sunrise Hospital, Pushpa Hotel Centre, Chalamavari Street, Kasturibaipet, Vijayawada - 520 008.
- 8. Guard file.

(Dr. S. Kerketta) Director

No- J-12011/12/2018-IA-I (R) Ministry of Environment, Forests and Climate Change Government of India [IA-I Division]

Indira Paryavaran Bhawan 3rd Floor, Vayu Wing Jor Bagh Road New Delhi-110003

Dated: 10th July, 2018

CORRIGENDUM

Subject: Pinnapuram HEP (1000 MW) Integrated Renewable Energy with Pumped Storage Project in Karnool District of Andhra Pradesh by M/s. Greenko Energies Pvt. Ltd. - regd.

Reference: (1) TOR letter dated 17.5.2018 (2) Your letter of Nil number dated 30.5.2018.

With reference to the subject cited above, it is to inform that the Ministry has reviewed the content of your letter and the following correction at SI.No.4 of the ToR letter has been made and it may be read as:

 "The scheme envisages non-consumptive re-utilization of 1 TMC of water of the Garakallu reservoir by circulation. The water in the Garakallu reservoir (lower reservoir) will be pumped up and stored in the Pinnapuran reservoir IRESP reservoir (upper reservoir) and will be utilized for power generation. The proposed rating of the Pinnapuran pump storage project is 1000 MWH by utilizing a design discharge of 862.50 cumec and rated head of 142.75 m. The pinnapuran IRESP will utilize 1140 MW to pump 1 TMC of water to the upper reservoir in 9.2 hours."

Instead of

"The scheme envisages non-consumptive re-utilization of 1 TMC of water of the Remuka Sagar reservoir by circulation. The water in the Remuka Sagar reservoir (lower reservoir) will be pumped up and stored in the 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 pinnapuram IRESP will utilize 1360 MW to pump 1 TMC of water to the upper reservoir in 9.2 hours"

2. Annexure is a Standard TOR for River Valley Projects and cannot be modified.

 All other terms and conditions of the Scoping /ToR Clearance stipulated in Letter No. J-12011/12/2018-IA.1 (R) dated 17.5.2018 shall remain unchanged.

This issues with the approval of Competent Authority.

Yours faithfully,

(Dr. S. Kerketta) Director

Copy to:

1. Secretary, Ministry of Water Resources, Shram Shakti Bhawan, Rafi Marg, New Delhi - 1.

2. The Secretary, Ministry of Power, Shram Shakti Bhawan, Rafi Marg, New Delhi -1.



No. J-12011/12/2018-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: 17th May, 2018

To,

The Authorised Signatory

M/s Greenko Energies Private Limited

Plot no. 1071, Road No.44,

Jubilee Hills, Hyderabad-500033, Telangana.

Sub: 1000 MW Pinnapuram HEP (Integrated Renewable Energy with Pumped Storage Project) near Village Pinnapuram in Karnool District of Andhra Pradesh by M/s Greenko Energies Private Limited.- reg. Terms of Reference (ToR).

Sir,

This has reference to online application no. IA/AP/RIV/74608/2018 dated 16.4.2018 on the above mentioned subject.

2. It has been noted that Proposed Pinnapuram Integrated Renewable Energy with Storage Project (IRESP) located in Kurnool District of Andhra Pradesh which will have a 4 GW project i.e. 2 GW of Solar Project and 2 GW of wind project with storage capacity of 1000/ 8000 MWH. The Storage Project will comprise of two reservoirs i.e. Gorakallu Reservoir (already existing) and Pinnapuram Reservoir (to be constructed in natural depression). This project is a one of its kind because both the reservoirs are not located on river course i.e. Gorakallu reservoir (existing) is a balancing reservoir and is located on a canal network and Proposed Pinnapuram reservoir in a natural depression. These reservoirs are 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	Pinnapuram IRESP Reservoir -Upper (Now Proposed)		
	Catchment Area	9.45 sq. km	
	Live Storage	1.00 TMC	

	Dead Storage	0.32 TMC
	Gross Storage	1.32 TMC
	Full Reservoir level (FRL)	EL +392.00 m
	Dimensions of earthen dam	510.0 m x 49.0 m x 6.0 m
	(Length x Height x Width)	
2	Gorakallu Lower Reservoir (Existi	ng)
	Live Storage	10.29 TMC (291.38 Mcum)
	Dead Storage	2.15 TMC (60.88 Mcum)
	Gross Storage	12.44 TMC (352.26 Mcum)
	Full Reservoir level (FRL)	EL +261.00 m
3	Power Intake	
	Туре	Open Semi Circular
	Elevation of Intake center line	EL +357.25 m
4	Tail Race Tunnel	Concrete Lined
	Type of tunnel & Nos.	Modified Horse Shoe & Twin
		Tunnels
	Diameter & Length of each Tunnel	12.0 m & 3860m each
5	Powerhouse	
	Туре	Underground 'D' Shape
	PH cavern Dimensions	L 270 m x B 25 m x H 49 m
6	Parameters of Storage Plant	
	Storage Capacity	8000 MWH
	Storage Capacity Rating	8000 MWH 1000 MWH
	Storage Capacity Rating No. of Units	8000 MWH 1000 MWH 6 (4 x 200 MW + 2 x 100 MW)
	Storage Capacity Rating No. of Units Turbine Capacity	8000 MWH 1000 MWH 6 (4 x 200 MW + 2 x 100 MW) 200 MW / 100 MW
	Storage Capacity Rating No. of Units Turbine Capacity Total Design Discharge	8000 MWH 1000 MWH 6 (4 x 200 MW + 2 x 100 MW) 200 MW / 100 MW 862.50 Cumec
	Storage Capacity Rating No. of Units Turbine Capacity Total Design Discharge Rated Head in Turbine mode	8000 MWH 1000 MWH 6 (4 x 200 MW + 2 x 100 MW) 200 MW / 100 MW 862.50 Cumec 134.00 m

6. Total land required for the construction of various components is about 380.48 Ha including submergence by formation of Pinnapuram reservoir. About 283.38 Ha (Surface: 263 ha & Under Ground: 20 ha) out of 380.48 Ha is part of Gani forest under Kurnool 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 3860m long twin tunnel and Power house complex, Surge chamber, Transformer cavern, Pressure shaft etc. the quantity of muck to be generated is estimated to be about 73.40 lakh Cum. It is expected that about 37.71 lakh Cum of this will be used for making aggregates which will be used in construction of various roads and buildings. The rest will require to be disposed-off in a planned manner. It is proposed to dump about 18.00 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 identified at suitable places.

8. The Pinnapuram IRESP is envisaged to be completed in a period of 3.5 years. The project cost works out to Rs. 4,829.22 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 Forests and Climate Change, Regional Office, (SEZ), Ist and IInd Floor, Handloom Export Promotion Council, 34 Cathedral Garden Road, Nungambakkam, Chennai-600034.
- 7. The Principal Secretary Environment, Science and Technology, Government of Andhra Pradesh, Secretariat Office, 4th Block, Ground Floor, Room no.187, Velagapudi, Amaravathi-522238, Andhra Pradesh.
- 8. The Chairman, Andhra Pradesh State Pollution Control Board, D.No. 33-26-14 D/2, Near Sunrise Hospital, Pushpa Hotel Centre, Chalamvari Street, Kasturibaipet, Vijayawada 520 008.
- 9. The District Collector, Karnool District, Collectorate Lane, Alluri Sitarama Raju Nagar, Opp. Govt. General Hospital, Kurnool, Andhra Pradesh 518002.
- 10. Guard file/Monitoring file.
- 11. Website of MoEF&CC.

Sofer Kend

(Dr. S. Kerketta) Director, IA.I

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 (SO₂) 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, NO₂, PO₄, CI, SO₄, 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. Hydrometeorological 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 km² 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 carriedout 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 avifauna, 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 microwatershed 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, cost 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 238.38 ha of forest land. Forest clearance should be obtained as per the prevailing norms of FC Act, 1980.

Syrrhend

Annexure Ib

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.

Sustainable development has many important facets/components like social, economic, environmental, etc. All these components are closely interrelated 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 the *j* 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.

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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 Expect 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 the deliberated in the EAC or SEAC or DEAC, as the case may be, with a due diligence object 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%

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- (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.

Jone 1-5/18

(Sharath Kumar Palleria) 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

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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.

COMPLIANCE TO TOR PINNAPURAM PUMPED STORAGE PROJECT (1200 MW)

MoEF&CC Letter no. F No.J-12011/12/2018-IA-I dated 17.05.2018; 10.07.2018 & 25.09.2018

S.No.	Scope of work	Compliance
1.	Scope of EIA Studies	EIA Chapter 1, introduction 1.2.2
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 2, Project Description: Section 2.6 & Figure 2.2
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 EIA Chapter 4, Figure.
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. 2.1
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 2, Project description, Section 2.6 & Figure 2.2
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 4, Environmental Baseline, Section 4.2.4, Page no:4.12 – 4.16 Fig: 4.18 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 4, Baseline Environment, Page no: 4.3-4.9
x	Remote sensing studies, interpretation of satellite imagery, topographic sheets along with ground	EIA Chapter 4, Baseline Environment, Figure. 4.20 & 4.21

	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.	
xi	Land details including forests, private and other land.	EIA Chapter 2, Table-2.2, Project Description, Section 4.3 Table 4.19
3.	Description of Environment and Baseline data	
А	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.	EIA Chapter 3, Methodology, Section. 3.2, Figure. 3.1
	The baseline studies should be collected for 3 seasons	EIA Chapter 4, Baseline Environment
4.	Details of the Methodology	EIA Chapter 3, Methodology
	The methodology followed for collection of baseline data	EIA Chapter 3, Methodology, Section. 3.2
Α	along with details of number of samples and their locations in the map	EIA Chapter 4, Baseline Environment, Fig-4.19
	For forest classification, Champion and Seth (1968) classification should be followed	EIA Chapter 4, Baseline Environment,4.3.2
5.	Method for collection of Biodiversity Data	EIA Chapter 4: Environmental Baseline data
	Methodology for Collection of Biodiversity Data	EIA Chapter 4, Baseline Environment
	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 Methodology
	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 4, Baseline Environment, 4.3.3.5
6.	Component of the EIA study	EIA Chapter 3: Methodology
Α	Physical and Chemical Environment	
i.	Geological and Geophysical Aspects and Seismo- Tectonics	
	Physical geography, Topography, Regional Geological aspects.	EIA Chapter 4, section 4.2.2
	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	EIA Chapter 4, Section 4.2.2.5, 4.2.2.6

	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	-
	lustification for location & execution of the project in	FIA Chapter 1 Section 1 3
	relation to the structural components (dam/barrage	FIA Chapter 4 Geology Section 4.2.2
	height).	
	Impact of project on geological environment.	EIA Chapter 6 Assessment of Impact
ii.	Meteorology, Air and Noise	
	Meteorology (viz. Temperature, Relative humidity, wind	EIA Chapter 4, Section 4.2.3
	speed/direction etc.) to be collected from nearest IMD	
	station.	
	Ambient air quality with parameters viz. Suspended	EIA Chapter 4, Baseline Environment,
	particulate matter (SPM), Respirable suspended	Section. 4.2.5 Table 4.6 & 4.7.
	particulate matter (RSPM) i.e. suspended particulate	
	Materials less than 10 microns, Sulphur dioxide (SO2) and Ovides of Nitrogen (NOV) in the study area. (El esations)	
	Existing Noise Levels and traffic density in the study area	FIA Chanter 4 Baseline Environment
	(5 Locations)	Section. 4.2.5.2 Table: 4.8. 4.9 & 4.10
iii.	Soil Characteristics	
	Soil classification, physical parameters (viztexture,	EIA Chapter 4. Baseline Environment.
	Porosity, Bulk Density and water holding capacity) and	Section 4.2.4, Table 4.2, 4.3, 4.4 & 4.5
	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).	
iv.	Remote Sensing and GIS studies	
	Generation of thematic maps viz. slope map, drainage	EIA Chapter 4 Baseline Environment
	map, soil map, land use and land cover map, etc. Based	section 4.3.1, Figure. 4.20, 4.21
	be prepared	
v	Water quality	
v.	Water quality for both surface and ground water for 6	FIA Chanter 4 Baseline Section 426
	Locations.	Page No: 4.20 - 4.28
	Delineation of sub and micro watersheds, their locations	Not Applicable
	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 SLUSUI.	
В	Water Environment and Hydrology	Not Applicable
	(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.	
	Catastrophic events live cloud bursts and flash flood, if	Not Applicable
	any should be documented	
	For estimation of sedimentation rate, direct sampling of	Not Applicable
	river flow is to be done during the EIA study. The study	

ToR compliance

	should be conducted for minimum 1 year.	
	Flow series, 10 daily with 90%, 75% and 50% dependable	Not Applicable
	years discharges.	
	Environmental flow release should be 20% of the average	Not Applicable
	of the 4 lean months of 90% dependable year and 30% of	
	monsoon flow.	
	A site specific study on minimum environmental flow	Not Applicable
-	Should be carried out.	
<u>с.</u>		
1.	Fiora	FIA Chapter 4 Section 4.2.2
	Forest and Forest types	ElA Chapter 4, Section: 4.3.2
	A species wise list may be provided	LIA Chapter 4, Section. 4.3.3, Page No:4.34-
	A species wise list may be provided.	FIA Chanter A Section A33A Page
	density frequency abundance diversity index similarity	No. $4.46 - 4.47$
	index, importance value index (IVI). Shannon Weiner	
	Index etc. of the species to be provided.	
	Economically important species like medicinal plants,	EIA Chapter 4
	timber, fuel wood etc.	
	Flora under RET categories should be documented using	EIA Chapter 4, Section. 4.3.3.5
	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.	
	Biodiversity study, a sub-component of EIA study, is to be	Biodiversity study prepared by CISMHE
	carried— out by associating a reputed	(University of Deini) is attached to Elvip
	Debradun or by ICERE Debradun A list of such institutes	
	is available on MoEF's website.	
ii.	Fauna	
	Fauna study and inventorisation.	EIA Chapter 4, Section. 4.3.4,
	Their present status along with schedule of the species.	page no:4.49-4.52
	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) Act, 1972.	
	Existence of barrier and corridors, if any, for wild animals.	
	Compensatory afforestration to compensate the green	EMP Chapter 7, Compensatory Afforestation
	proposed project development and loss of biodiversity	
D	Aquatic ecology	
<u>D</u> .	Documentation of aquatic fauna like macro-	Not Applicable
	invertebrates, zooplankton, phytoplanktons, benthos etc.	
	Fish and fisheries, their migration, breeding grounds and	Not Applicable
	conservation status.	
	Fish diversity composition and maximum length & weight	
	of the measured populations to be studies for estimation	
	of environmental flow.	
Ε.	Socio-economic	
	Collection of baseline data on human settlements, health	EIA Chapter 5, Section 5.3
	I status of the seven with and substrations infrastructure	1

	facilities for social welfare including sources of livelihood, job opportunities and safety and securities of workers	
	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.	EMP Chapter 10, Section 10.4
	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 5, Section 5.3 Page no: 5.3 – 5.9
	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.	Chapter-2 of EIA, Section 2.5.2.1
7	Impact prediction and Mitigation Measures	
Α.	 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 6, Assessment of Impact, Section. 6.2.11
В.	 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 6, Assessment of Impact, Section. 6.2.7
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 Immigration of labour population Quarrying operation and muck disposal Changes in land quality including effects of waste disposal 	EIA Chapter 6 Assessment of Impact, Section. 6.2.6
D.	 Biological Environment Impacts on forests, flora, fauna including wildlife, migratory avi-fauna, rare and endangered species, medicinal plants etc. 	EIA Chapter 6, Assessment of Impact, Section. 6.2.8 & 6.2.9

	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	
	Socio economic Aspects	EIA Chapter 6, Assessment of Impact,
	 Impact on local community including down a graphic graphic 	Section. 6.2.12
	demographic profile.	
	 Impact on socio-economic status. Impact on human health due to water/vector. 	
E.	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.	
8	Environment management Plan (EMP)	
	Catchment area treatment plan should be prepared	Not Applicable
	Micro-Watersned wise.	
	(SVI) method of SUISOI coupled with ground survey	
Α	Areas/ watershed falling under very severe and severe.	
	erosion categories.	
	Both biological and engineering measures should be	
	proposed in consultation with State Forest Department.	
	Command Area Development (CAD) Plan giving details of	Not Applicable
	implementation schedule with a sample CAD plan	EMD Chapter 7 Companyatory Afferentation
В	Compensatory Afforestation	Plan
	Piedivercity & Wildlife Concernation and Management	EMP Chapter 1, Biodiversity Conservation and
	Plan for conservation and preservation of endemic rare	Management Plan.
C	and endangered species of flora and fauna to be	Biodiversity study prepared by CISMHE
	prepared in consultation with State Forest Department.	(University of Delhi) is attached to EMP
_	Lickeries Concernation and Management Disc	Chapter.
	Prisheries Conservation and Management Plan	Chapter 2 of EIA Section 2 5 2 1
E	Green Belt Development Plan along the periphery of the	EMP Chapter 6, section 6.2
F	reservoir, colonies, approach road, canals etc.	
	Reservoir Rim Treatment Plan for stabilization of land	Not Applicable
G	slide/ land slip zones.	
Н	Plan for Land Restoration and Landscaping of project site.	EMP Chapter 6
	Muck disposal Plan- suitable sites for dumping of	EMP Chapter 2
1	excavated material should be identified in consultation	
-	with the State Pollution Control Board and Forest	
	Department.	Quarnuis not proposed for this project
	Plan for Restoration of quarry sites and landscaping of	EMP Chanter 6 Landscaping Restoration and
J	colony areas, working areas, roads, etc.	Green Belt Development Plan
L L	Study of Design Earthquake Parameters: A site specific	Design Earthquake Parameters study is under
~	study of earthquake parameters should be done. The	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. Dam Break Analysis and Disaster Management Plan: The	Not applicable
L	output of the dam break model should be illustrated with appropriate graphs and maps clearly bringing out the impact of Dam break scenario.	
м	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.	EMP Chapter 8
Ν	Public Health Delivery Plan including the provisions for drinking water facility for the local community.	Chapter 4
0	Labour Management Plan for their health and safety.	Chapter 4
Р	Sanitation and Solid waste management plan for domestic waste from colonies and labour camps etc.	EMP Chapter 3
Q	Local area development plan. Details of various activities to be undertaken along with its financial out lay should be provided.	EMP Chapter 10 (Covered under CER)
R	Environmental safeguard during construction activities including road construction.	EMP Chapter 8
S	Energy conservation measures	EMP Chapter 5
т	Environmental Monitoring Programme with physical and financial details covering all the aspects of EMP.	EMP Chapter 9
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.	EMP Chapter 12
9	Public Hearing as per EIA notification 2006	EMP Chapter 11
10	Corporate Environment Social Responsibility Plan	EMP Chapter 10

Annexure-III

	2013		2014		2015		2016		2017	
Month	Max	Min								
January	31	18	31	17	32	17	32	20	33	18
February	33	20	34	19	35	20	36	23	37	20
March	37	23	38	23	38	25	40	26	40	25
April	40	28	42	27	40	28	43	30	43	31
May	42	31	41	30	42	31	41	30	41	29
June	35	27	40	30	36	29	36	27	33	26
July	31	25	35	26	36	28	35	26	37	27
August	33	24	35	25	36	27	35	25	35	27
September	34	23	34	23	35	26	33	24	35	26
October	33	22	35	21	36	24	34	21	34	24
November	31	18	33	18	31	21	33	18	33	26
December	31	16	31	17	32	20	33	18	32	19

Metrology Data (Reference Year 2013-2017)

Mean Monthly Maximum Temperature and Minimum Temperature (°C) (refe. years 2013-2017) distt. Kurnool

Mean Monthly Average Rainfall (mm) and Numbers of Rainy Days (refer. years 2013-2017) district Kurnool.

Month	201	3	2014		2015		2016		2017	
wonth	Α	В	Α	В	Α	В	Α	В	Α	В
January	0.0	0	0.1	0	1.0	2	5.9	3	0.0	0
February	8.3	2	0.4	1	0.2	1	0.0	0	0.0	0
March	0.2	0	0.7	1	12.3	4	0.0	0	3.8	5
April	4.7	3	0.5	0	55.5	7	0.3	1	4.6	4
May	77.6	7	35.5	4	23.7	13	52.8	15	60.9	14
June	79.1	19	36.6	17	168.8	22	191.3	25	58.4	24
July	227.1	28	91.6	21	4.3	9	56.3	24	24.5	11
August	186.6	20	239.3	23	42.2	23	26.2	14	100.7	22
September	281.5	23	87.1	17	68.8	19	127.1	22	39.6	14
October	214.9	24	77.7	12	55.1	15	69.9	7	60.3	8
November	5.3	4	7.1	4	226.2	20	37.5	6	23.6	8
December	1.3	1	2.1	4	4.2	3	9.4	5	0.0	0
Annual Rainfall	1086.6	131	578.7	104	662.2	138	576.7	122	376.4	110

Note:-A-Rainfall(mm), B-Number of Rainy Days.

Months	2013	2014	2015	2016	2017	Average
January	15.8	17.3	15.8	19.1	15.5	19.1
February	18.4	17.6	23	25.2	16.9	25.2
March	18.7	18.4	26.6	27	20.5	27
April	18.4	16.9	24.8	23	17.6	24.8
May	19.1	16.6	24.8	23.4	17.3	24.8
June	24.1	22.3	29.2	22.7	20.5	29.2
July	24.8	25.6	27.7	24.1	26.6	27.7
August	20.2	18.7	25.6	24.5	20.9	25.6
September	13.7	16.9	16.9	21.2	16.6	21.2
October	12.6	12.2	13.7	13	13.3	13.7
November	11.5	11.9	18.4	10.8	14	18.4
December	13.7	13	15.8	13.3	14.4	15.8

Mean Monthly Maximum Wind Speed (kmph) (refe. years 2013-2017) district Kurnool.

Mean Monthly Humidity (%) (refe. years 2013-2017) district Kurnool.

Months	2013	2014	2015	2016	2017	Average
January	61	68	54	55	54	68
February	50	50	43	45	40	50
March	38	40	39	37	38	40
April	36	30	38	31	30	38
May	33	36	34	41	45	45
June	52	42	53	59	71	71
July	68	59	49	62	50	68
August	65	63	55	60	57	65
September	74	69	61	71	59	74
October	75	63	59	59	59	75
November	69	62	74	59	61	74
December	63	63	66	56	57	66

Annexure-IV

LIST OF PLANT SPECIES

S.No	Family	Scintific name	
1	Acanthaceae	Justicia adhatoda	
2	Acanthaceae	Justicia betonica	
3	Acanthaceae	Lepidagathis cristata	
4	Alangiaceae	Alangium salvifolium	
5	Amaranthaceae	Achyranthes aspera	
6	Amaranthaceae	Aerva javanica	
7	Amaranthaceae	Gomphrena globosa	
8	Anacardiaceae	Lannea coromandelica	
9	Anacardiaceae	Mangifera indica	
10	Anacardiaceae	Semecarpus anacardium	
11	Anonaceae	Polyalthia longifolia	
12	Apocyanaceae	Wrightia tinctoria	
13	Apocynaceae	Calotropis gigantea	
14	Apocynaceae	Holarrhena pubescens	
15	Apocynaceae	Nerium indicum	
16	Arecaceae	Borassus flabellifer	
17	Arecaceae	Phoenix sylvestris	
18	Asclepiadaceae	Wattakaka volubilis	
19	Asteraceae	Acanthospermum hispidum	
20	Asteraceae	Ageratum conyzoides	
21	Asteraceae	Echinops echinatus	
22	Asteraceae	Eclipta prostrata	
23	Asteraceae	Lantana camara	
24	Asteraceae	Parthenium integrifolium	
25	Asteraceae	Sonchus oleraceus	
26	Asteraceae	Sphaeranthus indicus	
27	Asteraceae	Tagetes erecta	
28	Asteraceae	Vernonia cinerea	
29	Asteraceae	Xanthium indicum	
30	Balanitaceae	Balanites aegyptiaca	
31	Bignoniaceae	Jacaranda mimosifolia	
32	Bignoniaceae	Millingtonia hortensis	
33	Bignoniaceae	Tecoma stans	
34	Bombacaceae	Bombax ceiba	

S.No	Family	Scintific name	
35	Boraginaceae	Cordia dichotoma	
36	Burseraceae	Commiphora caudata	
37	Capparidaceae	Cadaba fruticosa	
38	Capparidaceae	Capparis divaricata	
39	Caryophyllaceae	Polycarpaea corymbosa	
40	Casuarinaceae	Casuarina equisetifolia	
41	Celastraceae	Celastrus paniculatus	
42	Celastraceae	Maytenus emarginata	
43	Combretaceae	Combretum albidum	
44	Combretaceae	Terminalia catappa	
45	Convolvulaceae	Ipomoea carnea	
46	Erythroxylaceae	Erythroxylum monogynum	
47	Euphorbiaceae	Croton bonplandianum	
48	Euphorbiaceae	Euphorbia hirta	
49	Euphorbiaceae	Jatropha curcas	
50	Euphorbiaceae	Sapium insigne	
51	Euphorbiaceae	Tragia involucrata	
52	Fabaceae	Abrus precatorius	
53	Fabaceae	Acacia leucophloea	
54	Fabaceae	Acacia nilotica	
55	Fabaceae	Albizia amara	
56	Fabaceae	Albizia lebbeck	
57	Fabaceae	Alysicarpus longifolius	
58	Fabaceae	Bauhinia racemosa	
59	Fabaceae	Cassia fistula	
60	Fabaceae	Crotalaria medicaginea	
61	Fabaceae	Dalbergia paniculata	
62	Fabaceae	Leucaena leucocephala	
63	Fabaceae	Prosopis juliflora	
64	Fabaceae	Rhynchosia minima	
65	Fabaceae	Tephrosia purpurea	
66	Hernandiaceae	Gyrocarpus americanus	
67	Lamiaceae	Anisomeles indica	
68	Lamiaceae	Anisomeles malabarica	
69	Lamiaceae	Leonotis nepetifolia	
70	Lecythidaceae	Careya arborea	
71	Lythraceae	Ammannia baccifera	
72	Malvaceae	Abutilon crispum	

S.No	Family	Scintific name		
73	Malvaceae	Abutilon indicum		
74	Malvaceae	Byttneria herbacea		
75	Malvaceae	Corchorus olitorius		
76	Malvaceae	Corchorus trilocularis		
77	Malvaceae	Hibiscus ovalifolius		
78	Malvaceae	Pavonia zeylanica		
79	Malvaceae	Sida acuta		
80	Malvaceae	Sida cordata		
81	Malvaceae	Sida cordifolia		
82	Malvaceae	Thespesia populnea		
83	Malvaceae	Urena lobata		
84	Meliaceae	Azadirachta indica		
85	Meliaceae	Soymida febrifuga		
86	Menispermaceae	Cissampelos pareira		
87	Menispermaceae	Cocculus hirsutus		
88	Menispermaceae	Tiliacora acuminata		
89	Menispermaceae	Tinospora cordifolia		
90	Moraceae	Ficus hispida		
91	Moraceae	Ficus racemosa		
92	Moraceae	Ficus religiosa		
93	Moringaceae	Moringa concanensis		
94	Myrtaceae	Corymbia citriodora		
95	Nyctaginaceae	Boerhavia diffusa		
96	Nyctaginaceae	Bougainvillaea spectabilis		
97	Oxalidaceae	Biophytum sensitivum		
98	Oxalidaceae	Oxalis latifolia		
99	Papaveraceae	Argemone mexicana		
100	Periplocaceae	Hemidesmus indicus		
101	Rhamnaceae	Ziziphus mauritiana		
102	Rhamnaceae	Ziziphus xylopyrus		
103	Rubiaceae	Gardenia gummifera		
104	Rubiaceae	Hedyotis puberula		
105	Rubiaceae	Morinda pubescens		
106	Rubiaceae	Neolamarckia cadamba		
107	Rubiaceae	Pavetta tomentosa		
108	Rutaceae	Aegle marmelos		
109	Rutaceae	Chloroxylon swietenia		
110	Rutaceae	Toddalia asiatica		

S.No	Family	Scintific name	
111	Sapindaceae	Dodonaea viscosa	
112	Solanaceae	Datura metel	
113	Solanaceae	Physalis minima	
114	Sterculiaceae	Grewia flavescens	
115	Sterculiaceae	Grewia hirsuta	
116	Sterculiaceae	Guazuma ulmifolia	
117	Sterculiaceae	Helicteres isora	
118	Sterculiaceae	Sterculia urens	
119	Sterculiaceae	Triumfetta rhomboidea	
120	Sterculiaceae	Waltheria indica	
121	Strychnaceae	Strychnos nux-blanda	
122	Strychnaceae	Strychnos potatorum	
123	Ulmaceae	Holoptelea integrifolia	
124	Urticaceae	Pouzolzia zeylanica	
125	Verbenaceae	Gmelina arborea	
126	Verbenaceae	Gmelina asiatica	
127	Verbenaceae	Premna tomentosa	
128	Verbenaceae	Vitex negundo	
129	Violaceae	Hybanthus enneaspermus	
130	Vitaceae	Ampelocissus latifolia	
131	Vitaceae	Cissus quadrangularis	
132	Vitaceae	Cissus vitiginea	
133	Zygophyllaceae	Tribulus terrestris	

GOVERNMENT OF ANDHRA PRADESH ABSTRACT

Energy, Infrastructure & Investment Department – Establishment of India's largest Integrated Renewable Energy Project (IREP) by M/s. Greenko Energies Private Limited consisting of 1000 MW of Solar Power, 550 MW of Wind Power and 1200 MW of Standalone Pumped storage capacities - Approval of overall Integrated Renewable Energy Project (IREP) – Orders – Issued.

ENERGY, INFRASTRUCTURE & INVESTMENT (POWER.II) DEPARTMENT

G.O.Ms.No.24

Dated:19.07.2018 Read the following:-

- 1. G.O.Ms.No.8, Energy (Power.II) Deptt., dated 12.02.2015.
- 2. G.O.Ms.No.9, Energy (Power.II) Deptt., dated 13.02.2015.
- 3. MoU entered between M/s Greenko Energies Private Limited & GoAP during the
- Partnership Summit–2018 held at Visakhapatnam during 24-26th February, 2018.
- 4. M/s Greenko Energies Private Limited, Hyderabad proposals dated:02.02.2018 &11.06.2018 .
- 5. The VC&MD,New and Renewable Energy Development Corporation of Andhra Pradesh (NREDCAP) Ir. No. NREDCAP/WE/Greenko-IREP/2018 dated 14.02.2018.
- 6. The Chairman, APPCC & CMD, APTRANSCO letter No.CMD/CE/IPC&PS /APPCC/F.Solar/ D.No.301/18 dated 22.02.2018.
- 7. The G.A.(Cabinet) Dept., U.O.No.279/2018, dated:17.07.2018.

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Government of Andhra Pradesh is keen to harness the huge solar and wind potential of the State to meet its growing energy demands in an environmentally sustainable manner. Several initiatives such as investor friendly Solar and Wind Power Policies, large scale Solar Park(s) development, Green Corridor Investment for power evacuation etc., have been undertaken to promote Renewable Energy (RE) capacity addition. The Government of Andhra Pradesh has set a target to achieve 18,000 MW of renewable energy capacity by the year 2021-22, comprising of 10,000 MW of Solar Power and 8,000 MW of Wind Power, which is 10% of the national target.

2. The Government of Andhra Pradesh have announced the AP Solar Power Policy 2015 and AP Wind Power Policy 2015, wherein various incentives are offered for promotion of Wind and Solar Power Projects. With the promotion measures initiated by the Government, the share of Renewable Power in total power consumption has reached 18% during the year 2017-18. Further, the Government of Andhra Pradesh has announced Andhra Pradesh Industrial Development Policy(APIDP) 2015-20 to encourage large scale investments in the State. The Government have conducted Partnership Summits during the years 2016, 2017 and 2018 at Visakhapatnam to attract investments and create employment opportunities in the State.

3. In the reference 4th read above, M/s. Greenko Energies Pvt. Ltd., have submitted proposals for development of Integrated Renewable Energy Project(IREP) at Pinnapuram and other villages in Kurnool District to develop 550 MW of Wind, 1000 MW of Solar and 1200 MW of standalone pumped storage capacity utilizing 1 TMC water from the Gorakallu Reservoir on a non-consumptive basis. The power generated from this Wind Solar hybrid along with standalone pumped storage would be connected to Power Grid substation and delivered outside the State with first right of refusal to AP DISCOMs.

Greenko Energies Pvt. Ltd., have requested Government for approval for the following:

- i. Allocation of 1 TMC of water on a non-consumptive basis from the Gorakallu Reservoir as per the Industrial Water Supply Policy/Guidelines.
- ii. Allotment and permission for 550 MW of Wind component of the IREP.
- iii. Allotment and permission for 1000 MW Solar component of the IREP.
- iv. Allotment and permission for 1200 MW Standalone pumped storage component of the IREP.
- v. Approval of the overall IREP Scheme and recognition it as a "Mega Industrial Project" thereby facilitating Single Window clearance and facilitation.
- vi. Allot and alienate on a permanent basis the available Government land to the IREP.

4. Further, M/s Greenko Energies Private Limited informed that the Project would facilitate employment creation for 15000 people during construction and 3000 people after construction and would result in fresh investment of Rs.15000 crores in the State of Andhra Pradesh.

5. In the reference 3rd read above, M/s Greenko Energies Private Limited have signed MoU with the Government of Andhra Pradesh during the Partnership Summit-2018 held at Visakhapatnam between 24-26th February, 2018 for establishment of Integrated Renewable Energy Project (IREP).

6. In the reference 5th read above, the Vice Chairman & Managing Director, New and Renewable Energy Development Corporation of Andhra Pradesh Limited (NREDCAP), has submitted to consider the proposal of M/s Greenko Energies Private Limited and also submitted that the revenue land to an extent of 4766.28 acres in Pinnapuram village, Panyam Mandal, Kurnool District, is under the possession of NREDCAP pending finalization of regular land allotment by the Revenue Department. The VC & MD, NREDCAP has further stated that the completion period for development of Solar Project is 18 months and the Project Developer may have to commission the Project within 36 months from the date of handing over the land and M/s Greenko Energies Private Limited have requested for an estimated time line of 48 months for implementation of all the 3 components of the IREP Scheme.

7. In the reference 6th read above, the Chairman, APPCC & CMD, APTRANSCO has informed that APTRANSCO and DISCOMs have no objection on the above proposal as there is no obligation for DISCOMs in purchase of power and banking as Developer proposed to sell the power outside the State through PGCIL network. AP DISCOMs will have the first right of refusal to utilize the RTC energy as per the tariff of CERC. Further the power would be evacuated through PGCIL network duly obtaining evacuation approval from CTU.

8. Regarding the allocation of 1 TMC of water from existing Gorakallu Balancing Reservoir (GBR) for cyclic usage of water for IREP at Pinnapuram by forming Pinnapuram Reservoir (Upper Reservoir), the Water Resources(Irrigation) Department, has stated that 1(one) TMC of water can be allocated to the Project on non consumptive usage as this will not reduce the available quantum of water for Irrigation and drinking needs dependent on this Reservoir and allocation will be subject to the following conditions:

- i. The water can be allocated for non consumptive purpose, i.e. cyclical use only.
- ii. The designs for construction of work relating to the drawl and storage of water and tail race and leading channel back to GBR shall be vetted through Water Resources (Irrigation) Department.
- iii. The allocation shall be subject to terms and conditions of Industrial water supply policy of Andhra Pradesh.

9. Revenue Department has stated that, as per the provisions of Government Land Allotment Policy issued vide G.O.Ms.No.571 of Revenue (Assignment. I) Department, dated.14.09.2012 and in terms of B.S.O.24 and Andhra Pradesh Industrial Development Policy 2015-2020, the Government lands are being allotted for various purposes to different Government departments and private organizations.

10. Government after careful examination of the proposal of M/s Greenko Energies Private Limited and in view of the facilitation of employment creation for 15000 people during construction and 3000 people after construction by the developer and in view of the fresh investment of Rs.15000 crores in the State by the developer and also keeping in view of the recommendations of VC&MD, NREDCAP, have approved the proposal of M/s Greenko Energies Private Limited for establishment of India's largest Integrated Renewable Energy Project (IREP) at Pinnapuram Village, Panyam Mandal, Kurnool District and also hereby accorded approvals on the following:

- i. Approved for establishment of 1000 MW of Solar Energy.
- ii. Approved for establishment of 550 MW of Wind Energy.
- iii. Approved for establishment of 1200 MW of standalone pumped storage capacities.
- iv. Approved for allocation of 1 TMC of water on a non-consumptive basis from the Gorakallu Reservoir as per the Industrial Water Supply policy/guidelines and subject to guidelines issued by the Irrigation Department.
- v. Approved the overall IREP Scheme and recognition as a "Mega Industrial Project" thereby facilitating Single Window clearance and facilitation.
- vi. Approved for allotment and alienation of land to an extent of 4766.28 acres to the M/s.Greenko Energies Private Limited on outright sale basis as per the latest market value to be fixed by the Revenue Department.
- vii. The project should be completed within a period of 4 years (48 months) failing which the entire land will be resumed back to Government.

11. The power generated from this Wind Solar hybrid along with standalone pumped storage would be connected to Power Grid substation and delivered outside the State with no obligation for DISCOMs to purchase power. However, DISCOMs shall have first right of refusal.

12. The Vice Chairman & Managing Director, New and Renewable Energy Development Corporation of Andhra Pradesh, shall take further necessary action accordingly.

(BY ORDER AND IN THE NAME OF THE GOVERNOR OF ANDHRA PRADESH)

AJAY JAIN PRINCIPAL SECRETARY TO GOVERNMENT

To:

The Vice Chairman & Managing Director, NREDCAP, Tadepalli, Guntur District.

M/s. Greenko Energies Private Limited, Hyderabad.

The Principal Secretary to Government, Revenue Department.

The Principal Secretary to Government, Finance Department.

The Principal Secretary to Government, I&C Department.

The Principal Secretary to Government, Water Resources (Irrigation) Department.

The Commissioner of Industries Department, Vijayawada.

The Collector, Kurnool District.

Copy to:

The Chairman & Managing Director, APTRANSCO, Gunadala, Vijayawada.

The Managing Director, APGENCO, Gunadala, Vijayawada.

The Chairman & Managing Director, APSPDCL., Tirupathi.

The Chairman & Managing Director, APEPDCL, Visakhapatnam.

The Managing Director, APSPCL, Hyderabad.

The Chief Engineer & DWRO, Water Resources Department, Kurnool.

The General Manager, Industries Department, Kurnool.

The Revenue Divisional Officer, Nandyal, Kurnool District.

The Revenue Divisional Officer, Kurnool, Kurnool District.

The OSD to Chief Secretary to Government.

The OSD to Minister (Energy).

The P.S to Principal Secretary to Chief Minister.

The P.S to Secretary, LAW Department.

The P.S to Principal Secretary, Energy, I & I Department.

The Finance (FMU, Energy, I&I) Department.

The General Administration(Cabinet) Department(w.r.t. council resolution no.279/2018).

SF/SCs. (C.No,102/Pr. II/2018).

// FORWARDED :: BY ORDER //

K. Uand. SECTION OFFICER

THE RIGHT TO FAIR COMPENSATION AND TRANSPARENCY IN LAND ACQUISITION, REHABILITATION AND RESETTLEMENT ACT, 2013

ARRANGEMENT OF SECTIONS

CHAPTER I

PRELIMINARY

SECTIONS

- 1. Short title, extent and commencement.
- 2. Application of Act.
- 3. Definitions.

CHAPTER II

DETERMINATION OF SOCIAL IMPACT AND PUBLIC PURPOSE

A.—PRELIMINARY INVESTIGATION FOR DETERMINATION OF SOCIAL IMPACT AND PUBLIC PURPOSE

- 4. Preparation of Social Impact Assessment study.
- 5. Public hearing for Social Impact Assessment.
- 6. Publication of Social Impact Assessment study.

B.---APPRAISAL OF SOCIAL IMPACT ASSESSMENT REPORT BY AN EXPERT GROUP

- 7. Appraisal of Social Impact Assessment report by an Expert Group.
- 8. Examination of proposals for land acquisition and Social Impact Assessment report by appropriate Government.
- 9. Exemption from Social Impact Assessment.

CHAPTER III

Special provision to safeguard food security

10. Special provision to safeguard food security.

CHAPTER IV

NOTIFICATION AND ACQUISITION

11. Publication of preliminary notification and power of officers thereupon.

12. Preliminary survey of land and power of officers to carry out survey.

13. Payment for damage.

14. Lapse of Social Impact Assessment report.

15. Hearing of objections.

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manufacturing zones, as designated in the National Manufacturing Policy;

(iv) project for water harvesting and water conservation structures, sanitation;

 (v) project for Government administered, Government aided educational and research schemes or institutions;

(vi) project for sports, health care, tourism, transportation or space programme;

 (vil) any infrastructure facility as may be notified in this regard by the Central Government and after tabling of such notification in Parliament;

(c) project for project affected families;

(d) project for housing for such income groups, as may be specified from time to time by the appropriate Government;

(e) project for planned development or the improvement of village sites or any site in the urban areas or provision of land for residential purposes for the weaker sections in rural and urban areas;

(f) project for residential purposes to the poor or landless or to persons residing in areas affected by natural calamities, or to persons displaced or affected by reason of the implementation of any scheme undertaken by the Government, any local authority or a corporation owned or controlled by the State.

(2) The provisions of this Act relating to land acquisition, consent, compensation, rehabilitation and resettlement, shall also apply, when the appropriate Government acquires land for the following purposes, namely:—

(a) for public private partnership projects, where the ownership of the land continues to vest with the Government, for public purpose as defined in sub-section (1);

(b) for private companies for public purpose, as defined in sub-section (1):

Provided that in the case of acquisition for-

(*i*) private companies, the prior consent of at least eighty per cent, of those affected families, as defined in sub-clauses (*i*) and (ν) of clause (*c*) of section 3; and

(ii) public private partnership projects, the prior consent of at least seventy per cent. of those affected families, as defined in sub-clauses (i) and (v) of clause (c) of section 3,

shall be obtained through a process as may be prescribed by the appropriate Government:

Provided further that the process of obtaining the consent shall be carried out along with the Social Impact Assessment study referred to in section 4:

Provided also that no land shall be transferred by way of acquisition, in the Scheduled Areas in contravention of any law (including any order or judgment of a court which has become final) relating to land transfer, prevailing in such Scheduled Areas.

(3) The provisions relating to rehabilitation and resettlement under this Act shall apply in the cases where,—

(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;

(b) a private company requests the appropriate Government for acquisition of a part of an area so prescribed for a public purpose:

Provided that where a private company requests the appropriate Government for partial acquisition of land for public purpose, then, the rehabilitation and resettlement entitlements under the Second Schedule shall be applicable for the entire area which includes the land purchased by the private company and acquired by the Government for the project as a whole. appropriate Government, the following members, namely:---

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(a) a representative of women residing in the affected area;

(b) a representative each of the Scheduled Castes and the Scheduled Tribes residing in the affected area;

(c) a representative of a voluntary organisation working in the area;

(d) a representative of a nationalised bank;

(e) the Land Acquisition Officer of the project;

(f) the Chairpersons of the panchayats or municipalities located in the affected area or their nominees;

(g) the Chairperson of the District Planning Committee or his nominee;

(h) the Member of Parliament and Member of the Legislative Assembly of the concerned area or their nominees;

(i) a representative of the Requiring Body; and

(j) Administrator for Rehabilitation and Resettlement as the Member-Convenor.

(3) The procedure regulating the discharge of the process given in this section and other matters connected thereto of the Rehabilitation and Resettlement Committee shall be such as may be prescribed by the appropriate Government.

46. Provisions relating to rehabilitation and resettlement to apply in case of certain persons other than specified persons.—(1) Where any person other than a specified person is purchasing land through private negotiations for an area equal to or more than such limits, as may be notified by the appropriate Government, considering the relevant State specific factors and circumstances, for which the payment of Rehabilitation and Resettlement Costs under this Act is required, he shall file an application with the District Collector notifying him of—

(a) intent to purchase;

(b) purpose for which such purchase is being made;

(c) particulars of lands to be purchased.

(2) It shall be the duty of the Collector to refer the matter to the Commissioner for the satisfaction of all relevant provisions under this Act related to rehabilitation and resettlement.

(3) Based upon the Rehabilitation and Resettlement Scheme approved by the Commissioner as per the provisions of this Act, the Collector shall pass individual awards covering Rehabilitation and Resettlement entitlements as per the provisions of this Act.

(4) No land use change shall be permitted if rehabilitation and resettlement is not complied with in full.

(5) Any purchase of land by a person other than specified persons without complying with the provisions of Rehabilitation and Resettlement Scheme shall be void *ab lnitio*:

Provided that the appropriate Government may provide for rehabilitation and resettlement provisions on sale or purchase of land in its State and shall also fix the limits or ceiling for the said purpose.

(6) If any land has been purchased through private negotiations by a person on or after the 5th day of September, 2011, which is more than such limits referred to in sub-section (1) and, if the same land is acquired within three years from the date of commencement of this Act, then, forty per cent. of the compensation paid for such land acquired shall be shared with the original land owners.

Explanation .- For the purpose of this section, the expression-

(a) "original land owner" refers to the owner of the land as on the 5th day of September, 2011;

GOVERNMENT OF ANDHRA PRADESH ABSTRACT

The Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation & Resettlement Act, 2013 (No. 30 of 2013) – Andhra Pradesh Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Rules, 2014 – Notification – Orders – Issued.

REVENUE (LAND ACQUISITION) DEPARTMENT

G.O.MS.No. 389,

Dated: 20-11-2014. Read the following:-

- The Gazette of India No.40, dated 27-09-2013 of Ministry of Law & Justice, New Delhi.
- 2) The Gazette of India Notification No.2839, dated 19-12-2013.
- 3) From the Special Chief Secretary & Chief Commissioner of Land Administration, Andhra Pradesh, Hyderabad, Lr.No.G1/1420/2013, dated 23-1-2014.
- 4) From the Special Chief Secretary & Chief Commissioner of Land Administration, Andhra Pradesh, Hyderabad, Lr.No.G1/1420/2013, dated 04.08.2014.
- 5) G.O.Ms.No.316, Revenue (LA) Department, dated 13-09-2014.

ORDER:

The following Notification will be published in an Extra Ordinary Issue of the Andhra Pradesh Gazette, dated 21-11-2014:-

NOTIFICATION

Whereas, the draft rules, namely the Andhra Pradesh Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Rules, 2014 were published as required under Section 112 of the Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act, 2013 (30 of 2013), vide notification of the Government of Andhra Pradesh, Revenue (Land Acquisition) Department in Andhra Pradesh State Extraordinary Gazette No.1, dated 15th September, 2014 for inviting objections and suggestions from all persons likely to be affected there by before the expiry of a period thirty days from the date on which copies of the Gezzette containing the notification were made available to the public.

(2) And whereas, the copies of the Gazzette containing the said notification were made available to the public on the 15^{th} September, 2014.

(3) And whereas, the objections and the suggestions received from the public on the said draft rules have been considered by the Government of Andhra Pradesh.

(4) Now, therefore in exercise of the powers conferred by Section 109 of the Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act, 2013 (Act 30 of 2013), the Government of Andhra Pradesh hereby makes the following rules, as the same having been previously issued in G.O.Ms.No.316, Revenue (Land Acquisition) Department, dated 13-09-2014 and published in the Rules Supplement to Part-I, Extra ordinary of the Andhra Pradesh Gazette No.1, dated 15-09-2014 as required under section 112 of the said Act.

(BY ORDER AND IN THE NAME OF THE GOVERNOR OF ANDHRA PRADESH)

J.C. SHARMA PRINCIPAL SECRETARY TO GOVERNMENT

То

The Commissioner of Printing & Stationery (Printing Wing), Chanchalguda, Hyderabad. (With a request to publish the Notification in the Andhra Pradesh Extraordinary Gazette

and supply 1000 copies of the same)

The Special Chief Secretary & Chief Commissioner of Land Administration, A.P., Hyderabad. All Collectors in the State of Andhra Pradesh.

Copy to:-

The P.S. to Secretary to Hon'ble Chief Minister.

The P.S. to Deputy Chief Minister (Revenue).

The P.S. to Principal Secretary to Government, Revenue Department.

All the Departments of A.P.Secretariat.

SF/SC.

// FORWARDED :: BY ORDER //

SECTION OFFICER

(Annexure Appended)

refuses to refund the said excess amount paid to him, then such amount shall be recovered as an arrear of land revenue invoking the provisions of Revenue Recovery Act, 1864. Such proceedings shall be initiated within three years from the date on which the excess amount is found to have been paid.

29.Limits on extent of land under Section 2(3)(a) read with Section 46 of the Act-The limits on extent of land beyond which provisions of Rehabilitation and Resettlement under the Act apply, in Cases of purchase by a private company through Private Negotiation with the owner of the land shall be five thousand acres of dry land or equivalent extent of Irrigated Dry or Wet lands in rural areas subject to any further notification as may be notified by Government. However, the provisions of Rehabilitation and Resettlement shall be applicable wherever any habitation is part of such land.

CHAPTER VI

Administrator and Rehabilitation and Resettlement Committee and State Monitoring Committee

30.Power, duties and responsibilities of the Administrator- The Administrator shall exercise the powers and perform the duties and have the responsibilities as follows-

- (a) To conduct a survey and undertake a census of the affected families in the manner and within time as provided under these rules;
- (b) To prepare a draft Rehabilitation and Resettlement Scheme;
- (c) To publish the draft scheme by the mode provided under these Rules;
- (d) To make the draft scheme available to the concerned persons and authorities;
- (e) To organize and conduct public hearings on the draft scheme;
- (f) To provide an opportunity to the Requiring Body to make suggestions and comments on the draft scheme;
- (g) To submit the draft scheme to the Collector;
- (h) To publish the approved Rehabilitation and Resettlement Scheme in the affected area;
- (i) To help and assist the Collector in preparing the Rehabilitation and Resettlement award;
- (j) To monitor and supervise the implementation of the Rehabilitation award;
- (k) To assist in post-implementation audit of Rehabilitation and Resettlement, and
- (I) Any other work required to be done for Rehabilitation and Resettlement.

31.Rehabilitation and Resettlement Committee at Project Level- (1) The appropriate Government shall under Section 45(1) and (2) constitute a Rehabilitation and Resettlement Committee at project level to monitor and review the progress and

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ENVIRONMENTAL MANAGEMENT PLAN FOR STANDALONE PUMPED STORAGE COMPONENT (1200 MW) OF PINNAPURAM INTEGRATED RENEWABLE ENERGY PROJECT



November 2018

Prepared for:



GREENKO ENERGIES 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



Quality Council of India

National Accreditation Board for Education & Training



Certificate of Accreditation

R.S.Envirolink Technologies Pvt. Ltd., Gurgaon

402, Bestech Chamber Commercial Plaza, BBlock, Sushant LokPhase I,Gurgaon-122009

are 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:

SI.No.	Sector Description		Sector (as per)	
			MoEFCC	Cat.
1	Mining of minerals - Open cast 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	2 (b)	A
4	Jetties only	33	7 (e)	B
5	Highways	34	7 (f)	A
6	Automobile and Auto Components	40(i)	-	A

Note: Name of approved EIA Coordinators and Functional Area Experts are mentioned in SA AC minutes dated August 31, 2016 and Aug 4, 2017 posted on QCI-NABET website.

The Accreditation shall remain in force subject to continued compliance to the terms and conditions mentioned in NABET's letter of accreditation bearing no. QCI/NABET/ENV/ACO/17/0393 dated Sep 5, 2017. The accreditation needs to be renewed before the expiry date by R.S.Envirolink Technologies Pvt. Ltd., following due process of assessment.

Director I NABET Sr. Dated: Sep 5, 2017

Certificate No. NABET/EIA/1518/ SA 042 Validity till date Feb 13, 2018

For the updated List of Accredited Consultants with approved sectors please refer QCI-NABET website.





National Accreditation Board for Education and Training

(Member - International Accreditation Forum & Pacific Accreditation Cooperation)



August 14, 2018

QCI/NABET/EIA/ACO/18/00731 R. S. Envirolinks Technologies Pvt. Ltd. 402, Radisson Suites Commercial Plaza, B Block, Sushant Lok 1, Gurgaon – 122009 (Kind Attention: Sh. Ravinder Bhatia)

Sub: Validity of Accreditation as EIA Consultant organization- R. S. Envirolinks Technologies Pvt. Ltd.

Dear Sir,

This has reference to the accreditation of your organization under QCI-NABET EIA Scheme, the validity of **R. S. Envirolinks Technologies Pvt. Ltd.** is hereby extended till November 14, 2018 or completion of assessment process, whichever is earlier.

The above extension is subject to the submission of required information/documents related to assessment on time to NABET.

You are requested not to use this letter after expiry of the above stated date.

With best regards,

A.K Jha Senior Director | NABET

Institute of Town Planners India, 6th Floor, 4-A, Ring Road, I.P Estate, New Delhi-110,002, India

Telefax : +91-11-233 23 416, 417, 418, 419, 420 E-mail : ceo.nabet@qcin.org Fax : +91-11-233 23 415 Website : www.qcin.org




List '1' - Accredited EIA Consultant Organizations (ACOs) - as on October 11, 2018#

		Scope of Accr	editation		
		As per NABET	Scheme		Project or Activity as
S. No.	Consultant Organization	Sector Number	Name of Sector	Category	per Schedule of MoEFCC Notification dated September 14, 2006 and subsequent Amendments
	AadhiBoomiMiningandEnviroTechPrivate Limited (formerlyknownasSuriyaMining	1	Mining of minerals - opencast only	А	1 (a) (i)
	Services)	3	River Valley Projects	А	1 (c)
	Addresses 2/216 K S V Namer Narascothinatti Salam.	7	Mineral beneficiation	A	2 (b)
	636004	9	Cement Plants	А	3 (b)
1		34	Highways	В	7 (f)
	Email:suriyakumarsemban@gmail.com				
	Tel.:09842729655, 09443290855	38	Building and construction	В	8(a)
	Conditions apply		projects	. No.	
ſ	Aakhivi Consultants	1	Mining of minerals - opencast only	A**	1 (a) (i)
N	Noida, UP - 201 308	4	Thermal power plants	A**	1 (d)

List of Accredited Consultant Organizations (Alphabetically) Rev. 70, October 11, 2018

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		Scope of Accre	editation		
		As per NABET	Scheme		Project or Activity as
S. No.	Consultant Organization	Sector Number	Name of Sector	Category	per Schedule of MoEFCC Notification dated September 14, 2006 and subsequent Amendments
	R. S. Envirolinks Technologies Pvt. Ltd.	1	Mining of minerals- opencast only	A	1 (a) (i)
		3	River Valley projects	A	1 (c)
	Address: 402, Radisson Suites Commercial Plaza, B Block, Sushant Lok 1, Gurgaon – 122009		Oil & gas transportation pipeline (crude and refinery/		
			petrochemical products),		
172	e. mail:	27	passing through national parks/	A	6 (a)
C71	ravi@rstechnologies.co.in		sanctuaries/coral reefs		
			/ecologically sensitive Areas		
	Tel.: 0124 – 4295383		including LNG terminal		
	09810136853	33	Jetties only	В	7 (e)
		34	Highways	А	7 (f)
	Conditions apply	40 (i)	Automobile and Auto	1	
	Ramans Enviro Services Pvt. Ltd.	4	Thermal power plants	A	1 (d)
			Synthetic organic chemicals		
	Address: SF 23 & 24, Camps Corner, Nr. AUDA Garden, Prahladnagar Ahmedahad – 380015		industry (dyes & dye intermediates hulk drugs and		
VC1		10	intermediates excluding drug	<	E (f)
124	e. mail:	17	formulations; synthetic rubbers;	¢	
	ramans.consultancy@gmail.com		basic organic chemicals, other		
	samirchoksi88@yahoo.com		synthetic organic chemicals and		
			chemical intermediates)		
	Tel.: 079 – 26937472, 26937411	28	Isolated storage & handling of	В	6 (b)
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List of Accredited Consultant Organizations (Alphabetically) Rev. 70, October 11, 2018

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Final EIA Report Pinnapuram IRE Project

Greenko Energies Pvt. Ltd.

Declaration by Experts contributing to the EIA/EMP Report of Pinnapuram 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:

Period of Involvement: May 2018 - November 2018

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 	S-11/2018
2	WP	Ravinder P S Bhatia	 Baseline Data Review and Analysis –Water Quality Impact Assessment and Management Plan 	Ustan 2 5/11/2019
3	SHW	Ravinder P S Bhatia	 Impact Assessment Preparation of Waste Management Plan Public Health Delivery System Muck generation analysis and Dumping Plan 	Ustur 2 5/11/2018
4	SE	Zahoor A Wani	 Social Data Collection and Interpretation Social Impact Assessment Preparation of R&R Plan 	2 1/11/2016
5	EB	Arun Bhaskar	 Impact Assessment Preparation of Biodiversity Management Plan Compensatory Afforestation Plan 	An 5/11/2018
	17.13	Vivek Jhaldiyal	Baseline Data Collection, Analysis and Interpretation	Jul 5/11/2018
6	sc	Arun Bhaskar	Baseline Data Review and Analysis	1 - 11 2018

RS Envirolink Technologies Pvt. Ltd.

5/11/2018

Date-05/11/2018

Greenko Energies Pvt. Ltd.

Final EIA Report Pinnapuram IRE Project

			Impact Assessment	
- 18		Vivek Jhaldiyal	 Sampling and Interpretation 	Stul? [11/2018
7	AQ	Ravinder P S Bhatia	Impact Assessment of Air and Water Environment	Ustan 25111 12018
8	NV	Ravinder P S Bhatia	 Baseline Data Review and Analysis – Sound levels, Impact Assessment and Mitigation Plan 	Under 2 5 (1) 20047
9	HG	Vimal Garg	Impact Assessment	S-5/11/2-18
10	LU	Vimal Garg	 Impact Assessment Data Review and Analysis 	S-11/2-18
		Dimple Razdan	Preparation of Thematic maps	13-11-2018
11	RH	Harsh Pandya	• Risk Assessment	buffer "
12	GEO	Trilochan Singh Kaith	Geological & Geotechnical Investigations	11-14. (05/11/2018

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 Pinnapuram IRE project. I also confirm that the consultant organization shall be fully accountable for any mis-leading information in this statement.

Signature:

5/11/2018 an

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/1518/SA042, 05th September 2017 &

Validity Extension letter No. QCI/NABET/EIA/ACO/18/00731 dt. August 14, 2018

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 **1**

BIODIVERSITY MANAGEMENT & WILDLIFE CONSERVATION PLAN

As per ToR issued by MOEF&CC for Standalone Pumped storage component of Pinnapuram IRE Project, Biodiversity study, a sub-component of EIA study, is to be carried out by associating a reputed organization/institution as recommended by WII, Dehradun or by ICFRE, Dehradun.

Accordingly, Biodiversity Study for Standalone Pumped storage component of Pinnapuram IRE Project was carried out by CISMHE University of Delhi. Biodiversity Study report along with Biodiversity Conservation and Wildlife Management Plan is attached as separate **annexure.**

Keeping in view of the anticipated impacts of proposed project on the biodiversity of area, the main objectives of biodiversity conservation and wildlife management plan are as follows:

- Maintenance of ecological balance through preservation and restoration of wherever it has been disturbed due to project developmental activities,
- Conservation and preservation of natural habitats in and around project area
- Rehabilitation of critical species (endangered, rare and threatened species), with provisions for in situ or ex situ conservation,
- Mitigation and control of project induced biotic and/or abiotic pressures/ influences that may affect the natural habitats,
- Habitat enhancement in project area and catchment area by taking up afforestation and soil conservation measures,
- Creating all round awareness regarding conservation and ensuring people's participation in the conservation efforts and minimizing man-animal conflict

Following are the measures suggested for the said plan:

- i. Wildlife Habitat Preservation & Improvement
- ii. Establishment of Eco Park
- iii. Sowing of Grass
- iv. Biodiversity monitoring
- v. Awareness promotion
- vi. Strengthening of Infrastructural Facilities of Forest Department
- vii. Biodiversity Management Committee (BMC)

The estimated cost of implementation of various activities envisaged in the Biodiversity Conservation and Management Plan would be **Rs. 310.00 lakh**.

Table 1.1: Break-up of the Biodiversity	Management and Wildlife Conservation Plan
---	---

S. No.	Particulars	Total Budget (in Lakh)
1	Awareness Programme	10.00
2	Development of Grasslands	50.00
3	Establishment of Park/Garden	120.00
4	Fire Protection Measures	20.00
5	Infrastructure Development	50.00

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S. No.	Particulars	Total Budget (in Lakh)
	Monitoring of populations of Schedule I species in and around project	
6	area, Checking and monitoring of hunting	50.00
7	Good Practices	5.00
8	Biodiversity Management Committee	5.00
	Total Budget	310.00



MUCK DISPOSAL & MANAGEMENT PLAN

2.1 INTRODUCTION

Proposed Standalone Pumped storage component of Pinnapuram Integrated Renewable Energy Project (IREP) is in Kurnool District of Andhra Pradesh. Proposed Scheme will involve construction of Rock fill embankments of average height of around 12m to 14m with maximum of 33m height in lower reservoir and 35m in upper reservoir for very short reach for creation of Standalone Pumped storage component of Pinnapuram Integrated Renewable Energy Project reservoirs. Water is proposed to be diverted through five numbers of independent penstocks and one number of independent penstocks bifurcated into two from Power block of Pinnapuram IREP upper reservoir. A surface Power House will be located on the downstream of the power block and shall be equipped with five turbines and a pump/turbine having generating/pumping capacity of 200MW/244MW and two units of 100MW/130MW, respectively. The layout map of the project showing main construction sites and water conductor system is given at **Figure 2.1**.

2.2 QUANTITY OF MATERIAL TO BE EXCAVATED

The construction activities of the project would generate muck from excavation of various project structures. The total quantity of muck likely to be generated from excavation including construction of roads is about 9.73 Mcum. The component-wise quantity of muck to be generated is given at **Table 2.1**. However, after the utilization of muck for different project components and considering the swell factor of 40% for excavated material, the total quantity of muck to be disposed shall be **2.97 Mcum**. The entire excavated material is proposed to be dumped at one location identified specifically for this purpose.

S. No.	Project Component	Total Quantity of Muck to be generated (Cum)
1	Upper Reservoir	19,91,592
2	Concrete Power Block	124150
3	Lower Reservoir	661056
4	Approach Channel – Upper Reservoir	1200210
5	Power Intake	1071000
6	Pressure Shaft	2,58,826
7	Power House	10,80,044
8	TRC	24,27,689
9	Approach Channel – Lower Reservoir	9,15,779
	Total	97,30,346

 Table 2.1. Muck to be generated from various components of the project

Table 2.2. Quantity of muck to be disposed

S. No.	Description	Quantity in MCum
1	Total quantum of muck generated from the project	9.73
2	Total quantity of aggregate requirement	0.58
3	Total quantity of Rockfill	7.03
4	Total quantity to be utilised = (2+3)	7.61
5	Quantity of muck to be disposed = (1-4)	2.12
6	Total quantity of muck to be disposed after considering Swelling factor for loose muck @40%	2.97

2.3 MUCK DISPOSAL SITE

For the disposal of 2.97 MCum of muck an area of 21 Ha has been identified. The disposal site was identified taking into consideration availability of suitable area, minimum distance from generation sites.

2.3.1 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.

The identification of muck disposal areas was done in line with the topographic and sitespecific conditions as specified above.

S. No.	Chainage	Area (sq m)	Capacity in Cum	Total muck to be dumped in MCum
1	0 m	7558.77	0	-
2	150 m	8035.99	820633.25	-
3	300 m	8540.65	1243248.00	-
4	500 m	7361.25	1225637.5	-
	Total	31496.7	3289518.8	2.97

Table 2.3. Details of muck disposal site

2.3.2 Methodology of Dumping

The muck that needs disposal would be piled at \emptyset (angle of repose) maximum of 30° at the proposed dumping site. The description regarding the stabilization of the stacked material along the proposed roads has been discussed in the following paragraphs.

The options like dumping muck in stages and allowing it to consolidate/settle through the monsoon, compacting the dumped muck with Bulldozer movement, zoning of the dump judiciously to ensure the stability of 30° slope under all superimposed conditions will be explored and utilised. The plan and cross-sections of the proposed muck dumping site is given at **Figures 2.2**.

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 the muck disposal area;
- to improve and develop the sites into recreational site;
- to ensure maximum utilization of muck for the construction purpose;
- to develop the muck disposal site/ dumping yard to blend with the surrounding landscape; and
- to minimise damages due to the spoilage of muck in the project area.

In Standalone Pumped storage component of Pinnapuram 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) the populated /settlement areas are away from the dumping site and therefore will have least impact on human settlements, and
- iii) the identified muck site is close to the area of generation to avoid hazards related to transport of muck for long distances and minimizing traffic problems.

The generated muck will be carried in dumper trucks covered properly in line with approved best practices. All precautionary measures will be followed during the dumping of muck. All dumpers will be well maintained to avoid any chances of loose soil from being falling during the transportation. All routes will be periodically wetted with the help of sprinklers prior to the movement of dump trucks. Dumping would be avoided during the high-speed wind, so that suspended particulate matter (PM₁₀) levels could be maintained. Further, the dumping will be avoided during heavy traffic. After the dumping the surface of dumps will be sprayed with water with the help of sprinklers and then compacted.

The capacity/volume of the muck dumping sites is more than the volume of the muck to be disposed i.e. for 2.97 Mcum of muck to be disposed and area having a capacity of 3.28 Mcum has been identified (**see Table 2.3**). 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 site in a controlled and orderly manner. All measures would be adopted to ensure that the 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 proposed to be prevented by making concrete retaining walls to retain the piled muck. The top surface would be leveled and graded after the capacity of any dumping site is exhausted. The top surface will be covered with soil and grass seeding will be ensured to promote vegetation cover

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 Figures 2.2**).



Figure 2.1 : Layout Plan of Pumped Storage component of Pinnapuram IREP showing location of muck disposal site



Figure 2.2 : Plan of Muck Dumping Site

2.3.3 Rehabilitation of Muck Disposal Site

The Rehabilitation plan of muck dumping site includes engineering and biological measures. The project authorities would ensure that the dumping yards blend with the natural landscape to develop the site 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. The muck dumping site would be developed as Eco-Park which would not only aid in rehabilitation of disposed muck but also help in propagating biodiversity conservations measures.

The following engineering and biological measures have been proposed for the development of spoiled areas.

2.3.3.1 Engineering Measures

For stacking of dumped material, concrete reinforced retaining wall is proposed to be built before dumping of any material on the site (refer **Figures 2.2**). The minimum length of dumping site is 1940m and height of retaining wall is proposed to be 6m (**see Figures 2.3 & 2.4**). The retaining wall shall have RCC base of 100m thick and a width of about 4.5 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 by 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 utilised in filling. The excavation on hill side will be done to get a stable slope for the materials Greenko Energies Pvt. Ltd. EMP Report Standalone Pumped Storage Component of Pinnapuram IREP

encountered. At places breast wall, gabion walls shall be done in natural slope to retain filled material, particularly where there is problem of retaining the slope.

i) Retaining Wall

Total area for the dumping of muck is 21.0 ha which can accommodate more than **3.28 Mcum** though the estimated muck to be disposed is **2.97 Mcum**. The height of the retaining wall will be approximately 6 m. A typical sketch of the retaining wall is given at **Figure 2.2**. Total financial outlay for the retaining walls is **Rs.332.10** lakhs, and breakup is given in **Table 2.4**.

ii) Compaction

Compaction is an engineering measure, which would reduce bulk density of the muck thereby optimising the use of muck disposal area and would make it suitable for the plantation and other biological measures. Top surface would be levelled and graded to make the alternative use. The muck will be spread in layers of 500-700mm thick layers. Top surface would be levelled and graded to make the alternative use. On top a layer of soil would be spread to make the land suitable for plantation. The total cost for the process of compaction is **Rs. 50.00 lakhs**.

iii) Fencing

Fencing is a bio-engineering measure. After rehabilitation of muck the dumping area need protection for some time from disturbing by 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 the dumping piles. Project authorities will establish temporary wind barriers around 3 sides of dumps in close of settlement area.

S. No.	Particular	Volume (cum)	Rate in Rs./cum	Cost in Rs. Lakhs
1	Earthwork for foundation	3281	135	4.43
2	PCC 100 mm Thick M10 Grade Concrete	386	3500	13.51
3	R.R. Masonry	10440	2450	255.76
4	Weep Holes with PVC Pipe 100 mmØ @1.5m C/C Vertically & Horizontally	7000	120	8.4
5	Compacting and land leveling, etc.	LS	LS	50.00
	Total			332.10



Figure 2.3 : Cross-sections of Muck Dumping Site



Figure 2.4 : Cross-section of Retaining Wall

2.3.3.2 Biological Measures

Top surface area of the dumping is about 21.0 ha. This area will be treated for the purpose of plantation. Vegetation cover controls the hydrological and mechanical effects on soils and slopes. Therefore, biological measures to stabilize the loose slope are essential. 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

The selected species will be planted after their nurseries have been developed. The dumping areas are very small therefore; separate nursery would not be required. A nursery would be developed for the raise saplings for revegetation of dumping area. Nearly 1-2 years old saplings would be used for the plantation. Grasses and herbaceous species would 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.

After the process of compaction dumping site will be available for the plantation. In consultation with the horticultural department as well as forest department.

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	Scientific Name of Plant 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.148.75 lakh**. 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 2.5**).

S. No.	Particulars	Quantity	Rate (in Rs.)	Amount (Rs. in lakh)
1	Rolling of Muck	2.97 Mcum	_	Included in Engineering measures
2	Pitting (size: 0.45 m x 0.45 m x 0.45 m)	25000	75.00	18.75
3	Manure and soil filling in pits including transportation	-	Lumpsum	25.00
4	Raising of plants (including nursery cost, manure, transport, etc.)	-	Lumpsum	75.00
5	Fencing, maintenance, watering, transport, etc.	-	Lumpsum	30.00
	Total			148.75

Table 2.5: Total financial outlay for the biological measures at dumping sites

2.4 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.

2.5 FINANCIAL REQUIREMENT

The estimated cost of the relocation and rehabilitation of excavated material is given in **Table 2.6**. The total cost of these measures will be **Rs. 480.85 lakh.**

S. No.	Item	Amount (Rs.in lakh)
1.	Engineering measures	332.10
2.	Biological measures	148.75
	Total	480.85

Table 2.6: Financial requirements for implementation of Muck Disposal Plan

Chapter 3

SOLID WASTE MANAGEMENT PLAN

3.1 INTRODUCTION

Solid Waste Management is one among the basic essential requirement for public health and aesthetic surroundings. Therefore, the removal of any scattered and littered waste is important. This also brings to focus the necessity of synergy in the design, construction and maintenance of roads, surface (storm water) drains and storage, collection and transport of solid waste.

The construction of the proposed Standalone pumped Storage component of Pinnapuram IREP 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 3 years. Some of the workers will be accompanied by their families. The total population of workers and their families has been estimated as 1200 persons during peak construction time. These people will be living in temporary and permanent colonies/ settlements. The main sources of wastes in case of the proposed project can be divided into following categories:

- 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 (waste generated by health-care and veterinary establishments)
- Hazardous waste (generated from construction machinery and equipment)
- e-Waste (computer parts, Printer cartilages, 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 treatment from the colonies of labours and workers, water supply, cleaning of the colony area and solid waste disposal. Dwellings will be provided with septic tanks and soak pits along with water supply for drinking and other daily needs for each and proper waste disposal by adopting various disposable methods.

3.2 INFLUX OF MIGRANT POPULATION

At the time of peak construction work in the project, around 2000 persons may be engaged, Out of 2000 the majority of about 1100 nos (800 - labour and 300 - Technical) will be from the local population/surrounding Villages and balance persons about 900 (600 - labour and 300 - technical) will be migrate from other area. All the local persons will

up/down from their home only. Only the migratory manpower i.e. about 1200 persons (**Table 3.1**) will only stay at labour colonies and site camps.

Immigration of such a large population for a long duration in remote area can cause serious impact on various environmental resources including problems of sewage disposal, solid waste management, etc. Appropriate plan needs to be prepared and implemented to minimize impacts of waste generation especially during construction phase.

Α.	Migrant Population of Laborers	
	Total labor force	600
	Married laborers (20% of 600)	120
	Single laborers (80% of 600)	480
	Husband and wife both working Labour (90% of 120)	108
	Number of families where both husband and wife work (108/2)	54
	Number of families where only husband work (10% of 120)	12
	Total number of laborers families (54 +12)	66
	Total Migrant Population of Laborers (66 x 3)+480	678
В.	Migrant Population of Technical Staff	
	Total technical staff	300
	Married technical staff	60
	Single technical staff	240
	Total migrant population of technical staff (60x2 + 240)	420
	Migrant Workforce (Labor plus Technical)	1098
C.	Service Providers	
	Total service providers	25
	Married service providers (50 % as assumed)	13
	Single service providers	12
	Total migrant population of service providers (13x3+12)	51
	Total Migrant Population	1149
	Say	1200

Table 3.1: Calculation of Total Migratory Population

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 Andhra Pradesh average is about 364 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 400 grams/capita/day is expected to be generated. Further, the peak labour population is estimated to be 2000 persons and it is also expected that locals in the proximity will also use solid waste management facilities; keeping this in view, the plan is prepared for about 3000 persons.

For 3000 persons an estimated amount of about 438 tons/annum (0.4 kg x 3000 individuals x 365 days = 438 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.

3.3 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

3.3.1 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 disposed by composting and the manure generated will be provided to local community for cultivating vegetables and flowers and other agricultural activities.

3.3.2 Storage and Segregation

In the labour colony, provisions shall be made to separately store the degradable and nondegradable 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.

3.3.3 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 handdriven 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.

3.3.4 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.

3.3.4.1 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 - 60 days to mature.

A pit of 1.2m x 2m x 1m deep (0.3m free board) size can take 1.68 m³ (around 1200 Kg after compaction) of compostable waste. Therefore, 30 pits would be needed to store the biodegradable waste with 60 days retention time, however, a provision of 40 pits should be kept. The total area required would be almost three 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 about 300m². The pits will be covered with GI sheets. Additional 200m² 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 pit will be then watered on alternate days. Thereafter 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 to 60 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.

3.3.4.2 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 m³ say (953 m³)
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

3.3.5 Bio-medical Wastes

Biomedical waste is 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 Kurnool to treat/ dispose-off biomedical waste generated from project activities in their facility. Provision has been made in Local Area Development 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.

3.4 FINANCIAL REQUIREMENT

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. 201.16 lakh** (**Table 3.2**).

S. No.	Item	Cost (Rs. lakh)		
1	Cost of land*			
2	Construction at composting site and land fill site - digging of pits,			
Z	construction of pits, boundary wall, drainage, lining, etc.	45.00		
3	Reclamation and stabilization of land fill and composting site	15.0		
4	Three covered trucks for conveyance of solid waste to landfill site @			
4	Rs. 15.00 lakh per truck	45.00		
E	Manpower cost for 3 persons @ Rs. 12000 per person per month for			
C	3 years	12.96		
6	Two tractors with trolleys @ Rs. 10.00 lakh per tractor with trolley	20.00		
	Running, operation and maintenance of trucks and trolleys including			
7	drivers salaries @ Rs. 30000 per vehicle per month for 4 vehicles for			
	3 years	43.20		
8	Awareness programme/ Periodical Training	10.00		
9	Tools & Implements	10.00		
Total Cost 201.				

Table 3.2: Cost Estimate for Solid V	Waste Management Plan
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* Cost of land is taken from PR

Chapter **4**

PUBLIC HEALTH DELIVERY SYSTEM

4.1 EXISTING MEDICAL FACILITIES

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.

The district hospital serves as a referral centre for complicated cases, while the primary health centers and primary health sub-centers provide basic health services primarily to the inhabitants of rural areas. The district hospital is located in Kurnool. There are total 11 Primary Health Sub Centers, 8 Primary Health Centers, 4 Community Health Centers and 4 Hospitals within the Mandals (tehsils) falls in the study area. The details of the health care facility are given in **Table 4.1**. Besides these government medical facilities some private clinics in the area also provide basic health services primarily to the inhabitants of rural areas.

Tehsils	PHSC	PHC	СНС	Hospital
Midturu	1	2	-	1
Orvakallu	4	2	1	1
Panyam	3	1	2	1
Gadivemula	3	1	-	-
Banaganapalle	-	2	1	1
Total	11	8	4	4

 Table 4.1: Health Care facilities in the study area

(Source: Hand Book of Statistics – 2015 Kurnool District)

PHC-Primary Health Centre; PHSC-Primary Health Sub-Centers; CHC-Community Health Centers

Objective of Public Health Delivery System

- To improve efficiency in the allocation and use of health resources in the project area.
- To improve the performance of the health care system in the project area through improvements in the quality, effectiveness and coverage of health services at the first referral level and selective coverage at the primary level, so as to improve the health status of the people, especially the local, by reducing mortality, morbidity and disability.

4.2 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 1200. 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, TB, etc. The project authorities will hold screening camps for the labourers, where rapid blood tests will be conducted for diseases like AIDS, 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 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 two reservoirs and water will remain in circulation on daily basis from upper 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.

4.3 MEDICAL FACILITIES

A population of the order of 1200 persons is likely to congregate during the 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 can not 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.
- Three 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 in the project area.
- One Health Centre shall be opened in the Project Colony. The facilities thereof can be availed by local people.

4.4 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.

4.5 COST ESTIMATES

Budgetary estimates for public health delivery system have been worked out as **Rs. 168.00 lakh**, as per the break up given at **Table 4.2**.

SI. No.	Particulars	Amount (Rs. lakh)
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	Three first aid posts including sheds, furniture and basic equipment	15.00
4	Budget for running the first aid post @ Rs.8 lakh per post per annum including cost of medico, para-medico/Nurses and attendant, consumables, etc. for 3 years	72.00
5	Budget for strengthening existing medical facilities	20.00
6	Budget for Health Awareness/ Vaccination Camps @ Rs. 2.00 lakh per annum for 3 years	6.00
	Total (Rs. lakh)	168.00

Table 4.2: Budgetary	/ estimates f	for developing	health ca	are facilities
Table 4.2. Duugetal	estimates i	or developing	nearth ca	are facilities

Chapter 5

ENERGY CONSERVATION MEASURES

5.1 INTRODUCTION

As is discussed in the previous chapters, 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 1200 persons. It is 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.

5.2 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 the future use. In study area, supply of cooking gas and kerosene is available in all the villages, but fuel wood is the dominant source of energy due to easy availability; therefore, there is need to reduce the pressure on the natural forests for wood. With an estimated migrant population of 1200 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 kitchen and heating fuel.

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 the absence of fuel for cooking, they would resort to tree cutting and using wood as fuel. To avoid such a situation, 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 200 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 the 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.

5.3 COST ESTIMATES

A total grant of **Rs. 180.00 lakh** has been assigned towards the provision of kitchen fuel, and other facilities including establishment of community kitchen or canteens for the migrant workers (**Table 5.1**).

SL No	Darticulars	Amount	
51. NO.	Fai ticulai S	(Rs. In lakh)	
1	Upgradation of LPG Depot	8.00	
2	Connection cost of 300 connections @ Rs. 5000.00 per connection	15.00	
3	Distribution of Pressure Cooker and Solar Lantern	20.00	
4	Community Kitchen (2 No.) – capital cost (Rs. 3.00 lakhs per kitchen)	96.00	
	and running cost for 3 years @ Rs. 15 lakh per kitchen per annum		
5	Canteen (3 No.) – capital cost (Rs. 2.00 lakh per canteen) and	26.00	
	running cost @ Rs. 5.0 lakh per canteen per annum for 3 years		
6	Community Awareness Programme	5.00	
	Total (Rs. lakh)	180.00	

Table 5.1 : Financial Provision for Energy Conservation Measures

Chapter **6**

LANDSCAPING, RESTORATION & GREEN BELT DEVELOPMENT PLAN

6.1 LANDSCAPING AND RESTORATION OF CONSTRUCTION AREAS

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 disturbed areas to bring them back to their similar or near-similar pre-construction conditions and land use. Different project related activities will require acquisition of government as well as private land. The acquired land will also be used for dumping of muck and other garbage from the colony area. In addition to the habitat disturbance, project related activities will also result in the accumulation of large amounts of dumps at various construction sites, which need to be either relocated or as an alternative can be utilized for landscaping.

There will be indirect disturbance to the area due to increase in the human population and traffic movement. It will be essential for the project authority to restore the area back to its original state.

6.1.1 Restoration/Landscaping Of Disturbed Areas/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 **120.00 lakh (see Table 6.1).**

Table 6.1: Cost estimates for bio-engineering measures for constructior	areas
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S. No.	Item of work	Quantity	Rate/ unit (in Rs.)	Amount Rs. (In lakh)
1	Leveling and development of the area	10 ha	200000/ha	20.00

S. No.	Item of work	Quantity	Rate/ unit (in Rs.)	Amount Rs. (In lakh)
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		3.00
5	Maintenance for 10 years	10 ha	50000/ha	50.00
Total				120.00

6.2 GREEN BELT DEVELOPMENT

Green belt development will comprise of plantations at various places like alongside roads and at different project offices and colonies.

6.2.1 Roadside Plantation

In the proposed project area construction of 7.2 km of new roads are 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. For road side plantations, an amount of **Rs. 17.50 lakh** have been allocated.

6.2.2 Green Belt around Powerhouse, Reservoir and Office Complex

Plantation around the project colony 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 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.

S.No	Scientific Name	Common Name
1	Alistonia scholaris	Blackboard Tree (Saptaparni)
2	Anthocephalus cadamba	Kadamba
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

Table 6.2: Tree species suggested for Landscaping, Roadside and Avenue Plantation

Greenko Energies Pvt. Ltd. EMP Report Standalone Pumped Storage Component of Pinnapuram IREP

S.No	Scientific Name	Common Name
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)
10	Pterospermum	Kanaka champa, Matsa kanda, Karnikara.
10	acerifolium	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. 47.50 lakh** has been allocated.

S. No.	Green Belt Development	Cost (Rs. in lakh)
1	Roadside plantation (@ Rs. 3.50/ha in 5 ha)	17.50
2	Green belt around powerhouse, Reservoir, Colony and other areas	30.00
	Total	47.50

6.3 PLAN IMPLEMENTATION

The landscaping and restoration plan will be implemented with help of landscaping experts and in consultation with State Horticulture and Forest Department, the coordination and funding will be provided by the project proponent for successful implementation of this plan.

6.4 COST ESTIMATES

The estimated cost for the restoration works, landscaping, plantations, and creation of green belt around colony and working sites would be **Rs. 167.50 lakh (Table 6.4).**

S. No.	ltem	Amount (Rs. In lakh)
1.	Cost estimates for bio-engineering measures for construction areas	120.00
2.	Green belt Development	47.50
	TOTAL	167.50

Table 6.4: 1	Total budget	for landsca	ping of pr	oiect com	ponents
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Chapter 7

COMPENSATORY AFFORESTATION PLAN

7.1 INTRODUCTION

The Pumped Storage component of Pinnapuram IREP is being constructed in the jurisdiction of Kurnool Forest Division in Kurnool district, Andhra Pradesh. The total land required for the construction of proposed project activities is approximately **713.65 ha** with **365.66 ha** of forestland, **119.65 ha** of private land and **228.34 ha** government land (**Table 7.1**).

S. No	Land Type	Area (ha)
1	Forest Land	365.66
2	Private land	119.65
3 Govt/Assigned land		228.34
	Total	713.65

Table 7.1: Details of the Land to be acquired for Pinnapuram IRE Project

7.2 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 **[365.66 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. **7879.71 lakhs**.

	•	•	
Particulars	Area (ha)	Rate Rs./ha	Amount (Rs. lakhs)
Total area for compensatory afforestation as per the notification	365.66	3.50 lakh	1279.81
Cost of Land (Non-Forest Land)	485.62	13.59 lakh	6600.00
Tota			7879.81

Table 7.2: Cost estimates of Compensatory Afforestation Plan

7.3 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 (Refer Annexure II).

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		
		Consisting of Tropical Thorn Forests and Tropical Dry		
4 ECO-Class IV		Evergreen Forests		
E	Eco Class V	Consisting of Sub-tropical Board Leaved Hill Forests, Sub-		
5		Tropical Pine Forests and Sub Tropical Dry Evergreen Forests		
		Consisting of Montane Wet Temperate Forests, Himalayan		
6	Eco-Class VI	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 Standalone Pumped Storage component of Pinnapuram IRE Project activities is **365.66 ha** (**Refer Table 7.1**). 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 7.3: Cost	estimates	of NPV
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Particulars	
Forest Land to be Diverted (ha)	365.66
Eco Class	IV
Total NPV to be deposited @Rs. 6.26 lakhs per ha	Rs. 2289.03

7.4 ABSTRACT OF COST

The total cost of the compensatory afforestation plan, NPV, compensation of trees and cost of damage to fence and infrastructure is Rs. **10168.84 lakh**. The details are given in **Table 7.4**.

SI. No.	Particulars	Amount (Rs. in lakh) [*]
1	Compensatory Afforestation	7879.81
2	Net Present Value (NPV)	2289.03
	Total	10168.84

Table 7.4: Total Cost

* Cost of trees will be additional as per actual assessment

* Final cost can be changed as per Stage-I FC clearance

Chapter **8**

AIR & WATER MANAGEMENT PLAN

8.1 INTRODUCTION

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 that the 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.

8.2 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 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.

8.2.1 Impacts of Air Pollution

The various impacts of air pollution associated with PM, SO_2 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 SO₂ 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.

8.2.2 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, quarrying, 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.

8.3 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.

8.3.1 Impacts of Noise Pollution

Noise is generally harmful and is considered to be a serious health hazard. It has farreaching 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

8.3.2 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.

8.4 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.

8.4.1 Impacts of water pollution

Water pollution is harmful and is considered to be a serious health hazard. It has farreaching 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.

8.4.2 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.

Chapter **9**

ENVIRONMENTAL MONITORING PLAN

9.1 INTRODUCTION

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.

9.2 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. Two sampling sites have been identified along with parameters to be monitored, as detailed in **Table 9.1**. The total cost for analysis the samples work out to be **Rs. 1.00 lakh** per year. The monitoring is proposed to be for a period of 3 years of construction phase.

Operation phase

The surface and ground water quality of the project area and nearby villages can be monitored thrice a year (winter, pre and post-monsoon seasons). The proposed parameters to be monitored include; pH, temperature, electrical conductivity, turbidity, total dissolved solids, calcium, magnesium, total hardness, chlorides, Sulphates, Nitrates, DO, COD, BOD, Iron, Zinc and Manganese, Total coliforms, fecal coliforms. The sampling sites are Pinnapuram and Brahmanapalle villages in the proximity of proposed project area. The total cost of analysis will be **Rs. 1.00 lakh** per year.

During project operation phase, a Sewage Treatment Plant (STP) is proposed to be set up to treat the effluent from the labour colony. It is envisaged to analyze a sample once every month each before and after treatment from the STP. The parameters to be analyzed

include pH, Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Total Suspended Solids (TSS) and Total Dissolved Solids (TDS), Total coliforms and Fecal coliforms. The cost of analysis would be **Rs. 1.00 lakh/ year**. Thus, total cost for analysis in project operation works out to be **(3.00 + 3.00) Rs. 6.00 lakh**.

Physical & Chemical Parameter	Sampling Location in Construction Phase	Monitoring
Temperature, Electrical Conductivity, Turbidity, pH, DO, BOD, TDS, Total Hardness, Total alkalinity, Chloride, Nitrate, Phosphate, Total coliforms, fecal coliforms	Pinnapuram Village (Surface and Ground water) Brahmanapalle Village (Surface and Ground water)	Once in 3 months (seasonal)
Physical & Chemical Parameter	Sampling Location in Operation Phase for first three years	
pH, temperature, electrical conductivity, turbidity, total dissolved solids, calcium, magnesium, total	Pinnapuram Village (Surface and Ground water)	
hardness, chlorides, Sulphates, Nitrates, DO, COD, BOD, Iron, Zinc and Manganese, Total coliforms, fecal coliforms	Brahmanpalle Village (Surface and Ground water)	Once in 3 months (seasonal)

Table 5.1. Water Quality Monitoring Schedule	Table 9.1: Water	Quality	Monitoring	Schedule
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9.3 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 (SO₂) 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. 7.20 lakh/year** has been earmarked for this purpose.

Operation Phase

Same schedule, as followed during construction phase, should be continued for operation phase as well.

9.4 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, an Integrating Sound Level Meter will be required for which an amount of **Rs. 1.00 lakh** per year has been earmarked.

Operation Phase

Same schedule, as followed during construction phase, should be continued for operation phase as well.

9.5 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. 10.00 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.

9.6 MUCK DUMPING

In addition to the air quality, water quality and noise quality during the construction phase, management of construction debris and muck arising out of the earth work involved in the project during construction phase is also a major environmental issue. Adopting appropriate and well-designed engineering structures for retaining the construction debris and muck is very crucial and this needs to be monitored regularly both for stability of the dump sites and their vulnerability to stress failures due to various factors such as erodability, strong water currents and earth pressures. Regular monitoring of the muck dumping will be carried out by State forest department and Andhra Pradesh Pollution Control Board (APPCB).

9.7 FINANCIAL REQUIREMENT

A sum of **Rs. 163.20 lakh** have been allocated to implement various activities and programmes envisaged under EMP, the details are given in **Table 9.2**.

S. No.	Activities	Phase	Cost (Rs. in lakh)	
1	Monitoring	Construction Water quality		3.0
		Phase (3 years)	Air quality	21.60
			Noise	3.0
		Total		27.60
		Operation Phase Water quality		3.00
		(for 3 years)	Air quality	21.60
			Noise	3.00
			27.60	
	Total Monitoring (1)			55.20
2	Ecological Studies/ monitoring @Rs.10.00 lakhs per			60.00
2	year for 6 yea	ars (3 + 3 years) 60.00		
3	Awareness pro	ogramme @Rs.2.00 la	khs per year for	12.00

 Table 9.2: Cost Estimates for Environmental Monitoring Programme

S. No.	Activities	Phase	Parameter	Cost (Rs. in lakh)
	6 years (3 + 3	6 years (3 + 3 years)		
4	Monitoring of Muck/Debris Dumping and Disposal Rs. 2.00 lakhs per year for 3 years during construction period			6.00
5	Documentation & Reporting- Six monthly reporting @ Rs.5.00 lakhs per year for 6 years (3 + 3 years)			30.00
	GRAND TOTA	L (1-6)		163.20

Chapter 10

CORPORATE ENVIRONMENT RESPONSIBILITY PLAN

10.1 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.

10.2 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.

10.2.1 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.

10.2.2 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 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

10.2.3 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.

10.3 AFFECTED AREA FOR CER ACTIVITY

The proposed Project is located at Pinnapuram Village under Panyam Mandal, Kurnool District of Andhra Pradesh State. The Project affected District, Tehsils and Villages is presented in **Table 10.1** below.

District	Mandal	Gram Panchayat	Name of Village /Hamlet
	Panyam	Pinnapuram	Pinnapuram
Kurnool	Orvakallu	Brahamanapalle	Brahamanapalle & Gumtham Thanda
	Gadivemula	Chennakkapalle	Undulla

Table 10.1: Affected Area around the Project

Among the affected villages Pinnapuram Village and Gumtham Thanda Hamlet under Brahamanapalle Village are in close vicinity of the Project and affected due to the Project activities. Undulla Village under Chennakkapalle Panchayat is partially affected by the Project activity. Although the affected Gram Panchayat under Gadivemula Mandal is named as Chennakkapalle there is no habitation/settlement with that name. The socio-economic and demographic profile of the project affected villages including the Project District and Mandals is already presented in the Chapter 5 of the EIA Report.

10.4 FOCUS AREAS FOR CER ACTIVITY

Based on the need assessment 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 10.2** below presents the thrust area and the nature of activity proposed as part of the CER Plan.

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	Support for strengthening existing roads
Development	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
Agriculture and	Support for natural farming /organic farming
Animal Husbandry	 Awareness and training on modern agricultural practices
	 Support for Veterinary services through Veterinary camps
	Promote water efficiency Precision Agriculture
Skill Development	Skill Training of local youth for Job skills
and Training	 Support for Vocational Training in market trades
	Support for capacity building of local Teachers
Livelihood	 Support to un-employed youth for small enterprises
Enhancement	 Support to local youth for self-employment
	 Support to local youth of sen employment Support to local women for household enterprises
	 Support to local artisans
	 Support for training and capacity building of local women
Environment	Plantation along roads/open spaces/ community lands
	Strengthening existing water resources

Table 10.2: Focus Area and Nature of CER Activity

Focus Area	Nature of Activity
	Awareness and Training on conservation of natural resources
Sports	 Support the local schools with play material and equipment Support for local Anganwadi Centres with play equipment Support for developing play grounds Support the local sports events Support the performing local sports persons
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

10.5 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 10.3** below. The activity is proposed to be taken up during the Project construction period and completed before March 2022.

S. No	Focus Area	Amount
		(Rs in Lakh)
А	Education	250.75
В	Health Care	233.00
С	Infrastructure Development	240.25
D	Agriculture and Animal Husbandry	58.00
E	Skill Development and Training	43.00
F	Livelihood Enhancement for Economic Self Reliance	90.00
G	Environment	70.00
Н	Sports	20.00
E	Common Interest Activity	48.50
	Total	1053.50

Table	10.3:	Budget for CER Plan
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Chapter 11

PUBLIC CONSULTATION ISSUES AND RESPONSE

Public Hearing for the Standalone Pumped Storage Component of Pinnapuram IRE Project was conducted by Andhra Pradesh State Pollution Control Board (APPCB) on 2nd November 2018 near Mandal Parishad Upper Primary School, Pinnapuram, Panyam Mandal, Kurnool District, Andhra Pradesh. Meeting was chaired by District Collector, Kurnool and attended by many other government officials of the various government departments. Proceedings of the Public Hearing have been prepared by APPCB Regional Office, Kurnool and are enclosed as a separate document. Major issues of environmental and social concerns emerged during the Public consultation process have been tabulated below along with the response of the project proponent for ready reference.

SI. No	Questions/Queries Raised	Clarification given by project proponent
1	Will local villagers get job Opportunity?	On the demand of employment opportunities for the locals, it was informed that first priority will be given to the people from affected villages based on the requirement, eligibility and skill set. Further, to improve their employability skill upgradation and training will be provided to the local youth.
2	It is requested that project developer should provide various Infra structural facilities such as drinking water facility, setup a Hospital, construct of village approach Roads, toilet facility etc. It is requested that project developer should also provide basic amenities at nearby villages also.	Regarding medical provisions to locals, it was informed that primary health care will be provided through the Mobile Health Clinic. In addition, periodic medical camps will also be conducted. On the demand for village level development activities such as improving the basic infrastructure facilities such as roads, drinking water, sanitationworks, plantation etc., it was informed that most of their suggestions and demands will be covered in the proposed Corporate Environment Responsibility (CER) Plan.
3	With regard to the private land, villagers from project area do not have patta (land holding records) and requested the District Collector and the revenue authorities to initiate a detailed survey and update the land records.	District administration informed that based on the representations received, a detailed survey will be undertaken by the Revenue Department and all the grievances based on the survey will be resolved.
4	Villagers suggested for more initiatives on tree plantations in and around project area	About tree plantations and development of green belt, it was informed that as part of the Environment Management Plan, a Greenbelt Development Plan is prepared and the same will be implemented during the construction of the project.

5	Villagers requested the Project Proponent to adopt the local villages and develop the same.	With regard to development activities in surrounding villages, it was informed that most of their suggestions and demands will be covered in the proposed Corporate Environment Responsibility (CER) Plan and assured that they will take all possible developmental activities in the Pinnapuram village to make Pinnapuram as Model village in the district.
6	At present the total storage capacity of the Gorakallu reservoir is 10.23 TMC out which 1.2 TMC is allocated for the proposed which will impact the requirement of irrigation and drinking water needs of farmers in Chittoor and Kadapa.	On the issues raised on allocation of water from Gorakallu reservoir and apprehension raised on its impact to the local farmers and the viability of the Project, it was informed that the proposed Project is different from conventional Hydro Electric Projects that are usually developed across the river and draws water on a continuous basis. It was clarified that the proposed project is a first of its kind Pumped Storage Project built using the world class technologies. It was also informed that water from reservoir will be drawn initially for non-consumptive use during suitable season and this allocated water is sufficient for generation capacity of 1200 MW. Further any shortfall, if any is proposed to be replenished from Gorakallu Reservoir during suitable. It was further informed that the allocated water is then used for generation of electricity through recirculation in close loop process between the proposed upper and lower reservoir. It was also informed that the above allocation will not cause any water shortage to farmers.
7	Villagers requested the Project Proponent to protect the interests of the local people and ensure the availability of grazing lands, encourage animal husbandry activity and veterinary services.	It was informed that the existing veterinary and other animal husbandry services will be provided through periodic veterinary camps for the livestock and also informed that due care will be taken by them for ensuring the availability of grazing area for the livestock while planning of the project.

Main issues and queries submitted through written representations during the Public Hearing and response by the project proponent.

SI. No	Issues raised	Response
1	Utilization of 713.65 Ha of Forest Land for the proposed project and its impact on local Flora & Fauna.	The detailed impact on the flora and fauna in the study area including the proposed project area an appropriate bio diversity management plan is prepared and that will be implemented as part of the EMP. Further, as per the relevant guidelines issued by the State Forest Department the loss of forest is compensated through an appropriate Compensatory Afforestation Plan.
2	Allocation of Water from Gorakallu Reservoir and its associated Impact on the Farmers and Viability of the project.	The proposed Project is different from conventional Hydro Electric Projects that are usually developed across the river and draws water on a continuous basis. The water from reservoir will be drawn initially for non- consumptive use during suitable season and this allocated water is sufficient for generation capacity of 1200 MW. Further any shortfall, if any is proposed to be replenished from Gorakallu Reservoir during suitable. The allocated water is then used for generation of electricity through recirculation in close loop process between the proposed upper and lower reservoir. The above allocation will not cause any water shortages to the farmers.
3	Construction of the proposed project and impact from dust pollution	All necessary precautions will be taken to reduce the impact from dust pollution arising out vehicle movement through water sprinkling on the project roads. The other mitigative measures are also provided in EMP.
4	Skill development program for unemployed youth	All the eligible youth will be provided Skill Development Training. The youth will be training to improve their employability skills.
5	Rainwater Harvesting Structure & Tree Plantation in Project Villages	As part of the environment protection measures under the CER plan tree plantation activity will be taken up and rain water harvesting structures will be constructed.
6	Provision of employment in nontechnical & semiskilled jobs	With regard to employment opportunities for the locals, first priority will be given to the people from project affected Villages, surrounding villages based on the requirement, eligibility and skill set.

7	Provision of work and business opportunity to the locals	Based on the experience and skill priority will be given to the locals for providing petty work opportunity arising out of the project construction. Further locals will also get priority in allocation of petty shops and other business opportunity arising of the Project.
8	Undertake Village development activity such as improving education, health, transport, drinking water facility	All the village development activities in surrounding villages such as improving the basic infrastructure facility such as roads, drinking water, sanitation facility, plantation and others etc most of their suggestions and demands will be covered in the proposed Corporate Environment Responsibility (CER) Plan.
9	Special health checkups, health camps for surrounding Villagers and Construction workers	The primary health care requirements for the locals will be covered through the Mobile Health Clinic. In addition, periodic medical camps for locals people will also be conducted.
10	Issues pertaining to the existing land records of private land at Pinnapuram Village, specifically updating of the land records	The District Collector who is a competent authority on the issue raised by the local people assured that the Revenue Department will undertake a detailed survey of the land and taking into consideration merits of their representations all their grievances on the land issues will be resolved by the Government.

Chapter 12

COST ESTIMATES

The costs involved for implementation of Environmental Management Plan and Corporate Environment Responsibility Plan for Standalone Pumped storage Component of Pinnapurum 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. 12893.05 lakh (Table 12.1)**

S. No.	Management Plans	Amount (Rs. in lakh)	
Α	Environmental Management Plan		
1	Biodiversity Conservation & Wildlife Management Plan	310.00	
2	Muck Dumping and Management Plan	480.85	
3	Solid Waste Management Plan	201.16	
4	Public Health Delivery System	168.00	
5	Energy Conservation Measures	180.00	
6	Landscaping, Restoration & Green Belt Development Plan	167.50	
7	Compensatory Afforestation Plan*	10168.84	
8	Air, Water & Noise Management Plan**	162.20	
9	Environmental Monitoring Program	163.20	
	Total A	11839.55	
В	Corporate Environment Responsibility Plan	1053.50	
	Total (A+B)		

Table 12.1: Cost for Implementing Environmental	Management Plan & CER Activities
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*Actual cost of Compensatory Afforestation will be finalized by forest Department.

**Cost of Air, Water & Noise Management Plan is given in Environmental Monitoring Plan

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 Flora

1.1 INTRODUCTION

Habitat destruction and over exploitation of natural forests are the two major contributors to the loss of biodiversity world-wide. Forests as a natural resource which furnish food, fuel-wood, fodder and other forest product for local livelihood. However, due to continued pressure on forests with increasing human population, severe change in the forest cover is reported during the last five decades. Large scale conversion of forest into agriculture land and lack of access and control on annual fires in forest affected forest to a poor condition. About 55% of the total forest cover is prone to fires annually in India (Gubbi, 2003) and there is widespread concern about loss of biodiversity, increase in concentration of greenhouse gases and effects on atmospheric chemistry due to forest fires. Forest fires are reported as a major driver of the global change in terrestrial ecosystems (Rudel et al, 2005; Reddy et al, 2017). These anthropogenic disturbances not only influence landscape and ecosystem but also the physical environment and the availability of resources (White and Pickett, 1985).

To ensure sustained availability of many products such as food, fruits, vegetables, fuel, medicines raw materials and other indirect benefits and services such as ornamentals, shading or landscaping, fencing, etc cultivation of trees in agricultural systems is one of the major practices in the tropics of South and South East Asia (Fernandes and Nair, 1986). Therefore, in view of the depleting timber and NTFP resources in the wild, such intermixing of species of agriculture and forestry is considered as a potential source of solutions of many disturbed land use systems.

1.2 BIODIVERSITY STUDY TASKS

The account of Biodiversity profile of the project study has been described based on the primary survey in the area supplemented with the Forest Working plan and records of Kurnool Forest Division. The surveys were carried out for description of vegetation in the study area of Standalone Pumped Storage component of Pinnapuram Integrated Renewable Energy Project (IREP). It describes the forest types in the study area and the documentation of flora in the project area comprised of lower and upper reservoirs area and adjoining water supply source Gorakallu reservoir within 10 km radius near Gorakallu village.

1.3 FOREST TYPES

Andhra Pradesh is reported to have 19.57 % of the geographic area under forest which includes very dense, moderately dense, and open forest (FSI, 2017). The four major forest types found in the state are Tropical Dry Deciduous, Southern Tropical Thorn,



Southern Tropical Moist Deciduous and Littoral and Swamp forests (Champion and Seth, 1966). The study area of the proposed Pinnapuram Integrated Renewable Energy with Project (IREP) has only Group 6 - Tropical Thorn Forest type and belong to Subgroup 6A/C1, 6A/DS1 and 6A/DS2. However, majority of the project area between Brahmanapalle village and Pinnapuram village is comprised of agricultural and fallow lands with surrounding vegetation of thorny trees and scrubs. Rollapadu Wildlife Sanctuary is located at a distance of about 12km from the project area.

The vegetation in fallow lands or cropped area particularly in around Brahmanapalle village and Pinnapuram Village comprises much disturbed and degraded thorn forest. Cultivation of vegetables with cotton as a main cash crop throughout the region. The forests present in the study area have been grouped into different forest types following the 'A Revised Survey of the Forest Types of India' by Champion and Seth (1968), Negi, (1989, 1996), Mudgal and Hajra (1999) and Reddy *et al* (2014). The major forest type found in this region is discussed below.

6A Southern Tropical Thorn Forests

These are open forests in which low thorny and woody species predominate. The trees usually have short boles and low branching crowns and vary in height from 6 to 9 m. There usually occurs a mixture of many species. The vegetation is comprised of small trees and large shrubs. Grass growth is thin and appears during the short-wet season. Climbers are few and show xerophytic adaptations. The forest of this sub-group may be of the following types:

6A/C1 Southern thorn forest

This is an open dry deciduous forest in which thorny trees are scattered. These forests occur in the dry tracts of central and south India. The main tree species in this type are *Acacia arabica, A. leucopholea, A. planifrons, Balanites aegyptiaca, Canthium cormandelicum, Dichrostachys cinerea, Dalbergia latifolia, D. sissoo, Gymnosporia spinosa, Grewia tenax, Prosopis juliflora, Tamarindus indica, Ziziphus maurtiana, etc. Shrubs include Catunaregam spinosa, Dodonaea viscosa, Dolichandrone falcata, Euphorbia antiquorum, Flacourtia indica, Lantana camara, Phoenix sylvestris, Senna auriculata, Tamilnadia ulginosa, Ziziphus jujuba and Z. xylopyrus. This type of patchy forest is observed in Brahmanapalle, Husainpuram, Gorakallu and Pinnapuram village surrounding areas. The common grasses in the open and drier habitats are <i>Aristida adscensionis, Bothriochloa pertusa, Brachiaria reptans, Heteropogon contortus* and *Saccharum spontaneum*.



1.4 VEGETATION PROFILE IN THE STUDY AREA

The description of vegetation of the project area has been presented in terms of stretches which correspond to topographic/elevational class within the 10 km radius influence zone of the project. These are as follows:

- i) Area between and Brahmanapalle village and Hussainapuram village
- ii) Area around Kalava village and up to Pinnapuram village
- iii) Area beyond Pinnapuram village and its environ.

1.4.1 Area between Brahmanapalle and Hussainapuram Village

This area predominantly has open, much disturbed and degraded southern thorn forest in the bases of forested hills bordering villages and agricultural lands in Brahmanapalle area. Because of large scale human interference especially for agriculture farming, only few tree species can be observed on the edges of fallow land and agricultural fields. Cotton cultivation is practiced throughout the region. Besides cotton crop, Paddy (*Oryza sativa*), sugar cane, ground nut and vegetables are the main crops in agricultural fields (**Plate 1.1a**).

In and around of Hussainapuram, some large tree species like Azadirachta indica, Bauhinia racemosa, Cassia fistula, Chloroxylon swietenia, Dalberbergia latifolia, Eucalyptus spp., Hardwickia binata, Tamarindus indica, etc are seen on clay and clay loam soils especially on edges of agricultural fields (Plate 1.1b), whereas on dry forest soils Acacia spp., Balanites aegyptiaca, Canthium coromandelicum, Dichrostachys cinerea, etc are found scattered. The shrubby elements are composed of decumbent and spreading species, viz., Abutilon indica, Capparis divaricata, Catunaregam spinosa, Euphorbia antiquorum, Lantana camara, Mimosa hamata, Ziziphus mauritiana, Z. xylopyrus, etc. Besides cotton crop, maize (Zea mays), sugar cane (Saccharum officinarum) and vegetables are the main crops in agriculture in this area (**Plate 1.1c**).

In and around lower reservoir, near Brahmanapalle area, a fairly dense thorn forest is found at the bases of forested high hills bordering this area. The dominant trees near this project site are Acacia arabica, A. horrida, A. leucophloea, A. planifrons, Azadirachta indica, Bauhinia racemosa, Canthium coromandelicum, Chloroxylon swietenia, Hardwickia binata, Prosopis juliflora and Salvadora persica. Shrubs include Catunaregam spinosa, Euphorbia antiquorum, Flacourtia indica, Gardenia gummifera, Gymnosporia spinosa, Grewia tenax, Lantana camara, Tamilnadia ulginosa and Ziziphus maurtiana. The ground floor is disturbed show gaps and covered with few dry grasses and herbs like Aristida adscensionis, Bothriochloa pertusa, Cynodon dactylon, Heteropogon contortus, Paspalum vaginatum, Saccharum spontaneum, Sida cordata, S. rhombifolia, etc.



1.4.2 Area around Kalava village and up to Pinnapuram

A low thorny and spreading patches of few tree species can be seen in hillocks and near rocky areas. Around Pinnapuram village area, the main spreading and thorny tree species are Acacia leucophloea, A. planifrons, Balanites aegyptiaca, Canthium coromandelicum, Gymnosporia spinosa, Prosopis juliflora, Tamilandia ulginosa and Ziziphus mautiana. Other deciduous and planted tree species scattered found in the area include Albizia amara, Bauhinia racemosa, Gmelina arborea, Hardwickia binata, Holoptelea integrrifolia, etc. Understorey is thin composed of few invading shrubs like Calotropis gigantea, Capparis divaricata, Lantana camara, Mimosa hamata, Senna siamea, Urena lobata and Ziziphus xylopyrus (Plate 1.1d). Few fruit yielding trees like Sharifa (Annona squamosa), mango, Guava, banana, etc can be seen planted in the small orchards and edges of agricultural fields near villages. Under thorny vegetation herbs population is thin and meagre. The common dry habitat grasses in the forest floor are Aristida adscensionis, Bothriochloa pertusa, Cenchrus ciliaris, Eragrostis tenella, Heteropogon contortus and Saccharum spontaneum. Other herb species found in the area are Achyranthes aspera, Cleome viscosa, Datura metel, Gomphrena globosa, Parthenium hysterophorus, Saccharum spontaneum, Sida cordata and S. rhombifolia.

The forests especially in upper reservoir area (near Pinnapuram village) and adjoining Hussainapuram-Kalava area are of are under heavy biotic pressure due to deforestation by burning and tree felling for preparation of agricultural fields, road construction, other developmental works, etc. These anthropogenic activities are causing an irreparable damage to the flora of the state.

1.4.3 Area beyond Pinnapuram and its environs

There are number of economically important plant species found in the surrounding area of Ghani Reserve forest. Important tree species found in the surrounding forest area include Acacia chundra, Anogeisus latifolia, Bauhinia racemosa, Butea Cordia dichotoma, Hardwickia binata, Helictres isora, Lannea monosperma, coromandelica, Syzyajum cumini, Tectona grandis, Terminalia arjuna, T. tomentosa and Wrightea tinctoria. Other small trees and tall spreading shrub species occur in forest are Anacardium occidentale, Bambusa arundinacea, Borassus flabellifer, Calycopteris spinarum, floribunda, Carissa Cleistanthus collinus, Catunaregam spinosa, Dendrocalamus strictus, Hemidesmus indicus, Holarhena pubescens, etc.

1.5 FLORISTICS OF PROJECT AREA

The present Biodiversity study in the project area of Pumped storage component of Pinnapuram IREP was undertaken with the objectives of preparing a checklist of flora in



the Lower reservoir and upper reservoir are proposed; listing of rare/endangered, economically important and medicinal plant species.

1.5.1 Vegetation around Lower Reservoir Area

The Lower reservoir is located near Brahmanapalle village, downstream of Pinnapuram village, in Kurnool District of Andhra Pradesh. Across the right and left bank of proposed lower reservoir, the vegetation is fairly rich comprised of Southern thorn forest type. The upper reaches of the bordering hills are covered with southern dry deciduous forest. The top storey of forest consists of *Acacia arabica, A. horrida, Azadirachta indica, Bauhinia racemosa, Cassia fistula, Canthium coromandelicum, Chloroxylon swietenia, Dalberbergia latifolia, Hardwickia binata and Tamarindus indica.* Second storey consists of few small trees like *Acacia planifrons, Balanites aegyptiaca, Feronia limonia, Holoptelea integrifolia, Morinda pubescens, Phyllanthus emblica* and *Prosopis juliflora* (**Plate 1.2a**). The shrubby elements are composed of decumbent and spreading species, viz., *Abutilon indica, Capparis divaricata, Catunaregam spinosa, Euphorbia antiquorum, Lantana camara, Mimosa hamata, Ziziphus mauritiana, Z. xylopyrus.* Forest floor is disturbed and show gaps covered with grasses, weeds and herbs (**Plate 1.2b**). A total of 70 species of angiosperms including trees, shrubs and herbs are recorded in the Lower reservoir area during primary survey (**Table 1.1**).

Area					
Botanical Name	Indian /Local Name	Family	Uses		
Trees					
Acacia arabica	Nallathumma	Mimosaceae	Medicinal		
A. leucophloea	Tillatuma	Mimosaceae	Medicinal		
A. horrida	Boggili	Mimosaceae	Fuel-wood		
A. planifrons	Gundutumma	Mimosaceae	Fuel-wood		
Albizia amara	Chigara	Mimosaceae	Ornamental		
Azadirachta indica	Vepa	Meliaceae	Medicinal		
Balanites aeygptiaca	Hingota	Simarubaceae	Medicinal		
Bauhinia racemosa	Thati	Arecaceae	Vegetables		
Canthium coromandelicum	Billudu	Rubiaceae	Fuel-wood		
Chloroxylon swietenia	Rela	Meliaceae	Medicinal		
Cassia fistula	Irugudu	Caesalpiniaceae	Medicinal		
Dalbergia paniculata	Dobin	Papilionaceae	Timber		
Dichrostacys cinerea	Jangli Jalebi	Mimosaceae	Fuel-wood		
Feronia limonia	Bhenta	Rutaceae	Medicinal		
Hardwickia binata	Үері	Caesalpiniaceae	Timber		
Holoptelea integrifolia	Papri	Ulmaceae	Fuel-wood		
Phyllanthus emblica	Aonla	Euphorbiaceae	Medicinal		
Prosopis juliflora	Kabuli Kikar	Mimosaceae	Fuel-wood		
Salvadora persica	Goni	Salvadoraceae	Medicinal		
Tamarindus indica	Puli	Caesalpiniaceae	Fruits edible		
Shrubs					
Abutilon indicum	Aphra	Malvaceae	Medicinal		
	Botanical NameTreesAcacia arabicaA. leucophloeaA. horridaA. planifronsAlbizia amaraAzadirachta indicaBalanites aeygptiacaBauhinia racemosaCanthium coromandelicumChloroxylon swieteniaCassia fistulaDalbergia paniculataDichrostacys cinereaFeronia limoniaHardwickia binataHoloptelea integrifoliaPhyllanthus emblicaProsopis julifloraSalvadora persicaTamarindus indicaAbutilon indicum	AreaBotanical NameIndian /Local NameTreesAcacia arabicaA. leucophloeaTillatumaA. leucophloeaTillatumaA. horridaBoggiliA. planifronsGundutummaAlbizia amaraChigaraAzadirachta indicaVepaBalanites aeygptiacaHingotaBauhinia racemosaThatiCanthium coromandelicumBilluduChloroxylon swieteniaRelaCassia fistulaIruguduDalbergia paniculataDobinDichrostacys cinereaJangli JalebiFeronia limoniaBhentaHardwickia binataYepiHoloptelea integrifoliaPapriPhyllanthus emblicaAonlaProsopis julifloraKabuli KikarSalvadora persicaGoniAbutilon indicumAphra	Botanical NameIndian /Local NameFamilyTreesAcacia arabicaNallathummaMimosaceaeA. leucophloeaTillatumaMimosaceaeA. horridaBoggiliMimosaceaeA. horridaBoggiliMimosaceaeA. planifronsGundutummaMimosaceaeAlbizia amaraChigaraMimosaceaeAzadirachta indicaVepaMeliaceaeBalanites aeygptiacaHingotaSimarubaceaeBalanites aeygptiacaThatiArecaceaeCanthium coromandelicumBilluduRubiaceaeChloroxylon swieteniaRelaMeliaceaeDalbergia paniculataDobinPapilionaceaeDalbergia paniculataDobinPapilionaceaeDichrostacys cinereaJangli JalebiMimosaceaeHardwickia binataYepiCaesalpiniaceaeHoloptelea integrifoliaPapriUlmaceaeProsopis julifloraKabuli KikarMimosaceaeSalvadora persicaGoniSalvadoraceaeTernarindus indicaPuliCaesalpiniaceaeAbutilon indicumAphraMalvaceae		

Table 1.1: List of flowering plant species recorded in and around the Lower Reservoir



SI. No.	Botanical Name	Indian /Local Name	Family	Uses	
2	Calotropis gigantea	Aankh	Asclepiadaceae	Medicinal	
3	Capparis divaricata	-	Capparadaceae	-	
4	C. sepiaria	Heens	Capparadaceae	-	
5	Catunaregam spinosa	-	Rubiaceae	Medicinal	
6	Euphorbia antiquorum	Peddajamud	Euphorbiaceae	-	
7	Flacourtia indica	-	Flacourtiaceae	Fuel-wood	
8	Grewia tenax	-	Tiliaceae	Fodder	
9	Gymnosporia spinosa	Tandarsi	Celastraceae	Medicinal	
10	Helicteres isora	Marod phali	Sterculiaceae	Medicinal	
11	Lantana camara	Kuri	Verbenaceae	Fuel-wood	
12	Mimosa hamata	-	Mimosaceae	Medicinal	
13	Morinda pubescens	-	Rubiaceae	-	
14	Senna auriculata	Tangadi	Caesalpiniaceae	Medicinal	
15	Senna siamea	Mezali	Bignoniaceae	Medicinal	
16	Tamilnadia ulginosa	-	Rubiaceae	Medicinal	
17	Vallaris solanacea	Kinbot gye	Apocynaceae	Fiber	
18	Ziziphus maurtiana	Ber	Rhamnaceae	Fruits edible	
19	Z. xylopyrus	-	Rhamnaceae	-	
	Herbs				
1	Achyranthes aspera	Chir chita	Amaranthaceae	Medicinal	
2	Aristida adscensionis	-	Poaceae	-	
3	Apluda aristata	-	Poaceae	-	
4	Blumea lacera	-	Asteraceae	-	
5	B. densiflora	-	Asteraceae	-	
6	Bothriochloa pertusa	-	Poaceae	-	
7	Chloris dolichostachya	-	Poaceae	-	
8	Cissus quadrangularis	Hadjod	Vitaceae	Medicinal	
9	Cymbopogon martinii	Lemon grass	Poaceae	Aromatic oil	
10	Cynodon dactylon	Durba	Poaceae	Medicinal	
11	Cyperus irria	-	Cyperaceae	-	
12	Dicliptera bupleuroides	-	Acanthaceae	-	
13	Eragrostis tenella	-	Poaceae	Medicinal	
14	Euphorbia hirta	-	Euphorbiaceae	-	
15	Gnaphalium pensylvanicum	-	Asteraceae	-	
16	Gomphrena globosa	-	Amaranthaceae	-	
17	Heteropogon contortus	Kuri	Poaceae	-	
18	Indigofera linifolia	Sankhahuli	Papilionaceae	-	
19	Malvastrum coromandelianum	Kharenti	Mimosaceae	-	
20	Mimosa pudica	Chigara	Mimosaceae	-	
21	Paspalum vaginatum	-	Poaceae	-	
22	Parthenium hysterophorus	Gajar Ghass	Asteraceae	-	
23	Pavonia zeylanica	-	Malvaceae	-	
24	Phyllanthus fraternus	-	Euphorbiaceae	-	
25	Tephrosia purpurea	Sar Phunkha	Papilionaceae	-	
26	Saccharum spontaneum	Kaans	Poaceae	-	
27	Senna tora	-	Caesalpiniaceae	Medicinal	
28	Sida cordata	Kharenti	Malvaceae	Medicinal	
29	S. rhombifolia	-	Malvaceae	Medicinal	
30	Tridax procumbens	-	Asteraceae	Medicinal	
31	Vernonia cinerea	-	Asteraceae	-	

1.5.2 Vegetation around Upper Reservoir Area

The upper reservoir is proposed near Pinnapuram village area. The vegetation near project is comprised of patches of southern thorn forest interspersed with cotton fields.



The main trees species in the project area are Acacia arabica, Albizia amara, Annona squamosa, Balanites aegyptiaca, Cassia fistula, Hardwickia binata, Mangifera indica and Prosopis juliflora (Plate 1.2c). Understorey is also thin and composed of few patches of tall shrubs like Abutilon indica, Capparis divaricata, Catunaregam spinosa, Calotropis gigantea, Euphorbia antiquorum, Lantana camara, Mimosa hamata, Senna auriculata, S. siamea, Urena lobata, Ziziphus xylopyrus (Plate 1.2d). Ground cover consists of few herbaceous species and weeds like Achyranthes aspera, Apluda aristata, Aristida adscensionis, Bothriochloa pertusa, Cenchrus ciliaris, Datura metel, Eragrostis tenella, Gomphrena globosa, Sida cordata, S. rhombifolia, etc. A total of 61 species of flowering plants including trees, shrubs and herbs are recorded in the Upper reservoir area during primary survey (Table 1.2).

	Area					
SI. No.	Botanical Name	Indian/Local Name	Family	Uses		
	Trees					
1	Acacia arabica	Nallathumma	Mimosaceae	Medicinal		
2	A. leucophloea	Tillatuma	Mimosaceae	Medicinal		
3	A. horrida	Boggili	Mimosaceae	Fuel-wood		
4	A. planifrons	Gundutumma	Mimosaceae	Fuel-wood		
5	Albizia amara	Chigara	Mimosaceae	Ornamental		
6	Annona squamosa	Sharifa	Annonaceae	Fruits edible		
7	Balanites aegyptiaca	Hingota	Simarubaceae	Medicinal		
8	Bauhinia racemosa	Ari	Caesalpiniaceae	Vegetables		
9	Boswelia serrata	Anduga	Burseraceae	Medicinal		
10	Cassia fistula	Rela	Caesalpiniaceae	Medicinal		
11	Dalbergia latifolia	Irugudu	Papilionaceae	Timber		
12	Eucalyptus citridora	Neelagiri	Myrtaceae	Timber		
13	Gmelina arborea	Kumbili	Verbenaceae	Medicinal		
14	Hardwickia binata	Үері	Caesalpiniaceae	Timber		
15	Holoptelea integrifolia	Papri	Ulmaceae	Fuel-wood		
16	Mangifera indica	Aam	Anacardiaceae	Fruits edible		
17	Prosopis juliflora	Vialayati kikar	Mimosaceae	Fuel-wood		
18	Tamarindus indica	Puli	Caesalpiniaceae	Fruits edible		
4	Shrubs	A . I				
1	Abutilon Indicum	Apnra	Ivialvaceae	Medicinal		
2	Caloptropis gigantea	Аапкп	Asciepiadaceae	Medicinal		
3	Capparis alvaricata	-	Capparadaceae	-		
4	Catunaregam spinosa	-	Rublaceae	Medicinal		
5	Corchorus olitorius	Jute		Fiber		
5	Dodonaea Viscosa	-	Sapindaceae	Fuel-Wood		
/	Eupriorbia antiquorum	- Tauadaua:	Euphorbiaceae	Urnamental		
8	Gyrnnosporia spinosa	Tandarsi	Celastraceae	Nedicinal		
9	ipomoea carnea	-	Euphorbiaceae	iviedicinal		
10	Lantana camara	KURI	verbenaceae	Fuel-Wood		
11	iviimosa namata	- Tana and:	iviimosaceae	iviedicinal		
12	Senna auriculata	Tangadi	Caesaipiniaceae	iviedicinal		

Table 1.2 List of flowering plant species recorded in and around the Upper Reservoir

Standalone Pumped Storage Component of Pinnapuram IREP



SI. No.	Botanical Name	Indian/Local Name	Family	Uses	
13	Senna siamea	Mezali	Caesalpiniaceae	Medicinal	
14	Urena lobata	-	Malvaceae	Medicinal	
15	Tamilnadia ulginosa	-	Rubiaceae	Medicinal	
16	Ziziphus xylopyrus	-	Rhamnaceae	-	
	Herbs			-	
1	Aristida adscensionis	-	Poaceae	-	
2	Apluda aristata	-	Poaceae	-	
3	Blumea lacera	-	Asteraceae	-	
4	B. densiflora	-	Asteraceae	-	
5	Bothriochloa pertusa	-	Poaceae	-	
6	Cenchrus ciliaris	-	Poaceae	-	
7	Cissus quadrangularis	Hadjod	Vitaceae	Medicinal	
8	Cynodon dactylon	Durba	Poaceae	Medicinal	
9	Cleome viscosa	Hulhul	Capparadaceae	Medicinal	
10	Cyperus niveus	-	Cyperaceae	-	
10	Datura metel	Dhatura	Solanaceae	-	
11	Dicliptera bupleuroides	-	Acanthaceae	-	
12	Eragrostis tenella	-	Poaceae	-	
13	Euphorbia hirta	Dudhi	Euphorbiaceae	-	
14	Gomphrena globosa	-	Amaranthaceae	-	
15	Heteropogon contortus	Kuri	Poaceae	-	
16	Malvastrum coromandalica	-	Malvaceae -		
				Fruits	
17	Musa paradisiaca	Kela	Musaceae	edible	
18	Parthenium hysterophorus	Gajar Ghas	Asteraceae	-	
19	Paspalum vaginatum	-	Poaceae	-	
20	Phyllanthus fraternus	-	Euphorbiaceae	-	
21	Rungia pectinata	-	Acanthaceae	-	
22	Tephrosia purpurea	-	Papilionaceae	-	
23	Saccharum spontaneum	-	Poaceae	-	
24	Senna tora	-	Caesalpiniaceae	-	
25	Sida cordata	kharenti	Malvaceae	Medicinal	
26	S. rhombifolia	-	Malvaceae	Medicinal	
27	Tridax procumbens	Pather chatta	Asteraceae	Medicinal	

1.6 RET SPECIES

The project area is largely a degraded ecosystem due to high human pressure, large scale removal of fodder and timber species for preparation of agricultural fields, construction of road, etc. As per Red Data Book of India, no rare and endangered species are reported from the project area (Nayar and Sastry, 1987, 1988 & 1990). Since most of forest pockets or forest stands are already converted for agricultural practices in the Pinnapuram area, there is no possibility of these threatened species to be found in the dry and degraded areas of the proposed project.

During the present primary survey in the project area we came across four plant species which have been reported threatened in IUCN Red List of Threatened species. *Chloroxylon swietenia* and *Dalbergia latifolia* are listed in Vulnerable category, while



Azadirachta indica and *Senna siamea* are listed in Least Concern category from the project as well influence area of this project (**Plate 1.3a & b**).

1.7 ECONOMICALLY IMPORTANT PLANT SPECIES

Though most of the natural forest cover in Pinnapuram and adjoining (Hussainapuram-Brahamanapalle village) area has been cleared for agriculture, road construction, developmental works, etc., but few patches of Southern thorn forest and southern dry mixed deciduous forest can be observed in Lower reservoir area (near Brahamanapalle village) especially adjoining to Ghani Reserve Forest area of Kurnool District of Andhra Pradesh. Vegetation is varied in the forest area depending upon land use, climate and edaphic factors. The remnant forest in the project area is rich resource for many edible plants, medicinal plants, fibre and pulp industry, etc. Comprehensive account of these plant resources is given below:

i) Medicinal Plants

This state harbours a wide range of medicinal and aromatic plants used in Ayurvedic, Homoeopathic, Sidha medicines or used by the local people. Many local people or tribal population inhabited in the various adjoining pockets of the forest areas, use these plants for curing their common diseases. Recent floristic diversity study in Ghani Reserve forest, identifies about 111 medicinally important plants used by the people for the treatment of common diseases in Nerramalais forest area (Khaleel and Niaz Parveen, 2013). Different parts of medicinal plant species were used by local people as medicine (Mudgal and Hajra, 1999). Some of the important medicinal and aromatic plants of the project area are given in **Table 1.3 (Plate 1.4 a, b & C**).

Pinnapuram IREP			
Botanical Name	Indian/Local Name	Family	Part used
Abutilon indicum	Aphra	Malvaceae	Roots
Acacia arabica	Nallathumma	Mimosaceae	Pods
			Leaves,
Azadirachta indica	Vepa	Meliaceae	Twigs
Balanites aeygptiaca	Hingota	Simarubaceae	Fruits
Caloptropis gigantea	Aankh	Asclepiadaceae	Roots
Cassia fistula	Irugudu	Caesalpiniaceae	Pods
Catunaregam spinosa	-	Rubiaceae	Fruits
Cissus quadrangularis	Hadjod	Vitaceae	stem
Datura metel	Dhatura	Solanaceae	Fruits
Dicliptera bupleuroides	-	Acanthaceae	Roots
Feronia limonia	Bhenta	Rutaceae	Leaves
Gmelina arborea	Kumbili	Verbenaceae	Fruits
Gymnosporia spinosa	Tandarsi	Celastraceae	Leaves
Ipomoea carnea	-	Euphorbiaceae	Roots
Mimosa hamata	-	Mimosaceae	Fruits
Phyllanthus fraternus	-	Euphorbiaceae	Leaves

Table 1.3 Some of the medicinal plants recorded in the Standalone component of



Senna auriculata	Tangadi	Caesalpiniaceae	Leaves
Senna siamea	Mezali	Bignoniaceae	Leaves
Sida cordata	kharenti	Malvaceae	Leaves
S. rhombifolia	-	Malvaceae	Roots
Urena lobata	Vilayti San	Malvaceae	Roots

ii) Food Plants

A variety of wild edible plants occur in the project and influence area. These includes leaves and buds of *Senna auriculata, S. siamea, Chenopodium album, Bauhinia racemosa;* fruits of *Annona squamosa, Canthium coromandelicum, Grewia tiliiifolia, Musa paradisiaca, Ziziphus jujuba, Z. maurtiana;* Seeds of *Cassia fistula, Cleome viscosa, Helicteres isora*, etc. (**Plate 1.5 a & b**).

iii) Fibre yielding species

Some fiber yielding plant species include *Abutilon indicum, Grewia tiliiifolia, Helicteres isora, Sida rhombifolia,* etc. in the project as well as influence area.

iv) Plywood and Paper pulp Industry

Some important plywood and pulp yielding species in the project influence area are *Eucalyptus* spp., *Dalbergia sissoo* (Shisham) and *Mangifera indica* (Aam).



2.1 INTRODUCTION

Present study area is covered under the Deccan Plateau biogeographic province of India. The area comes under the jurisdiction of Kurnool district of Andhra Pradesh, a part of a distinct topographic region 'Rayalaseema'. Major area of Kurnool district is covered with agricultural land (about 65%) while designated forest area is nearly 19% (as per revenue record).

The natural floral and faunal composition of a region largely depends on the climatic conditions, relief, topography and land use/land cover. Zoo-geographically the area classified under the Indo-Malayan region. Major part of the study area is under rainfed fallow land, rainfed mixed crop land and rangeland land use, the small forest patches are in fragmented condition and the region is highly prone to drought (Anitha, 2016). The land use/land cover patterns and diversified climatic conditions reflect in the faunal composition of the region.

The present study was undertaken in the light of proposed Pumped Storage component of Pinnapuram IREP, the construction activities of the proposed projects are anticipated to lead adverse impacts on the flora and fauna of surroundings environ. The baseline data on different faunal elements would be helpful in the prediction of likely impacts of the project and in formulating a sound plan for mitigation measures.

2.2 STUDY AREA AND METHODOLOGY

The proposed project is located in Pinnapuram village of Panyam sub-division of Kurnool district. Major structure of the project envisages the creation of two reservoirs, a head race tunnel, powerhouse and embankment. The water of lower reservoir will be pumped up and stored in upper reservoir (Pinnapuram reservoir) and will be utilized for power generation. The Geographical coordinates of the proposed Pinnapuram reservoir are at longitude 78° 18' 29.17" E. and latitude 15° 35' 38.57" N.

The study essentially covered an area of 10 km radius of said structures (**Figure 2.1**). Faunal elements comprised of mammals, avifauna, herpetofauna, butterflies and other invertebrates. The data was gathered with the help of primary surveys, carried out for three seasons and secondary literature. Primary surveys included direct sightings, presence of pellets, calls and interaction with local people. To gather the data from secondary literature, Forest Working Plan of concerned Forest division was consulted. In addition, literature available from the adjoining areas was also consulted. Literature included Kurup (1992), Rao *et al.* (2005, 2007), Manakadan (2014), Harinath *et al* (2014)



and anonymous sources. All the species reported in secondary literature mentioned above were not included in the inventory list randomly. Only those species were included in this contribution whose presence in the study area was confirmed by local people and other sources. After preparation of inventory of species, each species was subjected to the assessment for its conservation status using criteria of IUCN (2018-1) and IWPA (1972).

2.3 SPECIES DIVERSITY AND DISTRIBUTION

2.3.1 Mammals

Major part of the study area is dominated with farm practices and scrub forests. The species inhabit this area are well adapted to scrub forests and grasslands. During the study, presence of a total of 31 species could be confirmed to inhabit this area from primary and secondary sources. All species are grouped under 21 families (Table 2.1). Primates are represented by three species, of which Bonnet Macaque is most common and widely distributed in the area. Striped Hyena and Civet Cat of families Hyaenidae and Viverridae, respectively are rarely reported in the study area. Hyaena occupies open grassland while Civet Cat is found in the inner part of forest areas. The species of Herpestidae (Mongoose) are very common species of the region. They inhabit all types of habitats like forests, scrubs, settlements and agricultural fields. Indian Porcupine (Hystricidae) is generally reported from small forest patches.

Ungulates comprise three species (Wild Boar, Cheetal and Black Buck). All these species inhabit grasslands and agricultural fields. In this area they are found to raid crops, therefore, man – wildlife conflicts due to these species are common in this area. Hedge Hog (Erinaceida) and Common Indian Hare (Leporidae) are commonly found in this region. Common Indian Hare is also reported from agricultural fields and is found to damage the crops. It is widely distributed species and occupies scrubs and grasses. Chiroptera (Bats) include about 7 species, all species are common in the area. Rodents comprise 7 species, of which 6 are mice and rats while one species is squirrel. A few more species of rodents and bats are anticipated to occur in the study area.

Table 2.1: Mammal species composition in the influence zone of Pumped storage componentof Pinnapuram IRE Project

				Conse Sta	Conservation Status	
S. No.	Family	Scientific Name	Common Name	IWPA 1972	IUCN 2018- 1	
1	Cercopithecidae	Macaca mulatta	Rhesus macaque	I	LC	
2	Cercopithecidae	Macaca radiata	Bonnet Macaque	II	LC	


				Conservation Status	
S. No.	Family	Scientific Name	Common Name	IWPA 1972	IUCN 2018- 1
3	Cercopithecidae	Semnopithecus entellus	Grey Langur	II	LC
4	Canidae	Canis aureus	Asiatic Jackal	II	LC
5	Felidae	Felis chaus	Jungle cat	II	LC
6	Hyaenidae	Hyaena hyaena	Striped Hyena		NT
7	Viverridae	Paradoxurus hermaphroditus	Civet Cat	11	LC
8	Herpestidae	Herpestes edwardsii	Indian Grey Mongoose	II	LC
9	Herpestidae	Herpestes auropunctatus	Small Indian Mongoose	V	LC
10	Hystricidae	Hystrix indica	Indian Porcupine	IV	LC
11	Suidae	Sus scrofa	Wild Boar		LC
12	Bovidae	Antilope cervicapra	Black Buck	I	LC
13	Cervidae	Axis axis	Cheetal		LC
14	Erinaceidae	Paraechinus micropus	Indian Hedge Hog	IV	LC
15	Leporidae	Lepus nigricollis	Common Hare	IV	LC
16	Megadermatidae	Megaderma lyra	Indian False Vampire	V	LC
17	Vespertilionidae	Pipistrellus coromandra	Indian Pipistrelle	V	LC
18	Pteropodidae	Pteropus giganteus	Indian Flying Fox	V	LC
19	Pteropodidae	Cynopterus sphinx	Short-nosed Fruit Bat	V	LC
20	Pteropodidae	Eonycteris spelaea	Cave Fruit Bat	V	LC
21	Rhinopomatidae	Rhinopoma hardwickei	Lesser Rat-tailed Bat	V	LC
22	Emballonuridae	Taphozous longimanus	Long-armed Sheath- tailed Bat	V	LC
23	Tupaiidae	Anathana ellioti	Madras Tree Shrew	V	LC
24	Soricidae	Suncus murinus	House Shrew	V	LC
25	Muridae	Tatera indica	Indian Gerbil	V	LC
26	Muridae	Rattus rattus	House Rat	V	LC
27	Muridae	Mus booduga	Field Mouse	V	LC
28	Muridae	Mus musculus	House Mouse	V	LC
29	Muridae	Mus saxicola	Elliot's Brown Spiny Mouse	V	LC
30	Muridae	uridae Bandicota indica Large Bandicoot Rat		V	LC
31	Sciuridae	Funambulus palmarum	Indian Palm Squirrel	IV	LC

LC – *Least Concern, NT* = *Near Threatened*

Conservation Profile: Most of the species of mammals are common and widely distributed in Deccan region. Majority of the species are under 'Least Concern' under the assessment of IUCN redlist (2018-1). Following the criterion of IWPA (1972), Black Buck is listed under Schedule I.

2.3.2 Avifauna

A total of 71 species of birds were recorded from the study area, which are grouped under 41 families. The families like Ardeidae, Accipitridae and Alaudidae were relatively diverse (**Table 2.2**). Out of 71 species, 27 species of birds were directly sighted and/or confirmed from the study area. The common and relatively abundant species recorded during the survey were *Bubulcus ibis*, *Egretta garzetta*, *Vanellus indicus*, *Phalacrocorax niger*, *Pavo*



cristatus, Streptopelia senegalensis, Streptopelia decaocto, Ceryle rudis, Hirundo rustica and *Corvus splendens*. In addition, local inhabitants revealed the presence of Great Indian Bustard and Lesser Florican in the surroundings of agricultural lands and grass lands. Their small populations are surviving is Rollapadu Wildlife Sanctuary (nearest protected area of project). It is located at an aerial distance of about 12 km from the nearest project component. Rollapadu Wildlife Sanctuary is very small protected area; therefore, populations of these species are also found outside of protected area. Primarily they are grassland dwellers, but they lay their eggs in and around the agricultural fields and reportedly damage agricultural crops. These species are also sufferers of man-animal conflicts in the area.

Nearly 80% of the total avifaunal species in the study area are widespread breeding resident while about 14% species are winter migrants. Seasonal migrants comprise *Himantopus himantopus* (Black-winged Stilt), *Sypheotides indicus* (Lesser Florican), *Coturnix coromandelica* Rain Quail), *Coturnix coturnix* (Common Quail) and *Dicrurus macrocercus* (Black Drongo).

S. No.	Family	Scientific Name	Common Name	Name Conservation Status		Habit
				IUCN 2018-1	IWPA 1972	
1	Ardeidae	Ardea cinerea*	Grey Heron	LC	IV	R
2	Ardeidae	Ardeola grayii	Indian Pond Heron	LC	IV	R
3	Ardeidae	Butorides striatus	Little Green Heron	LC	IV	R
4	Ardeidae	Bubulcus ibis*	Cattle Egret	LC	IV	R
5	Ardeidae	Egretta garzetta*	Little Egret	LC	IV	R
6	Podicipedidae	Tachybaptus ruficollis	Little Grebe	LC	IV	R
7	Anatidae	Sarkidiornis melanotos	Comb Duck	LC	IV	WM
8	Recurvirostridae	Himantopus himantopus*	Black-winged stilt	LC	IV	SM
9	Charadriidae	Charadrius hiaticula	Common Ringed Plover	LC	IV	WM
10	Charadriidae	Vanellus indicus*	Red Wattled Lapwing	LC	IV	R
11	Charadriidae	Vanellus malarbaricus	Yellow-wattled Lapwing	LC	IV	R
12	Ciconiidae	Ephippiorhynchus asiaticus	Black-necked Stork	NT	IV	R
13	Phalacrocoracidae	Phalacrocorax niger*	Little Cormorant	LC	IV	R
14	Otididae	Ardeotis nigriceps	Great Indian Bustard	CR	I	R
15	Otididae	Sypheotides indicus	Lesser Florican	EN	I	SM
16	Glareolidae	Cursorius coromandelicus	Indian Courser	LC	IV	R
17	Pterocidae	Pterocles exustus	Chestnut-bellied Sandgrouse	LC	IV	R

Table 2.2: Avifaunal composition in the influence zone of Pumped storage component of Pinnapuram IRF Project



S. No.	Family	Scientific Name	Common Name	Conservation Status		Habit
				IUCN 2018-1	IWPA 1972	
18	Accipitridae	Accipiter badius	Shikra	LC	I	R
19	Accipitridae	Elanus caeruleus*	Black-shouldered Kite	LC	I	R
20	Accipitridae	Butastur teesa	White-eyed Buzzard	LC	IV	R
21	Accipitridae	Circus macrourus	Pallid Harrier	NT	IV	WM
22	Accipitridae	Circus pygargus	Montagu's Harrier	LC	IV	WM
23	Falconidae	Falco tinnunculus	Common Kestrel	LC	IV	WM
24	Apodidae	Apus affinis*	Little Swift	LC		R
25	Rallidae	Gallinula chloropus	Common Moorhen	LC	IV	R
26	Phasianidae	Pavo cristatus*	Indian Peafowl	LC		R
27	Phasianidae	Francolinus pondicerianus*	Grey Francolin	IC	IV	R
28	Phasianidae	Coturnix coromandelica	Rain Quail		IV	SM
29	Phasianidae	Coturnix coturnix	Common Quail		IV	SM
			Eurasian Collared-			••••
30	Columbidae	Streptopelia decaocto*	dove	LC	IV	R
31	Columbidae	screptopena senegalensis*	Little Brown Dove	LC	IV	R
32	Meropidae	Merops leschenaulti	Chestnut-headed Bee-eater	LC	IV	R
22	N A a manufala a		Small Green Bee-			
33	weropidae	Merops orientalis*	eater	LC	IV	R
24	Moropidao	Marons philippinus	Blue-tailed Bee-			
54	wieropidae		eater	LC	IV	R
35	Coraciidae	Coracias benghalensis	Indian Roller	LC	IV	R
36	Alcedinidae	Ceryle rudis*	Pied Kingfisher	LC	IV	R
37	Alcedinidae	Halcyon smyrnensis	White-breasted Kingfisher	LC	IV	R
38	Cuculidae	Centropus sinensis	Greater Coucal	LC	IV	R
39	Cuculidae	Cuculus micropterus*	Indian Cuckoo	LC	IV	R
40	Cuculidae	Eudvnamvs scolopacea	Asian Koel	LC	IV	R
41	Psittacidae	Psittacula krameri*	Rose-ringed		N.7	P
40	Tutonidoo	Tuto alba	Parakeet			K D
42	Tytonidae	I ylo alba	Common Barn-OWI			K
43	Hirundinidae	HITUNDO TUSLICO*	Common Swallow	LC	IV	VVIVI
44	Hirundinidae	Hirundo daurica	Swallow	LC	IV	WM
45	Artamidae	Artamus fuscus	Ashy Woodswallow	LC	IV	WM
46	Sturnidae	Acridotheres tristis*	Common Myna	LC	IV	R
47	Nectariniidae	Nectarinia asiatica*	Purple Sunbird	LC	IV	R
48	Corvidae	Corvus macrorhynchos*	Indian Jungle Crow	LC	IV	R
49	Corvidae	Corvus splendens*	House Crow	LC	V	R
50	Lanidae	Lanius meridionalis	Southern Grey Shrike			R
51	Dicruridae	Dicrurus macrocercus*	Black Drongo	LC	IV	SM
52	Pittidae	Pitta brachvura	Indian Pitta	10	IV	R
53	Ploceinae	Ploceus philippinus	Bava Weaver	LC	IV	R
54	Pvcnonotidae	Pvcnonotus cafer*	Red-vented Bulbul	LC	IV	R
55	Turdinae	Saxicoloides fulicatus	Indian Black Robin	LC	IV	R
56	Sturnidae	Sturnus agodarum	Brahminy Starling	LC	IV	R
57	Timaliinae	Turdoides caudatus*	Common Babbler	LC	IV	R



S. No.	Family	Scientific Name	Common Name	Conservation Status		Habit
				IUCN 2018-1	IWPA 1972	
58	Timaliinae	Turdoides striatus*	Jungle Babbler	LC	IV	R
59	Turdinae	Copsychus saularis	Oriental Magpie- robin	LC	IV	R
60	Cisticolidae	Cisticola juncidis	Zitting Cisticola	LC	IV	R
61		Prinia inornata	Plain Prinia	LC	IV	R
62	Passeridae	Passer domesticus*	House Sparrow	LC	IV	R
63	Motacillidae	Anthus campestris	Tawny Pipit	LC	IV	R
64	Motacillidae	Anthus rufulus	Paddyfield Pipit	LC	IV	WM
65	Alaudidae	Eremopterix grisea	Ashy Crowned Sparrow Lark	LC	IV	R
66	Alaudidae	Mirafra erythroptera	Red-winged Bushlark	LC	IV	R
67	Alaudidae	Ammomanes phoenicurus	Rufous-tailed Finch-Lark	LC	IV	R
68	Alaudidae	Galerida deva	Sykes's Crested Lark	LC	IV	R
69	Alaudidae	Alauda gulgula	Oriental Skylark	LC	IV	R
70	Alaudidae	Calandrella brachydactyla*	Greater Short-toed Lark	LC	IV	WM
71	Estrildidae	Euodice malabarica	Indian Silverbill	LC	IV	R

LC = Least Concern; NT = Near Threatened; EN = endangered; CR = critically endangered; R = resident; WM = winter migrant; SM = seasonal migrant

Conservation Profile: Majority of the species found in the influence zone has been included under 'least concern' category of IUCN redlist. *Ardeotis nigriceps* (Great Indian Bustard), and *Sypheotides indicus* (Lesser Florican) have been assessed as 'Critically Endangered' and 'endangered' species, respectively. Both species are found in the Rollapadu Wildlife Sanctuary. In addition, *Ephippiorhynchus asiaticus* (Black-necked Stork) and *Circus macrourus* (Pallid Harrier) are 'Near Threatened' species. A total of five species including Great Indian Bustard, Lesser Florican and Shikra have been listed under Schedule I of IWAP (1972).

2.3.3 Herpetofauna

Herpetofauna of study area comprises 28 species, of which 9 species are grouped under the class Amphibia and remaining 19 species under Reptilia (**Table 2.3**). In the amphibian fauna, *Duttaphrynus melanostictus* (Common Indian Toad) and *Hoplobatrachus tigerinus* (Indian Bull Frog) were common species in the area. They are spotted frequently by local people. In reptilian fauna, *Hemidactylus brooki* (Brook's Gecko), *Hemidactylus flaviviridis* (Northern House Gecko), and *Calotes versicolor* (Garden Lizard) were recorded during the survey while the presence of *Varanus bengalensis* (Indian Monitor Lizard). *Naja kaouthia* (Indian Cobra) and *Bungarus caeruleus* (Common Indian Krait) were confirmed with help of indirect evidences.



Table 2.3: Herpetofauna species composition in the surrounding area of Pumped storage component of Pinnapuram IRE Project

S.N.	Family	Scientific Name	Common Name Conse Sta		rvation Itus
	Amphibia			IUCN 2017	IWPA 1972
		Duttaphrynus	Common Indian		
1	Bufonidae	melanostictus	Toad	LC	-
		Duttaphrynus			
2	Bufonidae	stomaticus	Marbled Toad	LC	-
3	Microhylidae	Microhyla ornata	Ornate microhylis	LC	-
4	Microhylidae	Microhyla rubra		LC	-
5	Microhylidae	Uperodon systoma	Marbled Ballon Frog	LC	-
		Hoplobatrachus			
6	Ranidae	tigerinus	Indian Bull Frog	LC	IV
7	Ranidae	Fejervarya limnocharis	Indian Cricket Frog	LC	IV
			Indian Burrowing		
8	Ranidae	Sphaerotheca breviceps	Frog	LC	IV
9	Rhacophoridae	Polypedates maculatus	Common Tree Frog	LC	-
	Reptilia				-
10	Gekkonidae	Hemidactylus brooki	Brook's Gecko	NE	-
			Northern House		
11	Gekkonidae	Hemidactylus flaviviridis	Gecko	NE	-
		Hemidactylus			
12	Gekkonidae	leschenaultii	Bark Gecko	NE	-
13	Agamidae	Calotes versicolor	Garden Lizard	NE	-
14	Agamidae	Sitana ponticeriana	Fan-throated Lizard	LC	-
15	Scincidae	Eutropis carinata	Common Skink	LC	-
			Indian Monitor		
16	Varanidae	Varanus bengalensis	Lizard	LC	II
17	Boidae	Gongylophis conicus	Russell's Earth Boa	NE	IV
			Common Indian		
18	Elapiddae	Bungarus caeruleus	Krait	NE	IV
19	Elapiddae	Naja kaouthia	Indian Cobra	LC	II
20	Colubridae	Amphiesma stolata	Buffstriped Keelback	NE	IV
		Coelognathus helena	•		
21	Colubridae	helanā	Trinket Snake	NE	IV
22	Colubridae	Dendrelaphis tristis	Indian Bronze Back	NE	IV
23	Colubridae	Lycodon striatus	Barred Wolf Snake	NE	IV
		-	Travancore Wolf		
24	Colubridae	Lycodon travancoricus	Snake	LC	IV
25	Colubridae	Óligodon arnensis	Banded Kukri Snake	NE	IV
26	Colubridae	Ptyas mucosa	Indian Rat Snake	NE	II
27	Viperidae	Daboia russelii	Russel's Viper	LC	II
28	Viperidae	Echis carinatus	Green Pit Viper	NE	IV

NE = Not evaluated, LC = least concern

Conservation Profile: Under the assessment of IUCN redlist, most of the species are not evaluated for their conservation profile while all evaluated species are categorised as 'least concern'. Similarly, in the schedule list of IWPA (1972), none of the herpetofaunal species is listed under Schedule I. A total of four species namely, *Varanus bengalensis* (Indian Monitor Lizard), *Naja kaouthia* (Indian Cobra), *Ptyas mucosa* (Indian Rat Snake) and *Daboia russelii* (Russel's Viper) are listed under Schedule II. It can be inferred that the region is moderately rich in herpetofauna diversity but is relatively less vulnerable from the conservation point of view.



2.3.4 Butterflies

During the primary survey, very low number of butterfly species was recorded from the study area. It indicates that the area is poor in butterfly richness. However, much data on the butterfly fauna from the present study area in particular is not available, therefore, data of adjacent areas as baseline was used for this study. To make data to study area, only very common species were included in the present inventory (see Harinath *et al.*, 2014). A total of 31 species of 5 families are reportedly found in the area (**Table 2.4**).

of Pinnapuram IRE Project S. Conservation Family **Scientific Name Common Name** No. Status IUCN 2018-**IWPA** 1 1972 Nymphalidae Danaus chrysippus chrysippus Plain Tiger 1 NE -2 Nymphalidae Danaus limniace leopardus Blue Tiger NE _ 3 Nymphalidae Euploea core core Common Crow LC IV 4 Nymphalidae Melanitis leda ismene Common Evening NE _ 5 Nymphalidae Ariadne merione merione Common Castor NE Nymphalidae Euthalia nais The Baronet NE 6 -Hypolimnas bolina 7 Nymphalidae Great Egg Fly NE _ 8 Nymphalidae Junonia almana Peacock Pansy LC _ Nymphalidae Junonia lemonias NE 9 Lemon Pansy 10 Nymphalidae Phalanta phalantha Common Leopard NE -11 Nymphalidae Mimacraea terpsicore Tawny Coster NE _ Lycaenidae Gram Blue 12 Euchrysops cnejus NE Indian cupid NE 13 Lycaenidae Everes lacturnus syntala 14 Lycaenidae Spindasis vulcanus vulcanus The Silverline NE _ Rathinda amor Monkey Puzzle 15 Lycaenidae NE -Common Short Lycaenidae NE 16 Spindasis ictis _ Silver Line Silver Grav Silver 17 Lycaenidae Spindasis nipalicus Ш Line Papilionidae Graphium agamemnon Tailed Jay NE 18 -19 Papilionidae Pachliopta aristolochiae Common Rose NE 20 Papilionidae Papilio demoleus Lime Butterfly NE _ 21 Pieridae Belenois aurota The Pioneer NE 22 Pieridae Catopsilia pyranthe Molted Emigrant NE _ 23 Pieridae Colotis danae danae NE Crimson Tip -Pieridae Colotis eucharis eucharis Plain Orange Tip 24 NE _ 25 Pieridae Colotis fausta Large Salmon Arab NE Cepora nerissa nerissa Common Gull 26 Pieridae NE -Common Grass 27 Pieridae Eurema hecabe simulate NE _ Yellow 28 Pieridae Eurema brigitta Small Grass Yellow LC _ Hesperiidae **Rice Swift** 29 Borbo cinnara NE Branded Small 30 Hesperiidae Pelopidas mathias mathias NE _ Swift

Indian Skipper

Table 2.4: Butterfly species composition in the influence zone of Pumped storage component of Pinnapuram IRE Project

NE = not evaluated; LC = least concern

31 Hesperiidae

Spialia galba

_

NE



Conservation Profile: Majority of the species listed in **Table 2.4** has not been evaluated for their conservation assessment under IUCN red list (2018-1). Only three species namely *Euploea core, Junonia almanac* and *Eurema brigitta* have been included under 'Least Concern' category. Also, in the IWPA's schedule list most of the species are in Schedule IV.

2.3.5 Other Invertebrates

Other invertebrate fauna of the region comprises molluscs, insects, earthworm, etc. Most common mollusc species which are common in the Nallamalai hill ranges and anticipated to inhabit the study area are *Stagnicola tungabhadraensis*, *Succinea gravelyi deccallensis*, *Bellamya bengalensis*, *Bellanlya crassa*, *Gabbia stenothyroides*, etc. Insect fauna includes dragon flies, beetles, diptera, bugs, moth etc. Common dragon flies are *Ischnura delicata*, *Ischnura senegalensis*, *Anax guttatus*, *Copera marginipes*, etc. Common Orthoptera are represented by *Cyrtocanthacris ranacea*, *Sathrophyllia* sp, and *Gerris* sp. Hemiptera comprises *Dysdercus cingulatus*, *Acanthaspis maculata*, *Homoeocerus signatus*, etc. Coleoptera (Beetles) are widely distributed and commonly represented by *Acanthophorus serraticornis*, *Prionomma atratum*, *Plocaederus* spp., *Heliocopris bucephalus*, *Oxyoetonia versicolor*. Common moth (Lepidoptera) species are *Nyctipao heiroglyphica*, *Othreis fullonica*, *Spodoptera mauritia*, *Eumeta crameri*, *Daphnis nerii*, *Marumba dyras*, etc. Common annelid species of this area is *Octochaetona albida*.

2.4 CONCLUSION

The faunal species mentioned under various groups are widely distributed in Indian subcontinent especially in Deccan Plateau. Except a few butterfly species, none of the species is endemic to this region and Deccan biogeographic region. However, a few threatened and Schedule I species especially mammals and birds are found in the study area.

Rollapadu Wildlife Sanctuary is nearest protected area of influence area of the proposed project, located beyond 10 km radius of the project. It is small sanctuary and harbours a good population of Great Indian Bustard, Lesser Florican and many mammal species like Jackal, Jungle Cat, etc. To conserve the biodiversity of the region, an effective and sound biodiversity management plan is warranted, which needs to address the concerns of local people, likely impacts of the project and involvement of local communities in the conservation strategies.



Figure 2.1: Area demarcated for the biodiversity studies



Biodiversity Management & Wildlife Conservation Plan

3.1 BACKGROUND

Habitat degradation, land use /land cover changes, hunting and poaching, invasiveness of exotic species are main threats to native biodiversity and wildlife. Most of these phenomena are related to man induced activities like population growth, increasing agricultural practices, urbanization, road construction and other developmental activities. In recent years, the pace in the developmental activities has led to additional pressures on biodiversity, as a result, not only the wildlife is under severe threats but there are increasing incidences of man – wildlife conflicts in many areas of India. The biodiversity conservation practices face many challenges, one of the challenges is socio-economic constraints of local population as their livelihood depends on the forests and forest resources.

The outline of biodiversity management plan relies on many factors related to the area of implementation. Understanding of diversity and distribution of floral and faunal species, identification of existing threats to biodiversity, concerns of local inhabitants and impacts of developmental activities on animal and plant species play an important role in preparation of sound management plan.

3.2 PROJECT ACTIVITIES AND LIKELY IMPACTS

Project activities are anticipated to lead additional stresses on the plant and animal species. The magnitudes of the impacts of the projects would rely on the size of project activities. The major activities involved in the proposed project are embankments, construction of new roads, dumping of muck, construction of tail race tunnel, project colonies, etc. Embankments are rock fill type having an average height of average height of around 12m to 14m with maximum of 33 m height in lower reservoir and 35 m in upper reservoir for very short reach for creation of Pinnapuram IRE Project upper and lower reservoir with 1.20 TMC live storage capacity. A 70 m wide concrete lined Tail race channel with FSD of 6.00m and 1300 m long connecting Tail race channel to the lower reservoir is proposed for the project. Total land required for various activities, viz. reservoir area, muck dumping, quarrying, construction camps and colony, etc. is 713.65 ha. In addition, ancillary activities like transportation of much, high level of noises, high concentration of particulate matter, vehicular movement, and influx of migrant labourers are associated with the project activities. All these activities are anticipated to lead to adverse impacts on the biodiversity of the project and its influence area.



3.3 BIODIVERSITY IMPORTANCE OF THE AREA

As per biogeographic classification of India, the study area is covered under Deccan Plateau biogeographic region. In terms of species richness, this region is not considered as rich as Western Ghats and Himalayan biogeographic regions. Majority of the species inhabiting this region are widely distributed in Indian sub-continent, however, many threatened species, especially faunal species are found in this zone including present study area. The important species included under IUCN red-list or/and Schedule I list of IWPA are *Antilope cervicapra* (Black Buck) among mammals, *Ephippiorhynchus asiaticus* (Black-necked Stork), *Ardeotis nigriceps* (Great Indian Bustard), *Sypheotides indicus* (Lesser Florican), *Pavo cristatus* (Indian Peafowl) among birds. In addition, there are a few plant species like *Dalbergia latifolia*, *Chloroxylon swietinia*, *Azadirachta indica* (Tree), *Gymnosporia spinosa*, *Senna auriculata*, *Justicia adhatoda* (Shrub), *Senna simea*, *Cissus quadrangularis*, *Alternanthera sissilis*, which are either included under IUCN redlist or having medicinal importance or are under threats. The proposed biodiversity and conservation plan would be focused mainly on these species.

3.4 CONCERNS OF LOCAL INHABITANTS

Usually the livelihood of villagers is associated to forests and forest resources. However, animal hunting and poaching for food, games and trophies is not reported from the zone of influence of proposed project. It would be worthy to mention that a few species like Black Buck, Wild Boar, Indian Hare, Great Indian Bustard and Lesser Florican are reported to raid agricultural land and reportedly damage the crops, which results in the man – wildlife conflicts. To control such conflicts, this issue is also needed to address in biodiversity management plan.

3.5 PLAN OF ACTION

The management and conservation strategies may affect the traditional rights of local people. Taking these concerns into account, the involvement of local people in formulation of effective management plan would be helpful in its implementation. Considering all factors related to local people, biodiversity of the region, size of the project and magnitude of the impacts, the present biodiversity management plan is proposed for Pinnapuram Pumped Storage project.

3.5.1 Awareness Programme

An effective wildlife conservation plan is a participatory management, involving the local communities in the conservation strategies. This approach requires a comprehensive awareness programme on the significance, benefits and sustainable utilization of biodiversity and forest resources. The awareness programme would focus on the fact that the protection of grassland dwelling species like Great Indian Bustard, Lesser Florican, and



small mammalian species can be achieved by the protection of grasslands, which would be beneficial to local people also (Rahmani, 2003). Local people can play a significant role in the implementation of this plan. The awareness programme would take certain issues like prevention of forest fire, to avoid the man-wildlife conflicts, not to damage the eggs/nets of bird species like Bustard and Florican, into account etc. These species wander in search of food and to lay eggs and raid agricultural fields, where they are encountered with local people. Awareness programme can be implemented by organising the public meetings with the help of NGOs and Forest Department, distributing pamphlets, posters and hoardings, etc. Total budget estimated for awareness programme is **Rs. 10,00,000** only.

3.5.2 Development of Grasslands

Black Buck, Jackal, Peacock, Common Indian Hare, Great Indian Bustard, Lesser Florican, etc. are grassland dwellers and forage around the cultivated lands. Black Buck, Common Indian Hare, Great Indian Bustard and Lesser Florican reportedly invade cultivated fields and damage the standing crops of local peoples. To prevent the crops from these animals, to control the animal raids, and to avoid the man-animal conflicts and to protect these species, there would be needs of more grasslands in the area. The development of grassland can be achieved by joint forest management mechanism by involving local people. Such grassland can be developed on the government and community lands. The development of new grasslands would be beneficial to local people and would control the animal raids on private agricultural lands. This programme would be implemented by Forest Department having a sound Joint Forest Management mechanism. The detailed plan of action for this plan would be formulated by forest department. Total financial outlay for this plan is **Rs. 50,00,000** only.

3.5.3 Fire Protection Measures

Grasslands are high prone to fire; forest fire is one of the concerns in this area. Forest fire damages not only palatable grasses, seedlings and other plants but damages the nests and eggs of birds and reptiles and increases the growth of a few non-palatable grasses to wild animal like *Heteropogon contortus* in this area. Thus, fire protection is an important component of management. A detailed programme on the identification of forests and grassland patches, which are habitats of Great Indian Bustard, Florican, Black Buck, etc. and are prone to forest fire, is proposed in the peripheral areas of the project. These patches would be provided with proper fire lines. State Forest Department shall implement this plan. Total financial outlay under this head is **Rs. 20,00,000**.



3.5.4 Infrastructure Development & Strengthening of Patrolling

To protect the biodiversity of the zone of influence, improvement in infrastructure facilities is warranted. 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. This plan will be implemented in the zone of influence of proposed project. Project authorities would provide one-time grant to State Forest Department to improve the infrastructure for the conservation of biodiversity. In order to improve the vigilance, to monitor the wildlife movement, and to check the poaching, State Forest Department shall be provided with grant to build necessary facilities like watch towers, check posts and patrolling paths and also grant for purchase of equipment like, cameras, binoculars, sleeping bags, search lights, health kits etc. Patrolling parties need to be equipped with Wireless communication system for more efficient system. Project authorities would provide funds to State Forest Department. Total financial outlay under this head would be **Rs. 50,00,000** only.

3.5.5 Conservation Measures for RET species

As already discussed, one Schedule-I mammal species Black buck is found in the project area. In addition, 5 Schedule I bird species are also found in and around the project area. Therefore, a conservation plan has been suggested for them.

I. Blackbuck (Antelope cervicapra)

Blackbuck is a species which thrives in open plains, scrub land, and agricultural fields and moves in herds of about 50. They are primarily grazers and avoid forested areas. They are common in the project area as well as Rollapadu Wildlife sanctuary where its increasing numbers are disturbing the habitat of Great Indian Bustard. They are known to move long distances in search of water and forage in summers (Rahmani, 2001). Despite their adaptability, Blackbuck are subject to increasing pressure from human population growth, increasing numbers of domestic livestock, and economic development.

Conservation Measures

- Ban on removal of bushes, creepers and closed canopy and thick undergrowth near tall grassland areas where these animals are found as they prefer closed canopy and thick undergrowth for resting and nursing young ones but may use open or scrub forest for foraging purpose.
- Development of some fruit trees or flower plants with seeds and pods near the areas of its habitat. Augmentation of its habitat with some shrub species with soft stems or creepers or climbers and small trees with thick leaves should be developed as they prefer leaflets of shrubs, trees and creepers.



• Fire protection - will save fodder from burning, also their breeding and littering sites.

II. Great Indian Bustard (*Ardeotis nigriceps*)

This species is listed as Critically Endangered because it has an extremely small population that has undergone an extremely rapid decline owing to a multitude of threats including habitat loss and degradation, hunting and direct disturbance. It prefers semi-arid grasslands with scattered short scrub, bushes and low intensity cultivation in flat or gently undulating terrain. There are no suitable habitats of semiarid and grassland ecosystem in and around study area as the study area habitat is dominated by agroecosystem. The main threat to its habitat is agricultural expansion. Though it was not sighted in the study area during the surveys, following conservation measures have been suggested.

Conservation Measures

- They avoid foraging inside the sanctuary and are seen in open grasslands adjoining the sanctuary (Rao & Javed, 2005). The breeding season is between April and December. Blackbuck is of major concern in the area. Villagers tend to shoo them away from raiding their crops and they are known to enter from the Sanctuary. Therefore, biotic interference near the sanctuary should be monitored and disturbance to be checked.
- Creation of awareness among local people as well as staff and contractors about the importance of protecting the habitat and foraging grounds outside the sanctuary.
- Creation of Environmental Cell to monitor any probable movement of Bustard in and around the project area.

III. Lesser Florican (Sypheotides indica)

It has listed as Endangered because its population rapidly due to pressure on remaining grasslands intensifies, and areas of its habitat are lost and degraded. It was not sighted during the surveys as it is found in general in Rollapadu Wildlife sanctuary. It occurs in productive dry grasslands, in lowland areas particularly dominated by *Sehima nervosum* and *Chrysopogon fulvus*, with scattered bushes and scrub; with breeding areas coinciding with areas of black cotton soil (Yahya, 2016).



Conservation Measures

- As hunting is one of the major causes of its declining populations, it should therefore be checked in consultation with forest department officials and severe penalties to be levied on anyone indulging in hunting in the project area.
- Grasslands in and around the project area should be protected and should not be allowed to be converted into agricultural fields.
- Project need to employ biodiversity specialist to monitor the movement of Blackbuck, Great Indian Bustard and Lesser Florican.

Similar conservation measures should be adopted for Schedule I species like Black shouldered kite and Shikra though they have been listed under Least Concern category in IUCN Redlist 2018-1.

For the Peafowl, an Eco-park has been proposed for their protection in the following section. In addition, hunting of Peafowl especially should be checked with the help of forest department.

3.5.6 Establishment of Eco-Park

For the preservation and conservation of biodiversity and wildlife in the area an Eco-Park (short for Ecological park) housing a Nature Interpretation Centre (NIC) may be developed. Eco-Park is setup generally as an entertainment cum education park without hampering its natural environment so that the biodiversity remains unaffected there. Generally, a particular area of a forest/Natural heritage/landscape is set aside or demarcated and brought under intensive management for this purpose.

The Nature Interpretation Centre (NIC) is a kind of museum, often associated with visitor centres or eco-museums, and built and located in areas to preserve biodiversity and cultural diversity. Interpretation centres use different means of communication to enhance the understanding of natural heritage. Environmental interpretation is usually carried out in areas which facilitate knowledge about nature and the relationship between society and nature in a specific location or region. The creation Eco-Park including Interpretation Centre will have trails and walks for use by the visitors as an important support mechanism for the environmental education process and complementing the educational possibilities in more innovative ways. NIC shall have an auditorium to showcase documentaries and movies of the ecosystem, a photography exhibition centre, a walkthrough of wildlife, an open museum with replicas of wild animals, a craft shop for souvenirs, an office block for management. The centre shall also host 'Teach the Mentor' programmes, where school and college teachers from neighbouring areas can experience



and learn more about the region's biodiversity first-hand. That way, they can educate the next generation about the importance of conserving the ecosystem, too.

The establishment of an Eco-park cum NIC would play an important role as creation of vegetation belt and cover in otherwise degraded landscape in the study area and act as a check against possible dust and noise pollution in the area and in creating awareness among the people. The rehabilitated muck disposal area can be utilised for the development of eco-park. The eco-park can be used for walks, jogging, and other activities. Most importantly avenue plantation to be done at the boundaries of park can act as a natural barrier and the park area can become roosting places for peafowl. The important plant species which are suggested to be planted in the proposed park are Dalbergia sissoo, Azadirachta indica, Terminalia arjuna, and Senna auriculata because of their height. The height of first branches of Dalbergia sissoo and Azadirachta indica can offer better protection to Peafowl from predators like stray dogs and humans. Peafowl can then watch the approaching predators as a safety measure as they would be able to hide behind the foliage of bigger trees. The budget heads include development of a nursery, collection of seeds and plant species, small laboratory and staff. For the landscaping of such park a professional landscape architect may be engaged along with the help of Forest Department, Government of Andhra Pradesh. Total budget allocated for the establishment of the ECO Park cum NIC is Rs. 120,00,000 only.

3.5.7 Good Practices

Project authorities would follow a few precautionary and good practices in the project areas. Such types of practices are not expensive but play a vital role in protecting the biodiversity. The important safeguard measures as good practices are given below:

- i. Project authorities shall organise a training programme for the workers. All project workers must be aware of importance of biodiversity and all such types of activities related to endangering the wildlife including plants and animals. All project workers must be aware of presence of a few threatened and Schedule species in the area and legal consequences of hunting, poaching of animals and harvesting of forest produces.
- ii. Each project worker shall be provided with an identity card and would not be allowed to enter in the village, forest, grassland and protected areas without a valid permission.
- iii. 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.



- iv. Project workers will be discouraged to plant any alien and/or invasive species in the camp and colony areas, which may spread in the forest areas. State Forest Department can provide the list of such plant species. Project authorities would ensure to uproot all existing alien/invasive species from the colony and other working areas. Restriction shall be imposed on the disposal of any types of pesticide, poison and other toxic material in the forest areas.
- v. Project authorities are suggested to follow the mechanism of control blasting especially in the breeding season of a threatened species wandering in the close vicinity of the project. This activity is to be restricted during nights, early mornings and late afternoons, which are the feeding times of most of the fauna. Total budget allocated for the implementation of good practices is **Rs. 5,00,000** only.

3.6 SETTING UP OF BIODIVERSITY MANAGEMENT COMMITTEE

In order to monitor the implementation of proposed Biodiversity Management and Wildlife Conservation plan, 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 for Standalone Pumped Storage component of Pinnapuram 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 will have 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** (Five lakhs) only.



3.7 BUDGETARY ESTIMATES

Total budget allocated for the Biodiversity Management and Wildlife Conservation Plan for Pinnapuram IRE Project would be **Rs. 310,00,000** (Rs. Three hundred Ten lakhs) only. Break-up of the budget is given in Table 3.1.

Table 3.1: Break-u	p of the Biodiversity	y Management and	Wildlife Conservation Plan

S. No.	Particulars	Total Budget (in Lakh)
1	Awareness Programme	10.00
2	Development of Grasslands	50.00
3	Fire Protection Measures	200.00
4	Infrastructure Development	50.00
5	Monitoring of populations of Schedule I species in and around project area, Checking and monitoring of hunting	50.00
6	Establishment of Eco Park	120.00
7	Good Practices	5.00
8	Biodiversity Management Committee	5.00
	Total Budget	310.00



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No. J-11011/1/2013-IA-1 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
- Additional Secretary, Ministry of Power, Shram Shakti Bhawan, New Delhi, Fax 23350780
- 5. Environment & Forest Secretaries/Principal Secretaries of all States
- 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

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- P.O. New Forest Dehradun 248008
- 14. Zoological Survey of India M Block, New Alipore Kolkata 700 053 Telefax: 033 24008595 Email: <u>zalkolkata@gmail.com</u>
- 16". Botanical Survey of India, P-8, Brabourne Road, Calcutta – West Bengal
- 16. Salim All Center for Omithology and Natural History (SACON) Analkatty P.O., Colmbatore 641 108 (Tamil Nadu)
- 13. Netional Institute of Oceanography (NIO) Dona Paula-Goa, 403 004
- National Environmental Engineering Research Institute (NEERI) Nehru Marg, Nagpur 440020

.;?

- 19, Centre for Ecological Science Indian Institute of Science Bangalore 560 012
- Central Arid Zone Research Institute (CAZRI)
 Near Industrial Training Institute (ITI)
 Light Industrial Area
 Jodhpur 342 003 (Rajasthan)

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R. Indian Institute of Forest Management (IIFM) Nehru Nagar, PO Box # 3577 Bhopal 462 003

- 4. Kalidas Road, Dehradun.
- G.B. Pant Institute of Himalayan Environment and Development (GBPIHED) Kosi-Katarmal, Almora-263 643

North Eastern Regional Institute of Science and Technology (NERIST) Nirjuli (Itanagar) - 791109 Arunachal Pradesh

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
- Bharati Vidyapeeth Institute of Environment Education & Research (Bhartiya Vidyapeeth Deemed University) Katraj-Dhankawadi, Pune 411 043
- 21 Manipal University Manipal 576104, Kamataka
- Anna University Sardar Patel Road Chennal-600 025 Tamil Nadu

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