Government of Telangana
Irrigation & CAD Department

B. NAGENDRA RAO, M.Tech.,
Chief Engineer, Kanthanapally Project

K.C Camp, Chintagattu,
Warangal (Urban)
Telangana
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Lr.No:CE/KP/WGL/OT2/TS4/ F.EIA&EMP/ 512 Date: 25.04.2019

To
The Director & Member Secretary,
River Valley and Hydroelectric Projects,
Ministry of Environment, Forests
and Climate Change,
Indira Paryavaran Bhavan,
Lodhi Road, New Delhi - 110003.
Sir,

Sub:- P V Narasimha Rao Kanthanapally Sujala Sravanthi Project near Thupakulagudem Village, Eturnagaram Mandal, Jayashankar Bhupalapally District by I & CAD Department, Govt. of Telangana(File No. J-12011/1/2010-IA-I & Proposal No. IA/TG/RTV/87571/2017) - **Final EIA report for issue of Environmental Clearance –Submission of certain Information**- Request-Reg.

Ref:-
1. ToRs issued by MoEF&CC, Govt. of India, vide letter No. J-12011/1/2010-IA-I (Part) dt: 03.04.2017.
2. EHS Consultants Pvt Ltd, Bangalore, Karnataka Mail, Dt:19.11.2018
3. SE/SRSP-II/ Lr.No SE/SRSP-II/DEE/T2/406/CE, Dt:03.12.2018
4. EHS Consultants Pvt Ltd, Bangalore, Karnataka Letter No:EHSCPL/I&CAD/KC- C/PVNRKSSP/2018-19/312, Dt:03.12.2018.
5. T.O Lr.No:CE/KP/WGL/OT2/TS4/F.EIA&EMP/1241 Dt:04.12.2018
6. Minutes of 21st Meeting of the Expert Appraisal Committee held on Dt:28.01.2019

&&&

Anent to the reference 6th cited, I am herewith submitting the required information along with revised EIA/EMP report for kind consideration.

Therefore, it is requested to kindly issue the Environmental Clearance for the P V Narasimha Rao Kanthanapally Sujala Sravanthi Project near Thupakulagudem Village, Eturnagaram Mandal, Jayashankar Bhupalapally District by I & CAD Department, Govt. of Telangana at the earliest.

Encl: As above

Yours faithfully

B. Nagendra 26/4/19

Chief Engineer, I&CADD.,
Kanthanapally Project
WARANGAL

25/4/19

P V Narasimha Rao Kanthanapally Sujala Sravanthi Project in Jayashankar Bhupalapally District in Telangana by I & CAD Department, Govt. of Telangana

(File No. J-12011/1/2010-IA-I, Proposal No. IA/TG/RTV/87571/2017)

Sl.No.	Information Sought by EAC	Compliance
1	Price of water to be lifted be calculated based on the energy required.	a) The total energy consumption for lifting ***38.18 TMC*** of water from Intake pump house at Gangaram village of J.Chokka Rao Devadula Lift Irrigation Scheme till Dharmasagar Tank for 170 Days is about***334.50 MW/ 1389.97 Million Units*** b) As per Govt. of Telangana circular (TSNPDCL Tariff Plan 2018-19), cost for 1 unit is ***Rs. 5.86/-*** c) Annual Energy cost= ***Rs. 814.52Crores*** d) Quantity of water lifting = ***38.18 TMC*** e) Cost of water / Cum $= \frac{\text{Annual Energy Cost (in Rs.) x } 35.315}{\text{Total water lifting x } 10^9}$ $= \frac{814.52 \times 10^7 \times 35.315}{38.18 \times 10^9}$ = **Rs. 7.53/Cum**
2	The environmental matrices for both construction and operation phases is to be revisited. Updated matrix shall be submitted to the Ministry for reconsideration.	The environmental matrices for both construction and operation phases has been presented in Table 4.3 of Section 4.3 of Chapter-4 (Page 4.19 - 4.25) of revised EIA/EMP report. However, a copy is enclosed for reference.
3	Provisions of fish pass be explored. List of fish species to be revisited from the secondary sources and accordingly be updated in the EIA/EMP report. Minimum flow requirement be calculated during the leanest season for fish like *Hilsa, Bengalensis.*	The construction of barrage does not affect the migratory paths/movements of the fishes as the sluice gates (11 Nos. of width 15 m) of the barrage provide an access for the fishes to cross the barrier. The list of fish species and the references of the secondary data are given in Table 3.34 of Section 3.5.3.4 in Chapter 3 (Page 3.122-3.127) of revised EIA/EMP report. As per the monthly inflow data collected from 1966-2013, the average inflow at the barrage site during the lean season in 3977.3 MCM (140.5 TMC) which is sufficient for the movement/breeding activities of *Hilsa* (Hilsa) *kelee* (Cuvier), *Hilsa* (Tenualosa) *ilisha* (Hamilton) and *Anguilla bengalensis* (Gray, 1831) species of fishes. Further, the migratory and behavioral aspects of the above species are discussed in Section 9.5.1 of Chapter 9 (Page 9.29 - 9.31) of revised EIA/EMP report.

<table>
<tr><th>Sl.No.</th><th>Information Sought by EAC</th><th>Compliance</th></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td>4</td><td>Detail present status of R&R to be implemented. 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 provisions of Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act, 2013.</td><td>The project requires 94 ha of private land, no person is affected due to this project, only land is affected, and hence there is no rehabilitation and resettlement. The present status of land acquisition is as given below;
<table>
<tr><th rowspan="2">Total land required for the project (ha)</th><th colspan="2">Compensation already paid as per LA, 1894</th><th colspan="2">Balance land to be acquired as per RFC&TLA, 2013</th></tr>
<tr><th>Extent (ha)</th><th>Amount (Crores)</th><th>Extent (ha)</th><th>Amount (Crores)</th></tr>
<tr><td>94</td><td>65</td><td>18.03</td><td>29</td><td>2.53</td></tr>
</table>
Right to fair Compensation and Transparency in land Acquisition, Rehabilitation and resettlement Act, 2013 and modified Telangana Act, 2016 will be followed for compensating the land losers.</td></tr>
<tr><td>5</td><td>Only three reptile species are reported from the project area. It needs to be updated with updated list of reptiles present in this area.</td><td>The data has been verified and the reptile species have been updated. Total number of species is 18. The checklist of the reptile species has been updated and is presented in Table 3.33 of Section 3.4.4.2.2 in Chapter 3 (Page 3.110 -3.111). However, Table is enclosed for ready reference.</td></tr>
<tr><td>6</td><td>Submission of certificate from the Chief Wildlife Warden that project is outside ESZ of Eturnagaram wildlife sanctuary.</td><td>It is submitted that originally during survey and study of the project, it was observed that the project is being proposed in the river bed/private lands only and therefore no requirement of forestland in Eturnagaram Wildlife Sanctuary. But during discussions held with PCCF (Wildlife), Govt of Telangana, it was mentioned that the project is touching the outer periphery/boundary of ESZ of Eturnagaram Wildlife Sanctuary. Based on the discussions and observations by State forest authorities necessary proposal/permission, if required, will be obtained from Competent Authority.</td></tr>
</table>

B. Nagendra 26/6/19

Chief Engineer,
Kanthanapally Project
I & CAD department,
K C Colony, Chintagattu,
25/6/19 Warangal– 506015,
Telangana

IRRIGATION & CAD DEPARTMENT

Government of Telangana

P. V. NARASIMHA RAO KANTHANAPALLY SUJALA SRAVANTHI PROJECT

Thupakulagudem village, Eturnagaram Mandal, Jayashankar Bhupalapally District

REVISED FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT FOR ISSUE OF ENVIRONMENTAL CLEARANCE

Volume –I

Schedule 1 (c) of EIA Notification, 2006, Category – A, Project Cost: Rs. 2121 Crores

Study Period : July, 2017 to March, 2018; Command Area : 5, 55, 310 ha

Project by

The Chief Engineer
I & CAD Department
Kanthanpally Project
KC Colony, Chintagattu
Warangal - 506015

NABET/EIA/1821/RA 0107

Consultants

Environmental Health & Safety
Consultants Pvt. Ltd
Bangalore, Karnataka
(Accredited by QCI-NABET)
080 - 23012100

APRIL 2019

Document No. EHSC/I&CAD/KCC/ETR/2017-18/PVNRKSSP

REVISED FINAL ENVIRONMENTAL IMPACT ASSESSMENT

REPORT

Of

P V NARASIMHA RAO KANTHANAPALLY SUJALA SRAVANTHI PROJECT

In

JAYASHANKAR BHUPALAPALLY DISTRICT, TELANGANA

Project By

CHIEF ENGINEER
IRRIGATION & CAD DEPT.,
K. C COLONY, CHINTAGATTU,
WARANGAL - 506015, TELANGANA.

Consultants

ENVIRONMENTAL HEALTH & SAFETY CONSULTANTS PVT LTD No.13/2, 1st Main Road, Industrial Town, Near Fire Station, Rajajinagar Bengaluru - 560 010, Karnataka	NABET/EIA/1821/RA 0107 Dated: 19.11.2018

DOCUMENT NO. EHSC/I&CAD/KCC/ETR/2017-18/PVNRKSSP

APRIL 2019

REVISION RECORD

Rev. No	Date	Purpose
EHSC/01	28.04.2018	Issued as Draft EIA Report for Comments and Suggestions
EHSC/02	04.07.2018	Issued as Draft EIA Report for submission to TSPCB for conducting Environmental Public Hearing
EHSC/03	19.11.2018	Issued as Final EIA Report to client and experts for comments and suggestions
EHSC/04	05.12.2018	Issued as Final EIA Report for submission to MoEF&CC, New Delhi for issue of Environmental Clearance
EHSC/05	25.04.2019	Issued as Revised Final EIA Report for submission to MoEF&CC, New Delhi for issue of Environmental Clearance along with additional details sought.

DOCUMENT CONTROL

Prepared by	Verified by	Approved by
Santhosh Kumar T M (EIA Coordinator)	Madhu Kumar C (Director-Technical)	Shivanand M Dambal (Chairman & Managing Director)

DISCLAIMER

The contents of this EIA/ EMP report are prepared based on the technical information provided by the project proponent. The data submitted in this report is factually correct to the best of our knowledge. The ToRs have been complied subject to its applicability with respect to project site. Any typographical errors in this report shall be brought to the notice of EHSCPL for further rectification.

"DECLARATION"

Declaration by list of Experts contributed to EIA report of **"P.V. Narasimha Rao Kanthanapally Sujala Shravanthi Project (PVNRKSSP) at Thupakulagudem village, Warangal district, Telangana"**.

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

EIA Coordinator

Name : **Santhosh Kumar T M**

Signature & Date : 11.04.18

Period of involvement : **May 2017 to Dec 2018**

Contact information : **080-23012100/ 080-23016200**

Functional Area Experts :

Sl. No.	Functional Areas	Name of the expert/s	Involvement	Signature
1	AP	Shri. Shivanand M Dambal	• Air pollution monitoring. • Baseline data review and analysis. • Air pollution prevention and control. • Impact identification and assessment both during construction and operation phase. • Preparation of air quality management plan. • Contribution to EIA documentation.	
2	SW&HW	Shri. Shivanand M Dambal	• Quantification of solid waste • Impact assessment. • Sanitation and solid waste management plan. • Muck Disposal Plan. • Contribution to EIA documentation.	
3	WP	Shri. Vishal N Wadkar	• Fixing surface and ground water sampling locations within the study area. • Baseline data review and analysis of water quality results. • Impact assessment and Management Plan. • Contribution to EIA documentation	
4	EB	Mr. Santhosh Kumar T M	• Conducting ecological surveys and preparation of status reports for rare, endangered and threatened species of animals and plants and also species protected under	

Sl. No.	Functional Areas	Name of the expert/s	Involvement	Signature
			national laws. • Identification and assessment of impacts on biodiversity from the project. • Biodiversity and Wildlife Conservation and Management Plan • Green belt development plan. • Contribution to EIA documentation.	
5	EB (AQ)	Shri. M F Rahman	• Conducting aquatic studies and preparation of status reports for rare, endangered and threatened species of fishes. • Documentation of aquatic fauna. • Fisheries Conservation and Management Plan. • Impacts prediction. • Contribution to EIA documentation.	
6	AQ	Mrs. Praveena Kumari H N	• Fixing of AAQM stations in the study area. • Impact studies on micro climate. • Collecting and using secondary data on meteorology. • Impact assessment using air quality model. • Contribution to EIA documentation.	Praveena
7	HG & GEO	Mr. Venkata Naresh Kumar	• History of the ground water table fluctuation in the study area. • Geological and Seismo-tectonic data collection. • Reservoir Rim Treatment Plan. • Geology and Geo morphological analysis / description, Stratigraphy /Lithology. • Developing geological maps. • Environmental impacts identification and suggesting suitable measures. • Contribution to EIA documentation.	E.V. Naresh Kumar
8	LU	Dr. B.C. Nagaraja	• Preparation of various thematic maps. • Assessing environmental impacts. • Contribution to EIA documentation.	
9	RH	Shri. Rakesh Gupta	• Dam Break Analysis and Disaster Management Plan. • Identification of hazards and hazardous substances. • Risks and consequences analysis. • Prediction of impacts. • Contribution to EIA documentation	
10	SC	Shri. Prabhakar K S	• Fixing soil quality sampling locations within the study area. • Assessment of fertility/productivity of soil, nutrient availability	

Sl. No.	Functional Areas	Name of the expert/s	Involvement	Signature
			• Management of soil salinity • Controlling degradation of soil / soil conservation • Contribution to EIA documentation	
11	NV	Shri. M N Sreehari	• Monitoring of noise /vibration levels using specific instruments, processing and analysis of data. • Prediction of noise isopleths using relevant models. • Contribution to EIA documentation.	
12	SE	Dr. Latha Bhaskar	• Secondary data collection. • Analysis of primary data collected by the surveyors. • Identification of positive and negative impacts. • Public Health Delivery System. • Labour Management Plan. • Local area development plan. • Contribution to EIA documentation.	
13	**Team member**			
13a	AP	Mrs. Praveena Kumari H N	• Assisting FAE-AP in fixing Air sampling locations • Laboratory coordination for analysis of air samples • Assisting FAE for coordination of field visit. • Assisting in baseline data review, analysis and impact assessment • Assisting FAE-AP in preparation of Management Plan	Praveena
13b	EB	Mrs. Shrinidhi R	• Assisting FAE for coordination of field visit • Assisting FAE-EB in survey and data entry	R. Shrinidhi
14	**Functional Area Associates**			
14a	SE	Mr. Naresh G	• Socio - economic data collection • Socio – economic survey and data entry • Assisting FAE in report preparation	
14b	AP & WP	Ms. Vijayalaxmi R Naik	• Assisting FAE baseline data collection • Assisting FAE in report preparation	
14c	AP & NV	Ms. Megha M	• Assisting FAE baseline data collection • Assisting FAE for report preparation	Megha-M
14d	EB (T & AQ)	Ms. Prabha S J	• Assisting FAE for data collection and data entry • Assisting FAE for report preparation	S.J. Prabha
14e	SHW	Ms. Divya M R	• Assisting FAE in site • Assisting FAE for report preparation	
15	**Supporting staff**			
15a		Mr. Tharakesh A B	Assisting FAE – EB and SE in survey and	

Sl. No.	Functional Areas	Name of the expert/s	Involvement	Signature
			data entry	
15b		Mr. Shivaraj Kumar M N	Assisting FAE – EB and SE in survey and data entry	
15c		Mr. Bharath L	Assisting FAE – EB and SE in survey and data entry	
15d		Mr. Naveen Kumar S	Assisting FAE – EB and SE in survey and data entry	

Declaration by the Head of the Accredited Consultant Organization

I, **SHIVANAND M DAMBAL**, hereby, confirm that the above mentioned experts prepared the EIA report. I also confirm that the consultant organization shall be fully accountable for any mis-leading information in this statement. It is certified that, no unethical practice like 'copy and paste', and used external data / text without proper acknowledgement, while preparing this EIA report.

Signature:

Name: **Shivanand M Dambal**

Designation: **Chairman & Managing Director**

Name of the EIA Consultant Organization: **Environmental Health and Safety Consultants Pvt. Ltd.**

NABET Certificate No. & Issue Date: **NABET/EIA/1518/SA 024 dt 31-05-2017**

PROJECT TEAM - IRRIGATION & CAD DEPARTMENT, GOVT. OF TELANGANA

Sl.No	Name	Designation
1.	Shri. B Nagendra Rao	Chief Engineer
2.	Shri. A Sudhakar IFS (Retd.)	Advisor to Hon'ble Minister of I&CAD, Govt. of Telangana
3.	Shri. A. Venkateshwar Rao	Superintending Engineer
4.	Shri. V Jagadeesh	Executive Engineer
5.	Shri. G Swamy	Dy. Executive Engineer
6.	Shri. L Samya Naik	Asst. Executive Engineer
7.	WAPCOS Ltd, New Delhi	DPR Consultants

Quality Council of India

National Accreditation Board for Education & Training

CERTIFICATE OF ACCREDITATION

Environmental Health and Safety Consultants Private Limited

#174/New No.13/2, 14th E Cross, Industrial Town,
Agrahara Dasarahalli, Bangalore - 560 044, Karnataka

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

Sl. No.	Sector Description	Sector (as per)		Cat.
		NABET	MoEFCC	
1	River Valley projects	3	1(c)	A
2	Thermal power plants	4	1 (d)	B
3	Metallurgical industries - ferrous only	8	3 (a)	A
4	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)	21	5 (f)	A
5	Distilleries	22	5 (g)	A
6	Sugar industry	25	5 (j)	B
7	Highways	34	7 (f)	A
8	Building and construction projects	38	8 (a)	B
9	Townships and Area development projects	39	8 (b)	A

Note: Names of approved EIA Coordinators and Functional Area Experts are mentioned in RAAC minutes dated October 12, 2018 posted on QCI-NABET website.

The Accreditation shall remain in force subject to continued compliance to the terms and conditions mentioned in QCI-NABET's letter of accreditation bearing no. QCI/NABET/ENV/ACO/18/0798 dated November 19, 2018.The accreditation needs to be renewed before the expiry date by Environmental Health and Safety Consultants Private Limited, Bangalore, following due process of assessment.

Sr. Director, NABET
Dated: Nov. 19, 2018

Certificate No.
NABET/ EIA/1821/ RA 0107

Valid till
22.04.2021

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

ABBREVIATIONS

AAQM	Ambient Air Quality Monitoring
ADVI	Agricultural Drought Vulnerability Index
AIBP	Accelerated Irrigation Benefit Programme
AIS & LUS	All India Soil and Land Use Survey
APHA	American Public Health Association
BIS	Bureau of Indian Standards
BOD	Biochemical Oxygen Demand
BPL	Below Poverty Line
BSI	Botanical Survey of India
CAD	Command Area Development Plan
CADA	Command Area Development Authority
CAT	Catchment Area Treatment
CCA	Cultivable Command Area
CGWB	Central Ground Water Board
COD	Chemical Oxygen Demand
CPCB	Central Pollution Control Board
CRIDA	Central Research Institute for Dryland Agriculture
CWC	Central Water Commission
DAP	Di-ammonium phosphate
dB(A)	Decibels - A noise scale rating
DC	Deputy Commissioner
DDP	Dry land Development Programme
DG	Diesel Generator
DPAP	Drought Prone Area Programme
DRSM	Dry rubble stone masonry
DWL	Depth to Water Level
EAC	Expert Appraisal Committee
E-FLOW	Environmental/ecological flow
EFs	Environmental Flows
EIA	Environment Impact Assessment
EL	Elevation
EMC	Environmental Management Classes
EMP	Environmental Management Plan
ENVIS	Environmental Information System
EPA	Environment Protection Agency

EPH	Environmental Public Hearing
ERDAS	Earth Resources Data Analysis System
ESZ	Eco-sensitive Zone
FDC	Flow Duration Curve
FRL	Full Reservoir Level
FRLHT	Foundation for Revitalisation of Local Health Traditions
FSD	Full Supply Discharge
GCA	Gross Cropped Area
GDP	Gross Domestic Product
GEFC	Global Environmental Flow Calculator
GEM	Ground Water Estimation Committee methodology
GEM-97	Groundwater Estimation Methodology-97
GIS	Geographical Information System
GoI	Govt. of India
GoT	Government of Telangana
GWDTA	Godavari Water Disputes Tribunal Award
Ha	Hectare
HFL	High Flood Level
I&CAD Dept.,	Irrigation & CAD Department
ICRISAT	The International Crops Research Institute for the Semi-Arid Tropics
IMD	Indian Meteorological Dept.,
IRS	Indian Remote Sensing satellites
IUCN	International Union for Conservation of Natural Resources
IWDP	Integrated Watershed Development Programme
IWMI	International Water Management Institute
JCRDLIS	J. Chokka Rao Devadula Lift Irrigation Scheme
K	Kelvin
LA	Land Acquisition
LISS	Linear Imaging Self-Scanning
LMD	Lower Manair Dam
LMR	Lower Manair Reservoir
M.CUM	Million Cubic Meter
MoEF&CC	Ministry of Environment, Forests and Climate Change
MW	megawatt
NAAQ	National Ambient Air Quality Standards

NBSS&LU	National Bureau of Soil Survey and Land Use
NDMA	National Disaster Management Authority
NGO	Non Governmental Organization
NIDM	National Institute for Disaster Management
NRSC	National Remote Sensing Centre
NTFP	Non Timber Forest Produce
NWDPRA	National Watershed Development Project for Rain fed Areas
OFD	On-farm Development Works
PAF	Project Affected Family
PAP	Project Affected Person
PDO	Panchayath Development Officer
PDS	Public Distribution System
PF	Protected Forest
PHC	Public Health Centre
PLDB	Primary Land Development Bank
PM	Particulate Matter
PPEs	Personal Protective Equipments
PVNRKSSP	P V Narasimha Rao Kanthanapally Sujala Sravanthi Project
PWD	Public Works Dept.
R&R	Rehabilitation and Resettlement
RET	Rare, Endangered and Threatened
RF	Reserve Forest
RFCTLARR	Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement
RL	Reduced Level
RSPM	Respirable Suspended Particulate Matter
SC	Scheduled Caste
SCADA	Supervisory control and data acquisition
SHG	Self Help Group
SIA	Social Impact Assessment
SoI	Survey of India
SPF	Standard Project Flood
SRSP	Sri Ram Sagar Project
ST	Scheduled Tribe
TFD	Telangana Forest Dept.,
TMC	Thousand Million Cubic Feet

ToRs	Terms of Reference
TSPCB	Telangana State Pollution Control Board
TSTRANSCO	Transmission Corporation of Telangana Limited
WHC	Water Holding Capacity
WL(P)A	Wildlife (Protection) Act
WLS	Wildlife Sanctuary
WRD	Water Resource Dept.,
WUA	Water Users Association
ZSI	Zoological Survey of India

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Chapter 1. Introduction

1.1 Purpose of the report

Environmental Impact Assessment is one tool available with planners to harmonize developmental activities with the environmental concerns. The objective of EIA is to foresee the potential environmental problems that would arise out of a proposed development and address them in the project's planning and design stage.

EIA integrates the environmental concerns in the developmental activities right at the time of initiating for preparing the feasibility report. In doing so, it can enable the integration of environmental concerns and mitigation measures in project development. EIA can often prevent future liabilities or alterations in project design[2].

1.2 Project Proponent

Irrigation & CAD Department, Government of Telangana, is making every effort to harness and utilize all the available water resources for benefitting of Agricultural sector, Industrial Sector and also providing drinking water for overall development in the process of achieving "Golden Telangana". I&CAD Department is entrusted with Survey, investigation, planning, designing, construction, maintenance and management of Major, Medium & Minor Irrigation Projects including Lift Irrigation Schemes.

Jayashankar Bhupalapally District in the State of Telangana experiences a hot and dry climate and covers a geographical area of 6,175 km^2 with crop land and forest land being dominant areas in the district. However, the irrigation depends on the rainfall and climatic conditions in Eturnagaram Mandal. Agricultural Drought Vulnerability Index (ADVI) as introduced by National Remote Sensing Centre is used to prioritize and address the drought management and development activities. ADVI of the Eturnagaram Mandal in Jayashankar Bhupalapally District belongs to vulnerable category showing variability of detrended crop yields[3].

In this direction, I&CAD Department, Government of Telangana intends to give more thrust to new areas of development such as participatory irrigation management, encouragement to modern irrigation practices with higher duty of water, exploration of new possibility of conjunctive use of water, advocating a holistic approach towards agricultural farming practices for economic security to the farmer and using modern technologies in survey and design of irrigation systems.

M/s Environmental Health & Safety Consultants Private Limited, Bengaluru is entrusted by I&CAD Department, GoT, to carry out the Environmental Impact Assessment &

[2]http://envfor.nic.in/divisions/iass/eia/Chapter1.htm

[3]Drought Management Manual for Telangana State (2016), Dr.MCR HRD Institute of Telangana, Govt. of Telangana, Page 12&13.

Environmental Management Plan studies for P V Narasimha Rao Kanthanapally Sujala Sravanthi Project (PVNRKSSP). I&CAD Department, GoT is the employer and executing agency for the project. The command area of the project is >50,000 ha and the proposed project falls under schedule 1(c) of EIA Notification, 2006 and its subsequent amendments on 14.08.2018, the proposed project is categorized as 'A' and requires Environmental Clearance from MoEF&CC, GoI, New Delhi. In addition to this, the proposed project attracts General Conditions of EIA notification, 2006 and its subsequent amendments due to the presence of Eturnagaram Wildlife Sanctuary (WLS) and Interstate boundary of Chattisgarh (2.5 Km) located within 10 Km radius of the project component. However, no project components are located within the boundary of Eturnagaram WLS. The Terms of References for the project has been accorded by MoEF&CC, GoI, New Delhi vide letter No. J-12011/24/2010-IA-I dated 03.04.2017 (Annexure-1).

This EIA report presents baseline data collected for three season viz., July 2017 to March 2018 for physical, biological and socio-economic components of environment, identification, prediction and evaluation of impacts based on the project activities and to prepare Environmental Management Plan (EMP) for mitigation of adverse impacts due to the proposed project.

1.3 Brief Description of the Project and its Importance to the Region

The proposed scheme involves construction of 1,132 m long barrage near Thupakulagudem village across River Godavari located 3 Km downstream of existing J.Chokka Rao Devadula Lift Irrigation Scheme (JCRDLIS). The proposed project stabilizes and provides irrigation facilities to existing 5,55,310 ha of command area belonging to J. Chokka Rao Devadula LIS (2,51,310 ha) and Sri Ram Sagar Project (SRSP) - Stage I & II (3,04,000 ha). 50 TMC of water will be utilized for stabilizing the existing command area and 50 TMC of water will be utilized for drinking water purpose for enroute villages. The command area is already benefitted by the existing irrigation facilities for the Khariff and bi-seasonal crops and the proposed scheme facilitates irrigation also during Rabi season. Total power required for the proposed project is 1.5 MW which is sourced from Transmission Corporation of Telangana Limited (TSTRANSCO).

The project has been proposed by the I & CAD Department, Govt. of Telangana to stabilize the existing JCRDLIS and SRSP - Stage I and II and provide irrigation facilities to the areas of Eturnagaram Mandal, Jayashankar Bhupalapally District. This will provide stability to agriculture and thus improving the per capita income and standard of living of the people. Therefore, the need of the proposed scheme is of priority which could

meet the demands of the farmers and shall also improve the Irrigation potential and Socio-economic conditions of the region.

Government of Telangana has accorded administrative approval (Annexure - 2) for PVNRKSSP vide order No. G.O.Ms.No.14 dated 13.02.2017 and the total cost of the project is 2121 Crores.

The boundary of Eturnagaram Wildlife Sanctuary is located adjacent to the proposed barrage. Reserve Forests namely; Nuguru RF and Perur RF is located at the close proximity and 3 Km respectively from the proposed barrage. No project activities will be carried out in the Eturnagaram WLS. The project is being proposed in the river bed/private lands only and therefore no requirement of forestland in Eturnagaram Wildlife Sanctuary. But during discussions held with PCCF (Wildlife), Govt of Telangana, it was mentioned that the project is touching the outer periphery/boundary of ESZ of Eturnagaram Wildlife Sanctuary. Based on the discussions and observations by State forest authorities necessary proposal/permission, if required, will be obtained from Competent Authority. However, project involves submergence area of 580.18 ha of river bed at FRL 77 m. Total of 674.18 ha of land (94 ha of private land + 580.18 ha of river bed area) is required for the proposed project.

1.4 Scope of EIA report

The present study includes detailed inventory of existing status of environment in the Study area for various identified environmental components viz. air, noise, water, land, biological and socio-economic aspects. Under the scope of EIA, the objective of the study is:

- To assess the present status of air, noise, water, land, biological and socio-economic components of the environment.
- To identify, predict and evaluate significant impacts due to project activities on various environmental components during the Construction and Operational stages of the project.
- To delineate proposed pollution control measures and accordingly formulating Environmental Management Plan (EMP).
- To delineate post-project environmental monitoring programme to be implemented by I & CAD Department, GoT.

1.5 Components of EIA

The sequence of EIA report follows generic structure of EIA/EMP report as specified in EIA Notification, 2006 except Environmental cost benefit analysis since it was not

recommended by the EAC during scoping stage. The sequence of the EIA/EMP report is as follows;

- Project Description
- Baseline Environmental Scenario
- Anticipated Environmental Impacts and Mitigation Measures
- Analysis of Alternatives (Technology and Site)
- Environmental Monitoring Program
- Additional Studies - Public Consultation, Risk Assessment, Social Impact Assessment for Land Acquisition
- Project Benefits
- Environmental Management Plan
- Summary & Conclusion
- Disclosure of Consultants engaged

1.6 Approach and Methodology

The EIA report has been prepared and presented as per requirements of the EIA, Notification 2006 and its amendments of MoEF under the Environment (Protection) Act, 1986. The methodology adopted for preparation of EIA studies and to obtain Environmental Clearance for the project is given below.

Table 1.1 Methodology adopted for preparation of EIA studies

Sl. No.	Components	Source
1	Secondary data collection	▪ FAO publications ▪ MoEF guidelines on EIA ▪ Central Groundwater Board reports ▪ Telangana State Natural Disaster Monitoring centre reports ▪ Survey of India toposheets ▪ National Institute of Disaster Management, GoI ▪ Published literature ▪ Geological Survey of India data ▪ Indian Space Research Organization data ▪ National Remote Sensing Centre data ▪ Forest Dept., working plans

Sl. No.	Components	Source
		▪ Indian Meteorological data
2	**Primary data collection**	**Methodology**
2.1	Ambient Air Quality	▪ Installation of weather monitoring station ▪ Selection of AAQM locations as per BIS/CPCB guidelines ▪ AAQM monitoring as per NAAQ standards - 2009, CPCB, New Delhi ▪ Interpretation of results as per AQI Index, CPCB, New Delhi
2.2	Ambient Noise Level	▪ Selection of Ambient Noise level monitoring locations as per Protocol for Ambient Noise Level Monitoring, CPCB, New Delhi ▪ Ambient Noise level monitoring ▪ Interpretation of results as per Noise (Regulation and Control) rules - 2000, MoEF, GoI
2.3	Hydrology and Geology	▪ Collection of the relevant data contained in the EIA and EMP Reports, from the reports and maps of Central Ground Water Board (CGWB) Geological Survey of India (GSI), other Institutions and Departments. ▪ Identify Inter- related and Inter – dependent key factors that play vital role in the occurrence of ground water its quality and potential. ▪ Identify surface water resources in the project site and its catchment area. ▪ Assess the ground water resource potential in the catchment area of the project site. ▪ Bring out various events and processes that comprise the project activity. ▪ Identify the site specific environmental issues and mitigation measures and

Sl. No.	Components	Source
		▪ Compile a consolidated, comprehensive and meaningful report of the Project site and its catchment area.
2.4	Surface and Groundwater Quality	▪ Identification of sampling locations ▪ Collection, preservation and Transportation of samples as per CPCB guidelines ▪ Analysis of water samples as per BIS and APHA guidelines ▪ Interpretation of results as per CPCB and BIS
2.5	Soil characteristics	▪ Identification of Soil types, status, crops and cropping pattern in the study area ▪ Identification of soil sampling locations based on geology and soil maps ▪ Collection and analysis of soil samples, manual of Food and Agricultural Organization and Soil manual of Department of Agriculture and co-operation, Ministry of Agriculture, GoI. ▪ Interpretation of results
2.6	Land use assessment	▪ Processing of satellite imageries by using ARC GIS 9.2 and ERDAS IMAGINE 9.1 tools for generation of various thematic maps ▪ Interpretation of thematic maps as per NRSA guidelines ▪ Practical Manual for hands on training/experiential learning released from UAS, Bengaluru, AISS & LU and GSI.
2.7	Ecology and Biodiversity (Terrestrial)	▪ Discussion with forest officials and local people ▪ Identification of sampling locations ▪ Quadrate and line transact method for collection of flora ▪ Transact method for collection of fauna

Sl. No.	Components	Source
		and point count method for collection of avi - fauna data ▪ Identification of Conservation status of flora and fauna by using IUCN, BSI and wildlife schedules ▪ Assessment of Phyto - sociological parameters - frequency, density, species richness, species diversity ▪ Interpretation of results
2.8	Ecology and Biodiversity (Aquatic life)	▪ Collection of water samples for Physico - chemical analysis ▪ Collection of samples by using plankton net. the collected samples were fixed in 5% Formaldehyde solution and subjected to qualitative and quantitative analysis by using Microscope and Sedge wick - Rafter plankton counting cell ▪ Collection of samples for littoral fauna by operating 'D' frame net and sieved through No.40 sieve and fixed in 5% Formaldehyde solution followed by qualitative and quantitative analysis ▪ Fishing operation with the help of local fishermen and visiting fish markets ▪ Discussion with fishermen ▪ Identification of conservation status of fishes by using IUCN ▪ Interpretation of results
2.9	Social Impact Assessment	▪ Discussion with Project Proponent ▪ Delineation of Demographic profile, Literacy, Occupation status, infrastructure facilities available, health status, religion and caste, cultural properties of the study area ▪ Questionnaire survey and focal group discussions of PAPs ▪ Prediction of impacts on land acquisition

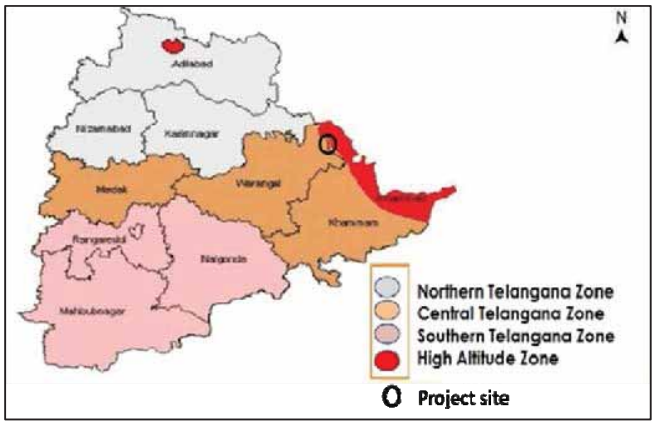
Sl. No.	Components	Source
		▪ Estimation of cost on land acquisition ▪ Conducting Environmental Public Hearing at site ▪ Compliance to observations raised during EPH
2.10	Risk Assessment and Hazard Management	▪ Identification of risk and hazards associated with the project activities during Construction and Operation phase
3	Impact identification and prediction	▪ Estimation of E-flow using Global Environmental Flow Calculator model developed by IWMI, Srilanka ▪ Prediction of Impacts on Air quality by using AERMOD tool ▪ Prediction of Noise quality by using dhwani pro model. ▪ Estimation of soil loss and soil erodability index by using Universal Soil Loss Equation ▪ Estimation of sediment index using regression analysis ▪ Evaluation of impacts by using Leopold matrix method
4	Project benefits	▪ Socio-economic benefits ▪ Ecological benefits ▪ Conjunctive use of surface and ground water ▪ Underground recharge ▪ Enhanced agricultural productivity
5	Environmental Management Plan	EMP for Air, water, noise pollution, Soil Conservation measures and CAT, CAD, Muck Disposal, Fisheries conservation plan, afforestation / greenery development plan, R&R plan, Environmental Monitoring programme, etc along with cost for implementation of each EMP with specific time frame and responsibility.

Sl. No.	Components	Source
6	Environmental Public Hearing	Submission of Draft EIA report along with Executive Summary in English and Vernacular Language to State PCB, Finalization of Date of EPH by RO, TSPCB and DC, Paper Advertisements in National and regional daily news papers, Local Paper advertisements, preparation of presentation of draft EIA report in local language, Presentation to public regarding the project in local language, Issue of proceedings and video recording by state PCB.
7	Issue of Environmental Clearance	Preparation of compliance to proceedings of Environmental Public Hearing, finalizing the final EIA report, uploading Final EIA Report to MoEF website, circulation of project documents to EAC members, preparation of Final EIA presentation, presentation to EAC, recommendation by EAC, issue of EC by MoEF&CC.

Chapter 2. Project Description

2.1 Need for the project

2.1.1 Agro – climatic zones



Telangana has been divided into 4 agro-climatic zones based on the physiography, rainfall, soil types, crops, cropping pattern, etc. Command area lies in **'Central Telangana Zone'**[4]. The project region experiences a hot summer and general dryness except South West Monsoon season with an average annual rainfall of 1015.8 mm. About 81 % of annual rainfall is received during South West monsoon season (June to September). Some rainfall is received in the latter half of the summer season and in the post monsoon season. The soil in the command area comprises of sandy loam and black cotton soils[5]. The common crops grown in this region includes Jowar, Paddy, Groundnut, pulses, Chillies, etc.

2.1.2 River Godavari

The Godavari is the second largest basin and accounts for nearly 9.5% of the total geographical area of the country. It extends over states of Maharashtra (48.7%), Andhra Pradesh (23.7%), Chhattisgarh (12.4%) and Odisha (5.7%) in addition to smaller parts in Madhya Pradesh (7.8%), Karnataka (1.4%) and Union territory of Puducherry (0.01%). It extends over an area of 302065.10 Sq. km, with a maximum length and width of about 995 km and 583 km, respectively. The CWC reported area of the basin is 312812.0 Sq. km. The basin falls in the Deccan Plateau lying between 73°24′ to 83°4′ east longitudes and 16°19′ to 22°34′ north latitudes. The basin is bounded on the north by the Mahadeo Hills, the Satmala Hills, on the north-west by the Ajanta Range, on the west by the North Sahyadri range of the Western Ghats, on the east and south-east by the Eastern Ghats and on the south by the Balaghat Range.

The core components of the water network include the River Godavari, the largest of the peninsular river and its principal tributaries finally draining into the Bay of Bengal. The River Godavari is the biggest east-flowing rivers of the peninsular India and the second largest

[4] Task Force Report, Agriculture challenges and way forward, Govt. of Telangana Agriculture and Cooperation Department, Page 5.
[5] Working Plan for Warangal District (1991-92 to 2000-01), K Suresh Chander Rao, Working Plan Officer, Page 5&6.
Image source: Task Force Report, Agriculture challenges and way forward, Govt. of Telangana Agriculture and Cooperation Department, Pg5.

river draining in India. Godavari River originates near Trimbakeshwar near disrtict Nashik, northeast of Mumbai in the state of Maharashtra at an elevation of 1067 m and flows for a length of about 1465 km, in a generally south-east direction before joining the Bay of Bengal. It flows through the Eastern Ghats and emerges out of Polavaram into the plains. At Dhawaleswaram the river divides into two branches, the Gautami and Vasishta. Between the two lies the Godavari Central delta. The Pravara, the Manjra are the main tributaries joining on the right bank of the river and the Purna, the Pranahita, the Indravati, the Sabari are the main tributaries joining on the left bank[6].

The proposed project has been taken up as per GWDT award without any interstate aspects and is located in the lower Godavari sub-basin.

[6] Godavari basin status report (March 2014), Govt. of India Ministry of Water Resources, Page 15.

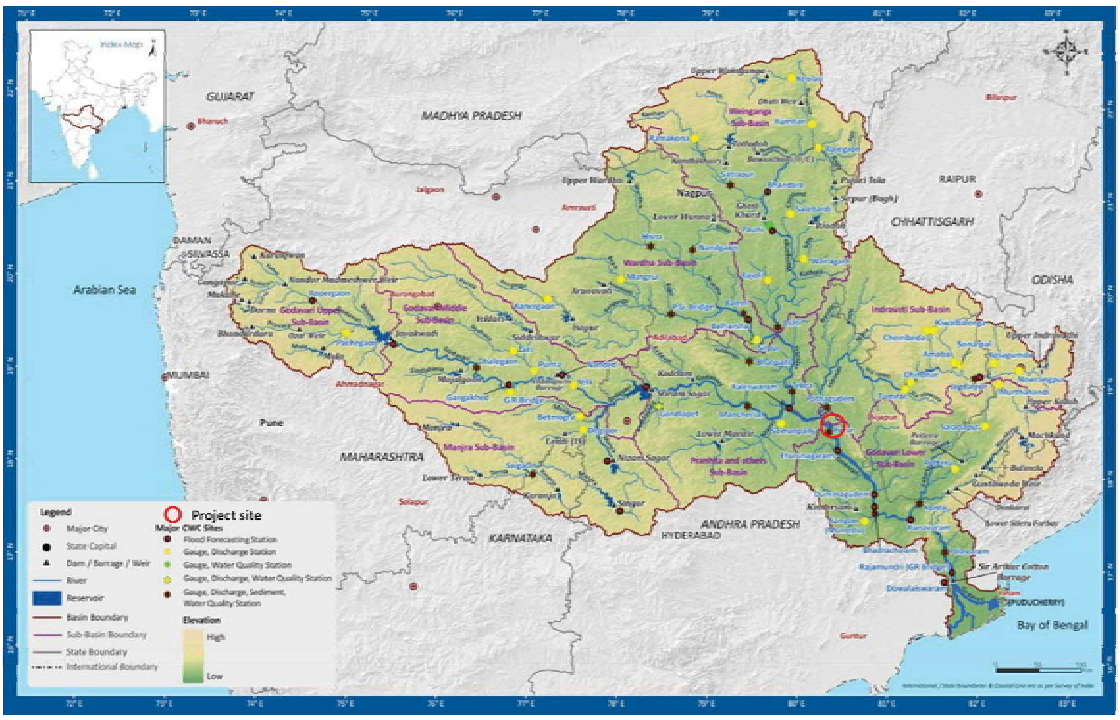


Fig 2.1 Map showing Godavari basin and proposed project location[7]

[7] Godavari Basin, V2.0, (2014), CWC and NRSC, Govt. of India, Ministry of water resources, Page 2

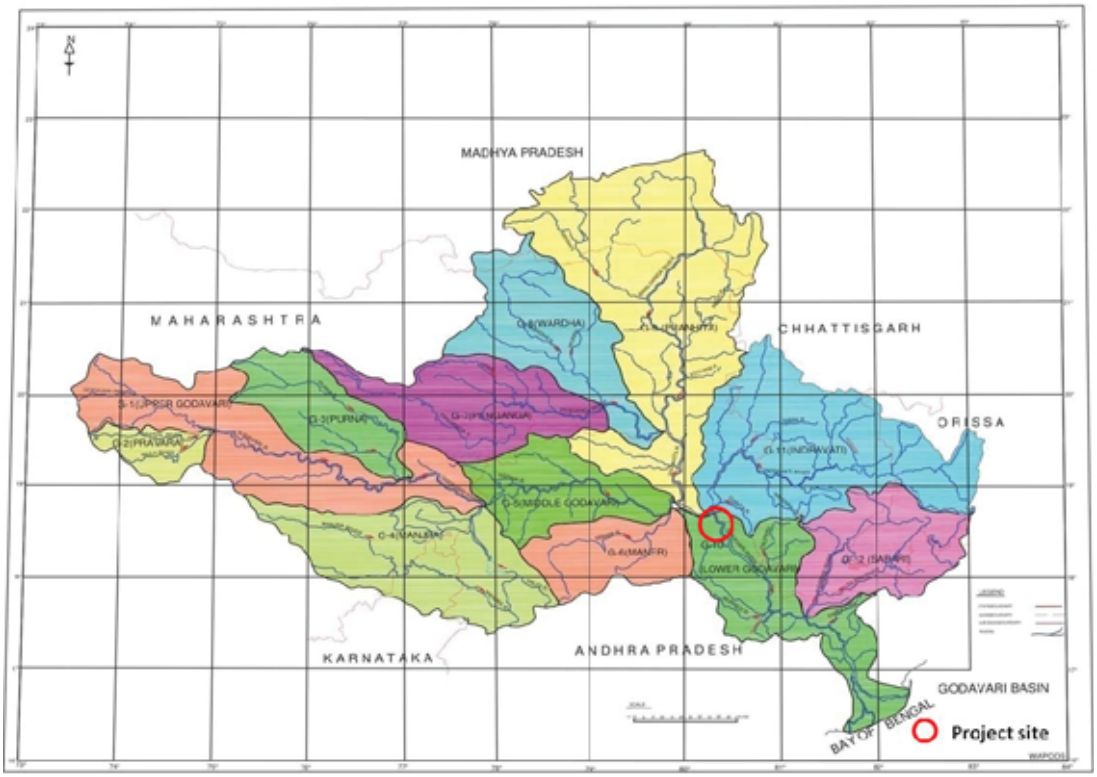
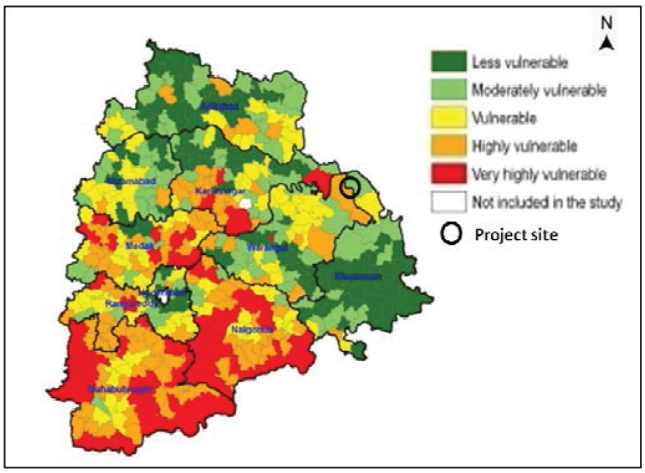


Fig 2.2 Map showing Godavari basin, its sub-basins and project location

2.1.3 Erratic droughts in command area



Droughts are common in the study areas. The existing command areas of the JCR Devadula LIS and SRSP Stage - I&II is severely prone to erratic droughts ranging from less vulnerable to moderately vulnerable levels as per Agricultural Drought Vulnerability Index (ADVI) introduced by National Remote Sensing Centre (NRSC). However the proposed barrage site near Thupakulagudem village, Eturnagaram Mandal belongs to "Vulnerable" category as per NRSC[8].

Droughts are common in the study area. Severe droughts have occurred in 1970-72 and 1983-84 and during 1987-88 few parts of the district were partly affected by drought[9]. The irrigation depends on the rainfall and climatic conditions in Eturnagaram Mandal. Agricultural Drought Vulnerability Index (ADVI) as introduced by National Remote Sensing Centre is used to prioritize and address the drought management and development activities. ADVI of the Eturnagaram Mandal in Jayashankar Bhupalapally District belongs to vulnerable category showing variability of detrended crop yields[10]. The people of this region depend on agriculture and hence providing irrigation and stabilizing the agricultural production, provides a much needed relief to the people. It improves the per capita income and standard of living of the people. Further it utilizes the water and land resources and substantially improves GDP contribution from agriculture. Therefore, stabilization of command areas of JCRDLIS and SRSP has been need of the hour.

2.1.4 Stabilization of existing irrigation schemes

2.1.4.1 J Chokka Rao Devadula Lift Irrigation Scheme

J Chokka Rao Devadula Lift Irrigation Scheme (JCRDLIS) project involves lifting water from River Godavari from an elevation of +71 m during monsoon season (June - December) near Gangaram village upto an elevation of 470 m and conveyed through pressurized pipeline. The water conductor system is integrated with eight existing balancing reservoirs and lift the water to the desired elevation in 10 stages to irrigate a command area of 2,51,310 Ha

[8] Drought Management Manual for Telangana State (2016), Dr.MCR HRD Institute of Telangana, Govt. of Telangana,
[9] Working Plan for Warangal District (1991-92 to 2000-01), K Suresh Chander Rao, Working Plan Officer, Page 7.
[10]Drought Management Manual for Telangana State (2016), Dr.MCR HRD Institute of Telangana, Govt. of Telangana, Page 12&13.
Image source; Drought Management Manual for Telangana State (2016), Dr.MCR HRD Institute of Telangana, Govt. of Telangana

involving the then Warangal, Karimnagar, Nalgonda and Medak Districts of Andhra Pradesh from an Elevation +71 m. to +540 m by utilizing 38.18 TMC of water out of 467.24 TMC water available at Intake point in the River Godavari. Pumping period proposed for 170 days between late June/early July and end of November. Government of Telangana vides G.O.Rt. No; 25, Dt: 21.01.2015 enhanced water allocation to 60 TMC. The total land requirement of JCRDLIS project was 5,610 ha (inclusive of 344 ha of forest land) and involved no displacement/ R&R activities. Forest Clearance for 344 ha of forest lands was issued on 14.09.2005. Environmental clearance for JCRDLIS project was issued by MoEF&CC, New Delhi on 06.12.2005 (Annexure-3) and the technical details of the existing JCRDLIS project is enclosed as Annexure-4.

Table 2.1 Salient features of JCRDLIS project

Utilization	
Source	Godavari River
Location	Latitude 18°35'23.16"N, Longitude 80°21'0.16"E
Water to be lifted from River Godavari	38.182 TMC
Water for Agriculture usage (Govt.Memo No: 16444/WRG/2012-6,Dt: 28.03.2013)	35.34 TMC
Water for Non-Agriculture usage	2.842 TMC
Industrial usage	0.012 TMC
Drinking Water usage	2.830 TMC
Power Requirement (Ultimate)	484 MW
Project Cost (Estimated Cost)	Rs. 6016 Crores
Revised Estimate Cost (TAC, CWC, Govt. of India accorded clearance during 106th Meeting held on 16-09-2010)	Rs. 9427.73 Crores was sanctioned Vide G.O. Rt. No: 606, (I&CAD), dt:16.09.2010.
Ayacut	
Ayacut with lifted water through Canals	220048 ha
Ayacut with regenerated water	31262 ha
Source of Funding	Central funding (AIBP): 25%, State funding: 75%
Physical Progress	Phase-I Physically completed. Phase-II Physically completed. Phase-III-Package-I physically completed.

Lat: 18°35'23.08"N, Long: 80°21'5.04"E

Lat: 18°35'22.98"N, Long: 80°21'1.86"E

Lat: 18°35'25.25"N, Long: 80°21'3.26"E

Lat: 18°35'23.01"N, Long: 80°21'3.49"E

JCR Devadula LIS Intake Pump House

Table 2.2 Irrigation potential of JCRDLIS project

Ayacut with Gravity Canals (ha)	Ayacut with ground generated water (ha)	Total Ayacut (ha)	Phase-wise IP Contemplated (ha)				IP Created up to 2015 (Ha)	Balance IP to be created (ha)
			Phase-I	Phase-II	Phase-III	Total		
220048	31262	251310	49655	72544	97849	251310	42760	177288

During the course of time, there was a change in the course of River Godavari due to which boulders and rocky strata exposed near the lift point of JCRDLIS causing reduction in water availability which necessitates P V N Kanthanapally Sujala Sravanthi Project. The irrigation potential created upto 2015 is 42,760 ha and in order to achieve the irrigation potential for the balance command area of 177288 ha, the proposed project is essential. The CWC Clearance and its schematic diagram of JCRDLIS are enclosed as Annexure 4.

2.1.4.2 Sri Ram Sagar Project Stage I and II

The Sri Ram Sagar Project (SRSP), formerly known as the Pochampadu irrigation project has been built on Godavari River. Sriram Sagar Project involves two stages providing irrigation to 3,04,000 ha of land. This irrigation project is located at Pochampadu village in Nizamabad

district of the then Andhra Pradesh (AP). This project has been built to utilize Godavari River water for irrigation and drinking purposes in Telangana. The regions such as Nizamabad, Adilabad, Karimnagar, and Warangal districts of the then state of Andhra Pradesh are covered under this project. The SRSP dam comprises of concrete spillway sections with 42 gates with flanked non-overflow masonry and earthen embankment structures on either sides. The reservoir has a water spread area of about 435 Million square meters (Msqm) at the Full Reservoir Level (FRL) equal to 332.54 m. A flood flow canal (Kakatiya Canal) has been built to utilize flood water and this water is stored in the Lower Manair Reservoir (LMR) which is situated at a chainage of 146 km from the SRSP[11]. The Environmental Clearance for SRSP Stage I and II was obtained on 14.10.1980, 07.07.1995, 24.06.2002 and 14.05.2003 respectively. Copies of the same are enclosed as Annexure-5. The technical details of the existing SRSP Stage – I&II project and its schematic diagrams are enclosed as Annexure 6.

Lower Manair Dam	Sriram Sagar Dam

- Sri Ram Sagar Project Stage I

In 1951, the erstwhile Government of Hyderabad submitted a scheme to the Government of India, Planning Commission with a dam proposal at Pochampadu on River Godavari and dams on its tributaries namely the Kaddam and Manair Rivers. The Pochampadu site was located a little below the entry Point of Godavari River into A.P. territory. Only Kaddam dam was built. Pochampadu Project is taken up to provide irrigation facilities to the most backward districts of Telangana Region viz. Nizamabad, Adilabad, Karimnagar, Warangal, Nalgonda and Khammam districts. It is a multipurpose and composite (Earthern and Masonry) dam constructed across Godavari River at Pochampadu (v), Balakonda Mandal of Nizamabad district. The Pochampadu Project proposals were cleared in 1946 for a utilization of 66 TMC of Godavari water. The Pochampadu Project is built with a gross storage of 112 TMC or 3171.90 M.cu.m. (82.1 TMC live storage or 2325 M.cum.) To irrigate initially 2, 31,000 ha of command area through 113 Kms long Kakathiya Canal. The dam was also meant for generating (4*9 MW) 36MW power of which 3*9MW are already constructed and operational.

[11] Performance evaluation of Sriram Sagar Irrigation Project (2013), C M Rao & R V Kale, Journal of IWRS, Page 2.

The Pochampadu project was renamed as Sri Ram Sagar Project in 1982-84 and it was formulated (a) to increase the command area from 0.231 M.ha to 0.392 M.ha command, and supply water to Warangal town at Kakatiya canal Km 234 and (b) including two new canals from Sri Ram Sagar Project viz. Saraswathi canal for serving an ayacut of 17,000 ha by linking Sri Ram Sagar Project to Kaddam reservoir and Laxmi canal to serving 6400 ha ayacut.

Sriram Sagar Project Stage-I is a multipurpose project constructed across the Godavari River near Pochampad (V) Balkonda (M) Nizamabad (District) during 1964. The project is envisaged to irrigate an ayacut of 9, 68,640 Acres covering four Districts viz, Nizamabad, Adilabad, Karimnagar and Warangal. Sriramasagar Project, Comprises the following:

- Sriramasagar Dam across Godavari River
- Lower Manair Dam across Manair River

Prof. G.V. Sudhakar Rao Lower Manair Dam was constructed on Manair River tributary of River Godavari is situated in Karimnagar District of Telangana State. The dam is commissioned during the year 1985.

Table 2.3 Salient features of SRSP Stage - I project

1. SRSP Dam, Pochampad	
Source	Godavari River at Pochampadu Village
Project Location	Pochampad village, Balkonda Mandal, Nizamabad District
Foundation of Stones	26th July, 1963. Laid by the Late Prime Minister of India Pandit. Jawaharlal Nehru
Purpose of Project	Water supply/Power/ Multi-purpose/Irrigation
Completion of Project	1983
Latitude and Longitude	18°-58′N, 78°- 20′E
Gross storage	112 TMC (3172 M.Cum)
Catchment area	91751 Sq. Km (35425 Sqm)
Levels	
Crest Level	(1058 fts) 322.478 Mtrs
MDDL	(1064 fts) 324.307 Mtrs
FRL	(1091 fts) 332.537 Mtrs
MWL	(1093 fts) 333.146 Mtrs
TBL	(1108 fts) 337.718 Mtrs
First Filling (Year/Levels)	(1983/1091 Fts) 332.537 Mtrs
Maximum height of the dam	38 Mtrs
Length of earth dam	14462.39 Mtrs
Length of Masonry Dam	957.53 Mtrs

Area under submergence	453 Sq. Km	
GATES	**Spillway**	**River sluice**
Numbers	42	6
Size	50'x33'	8' x 12'
Type	Redial	Vertical
Designed flood (100 yrs)	45,307 Cumecs (16 Lakh cusecs)	
Capacity of Hydel Power House	36 Mega Watts (4x9 MW)	
2. Lower Manair Dam		
Location	Alugunu (V), Karimnagar (D)	
Latitude	18^0 - 24' North	
Longitude	79^0 -20' East	
River/ Basin	Manair /Godavari	
Catchment area	6648 Sq.Km.	
Reservoir Data		
MWL	+ 281.026M	
FRL	+280.416M	
MDDL	+276.0042M	
Sill of Regulator	+ 266.700M	
TBL	+ 284.378M	
Capacity of the reservoir		
Gross	24.034TMC	
Live	21.938TMC	
Height of dam above river bed	26.882M – Earth Dam, 40.538 M- Masonry	
Top width of dam	4.27 m	
Length of dam		
Gravity	10.10 Km.	
Composite	0.641 Km.	
Max. Flood discharge	5.00 Lakh Cusecs	
Regulator sluices	4 vents of size 8' ft X 18' ft	
Main canal		
Length of Main canal	(146.00 Km to 284Km) = 138Km	
Distributaries	54 Nos	
Maximum flood discharge	3.50 lakh cusec (computed)	
Area irrigated		
Command area (ha)	392000	

Components of SRSP Stage I	• Sri Ram Sagar Project dam a gravity dam with FRL + 332.54M (1091 ft) and TBL+337.72 M across the River Godavari near Pochampadu (V) with original reservoir capacity of 112 TMC and now revised to 90.313 TMC after allowing for siltation and sedimentation. • Lower Manair dam a balancing reservoir across Manair River with FRL+280.416M (+920 ft) and TBL+284.378M with reservoir capacity 680.648 Mm3 24.074 TMC. • Kakatiya canal from Km. 0.0 to Km.146.0 and its Distributory system from D5 to D94 up to LMD and from km 146.0 to Km.284.0 with distributaries DBM/1 to DBM/31 and from Km.234.0 to Km.284.0. • Saraswathi canal from km 0.0 to km 47.0 and its Distributory system. • Laxmi canal up to Km 3.50 and its Distributory system.
Source of Funding	The Sriram sagar project (Stage-I) was cleared by the planning commission and central water commission in august 1964 and the government of Andhra Pradesh accorded Administrative sanction to the project estimate for Rs. 40.00 crores vide G.o.Ms.No.361 (PWD. Irrigation Project Wing) dt: 27.11.1964.
Cost of the Project	a) Original Cost (1964): Rs. 40.13 Crores b) Revised Estimated Cost (S.S.R. 92-93): Rs. 1519.15 Crores c) Updated cost: Rs. 3600 Crores

Table 2.4 Irrigation potential of SRSP project Stage-I

Sl.No.	Year	Khariff		Rabi	
		Ayacut (ha)	Water used (TMC)	Ayacut (ha)	Water used (TMC)
1	2000-01	184785	78.274	112936	61.818
2	2001-02	191565	65.833	130926	64.629
3	2002-03	194779	83.399	45903	34.518
4	2003-04	178654	85.28	94999	23.737
5	2004-05	No Irrigation due to failure of monsoon			

Sl.No.	Year	Khariff		Rabi	
		Ayacut (ha)	Water used (TMC)	Ayacut (ha)	Water used (TMC)
6	2005-06	273655	71.86	316875*	62.66
7	2006-07	253744	70	334068*	74.19
8	2007-08	**	**	337507*	76
9	2008-09	**	**	307911*	61
10	2009-10	**	**	**	**
11	2010-11	242811	51.268	358956*	78.48
12	2011-12	283436	64.2	206389*	51
13	2012-13	**	**	202342*	56.116
14	2013-14	327518*	61	323748*	60
15	2014-15	No Irrigation due to failure of monsoon			
16	2015-16	No Irrigation due to failure of Monsoon			

** No Irrigation during Khariff season due to failure of Monsoon

*Area proposed for Irrigation during Khariff and Rabi

- Sri Ram Sagar Project Stage II

Sri Rama Sagar Project Stage-II is envisaged from Km 284.000 to Km 346.000 of Kakatiya Main Canal. The project envisages irrigation facility to an area of 1, 78,066 ha (4, 40,000 Ac.) in the drought prone areas of Telangana region viz., Warangal, Khammam and Nalgonda districts. Government has accorded administrative approval for the project estimates of Rs.1043.14 Crores vide G.O.Ms.No.35, Dt: 27.02.2006 and approved under AIBP scheme at the ratio of 1:3 Central and State Government Share.

Table 2.5 Salient features of SRSP Stage - II project

Source	Sri Rama Sagar Project on Godavari River.
Location	Pochampad (V), Balakonda (M), Nizamabad District
Latitude	16 55'N to 17 52'N
Longitude	75 15'E to 80 10'E
Components	Canal and Distributory System.
Source of Funding	Central Assistance (AIBP) and State Government in 1:3 proportions
Cost of the Project	Rs: 1043.14 Cr
Budget for this year	Rs: 40.00 Cr
Expenditure Incurred	Rs: 944.22 Crores
Physical Progress	Works currently under progress are: Package 52 : Lining Works Package 53,54,55,58 : Earth Work and Structures

Starting Location:	
Village	Illanda
Mandal	Wardhannapet
District	Warangal
Hydraulic Particulars @ Km 284.00 on Kakatiya Main Canal	
Required Discharge	95.00 Cumecs (3355 Cusecs)
Design Dischargeb)	123.01 Cumecs (4344 Cusecs)
Bed Width	16.76 m
F.S.D.	4.34 m
F.B.	0.90 m
Side slopes	1 ½:1 / 2:1
Bed fall	1 in 9500
Value of 'n	0.018
Velocity	1.216 m/sec
Top Width of Banks	7.750/4.00 m
Command area (ha)	178066
Intensity	109.00%

Table 2.6 Irrigation potential of SRSP Stage - II project (under Kakatiya Canal from km 284 to 346)

Distributory/ Package wise	**District**	**Name of the Constituency**	**Name of the Mandal**	**No. of villages covered in Mandal**	**Ayacut (ha)**
DBM-54	Warangal	Wardhannapet	Wardhannapet	2	536
DBM-54	Warangal	Wardhannapet	Parvathagiri	3	3111
			Wardhannapet Constituency		**3647**
DBM-54	Warangal	Palakurthy	Rayaparthi	10	5411
DBM-55	Warangal	Palakurthy			
DBM-56	Warangal	Palakurthy			
DBM-57	Warangal	Palakurthy			
DBM-57	Warangal	Palakurthy	Thorrur	23	10490
DBM-59	Warangal	Palakurthy			
DBM-60-Pkg-53	Warangal	Palakurthy			
DBM-61	Warangal	Palakurthy			
DBM-61	Warangal	Palakurthy	Kodakandla	9	2287
DBM-63	Warangal	Palakurthy			

Distributory/ Package wise	District	Name of the Constituency	Name of the Mandal	No. of villages covered in Mandal	Ayacut (ha)
DBM-65	Warangal	Palakurthy			
DBM-67	Warangal	Palakurthy			
DBM-69-Pkg-55	Warangal	Palakurthy			
				Palakurthy Constituency	**18187**
DBM-60-Pkg-53	Warangal	Dornakal	Narsimhulapet	3	13063
DBM-69-Pkg-55	Warangal	Dornakal			
DBM-60-Pkg-53	Warangal	Dornakal	Maripeda	2	9421
DBM-60-Pkg-54	Warangal	Dornakal			
DBM-69-Pkg-55	Warangal	Dornakal			
				Dornakal Constituency	**22484**
				Warangal district	**44318**
DBM-60-Pkg-53	Khammam	Palair	Thirumalayapalem	24	13682
DBM-60-Pkg-54	Khammam	Palair			
DBM-60-Pkg-54	Khammam	Palair	Kusumanchi	14	9489
DBM-60-Pkg-54	Khammam	Palair	Nelakondapally	3	1197
				Palair Constituency	**24369**
DBM-60-Pkg-54	Khammam	Khammam	Khammam Rural	14	5101
				Khammam Constituency	**5101**
DBM-60-Pkg-54	Khammam	Madhira	Mudigonda	3	987
				Madhira Constituency	**987**
				Khammam district	**30457**
DBM-69-Pkg-55	Nalgonda	Thungathurthi	Nuthankal	24	13144
DBM-71-Pkg-56	Nalgonda	Thungathurthi			
DBM-69-Pkg-55	Nalgonda	Thungathurthi	Thungathurthy	25	12696
DBM-70	Nalgonda	Thungathurthi			
DBM-71-Pkg-56	Nalgonda	Thungathurthi			
DBM-69-Pkg-55	Nalgonda	Thungathurthi	Thirumalagiri	10	2625
DBM-70	Nalgonda	Thungathurthi			
Tail End Distributory	-	Thungathurthi			
DBM-71-Pkg-56	Nalgonda	Thungathurthi			

Distributory/ Package wise	District	Name of the Constituency	Name of the Mandal	No. of villages covered in Mandal	Ayacut (ha)
DBM-70	Nalgonda	Thungathurthi	Jajireddy Gudem	17	9523
DBM-71-Pkg-56	Nalgonda	Thungathurthi			
				Thungathurthi Constituency	**38133**
DBM-71-Pkg-56	Nalgonda	Suryapet	Suryapet	14	5416
DBM-71-Pkg-57	Nalgonda	Suryapet			
DBM-71-Pkg-58	Nalgonda	Suryapet			
DBM-69-Pkg-55	Nalgonda	Suryapet	Atmakur (S)	26	12116
DBM-71-Pkg-56	Nalgonda	Suryapet			
DBM-71-Pkg-57	Nalgonda	Suryapet			
DBM-71-Pkg-57	Nalgonda	Suryapet	Chivemula	25	8561
DBM-71-Pkg-58	Nalgonda	Suryapet			
DBM-71-Pkg-58	Nalgonda	Suryapet	Penpahad	15	5821
				Suryapet Constituency	**31915**
DBM-71-Pkg-58	Nalgonda	Kodad	Munagala	9	3861
DBM-71-Pkg-57	Nalgonda	Kodad			
DBM-71-Pkg-56	Nalgonda	Kodad	Mothey	21	10792
DBM-71-Pkg-57	Nalgonda	Kodad			
DBM-71-Pkg-58	Nalgonda	Kodad			
DBM-71-Pkg-57	Nalgonda	Kodad	Nadigudem	4	1479
				Kodad Constituency	**16133**
DBM-71-Pkg-58	Nalgonda	Huzur Nagar	Garidepalli	2	87
				Huzur Nagar Constituency	87
				Nalgonda district	**86268**
				Warangal	44318
				Khammam	30457
				Nalgonda	86268
				Grand Total	**161043**

The ultimate average irrigation potential created under SRSP Stage-I between 2000-01 to 2015-16 is 236000 ha in Khariff season and 231000 ha during Rabi season against the total command area of 392000 ha. Similarly, under SRSP Stage-II, the ultimate irrigation potential created is 161043 ha against the contemplated 178066 ha. This is mainly because of erratic

rainfall, severe droughts and change in cropping pattern by the farmers leading to failure of water conveyance to tail end farmers. Hence, out of 570066 ha in both Stage-I and II, an area of 304000 ha is suffering ayacut which need irrigation facilities through the proposed project. The schematic diagram of SRSP is enclosed as Annexure-6.

2.1.5 Irrigation efficiency of JCRDLIS and SRSP Stage-I and II

"Irrigation efficiency is used to estimate the percentage of water utilized efficiently and the percentage of water which is lost. In other words, not all the water taken from a source reaches the root zone of the plants. Since, a part of the water is lost during transport through the canals and in the fields. The remaining part is stored in the root zone and eventually utilized by the plants. Therefore, only a part of the water is used efficiently, the rest of the water is lost for the crops on the fields that were to be irrigated.

The scheme irrigation efficiency (e in %) is that part of the water pumped or diverted through the scheme inlet which is used effectively by the plants.

The scheme irrigation efficiency can be sub-divided into:

The conveyance efficiency which represents the efficiency of water transport in canals, and

The field application efficiency which represents the efficiency of water application in the field.

It is calculated by the given formula:

e (%)= ec x ea/100

Where,

e (%) = scheme irrigation efficiency,

ec (%) = conveyance efficiency

ea (%) = field application efficiency

The conveyance efficiency mainly depends on the length of the canals, the soil type or permeability of the canal banks and the condition of the canals. In large irrigation schemes such as the proposed project more water is lost compared to smaller schemes. The indicative values for ec and ea is as given below;

Table 2.7 Indicative values of the conveyance efficiency (ec) for adequately maintained canals

Type of canal	**Earthen canals**			**Lined canals**
Soil type	Sand	Loam	Clay	-
Canal length	-	-	-	-
Long (> 2000 m)	60%	70%	80%	95%

Type of canal	Earthen canals			Lined canals
Medium (200-2000 m)	70%	75%	85%	95%
Short (< 200 m)	80%	85%	90%	95%

Table 2.8 Indicative values of the field application efficiency (ea)

Irrigation methods	Field application efficiency
Surface irrigation (border, furrow, basin)	60%
Sprinkler irrigation	75%
Drip irrigation	90%

A scheme irrigation efficiency of 50-60 % is good; 40 % is reasonable, while a scheme Irrigation efficiency of 20-30 % is poor"[12].

2.1.5.1 Irrigation efficiency of JCRDLIS

Based on the above calculation, the irrigation efficiency of JCRDLIS in the existing irrigating area is 57 % which appears to be good. In this project, only 17 % of area under contemplated command is achieved. However, a balance area of 83 % is required to be stabilized under the proposed project.

2.1.5.2 Irrigation efficiency of SRSP Stage-I and II

CWC in 2014 conducted performance evaluation studies of 131 completed major and medium irrigation projects in India. Under the program, SRSP Stage-I project was also reviewed. According to the studies, conveyance efficiency is 97.93 %, on farm application efficiency is 57.28 % and overall efficiency of the project is 44.66 %[13] which appears to be nearly good as per FAO classification.

In addition to this, a performance evaluation of the SRSP Stage-I and II project by formulating a tri-seasonal optimization model using 44 years (1950-1993) of historical data was conducted by C M Rao and R V Kale of National Institute of Technology, Jamshedpur and NIH, Roorke in 2013. The studies indicate that the drinking water supply demands have been met in all the 44 years. During this span, three irrigation releases for the Khariff season and six irrigation releases for the Rabi season has given 33 years of satisfaction with 11 deficit years, which is said to be well within the 75% dependability condition. Hence, it is a practicable case of optimal release combination. No irrigation release is assured during the summer season. As the developed optimization model accounts for the whole command area for simulation, further extension of area is not recommended.

[12] Annex I- Irrigation efficiencies (http://www.fao.org/docrep/t7202e/t7202e08.htm), FAO

[13] http://www.cwc.nic.in/newsite/Documents/Performance_Evaluation_Studies.pdf

Rabi crop is planned depending on the water availability status at each end of the Khariff season. The computed optimal release combination (3, 6) obtained from the Linear Programming model was again verified by the selected comparative indicators. For this purpose, the annual water balance study was also performed and their cumulative values are estimated for a period of 44 years. The relative irrigation supply with RIS = 1.00 for the Khariff season indicates adequate supply of water and a value of (Relative Irrigation Supply) RIS = 0.91 for the Rabi season indicates slightly inadequate supply of water from the reservoir. Further, the Water Self-Sufficiency (WSS) value with WSS = 118.25 % indicating that the SRSP reservoir is self-sufficient and does not need any other source of supply when (3, 6) release pattern is adopted (Annexure 7)[14].

2.1.5.3 Proposed P V Narasimha Rao Kanthanapally Sujala Sravanthi Project

The proposed project aims at stabilizing the existing irrigation facilities of JCRDLIS and SRSP Stage I & II schemes. At present, there is no barrage built downstream of the intake channel and hence there is no pondage for drawing the water. Therefore, Telangana Government has proposed to take up this flagship project, by proposing a barrage along River Godavari to create a pondage with an operational pond level of 77 m downstream of the intake channel of JCRDLIS and the proposed barrage will stabilize the existing command areas of 2,51,310 ha of Devadula Lift Irrigation Scheme and 3,04,000 ha of SRSP stages I & II. Further, the project will also provide 50 TMC of drinking water facility to enroute cities, towns and villages.

2.2 Present proposal

The project envisages construction of 1,132 m long barrage across Godavari River near Thupakulagudem village, Eturnagaram Mandal, Jayashankar Bhupalapally district to raise the water level in the River Godavari to stabilize the existing command areas of 5,55,310 ha of Devadula LIS and Sri Ram Sagar Project Stage I and II. 50 TMC of water shall be utilized for stabilizing the existing command area and 50 TMC of water shall be utilized for drinking purpose by the villages in the enroute cities, towns and villages. There are no additional infrastructures proposed in the existing command areas of the project. The command area is already endowed by the existing irrigation facilities for the Khariff and bi-seasonal crops and the proposed scheme also facilitates irrigation also during Rabi season.

The project site is approachable by road and the nearest village is Thupakulagudem at a distance of 400 m. The nearest railway station is at Mancherial District at a distance of 106 km. The nearest airport is Hyderabad at a distance of 255 km. The National highway NH-202 passes through the project area and serves as important means of commuting. Command

[14] Performance evaluation of Sriram Sagar Irrigation Project (2013), C M Rao & R V Kale, Journal of IWRS

area map is enclosed as Annexure – 8. The salient features of the project along with schematic diagram and location map is given below;

Table 2.9 Salient Features of the proposed PVNRKSSP

1	Name of the project	P V Narasimha Rao Kanthanapally Sujala Sravanthi Project
2	Type of project	Stabilizing the existing command areas of JCRDLIS (2,51,310 ha) and SRSP stage -I&II (3,04,000 ha) and providing drinking water facilities to the en route villages.
4	River	Godavari
5	Latitude and Longitude of the proposed barrage	• Left Bank Coordinates: 18° 35' 19.43" N, 80° 23' 49.13" E • Right Bank Coordinates: 18° 35' 02.94" N, 80° 23' 14.46" E
6	Water Utilization	50 TMC for stabilizing the existing command areas (JCRDLIS and SRSP Stage I & II) and 50 TMC of water for drinking purpose for enroute villages.
7	Command Area	5,55,310 ha - J. Chokka Rao Devadula LIS (2,51,310 ha); Sri Ram Sagar Project (SRSP) - Stage I & II (3,04,000 ha).
8	Districts benefitted	Jayashankar Bhupalapally, Warangal (Rural and Urban), Nalgonda and Khammam
9	Cost of the Project	Rs. 2,121 Crores
10	Land required for Project	94 ha of private/patta land
11	Submergence	580.18 ha of river bed area alongside River Godavari near the proposed barrage at FRL: 77 m
12	R & R	Nil
13	Power requirement	1.5 MW Source- TSTRANSCO
14	B.C Ratio	1.53

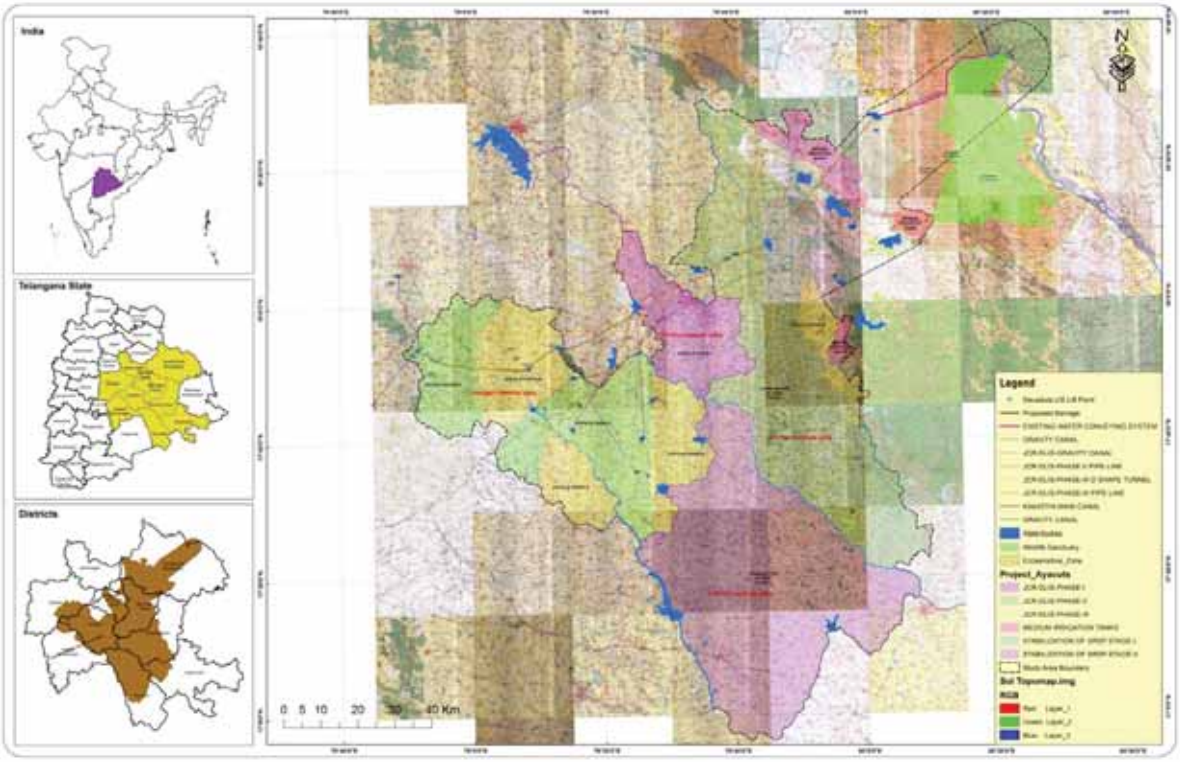


Fig 2.3 Location map of P V Narasimha Rao Kanthanapally Sujala Sravathi Project on SoI toposheet

Fig 2.4 Google view showing proposed barrage and River Godavari

2.2.1 Water availability

As per the Godavari Water Disputes Tribunal Award (GWDTA), the total allocation of water in the Godavari River to the Telangana State and Andhra Pradesh works out to be 1480 TMC. With a view to optimally utilize the water earmarked to projects in Telangana region, the Irrigation & CAD Department prepared a comprehensive plan for irrigation development in the region, considering various factors such as;

- Shortfalls in the existing projects,
- Shortfalls at the site of ongoing project, and
- Reallocation and readjustment of water for the proposed projects.

The net availability of water to Telangana/Andhra Pradesh in the different sub basins of Godavari and at the project sites has been assessed keeping in view GWDT allocation of water for the upstream states and is given in the table below.

Table 2.10 Yields of various sub-basins and entitlements of Telangana/ Andhra Pradesh at 75% dependability

Sl. No.	Sub-basins	Virgin Yield of sub-basins		Entitlement of other states	Entitlement of Telangana/AP	Contribution of regeneration	Total
		MCM	TMC	TMC	TMC	TMC	TMC
1	Penganga	3840.51	135.66	96.78	38.88	3.51	42.39
2	Wardha	4800.0	169.51	149.88	19.63	0	19.63
3	Pranahita	23633.3	834.60	561.58	273.02	10.38	283.40
4	Lower Godavari	6548.2	231.25	20.28	210.97	10.23	221.20
5	Indravati	20872.5	737.11	456.96	280.15	9.07	289.22
6	Sabari	11138.3	393.35	245.18	148.17	6.30	154.47
	Total	**70832.8**	**2501.48**	**1530.66**	**970.82**	**39.49**	**1010.31**

To assess the net availability of water at the project site, the flow data of CWC hydrological observation namely Polavaram, Koida, Perur, Somanpally and Mancherial are used. The consistency check has been carried out by specific flow analysis and results are as under.

Table 2.11 Specific flows at Perur and adjoining sites on Godavari (ltrs/sec/sq.km)

Name of the location	Polavaram	Koida	Perur	Somanpally	Mancherial
June	849063	1054733	741896	70863	744961
July	6028669	6389981	4842500	492870	4762343
August	11797621	13331942	9577856	1310953	9535893
September	8466875	8628774	6919188	1303360	6624625
October	3510786	3685957	2685605	728491	2542218
November	917938	985203	692229	131444	648804
December	520585	571369	297399	57205	292174
January	368891	418548	194261	36305	180408
February	307902	367431	156317	33347	148778
March	262016	323890	111149	31618	107964
April	239875	271049	70361	17825	66069
May	225242	272569	63085	11180	53632

However, Perur G&D site maintained by Central Water Commission is very close to the proposed barrage at Thupakulagudem (approximately 3 km upstream). Therefore, it is decided to consider the data at Perur for assessing the net availability of water at the project site taking into account the utilization under ongoing and planned projects as the existing utilization is already reflected in the observed data at Perur. The net availability of water at 75% dependability (1534.4 TMC) at the proposed Thupakulagudem barrage Site has accordingly been assessed considering the observed data for the period 1966-67 to 2012-13 of the CWC G&D Site at Perur on Godavari (Catchment Area: 2,68,000 Sq. Km) strictly sticking to Godavari Water Dispute Tribunal Award (Annexure 9). The net water availability at Thupakulagudem barrage site for the present purpose considering utilization under ongoing and planned projects are as mentioned below.

Table 2.12 Net availability of water at Thupakulagudem barrage site

Units	75% dependable flow at Perur reduced pro rata	Utilization under ongoing projects	Utilization under planned projects	Net Availability at 75% dependability
MCM	43450.6	10312.9	21602.8	11535.0
TMC	1534.7	364.3	763.0	407.4*

* - Excluding water requirement of Kaleshwaram Lift Irrigation Scheme

Out of 407.40 TMC of available water at the proposed barrage site at River Godavari, 180 TMC is allocated for Kaleshwaram Irrigation project (peddha), 4.5 TMC for Kaleshwaram LIS (tank filling) and the proposed PVNRKSSP requires 100 TMC of water amounting to 284.5 TMC leaving 122.90 TMC of water downstream.

2.2.2 Environmental flow

Rivers, streams and wetlands need certain amounts of water to support healthy aquatic ecosystems. The normal riverine flow is changed owing to construction of dams, water abstractions. However, construction of barrage in this case may alter the natural flow of the river. Hence, environmental flows are designed to mimic the natural condition of rivers along with the timing and quality of the river water. Rivers naturally experiences periods where there is low flow or no flow and on the contrast causes floods which can severely impair the functioning of aquatic ecosystems. Therefore, environmental flow is an essential component so as to maintain the ecological integrity of the river system and simultaneously providing water for domestic supply, irrigation, industrial purposes, etc. Any alteration in the flow can lead to depletion in water quality, establishment of invasive species and loss of biodiversity[15].

The Global Environmental Flow Calculator (GEFC) software developed by International Water Management Institute (IWMI), Srilanka is utilised for desktop rapid assessment of Environmental Flows (EFs). The calculator uses monthly time series flow conditions and its corresponding Flow Duration Curve (FDC) – a cumulative distribution function of flows for EF estimation[16]. Further, FDC is represented by a table of flow values (percentiles) covering the entire range of probabilities of occurrence. All FDCs in this study are represented by a table of flows corresponding to the 17 fixed percentage points: 0.01, 0.1, 1, 5, 10, 20, 30, 40, 50, 60, 70, 80, 90, 95, 99, 99.9 and 99.99 percent. Further, six EMC'S namely A, B, C, D, E and F indicating that the higher the EMC, the more water will need to be allocated for ecosystem maintenance or conservation and more flow variability will need to be preserved[17]. The e flow details from the year 1901-2000 for the proposed project are as given below.

[15] Environmental Flows in India towards sustainable water management (2014), S.K Jain and P. Kumar, Hydrological Sciences, Journal, vol 59, 3-4, 751-769

[16] Environmental Flow Requirements: A Case study of River Sone (2014), D N Jha, A Alam, K D Joshi, CIFRI, Page 2

[17] An Assessment of Environmental Flow requirements of Indian River Basins (2006), V. Smakhtin and M. Anputhas., page 15-18

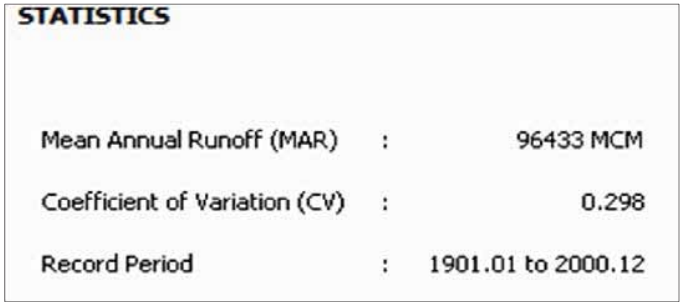


Fig 2.5 Statistical data showing Mean Annual Runoff in Godavari River at Project site

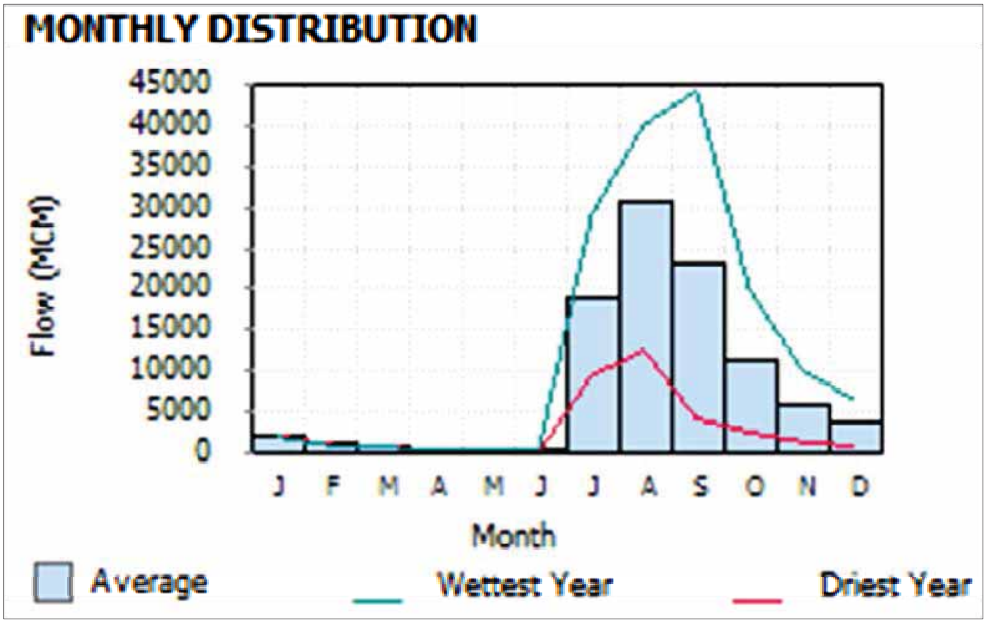


Fig 2.6 Graph showing monthly distribution of flow at Godavari River at Project site

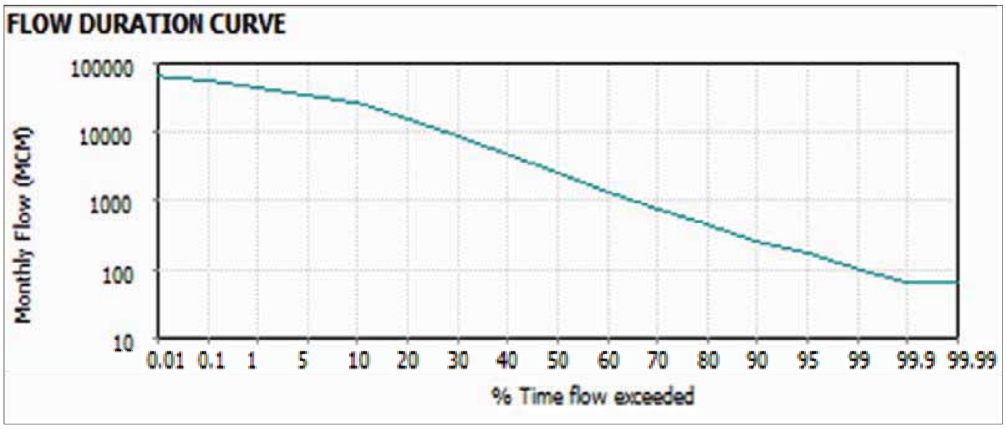


Fig 2.7 Graph showing Flow Duration Curve (FDC) with 17 fixed percentage points

Table 2.13 Default Environmental Management Classes

Default Environmental Management Classes			**% Natural**
A	Natural	Pristine condition or minor modification on In-stream and Riparian Habitat	63.9
B	Slightly Modified	Largely Intact Biodiversity and Habitats despite water resources development and/or Basin modifications	38.7
C	Moderately Modified	The habitats and dynamics of the biota have been disturbed, but basic ecosystem functions are still intact. Some sensitive species are lost and/or reduced in extent. Alien species present.	22.1
D	Largely Modified	Large changes in natural habitat, biota and basic ecosystem functions have occurred. A clearly lower than expected species richness. Much lowered presence of intolerant species. Alien species prevail.	12.3
E	Seriously Modified	Habitat diversity and availability have declined. A strikingly lower than expected species richness. Only tolerant species remain. Indigenous species can no longer breed. Alien species have invaded the ecosystem.	6.9
F	Critically Modified	Modifications have reached a critical level and ecosystem has been completely modified with almost total loss of natural habitat and biota. In the worst case, the basic ecosystem functions have been destroyed and the changes are irreversible.	4

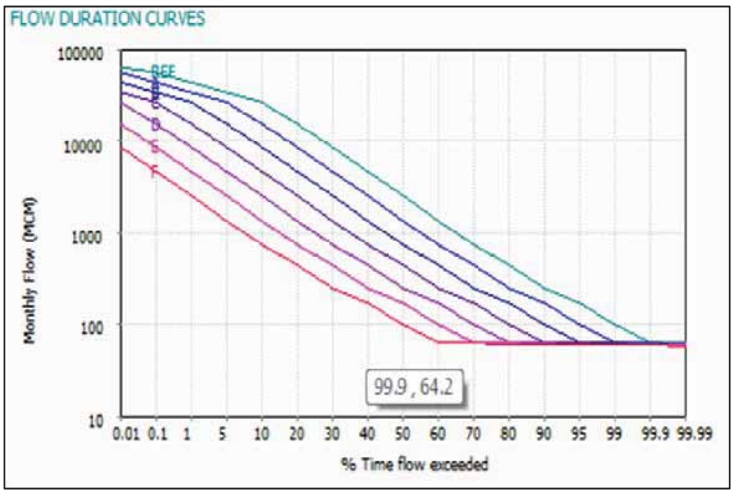


Fig 2.8 Graph showing Flow Duration Curve (FDC) with 17 fixed percentage points

Table 2.14 Default Environmental Management Classes details with 17 percentage points

%	REF	A	B	C	D	E	F
0.01	64606	56712	44092	34254	26738	15547	8734
0.1	56712	44092	34254	26738	15547	8734	4704
1	44092	34254	26738	15547	8734	4704	2591
5	34254	26738	15547	8734	4704	2591	1352
10	26738	15547	8734	4704	2591	1352	757
20	15547	8734	4704	2591	1352	757	454
30	8734	4704	2591	1352	757	454	253
40	4704	2591	1352	757	454	253	175
50	2591	1352	757	454	253	175	102
60	1352	757	454	253	175	102	64.2
70	757	454	253	175	102	64.2	63.6
80	454	253	175	102	64.2	63.6	63
90	253	175	102	64.2	63.6	63	62.4
95	175	102	64.2	63.6	63	62.4	61.9
99	102	64.2	63.6	63	62.4	61.9	61.3
99.9	64.2	63.6	63	62.4	61.9	61.3	60.8
99.99	63.6	63	62.4	61.9	61.3	60.8	60.2

The e-flow analysis shows that the proposed project involves minor modifications on riparian vegetation, maintains intact biodiversity and habitats irrespective of construction of barrage and basin modification and also shows that basic environmental functions area intact despite the disturbance that will be caused due to the construction of barrage. Therefore, the proposed project maintains the natural conditions (64 %) with slightly (40 %) and moderately modified (22 %) environmental functions hereby supporting fair amount of aquatic biota in River Godavari. As only minimal percentage (largely modified - 12.3 %, seriously modified 6.9 % and Critically modified state- 4 %) is observed from the analysis, the proposed project does not have a major impact on the natural e flow and aquatic biota.

2.2.3 Crop water requirement

The command area is already being benefitted by the existing irrigation facilities (JCR Devadula LIS and SRSP Stage I and II) for the Khariff and bi-seasonal crops and the proposed scheme facilitates irrigation only during Rabi season. Therefore, out of 100 TMC of water required for the proposed project, 50 TMC of water shall be utilized for stabilizing the existing command areas during Rabi season when there is deficiency of water for irrigation.

2.2.4 Command area

The command area of 5,55,310 ha includes all the benefitting villages falling under the existing command areas of JCR DLIS and SRSP S-I & II. The benefitting villages are spread across Jayashankar Bhupalapally, Nalgonda and Khammam Districts of Telangana. The command area villages are deprived of irrigation only during Rabi season which shall be made available by the proposed project.

Table 2.15 Benefitting mandals

Sl.No.	Name of the project	No. of Districts	No. of Mandals	No. of villages
1	JCRDLIS	8	37	364
2	SRSP Stage-I	3	11	81
3	SRSP Stage-II	3	7	73

River Godavari
Lat: 18°35'20.61"N, Long: 80°23'30.42"E

Proposed barrage
Lat: 18°35'3.69"N, Long: 80°23'19.16"E

Command area
Lat: 17°44'53.5"N, Long: 79°16'31.6"E

Command area
Lat: 17°51'10.1"N, Long: 79°08'51.9"E

2.2.5 Proposed project component

2.2.5.1 Construction of barrage

The proposed barrage (1,132 m) is located at Latitude 18˚35'19.43"N and Longitude 80˚23'49.13"E on the left bank and Latitude 18˚35'2.94"N and Longitude 80˚23'14.46"E on the right bank of River Godavari near Thupakulagudem village, Eturnagaram Mandal, Jayashankar Bhupalapally District. The purpose of the proposed barrage is to raise the water level in the river to feed the existing canals for commanding the irrigated area. The salient features of the proposed barrage are as given below;

Table 2.16 Salient features of the barrage

Barrage storage		
1	High Flood Level (HFL)	+83 m
2	Pond level	+77 m
3	Minimum draw down level	Not Applicable
4	Dead Storage level	Not Applicable
5	Free board	2 m
Head works		
1	Location of the barrage	200 Km downstream of SRSP
2	Total length of barrage (m)	1,132 m
3	Spillway bays	927 m
4	Sluice bays	205 m
5	Maximum height of spillway crest above deepest foundation	11 m
6	Length of bay	15 m
7	Crest level (EL m) for Spillway	+71.00 m
8	Crest Level For Under Sluice	+70.00 m
9	Number of gates in Spillway bays	48
10	Number of gates in Under Sluice bays	11
11	Type of gates	Radial lift

12	Size of gate for Spillways (m)	15 x 14
13	Size of gate for Under sluice (m)	15 x 15
14	Type of energy dissipation arrangement	Hydraulic jump on cistern floor
15	Maximum discharging capacity (Cumec)	8,50,000
16	Tail water (EL – M) Maximum: Minimum:	 +87.25 m +69.0 m
17	Under Sluice bays	11 Nos. on right side of barrage

2.2.5.2 Design flood at Thupakulagudem barrage site

The design flood for the barrage at Thupakulagudem, has been determined keeping in view the criteria laid done in IS 6966 Part-I 1989 – "Hydraulic Design of Barrage and Weirs". According to this code the design flood for Barrages and Weirs should be 50 year flood. However, in this particular case 100 year flood is proposed to be considered as design flood for barrage. For, fixing the free board normally 500 year return period flood or Standard Project Flood (SPF) as the case may be can be considered. Since the catchment area intercepted by the barrage is quite large, it was decided to estimate the design flood by resorting to frequency approach utilizing the annual peak discharge data readily available at the CWC sites namely Polavaram, Koida, Perur, Somanpally and Mancherial on Godavari/Tributaries of Godavari.

Frequency Analysis has been conducted using the data of the above mentioned sites and the flood values against various return periods viz: 50, 100 and 500 years have been arrived at. Before the annual peak data is subjected to frequency analysis as is customary Chi Square Test/ Kolmogorov-Smirnov (K-S) tests on the data have been carried out to decide up on the type of distribution to which the data fits. The software HYFA has been used for the study. The results of the study are given in the table below.

Table 2.17 Flood frequency analysis for different distributions and return periods

Site Name		**Koida**	**Pathagudem**	**Mancherial**	**Perur**	**Polavaram**
Catchment Area in Sq.Km		**305460**	**40000**	**102900**	**268200**	**307800**
Years of Data		**29**	**47**	**48**	**47**	**47**
Gumbel Type I	50 Year	68353.5	30870.6	25892.4	67155.0	66860.3

Site Name		Koida	Pathagudem	Mancherial	Perur	Polavaram
	100 Year	77128.9	34380.5	29620.5	74918.8	74258.2
	500 Year	93571.2	42491.4	38235.7	92859.9	91353.7
Log Normal 2-Parameter	50 Year	70412.4	33321.6	32722.6	66040.4	63001.4
	100 Year	79052.9	37824.6	40863.3	74187.9	69756.6
	500 Year	99922.0	48886.8	64064.8	93884.4	85726.8
Log Normal 3-Parameter	50 Year	68236.5	32821.2	30613.8	61284.5	58265.3
	100 Year	75324.9	36907.0	35549.3	66461.7	62371.0
	500 Year	91601.4	46680.8	47420.5	77689.1	71039.0
Pearson type - III	50 Year	69726.6	33561.6	31547.1	61758.3	58528.7
	100 Year	77302.7	37809.0	36694.2	67068.2	62718.5
	500 Year	94484.5	47654.9	48672.6	78543.1	71568.1
Log Pearson type - III	50 Year	71480.0	33591.5	33053.6	64977.7	59884.2
	100 Year	80014.5	38115.1	37723.6	71179.7	64057.3
	500 Year	100217.0	49175.6	46649.0	84462.3	72329.9
2 Parameter Gamma	50 Year	66277.0	30699.9	32472.4	63706.1	61008.8
	100 Year	72523.8	33769.2	38299.9	69945.5	66312.2
	500 Year	86344.2	40594.2	52146.8	83794.3	77969.1
Accepted values	50 Year	66277	30871	25892	63706	58265
	100 Year	77129	34381	29621	74919	66312
	500 Year	93571	42491	38236	92860	77969

The 100 year return period flood of say 85,000 cumecs is proposed to be adopted as the design flood for the Thupakulagudem barrage. The 500 year flood of magnitude 1,02,000 cumecs is proposed to be considered for fixing the free board.

2.2.5.3 Sedimentation

As per DPR, the proposed structure at Thupakulagudem is only gated barrage, the chance of facing any problem on account of sedimentation is quite remote and if at all encountered it is going to be quite insignificant. Therefore, detailed sedimentation study is perhaps not needed.

2.2.5.4 Geological investigations

William King (1872-1881) surveyed the entire Godavari valley and gave the comprehensive geological account of the geology and structure. In the recent years, officers of geological survey of India have systematically mapped the area on 1:63,360 scale. The geological details of the barrage area is given below;

Table 2.18 Regional geological set up of the area

Age	Stratigraphic unit		Lithology
Upper Carboniferous	Gondwana Super	Chikiala formation	Sandstones and

Age	Stratigraphic unit		Lithology
to Permian	Group	Kota formation Maleri formation Kamthi formation	pebble beds. Sandstone, limestone & clays. Variegated sandstone & clays. Red, brown, yellow, friable, soft
Upper Precambrian	Sullavai Group Pakhal Group		Quartzose Sandstones, grits and pebble bed, Quartzites, phyllites, shales,
ARCHEAN	ARCEANS		Granites and Gneisses

The Godavari River bed at proposed barrage site is 950m wide. Here also the major part of the lean discharge of the river flows through a narrow & deep gorge on the left abutment. The left abutment rises steeply with 2 to 1 slope consisting of hard rock; the rest of the river bed is generally plain without any exposure of rock and is deeply covered by sand. The average river bed RL is 73.0m and the deepest is 63m. The right flank is also steeper slope but comparatively gentler with left bank slope.

On the left bank about 150 m on either side of the axis on which Quartzo-schistic rock are exposed, very close to the river, they are fine grained pinkish and dark greyish in colour, striking in N-W and S-E direction and dip 15 to 250 towards N- E, i.e. towards left bank. These quartzo-schistic rock are highly folded as compared to the 1st axis quartzo-schistic dark grey in color.

The Godavari River is confined to flow through 400m wide channel in the lean season close to the rocky left bank. The deepest channel is noted 9m depth during Hydrographical survey (in the month of October) around the barrage axis, however this deepest point does not occur across the axis but lies about 1000m upstream of it, in general 0.5m to 7m deep, water depth observed, across the flowing channel .

After flow channel, in and around the barrage axis the river bed is plain gently sloping (towards left bank) and consisting of medium to coarse grained sand. The sand cover is 3m to 8.5m in thickness as revealed during the geo-technical investigation. The width of river bed, (bank to bank) is about 950m.

Sub-surface exploration has revealed the occurrence of bed rock below the sand cover is 3.5m to 8.5m and the rock is dark grey schistic Quartzite or Quartzo-schistic rock, in the center of the river bed, the rock is hard and massive, but highly fractured, with low core

recovery noted in BHT-7 & 8, almost zero percent RQD, but rock is improved in the bore hole no. BHT-9 & 10 in this reach of the river bed, the core recovery crossed 50% and in BHT-10 the RQD is also noted as maximum as 65%, which is good to be tied up the barrage.

2.2.5.5 Technical specifications of Thupakulagudem barrage

- Spillway Radial Gates (Other Bays)

It is proposed to provide 48 sets of Radial Type gates of (15000*14000) mm for Spillways. The gates shall be designed for height of 14 m. corresponding to Pond level and checked for HFL in accordance with the provision contained in IS 4623-2000. Each gate shall be operated with the help of downstream suspension Rope drum Hoist of 280 tons (Tentative) capacity. The regulation of discharge from this gate has been envisaged. The skin plate shall consist of stainless steel plate of minimum 12.0 mm thickness cladded through Mill Cladding Process.

Table 2.19 Salient features of spillway radial gates

Sl.No.	Particulars	Remarks
1	Deck Level	EL 90.0 m
2	HFL	EL 83.0 m
3	Pond Level	EL 77.0 m
4	Crest Level	El 71.0 m
5	Sill Level	El 71.0 m
6	Top of opening	EL 85.3 m
7	C. L. Trunnion	EL 88.75 m
8	Clear Width of Opening	15.0 m
9	Radius of Gate up to inside of skin plate	22.0 m
10	Water Head on sill	14.0 m
11	Total No. of opening	48 Nos.
12	Total No. of gate required	48 Nos.
13	Types of gates proposed	Radial Type Gates
14	Position of Skin plates and sealing	Upstream
15	Skin Plate	Structure steel cladded with stainless steel plate of 6mm thickness mill/ explosion cladded
16	Mode of operation	D/s suspension Rope drum hoist of adequate capacity
17	Operation	Regulation of discharge
18	Design Standard	IS 4623, IS:800, IS 6938
19	Approximate Weight of Gate	190 tons

Sl.No.	Particulars	Remarks
20	Approximate Weight of Embedded Parts	70 tons
21	Hoist Capacity	280 tons
22	Approximate Wt. of Hoist Bridge	30 tons
23	Approximate Wt. of Walkaway Bridge	7.5 tons

- Under Sluice Radial Gates

It is proposed to provide 11 sets of Radial Type gates of (15000*15000) mm for Spillways. The gates shall be designed for un-balanced head of 15 m. corresponding to Pond Level and checked for HFL in accordance with the provision contained in IS 4623-2000. Each gate shall be operated with the help of downstream suspension Rope drum Hoist of 310 tons (Tentative) capacity. The regulation of discharge from this gate has been envisaged. The skin plate shall consist of stainless steel plate of minimum 12.0 mm thickness cladded through Mill Cladding Process.

Table 2.20 Salient features of under sluice radial gates

Sl.No.	Particulars	Remarks
1	Deck Level	EL 90.0 m
2	HFL	EL 83.0 m
3	Pond Level	EL 77.0 m
4	Crest Level	El 71.0 m
5	Sill Level	El 71.0 m
6	Top of opening	EL 85.3 m
7	C. L. Trunnion	EL 88.75 m
8	Clear Width of Opening	15.0 m
9	Radius of Gate up to inside of skin plate	22.0 m
10	Water Head on sill	15.0 m
11	Total No. of opening	11 Nos.
12	Total No. of gate required	11 Nos.
13	Types of gates proposed	Radial Type Gates
14	Position of Skin plates and sealing	Upstream
15	Skin Plate	Structure steel cladded with stainless steel plate of 6mm thickness mill/ explosion cladded
16	Mode of operation	D/s suspension Rope drum hoist of adequate capacity
17	Operation	Regulation of discharge

Sl.No.	Particulars	Remarks
18	Design Standard	IS 4623, IS:800, IS 6938
19	Approximate Weight of Gate	200 tons
20	Approximate Weight of Embedded Parts	73 tons
21	Hoist Capacity	310 tons
22	Approximate Wt. of Hoist Bridge	32 tons
23	Approximate Wt. of Walkaway Bridge	7.5 tons

- Under Sluice Stoplogs

It is proposed to provide two set of Sliding Type logs consisting of 12 equal size unit of 15000*1275 size i.e. eleven units as interchangeable units and the top units as non-interchangeable unit for maintenance of under sluice Spillway gates. The stop logs shall be designed for unbalanced head of 15.0 m corresponding to Pond Level and checked for HFL in accordance with the provision contained in IS: 9349. The stop log shall have downstream skin plate and sealing. Each stop logs shall be operated with the help of a lifting beam and Gantry Crane of adequate capacity under balance head condition achieved with the help of a pair of filling valve to be provided in the top unit or crack opening from the top of the barrage.

Table 2.21 Salient features of under sluice stoplogs

Sl.No.	Particulars	Remarks
1	Deck Level	EL 90.0 m
2	HFL	EL 83.0 m
3	Pond Level	EL 77.0 m
4	Crest Level	EL 70.0 m
5	Sill Level	EL 70.0 m
6	Clear Width of Opening	15.0 m
7	C/C of side seal	15.15 m
8	C/C of track plates	15.60 m
9	Total Height of stop log	15.3 m
10	Size of Each unit	(15.15*1.275) m
11	Water Head on Sill	15.0 m
12	Total no. of opening	11 Nos.
13	Total No. of stop logs required	Two set consisting of eleven interchangeable units and one (Top) unit as non-interchangeable

Sl.No.	Particulars	Remarks
14	Type of stop logs proposed	Sliding type Gates
15	Position of Skin plates and sealing	Downstream
16	Seals-Rubber	IS:11855
17	Side Seal	Music Note Type
18	Bottom Seal	Wedge Type
19	Mode of Operation	Lifting Beam + Gantry Crane of Adequate Capacity
20	Operation	balance head condition achieved with the help of two filling valves provided in top unit or crack opening
21	Design Standard	IS 9349, IS 800, IS 698, IS 3177, IS 807
22	Approximate Weight of Stop Log Set	145 tons
23	Approximate Weight of Embedded Parts	10 tons
24	Gantry Crane Hoist Capacity (tentative)	40 tons
25	Lifting Beam	5 tons
26	Approximate wt. Gantry Girder Bridge	17 tons/bays
27	Rail for Gantry Crane (19 mts/bay)	2.85 tons/bay

- Spillway Stoplogs

It is proposed to provide five set of Sliding Type logs consisting of 11 equal size unit of 15000*1300 size i.e. ten units as interchangeable units and the top units as non-interchangeable unit for maintenance of Spillway Stop logs. The stop logs shall be designed for unbalanced head of 14.0 m corresponding to Pond Level and checked for HFL in accordance with the provision contained in IS: 9349. The stop log shall have downstream skin plate and sealing. Each stop logs shall be operated with the help of a lifting beam and Gantry Crane of adequate capacity under balance head condition achieved with the help of a pair of filling valve to be provided in the top unit or crack opening from the top of the barrage.

Table 2.22 Salient features of spillway stoplogs

Sl.No.	Particulars	Remarks
1	Deck Level	EL 90.0 m
2	HFL	EL 83.0 m

Sl.No.	Particulars	Remarks
3	Pond Level	EL 77.0 m
4	Crest Level	EL 71.0 m
5	Sill Level	EL 71.0 m
6	Clear Width of Opening	15.0 m
7	C/C of side seal	15.15 m
8	C/C of track plates	15.60 m
9	Total Height of stop log	14.3 m
10	Size of Each unit	(15.15*1.3) m
11	Water Head on Sill	14.0 m
12	Total no. of opening	48 Nos
13	Total No. of stop logs required	Five set consisting of ten interchangeable units and one (Top) unit as non interchangeable.
14	Type of stop logs proposed	Sliding type Gates
15	Position of Skin plates and sealing	Downstream
16	Seals-Rubber	IS:11855
17	Side Seal	Music Note Type
18	Bottom Seal	Wedge Type
19	Mode of Operation	Lifting Beam + Gantry Crane of Adequate Capacity
20	Operation	Balance head condition achieved with the help of two filling valves provided in top unit or crack opening
21	Design Standard	IS 9349, IS 800, IS 698, IS 3177, IS 807
22	Approximate Weight of Stop Log Set	145 tons
23	Approximate Weight of Embedded Parts	9 tons
24	Hoist Capacity (Tentaive)	Gantry Crane of 40 tons
25	Lifting Beam	5 tons
26	Approximate wt. Gantry Girder Bridge	17 tons/bays
27	Rail for Gantry Crane (19 mts/bay)	2.85 tons/bay

2.2.5.6 Construction planning

The major component of the project is the proposed barrage. It is proposed to undertake the construction work in two shifts for works to meet the construction schedule described earlier. Mechanized equipment shall be needed to achieve the requisite progress in works. The excavation & concreting has been planned from two shifts on both the flanks of the

River Godavari for construction of barrage and intake works. The river has to be suitably diverted to make the area dry for working in the river bed by laying suitable coffer dam in all the three seasons.

The construction materials for the construction of the barrage include;

- Cement
- Bagged / bulk cement is available and will have to be transported from Warangal for Thupakulagudem Barrage at a distance of about 148 Km distance.
- Fine Aggregate / Sand
- Fine to medium grained sand is available at a distance of about 10 km from the work site of Barrage. Requisite quantity of sand can be stacked for batching and mixing plants near barrage site and near both right and left bank.
- Coarse Aggregate for Concrete
- Coarse aggregate for concrete shall be obtained from crushing of the boulders available in Kothagutta which is at a distance of 132 Km from the barrage site.
- Steel Reinforcement
- Steel reinforcement will have to be transported from Warangal to Barrage Site at a distance of about 148 Km.
- Structural Steel for Gates/Stoplogs.
- Fabrication and supply of steel for gates, stoplogs, and other mechanical equipment will be arranged from suitable workshops in the region and to be transported from Warangal to Barrage is at a distance of about 148 Km distance.
- Fill Placement for Earth Dam / Coffer Dam
- Impervious material for core zone is available nearby on the right bank of River Godavari. Semi impervious / pervious materials are also available on the flanks of the River Godavari.

The infrastructural facilities for the proposed barrage include;

- Approach Roads
- About 1.0 Km long approach road has to be constructed connecting Thupakulagudem Village to Barrage from existing road on the right bank of River Godavari.
- Dumping Area / Spoil Tips

- Most of excavated material from barrage may be utilized for construction of Guide bunds and Tie bunds on left and right side of the barrage.
- Workshops / Temporary Sheds
- Workshops sheds are proposed to be set up near barrage on the right bank, for repairs and assembly of machinery / equipments, gates, electro-mechanical equipment etc.
- Residential Buildings:
- The following buildings are proposed to be constructed near barrage Complex on right flank.
    - Permanent Quarters for operation and maintenance staff.
    - Temporary Labour colony to be set up by the Contactor for Construction requirement.
    - Permanent Building / Residential Colony (Temporary) to cater to construction / operation and maintenance requirements.

Table 2.23 Quantities of major items of work involved in the construction

Sl. No.	Particulars	Total Quantity (cum)
	BARRAGE	**Thupakulagudem**
1.	**Coffer Dam**	
a)	Earth Work	664472
2.	**Barrage**	
a)	Earth Work	2390445
b)	Sheet Pile (Sq.mt.)	33557
c)	Cement Concrete (M20)	54515
d)	Cement Concrete (M25)	977353
e)	Steel (M.T.)	47870
3.	**Abutment, Wing Wall and Flank Wall**	
a)	Earth Work	214252
b)	RCC (M20)	44289
c)	Steel (M.T.)	1985
4.	**Upstream & Downstream Apron**	
a)	CC M15 Bed blocks and Lean Concrete	274436
b)	Loose Apron	118515
5.	**Guide Bunds**	

Sl. No.	Particulars	Total Quantity (cum)
a)	Earth Work	157730
b)	Rough Stone Dry Packing for pitching	26945
c)	Stone Apron	32191
d)	CC Blocks	17131
e)	Filter	12704
6.	**Tie Bund Right Flank & Left Flank**	
a)	Earth Work in filling	9150
7.	**Road Bridge**	
a)	R.C.C. M25	9935
b)	Steel (M.T.)	1349
8.	**MS Radial Gates together with gantry crane and**	
a)	Other Bays (Nos.)	48
b)	Under Sluice (Nos.)	11

2.2.5.7 Seismic analysis

The barrage location is almost at the border of Zone II and Zone III. With the Project being an important one, it is considered to be located in Zone III, even though it is on the fringe of the Zone II.

2.2.5.8 Power Requirement and electrical substation

Power requirement during construction and operation phase of the barrage is 2 MW and 1.5 MW respectively and is sourced from TSTRANSCO.

2.2.6 Drinking water facilities

The proposed project involves supplying 50 TMC of water for drinking purpose for enroute villages of the existing command areas of JCRDLIS and SRSP Stage I & II. All the villages (Annexure 10, 11 & 12) falling under the existing command areas face an insufficient drinking water facility which urges the need for the project. The list of the then districts of Andhra Pradesh falling under the existing command areas to be benefitted with drinking water facilities are enclosed as Annexure 10, 11 & 12.

2.2.6.1 Population projection and drinking water provision

Design of water supply and sanitation scheme is based on the projected population of a particular city, estimated for the design period. Any underestimated value will make system inadequate for the purpose intended; similarly overestimated value will make it costly.

Changes in the population of the city over the years occur, and the system should be designed taking into account of the population at the end of the design period.

For population projection Arithmetical Increase method is used. This method is suitable for large and old city with considerable development. If it is used for small, average or comparatively new cities, it will give lower population estimate than actual value. In this method the average increase in population per decade is calculated from the past census reports. This increase is added to the present population to find out the population of the next decade. Thus, it is assumed that the population is increasing at constant rate. Hence, dP/dt = C i.e., rate of change of population with respect to time is constant. Therefore, Population after n^{th} decade will be Pn= P + n.C

Where,

- Pn is the population
- 'n' decades and
- P is present population[18]

Table 2.24 Population projection and drinking water requirement

Sl. No.	District	2011*	2021	2031	2041	2051	2061	2071
1	Warangal	3512576	3779148	4045720	4312292	4578864	4845436	5112008
2	Nalgonda	3488809	3729636	3970463	4211290	4452117	4692944	4933771
3	Karimnagar	3776269	4060716	4345163	4629610	4914057	5198504	5482951
4	Medak	3033288	3396479	3759670	4122861	4486052	4849243	5212434
5	Nizamabad	2551335	2756985	2962635	3168285	3373935	3579585	3785235
6	Khammam	2797370	3015813	3234256	3452699	3671142	3889585	4108028
Total projected population		**19159647**	**20738777**	**22317907**	**23897037**	**25476167**	**27055297**	**28634427**
Total water requirement (MLD)		**2586.55**	**2799.73**	**3012.92**	**3226.10**	**3439.28**	**3652.47**	**3865.65**
Total water requirement (MCM)		**944.09**	**1021.90**	**1099.71**	**1177.53**	**1255.34**	**1333.15**	**1410.96**
Total water requirement (TMC)		**33.34**	**36.08**	**38.83**	**41.58**	**44.33**	**47.07**	**49.82**

Note: As per Central Public Health and Environmental Engineering Organization manual (1999), 135 lpcd was considered for calculation. * - Census data, 2011

[18] http://nptel.ac.in/courses/105105048/M5L5.pdf

As per the National Water Policy, drinking water facilities must be given a major priority. From the studies, it can be concluded that the proposed project supports drinking water needs for about 6 decades for all the enroute villages of the existing command areas. Therefore, the proposed project is said to have a major positive impact on the social lifestyle and economic aspects of the people in the benefitting districts.

2.2.7 Natural Catastrophes in command area

2.2.7.1 Floods

Floods by nature depend on several factors; one being incessant rains; rains in a short period of time crippling natural drainage. However, other factors such as nature of the collecting basin, nature of the streams, type of soil, natural and man-made vegetation, amount of rainfall, obstruction to natural drainage etc. determine the type and extent of floods. Khammam district in Telangana region is most prone to monsoon floods[19]. Godavari River basin is the largest contributing to the micro-climatic changes in the state of Telangana. The basin receives the major part of its rainfall during the Southwest Monsoon period. More than 85 percent of the rain fall is seen from July to September. Annual rainfall of the basin varies from 880 to 1,395 mm and the average annual rainfall is 1,110 mm. Floods are a regular phenomenon in the basin. Bhadrachalam, Kunavaram, and the deltaic portion of the river are prone to floods frequently. Perur and Koida gauge stations are the main base stations of the Central Water Commission for flood forecasting in the basin[20]. From the analysis of previous years of NDMA, proposed barrage location is not prone to floods.

2.2.7.2 Earthquake

In the state of Telangana, no major earthquakes are reported/known, but it is to be noted that in the year 1969 an earthquake of magnitude 5.7 (known as Bhadrachalam Earthquake) occurred with its epicentre located about 80km downstream of the present site. The earthquake caused damage over an area of about 3750 sq.km around Bangaruchilka village and felt over a large area. As per the seismic map of India the project site involving the proposed

[19] State Action Plan on Climate Change for Telangana State, Ministry of Environment, Forests, and Climate Change, Government of India, New Page 27.

[20] Flood Management in Andhra Pradesh and Telangana States of India (2016), Naidu *et al*., International Journal of Academic Research.

Image sources: https://www.mapsofindia.com/maps/india/seismiczone.htm, http://www.ndma.gov.in/images/landslidezone.jpg

barrage is in zone-III (Moderate Damage Risk Zone).

2.2.7.3 Landslides

From the landslide zone map given by NDMA, GoI, it is noted that Himalayas of Northwest and Northeast India and the Western Ghats are two regions of high vulnerability and are prone to landslides. The project site in Telangana state falls under "Very Low Hazard Zone".

2.2.8 Land Requirement

The proposed project requires a total land of 674.18 ha including 94 ha of private (patta) land for implementation of the project and 580.18 ha of river bed area (submergence area). There is no submergence of private land and hence there is no R&R due to the project. The required land will be acquired as per the Right to Fair Compensation and Transparency in Land Acquisition Rehabilitation and Resettlement Act, 2015.

Table 2.25 Details of land requirement

Sl.No.	Village Name	District	Taluk	Private land (ha)
1	Thupakulagudem	Jayashankar Bhupalapally	Warangal	65.87
2	Thimmaigudem			5.58
3	Venchepally			-
4	Gangaram			12.96
5	Mukanuru			9.86
			Total	**94**

2.2.9 Submergence of River bed area

The proposed project involves submergence of 580.18 ha of river bed area alongside River Godavari near the proposed barrage at FRL of 77 m. The FRL map showing the submergence area is enclosed as Annexure 13.

2.2.10 Benefit cost ratio

The benefit cost ratio has been worked out to be 1.53 which involves construction of barrage and its components.

Table 2.26 Benefit-cost ratio

	Description	Rs. in lakh
A	**Construction of barrage across Godavari River**	
1	Barrage Spillway, Road bridge over Barrage	1284.68
2	Guide Bunds	25.62
3	Spillway Gates, Head regulator Gates	343.84

	Description	Rs. in lakh
4	Coffer Dam	28.29
5	Head Regulator for power channel	66.19
6	Provision for Construction of Buildings for staff	10.03
7	Miscellaneous items	14.6
8	Provision for approach roads to barrage	1.20
	Total	**1774.45**
B	**O&M works @ 0.1% per year for 3 years excluding coffer dam**	5.24
C	**Provision for detailed investigation design, preparation of drawings and estimates, LA proposals, sub-soil exploration etc., for the scheme and fixing of boundary, chainage, DCBM, HM, KM, stones, HP sign boards and gateway @ 0.5%on Rs.1774.15 Crores**	8.87
	Total Contract value (A+B+C)	**1788.56**
D	**L.S. Provisions (Reimbursable)**	
1.	Provision towards labour welfare cess @ 1.0%	17.88
2.	Provision towards VAT @ 5% as per actual	89.41
3.	Provision towards NAC @ 0.1% as per actual	1.79
4.	Excise duty as per actual on 75% of machinery and labour @ 13% on gates	33.52
5.	towards Service tax as per actual on Engineering works @ 4.12% on detailed investigation	0.37
6.	Provision for instrumentation	14.01
E	**Other provisions**	
8.	Photography, videography charges etc.	0.10
9.	Stationery, Xerox, computer typing and preparation of tender schedules	0.16
10.	Provision for beautification and gardening with amenities	1.50
11.	CC Operations @ 0.50% on ECV value	8.94
12.	Consultancy charges for the services of GSI, for T.S. Genco for vetting Electro Mechanical Components	8.20
13.	Provision towards live model of projects	0.25
14.	Provision towards model studies (to be included in reimbursable items)	0.20
15.	Provision towards amount payable to TSNPDCL for extension of power supply	4.00

	Description	Rs. in lakh
16.	Provision towards power consumption charges during maintenance period of 3 years (At 15000000/year)	4.50
17.	Provision of wireless communication system and mobile /land phone connections	0.06
18.	Provision for Land Acquisition	45.00
19.	Provision towards net project value in respect of forest land and for conducting DGPS survey, fixing of stones, vetting fee to the forest department for forest land and other miscellaneous unforeseen items, if required	40.00
20.	Provision for U/s over burden and D/s River training works	60.00
21.	Miscellaneous items (Contingencies, Brochures, Inaugural function etc.)	2.85
	Sub-Total (D+E)	**332.74**
	Total(A+B+C+D+E)	**2121.3**
1	**Total Gross Receipts**	**137707**
2	**Total expenses**	**82923**
3	**Total Net Annual Benefits**	**241783**
4	**Annual cost**	**158512**
	Benefit Cost Ratio: Annual benefit/ Annual Cost	**1.53**

Chapter 3. Baseline Environment Scenario

3.1 Environmental Settings

Environmental attributes describes the resources that can be found on the project site and vicinity. It provides a framework for evaluating the project and will help in making the decision as to whether the project is appropriate for the area in which it is proposed. Collecting the baseline environmental status of the project area helps to predict the magnitude of impacts that are likely to be caused due to the proposed project on different environmental components. It also helps to identify critical environmental attributes required to be monitored during and after the proposed project. The environmental settings w.r.t the proposed PVNRKSSP is given below;

I. Near the proposed barrage	
Location of the proposed barrage	Thupakulagudem Village, Eturnagaram Mandal, Jayashankar Bhupalapally District, Telangana
Distance of the village from the proposed barrage	0.58 km
Rivers and streams	River Godavari
Length of barrage	1132 m
Climate and meteorology	Maximum temperature : 43.7 ^{o}C Minimum temperature : 12.8 ^{o}C Average rainfall : 1015.8 mm
Agro-climatic zone	Central and Southern Telangana zone
Type of land use and vegetation pattern at the project site	Land: Forest lands on either sides of River Godavari. Vegetation: Riparian vegetation
Nearest densly populated area	Thupakulagudem village
Topography	Deccan plateau – relatively mild to medium slopes
Soil type	Alluvial soil, Red earths, Black soils, Forest soils
Biological resources at the project site	*Tectona grandis* L.f., *Terminalia alata* Heyne ex Roth, *Barringtonia acutangula* (L.) Gaertn., *Pterocarpus indicus* Willd., *Tamarindus indicus* L., *Ficus racemosa* L., *Ficus hispida* L. fil., etc.
Cultural resources at the project site	Nil
Protected Area/Wildlife Sanctuaries/ Eco-sensitive areas/ Reserve Forest	The boundary of Eturnagaram WLS is adjacent to the project location
Upstream Project	J Chokka Rao Devadula LIS at a distance of 6.2 Km (along the River)

Downstream project	Dummagudem LIS at a distance of 105 Km (along the River)
Interstate Boundary	Chattisgarh adjacent to the Project site
Nearest IMD	Ramagundem, Peddapalli District, 93.5 Km
Nearest CWC station	Perur, 6 Km (aerial distance)
Nearest Railway Station	Warangal , 150 Km
Nearest Airport	Hyderabad, 300 Km
Earthquake Zone	Zone III
Toposheet Nos.	E44I-6 (Old No. 65 B6)
Catchment area at barrage site	2,68,000 Sq.Km
75% annual net yield	407.4 TMC (11536 Mcm)
Nearest areas already subjected to pollution	Nil
II. Command area	
Command Area	2,51,310 ha - Existing J. Chokka Rao Devadula LIS 3,04,000 ha - Existing Sriram Sagar Project (Stage I & II)
Districts benefitted	Jayashankar Bhupalapally, Nalgonda, Khammam
Climate & Rainfall	Hot and dry climate with an average annual rainfall ranges from 751 mm to 1061 mm
Soil type	Chalakas, Dubbas, Black soils, Red soils, Alkaline soils, alluvial soils
Geology	Sandstone, Breccia Conglomerate with few Clay Beds, Siltstone, Carboniferous Clay, Limestone beds and Shale
Mineral resources	Granite blocks
Biological resources in the command area	*Terminalia arjuna, Terminalia tomentosa, Tectona grandis, Butea monospermia, Wrightia tinctoria, Cassia renigera, Azadirachta indica, Choloroxylon swietenia,* etc.
Reserve Forest within the study area	Annaram RF, Nuguru RF, Perur RF, Nagaram RF, Bangoranikonta RF, Marimalli PF

In order to assess the baseline environmental status, 10 Km radius from the main project components were considered. The construction activities will be restricted only to barrage location and there is no new works envisaged in the command area. However, to understand the baseline status, command area also considered for the study. The data was collected for three seasons (July 2017 - March 2018). In addition to the baseline environmental monitoring, field inspection in the study area, collection of primary and secondary information for all the environmental components and discussions with the officials and local public were conducted by the experts. The baseline environmental status presented below comprises of;

- Physical Environment
- Land use assessment of study area
- Biological (Terrestrial) Environment
- Aquatic Environment
- Socio – economic Environment (Chapter 7)

3.2 Physical Environment

3.2.1 Topography

The proposed project is located in Deccan plateau of India. Topography is relatively mild to medium slopes.

3.2.2 Climate & Meteorology

Air borne pollutants is dispersed by atmospheric motion. Knowledge of these motions, which range in scale from turbulent diffusion to long-range transport by weather systems, is essential to simulate such dispersion and quality of impacts of air pollution on the environment. The purpose of EIA is to determine whether average concentrations are likely to encounter at fixed locations (Known as the receptor), due to the given sources (locations and rates of emission known) under idealized atmospheric conditions. The meteorological data (monthly) obtained from the meteorological station Ramagundem, Telangana located at a distance of 93.54 Km from the proposed barrage is as given below;

Table 3.1 Monthly meteorological data from the year 2006-2016

Year	Month	Temperature (^{0}C)		Rainfall (mm)	Mean Relative Humidity (%)		Average Wind Speed (Kmph)
		Max	Min		0830 Hrs IST	1730 Hrs IST	
2006	1	30.9	13.9	0	77	41	1
2006	2	34.9	16.4	0	67	36	2
2006	3	34.9	22.1	43.5	70	47	4
2006	4	39	25.3	30.2	65	41	5
2006	5	39.5	27.3	55.4	64	45	5
2006	6	37.9	27.9	66.3	58	53	5
2006	7	32.4	25.6	178.8	75	68	4
2006	8	31.5	25.3	373.2	78	70	5
2006	9	32.7	24.5	381	84	75	3
2006	10	33	22.6	16.9	80	70	2
2006	11	30.4	19.2	52.7	88	73	2
2006	12	30.9	15.7	0	88	61	2
2007	1	31.3	14.9	0	83	52	2
2007	2	33.6	17.5	0	74	38	5
2007	3	36.9	21.5	0	65	39	6
2007	4	38.8	24.9	13.7	66	32	7
2007	5	42.2	28.4	31.3	48	59	5
2007	6	36.1	27.1	153.9	73	65	5
2007	7	33.6	25.8	67.8	78	70	4
2007	8	32.5	24.8	178.3	81	76	3
2007	9	32.3	24.3	274.1	84	61	3
2007	10	32.3	20.7	14.9	76	48	2
2007	11	31.6	16.2	0	73	47	1
2007	12	31.1	15.8	0	79	43	1
2008	1	31.2	15.1	2.3	78	46	3
2008	2	32.5	18.3	0.2	82	42	5
2008	3	35	21.1	123.3	70	40	4
2008	4	38.3	24.6	0.4	83	30	4
2008	5	42.2	27.7	6.4	41	51	3
2008	6	35.5	27	154.6	68	68	3
2008	7	32.8/	25	160.3	81	77	2

Year	Month	Temperature (^{0}C)		Rainfall (mm)	Mean Relative Humidity (%)		Average Wind Speed (Kmph)
		Max	Min		0830 Hrs IST	1730 Hrs IST	
2008	8	31.6	24.7	269.1	85	73	3
2008	9	32.8	24.3	226.2	82	58	2
2008	10	33.8	21.6	32.8	74	54	2
2008	11	32.1	18.3	2.8	69	44	3
2008	12	31.7	14.9	0	83	35	2
2009	1	32	16	0	85	33	3
2009	2	35.3	19.2	0	74	30	3
2009	3	37.1	20.9	6.5	65	29	4
2009	4	40.6	25.3	4.2	62	34	5
2009	5	42.2	28.1	80.1	56	46	5
2009	6	39.6	29.1	133.4	58	66	6
2009	7	32.8	25.5	199.8	79	64	4
2009	8	34.3	25.2	179	78	61	3
2009	9	34.7	25	75.4	78	51	2
2009	10	33.8	21	69.6	76	53	2
2009	11	32	19.4	124.8	76	48	3
2009	12	30.4	15.7	1.2	82	36	2
2010	1	30	14.1	4.5	76	34	2
2010	2	33.9	19.4	3.6	75	32	4
2010	3	38.7	29.6	0	65	26	5
2010	4	42.9	26.5	1	61	28	5
2010	5	42.8	28.8	12.9	56	45	6
2010	6	39.2	27.4	227.6	69	69	5
2010	7	32	25.4	459.9	84	70	3
2010	8	32.4	25.5	113.9	84	17	3
2010	9	32.2	24.7	339.9	84	74	3
2010	10	32.8	22.9	117.5	83	66	2
2010	11	32.1	21.9	29	84	64	2
2010	12	29.32	15.6	16.3	81	48	2
2011	1	30.4	13	0	78	28	2
2011	2	33.1	17.7	22	80	31	3
2011	3	36.6	20.8	1.4	74	33	3

Year	Month	Temperature (^{0}C)		Rainfall (mm)	Mean Relative Humidity (%)		Average Wind Speed (Kmph)
		Max	Min		0830 Hrs IST	1730 Hrs IST	
2011	4	36.3	24.9	6	77	44	3
2011	5	41.5	28	16.5	60	40	4
2011	6	37.4	27.3	103.7	73	54	5
2011	7	33.1	25.2	217.3	81	73	3
2011	8	31.5	24.9	193.5	87	79	3
2011	9	32.3	24.5	124.9	85	75	2
2011	10	33.7	21.8	6.5	82	56	2
2011	11	32.9	17.5	0	76	42	1
2011	12	31.2	13.5	0	83	39	2
2012	1	30.3	16.4	2.8	82	39	2
2012	2	33.9	17.2	0	77	28	4
2012	3	38.7	19	0.6	68	20	4
2012	4	39.8	26.5	10.7	69	32	3
2012	5	43.7	28.5	1.2	48	21	6
2012	6	38.3	27.9	90.8	61	44	3
2012	7	31.9	24.7	403.9	82	69	5
2012	8	31.2	24.3	367.9	80	67	3
2012	9	32.4	24.6	164.6	80	70	3
2012	10	32.8	21.3	83.8	79	59	2
2012	11	30.8	18.4	22.4	82	57	2
2012	12	31.1	15.6	0	86	40	2
2013	1	31	16.7	0	82	44	2
2013	2	32.5	18.6	38.2	83	36	3
2013	3	36.4	21.4	0	72	30	4
2013	4	39.6	24.9	50	68	33	5
2013	5	43.4	29.2	16.2	55	26	6
2013	6	33.9	25.6	258.1	70	57	6
2013	7	30.7	24.3	491.9	78	69	5
2013	8	30.3	23.6	219	79	70	5
2013	9	32.8	23.8	140.1	78	65	4
2013	10	31.6	22.2	201.3	82	70	3
2013	11	30.1	17.3	0.2	78	52	3

Year	Month	Temperature (^{0}C)		Rainfall (mm)	Mean Relative Humidity (%)		Average Wind Speed (Kmph)
		Max	Min		0830 Hrs IST	1730 Hrs IST	
2013	12	29.5	12.8	0	81	40	2
2014	1	30.2	15.3	0	82	39	2
2014	2	31.8	16.6	0.9	77	33	3
2014	3	33.8	21.4	76.1	75	37	5
2014	4	39.4	34.8	21	69	32	4
2014	5	40.3	26.7	58.5	63	30	4
2014	6	38.9	28.3	81	61	36	5
2014	7	32.8	25.3	196.2	74	62	5
2014	8	33.4	25.2	153.5	76	61	5
2014	9	32.5	24.3	231.3	78	62	3
2014	10	33.4	22.5	11.3	78	49	3
2014	11	31.8	17.7	2.5	83	49	1
2014	12	29.2	14	1.3	85	48	2
2015	1	29.2	14.6	63.8	87	45	2
2015	2	33.4	17	0	87	39	3
2015	3	35	21.9	41.2	81	47	4
2015	4	37.5	43.3	43.5	79	44	5
2015	5	42.6	28.2	5.2	63	37	5
2015	6	35.8	26.5	176.8	79	61	5
2015	7	35.1	26	182.2	73	60	4
2015	8	32.8	34.9	101.9	85	73	3
2015	9	33.6	24.3	167.3	86	69	3
2015	10	35.3	22.6	13	84	55	2
2015	11	33.1	19.6	0	82	46	2
2015	12	32.1	18.2	0	84	44	4
2016	1	31.1	15.3	5	86	38	3
2016	2	35.6	20.8	0	84	38	5
2016	3	38	23.5	22.6	78	37	5
2016	4	42.8	27.2	10	68	33	5
2016	5	43.4	27.8	33.5	57	36	6
2016	6	38.69	26.8	206.5	72	53	5
2016	7	32.6	25	372.6	83	73	4

Year	Month	Temperature (^{0}C)		Rainfall (mm)	Mean Relative Humidity (%)		Average Wind Speed (Kmph)
		Max	Min		0830 Hrs IST	1730 Hrs IST	
2016	8	33.4	24.5	142.3	82	66	3
2016	9	31.2	23.9	219.8	42	25	2
2016	10	32	21	140	82	64	2
2016	11	31	16	0	81	49	2
2016	12	30	14.3	0	85	42	2

From the meteorological data collected for a decade (2006-16) from Ramagundem meteorological station, the maximum temperature was recorded to be 43.7^{0}C in the month of May 2012 and the minimum temperature was recorded to be 12.8^{0}C in the month of December 2013. The average annual rainfall was recorded to be 1015.8 mm with the highest rainfall of 491.9 mm recorded in the month of July 2013. Highest average annual wind speed was recorded to be 7 kmph in the month of April 2007.

Similarly, meteorological data recorded from the meteorological station installed at the project site shows a maximum temperature of 41 ^{o}C recorded during pre-monsoon season and a minimum temperature of 12.4 ^{o}C recorded during post-monsoon season. From the wind rose diagram Fig 3.4, it can be indicated that the prevailing wind direction during the study period is from SE Direction. Wind rose diagram showing the wind speed during different seasons are as given below;

Table 3.2 Meteorological data collected at the project site for the study period

Parameters & range	Year	Season	Cloud Clover	Temp	Rel.Humidity	Pressure	Speed	Rainfall	Radiation
	YYYY	-	Oct	^{o}C	%	hPa	km/h	mm	Wh/m^2
Max	2017	Monsoon	8.0	37.7	98.2	996.8	10.8	40.7	1013.1
Min			1.8	23.6	35.3	983.7	0.1	0.0	0.0
Avg			7.5	29.8	67.4	991.0	3.0	0.2	208.8
Max	2017	Post Monsoon	8.0	35.7	99.8	1006.2	9.0	25.8	938.6
Min			0.0	12.4	15.4	989.8	0.0	0.0	0.0
Avg			5.5	25.8	54.2	998.0	2.2	0.0	226.3
Max	2018	Pre monsoon	8.0	41.0	96.4	1007.1	12.1	4.1	1050.1
Min			0.0	13.2	8.1	990.9	0.1	0.0	0.0
Avg			4.1	26.1	36.2	998.7	2.5	0.0	257.8

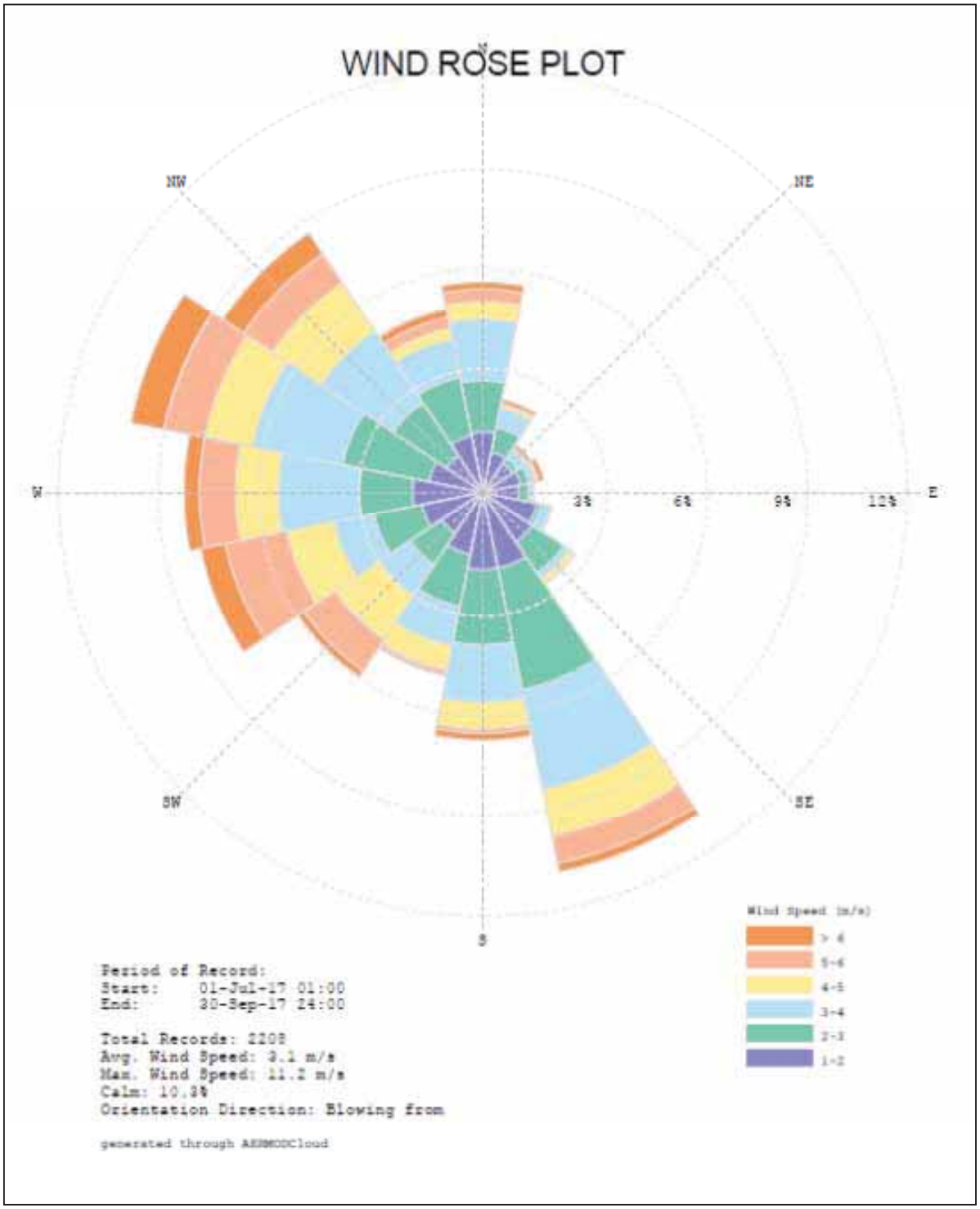


Fig 3.1 Wind rose diagram for the months July 2017 - September 2017 (Monsoon season)

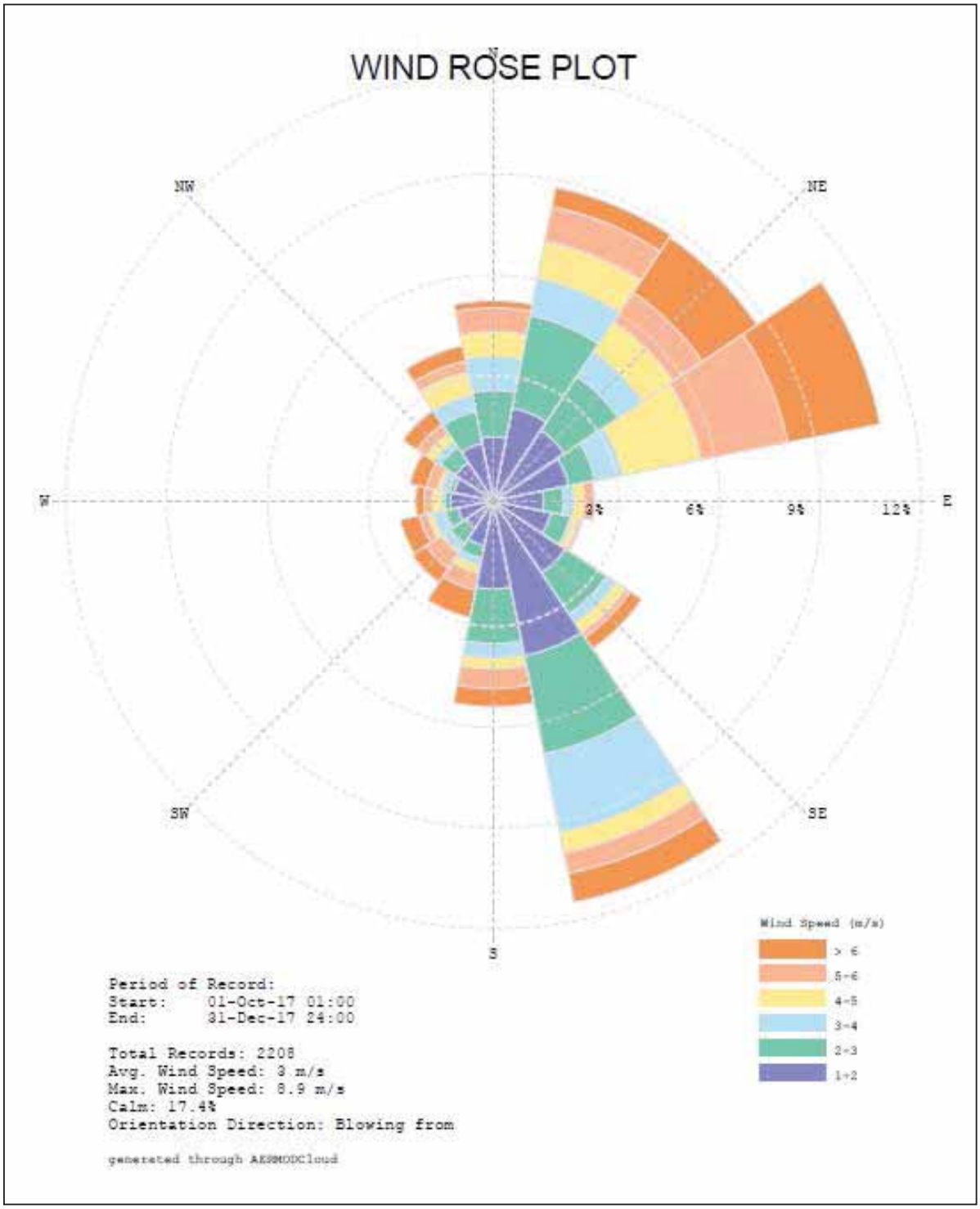


Fig 3.2 Wind rose diagram for the months October 2017 - December 2017 (Post-monsoon season)

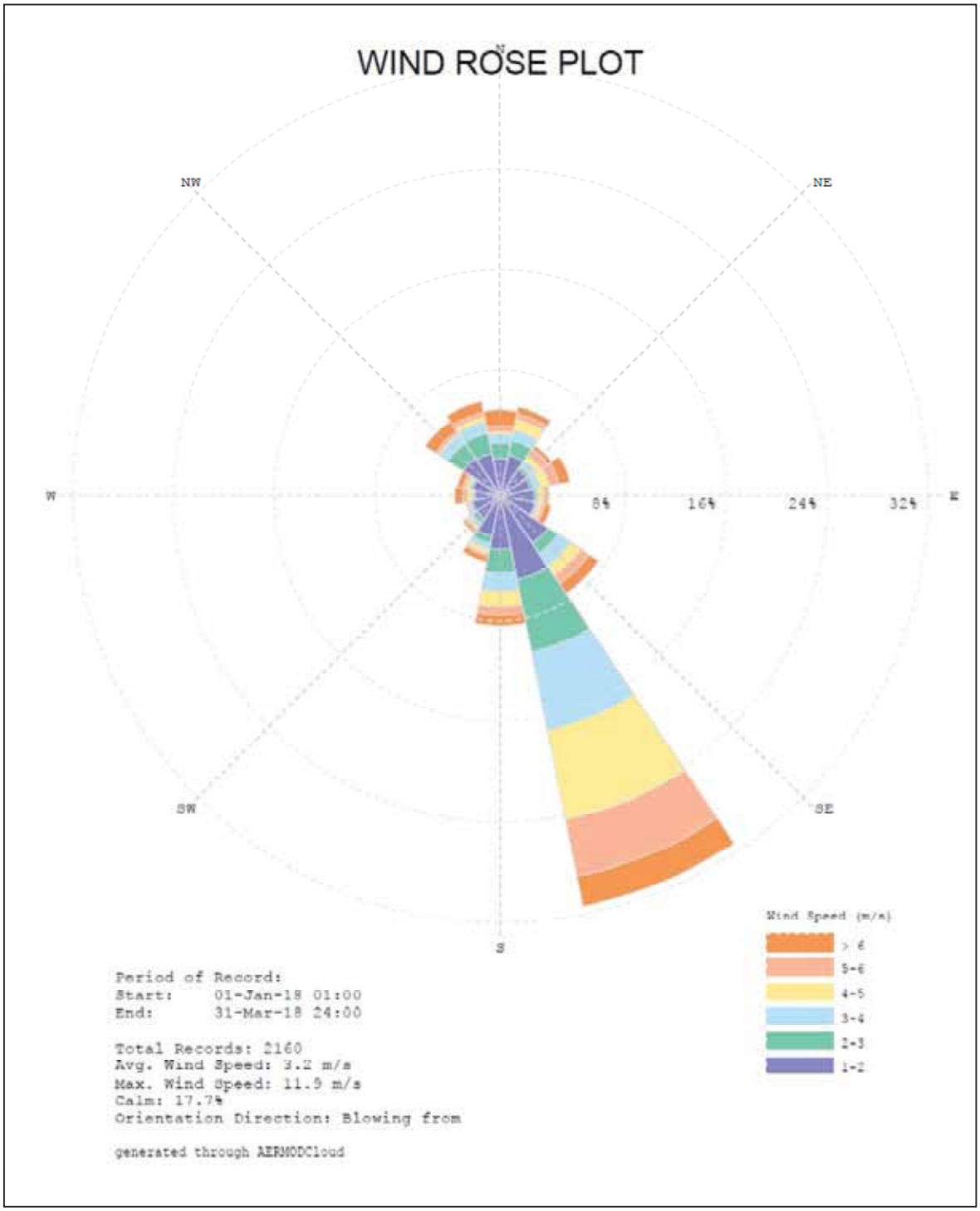


Fig 3.3 Wind rose diagram for the months January 2018 - March 2018 (Pre-monsoon season)

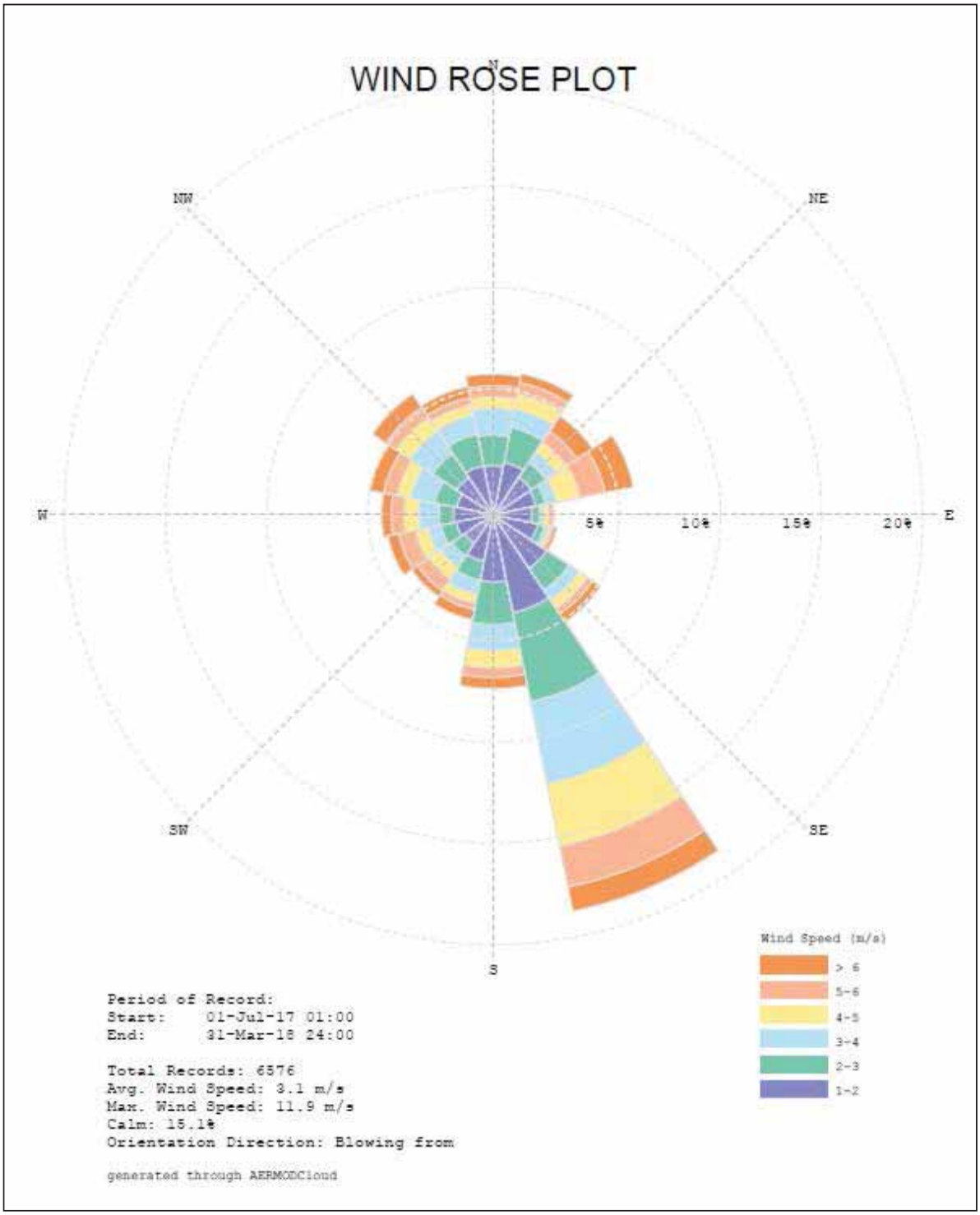


Fig 3.4 Wind rose diagram for the study period July 2017 – March 2018 (Study period)

3.2.3 Ambient Air Quality

As per preliminary investigations, the ambient air quality in the study area is found to be good, in the absence of industrial growth in the command area. MoEF guidelines[21] for preparation of EIA studies for Irrigations projects do not mandate AAQM studies in the absence of pollution sources. However, as part of the baseline data collection and in order to understand the status of ambient air quality in the study area, six ambient air quality monitoring stations were established and continuously monitored during the study period. The criteria followed for selection of Ambient Air Quality Monitoring (AAQM) locations and parameters monitored are given below;

- The stations were selected at a place where interferences are not present.
- Height of the inlet was maintained at 3 ± 0.5 m above the ground.
- The sampler was kept more than 20 m away from trees.
- There was unrestricted airflow in three of four quadrants.
- The sampling stations selected were away from major pollution sources[22].

Air Quality Index for dust and gases were estimated using the formula;

- Ip = [{(IHI - ILO)/ (BHI -BLO)} * (Cp-BLO)] + ILO
- BHI = Breakpoint concentration greater or equal to given conc.
- BLO = Breakpoint concentration smaller or equal to given conc.
- IHI = AQI value corresponding to BHI
- ILO = AQI value corresponding to BLO

Table 3.3 Details of AAQM parameters with analysis methodology[23]

Pollutants			Frequency of Monitoring	NAAQM Standards, 2009	Unit	Method of analysis
Dust	PM_{10}	Particulate matter	Three month during the study period for 24 Hrs at all stations	100	$\mu g/m^3$	Gravimetric
	$PM_{2.5}$	Particulate matter		60	$\mu g/m^3$	Gravimetric
Gases	SO_2	Sulphur dioxide		80	$\mu g/m^3$	Improved West and Geake
	NO_2	Nitrogen dioxide		80	$\mu g/m^3$	Jacob & Hochheisser modified method

[21]Draft Guidance Manual for Environment Impact Assessment & Clearance of River Valley projects, MoEF, GoI, 2011

[22]Methods for Measurement of Air Pollution (2005), Part 14 Guidelines for Planning the Sampling of Atmosphere, IS 5182 (Part 14): 2000.

[23]National Ambient Air Quality Standards - 2009, CPCB, New Delhi.

Table 3.4 Details of Ambient Air Quality Monitoring Stations

Station Code	Name of the location	Geographical Coordinates	Criteria for selection
A1	Near proposed barrage	18°35′19.43″N, 80°23′49.13″E	Major project component construction area
A2	Kesamudram	17°41'11.27"N, 79°53'38.89"E	Existing Command area
A3	Mogula Pally village	17°45'16.68"N, 79° 8'19.00"E	Existing Command area
A4	Rampur village	17°24'55.82"N, 79°46'29.83"E	Existing Command area
A5	Mallapura village	18°58'5.68"N, 78°42'18.26"E	Existing Command area
A6	Odela Village	18°27'19.62"N, 79°26'50.57"E	Existing Command area

Location map of ambient air quality monitoring stations is given below.

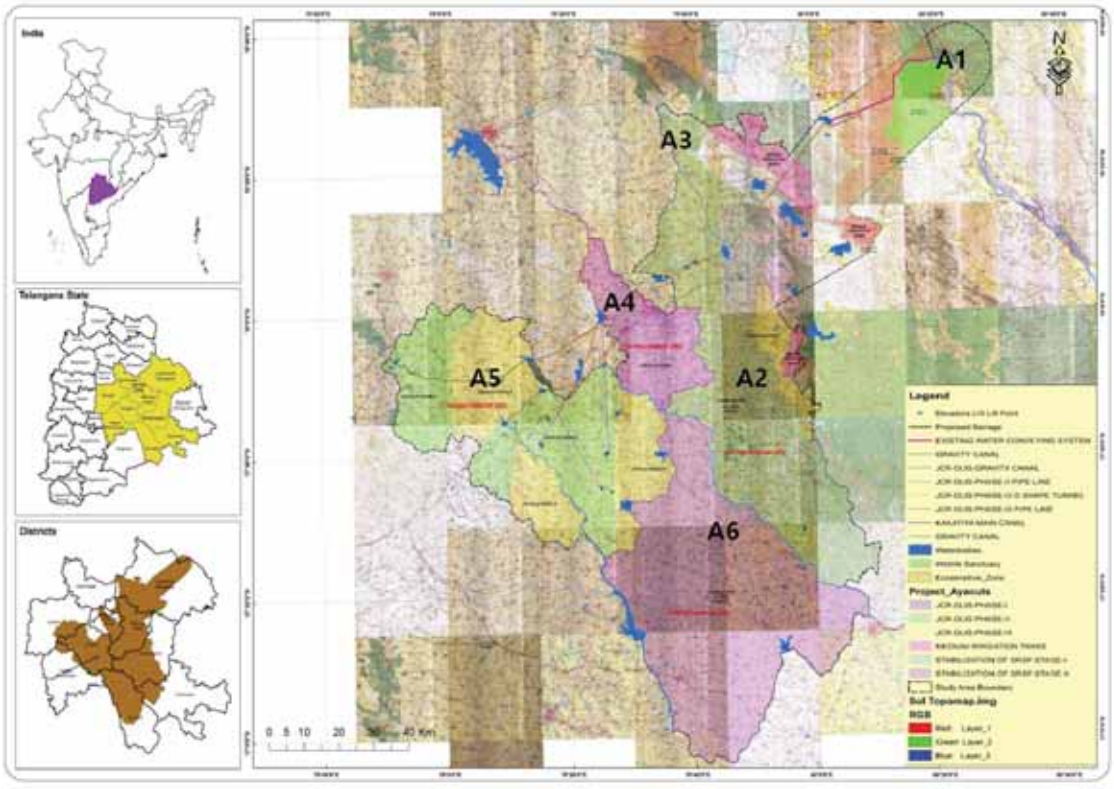


Fig 3.5 Location of AAQM stations on study area map

3.2.3.1 Results of Ambient Air Quality

Overall, Air quality index of the study area for gases and dust are found to be good and satisfactory respectively. The results of individual parameters are discussed below and enclosed as Annexure 14;

Particulate Matter <2.5µ &<10µ: The NAAQ standards fixed for PM_{10} is 100 µg/m^3 and $PM_{2.5}$ is 60 µg/m^3. PM is categorized by size and continues to be the fraction of air pollution that is most reliably associated with human disease and excessive exposure to PM can cause lung problems, breathing difficulties.[24] The minimum and maximum level of Particulate Matter <2.5µ recorded within the study area were in the range of 11 to 25 µg/m^3. The minimum and maximum level of Particulate Matter <10µ recorded within the study area were in the range of 40 to 70 µg/m^3. The 24 hourly average values of Particulate Matter <2.5µ & Particulate Matter <10µ were compared with the national ambient air quality standards and found that all sampling stations recorded values within the applicable limits for all locations in study area. The use of generator sets is in the rural areas, where they are utilized for the pumping water in the agricultural lands will be the major source of PM. The other sources of particulate matter includes agricultural operations, industrial processes, combustion of wood and fossil fuels, construction and demolition activities, and entrainment of road dust into the air[25].

Sulfur Dioxide: Sulfur dioxide in atmosphere is significant because of its toxicity. Sulfur dioxide is capable of producing illness and lung injury. Further it can combine with water in the air to form toxic acid aerosols that can corrode metal surfaces, fabrics and the leaves of plants. Sulfur dioxide is irritating to the eyes and respiratory system. The major health concerns associated with exposure to high concentrations of SO_2 include respiratory irritation and dysfunction, and also aggravation of existing cardiovascular disease[26]. The minimum and maximum level of SO_2 recorded within the study area was in the range of 3.89 µg/m^3 to 5.64 µg/m^3. The 24 hourly average values of SO_2 were compared with the national ambient air quality standards and it was found that all sampling stations recorded values much lower than the applicable limit of 80 µg/m^3. Motor vehicle emissions are the major source of SO_2[27].

Oxides of Nitrogen: Oxides of Nitrogen are also an inorganic gaseous pollutant like Sulfur dioxide. Oxides of Nitrogen emissions are expected to be emitted wherever combustion at high temperatures takes place. Nitrogen oxides are produced naturally by lightning, and also,

[24]https://link.springer.com/article/10.1007/s13181-011-0203-1

[25] http://www.valleyair.org/air_quality_plans/AQ_plans_PM_sources.htm

[26]https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5122104/

[27]http://www.environment.gov.au/protection/publications/factsheet-sulfur-dioxide-so2

to a small extent, by microbial processes in soils[28]. Nitrous oxide and nitric acid mist are the other important pollutants in the inorganic nitrogen group.

NO2 has inherent ability to produce deleterious effects by themselves like toxicity. It acts as an asphyxiate when in concentrations great enough to reduce the normal oxygen supply from the air. The minimum and maximum level of NOx recorded within the study area was in the range of 9.52 µg/m^3 to 34.82 µg/m^3. The 24 hourly average values of NOx were 0compared with the national ambient air quality standards and it was found that all the sampling stations recorded values much lower than the applicable limit of 80 µg/m^3. The major source of NOx includes high motor vehicle traffic[29].

Table 3.5 Results of Particulate Matter (PM_{10})

LOCATION	MAX	MIN	AVG	SD	GM	PERCENTILE			
						98	85	50	35
A1	68	48	60.4	5.25	60.21	67.52	65.8	61	58.4
A2	69	40	57.3	9.26	56.59	70	67	60.5	51.05
A3	70	51	61.8	5.53	61.51	70	67.55	62.5	60
A4	65	47	56.9	5.14	56.69	65	62	56.5	55
A5	67	45	56.0	4.93	55.75	64.7	60.55	56.5	53.05
A6	66	44	58.0	5.76	57.71	65.08	63	60	57

Table 3.6 Results of Particulate Matter ($PM_{2.5}$)

LOCATION	MAX	MIN	AVG	SD	GM	PERCENTILE			
						98	85	50	35
A1	23	13	18.2	2.39	18.09	22.52	20.40	18.00	17.40
A2	23	11	11.0	3.54	16.38	22.54	20.55	18.00	15.05
A3	25	14	18.8	3.00	18.60	24.08	22.00	19.00	18.00
A4	22	14	17.0	2.65	16.77	21.54	20.55	16.00	15.05
A5	23	13	16.3	2.35	16.14	22.54	17.55	16.00	15.00
A6	23	12	17.8	3.58	17.39	23.00	21.55	19.00	15.05

Table 3.7 Results of Sulphur di-oxide (SO_2)

LOCATION	MAX	MIN	AVG	SD	GM	PERCENTILE			
						98	85	50	35
A1	5.43	4.16	4.73	0.37	4.72	5.43	5.14	4.76	4.60

[28]http://www.apis.ac.uk/overview/pollutants/overview_NOx.htm

[29] http://www.icopal-noxite.co.uk/nox-problem/nox-pollution.aspx

A2	5.32	3.96	4.78	0.40	4.76	5.39	5.16	4.71	4.51
A3	5.64	3.96	4.69	0.41	4.67	5.52	5.18	4.63	4.46
A4	5.06	3.96	4.69	0.41	5.05	6.10	5.28	5.02	4.98
A5	5.44	3.89	4.59	0.42	4.58	5.35	5.11	4.58	4.37
A6	5.44	4.28	4.86	0.33	4.85	5.41	5.24	4.87	4.71

Table 3.8 Results of Nitrogen di-oxide (NO_2)

LOCATION	MAX	MIN	AVG	SD	GM	PERCENTILE			
						98	85	50	35
A1	33.14	20.68	29.49	3.47	29.28	33.05	32.40	31.16	28.50
A2	32.08	21.96	28.80	2.96	29.05	31.97	31.58	29.70	28.91
A3	34.82	22.86	29.73	3.89	29.47	34.56	33.30	30.20	28.78
A4	32.64	9.52	27.73	5.73	26.87	32.47	31.61	30.08	27.18
A5	32.14	21.98	28.43	3.38	28.22	32.00	30.94	30.08	29.57
A6	32.64	21.16	28.63	3.84	28.36	32.56	31.86	30.44	28.80

Table 3.9 Ambient Air Quality Index for dust

Location	PM_{10}, $\mu g/m^3$	AQI	Remarks	$PM_{2.5}$, $\mu g/m^3$	AQI	Remarks
A1	67.52	67.52	Satisfactory	22.52	37.60	Good
A2	70	70	Satisfactory	22.54	37.64	Good
A3	70	70	Satisfactory	24.08	40.21	Good
A4	65	65	Satisfactory	21.54	35.97	Good
A5	64.7	64.7	Satisfactory	22.54	37.64	Good
A6	65.08	65.08	Satisfactory	23.00	38.41	Good

Table 3.10 Ambient Air Quality Index for gases[30]

Location	SO_2, $\mu g/m^3$	AQI	Remarks	NO_2, $\mu g/m^3$	AQI	Remarks
A1	5.43	6.78	Good	33.05	41.31	Good
A2	5.39	6.73	Good	31.97	39.96	Good
A3	5.52	6.9	Good	34.56	43.2	Good
A4	6.10	7.62	Good	32.47	40.58	Good
A5	5.35	6.68	Good	32.00	40.00	Good
A6	5.41	6.76	Good	32.56	40.7	Good

[30]National Air Quality Index, Control of Urban Pollution Sources Series, (2015), CUPC/82/2014-15, CPCB, New Delhi.

3.2.4 Ambient Noise Levels

The noise levels obtained for the day as well as night are well within the standards prescribed by CPCB norms and guidelines. However, various measures will have to be practiced and followed to safeguard for protecting the workers and neighborhood. This also takes care of birds and other animals which are living in the proximity, thus enhancing the quality of life. As part of the baseline environment studies ambient noise levels were measured at 6 locations using pre-calibrated instrument for 24 Hrs for Leq (day) and Leq (night)[31]. The details of the monitoring locations are given below;

Table 3.11 CPCB standards for noise levels[32]

Parameters	Frequency	CPCB Standards dB(A) Leq		
Leq (Day) Leq (Night)	24 hrs	**Category**	**Day**	**Night**
		Industrial area	75	70
		Commercial area	65	55
		Residential area	55	45
		Silence zone	50	40

Table 3.12 Details of Noise Level Monitoring locations

Station Code	Name of the location	Geographical Coordinates	Criteria for selection
N1	Near proposed barrage	18˚35’19.43”N, 80˚23’49.13”E	Sesnsitive receptor due to presence of Eturnagaram WLS and Major project component construction area
N2	Kesamudram	17°41'11.27"N, 79°53'38.89"E	Existing Command area
N3	Mogula Pally village	17°45'16.68"N, 79° 8'19.00"E	Existing Command area
N4	Rampur village	17°24'55.82"N, 79°46'29.83"E	Existing Command area
N5	Mallapura village	18°58'5.68"N, 78°42'18.26"E	Existing Command area
N6	Odela Village	18°27'19.62"N, 79°26'50.57"E	Existing Command area

[31]Protocol for Ambient Noise Level Monitoring (2015), CPCB, New Delhi

[32]Noise (Regulation and Control) Rules (2000), MoEF, Govt. of India

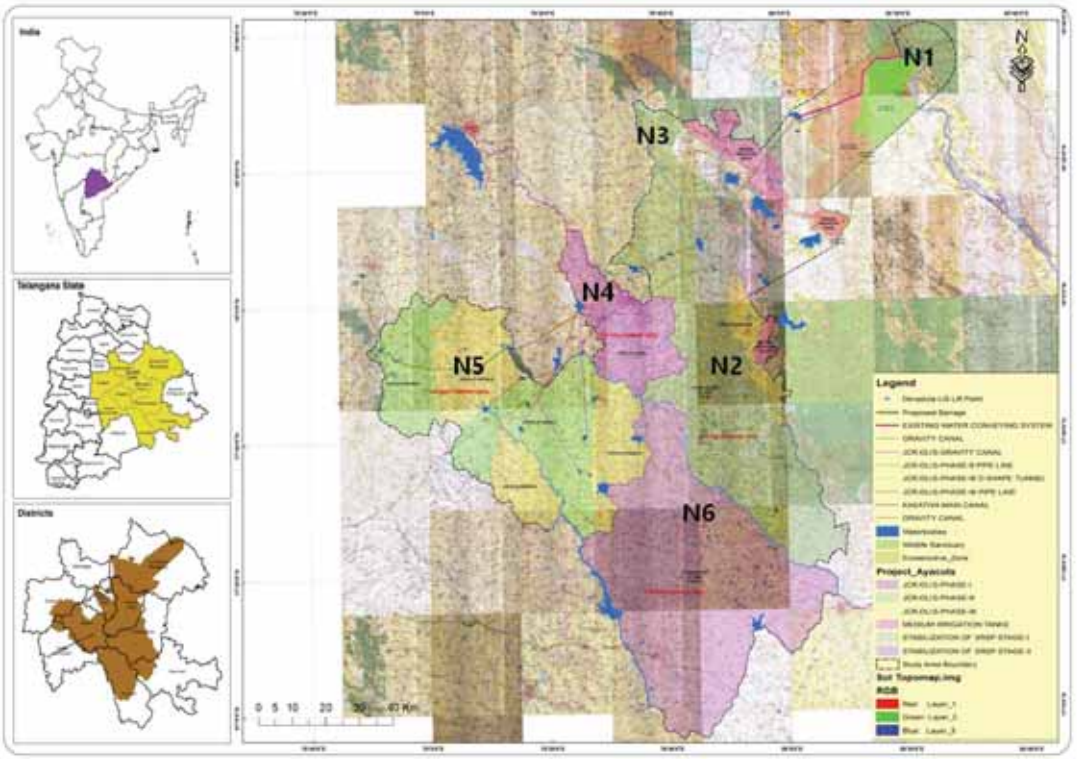


Fig 3.6 Location map of noise monitoring locations on study area map

3.2.4.1 Results of Ambient Noise Levels

The results of ambient noise levels were compared with Residential standards and results reveal that, the noise levels in the study area ranging from 42.16 to 51.66 dB(A) for day time and 34.48 to 37.4 dB(A) for night time. Overall, the noise levels in all the seasons were observed to be well within the CPCB standards. Results of Ambient Noise Levels are given below.

Monsoon season (July 2017- September 2017): During the monsoon season, the maximum noise was measured at Rampura Village with a value of 53.58 dB(A) during day time, which is reasonably close to the standards and of course well within the limits of 55 dB(A) as per CPCB norms and the maximum noise was measured at Rampura Village with a value of 42.72 dB(A) during night time which is well within the limits of 45 dB(A).

Post-monsoon season (October 2017- December 2017): During the post-monsoon season, the maximum noise was measured near the proposed barrage with a value of 47.8 dB(A) during day time, which is reasonably close to the standards and of course well within the limits of 55 dB(A) as per CPCB norms and the maximum noise was measured near the proposed barrage with a value of 36.44 dB(A) during night time which is well within the limits of 45 dB(A).

Pre-monsoon season (January 2018- March 2018): During the pre-monsoon season, the maximum noise was measured at Mogula Pally Village with a value of 48.24 dB(A) during day time, which is reasonably close to the standards and of course well within the limits of 55 dB(A) as per CPCB norms and the maximum noise was measured near the proposed barrage with a value of 37.4 dB(A) during night time which is well within the limits of 45 dB(A).

Table 3.13 Results of Ambient Noise levels

Seasons	Monsoon season (July 2017 - September 2017)		Post-monsoon season (October 2017 - December 2017)		Pre-monsoon season (January 2018 - March 2018)		CPCB Standards	
Locations	**Leq day dB(A)**	**Leq night dB(A)**	**Leq day dB(A)**	**Leq night dB(A)**	**Leq day dB(A)**	**Leq night dB(A)**	**Day dB(A)**	**Night dB(A)**
Mogula Pally Village	50.38	39.34	46.22	35.68	48.24	37.2	55	45
Kesamudram	52.26	41.56	43.24	35.16	45.8	36.34	55	45
Rampura Village	53.58	42.72	42.82	36.26	43.72	34.48	55	45
Near Proposed Barrage	51.66	41.24	47.8	36.44	46.92	37.4	55	45
Mallapura Village	48.98	39.38	43.84	35.62	45.06	36.28	55	45
Odela Village	52.42	40.3	42.16	34.84	44.76	34.98	55	45

3.2.5 Hydrology Geology and Minerals

In any given environment the occurrence and movement of ground water and its quality & quantity is chiefly controlled and governed by many factors such as geographical set-up, climate and rainfall conditions, hydrological features, topography, soil characteristics, the nature and thickness of underlying rock formations and other related aspects that prevail in an area. Therefore the study envisages indentifying the existing both surface & ground water conditions comprising both quality and potential within the project site and its neighborhood, relating the projected lift irrigation scheme activity, identifying the likely impacts on surface and ground water resources and indicating mitigation measures.

Subsequently field investigation was carried out during the second week of January, 2018. During the survey surface rock outcrops, geological cross sections in the Road, Nala Cuttings and Dug wells were observed. Data available from the Irrigation Department and also from IMD authorities has been collected. Inventory of wells representing the entire Command area, Barrage site & Ten kilometer buffer zone was carried out. The chemical quality of ground water was assessed by measuring the Specific Electrical Conductance (EC) using a sensitive pocket type Electrical Conductivity meter. Hydrogeological data of about 30 Borewells was collected. Water levels were measured using an embossed steel measuring tape from Dug wells and Electrical conductivity was recorded using EC meter.

Information already available and the data collected during the survey is collated and analyzed to comprehend the overall groundwater situation in the area. An attempt is made to predict the likely changes that could occur on account of the proposed PVNRKSSP and certain mitigation measures have been indicated to avoid adverse effect on the Surface & Groundwater environment.

3.2.5.1 Location and accessibility

The Project area is accessible by Road from Hyderabad at a distance of 319 Kms. After travelling 165 Kms on NH-163 Warangal is reached where a diversion to north is to be taken and travel further 112 Kms on N.H-202 to reach Eturnagaram. From Eturnagaram turn north and take the road leading to Devadula and travel 40 Kms to reach Thupakulagudem. The Barrage site is 2.2 Kms north east of Thupakulagudem village. The project site can also be accessed from Jayashankar Bhupalapally. From Bhupalapally travel 92 Kms south east on NH 163 to reach Eturnagaram where a detour to north is to be taken and travel 4.0 Kms on Devadula road to reach Thupakulagudem to reach the barrage site. The nearest Airport is Rajiv Gandhi International Airport, Shamshabad at 350 Kms while Warangal Railway Station is at a distance of 150 Kms.

3.2.5.2 Command area of the project

The command area covering the parts of Karimnagar, Nizamabad, Medak, Nalgonda, Ranga Reddy, Peddapalli, Khammam and Warangal Districts receives scanty rainfall and not evenly distributed as the area falls over rain shadow zone. Warangal district experiences severe drought and famine affecting the livelihood conditions of the people who depend chiefly on agriculture. The soil is fertile and crops can be raised if irrigation facilities are provided as such the present project proposals.

3.2.5.3 Drainage

The Project site and the command area form part of the Godavari River Basin. The proposed project site is near Thupakulagudem Village. Nalla Vagu, Pattanilakanta Vagu, Modikunta Vagu, Untimamidi Vagu, Shriramalu Vagu, Gorkalkanta Vagu, Dubba Vagu are draining in to Kistapuram Vagu and Regma Vagu, Ippakanta Vagu, Lotipitagandla Vagu are draining to Pairla Vagu. Both Kistapuram Vagu and Pairla Vagu are flowing southwest joining into Godavari River in the study area along with the Mulkampally Vagu, Parikala Vagu is culminating into Chitiyala Vagu which is flowing west to east and Pedda Vagu are the streams joining to Godavari River. Laknavaram River is flowing east-west over southern part of the proposed project area. All these are ephemeral which drain in to Godavari River. Drainage pattern is observed to be dendritic to sub-dendritic with drainage density varying between 0.71 Kms/ Sq. Kms. Dense drainage is observed in the Eastern and Western portions of the command area while the Northern portion of the command area is occupying sparse drainage. All the stream courses flow from higher reaches to lower levels following topography. Drainage Map is enclosed.

3.2.5.4 Geology

The main rock type observed in the command area is Sandstone, Breccia, Conglomerate along with few clay beds, Limestone beds of Chikiyala Formation and Sandstone, Siltstone, Clay, Limestone beds of Kota formation belongs to Upper Gondwana Group of Meso-proterozoic age and Sandstone of Albaka Formation belonging to Pakhal supergroup, Shale of Lakkavaram Formation belonging to Mulugu group of Meso-proterozoic age along with Unclassified of Sullavai Group of rocks.

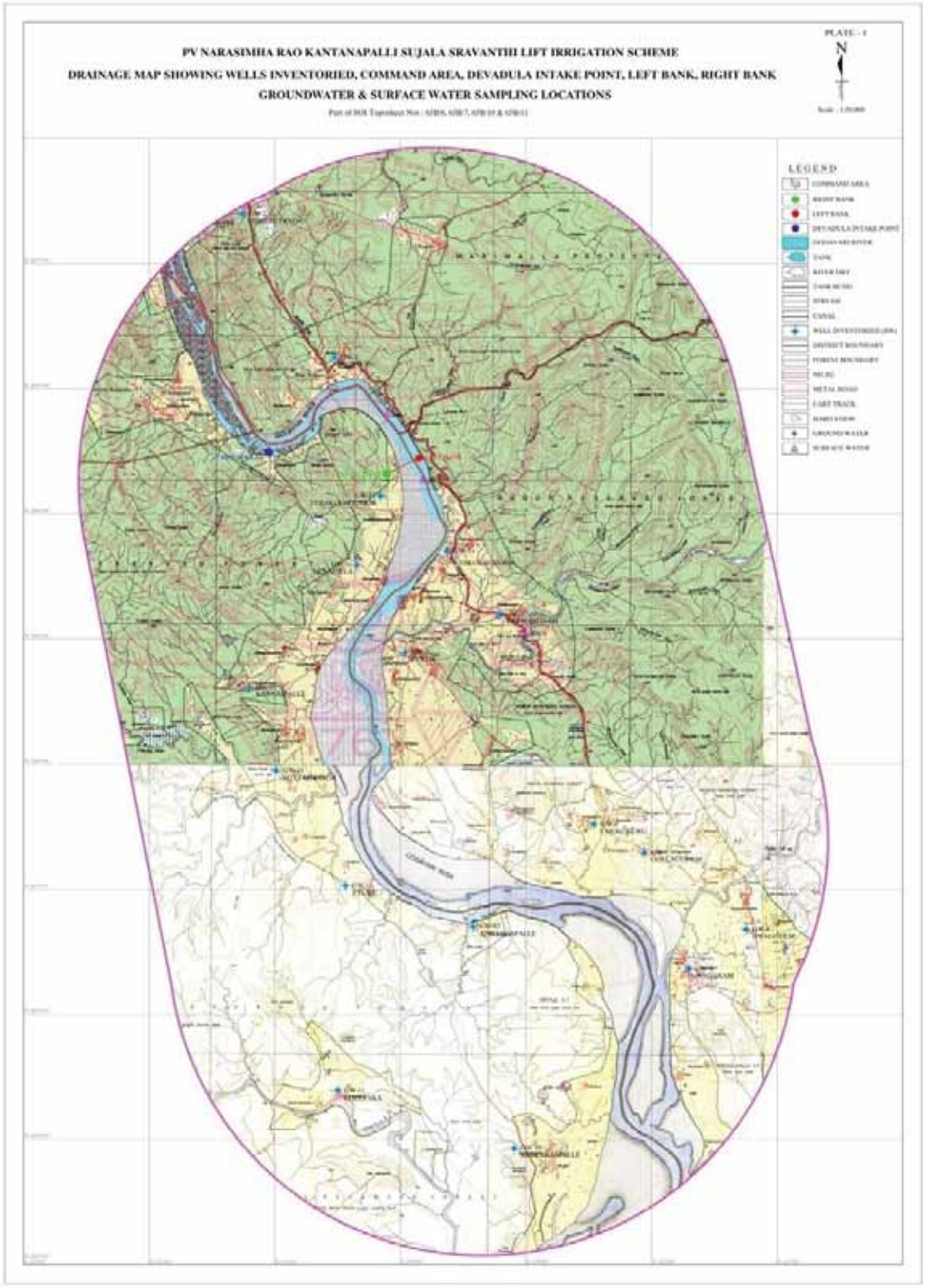


Fig 3.7 Map showing key cum location plan

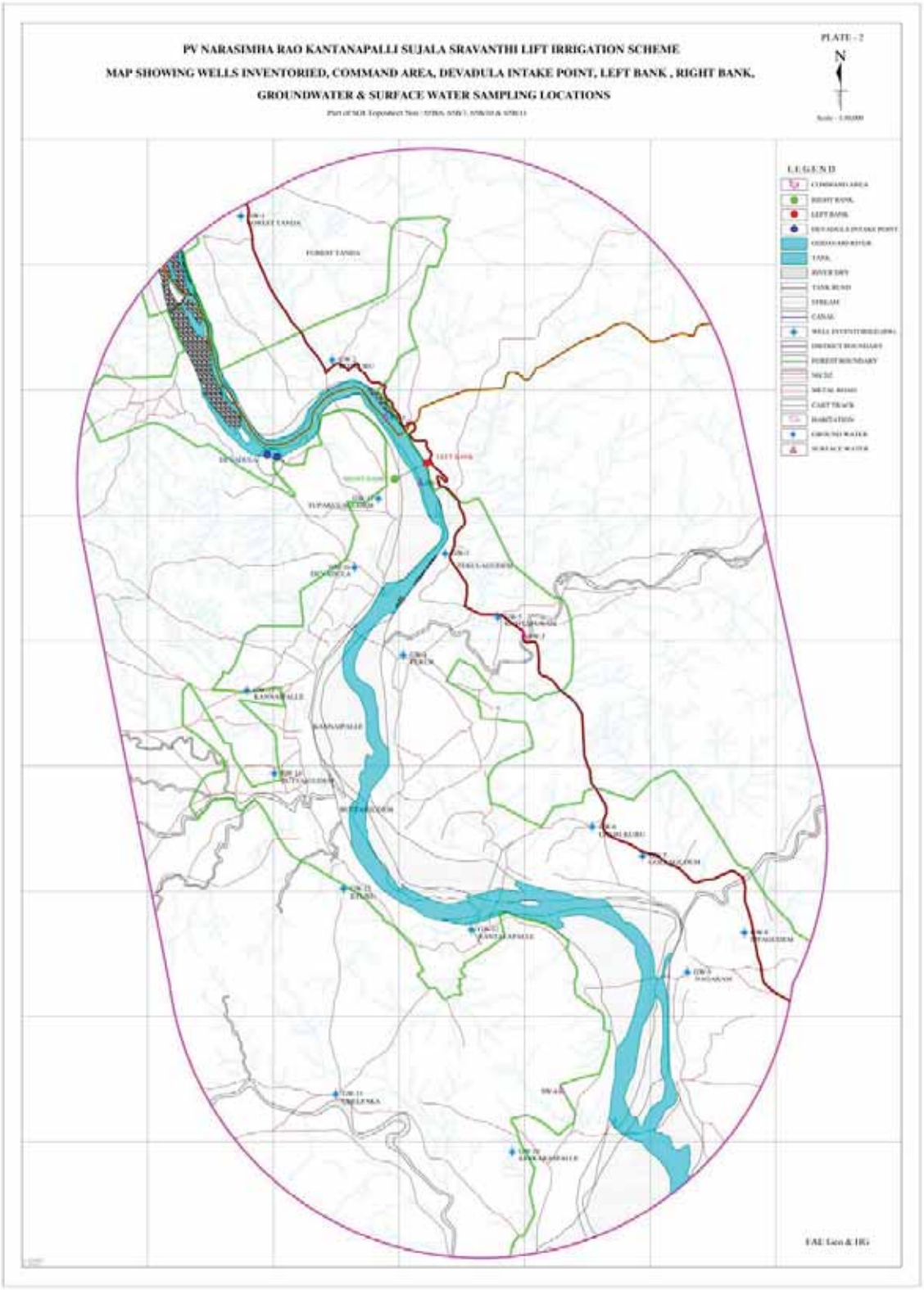


Fig 3.8 Drainage map of the proposed project

Table 3.14 Geological succession of the study area[33]

Rock type	Formation	Group	Super group	Age
Sandstone, Breccia Conglomerate with few Clay Beds	Chikiyala Formation	Upper Gondwana Group	Gondwana Super Group	Cretaceous to Permo Carboniferous
Sandstone, Siltstone, Clay, Limestone beds	Kota Formation			
Unclassified	-	Sullavai Group	-	Neo-Proterozoic
Sandstone	Albaka Formation	-	-	Meso-Proterozoic
Shale	Laknavaram/ Tippapuram Formation	Mulugu Group	Pakhal Super Group	

3.2.5.5 Structure

No major faults or any structural disturbances are observed in the project site area and command area of the project excepting minor Fractures / lineaments. However, the streams are flowing in fracture zones. Lineaments striking NE-SW along the streams are formed and these act as conduits for the movement of surface and groundwater. The movement and occurrence of groundwater is controlled by these structures and these have been marked in the Geology & Structure Map.

3.2.5.6 Geomorphology

Geomorphology of the study area environs is Plateau dissected with valleys.

3.2.5.7 Mineral Resources

Granite Blocks - Granite is quarried for rough blocks of varying dimension stone in parts of Jayashankar Bhupalapally District. Kataram and Mahadevpur is endowed with enormous high grade Coal reserves useful thermal power stations.

3.2.5.8 Rainfall and climate

Jayashankar Bhupalapally District is drained by the River Godavari. The main streams draining the district are Kistapuram Vagu, Pairla Vagu, Laknavaram Rover and their small tributaries which are of ephemeral in nature draining into Godavari River. River Godavari enters the district near Kaleshwaram village on the north-western portion and flows in south eastern direction. Average rainfall of the district is 1015.8 mm. Climate varies from 12.8° C to 43.7° C.

[33]Geological Quadrangle Map (1984), Geological Survey of India, GoI

Majority of the catchment area falls in the administrative region of Jayashankar Bhupalapally District[34].

3.2.5.9 Hydrogeology

The study area and its environs in the 10.0 Kms buffer zone is underlain with Sandstone, Breccia, Conglomerate with few clay beds and Limestone beds. These rocks are having of primary to medium porosity. However, weathering, fractures, joints and fault zones act as conduits for movement and storage of groundwater and yield water in abstraction structures. The main source of recharge is precipitation. Groundwater occurs under phreatic conditions in weathered zone and under semi-confined to confined conditions in joints and beddings of carbonate rocks. Surface water occurrence is negligible and tanks were observed to be dry during pre monsoon period. Alluvium is confined to major rivers with thickness ranging between 3.0 to 8.0 mts.

Water table generally follows the topography of the study area and is at greater depths in the water divide area and topographic heights but occurs at shallow depth in the valleys and low lying terrain and therefore groundwater moves down and follows the gradient from the higher to lower elevations i.e. from recharge area to discharge areas. The general flow direction of groundwater in the study area is towards South.

3.2.5.10 Hydrogeological survey

Hydrogeological survey was carried out in the 10.0 Kms buffer zone of the proposed barrage point of River Godavari and the total command area of the proposed project. 40 (23+17) wells were inventoried for deciphering the groundwater regime. Water samples have been collected from 17 borewells and 4 Surface water bodies representing the study area and subjected to chemical analysis conforming to IS 10500:2012 (second revision) standards to assess the quality. The aquifer performance test conducted by the CGWB authorities was referred to and concluded the field data observed randomly during the field survey.

3.2.5.11 Depth to Water level

The depth to water level in the study area was measured wherever it was feasible and recorded as reported during the field study. The depth to water level varied between 3.0 m to 24.0 m. The deeper water levels observed i.e., 24.0 m was observed at Tekulagudem. The depth to water level arrived corresponds to the well inventory data.

3.2.5.12 Water table elevation

Water table elevation in the study area ranges from less than 81 mts to more than 150 mts.

[34] Groundwater Information Booklet of CGWB 2013, Khammam District, Telangana State

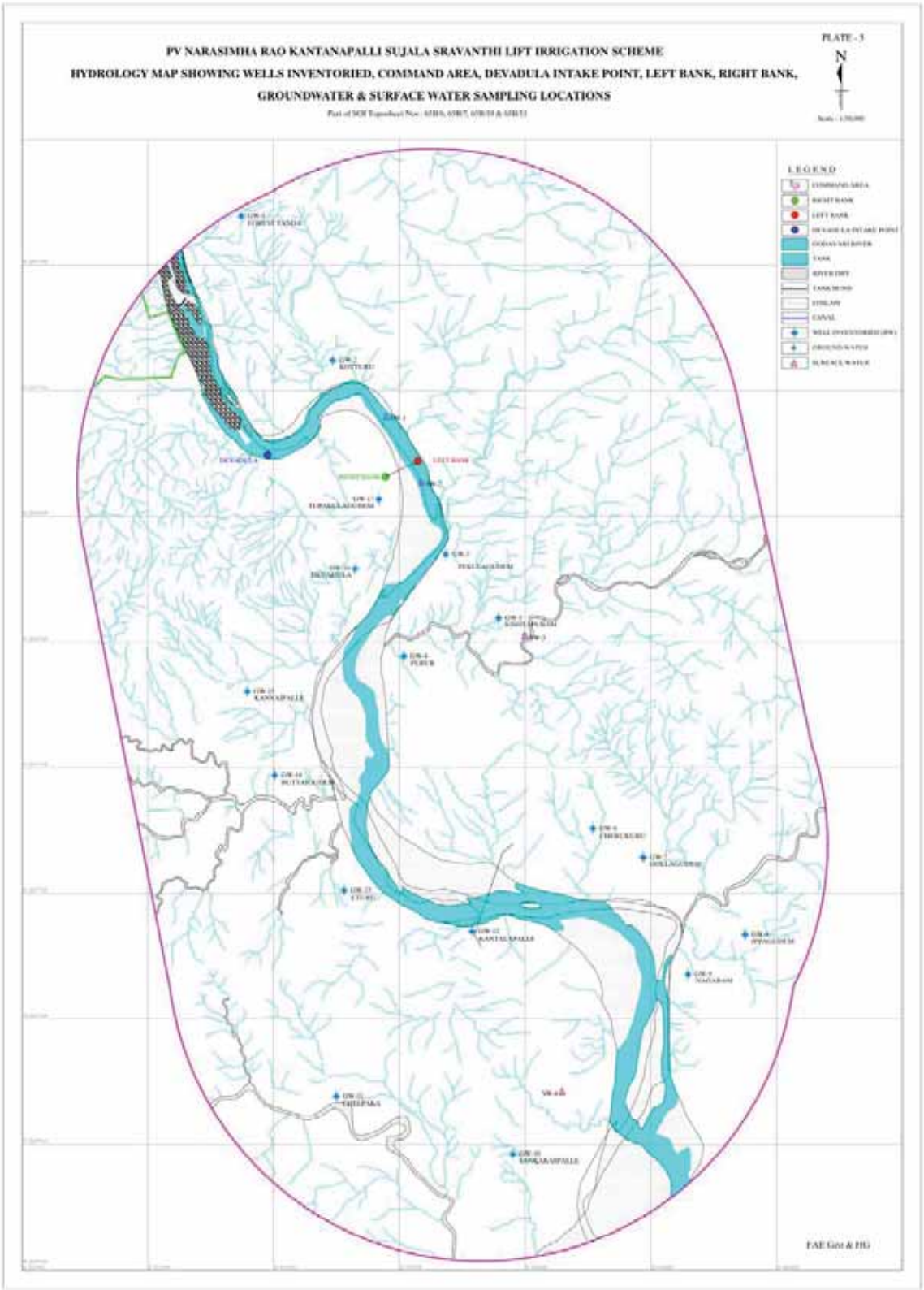


Fig 3.9 Hydrology map showing surface and ground water sampling locations

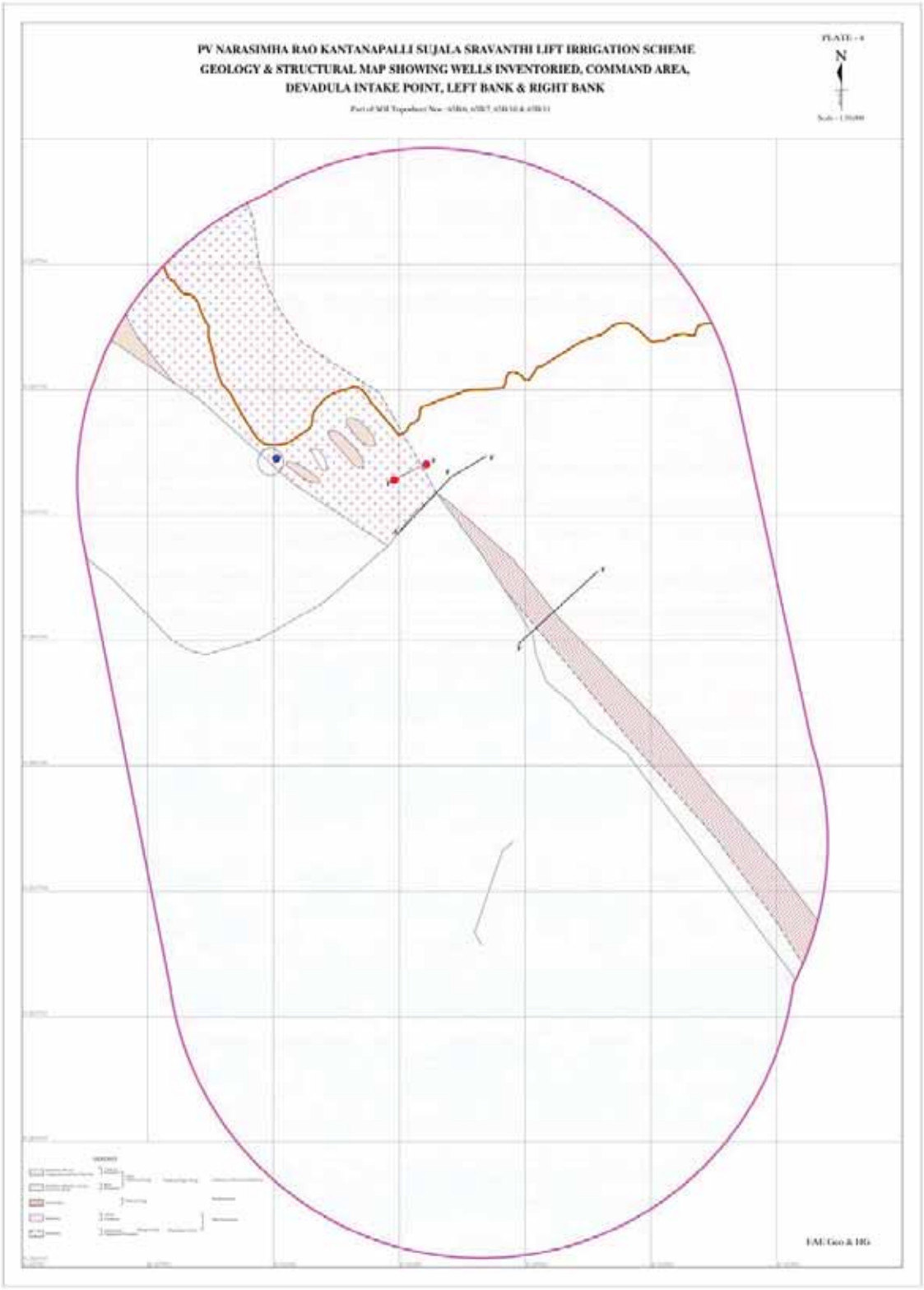


Fig 3.10 Geology and structural map of the proposed project

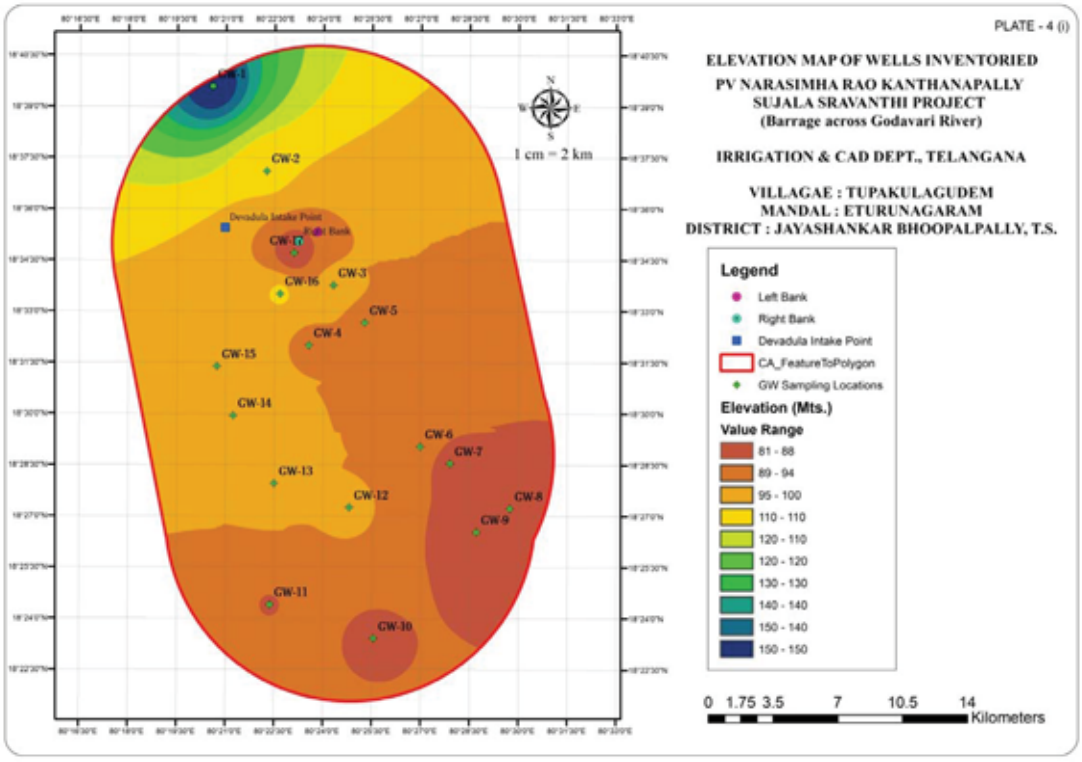


Fig 3.11 Elevation map of wells inventoried for the proposed project

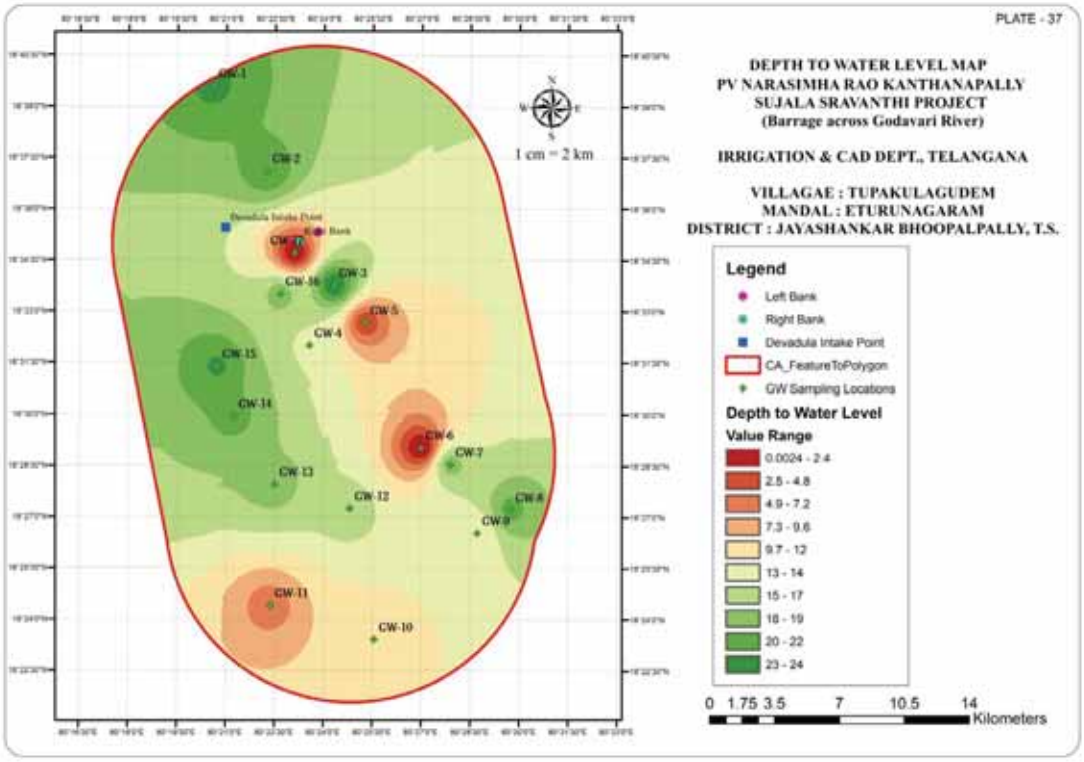


Fig 3.12 Depth to water level map for the proposed project

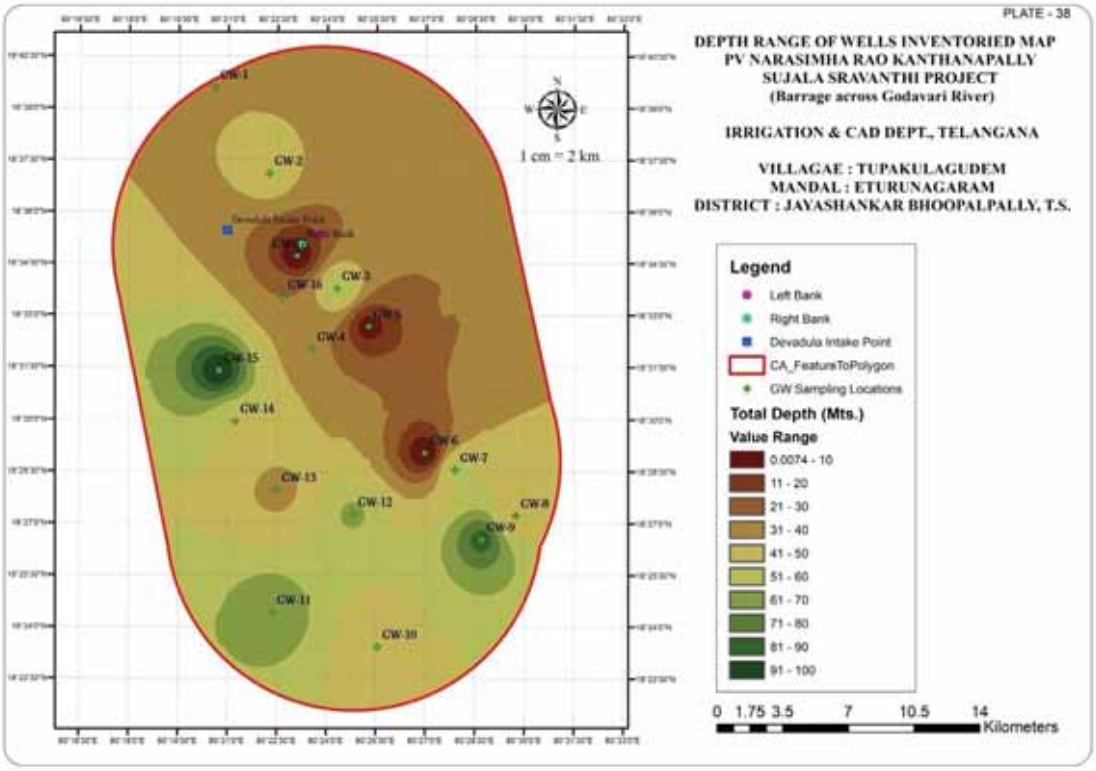


Fig 3.13 Total depth range map for the proposed project

3.2.5.13 Water quality

A total of 21 representative samples (17 GW + 4 SW) have been collected from the study area and subjected to water quality analysis as recommended by Std. IS 10500:2012 (Second Revision) for drinking water standards. The result of the water quality and the field photographs are enclosed as Annexure 15. In total the water quality in the study area is potable except at outskirts of village Royyur.

Conductivity: Conductivity in the study area ranges from 99 µS/cm to 2,840 micro mhos/cm. Conductivity having more than 2,840 µS/cm may be considered as either brackish or saline. The conductivity more than the normal limits, highest at Tekulagudem with values 2,840 µS/cm.

Chloride: Chloride in water samples in the study area range from 7.77 mg/ltr to 422 mg/ltr at Tekulagudem and this constituent is within the permissible limits of 1,000 mg/ltr over the study area. The distribution of chloride is illustrated in figures in the next section.

Constituents like Nitrate and Fluoride levels are well within the permissible limits. The Government and few social service organizations have installed mineral water plants in the villages to supply safe water. The relevant quality maps are enclosed as Annexure 15.

Table 3.15 Details of water sampling locations

Sl.No.	Village Name	Geographical coordinates	Type of Well	Date of Sampling	Criteria for sampling
01	Forest Tanda	N 18° 39′ 35.5″ E 80° 20′ 35.1″	GW	11-01-2018	Depth at water level 23m-24m bgl
02	Kotturu	N 18° 37′ 06.5″ E 80° 22′ 15.1″	Govt. HP	11-01-2018	Depth at water level 20m-22m bgl
03	Tekulagudem	N 18° 33′ 45.9″ E 80° 24′ 18.1″	Govt. HP	11-01-2018	Depth at water level 23m-24m bgl
04	Perur	N 18° 32′ 00.2″ E 80° 23′ 33.3″	Govt. HP	11-01-2018	Depth at water level 13m-14m bgl
05	Krishnapuram	N 18° 32′ 39.9″ E 80° 25′ 16.0″	Govt. HP	11-01-2018	Depth at water level 4.9m-7.2m bgl
06	Alli Ram Babu	N 18° 29′ 02.2″	Govt. HP	11-01-2018	Depth at water

Sl.No.	Village Name	Geographical coordinates	Type of Well	Date of Sampling	Criteria for sampling
		E 80° 26′ 59.1′′			level 0.0024m-2.4m bgl
07	Gollagudem	N 18° 28′ 32.5′′ E 80° 27′ 53.8′′	DW	11-01-2018	Depth at water level 15m-17m bgl
08	Sundariah Colony	N 18° 27′ 13.0′′ E 80° 29′ 44.6′′	Govt. BW- HP	11-01-2018	Depth at water level 20m-22m bgl
09	Nagaram	N 18° 26′ 31.7′′ E 80° 28′ 42.8′′	Govt. BW- HP	12-01-2018	Depth at water level 13m-14m bgl
10	Gugloth Saraiah	N 18° 23′ 24.6′′ E 80° 25′ 33.4′′	Govt. HP	12-01-2018	Depth at water level 9.7m-12m bgl
11	Chelpaka	N 18° 24′ 24.1′′ E 80° 22′ 21.8′′	BW	12-01-2018	Depth at water level 4.9m-7.2m bgl
12	Kantalapalle	N 18° 27′ 15.2′′ E 80° 24′ 48.3′′	Govt. HP	12-01-2018	Depth at water level 15m-17m bgl
13	Dr. Venkatesh RMP	N 18° 27′ 57.3′′ E 80° 22′ 29.4′′	Govt. HP	12-01-2018	Depth at water level 18m-19m bgl
14	Sri Poliah Buttaigudem	N 18° 29′ 56.7′′ E 80° 21′ 13.7′′	BW	12-01-2018	Depth at water level 20m-22m bgl
15	Kannaipalli	N 18° 31′ 22.9′′ E 80° 20′ 43.7′′	BW	12-01-2018	Depth at water level 23m-24m bgl
16	Devadula	N 18° 33′ 30.8′′ E 80° 22′ 40.1′′	BW	12-01-2018	Depth at water level 18m-19m bgl
17	Mr. Kanta Rao	N 18° 34′ 42.7′′ E 80° 23′ 05.7′′	BW	12-01-2018	Depth at water level 0.0024m-2.4m bgl

Sl.No.	Village Name	Geographical coordinates	Type of Well	Date of Sampling	Criteria for sampling
18	Godavari River	N 18° 34′ 58.9′′ E 80° 23′ 51.7′′	SW-1	13-01-2018	Zone of influence, major construction activity
19	Near Godavari River	N 18° 36′ 06.9′′ E 80° 23′ 13.2′′	SW-2	12-01-2018	Depth at water level 2.5 m-4.8m bgl
20	Krishnapuram vagu	N 18° 32′ 20.5′′ E 80° 25′ 44.3′′	SW-3	13-01-2018	Representative sample from south eastern portion from the proposed barrage
21	Tank Near Mullikota	N 18° 24′ 28.7′′ E 80° 26′ 16.1′′	SW-4	13-01-2018	Representative sample from southern portion from the proposed barrage

3.2.5.14 Ground water resources

The resource estimation and categorization is to be carried out as per the recommendations of Groundwater Estimation Methodology-97 (GEM-97) considering watershed as a unit. Watershed and administrative boundaries do not match with the administrative boundaries. As a result different parts of Mandals fall in different watersheds having different stages of groundwater development and categorization. Pro-rata approach to consolidate the watershed data into Mandal wise data gives only details on groundwater resource, draft and additional irrigation potential. Pro-rata approach cannot be applied to Mandal, as a unit, as far as stage of development and categorization is concerned. However, average stage of development is given to have an overall idea of the Mandal[35].

Groundwater resources and recharge assessment has been arrived taking in to consideration of the monsoon and non-monsoon rainfall, command and non-command area, areas of recharge and discharge, water table fluctuations, specific yield of rock formations/litho units and normalized monsoon recharge. As the present project does not involve pumping of

[35] CGWG- Groundwater Information Booklet: Khammam District, Telangana 2013

groundwater the specific studies relating to aquifer parameters have not been carried out. However, already published relevant data was consulted and prepared this report.

The already published data of CGWB in the form of Groundwater information Booklets for the parts of Jayashankar Bhupalapally (erstwhile Khammam District) District covering the subject area have been consulted and arrived at the conclusion. The Groundwater resource for Khammam is categorized as over exploited area to the tune of 100% as per the published data of CGWB-2013. This area requires serious formulation of artificial recharge programmes and groundwater budgeting. The District as a whole comes under over exploited stage of development.

Table 3.16 Details of wells inventoried

Sl.No.	Village Name	Geo coordinates		Type of Well
		Latitude	Longitude	
01	Annaram	N 18° 39′ 07.0′′	E 80° 24′ 00.3′′	BW
02	Gangaram	N 18° 33′ 23.3′′	E 80° 24′ 07.0′′	BW
03	Chandrupatla	N 18° 32′ 59.0′′	E 80° 23′ 44.3′′	BW
04	Motla gudem	N 18° 31′ 35.6′′	E 80° 23′ 14.9′′	BW
05	Kadekal	N 18° 31′ 51.9′′	E 80° 25′ 45.8′′	BW
06	Teklabor	N 18° 30′ 25.8′′	E 80° 23′ 21.8′′	BW
07	Dharmaram	N 18° 30′ 21.0′′	E 80° 24′ 59.0′′	BW
08	Ayyavaripeta	N 18° 29′ 23.8′′	E 80° 23′ 04.4′′	BW
09	Korakallu	N 18° 29′ 30.3′′	E 80° 23′ 43.6′′	BW
10	Lingapeta	N 18° 28′ 45.1′′	E 80° 24′ 26.4′′	BW
11	Sitanagaram	N 18° 29′ 15.3′′	E 80° 25′ 16.9′′	BW
12	Arlagudem	N 18° 28′ 34.8′′	E 80° 25′ 13.5′′	BW
13	Chinturu	N 18° 28′ 23.1′′	E 80° 25′ 01.3′′	BW
14	Sriramanagaram	N 18° 29′ 13.5′′	E 80° 27′ 42.3′′	BW
15	Virapuram	N 18° 28′ 46.8′′	E 80° 28′ 41.4′′	BW
16	Pusuru	N 18° 24′ 43.7′′	E 80° 28′ 27.3′′	BW
17	Muppanapalli	N 18° 30′ 34.5′′	E 80° 21′ 28.9′′	BW
18	Gurirevala	N 18° 31′ 42.6′′	E 80° 21′ 44.6′′	BW
19	Gangagudem	N 18° 32′ 02.4′′	E 80° 21′ 18.1′′	BW
20	Lakshmipuram	N 18° 32′ 54.4′′	E 80° 22′ 47.1′′	BW
21	Rajanapeta	N 18° 33′ 04.9′′	E 80° 22′ 04.7′′	BW
22	Bhndarigudem	N 18° 36′ 44.3′′	E 80° 19′ 16.0′′	BW
23	Kotta Tarlagur	N 18° 36′ 48.7′′	E 80° 21′ 59.8′′	BW

3.2.6 Surface and Ground Water Quality

The resource estimation and categorization is to be carried out as per the recommendations of Groundwater Estimation Methodology-97 (GEM-97) considering watershed as a unit. Watershed and administrative boundaries do not match with the administrative boundaries. As a result different parts of Mandal fall in different watersheds having different stages of groundwater development and categorization. Pro-rata approach to consolidate the watershed data into Mandal wise data gives only details on groundwater resource, draft and additional irrigation potential. Pro-rata approach cannot be applied to Mandal, as a unit, as far as stage of development and categorization is concerned. However, average stage of development is given to have an overall idea of the Mandal[36].

Any effect on physical, chemical and biological properties of water has direct impact on the quality of water[37]. The baseline status of water quality in the command area has been established through the sampling and analysis of various water quality parameters. Water samples were collected at 35 locations (10 Surface Water and 25 Ground Water) in the study area during the study period (July 2017 - March 2018). The prime objective of the baseline water quality study was to establish the existing water quality in the study area to evaluate the anticipated impact of the proposed project on water quality and to suggest appropriate mitigation measures for implementation. This will also be useful for assessing the conformity to the standards of water quality during the construction and operation phase of the project. The details of sampling locations are given below;

Table 3.17 Details of Water sampling locations

Sampling Station Code	Name of the sampling station	Geographical Coordinates	Source	Criteria for sampling
SW-1	Upstream of Godavari River	18°36'3.17"N, 80°23'1.77"E	Surface Water	Representative sample near the proposed barrage
SW-2	Downstream of Godavari River	18°27'34.55"N, 80°24'14.01"E		Representative sample near the proposed barrage
SW-3	Rajulakota Palli	17°37'40.91"N, 79°47'52.21"E		Representative sample from the tanks in the existing command area

[36] CGWG- Groundwater Information Booklet: Khammam District, Telangana 2013

[37] Furhan,I., Ali,M., Salam, A., Khan,B.A,. Ahmad,S,. Quamar M and Omer, Kashif (2004), *Seasonal variations of physico-chemical characteristics of river Soan water at Dhoak, Pathan Bridge (Chakwal), Pakisthan*, International J. of Agriculture and Biology, 6(1):89-92

Sampling Station Code	Name of the sampling station	Geographical Coordinates	Source	Criteria for sampling
SW-4	Chali Vagu	18° 9'18.07"N, 79°45'55.84"E		Representative sample from the reservoir in the existing command area
SW-5	Noonegudem cheruvu	17°31'48.86"N, 79°18'23.45"E		Representative sample from the tanks in the existing command area
SW-6	Mylaram cheruvu	17°40'14.39"N, 79°34'38.33"E		Representative sample from the tanks in the existing command area
SW-7	Chokkaraoplle	18°23'20.05"N, 79° 8'13.10"E		Representative sample from the reservoir in the existing command area
SW-8	Chokkarao cheruvu	17°45'12.11"N, 79° 9'22.41"E		Representative sample from the tanks in the existing command area
SW-9	Musi reservoir	17°15'33.76"N, 79°30'0.84"E		Representative sample from the reservoir in the existing command area
SW-10	Palair Reservoir	17°14'22.07"N, 79°52'46.55"E		Representative sample from the reservoir in the existing command area
GW-1	Peddapalli village	18°25'51.77"N,79°51'39.00"E	Ground water	Depth at water level 2.5 m-4.8m bgl
GW-2	Nekkonda village	17°47'41.42"N,79°48'5.32"E		Representative sample from north eastern portion of the Command Area
GW-3	Mathpally village	17°55'37.19"N,78°48'17.90"E		Representative sample from western portion of the Command Area
GW-4	Medaramatla village	18°16'17.58"N,79°40'47.71"E		Representative sample from north eastern portion of the Command Area

Sampling Station Code	Name of the sampling station	Geographical Coordinates	Source	Criteria for sampling
GW-5	Kamalapura village	18°10'38.64"N,79°31'30.49"E		Representative sample from northern portion of the Command Area
GW-6	Madulaplli village	18°42'1.73"N, 79°1'55.39"E		Representative sample from north western portion of the Command Area
GW-7	Sangem village	17°53'25.99"N, 79°42'33.38"E		Representative sample from eastern portion of the Command Area
GW-8	Dharmasagara village	17°59'36.42"N, 79°26'33.89"E		Representative sample from central portion of the Command Area
GW-9	Gadepally village	17°55'4.48"N, 79°38'1.80"E		Representative sample from southern portion of the Command Area
GW-10	Venkatagiri village	17°43'19.56"N, 79°53'26.22"E		Representative sample from south eastern portion of the Command Area
GW-11	Nuthankal village	17°19'50.61"N, 79°41'57.80"E		Representative sample from southern portion of the Command Area
GW-12	Jallepalli village	17°22'31.68"N, 79°58'6.08"E		Representative sample from south eastern portion of the Command Area
GW-13	Vastakondur	17°29'32.13"N, 79°21'12.01"E		Representative sample from south western portion of the Command Area
GW-14	Gundala village	17°30'35.85"N, 79°17'39.98"E		Representative sample from south western portion of the Command

Sampling Station Code	Name of the sampling station	Geographical Coordinates	Source	Criteria for sampling
				Area
GW-15	Neermala village	17°34'33.68"N, 79°15'12.77"E		Representative sample from south western portion of the Command Area
GW-16	Aler village	17°38'26.33"N, 79° 2'35.08"E		Representative sample from south western portion of the Command Area
GW-17	Salvapur village	17°48'58.19"N, 78°52'53.08"E		Representative sample from western portion of the Command Area
GW-18	Komuravelli village	17°55'51.93"N, 78°53'46.04"E		Representative sample from western portion of the Command Area
GW-19	Kootigal village	17°57'59.20"N, 79° 7'21.04"E		Representative sample from western portion of the Command Area
GW-20	Machupahad	17°52'3.23"N, 79°12'55.95"E		Representative sample from western portion of the Command Area
GW-21	Fathepuram village	17°53'45.27"N, 79°15'35.50"E		Representative sample from western portion of the Command Area
GW-22	Suryapet village	17° 8'8.70"N, 79°37'58.77"E		Representative sample from southern portion of the Command Area
GW-23	Yerra Pahad village	17°22'1.32"N, 79°43'21.06"E		Representative sample from southern portion of the Command Area
GW-24	Mathpally village	17°55'37.19"N, 78°48'17.90"E		Representative sample from western portion of the Command Area
GW-25	Jallepalli village	17°22'31.68 "N, 79°58'6.08"E		Representative sample

Sampling Station Code	Name of the sampling station	Geographical Coordinates	Source	Criteria for sampling
				from southern portion of the Command Area

Surface and ground water samples were collected (grab sampling) at each location as per CPCB guidelines[38]. Surface water sample was collected from the River by using a weighted bottle. Ground water samples from the production tube wells were collected after running the well for about 5 minutes. Adequate parameter specific preservatives were added to the samples and collected samples were brought to the laboratory by maintaining 4˚C in the ice boxes. Separate sterilized bottles were used for collection of water samples for microbial analysis. Surface and ground water quality analysis results are enclosed as Annexure 16.

[38]Guidelines for Water Quality Monitoring (2007), MINARS/27/2007-08, CPCB, New Delhi

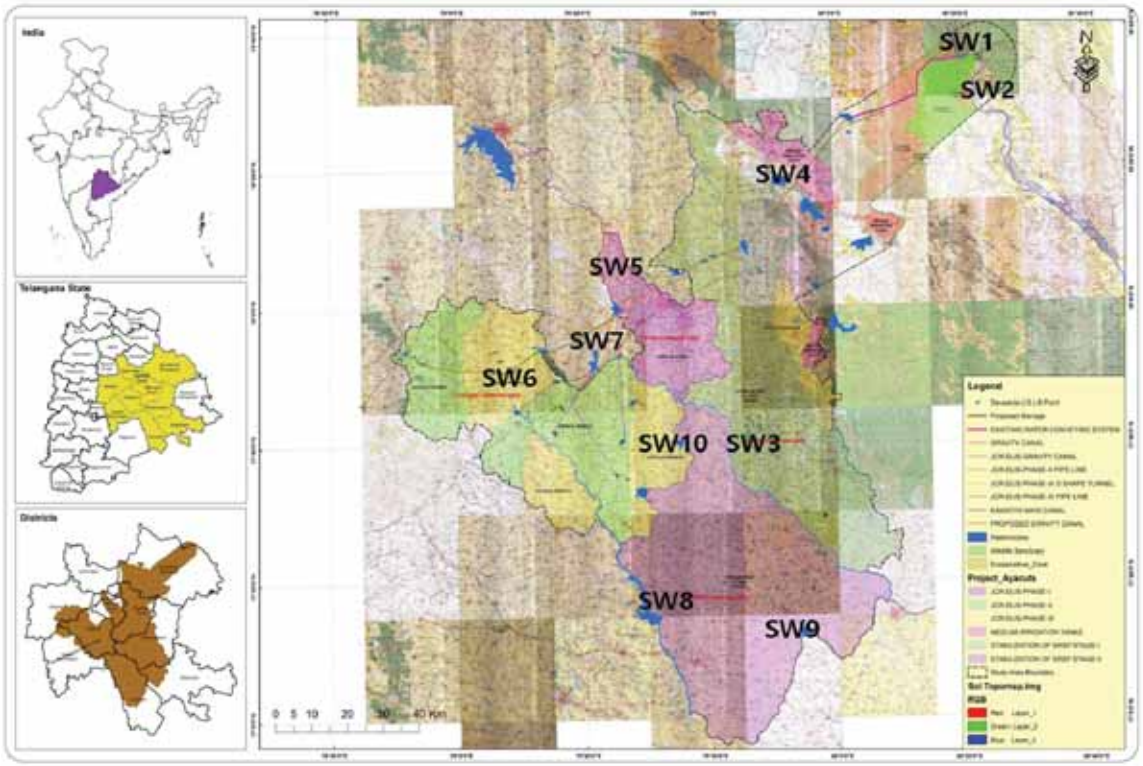


Fig 3.14 Surface Water Quality sampling locations

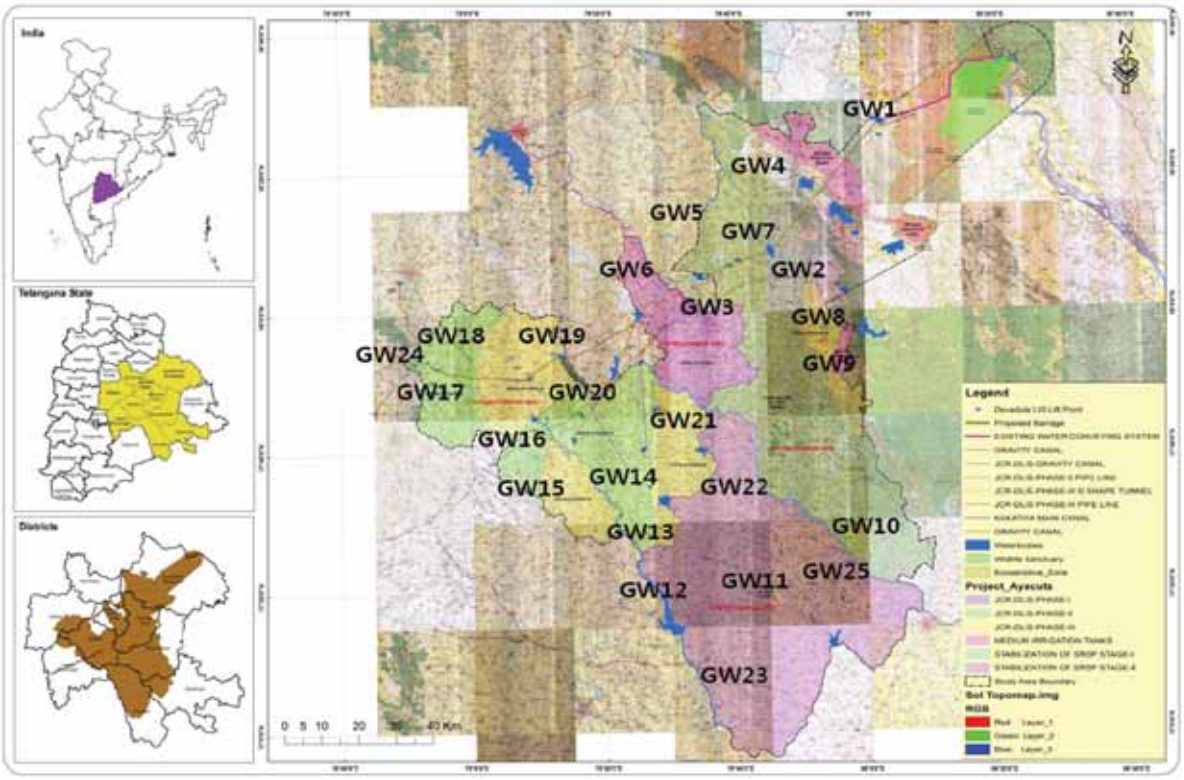


Fig 3.15 Ground Water Quality sampling locations

3.2.6.1 Surface and Ground Water Quality Results

- Monsoon season (July 2017 - September 2017)

Surface water results: pH was in the range of 7.02 - 8.14 at Rajulakota Palli and Chokkarao cheruvu respectively. Total Hardness in the surface water was in the range of 58 mg/L - 244 mg/L at Mylaram cheruvu and Musi reservoir respectively, Dissolved oxygen was found to be 4 mg/L - 5.5 mg/L at Rajulakota Palli and Mylaram cheruvu respectively. Highest values of conductivity and chloride were found to be 1021 µS/cm and 160.5 mg/L respectively at Musi reservoir. Due to improper sanitation and utilization of River water for various domestic purposes Total Coliform and E-coli was found at all locations in the range of 10-84 MPN/100ml and <1.8 MPN/100ml respectively which is due to the discharge of animal and human waste directly into the water body.

Groundwater results: The ground water quality analysis results reveal that, the Total Hardness was found to be in the range of 148 mg/L - 1080 mg/L at Vastakondur and Gundala village respectively. Electrical Conductivity was found to be in the range of 616 µs/cm - 6280 µs/cm at Jallepalli village and Kamalapura village respectively. Total Coliform was to be in the range of <1.8-2 MPN/100 ml at all locations. Sources of Total and E- Coli in groundwater includes: Agricultural runoff, effluent from septic systems or sewage discharges and infiltration of domestic or wild animal fecal matter[39].

- Post-monsoon season (October 2017 - December 2017)

Surface water results: pH was in the range of 6.91 - 7.9 at Chali Vagu Project and several locations respectively. Total Hardness in the surface water was in the range of 46 mg/L - 590 mg/L at Chokkarao cheruvu and Chali Vagu respectively, Dissolved oxygen was found to be 4.4 mg/L - 5.7 mg/L at Chokkaraoplle and downstream of Godavari River respectively. Highest values of conductivity and chloride were found to be 1800 µS/cm and 272.96 mg/L respectively at Chali Vagu. Due to improper sanitation and utilization of river water for various domestic purposes Total Coliform and E-coli was found at all locations in the range of 4-120 MPN/100ml and <1.8-21 MPN/100ml respectively which is due to the discharge of animal and human waste directly into the water body.

Groundwater results: The ground water quality analysis results reveal that, the Total Hardness was found to be in the range of 102 mg/L - 874 mg/L at Gundala village and Gadepally village respectively. Electrical Conductivity was found to be in the range of 328 µs/cm - 2530 µs/cm at Neermala village and Dharmasagara village respectively. Total Coliform and E- coli was found to be <1.8-2 MPN/100ml at all locations. Sources of Total and E- Coli

[39] British Columbia Ground Water Association. (2007). Total, Fecal and E. coli Bacteria in Groundwater. *Water Stewardship Information Series*.

in groundwater includes: Agricultural runoff, effluent from septic systems or sewage discharges and infiltration of domestic or wild animal fecal matter.

- Pre-monsoon season (January 2018 - March 2018)

Surface water results: pH was in the range of 7.13 - 9 at Chokkaraoplle and upstream of Godavari River respectively. Total Hardness in the surface water was in the range of 72 mg/L - 416 mg/L at Mylaram cheruvu and Musi reservoir respectively, Dissolved oxygen was found to be 1.2 mg/L - 6 mg/L at Noonegudem cheruvu and upstream of Godavari River respectively. Highest values of conductivity and chloride were found to be 2370 µS/cm and 404.98 mg/L respectively at Musi reservoir. Due to improper sanitation and utilization of river water for various domestic purposes Total Coliform and E-coli was found at all locations in the range of 12-3900 MPN/100ml and <1.8-550 MPN/100ml respectively.

Groundwater results: The ground water quality analysis results reveal that, the Total Hardness was found to be in the range of 146 mg/L - 900 mg/L at Komuravelli village and Medaramatla village respectively. Electrical Conductivity was found to be in the range of 716 µs/cm - 5950 µs/cm at Mathpally village and Kamalapura village respectively. Total Coliform was to be in the range of <1.8-4 MPN/100ml at all locations. Sources of Total and E- Coli in groundwater includes: Agricultural runoff, effluent from septic systems or sewage discharges and infiltration of domestic or wild animal fecal matter.

From the baseline studies, the surface water samples and their criteria as per CPCB Guidelines are as given below;

Sample code	Location	Water quality criteria		
		Monsoon season	Post monsoon season	Pre monsoon season
SW-1	Upstream of Godavari River	B	B	C
SW-2	Downstream of Godavari River	B	B	C
SW-3	Rajulakota Palli	D	D	D
SW-4	Chali Vagu Project	B	B	C
SW-5	Noonegudem cheruvu	D	D	E
SW-6	Mylaram cheruvu	B	B	D
SW-7	Chokkaraopalle	D	D	D
SW-8	Chokkarao cheruvu	B	B	C
SW-9	Moosi reservoir	E	E	C
SW-10	Palair Reservoir	C	C	C

Note: **A-** Drinking Water Source without conventional Treatment but after disinfection

B- Outdoor Bathing (Organized).

C- Drinking Water source with conventional treatment followed by disinfection

D- Propagation of wild life, fisheries.

E- Irrigation, industrial cooling, controlled waste Disposal.

From the table, it can be concluded that, out of 30 samples (inclusive of all seasons), 10 samples belongs to criteria 'B' (33.33%), 8 samples belongs to criteria 'C' (26.67%), 9 samples belongs to criteria 'D' (30%) and 3 samples belongs to criteria 'E' (10%). Therefore, all the water from the above locations is suitable for irrigation purposes.

3.2.7 Soil Characteristics

3.2.7.1 Introduction

The economy of Telangana is mainly driven by agriculture. About 73% of the population is rural. The economy of the state is predominantly agrarian; agriculture contributes about 50% of the state's income and employs about 70% of the work force.

3.2.7.2 Agro-climatic zone

Jayashankar Bhupalapally District of Telangana State, belongs to Central Telangana Zone III. The zone comprises of the districts of Medak, Warangal and Khammam. The zone covers an area of 3.86 m. ha. The soils of the zone are mainly red sandy loams, very red soils and deep black soils. The zone receives an annual normal rainfall of 996 (868—1124) mm. About 88.03 per cent of total rainfall is received during south west monsoon only. The net sown area is l.25 m. ha. Of which, 0.51 m. ha is irrigated representing 40.68 per cent of the net sown area. The principal crops grown in the zone are Paddy, Cotton, Red gram, Maize, Sugarcane, Black gram and Green gram. It is the important Cotton growing zone of Telangana.

3.2.7.3 Rivers

The major rivers flowing in the district are Godavari and Krishna Basin. Important rivers of India such as the Godavari, Krishna flow through the state, providing irrigation. Apart from major rivers, there are small rivers like Tungabhadra, Bhima, Dindi, Kinnerasani, Manjeera, Manair, Penganga, Pranahita, Peddavagu and Taliperu. There are many multi-state irrigation projects in development, including Godavari River Basin Irrigation Projects and Nagarjuna Sagar Dam, the world's highest masonry dam. The region is drained by two major rivers, with about 79% of the Godavari River catchment area and about 69% of the Krishna River catchment area, but most of the land is arid. Telangana is also drained by several minor rivers such as the Bhima, the Maner, the Manjira and the Musi.

3.2.7.4 Agriculture

The net sown area of the state is 40 % of the TGA, with a cropping intensity of 124 %. The Net Irrigated Area (NIA) of the state is 1.88 M ha, which is 44.5 % of the net cropped area and only 39 % of undivided Andhra Pradesh. Most of the irrigation is provided by wells, with the area that is irrigated being nearly 72 % of the NIA. Development of irrigated agriculture has played a major role in the economic growth and poverty alleviation through successive plan periods. These can be achieved by expanding and improving the irrigation sector, exploiting the considerable water resources, with which the state is blessed. Rice is major food crop and staple food of the state. Other important crops are maize, tobacco, mango and cotton. Agriculture has been the chief source of income for the state's economy. Agri Export Zones for the Gherkins are proposed at Jayashankar Bhupalapally: Mangoes and grapes in Hyderabad, Rangareddy, Medak, Mahabubnagar.

Eturnagaram Mandal of Jayashankar Bhupalapally district in Telangana is agriculturally dominated as the occupation of about 80% of people is farming. Rain fed farming is dependent on several factors ie.,the management of soils, crops, animals; use of package of practices, farm techniques, farm machinery and agricultural implements, marketing, human resources in a systematic way. To meet the burgeoning population's food security, it is planned to increase food production with an estimated average of 4 tons per hectare from the present 1.5 tons per hectare. Due to the great dependence and pressure on land and water resources, obviously, there will be an effect on soil properties and crop productivity. As per some estimates, the soils have been degrading at the rate of one million a hectare per year and 57% of geographical area is affected by various forms of degradation viz., water and wind erosion, physical and chemical deterioration (NBSS & LUP 2014). According to Telangana agriculture department, 8.3 lakh hectares are affected by salinity and alkalinity. This is about 20 per cent of the total cultivated area in the state. Similarly depletion of ground water levels has also been noticed at an alarming rate in recent times through the rapid depletion of the ground water resources. In this context, it is a great challenge to the scientific community, to evolve and develop appropriate strategies, to increase productivity and production of food on a sustainable basis.

3.2.7.5 Cropping pattern

Many parts of the proposed project area often experiences shortfall in rains and at times with shallow flow in the Godavari which directly affect the life style and economy of the population, mainly on agriculture. However various Khariff and Rabi crops that can be raised in the region by providing micro-irrigation facilities would not only boost production but improve the socio-economic constituents of the area. The entire population in the proposed

project area is depending on agriculture for livelihood and crops like cotton, chillies, banana, paddy, maize, pulses, and vegetables etc., which are traditionally grown in the area.

Out of 12,834 km^2 of geographical area, Gross Cropped Area is 62.88 lakh ha and Net Cropped Area is 49.61 lakh ha. Out of which, Gross Irrigated Area accounts for 31.64 lakh ha and Net Irrigated area is 22.55 lakh ha with a Cropping Intensity of 127 % and Irrigation Intensity of 138 % area under rain fed agriculture works out to 63.6 %. Percent Area from underground water is 84 %[40]. Main Crops grown in the state of Telangana are Paddy, Cotton, Maize, Chilly, Green gram, Groundnut. There are three distinct crop seasons in the northern and interior parts of country, namely kharif, rabi and zaid. The kharif season largely coincides with Southwest Post-monsoon under which the cultivation of tropical crops such as rice, cotton, jute, pulses and vegetables is possible. The Rabi season begins with the onset of winter in October-November and ends in March-April. The low temperature conditions during this season facilitate the cultivation of temperate and subtropical crops such as wheat, gram and vegetables.

Zaid is a short duration summer cropping season beginning after harvesting of rabi crops. The cultivation of watermelons, cucumbers, vegetables and fodder crops during this season is done on valley lands. However, this type of distinction in the cropping season does not exist in southern parts of the country. Here, the temperature is high enough to grow tropical crops during any period in the year provided the soil moisture is available. Therefore, in this region same crops can be grown thrice in an agricultural year provided there is sufficient soil moisture.

Crops grown in Kharif season: Cotton, Tobacco, Chilies, Paddy, Maize, Pulses, Green gram

Crops grown in Rabi season: Bengal gram

One season crop: Cotton

Commercial crops: Cotton, Chillies, etc.

Plantation: Banana, Natural vegetation,

Crops Raised Under Irrigated Condition: Maize, Cotton

3.2.7.6 Soil types

They belong to 3 orders, namely Inceptisols, Entisols and Vertisols. Of the total area of Telangana, 27% is covered with Alfisols, 25% by Inceptisols, 16% by Entisols, 15% by Vertisols, 8% by Ultisols, 5% by Aridisols and 1% by Mollisols. And about 4% includes rocky lands, water-bodies and urban area. The Red soils developed are deep to very deep,

[40] Directorate of Economics and Statistics: Statistical year book 2016

excessively drained, loamy to gravelly clay soils with iron concretions and are moderately Rapid Permeability granite is deep to very deep, well drained, clay loam with moderately rapid permeability. Forest brown soils occurring in eastern parts of the district are deep, well drained, loam to clay with moderate Permeability.

Soil types: Red earths, Black soils, Forest soils in and around Jayashankar Bhupalapally. Various soil types abound, including chalkas, red sandy soils, dubbas, deep red loamy soils and very deep black cotton soils. The soil texture varied from sandy loam to sandy clay loam to clay loam in surface horizons and sandy clay loam to clay loam to clay in sub-surface horizons. The Red soils developed on Granite occur in Thupakulagudem and are shallow to moderately deep, well drained, loamy to clay soils with moderate to moderately slow Permeability. The Red soils formed on kaolin limestone and white quartz is deep, well drained, clay with low permeability.

The major soil forms found in the Jayashankar Bhupalapally district are red gravelly clay soil; red clay soil; lateritic gravelly clay soil; lateritic clay soil; medium deep black soil; non-saline and saline alluvo-colluvial soil; brown forest soil. The major minerals found in the district are limestone; white quartz; kaolin; kyanite; manganese. Various soil types abound, including chalkas, red sandy soils, dubbas, deep red loamy soils, and very deep black cotton soils that facilitate planting mangoes, oranges and flowers.

- Acid Soils

These soils develop in humid and per-humid areas due to excessive leaching of cations with high rainfall, resulting in lowering of pH and loss of soil fertility, and can be reclaimed by addition of chemical amendments like lime. For assessing area under acid soils, soil maps of different states on 1: 2,50,000 scale were digitized in the GIS format. The non-spatial (attribute) data on pH values were linked to master soil layer to generate soil reaction. The acidity map of India facilitates understanding of spatial distribution and pH status of soils in different parts of India. Based on the range of pH values, the map has been reclassified as strongly acidic (pH < 4.5); moderately acidic (pH 4.5–5.5); slightly acidic (pH 5.5–6.5) and non-acidic (pH > 6.5). However, for the estimation of the degraded lands of India, only strongly acidic - pH < 4.5 and moderately acidic – pH 4.5–5.5 soils have been considered. Accordingly, area covered by acid soils having pH < 5.5. About 6.98 M ha are affected by acid soils; which is about 9.4% of the total geographical area.

The Red soils on laterites, limestone and Kaolin are deep, are moderately well drained, clay with slow permeability and is rich in bases (alkaline condition) and has a very high water holding capacity. The soils in the PVNRKSSP area are mostly red soil, while the red and mixed soils constitute only 20 percent, and are 30 to 60 cm deep, medium to heavy in texture, with 45 to 55 per cent clay.

3.2.7.7 Scope and Methodology

The EIA report shall identify the relevant environmental concerns and focus on the potential impacts that may change due to the construction of the project. Based on the baseline data collected for three seasons, the status of the existing environment in the area and capacity to bear the impact on this is analysed. Based on the analysis, the mitigation measures for minimizing the impact shall be suggested in the EIA/EMP.

A preliminary soil survey was conducted in the study area and soil sampling stations were identified followed by a wide-ranging sampling programme undertaken during the 2017. Pre and post-monsoon and monsoon season in the radius of 10 sq kms. Soil samples were collected from different agricultural lands. A total of 15 sampling sites extended over different villages, were identified during preliminary survey which are as given below. The data provided here are for these stations which will be monitored during the construction and post operational stages of the project.

Standard techniques of soil survey were used to obtain qualitative and quantitative data on the soils. Various soil quality parameters viz., pH, electrical conductivity, chlorides, available calcium and magnesium, phosphorus, exchangeable sodium and potassium, available nitrogen etc., were determined employing standard methods of analyses and the results are enclosed as Annexure 17.

Table 3.18 Details of soil sampling locations

Location code	Location	Geographical coordinates	Criteria for selection
S1	Near proposed barrage	18˚35′19.43″N, 80˚23′49.13″E	Geology and soil types, major construction area
S2	Kuravi	17°31'30.97"N, 80° 0'6.98"E	Geology and soil types
S3	Girnibhavi	17°57'16.40"N, 79°47'46.67"E	Geology and soil types
S4	Mogula Pally	18°19'8.69"N, 79°38'34.16"E	Geology and soil types
S5	Velchal	18°25'6.14"N, 79°37'35.85"E	Geology and soil types
S6	Bachannapet	17°47'25.36"N, 79° 2'29.21"E	Geology and soil types
S7	Jangaon	17°43'11.74"N, 79°10'46.56"E	Geology and soil types
S8	Chunchankota	17°52'38.02"N,	Geology and soil types

Location code	Location	Geographical coordinates	Criteria for selection
		78°57'50.75"E	
S9	Mallapur	18°58'10.87"N, 78°42'16.44"E	Geology and soil types
S10	Dharur	18°45'53.40"N, 78°54'33.48"E	Geology and soil types
S11	Peddapalli	18°37'2.32"N, 79°22'58.12"E	Geology and soil types
S12	Aler	17°38'32.15"N, 79° 3'10.52"E	Geology and soil types
S13	Bommannaplly	18°12'23.89"N, 79°14'19.75"E	Geology and soil types
S14	Kudali	17°16'32.29"N, 79°48'48.46"E	Geology and soil types
S15	Ailapuram	17°11'45.82"N, 79°37'57.93"E	Geology and soil types

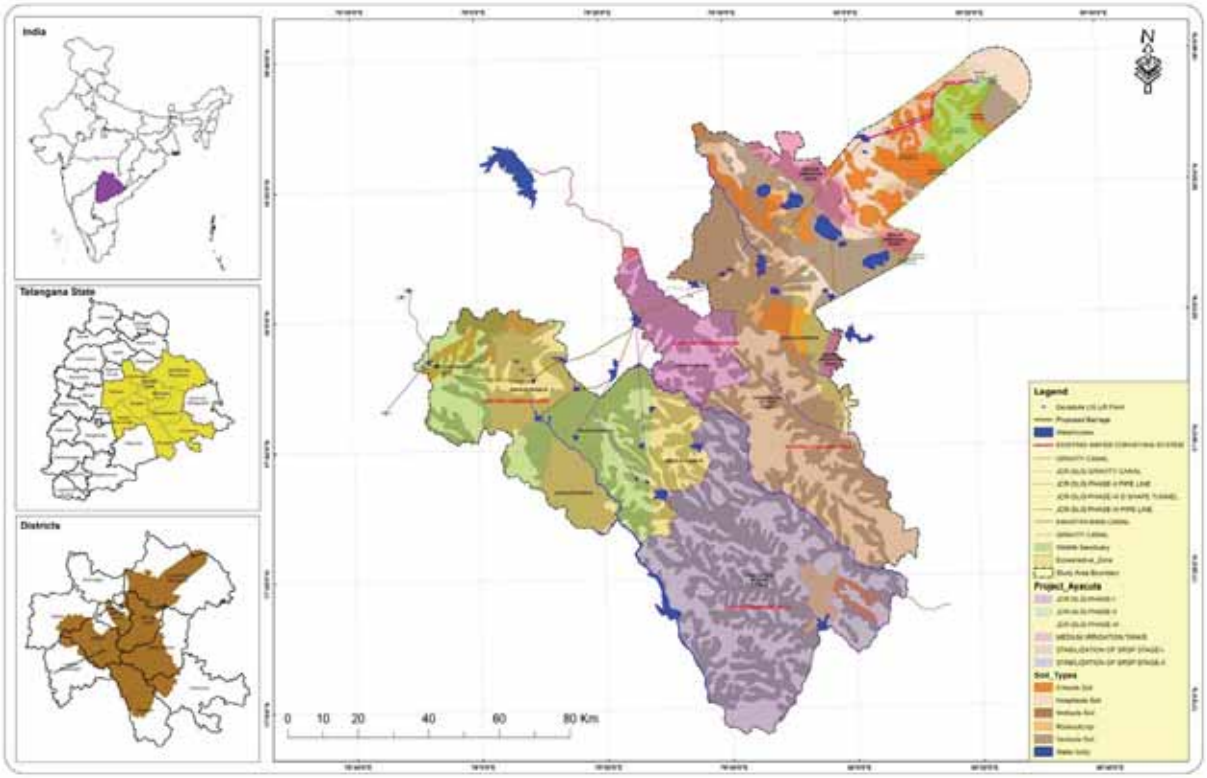


Fig 3.16 Types of soil in the study area

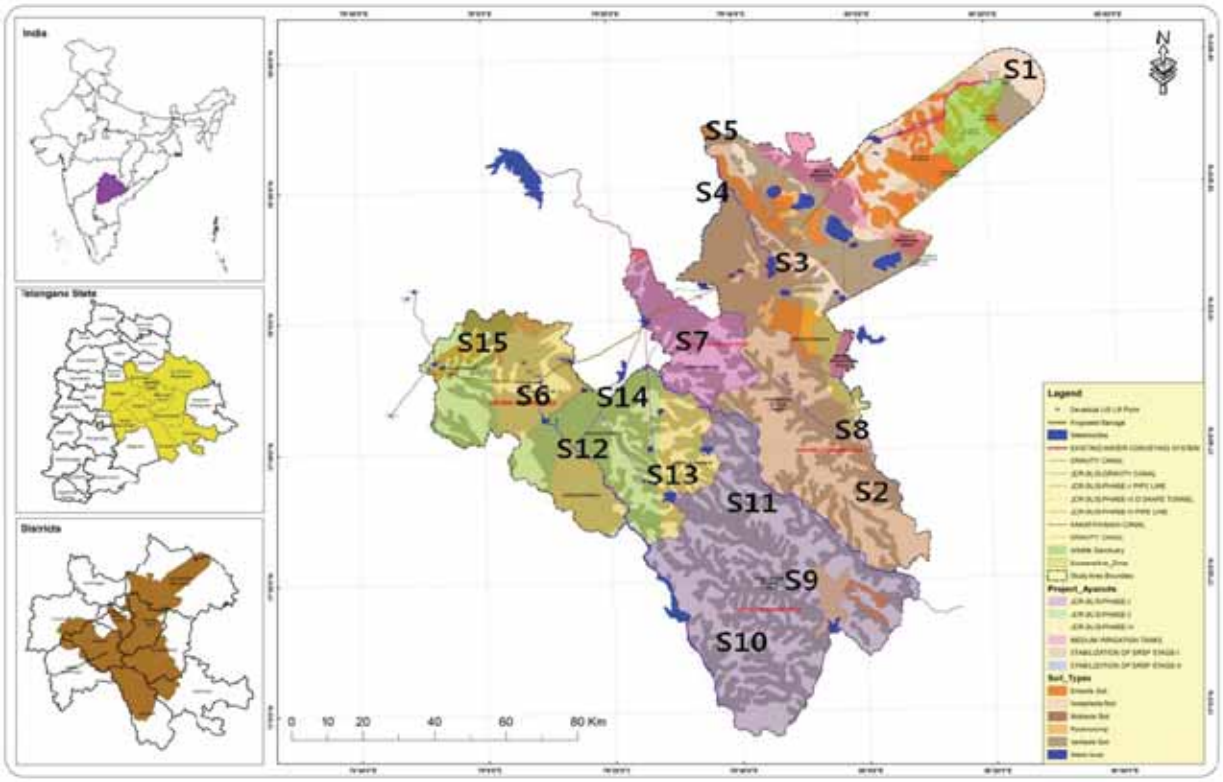


Fig 3.17 Soil sampling locations on study area map

3.2.7.8 Soil analysis Results

- Soil pH

pH of soil is the measure of hydrogen ion activity and depends largely on the relative amounts of the adsorbed hydrogen and other metallic ions present in the soils. pH of soil mainly depends on the soil water ratio. pH of soil mainly depends on the soil water ratio. From the results, it is seen that pH of the Soil samples in the study area ranged between 5.58 and 8.76. The lowest pH value of 5.58 was found in sample which belongs to an agricultural land of Velchel in post-monsoon season and the maximum pH of 8.76 was observed in Bacchannapet during monsoon month. In pre monsoon it is found in between 7.14 and 8.34 where as in monsoon the pH values are from 5.9 and 8.76. However, during post monsoon the values are ranging from 5.58 to 8.71.

The results have shown that sampling areas come under all the 3 categories of Class-I, Class-II and Class-III which clearly indicates that Soil samples are differently characterized. In the study area, in post monsoon season, the soil sample of Mogulapally and Velchel are acidic in nature, where as soil sample of Janagoan & Kudali are neutral (pH of 6.5 to 7.5) in nature. The remaining Soil samples Near proposed barrage, Kuravi, Girnibhavi, Bachannapet, Mallapura, Dharur, Peddapalli, Aleru, Bommannapalli, Ailapuram and Chunchankota of the post-monsoon season. Soil samples are alkaline (pH >7.5) in nature. In case of Monsoon season, soil samples of Kuravi, Mogulapally and Bommannapalli, pH values of < 6.5 are acidic in nature, and this may be due to high amount of leaching which has led to the leach out of exchangeable anions and are considered as acidic. Whereas monsoon season soil samples Mallapura, Peddapalli, Kudali, and Ailapuram are neutral may be due to high amount of leaching which has led to the leach out of exchangeable anions and are considered as neutral. However, Soil samples of monsoon which are alkaline in nature are from agricultural fields of villages near proposed barrage, Girnibhavi, Velchel, Bachannapet, Janagoan, Dharur, Aleru and Chunchankota. In the case of pre-monsoon season soil sample of Mogulapally and that of Kudali are neutral (pH between 6.5 and 7.5) in nature.

The remaining soil samples Near proposed barrage, Kuravi, Girnibhavi, Velchel, Bachannapet, Janagoan, Mallapura, Dharur, Peddapalli, Aleru, Bommannapalli, Ailapuram and Chunchankota of the pre-monsoon season are alkaline (pH >7.5) in nature.

Variation in pH values has an impact on survivability of soil flora and fauna. However some species of plants may tolerate the pH fluctuations and it is essential to study the pH of the soil in management practices, through which it gives the overall status of soil minerals to the plants. In the study area most of the Soil samples were alkaline and few soil samples (8 samples) found to be neutral and 5 samples are acidic.

It is observed that the pre and post monsoon soil samples are more prone to salinity than the pre monsoon soil samples and the sub surface drainage has to develop during and after monsoons.

- Electrical conductivity

The EC values of the soil samples varied from 27.4 µmhos/cm to 905 µmhos/cm. The highest value of EC was observed in monsoon sample, which belongs to agricultural land of Jangoan village whereas the lowest EC value of 27.04 µmhos/cm was noticed in the post-monsoon soil sample which belongs to the Agricultural land in Jangoan village. The remaining Soil samples of the three season soils have varying ranges in between the values of 27.4 µmhos/cm to 905 µmhos/cm.

Electrical conductivity, as the measure of current carrying capacity, gives a clear picture of the amount of soluble salts present in the soil. It plays a major role in the salinity of soils. There is a relation between electrical conductivity and salinity, lesser the EC value low will be the salinity value of soil and vice-versa. The Electrical Conductivity values of the soil samples vary from 27.04 to 905 µmhos/s, as shown below.

Sl.No.	EC values (µmhos/cm)	Pre monsoon	Monsoon	Post-monsoon
1	10 to 500	15	14	15
2	501 to 1000	0	1	0
3	1001 to 1500	0	0	0
4	1501 to 2000 and above	0	0	0

Electrical conductivity values within 800 µmhos/cm are considered as normal nature of soil, and in the present study about 100 percent of the samples were observed to be in the normal range in the pre and post-monsoon season soil samples. In the monsoon sample of Mallapur EC value is 905 which is considered as critical for tolerant crops. While EC values between 800 and 1600 are considered critical for tolerant crops, while EC values ranging between 1600 and 2500 are considered critical for salt tolerant crops, only post-monsoon season soil sample is considered as critical for salt tolerant crops and EC values more than 2500 are not considered safe for most of the crops. In the study area no samples have crossed 1500, and therefore almost all the soil samples are found to be suitable for agriculture.

- Colour

Soil colour is one of the visual judgment through which the soil type can be classified. The soil colour may vary from region to region or spatially. Soil derives its colour from the source

of the material. However, the colour may also vary due to, Soil forming process, Moisture content and drainage and Nature and amount of organic matter.

- Mineral sources

In the study area, the soil sample has shown similarity in colour. Majority of the soils are Brown to red; whereas about 10 percent of the samples were grey to brown. The colour of samples indicated that majority of the samples belong to Red sandy loam to loamy sand soils.

- Salinity

Based on the electrical conductivity of the soil, soil salinity can be classified into four classes:

Water class	**Electrical conductivity (micromhos/cm) at 25˚C**	**Approximate salt concentration**
Class - I - Low salinity	0 to 250	<0.16
Class - II - Medium salinity	250 to 750	0.16 to 0.50
Class - III - High salinity	750 to 2250	0.50 to 1.50
Class - IV - Very High salinity	2250 to 5000	1.5 to 3

CI water is considered as safe with without any salinity problems.

CII When used for irrigation, moderate leaching is required.

CIII and **CIV** cannot be used on soils with inadequate drainage, since salinity develops.

In the study area all 15 soil sample of pre and post monsoon samples come under the category of Class-I, this indicates that the Soil samples are under low salinity. ie., soil samples of Velchel, Girnibhavi and Kuravi, Bachannapet. Soil samples of Aleru, Dharur, Chunchankota and Peddapalli drawn during monsoon months are having medium salinity. Whereas soil sample from Mallapur is of high salinity during monsoon season samples indicating salt encrustations on the surface soil which needs drainage to leach out salts.

Salt affected problems are commonly seen in arid and semi arid regions, in irrigation areas and in the regions where the poor drainage and poor quality / contaminated water is being used for irrigation. Saline soils are those, which dominated/appreciable quantities of soluble salts to interfere growth and productivity of the crops. Generally, they are rich in neutral salts including the salts of chlorides and sulphate of sodium, calcium and magnesium (excluding

gypsum) in excess quantities, enough to cause significant effect particularly on growth of the crop plants. In these saturated soils the various soil characteristics such as the pH was observed to be less than 8.5 mainly due to the presence of neutral salts, and the electrical conductivity is more than 4.0 µmhos/cm (at 25˚C) and the Exchangeable Sodium percentage (ESP) is less than 15. Salinity is usually measured/expressed in terms of electrical conductivity and expressed in micromhos/cm (at 25˚C).

- Exchangeable Calcium

The minimum concentration of Exchangeable Calcium was found to be 3.1 during monsoon season in the soil sample at Kudali, while the maximum value of 52.2 was found during pre-monsoon (expressed Ca as m eq/100g) in the sample near proposed barrage. There was wide variation in the distribution of Exchangeable Calcium content in the study area.

- Exchangeable Magnesium

The minimum concentration of Exchangeable magnesium is found to be 1 m eq/100g in Ailapuram of pre-monsoon which is, and similarly the maximum Exchangeable magnesium value of 11 m eq/100g in Kuravi of post-monsoon agricultural land. The Exchangeable magnesium value found ranged between 0.1 m eq/100g and 11 meq/100g.

- Organic Carbon

Soil resource is a major anchor to all the life beings, such as plants, animals and microorganisms in various stages of decomposition process, which gives the end products in the form of organic matter. The organic substances are a major determinant of soil structure, moisture content, pH and the soil nutrient status of the topsoil. The importance of organic matter in the soil is improved soil structure and fertility status of the soil, which differentiates the soil and other non-fertile soils.

Percent Organic Carbon was found to be in the range of 0.12 to 0.72 and the minimum value was observed in Dharur, Bommanapally belonging to pre-monsoon and in Bachannapet during monsoon season. While the maximum percent Organic Carbon value of 0.72 was found in Peddapalli village during monsoon season, indicating variable organic matter content and degradability rate. The percentage of organic matter varied spatially and generally has a higher organic content in the case of thickly vegetated areas. The requirement of optimum level of organic matter required by the plants slightly varies between species, as it is not a single nutrient source required for all the plants and for all the soils. The variation is also dependent on soil type, climate, existing plant and animal species.

Percentage organic carbon	Rating
<0.40	Low
0.4 to 0.75	Medium

>0.75	High

In the study area it was noticed that the percent organic carbon was found to be in different ranges in all samples of post-monsoon season i.e., post-monsoon season Soil samples of Soil sample have high organic carbon content due to the presence of thick vegetation. In the monsoon season the following soil results have shown that the soil samples have low organic carbon.

Whereas soil samples of Girnibhavi, Velchel, Dharuru, Peddapalli and Aleru are having medium of organic content in the soil and only soil sample of Mallapur has high organic content in the soil. In the case of post and pre-monsoon season soil samples, the organic content is low in all cases.

The status of the monsoon season soil results are as follows with respect to organic carbon

Sl.No.	Location code	Location	OC Status as Low/Medium/High
1	S1	Near proposed barrage	Low
2	S2	Kuravi	Low
3	S3	Girnibhavi	Medium
4	S4	Mogula Pally	Low
5	S5	Velchal	Medium
6	S6	Bachannapet	Low
7	S7	Jangaon	Low
8	S8	Chunchankota	Low
9	S9	Mallapur	High
10	S10	Dharur	Medium
11	S11	Peddapalli	Medium
12	S12	Aler	Medium
13	S13	Bommannaplly	Low
14	S14	Kudali	Low
15	S15	Ailapuram	Low

Therefore most of the samples in the area appear to possess low to medium content of percent organic carbon, which indicates that the farmer has to apply sufficient quantity of green manure and farm yard manure to get higher yield of crops.

- Percent Organic Carbon

Percent Organic Carbon was found to be in the range of 0.12 to 0.72 and the minimum value was observed in Dharur and Bommanapally belonging to pre-monsoon and in

Bachannapet during monsoon season. While the maximum percent Organic Carbon value of 0.72 was found in Peddapalli village during monsoon season.

- Exchangeable Sodium

The exchangeable sodium content in the study area ranged between 1.37 to 197.52 mg/100gm as observed. The minimum Exchangeable sodium value of 1.37 mg/100gm was observed in pre-monsoon Soil sample of Girnubhavi village and the maximum value was also found in same village which belonged to post-monsoon.

Potassium (K) is the third most essential element required by most of the plants. Simultaneously there is a negative effect at higher levels as it affects cell division, formation of carbohydrates, activation of various enzymatic reactions, cell permeability, while it improves resistance of some plants to some diseases. It also plays an important role in water balancing of plants or regulation of osmosis. Generally it forms a most abundant metal cation in plant cell (about 2 to 3 % by dry weight).

Deficient supply of (K)	Less than 113 Kg/ha
Doubtful supply of (K)	113 to 280 Kg/ha
Adequate supply of (K)	More than 280 Kg/ha

- Available Potassium

The available potassium values were found to be in a narrow range and ranged between 1.03 to 139.66 Kg/ha. The minimum potassium value was noticed in soil sample of Bommanapally belonging to pre-monsoon, while the maximum value was found in post-monsoon season at Girnabhavi village which is in the range of doubtful availability. All other soil samples are of deficient level, thus the area by and large require supplementation of potassic fertilizers to maintain the balanced requirement of nutrients' to the crop lands.

- Available Nitrogen

The available nitrogen ranged between 38 to 480.65 Kg/ha and the minimum value was found in pre monsoon season which belongs to Agricultural land at Aler and the maximum value was observed in Dharur village which belonged agricultural land during monsoon season.

Nitrogen is one among the four primary elements essential for the plant tissues. It is the major component of proteins, nucleic acids and chlorophyll. The atmospheric nitrogen gets trapped in the soil during electro and photo-chemical fixation and also by the action of microorganisms. Soil nitrogen is made available through a process of mineralization. The available nitrogen in soil exists in the form of both organic and inorganic forms. However, relatively most of the nitrogen content in organic form is at the most about 90 per cent.

Organic content present in the soil decaying by microbial activity, during process all the organic nitrogen gets converted to ammonium, nitrates and nitrites. Nitrogen is having a major role in maintaining the fertility of the soil and nitrogen content in almost all the soils are observed to be very low and is found as nitrates, nitrite and ammonium. Plants are more dependent upon nitrate nitrogen, during the aerobic conditions and ammonia nitrogen during anaerobic conditions. Concentration of Ammonia Nitrogen in the soil is as given below;

Sl. No	Quantity of nitrogen	Rating
1	< 272 Kg/ha	Low
2	272 to 554 Kg/ha	Medium
3	> 554 Kg/ha	High

In the study area In the study area it was noticed that the availability of Nitrogen was found to be low in all samples of pre-monsoon season except in Near proposed barrage site and Chunchankota which are having medium level of Nitrogen availability (325.98 and 332.57 kgs/ha respectively. However, the monsoon season soil samples are also have low level of Nitrogen availability and the following soil samples possessing the medium level of Nitrogen availability. The details are:

Location code	Sampled Village	Availability of Nitrogen Kg/Ha
S4	Mogulapally	280.48
S8	Chunchankota	374.25
S9	Mallapur	302.49
S10	Dharur	321.75
S11	Peddapalli	480.65
S12	Aleru	332.47

Soil moisture content is having a major contribution to vary the process and also one of the important factors affecting nitrification. In water logged areas soil suppresses the process of nitrification because of deficient oxygen. However it is totally different in the case of dry soils. As in the case of present study area in the soils however, there will be enough moisture for the process of bacterial metabolism and such soils possess higher rate of biosynthesis of nitrogen which also contribute to fertility of the soil.

- Available Phosphorus

Phosphorus is the second most important micro nutrient available in the soil of the biological systems which covers more than 1% of the dry organic weight. It is a major content of nucleic acid, phospholipids and many phosphor related compounds. Similarly it is

second most limiting factor often affecting plant growth. Chemically Phosphorus exists in the form of both organic and inorganic forms. Generally plants depend on phosphorus in the inorganic compounds especially in the form of phosphate ions. Whereas organic phosphates are also important sources of phosphorus in all most all types of soils. However, comparatively the phosphorus is required in small quantity, but it may be the most limiting factor in the productivity of the plant. Therefore, ecologically it is more significant.

Table 3.19 Concentration of phosphorous

Sl.No.	Grade	Concentration(Kg/ha)
1	Low Phosphorus	<12.4
2	Medium Phosphorus	12.4 to 22.4
3	Adequate Phosphorus	> 22.4
4	Abundant Phosphorus	Still higher

The available Phosphorus in the project area ranges from 51.09 to 1673.22 drawn from the soil samples of pre-monsoon season. The Soil sample of Kuravi village and Velchel has minimum value.

Soils of the study area showed maximum range of abundant range of phosphorous availability in all the soil samples of monsoon, pre and post-monsoon season. In general, the Soil sample showing lower levels of available phosphorus content have to be supplemented by applying phosphorus rich fertilizers as required by a specific crop.

- Chlorides

The Chloride content of the soil is the measure of salinity of the soil. The Chloride content of the soil ranged from 0.14 meq/l to 2.35 meq/l. The chloride content was taken as major factor for the estimation of salinity of the soil samples. The maximum chloride content of 2.35 meq/l was observed in monsoon Sample of Bommanapally whereas, the lowest chloride of 0.14 meq/L was observed in monsoon at Jangoan village.

- Particle size distribution

The soil particle size is major parameter and a relative proportion of the soil particles of various sizes are an important physical parameter, which emphasizes the texture of soil of a particular region. Larger particle size helps in providing the physical support to the plants, while smaller particles encourage the soil to hold water and availability of nutrients.

As per the International System of Classification, the range of the particle sizes in the soil is as under:

Sl.No.	Category	Particle Size
1	Coarse sand	0.2 to 2.0 mm
2	Fine sand	0.02 to 0.2 mm
3	Silt	0.002 to 0.02 mm
4	Clay	<0.002mm

- Sodium Absorption Ratio (SAR) and Percent Sodium

The Sodium Absorption Ratio ranged from 0.05 to 22.71. A minimum SAR value of 0.05 was found in Mogulapally and Bommanapally of monsoon. The maximum SAR value was found in post-monsoon season, which belonged Agricultural land of Girnibhavi village.

- Soil texture

Soil texture refers to the relative proportion of clay, silt and sand in a sample of soil. Based on dominancy of the size fraction the soil texture can be classified as various types, such as clay, sandy clay, silt clay etc, whereas the fine particle fraction of the soil is used to describe as loam. Soil texture is an indicator parameter, through which the other soil properties can be studied, but if used alone, it has limited predictive value; viz., ability of a soil to adsorb cations from solution depends on the mineralogy of the clay fraction as well as on the percentage of clay. It also depends on the amount and nature of the organic matter, the soil holds. The permeability of soil to water depends on shape, mineral particles and organic matter into structural units with pore spaces between them. Texture does however; indicate the ease with which the application of the soil can be recommended. Higher content of clay in soils are often described, as 'heavy' and sandy soils are known as 'light'. But clay soils retain more water against gravity and consequently warm up more slowly in spring. Accordingly the soil texture of soils varied from sandy loam to loamy soils except for one soil type exhibiting loamy character in the project area.

Accordingly the soil texture of post-monsoon season varied from sandy loam (Soil samples S1, S2, S5, S6, S7, S8, S9 and S10) to loamy sand (Soil samples S3, S4, S11, S13, S14 and 15) and loam in soil sample S12 of Aleru village. Textural classes are as follows:

Table 3.20 Textural classes of soil

Sl. No.	Location code	Location	Texture Class		
			Sandy loam	Loamy sand	Loam
1.	S1	Near proposed barrage	√		
2	S2	Kuravi	√		
3	S3	Girnibhavi		√	
4.	S4	Mogula Pally		√	
5.	S5	Velchal	√		
6.	S6	Bachannapet	√		
7	S7	Jangaon	√		
8	S8	Chunchankota	√		
9	S9	Mallapur	√		
10	S10	Dharur	√		
11	S11	Peddapalli		√	
12	S12	Aler			√
13	S13	Bommannaplly		√	
14	S14	Kudali		√	
15	S15	Ailapuram	√		

- Water holding capacity (WHC)

Water holding capacity is the amount of water that can be retained by the soil when all the pores in the soil have been filled with water; soil is saturated with water, accompanied by very poor drainage. The water retained at zero bar tension, is rarely utilized by plants as it reduces the respiration rate and creates anaerobic conditions for the roots. In the study area the soil sample exhibited a significant correlation between the clay content and water holding capacity. WHC was more in the surface soil layer where a greater accumulation of organic matter, litter and root mass etc., existed. Thereby it supports rather stronger influence of soil organic matter on water holding capacity of the soil.

Salinity causing factors

The various natural factors affecting salinity are meteorological, drainage pattern, agricultural practices and soil characteristics

I. Climate: Climate is the most important factor responsible to change and formation of saline soils in a specific region. They mainly occur in regions with arid and semi arid climate as where low rainfall is formed to leach and transport the soluble salts formed during

weathering. Arid climate is commonly characterized by maximum evaporation rates, which leads to more and more concentration of salt in the soil surface. Whereas in the humid regions the soluble salts formed due to weathering process are transported downwards to the ground water regime, and, streams finally reach the oceans. Therefore saline soils are non-existent in humid regions except when the soil has been subjected to seawater inundation, as in river deltas and near the sea, where as in the arid regions, leaching and transportation of salts will be very poor, unlike in the case of humid regions.

II. Controlled drainage: This is another important contributing factor for salinity, during formation of saline soils, having a direct connection with the deeper ground water table or low permeability of soils. The depth of the water table often depends upon the topography of the land. In the case of arid regions of low rainfall area, the surface drainage ways are poorly developed, and which leads to the drainage basins without outlets to permanent streams. The salty drainage waters enter from the higher lands of the basin leading to increase in the ground water level to the soil surface on the low lands.

III. Low permeability of soils: Poor drainage mainly causes an effect on the downward movement of water. The low permeability of soil is mainly because of unfavorable soil texture (very fine) or it could be also due to the presence of hard layers in the form of clay pans, caliches layer or a silica hard pan, as a result of ploughing with heavy tillage equipments.

IV. Water holding capacity: Water holding capacity is the amount of water that can be retained by the soil when all the pores in the soil have been filled with water; soil is saturated with water, accompanied by very poor drainage. The water retained at zero bar tension, is rarely utilized by plants as it reduces the respiration rate and creates anaerobic conditions for the roots.

In the study area the soil sample exhibited a significant correlation between the clay content and water holding capacity. WHC was more in the surface soil layer where a greater accumulation of organic matter, litter and root mass etc., existed. Thereby it supports rather stronger influence of soil organic matter on water holding capacity of the soil. The water holding capacity of the monsoon soils are 10.5% in Bachannapet village and 55.75% in Aleru and the values for post monsoon season varies from 11.09% in Jangoan to 26.75% in Kudali. However, in the pre monsoon season soil samples, the range is from 10.40% in Bommannapalli and 26.35% in Chunchankota.

V. Irrigation practices: This is another important factor which has a bearing effect on salinity of the region. Expansion of irrigation activities has become one of the key strategies to achieving higher food production. In India the net irrigated area has increased from 20 million hectares (1950) to more than 45 million hectares, at present. This extended irrigation

activities have been achieved through transported water. Irrigation practice also contributes to improve the ground water table and when the ground water table is within 2 m of the surface, it contributes significantly to increase in the salinity of the soil due to capillary rise of water and its evaporation from the soil surface. In most of the canal irrigated areas, the problems of salt accumulation is a matter of serious dimension.

VI. Fertility Status of soils: Based on the results and nutrient indices, it is possible to classify nutrient status of the particular area and classify each nutrient level i.e., low, medium or high based on a rating chart, which was made use of while rating the soil analysis results, as follows:

Table 3.21 Rating Chart for Soil Test values and their Nutrient Indices

1. Soil pH			
	Acidity	Neutral	Alkaline
Range	Below 6	6-8	Above 8
Soil Reaction Index	I (2)	II (28)	III (15)
2. Electrical Conductivity			
	Normal	Critical	Injurious
Range (µmhos/cm)	below 1000	1000-2000	above 2000
Salt index	I (45)	II (0)	III (0)
3. Organic Carbon			
	Low	Medium	High
Range (%)	Below 0.5	0.5-0.75	Above 0.75
Nutrient index	I (44)	II (1)	III (0)
4. Available Phosphorus (By Bray's method)			
	Low	Medium	High
Range (Kg/ha)	Below 22	22-54	Above 54
Nutrient index	I (0)	II (0)	III (45)
5. Available Potassium			
	Low	Medium	High
Range (Kg/ha)	Below 123	123-296	Above 296
Nutrient index	I (44)	II (1)	III (0)
6 Parameters for fertility status			
Nutrient Index	Range	Remarks (OC, N, P, K)	
I	Below 1.67	Low	
II	1.67-2.33	Medium	
III	Above 2.33	High	

OC – organic carbon; P - Available phosphorus; K - Available potash

The nutrient index values are evaluated for the Soil sample analyzed using the following formula:

Nutrient index= [(1x No. of samples in low category) + (2 x No. Samples in medium category) + (3 x No. of samples in high category)] / Total number of samples The values are:

Characteristics	Nutrient index	Remarks
Organic carbon (OC)	1.022	Low
Available Phosphorus (P)	3.0	High
Available potash (K)	0.688	Low

From the overall results of physico-chemical analysis of the soil samples, it is noticed that the soil pH values range between 5.58 and 8.76 and most of the values belong to soil reaction index II & III which shows that the soils of the study area are under the Neutral to alkaline range. The electrical conductivity of the soil samples were observed to be in the range between 27.4 and 905 µmhos/cm. Based on the rating chart of soil tests, all the soil samples belong to normal i.e., salt index I. whereas organic carbon content of soil sample were observed to range from 0.12 to 0.72 percent. As per the nutrient index, the organic carbon in all soil samples was at low except for medium level in Peddapalli. However, most soil sample are having low nutrient index and phosphorus has high nutrient index.

3.3 Land use assessment of study area

3.3.1 Introduction

Land is a limited resource having competing demands. The need to augment the food production, infrastructure and industrial development has serious impacts on land use, resulting in accelerated land degradation. Progress in science and technology has eased out pressure on natural resources to some extent, but developmental projects have created an imbalanced growth and exploitation of natural resources. Land conservation serves many critical purposes in society. It provides open spaces, parks, and recreational spaces necessary for many critical purposes in urban area. It protects agricultural lands and rural communities from encroachment by development. It promotes biodiversity by preserving plant species and habitat critical to wildlife species. It also maintains ecological processes and functions, such as energy and nutrient flows, temperature and climate effects, renewal of soils, ecologically important disturbance regimes such as floods and processing of the chemical, biological and physical content of air, soils and waters.

Land use refers to a human activity for various category of uses carried out on land' and land cover refers to 'natural vegetation, water bodies, rock/soil, artificial cover and others

resulting from land transformations'. Land use is generally inferred based on the cover. The spatial information on land use and their pattern of change are essential for planning, management, industries, environmental studies, economic progress etc. Now, with the growing population, and consequent pressure on land and increasing land degradation, the need for optimum utilization of land assumes greater relevance. Land use inventories are assuming increasing importance in various resource sectors like agricultural planning, settlement and cadastral surveys, environmental studies and operations based on agro-climatic zones. Information on land use cover permits a better understanding of land, including grazing land, waste land, and surface water bodies etc., which are vital for developmental planning.

3.3.2 Approach and methods

We obtained high resolution satellite imageries from National Remote Sensing Center (NRSC) Hyderabad and then prepared land use maps for 10-km radius showing crop land, forest, settlements, water bodies, vegetation etc. Geocoded False Colour Composite scene of IRS-IC LISS III with PAN merged data on 1:10,000 scale coinciding with Survey of India (SOI) Topo sheet is used to prepare various thematic maps and land use and land cover map to the present study.

For the purpose of study of land use/land cover ARC GIS 9.2 and ERDAS IMAGINE 9.1 are used for extracting the land use, land cover layers, from SOI toposheets and satellite imageries. The land use/land cover classes include agriculture land forest, wetlands, settlements, built-up land etc. This classification and methodology is performed based on the standard methodology. The feature classes were identified based on the visual interpretation of the satellite imagery coupled with field observations. These datasets were digitized and analyzed to obtain land use/land cover statistics for the areas under each of these categories.

The study has made use of various primary and secondary data. These include Survey of India (SOI) topographic sheets of 1:50,000 scale and satellite image IRS P6 LISS III (PAN merged) geocoded data of 1:10,000 scale for the year 2017. The Indian Remote Sensing Satellite (IRS) data was visually and digitally interpreted by using the image interpretation elements (such as tone, texture, shape, pattern, association etc.) and Arc GIS software was used for processing, analysis and integration of spatial data to reach the objectives of the study. Adequate field checks were made before finalization of the thematic maps.

All these thematic layers were scanned and vectorized using Geographical Information System (GIS). The coverage created is edited to remove any possible errors. All the features in the GIS coverages are assigned the attributes and GIS data base is created as per the required objectives and the information needed to meet them. The coverages are projected

to polyconic projection. The coverages created using digitizer will have digitizer units for its tics. These values should be projected to real world using latitude and longitude information.

3.3.3 Results and Observations

3.3.3.1 Project location and Extent

The proposed project is located in Deccan plateau of India. The proposed project envisages construction of 1132 m long barrage across Godavari River near Thupakulagudem, 3 km downstream of existing J. Chokka Rao Devadula Life Irrigation scheme. The proposed project will stabilize the existing Devadula LIS having command area of 2, 51,310 ha and also provide irrigation facility for a command area of 3, 04,000 ha of Sriram Sagar Project. The total land requirement is about 674.18 ha. Total submergence area is 580.18 ha which is in the river bed only. The project is at a distance of 2.5 km from boundary of Chattisgarh state.

Topography is relatively mild to medium slopes. Five Reserved Forests and one protected forest – Annaram R.F, Nuguru R.F, Perur R.F, Nagaram R.F, Bangoranikonta R.F and Marimalli P.F – are falling under the project study area. The proposed Barrage is located at $80^0$23′36″ E longitude and $18^0$35′10″ N latitude on Godavari near Thupakulagudem village, Eturnagaram Mandal, Jayashankar Bhupalapally District. The region is subject to frequent drought and famine, affecting the life and economic status of the population, which subsists mainly on agriculture. The soil in this region is fertile which enables growth of food crops by providing irrigation facilities.

3.3.3.2 Land Use and Land Cover

The results indicate that the buffer zone is dominated by crop lands followed by forest and water bodies. It also includes built-up and scrub land. The ground truth survey revealed that the major crops cultivated in the region are rice and cotton. The other crop includes maize, sorghum, pulses, groundnut, green gram, red gram, bajra, and Bengal gram.

Table 3.22 Land use and Land cover data of study area

Sl. No.	LULC Types	Area (Sq. m.)	Area (Sq. Km)	Area (ha)	Percentage (%)
1	Built-up	265166743.3	265.17	26517	2.10
2	Agriculture Plantation	23153908.01	23.15	2315	0.18
3	Crop Land	9814032977	9814.03	981403	77.62
4	Forest	1564881858	1564.88	156488	12.38
5	Land With & Without Scrub	48974943.93	48.97	4897	0.39
6	Scrub Forest	240607441.3	240.61	24061	1.90
7	Water bodies	687673385.1	687.67	68767	5.44
	Total	**12644491257**	**12644.49**	**1264449**	**100.00**

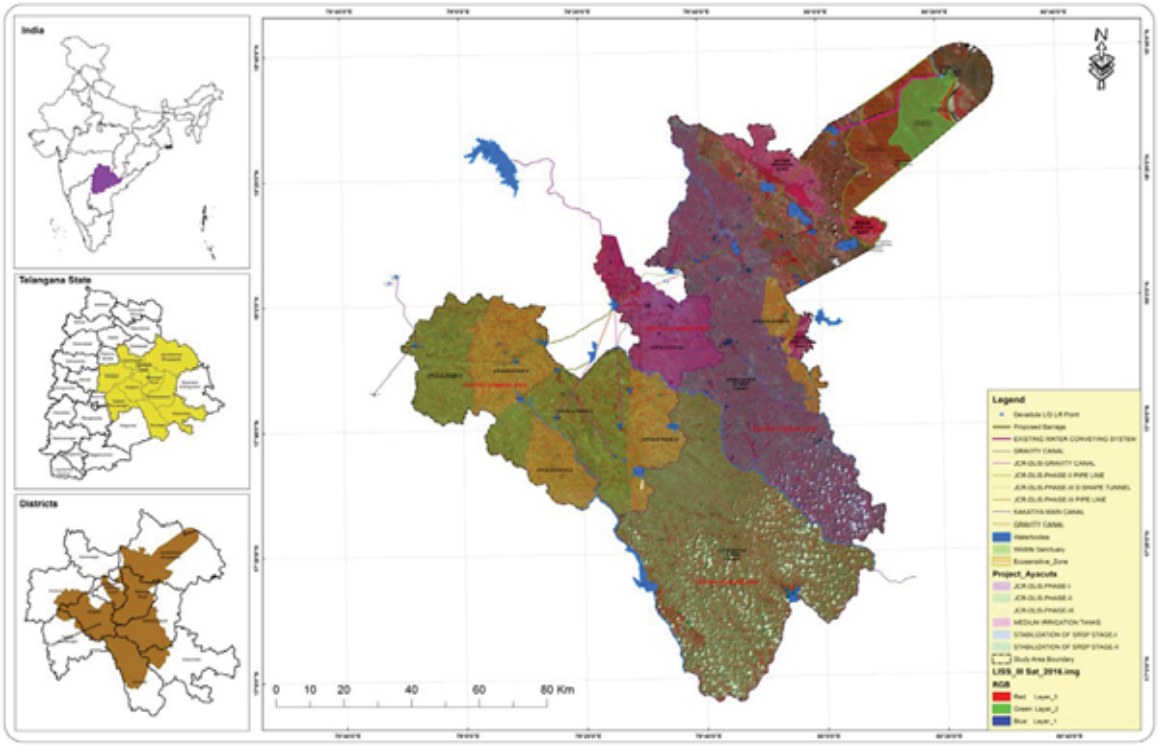


Fig 3.18 Satellite image showing the proposed barrage and command area

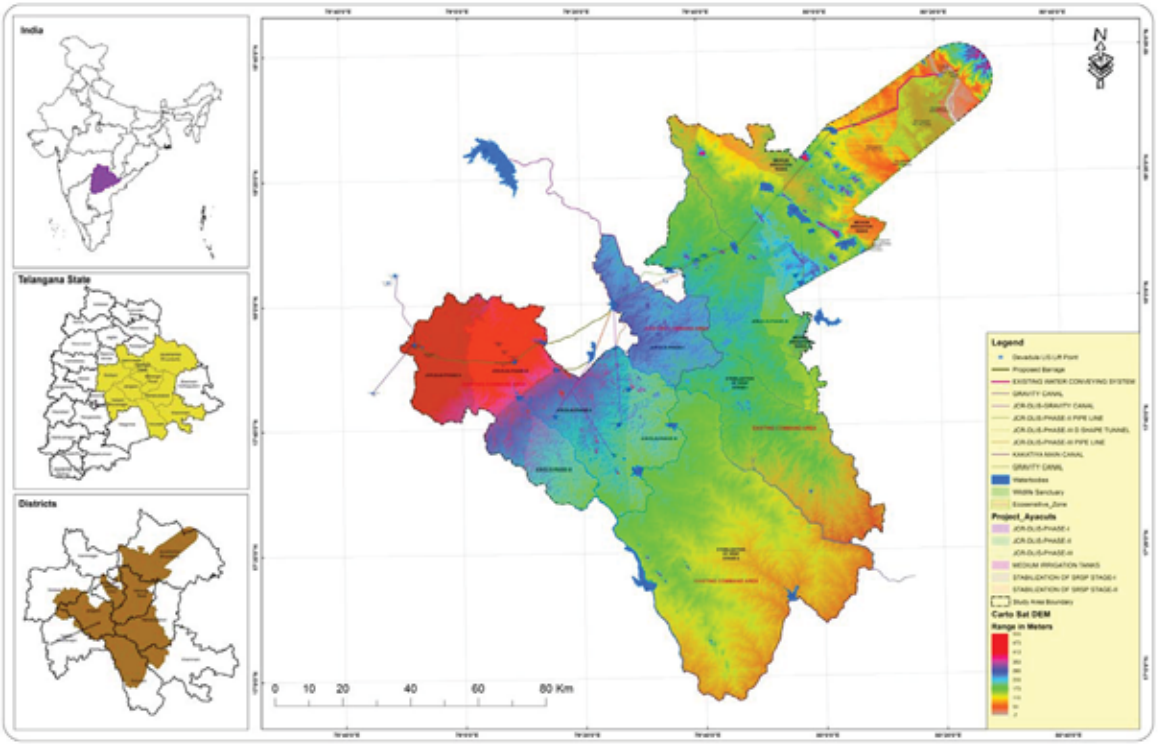


Fig 3.19 DEM map showing the proposed barrage and command area

Agricultural field with teak and paddy 17°54'46.47"N, 79°39'6.06"E	Cotton field 18° 5'19.71"N, 79°45'39.95"E
Eucalyptus Plantation 17°41'49.64"N, 79° 9'13.98"E	Raghunathpally RF 17°46'37.04"N, 79°16'22.71"E
Paddy field 17°33'14.42"N, 79°42'38.17"E	Pedda cheruvu 17°40'20.83"N, 79°45'47.47"E

3.3.3.3 Soil type and Erosion classification

The slope varies from nearly level to moderate slope and soil erosion varies from slight to moderate. The major soil types are Vertisols followed by Inceptisols. Soils are classified as residual, transported or organic, depending upon their origin.

Table 3.23 Soil types of study area

Sl. No.	Soil Types	Area (Sq.m.)	Area (Sq. Km.)	Area in ha	Percentage (%)
1	Entisols Soil	963062274.9	963.0622749	96306.23	7.62
2	Inceptisols Soil	4870956052	4870.956052	487095.61	38.52
3	Mollisols Soil	144228167.8	144.2281678	14422.82	1.14
4	Rockoutcrop	188377011.2	188.3770112	18837.70	1.49
5	Vertisols Soil	6403429359	6403.429359	640342.94	50.64
6	Water body	74322179.3	74.3221793	7432.22	0.59
	Total	**12644375044**	**12644.37504**	**1264437.50**	**100**

On the basis of composition and physical characteristics, soil can be designated as clayey, loamy, silty, sandy, gravelly or combinations thereof. Broadly, they are called fine-texture, medium-textured or coarse-textured. Soils have characteristic hydrological properties, namely soil permeability and porosity, which govern the surface run-off vis-à-vis subsurface infiltration. Soils can be grouped as poorly drained, moderately drained, well drained and excessively drained. The coarse-textured soils, owing to their larger grain size, are invariably better drained than the fine-textured soils, in which infiltration of water is inhibited. Various soil types abound, including chalkas, red sandy soils, deep red loamy soils and very deep black cotton soils. The soil texture varied from sandy loam to sandy clay loam to clay loam in surface horizons and sandy clay loam to clay loam to clay in sub-surface horizons.

3.3.3.4 Drainage and Watershed

The collective pattern of streams and their course constitutes drainage pattern. Factors like slope, geological features, and topography are reflected in the drainage patterns of an area. The proposed command area constitutes dendrite pattern of drainage system covering part of Warangal urban & rural, Jangaon, Mahaboobabad, Khammam, Serape, Siddipet, Karimnagar and Jayashankar Bhupalapally districts of Telangana.

Drainage density is dependent on factors like relief, rainfall intensity, and infiltration capacity of the soil and vegetation cover. High drainage density is observed in parts of Jangaon and Mahabubabad, Khammam district, because of more undulations. Drainage system of the study area falls under Godavari basin.

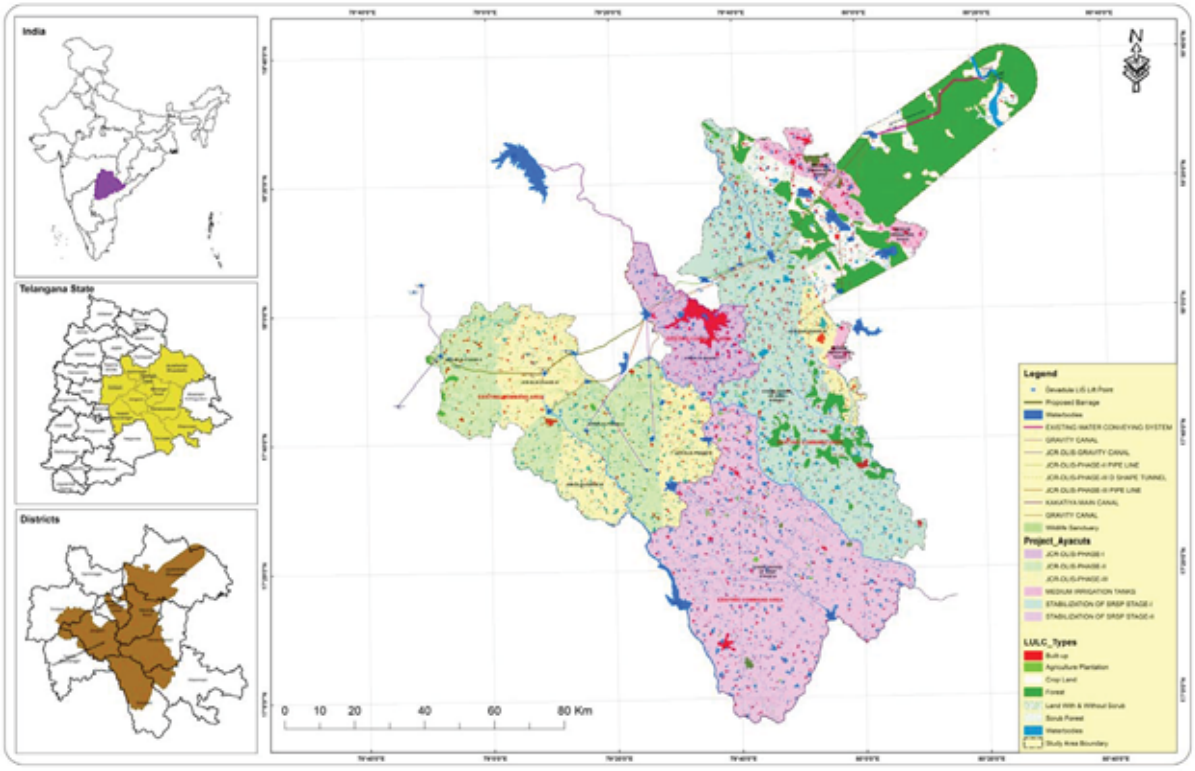


Fig 3.20 Land use/ Land cover map of study area

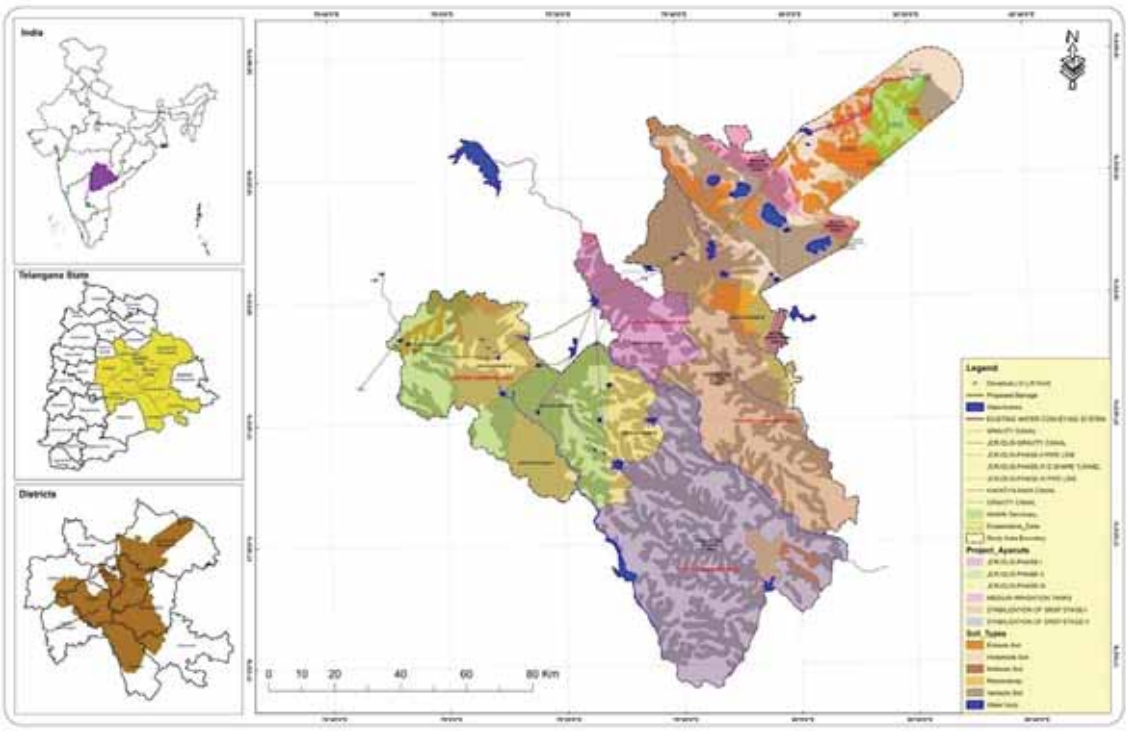


Fig 3.21 Soil types in the study area

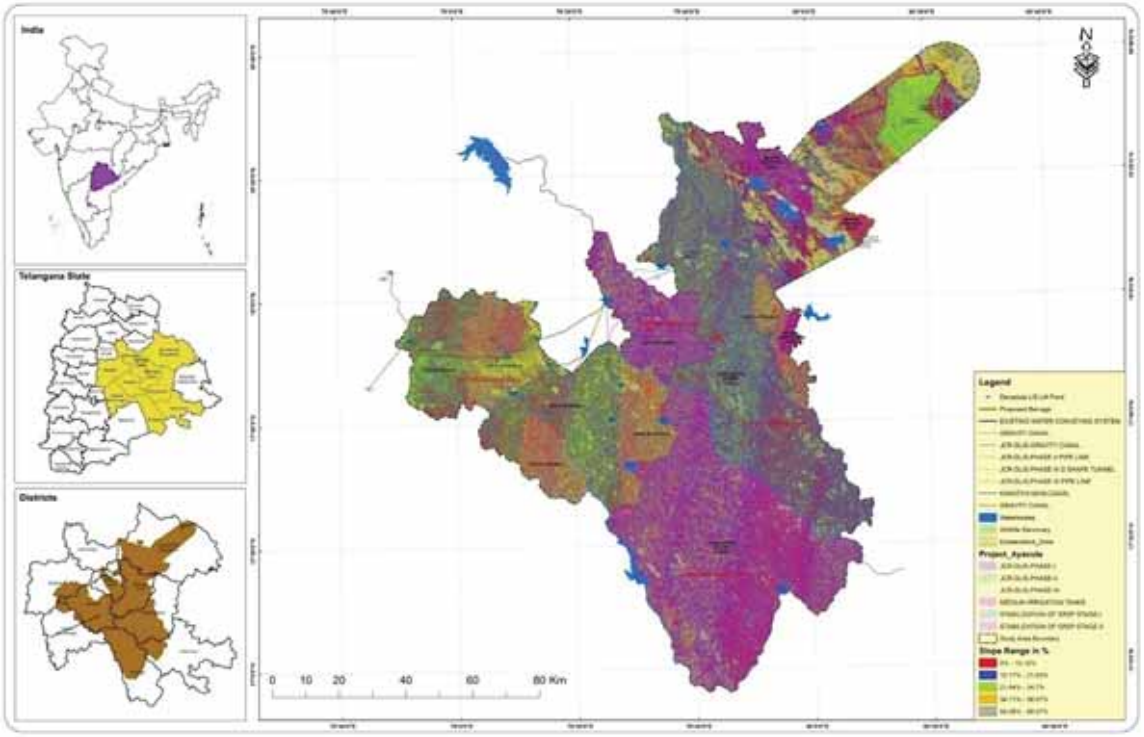


Fig 3.22 Slope map of the study area

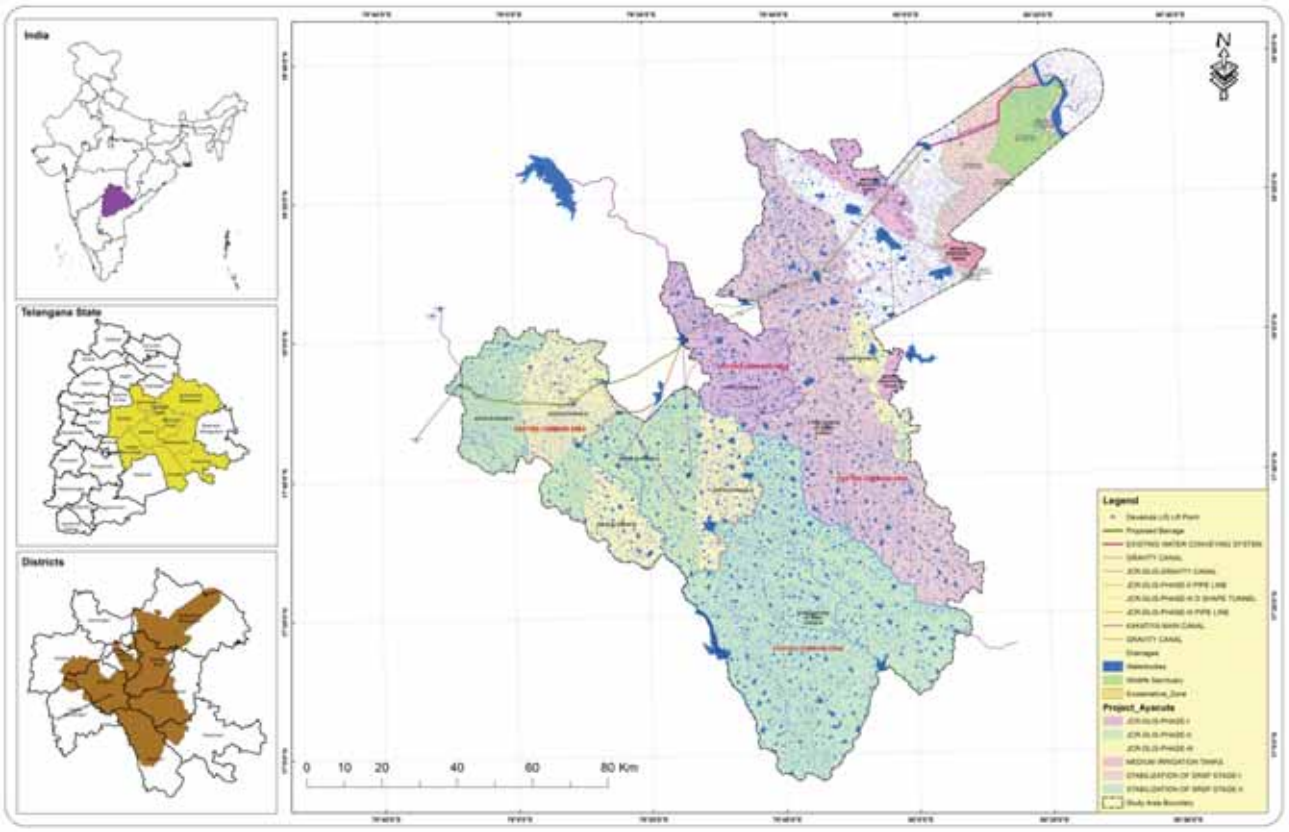


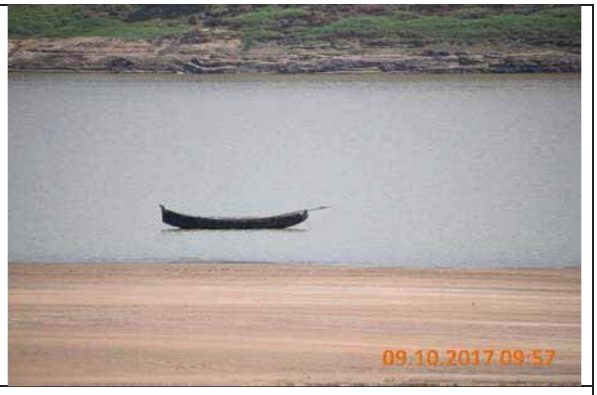
Fig 3.23 Drainage map in the study area

3.4 Biological Environment

3.4.1 Description of Project Site & Study Area

A. Project area (Near proposed barrage)	
Location of the proposed barrage	Thupakulagudem Village, Eturnagaram Mandal, Jayashankar Bhupalapally District, Telangana
Rivers and streams	River Godavari
Length of barrage	1132 m
Protected areas and ecologically sensitive areas within 10 km radius from the project site	Eturnagaram Wildlife Sanctuary - < 5 Km from the proposed barrage
Soil type	Alluvial soil
Submergence land (River portion)	580.18 ha
Existing plant species available within the project site	*Tectona grandis* L.f., *Terminalia alata* Heyne ex Roth*, Barringtonia acutangula* (L.) Gaertn.*, Pterocarpus indicus* Willd., *Tamarindus indicus* L.*, Ficus racemosa* L.*, Ficus hispida* L. fil., etc.
B. Command area	
Command Area	2,51,310 ha - Existing J. Chokka Rao Devadula LIS 3,04,000 ha - Existing Sriram Sagar Project (Stage I & II)
Districts benefitted	Jayashankar Bhupalapally, Nalgonda, Warangal (Rural & Urban) and Khammam
Climate & Rainfall	Central and Southern Telangana zone, hot and dry climate with an average annual rainfall ranges from 751 mm to 1061 mm
Soil type	Chalakas, Dubbas, Black soils, Red soils, Alkaline soils, alluvial soils
Vegetation in the command area	*Terminalia arjuna* (Roxb.) Wight & Arn., *Terminalia tomentosa* (Roxb.) Wight & Arn., *Tectona grandis* L.f., *Butea monosperma* (Lam.) Taub., *Wrightia tinctoria, Cassia renigera, Azadirachta indica, Choloroxylon swietenia,* etc.
Reserve Forest within the study area	5 Reserved Forests and 1 Protected Forest; • Annaram RF • Nuguru RF • Perur RF • Nagaram RF • Bangoranikonta RF • Marimalli PF
Rivers and streams	River Godavari

The proposed scheme involves construction of a barrage at Thupakulagudem on River Godavari for stabilizing and providing irrigation facilities to existing 5,55,310 ha of command area belonging to J. Chokka Rao Devadula LIS (2,51,310 ha) and Sriram Sagar Project - Stage I & II (3,04,000 ha). The command area is already benefitted by the existing irrigation facilities for the Khariff and bi-seasonal crops and the proposed scheme facilitates irrigation only during Rabi season. Therefore, there shall be no impact on floral and faunal aspects present in the command area. Since, the construction of the barrage is the only new component in the proposed scheme which involves submergence of 580.18 ha of river bed area, Ecology and biodiversity studies along the upstream and downstream areas of the river Godavari highlights the impact on flora and fauna. However, in order to understand the biodiversity aspects of the study area sampling locations within the command area has also been considered for the study along with the submergence areas along River Godavari near the proposed barrage.

	
Location of the proposed barrage 18°35'10.77"N, 80°23'34.08"E	River Godavari 18°35'51.49"N, 80°23'5.76"E
Bommakur tank 17°50'46.69"N, 79° 9'2.82"E	Command area (Nagaram) 18°13'13.89"N, 79°42'1.86"E

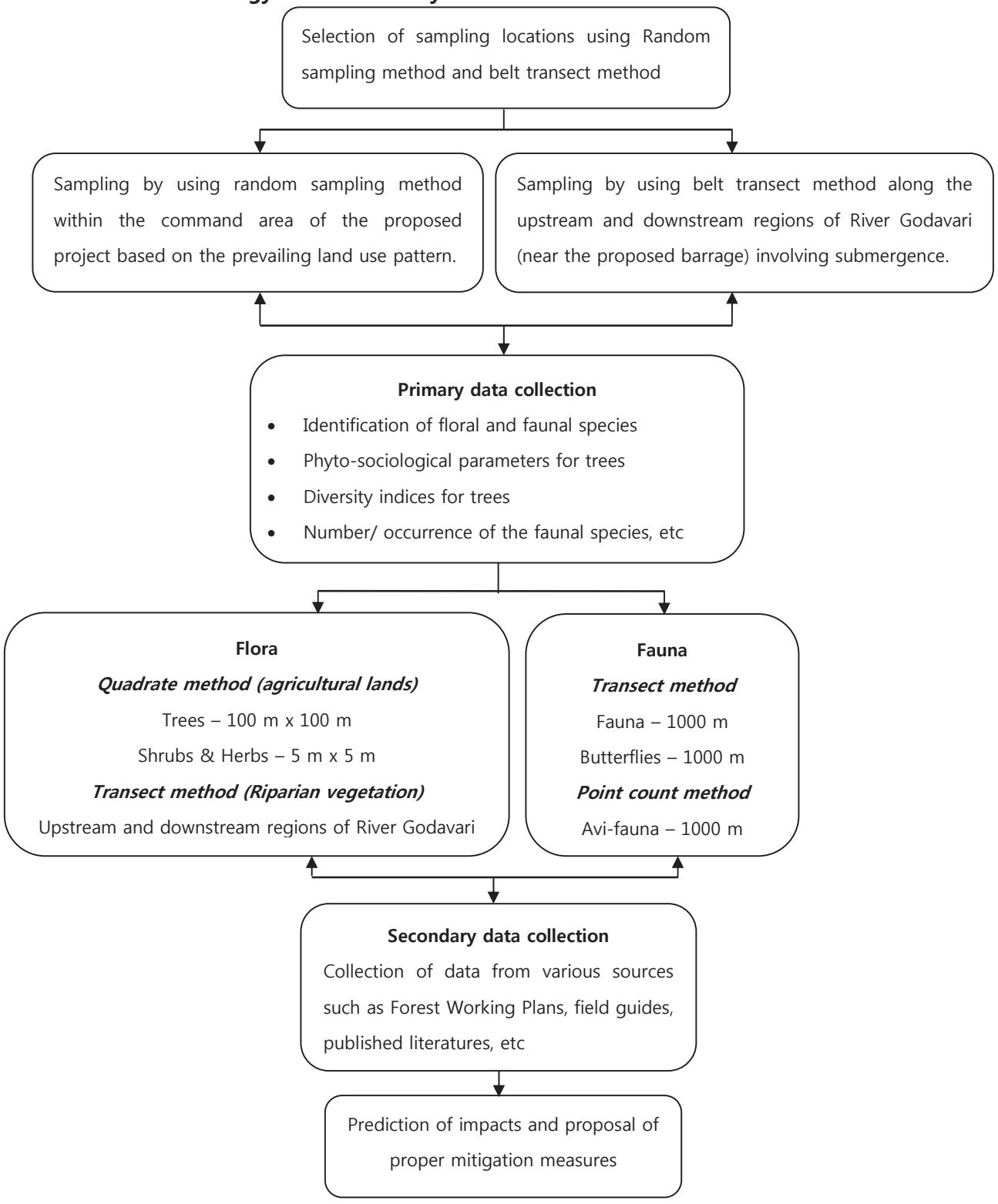
3.4.2 Eturnagaram Wildlife Sanctuary (WLS)

Eturnagaram WLS (80,600 ha) is located at the close proximity (< 5 Km) from the proposed barrage in Eturnagaram village in Bhupalapally district of Telangana. According to Champion and Seth classification (1968), the forest type in Eturnagaram WLS is Tropical Dry Deciduous Forest with unique climbers and dominant tree species such as Tectona grandis, *Terminalia arjuna, Bambusa vulgaris, Madhuca sp., Terminalia sp.* and *Pterocarpus marsupium*. A perennial river known as "Dayyam Vagu" divides the sanctuary into almost two parts. Major faunal attractions of this Sanctuary includes Tiger, Panther, Gaur, Sambar, Chital, Nilgiri Black buck and reptiles such as Mugger crocodiles, Cobra, Python and Krait.

The project is being proposed in the river bed/private lands only and therefore no requirement of forestland in Eturnagaram Wildlife Sanctuary. But during discussions held with PCCF (Wildlife), Govt of Telangana, it was mentioned that the project is touching the outer periphery/boundary of ESZ of Eturnagaram Wildlife Sanctuary. Based on the discussions and observations by State forest authorities necessary proposal/permission, if required, will be obtained from Competent Authority.

3.4.3 Approach and Methodology

3.4.3.1 Methodology for Biodiversity assessment



3.4.3.2 Primary data - Flora and Fauna (Three seasons baseline data collection)

Sl. No.	Habitat	Method	Size of the quadrate/ transect (m)	Number	Time and duration of sampling
Flora (Command area)					
1	Trees	Quadrate method (agricultural lands)	100 x 100	6	Monsoon season-September 2017, Post-monsoon season-December 2017 and Pre-monsoon season-March 2018
2	Shrubs		5 x 5	6	
3	Herbs and Grass		5 x 5	6	
Flora (Near proposed barrage)					
1	Trees	Transect method (riparian vegetation)	Upstream and downstream regions of River Godavari involving submergence	-	Monsoon season-September 2017, Post-monsoon season-December 2017 and Pre-monsoon season-March 2018
2	Shrubs				
3	Herbs and Grass				
Fauna					
1	Fauna	Transect method	1000	7	Monsoon season-September 2017, Post-monsoon season-December 2017 and Pre-monsoon season-March 2018
2	Butterflies	Transect method	1000	7	
3	Avi-fauna	Point count method	--	7	

3.4.3.3 Secondary data

Forest working plan of Warangal[41], Khammam[42] and Nalgonda[43] divisions, Botanical Survey of India[44], Zoological Survey of India[45], IUCN Red Data Book[46], Wildlife Schedules of Wildlife (Protection) Act, 1972[47], Book of Indian Birds[48], ENVIS[49], FRLHT[50], Butterflies of India[51], Reptiles of India[52], Andhra Pradesh Biodiversity Field Guide[53], Trees of Hyderabad[54], Handbook on Weed identification[55] and Common Dry land Trees of Karnataka[56] will be used for identification and validation of species. Identified species will be cross verified and confirmed with the Field Guides and TFD records. Consultation with local people and respective Forest Divisions will also be carried out during the site visit to understand the distribution and seasonality of herbs, shrubs, climbers and fauna in the region. The unidentified species will be photographed and the specimens will be collected and verified by using BSI, FRLHT, YETI, Digital flora of IISC data base and will be cross checked with experts.

[41] Working plan for Warangal District (1991-20001), K S Chander Rao, Vol 1. Telangana Forest Department.
[42] Working plan for the forests of Bhadrachalam(N) division, Khammam Circle (2003-2013), K Eswarchand, Vol 1&2. GoAP Forest Department.
[43] Working plan for the forests of Nalgonda Ditrict, (1994-2004), K Saradhi *et al.,*, Vol 1&2. GoAP Forest Department.
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[45] Zoological Survey of India, 1915. Handbook and Pictorial guides. DOI: http://faunaofindia.nic.in/php/hpg_books_list.php accessed on 12.11.2017
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[54] Prasanna P. V., Reddy C. M., Ramana M. V., & P. Venu, (2012). Trees of Hyderabad a pictorial Guide. Kolkata, West Bengal: Botanical Survey of India.
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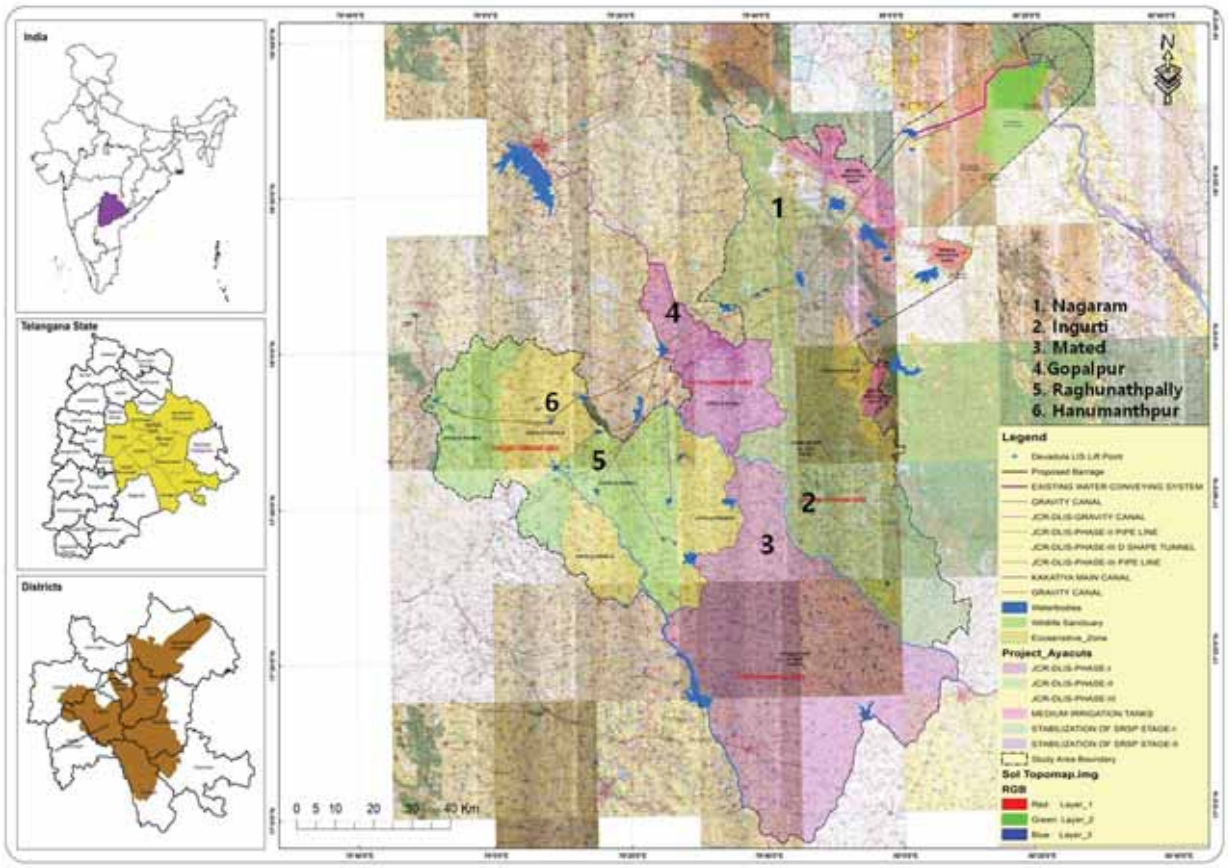

Fig 3.24 Command area map showing biological environment sampling locations

Fig 3.25 Map showing the upstream and downstream areas of River Godavari.

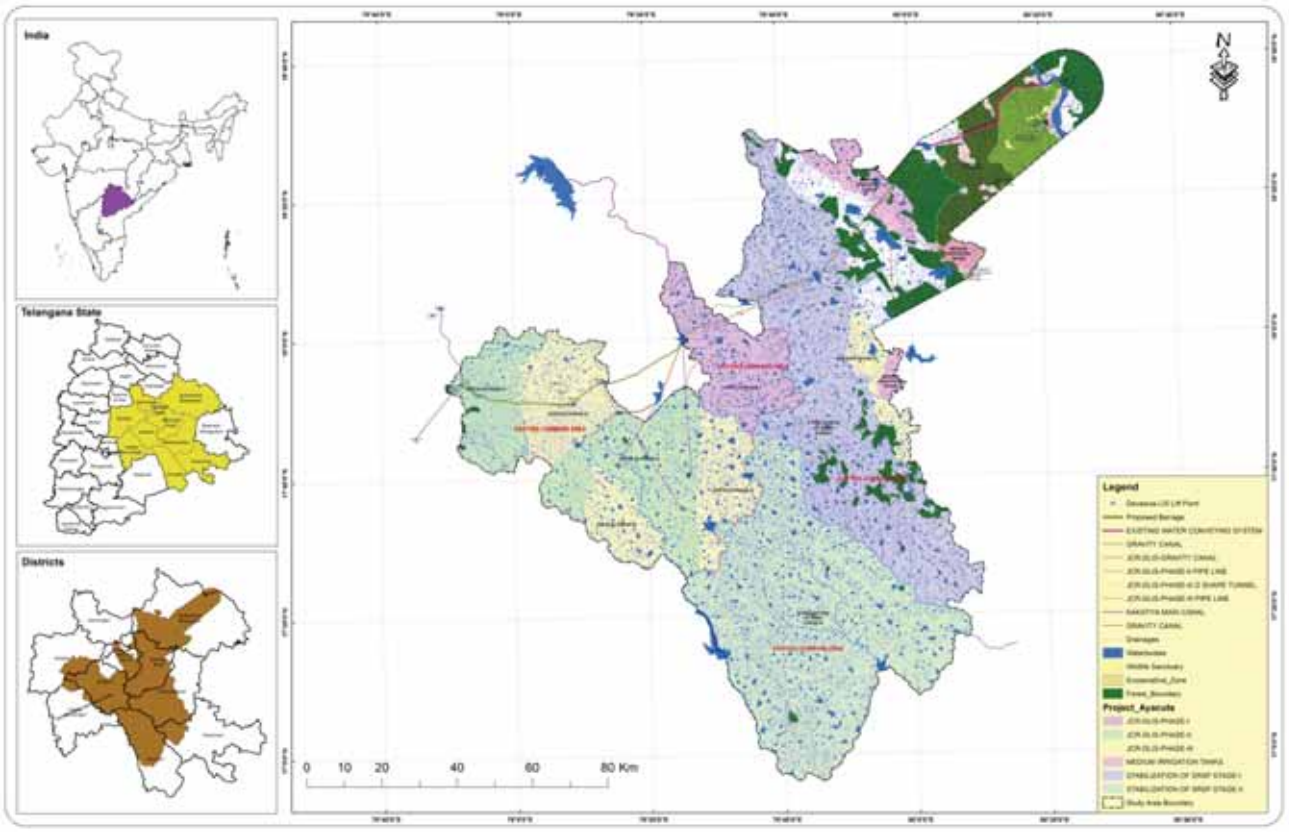

Fig 3.26 Map showing forest area and water bodies within the study area.

3.4.3.4 Details of sampling locations

Table 3.24 Details of the sampling locations

Sl. No	Sampling location	Geographical co-ordinates	Criteria for sampling
A. Command area (Random sampling- quadrate method)			
1	Nagaraam	18°13'16.40"N, 79°41'43.21"E	Tank and agricultural land
2	Gopalpur	18° 6'30.23"N, 79°24'27.77"E	Tank and agricultural land
3	Hanmanthapur	17°51'15.94"N, 79° 9'20.80"E	Bommakuru dam and agricultural land
4	Raghunathpally	17°45'47.43"N, 79°16'31.46"E	Reserve Forest surrounded by agricultural land
5	Ingurti	17°40'20.83"N, 79°45'47.47"E	Reserve Forest and agricultural land
6	Mated	17°32'41.23"N, 79°42'2.78"E	Tank and agricultural land
B. Upstream and downstream areas along River Godavari (Transect method)			
1	Proposed barrage	18° 35' 10" N, 80° 23' 36" E	Riparian areas along River Godavari

3.4.4 Results and Discussion

3.4.4.1 Near Proposed barrage

3.4.4.1.1 Flora

- Trees community

The proposed project involves construction of barrage near Thupakulagudem village of Eturnagaram Mandal in Jayashankar Bhupalapally District. Therefore, belt transect method of 10 m width was used to assess the riparian floral composition along River Godavari (Upstream and Downstream of both left bank and right bank) involving submergence, totally 4 transacts were laid on both the banks of River Godavari. A total of 39 tree species (n=352) belonging to 21 families and 29 genera were recorded at the riparian stretch of both the banks of River Godavari. Of which all are common to the region except *Pterocarpus indicus, Calophyllum inophyllum* and *Acacia nilotica which* are considered as vulnerable and least concern category respectively, as per IUCN Conservation status, 2018. *Acacia nilotica* (n=56) *Pterocarpus indicus* (n= 46), followed by *Ficus racemosa* (n=32) and *Terminalia alata* (n=23) are the predominant tree species recorded at the riparian stretch of Godavari River, near proposed barrage. The list of tree species, along with RET/ IUCN status of the recorded tree species and their phyto-sociological parameters are given as Annexure 18.

The importance value index is used to determine the overall importance of the each species in the community structure. *Pterocarpus indicus* is the most important species having an IVI of 46.48 followed by *Acacia nilotica* and *Tamarindus indicus* having IVI values of 31.55 and 23.37 respectively; *Terminalia arjuna* had the least IVI of 2.12. The IVI of dominant species is tabulated below.

Table 3.25 Importance Value Index of dominant tree species.

Sl.No	Scientific Name	IVI
1	*Pterocarpus indicus* Willd.	46.48
2	*Acacia nilotica* (L.) Willd. ex Delile	31.55
3	*Tamarindus indicus* L.	23.37
4	*Ficus racemosa* L.	22.54
5	*Terminalia alata* Heyne ex Roth	15.10
6	*Diospyros melanoxylon* Roxb.	11.25
7	*Tectona grandis* L.f.	11.21
8	*Ficus hispida* L.f.	11.10
9	*Boswellia serrata* Triana & Planch.	9.21
10	*Acacia leucocephala* (Lam.) Link	8.31

The dominant tree species *Pterocarpus indicus* contributed basal area of 2.44 m^2/ha followed by *Tamarindus indicus* and *Acacia nilotica* having basal area of 1.34 m^2/ha and 1.13 m^2/ha respectively. Out of Four sampled transects, *Ficus racemosa* and *Holoptelea integrifloia* are the species recorded in three transects, hence the frequency of these species is 75 %. In addition to this, diversity indices such as Shannon-Weiner diversity index and Simpson diversity index were estimated to be 2.99 and 0.93.

Table 3.26 Basal area of dominant tree species.

Sl.No	Scientific Name	Basal area (m^2/ha)
1	*Pterocarpus indicus* Willd.	2.44
2	*Tamarindus indicus* L.	1.34
3	*Acacia nilotica* (L.) Willd. ex Delile	1.13
4	*Ficus racemosa* L.	0.65
5	*Terminalia alata* Heyne ex Roth	0.55
6	*Pterospermum acerifolium* (L.) Willd.	0.24
7	*Acacia leucocephala* (Lam.)Link	0.20
8	*Boswellia serrata* Triana & Planch.	0.16
9	*Diospyros melanoxylon* Roxb.	0.13
10	*Ficus hispida* L.f.	0.12

As shown in the below table the maximum number of stems falls under 30-60 cm girth class (172 trees) which contribute to 48.86 % of the total population. The category of girth class in which the second most maximum number of stems fall in is 60-90 cm girth class (75 trees) which contributes to 21.31 % of the total individuals, followed by 90-120 cm girth class (40 trees) and 150-180 cm girth class (10 trees) contributing 11.36 % and 3.13 % respectively.

Table 3.27 Girth class distribution of trees near proposed barrage site.

Sl.No	Girth class	Number	Percentage (%)
1	0-30	11	3.13
2	30-60	172	48.86
3	60-90	75	21.31
4	90-120	40	11.36
5	120-150	6	1.70
6	150-180	11	3.13
7	180-210	7	1.99
8	210-240	9	2.56
9	240-270	10	2.84
10	270-300	9	2.56
11	300-330	2	0.57
	Total	**352**	**100**

Pterocarpus indicus Willd.
Upstream of River Godavari
18°36'9.06"N, 80°22'46.51"E

Xylia xylocarpa Roxb. Taub.
Upstream of River Godavari
18°36'9.97"N, 80°22'4.38"E

Ficus hispida L.f. Near the proposed barrage 18°35'7.37"N, 80°23'7.32"E	*Ficus racemosa* L. Downstream of River Godavari 18°34'5.43"N, 80°23'18.14"E
Tamarindus indicus L. Downstream of River Godavari 18°34'22.36"N, 80°23'19.01"E	*Hardwickia binata* Roxb. Downstream of River Godavari 18°33'40.66"N, 80°23'7.85"E
Mitragyna parvifolia (Roxb.) Korth Near the proposed barrage 18°35'7.37"N, 80°23'7.32"E	*Diospyros melanoxylon* Roxb. Upstream of River Godavari 18°36'9.97"N, 80°22'4.38"E

- Herbs, shrubs and climbers community

Monsoon (July 2017): During Monsoon, a total of 93 species of herbs, shrubs and climbers belonging to 34 families were recorded. Out of which, Family Asteraceae (n=15) and Poaceae (n=8) are the dominant families. About 76 herbs belonging to 29 families, 64 genera, 10

species of shrubs belonging to 9 families and 10 genera and 7 species of climbers belonging to 5 families and 7 genera were recorded during the inventory. As per IUCN conservation status, 2018; 13 species of herbs belongs to Least Concern category and no RET species were recorded.

Post-Monsoon (October 2017): During Post-Monsoon season, a total of 48 species of herbs, shrubs and climbers belonging to 25 families were recorded. Out of which, Poaceae (n=6) and Fabaceae (n=4) are the dominant families. About 34 species of herbs belonging to 19 families and 34 genera, 10 species of shrubs belonging to 9 families and 10 genera and 4 species of climbers belonging to 4 families and 4 genera were recorded during the inventory. As per IUCN conservation status, 2018; 7 species of herbs belongs to Least Concern category and no RET species were recorded. During post monsoon season, species such as *Xanthium strumarium, Borreria hispida, Boerhavia diffusa* and *Sida acuta* were found to be desiccated due to loss of moisture content.

Pre-Monsoon (January 2018): During Pre-Monsoon season, a total of 77 species of herbs, shrubs and climbers belonging to 26 families were recorded. Out of which, Asteraceae and Poaceae are the dominant families having n=13 and n= 10 species respectively. About 62 species of herbs belonging to 22 families and 54 genera, 10 Species of shrubs belonging to 9 families and 10 genera and 5 species of climbers belonging to 3 families and 5 genera were recorded during the inventory. 14 species of herbs belongs to Least Concern category as per IUCN conservation status, 2018 and no RET species were recorded. *Hemidesmus indicus* and *Pergularia daemia* are the two important medicinal climbers identified all along the riparian stretches. *Chrozophora rottileri, Chamaecrista pratensis* and *Vernonia cinerea* are the dominant herbs emerged all along the riparian stretch during Pre-Monsoon.

Table 3.28 Family-wise number of species recorded near proposed barrage site.

Sl.No.	Family	Number			Total
		Monsoon	Post Monsoon	Pre Monsoon	
1	Acanthaceae	2	-	1	3
2	Aizoaceae	1	1	1	3
3	Amaranthaceae	5	3	5	13
4	Apocynaceae	1	1	1	3
5	Asclepiadaceae	2	1	2	5
6	Asteraceae	15	3	13	31
7	Boraginaceae	1	-	-	1
8	Caesalpiniaceae	4	2	4	10
9	Cleomaceae	2	-	1	3
10	Commelinaceae	1	1	-	2
11	Convolvulaceae	4	2	2	8
12	Cucurbitaceae	3	1	2	6
13	Cyperaceae	1	1	1	3
14	Euphorbiaceae	6	3	5	14
15	Fabaceae	6	4	8	18
16	Hypericaceae	1	-	1	2
17	Lamiaceae	4	2	3	9
18	Lythraceae	2	1	2	5
19	Malvaceae	3	3	1	7
20	Molluginaceae	1	-	-	1
21	Nyctaginaceae	1	1	-	2
22	Papaveraceae	1	1	-	2
23	Phyllanthaceae	1	-	1	2
24	Plumbaginaceae	1	1	-	2
25	Poaceae	8	6	10	24
26	Rhamnaceae	2	2	2	6
27	Rubiaceae	4	2	2	8
28	Sapinadaceae	1	-	-	1
29	Scrophulariaceae	2	-	2	4
30	Solanaceae	1	2	2	5
31	Stirculiaceae	1	1	-	2
32	Tiliaceae	3	2	2	7
33	Verbenaceae	1	1	2	4

Sl.No.	Family	Number			Total
		Monsoon	Post Monsoon	Pre Monsoon	
34	Zygophyllaceae	1	-	1	2
Total		**93**	**48**	**77**	**218**

Chromolaena odorata (L.) R.M.King & H.Rob.
Downstream of River Godavari
18°34'5.43"N, 80°23'18.14"E

Argemone Mexicana L.
Upstream of River Godavari
18°36'9.06"N, 80°22'46.51"E

Solanum xanthocarpum Schrader & Wendland
Upstream of River Godavari
18°36'9.06"N, 80°22'46.51"E

Citrullus colocynthis (L.) Schrader
Downstream of River Godavari
18°34'5.43"N, 80°23'18.14"E

Heliotropium indicum L.
Downstream of River Godavari
18°34'5.43"N, 80°23'18.14"E

Chrozophora rottleri (Geiseler) Spreng.
Upstream of River Godavari
18°36'9.06"N, 80°22'46.51"E

Physalis minima L. Upstream of River Godavari 18°36'9.06"N, 80°22'46.51"E	*Sphaeranthus indicus* Gaertn. Upstream of River Godavari 18°36'9.06"N, 80°22'46.51"E

3.4.4.1.2 Fauna

Eturnagaram Wildlife Sanctuary is a well renowned eco-sensitive area and wildlife habitat located at a distance of < 5 Km to the proposed Thupakulagudem barrage. The command area of the proposed project is well irrigated with healthy vegetation and fresh water tanks supporting various faunal and avifaunal species.

Monsoon season (July 2017): A total of 29 avifaunal species (n=111) was recorded during monsoon season. Pied bush chat (n=29), Blue tailed bee-eater (n=18), Black headed cuckoo shrike (n=15) and Purple rumped sunbird (n=6) were the predominant avifaunal species recorded during the study. Black tailed godwit (n=1) and Jerdon's courser (n=1) are the species belongs to near threatened and critically endangered category as per IUCN conservation status, 2017 and Common Buzzard (n=1), Indian peafowl (n=1) and Jerdon's courser (n=1) are the avifaunal species belonging to Schedule I of Wildlife (Protection) Act, 1972. All other species are common to region.

A total of 46 butterfly species (n=234) were recorded during the study and Plain tiger (n=38), Cabbage white (n=26) and Blue tiger (n=26) were the predominant butterfly species recorded. As per IUCN conservation status, 2018; Euploea core (n=18), Eurema brigitta (n=1) and Pontia daplidicea (n=1) belongs to Least Concern category. Common Pierrot (n=1), Chocolate albatross (n=2), Common gem (n=5) and Common gull (n=1), Great black vein (n=1), Malabar blue (n=1), Common crow (n=18) and Striped blue crow (n=1) belongs to Schedule I, II and IV of Wildlife (Protection) Act, 1972 respectively.

Post Monsoon season (October 2017): A total of 29 avifaunal species (n=172) were recorded during post-monsoon season. Of which Blue-breasted flycatcher (n=39) and Red wattled lapwing (n=23) is the predominant avifaunal species recorded during the study. Blue-breasted flycatcher (n=39) is the only avifaunal species belonging to Near threatened category and rest of the species belongs to Least Concern category of IUCN Conservation status, 2018 and all

the species belongs to Schedule IV of Wildlife (Protection) Act, 1972. No RET species were recorded during the study.

A total of 30 butterfly species (n=203) were recorded during post-monsoon season. Common leopard (n=39), Striped tiger (n=19) and Common jezebel (n=15) were the predominant butterfly species recorded. Common Pierrot (n=2), Malabar blue (n=1) and Common crow (n=7) belongs to Schedule I, II and IV of Wildlife (Protection) Act, 1972 respectively. Small grass yellow (n=1), Yellow pansy (n=3) and Common crow (n=7) belongs to Least Concern category of IUCN Conservation status, 2018. Rest of the species are common to the region.

Pre Monsoon season (January 2018): A total of 61 avifaunal species (n=309) were recorded during pre-monsoon season. Out of which; Intermediate egret (n=54) and House sparrow (n=27) and Tufted pochard (n=25) are the predominantly recorded species near the Barrage site. Black necked stork (n=1) Black tailed godwit (n=2), Darter Oriental (n=1), Finn's weaver (n=1), Indian skimmer (n=3) and Purple wood pigeon (n=2) are belongs to Near threatened and Vulnerable category as per IUCN status 2018, and remaining are least concern. Indian peafowl (n=4) Jerdon's courser (n=1) and Shikra (n=2) are the species belonging to Schedule I of Wildlife (Protection) Act, 1972.

A total of 34 butterfly species (n=213) were recorded during pre-monsoon season. Out of which; Cabbage white (n=32) and Lime (n=27) and Spicebush Swallowtail (n=20) are the predominantly recorded species near the Barrage site. Common crow (n=3) and Yellow pansy (n=4) belongs to least concern category as per IUCN status 2018, and remaining are common. Chocolate albatross (n=1) Common gem (n=7), Common gull (n=2), and Common yellow swallowtail (n=2) are the species belonging to Schedule II of Wildlife (Protection) Act, 1972.

White Browed Wagtail Upstream of River Godavari 18°35'26.28"N, 80°20'58.09"E	Common Buzzard Upstream of River Godavari 18°35'34.15"N, 80°23'12.01"E

Pond Heron Upstream of River Godavari 18°35'36.22"N, 80°23'20.46"E	Small Pratincole Upstream of River Godavari 18°35'34.15"N, 80°23'12.01"E
Indian Robin Upstream of River Godavari 18°35'26.28"N, 80°20'58.09"E	Little ringed plover Upstream of River Godavari 18°35'29.61"N, 80°23'25.52"E
Mountain imperial pigeon Upstream of River Godavari 18°36'8.12"N, 80°22'26.90"E	Spotted Owlet Upstream of River Godavari 18°36'4.63"N, 80°21'54.07"E

Table 3.29 Family-wise occurrence (%) of avifaunal species recorded near propose barrage.

Sl.No	Family	Occurrences (%)
1	Accipitridae (Eagles and kites)	1.18
2	Alcedinidae (Kingfishers)	0.68
3	Anatidae (Ducks, Geese and Swans)	4.22
4	Anhingidae (Darters and Snakebirds)	0.17
5	Apodidae (swifts)	17.74
6	Campephagidae (Minivets)	4.05
7	Charadriidae (Plovers and lapwings)	5.57
8	Ciconiidae (Storks)	0.68
9	Cisticolidae (Prinias and tailor birds)	0.34
10	Columbidae (Pigeons and doves)	4.39
11	Coraciidae (rollers)	0.17
12	Corvidae (Crows, Ravens, Rooks, Jackdaws, Jays, Magpies and Treepies)	1.18
13	Cuculidae (Cuckoo, Koels, Malkohas and Coucals)	2.87
14	Dicruridae (Drongos)	1.86
15	Estrildidae (Munias)	0.68
16	Glareolidae (Pratincoles and coursers)	0.51
17	Gruidae (Cranes)	1.01
18	Hirundinidae (Swallows and Martins)	1.01
19	Laniidae (Shrikes)	1.01
20	Laridae (Gulls, Terns and Skimmers)	0.68
21	Leiothrichidae (Laughingthrushes)	1.52
22	Megalaimidae (Asian barbets)	0.17
23	Meropidae (Bee-eaters)	8.45
24	Motacillidae (Wagtails and pipits)	5.41
25	Muscicapidae (Robins, Flycatchers, Bluethroats, Bush Chats, Stonechats)	13.51
26	Nectariniidae (Sunbirds)	4.90
27	Parulidae (Warblers)	0.34
28	Passeridae (Sparrows)	4.90
29	Pelecanidae (Pelicans)	0.51
30	Phalacrocoracidae (Cormorants)	1.52
31	Phasianidae (Pheasants, Partridges, Jungle fowls, Chickens, Quails and Peafowls)	1.18
32	Phoenicopteridae (Flamingos)	0.84
33	Ploceidae (weavers or weaverbirds)	1.52
34	Podicipedidae (Grebe)	0.34
35	Psittacidae (Parakeets)	1.01
36	Pycnonotidae (Bulbuls)	1.18

Sl.No	Family	Occurrences (%)
37	Recurvirostridae (Stilts)	0.17
38	Rhipiduridae (Fantails)	0.17
39	Scolopacida (Sandpipers)	0.84
40	Strigidae (Owls)	0.17
41	Sturnidae (Starlings)	0.68
42	Tephrodornithidae (Woodshrikes)	0.34
43	Threskiornithidae (Ibises)	0.34
Total		**100.00**

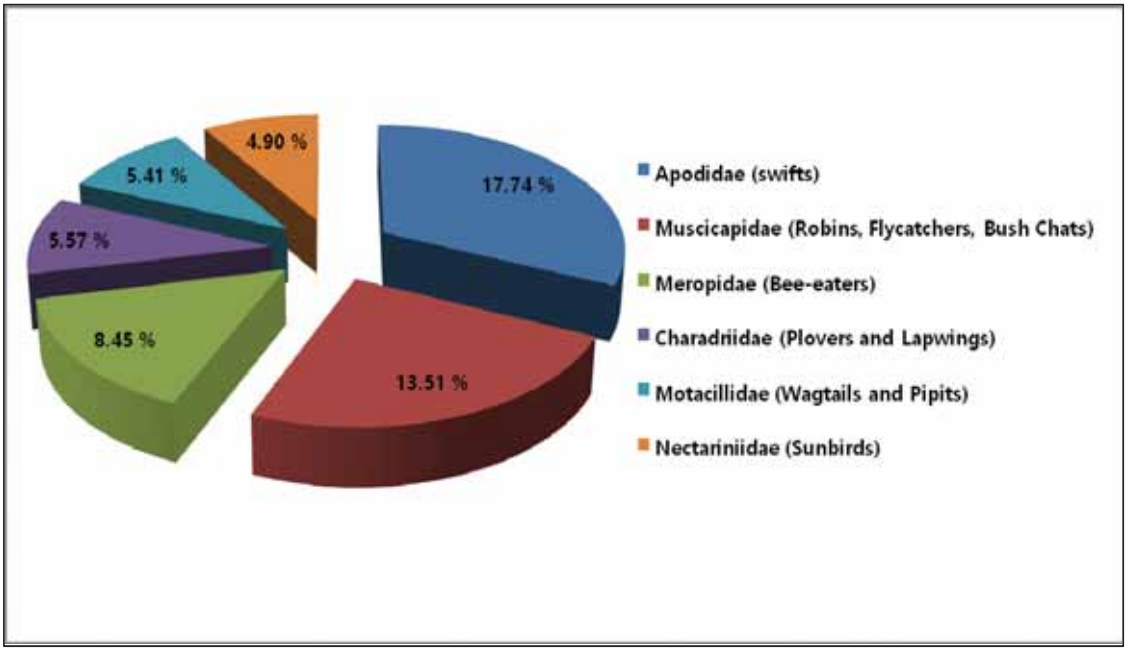

Fig 3.27 Graph showing predominant avifaunal species recorded during the study.

Grass Yellow Upstream of River Godavari 18°35'41.74"N, 80°22'42.72"E	Lemon Pansy Upstream of River Godavari 18°35'41.74"N, 80°22'42.72"E
Tawny coster Upstream of River Godavari 18°36'9.66"N, 80°22'42.48"E	Mottled Emigrant Upstream of River Godavari 18°36'9.56"N, 80°22'44.48"E
Cabbage White Downstream of River Godavari 18°34'4.86"N, 80°23'18.02"E	Common Crow Downstream of River Godavari 18°34'4.86"N, 80°23'18.02"E

Common Leopard Upstream of River Godavari 18°36'9.66"N, 80°22'42.48"E	Crimson Rose Upstream of River Godavari 18°36'9.66"N, 80°22'42.48"E
Striped Tiger Downstream of River Godavari 18°34'4.86"N, 80°23'18.02"E	Blue Tiger Downstream of River Godavari 18°34'4.86"N, 80°23'18.02"E
Plain Tiger Downstream of River Godavari 18°34'4.86"N, 80°23'18.02"E	Lime Butterfly Near the proposed barrage 18°35'8.86"N, 80°23'17.14"E

3.4.4.2 Command area

3.4.4.2.1 Flora

- Tree community

The command area of the existing project includes the well irrigated lands of J. Chokka Rao Devadula LIS and Sriram Sagar Project - Stage I & II. The existing command area is facilitated with a number of good water tanks providing irrigation involving Khariff and bi-seasonal crops. About 26 tree species (n=148) belonging to 14 families were recorded in the command area. *Azadirachta indica* (n=59) followed by *Tectona grandis* (n=20) and *Butea monosperma* (n=14) were the predominant tree species recorded in the command area. All the tree species recorded were common to the region. The list of tree species along with their use is given as Annexure 18.

Phyto-sociological features such as relative frequency, relative density, dominance and IVI of the identified tree species were studied. *Azadirachta indica* (IVI-97.05) is the most widespread species in the Command area followed by *Butea monosperma* (IVI-34.04), *Borassus flabellifer* (IVI-30.91) and *Tectona grandis* (IVI-20.72).

Basal area of the recorded tree species greater than 0.10 cm^2 was studied. Of which, *Azadirachta indica* (3.97 cm^2) had the highest Basal area followed by *Borassus flabellifer* (1.44 cm^2), *Butea monosperma* (1.22 cm^2) and *Acacia nilotica* (0.49 cm^2) indicating the dominant species with greater tree biomass. In addition to this, diversity indices such as Shannon-Weiner diversity index and Simpson diversity index were estimated to be 2.30 and 0.80.

As shown in the below table, the maximum number of stems falls under the girth class of 30.1 to 60 cm (53 trees) which contributes to 35.81 % of the total individuals followed by the girth class of 60.1 to 90 cm (31 trees) which contributes to 20.95% of the total individuals and girth class of 0.00 to 30 cm (22 trees) contributing to 14.86 % of the total individuals.

Table 3.30 Girth class Distribution of trees in the command area

Sl.No.	Girth class (cm)	Number (n)	Percentage (%)
1	0-30	22	14.86
2	30-60	53	35.81
3	60-90	31	20.95
4	90-120	19	12.84
5	120-150	13	8.78
6	150-180	9	6.08
7	180-210	1	0.68
	Total	**148**	**100**

Wrightia tinctoria Bommakur Tank 17°51'15.94"N, 79° 9'20.80"E	*Annona squamosa* L. Ghanpur tank 17°50'31.64"N, 79°21'6.93"E
Acacia nilotica (L.) Willd. ex Delile Nagaram 18°13'16.40"N, 79°41'43.21"E	*Borassus flabellifer* L. Near Raghunathpally RF 17°45'47.43"N, 79°16'31.46"E

- Herbs, Shrubs and Climbers community

Monsoon (July 2017): During Monsoon, a total of 106 species of herbs, shrubs and climbers belonging to 34 families were recorded. Out of which, Family Poaceae (n=26) and Fabaceae (n=10) are the dominant families. About 85 herbs belonging to 26 families, 13 species of shrubs belonging to 9 families and 10 species of climbers belonging to 5 families were recorded during the inventory. As per IUCN conservation status, 2018; 13 species of herbs belongs to Least Concern category and no RET species were recorded.

Post-Monsoon (October 2017): During Post-Monsoon season, a total of 77 species of herbs, shrubs and climbers belonging to 29 families were recorded. Out of which, Poaceae (n=15) and Fabaceae (n=9) are the dominant families. About 57 species of herbs belonging to 21 families, 13 species of shrubs belonging to 9 families and 9 species of climbers belonging to 4 families were recorded during the inventory. As per IUCN conservation status, 2018; 9 species

of herbs and 1 species of Climber belongs to Least Concern category and no RET species were recorded.

Pre-Monsoon (January 2018): During Pre-Monsoon season, a total of 91 species of herbs, shrubs and climbers belonging to 32 families were recorded. Out of which, Poaceae and Fabaceae are the dominant families having n=18 and n= 10 species respectively. About 69 species of herbs belonging to 25 families and, 13 Species of shrubs belonging to 9 families and 9 species of climbers belonging to 6 families were recorded during the inventory. 5 species of herbs and one species of Climber belongs to Least Concern category as per IUCN conservation status, 2018 and no RET species were recorded.

Table 3.31 Family-wise number of species recorded in Command area.

Sl.No.	Family	Number			Total
		Monsoon	Post Monsoon	Pre Monsoon	
1	Acanthaceae	1	-	-	1
2	Amaranthaceae	4	5	4	13
3	Annonaceae	1	1	1	3
4	Asclepidaceae	1	3	2	6
5	Asteraceae	7	5	8	20
6	Boraginaceae	-	1	1	2
7	Cannabaceae	1	-	1	2
8	Capparidaceae	2	2	2	6
9	Caryophyllaceae	1	1	1	3
10	Chenopodiaceae	1	1	1	3
11	Commelinaceae	3	2	3	8
12	Convolvulaceae	5	-	4	9
13	Cucurbitaceae	3	2	2	7
14	Cyperaceae	3	1	1	5
15	Euphorbiaceae	4	1	3	8
16	Fabaceae	10	9	10	29
17	Lamiaceae	2	3	2	7
18	Lilaceae	1	-	1	2
19	Malvaceae	11	10	9	30
20	Menispermaceae	1	-	1	2
21	Molluginaceae	1	1	-	2
22	Musaceae	1	1	1	3
23	Oxalidaceae	-	1	-	1
24	Passifloraceae	1	1	1	3

Sl.No.	Family	Number			Total
		Monsoon	Post Monsoon	Pre Monsoon	
25	Pedaliaceae	1	1	1	3
26	Phyllanthaceae	2	2	2	6
27	Poaceae	26	15	18	59
28	Primulaceae	1	1	1	3
29	Rubiaceae	2	1	2	5
30	Rutaceae	1	1	1	3
31	Sapindaceae	1	-	1	2
32	Scrophulariaceae	-	1	1	2
33	Solanaceae	2	1	2	5
34	Tiliaceae	2	1	-	3
35	Urticaceae	-	-	1	1
36	Verbenaceae	2	2	2	6
37	Zygophyllaceae	1	-	-	1
Total		**106**	**77**	**91**	**274**

Ipomea carnea Jace. Ghanpur tank 17°50'31.64"N, 79°21'6.93"E	*Calotropis gigantean* (L.) W. T. Aiton Bommakur Tank 17°51'15.94"N, 79° 9'20.80"E
Indoneesiella echioides (L.) Sreemadh. Near Raghunathpally RF 17°45'47.43"N, 79°16'31.46"E	*Ipomoea pes-tigridis* L. Near Raghunathpally RF 17°45'47.43"N, 79°16'31.46"E
Blainvillea acmella (L.) Philipson Near Raghunathpally RF 17°45'47.43"N, 79°16'31.46"E	*Digera arvensis* Forsk. Near Raghunathpally RF 17°45'47.43"N, 79°16'31.46"E

Hemidesmus indicus (L.) R. Br. Near Raghunathpally RF 17°45'47.43"N, 79°16'31.46"E	*Sesbania sesban* (L.)Merr. Near Raghunathpally RF 17°45'47.43"N, 79°16'31.46"E

3.4.4.2.2 Fauna

Monsoon season (July 2017): A total of 61 avifaunal species (n=309) was recorded during monsoon season. Intermediate egret (n=54), House sparrow (n=27), Tufted pochard (n=25) and White wagtail (n=15) were the predominant avifaunal species recorded during the study. Jerdon's courser (n=1), Black necked stork (n=1), Black tailed godwit (n=2), Darter Oriental (n=1), Finn's weaver (n=1) and Purple wood pigeon (n=2) are the species belongs to critically endangered and Near threatened category as per IUCN conservation status, 2018 and Common Buzzard (n=1), Indian peafowl (n=1), Shikra (n=2) and Jerdon's courser (n=1) are the avifaunal species belonging to Schedule I of Wildlife (Protection) Act, 1972. All other species are common to region.

A total of 34 butterfly species (n=213) were recorded during the study and Cabbage butterfly (n=32), Spicebush Swallowtail (n=20) and Lime butterfly (n=27) were the predominant butterfly species recorded. As per IUCN conservation status, 2018; Common crow (n=3), and Yellow pansy (n=4) belongs to Least Concern category. Chocolate albatross (n=1), Common gem (n=7), Common gull (n=2) and Common yellow swallowtail (n=2) and Common crow (n=3) belongs to Schedule II and IV of Wildlife (Protection) Act, 1972 respectively.

Post Monsoon season (October 2017): A total of 29 avifaunal species (n=124) were recorded during post-monsoon season. Of which little cormorant (n=19) and House Swift (n=18) is the predominant avifaunal species recorded during the study. All the species belongs to Least Concern category of IUCN Conservation status, 2018 and all the species belongs to Schedule IV of Wildlife (Protection) Act, 1972. No RET species were recorded during the study.

A total of 20 butterfly species (n=71) were recorded during post-monsoon season. House Swift (n=12), Yellow pansy (n=11) and Common sailor (n=7) were the predominant butterfly species recorded. Common crow (n=1) belongs to Schedule IV of Wildlife (Protection) Act, 1972.

Common crow (n=1) and Yellow pansy (n=11) belongs to Least Concern category of IUCN Conservation status, 2018. Rest of the species are common to the region.

Pre Monsoon season (January 2018): A total of 60 avifaunal species (n=180) were recorded during pre-monsoon season. Out of which; Intermediate egret (n=38) and House sparrow (n=30) and Tufted pochard (n=22) are the predominantly recorded species near the Barrage site. Jerdon's courser (n=1), Black necked stork (n=1), Black tailed godwit (n=2), Darter Oriental (n=1), Finn's weaver (n=1) and Purple wood pigeon (n=2) are belongs to near threatened and Vulnerable category as per IUCN status 2018, and remaining are least concern. Indian peafowl (n=4) Jerdon's courser (n=1) and Shikra (n=2) are the species belonging to Schedule I of Wildlife (Protection) Act, 1972.

A total of 34 butterfly species (n=171) were recorded during pre-monsoon season. Out of which; Cabbage white (n=24) and Spicebush Swallowtail (n=17) and Lime butterfly (n=15) are the predominantly recorded species in Command area. Common crow (n=3) and Yellow pansy (n=3) belongs to Least Concern category of IUCN Conservation status, 2018, and remaining are common. Chocolate albatross (n=1) Common gem (n=6), Common gull (n=2), and Common yellow swallowtail (n=2) and Common crow (n=3) are the species belonging to Schedule II and IV of Wildlife (Protection) Act, 1972 respectively.

White throated Kingfisher Pedda cheruvu 18°13'16.40"N, 79°41'43.21"E	Asian Open Billed Stork Gopalpur 18° 6'30.23"N, 79°24'27.77"E

Cattle Egret Gopalpur 18° 6'30.23"N, 79°24'27.77"E	Common Myna Gopalpur 18° 6'30.23"N, 79°24'27.77"E
Eurasian collared dove Ingurti 17°40'20.83"N, 79°45'47.47"E	Black drongo Gopalpur 18° 6'30.23"N, 79°24'27.77"E
Pied bushchat Gopalpur 18° 6'30.23"N, 79°24'27.77"E	Greater Egret Pedda cheruvu 18°13'16.40"N, 79°41'43.21"E

Table 3.32 Family-wise occurrence (%) of avifaunal species recorded in the command. area.

Sl.No.	Family	Occurrence (%)
1	Accipitridae (Eagles and kites)	0.56
2	Alaudidae (Larks)	0.56
3	Alcedinidae (Kingfishers)	0.70
4	Anatidae (Ducks, Geese and Swans)	6.56
5	Anhingidae (Darters and Snakebirds)	0.28
6	Apodidae (Swifts)	2.51
7	Ardeidae (Herons)	18.44
8	Campephagidae (Minivets)	1.40
9	Charadriidae (Plovers and lapwings)	2.51
10	Ciconiidae (Storks)	2.09
11	Cisticolidae (Prinias and tailor birds)	1.68
12	Columbidae (Pigeons and doves)	5.87
13	Corvidae (Crows, Ravens, Rooks, Jackdaws, Jays, Magpies and Treepies)	1.82
14	Cuculidae (Cuckoo, Koels, Malkohas and Coucals)	3.07
15	Dicruridae (Drongos)	2.51
16	Estrildidae (Munias)	1.12
17	Glareolidae (Pratincoles and coursers)	0.28
18	Gruidae (Cranes)	1.54
19	Laniidae (Shrikes)	1.54
20	Laridae (Gulls, Terns and Skimmers)	1.26
21	Leiothrichidae (Laughingthrushes)	2.23
22	Meropidae (Bee-eaters)	4.33
23	Motacillidae (Wagtails and pipits)	5.17
24	Muscicapidae (Robins, Flycatchers, Bluethroats, Bush Chats, Stonechats)	2.37
25	Nectariniidae (Sunbirds)	4.75
26	Paridae (Tits)	0.28
27	Parulidae (Warblers)	0.98
28	Passeridae (Sparrows)	7.96
29	Phalacrocoracidae (Cormorants)	3.91
30	Phasianidae (Pheasants, Partridges, Junglefowl, Chickens, Old World quail and Peafowl)	1.12
31	Phoenicopteridae (Flamingos)	1.40
32	Ploceidae (weavers or weaverbirds)	2.09
33	Podicipedidae (Grebe)	0.56
34	Psittacidae (Parakeets)	1.12
35	Pycnonotidae (Bulbuls)	0.84

Sl.No.	Family	Occurrence (%)
36	Recurvirostridae (Stilts)	0.56
37	Rhipiduridae (Fantails)	0.28
38	Scolopacida (Sandpipers)	0.84
39	Sturnidae (Starlings)	1.54
40	Tephrodornithidae (Woodshrikes)	0.56
41	Threskiornithidae (Ibises)	0.84

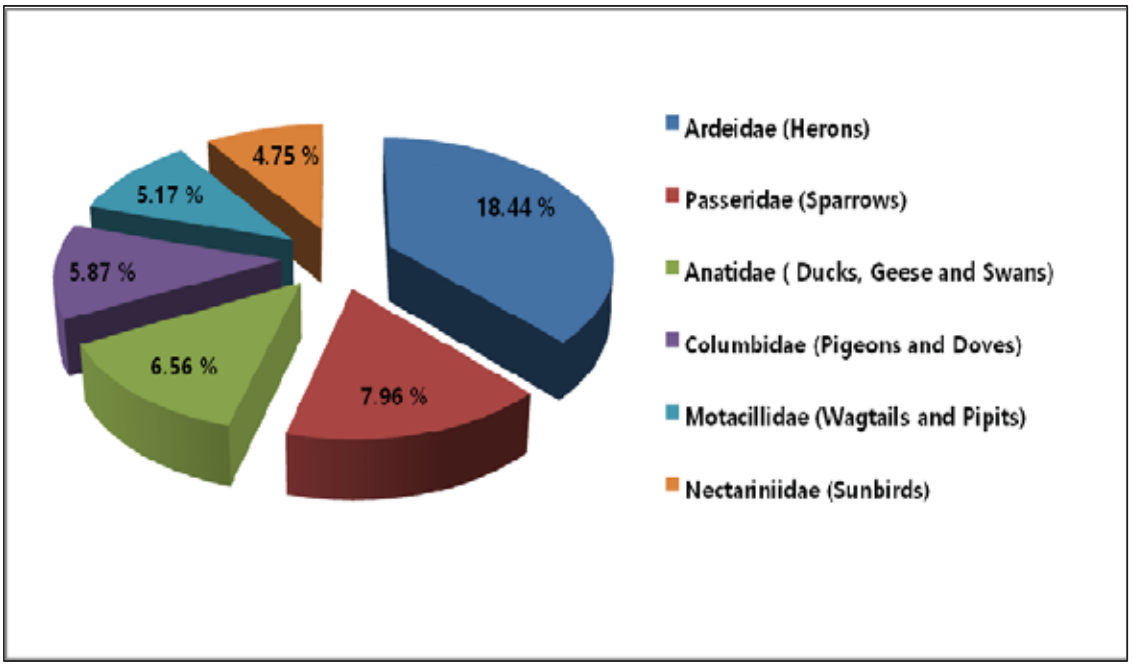

Fig 3.28 Graph showing predominant avifaunal species recorded during the study.

Common Gull Bommakur Tank 17°51'15.94"N, 79° 9'20.80"E	Plain Tiger Bommakur Tank 17°51'15.94"N, 79° 9'20.80"E
Lime butterfly Ghanpur tank 17°50'31.64"N, 79°21'6.93"E	Indian Cupid Gopalpur 18° 6'30.23"N, 79°24'27.77"E
Grass Yellow Ingurti 17°40'20.83"N, 79°45'47.47"E	Mottled Emigrant Pedda cheruvu 18°13'16.40"N, 79°41'43.21"E

Dicsussion with Eturnagaram WLS officials, local people and shepherds expressed that, Cobra, Sloth bear, wild boar; fox, wolf, porcupine, etc are the commonly found species in the study area. Chital, Indian Giant squirrel and Nilgai were recorded in the study area near Ingurti due to the presence of a Reserved Forest nearby. The list of mammals, reptiles and amphibians recorded in the study area are given below. Of which, Black buck, Four horned antelope, Indian wolf and Sloth bear belongs to Schedule -I of Wildlife (Protection) Act, 1972. As per IUCN Conservation status, 3 vulnerable species (Four horned antelope, Sambar deer and Sloth bear) and one near threatened species (Black buck) were recorded. Two amphibians namely *Duttaphrynus melanostictus* and *Bufo stomaticus* were recorded near River Godavari.

Table 3.33 List of reptiles and mammals near the proposed lift point

Sl.No.	Common Name	Scientific Name	Occurrence	IUCN Conservation Status (2018)	Wildlife (Protection) Act, 1972 Schedule
Reptiles					
1	Banded Krait#	*Bungarus fasciatus* (Schneider 1801)	-	LC	-
2	Common house Gecko#	*Hemidactylus frenatus* (Schlegel, 1836)	-	LC	-
3	Giant Leaf toed Gecko#	*Hemidactylus giganteus* (Stoliczka, 1871)	-	LC	-
4	Green tree snake#	*Ahaetulla nasuta* (Lacépède, 1789)	-	NA	-
5	Indian chameleon#	*Chamaeleo zeylanicus* (Laurenti, 1768)	-	LC	-
6	Indian Cobra+	*Naja naja* (Linnaeus, 1758)	-	-	II
7	Indian Krait#	*Bungarus caeruleus* (Schneider, 1801)	-	NA	II
8	Indian pond terapin#	*Melanochelys trijuga* (Schweigger, 1812)	-	NT	-
9	Indian rock python#	*Python molurus* (Linnaeus, 1758)	-	VU	I
10	Leschenault's leaf-toed gecko#	*Hemidactylus leschenaultii* (A.M.C. Duméril & Bibron, 1836)	-	NA	-
11	Monitor Lizard#	*Varanus sp.*	-	-	II
12	Oriental Garden Lizard*	*Calotes versicolor* (Daudin, 1802)	1	NA	-
13	Rat snake#	*Ptyas mucosa* (Linnaeus, 1758)	-	NA	II
14	Star tortoise#	*Geochelone elegans* (Schoepff, 1795)	-	VU	-

Sl.No.	Common Name	Scientific Name	Occurrence	IUCN Conservation Status (2018)	Wildlife (Protection) Act, 1972 Schedule
15	Termite hill gecko#	*Hemidactylus triedrus* (Daudin, 1802)	-	NA	-
16	Viper#	*Daboia russelii* (Shaw & Nodder, 1797)	-	LC	II
17	Water snake/ checkered keelback#	*Xenochrophis piscator* (Schneider, 1799)	-	NA	-
18	Yellow bellied Gecko#	*Hemidactylus flaviviridis* (Rüppell, 1835)	-	NA	-
Mammals					
1	Black Buck+	*Antilope cervicapra* (Linnaeus, 1758)	-	NT	I
2	Chital/Spotted deer*	*Axis axis* (Erxleben, 1777)	1	LC	III
3	Four horned antelope#	*Tetracerus quadricornis* (de Blainville, 1816)	-	VU	I
4	Indian Crested Porcupine+	*Hystrix indica* (Kerr, 1792)	-	LC	IV
5	Indian Fox+	*Vulpes bengalensis* (Shaw, 1800)	-	LC	II
6	Indian Giant Squirrel*	*Ratufa indica* (Erxleben, 1777)	1	LC	II
7	Indian Wolf+	*Canis indica* (Sykes, 1831)	-	NA	I
8	Nilgai*	*Boselaphus tragocamelus* (Pallas, 1766)	1	LC	III
9	Rhesus Macaque#	*Macaca mulatta* (Zimmermann, 1780)	-	NT	II
10	Sambar deer+	*Rusa unicolor* (Kerr, 1792)	-	VU	III
11	Sloth Bear+	*Melursus ursinus* (Shaw, 1791)	-	VU	I
12	Wild Boar+	*Sus scrofa* (Linnaeus, 1758)	-	LC	III
Amphibians					
1	Common Indian toad	*Duttaphrynus melanostictus* (Schneider, 1799)	6	LC	-
2	Marbled Toad	*Bufo stomaticus* (Lütken, 1864)	1	LC	-

Note: * - Species identified by EHSCPL team, + - Secondary information from local people, # - Secondary information from published literatures [57]and Forest Working Plan of Warangal, Khammam and Nalgonda Districts. LC- Least Concern, VU- Vulnerable, NT- Near Threatened, EN- Endangered, NA- Not Assessed.

- [57] Andhra Pradesh Biodiversity Field Guide, 2.16. Hyderabad, Andhra Pradesh: Andhra Pradesh State biodiversity Board.
- Kaiser, H., Lim, J., Worth, H., & O'Shea, M. (2016). Tangled skeins: a first report of non-captive mating behavior in the Southeast Asian Paradise Flying Snake (Reptilia: Squamata: Colubridae: Chrysopelea paradisi). *Journal of Threatened Taxa*, *8*(2), 8488-8494.

Marbled Toad Upstream of River Godavari 18°35'41.74"N, 80°22'42.72"E	Common Indian toad Upstream of River Godavari 18°36'8.12"N, 80°22'26.90"E

3.4.4.3 Conclusion

The proposed project involves construction of the barrage across River Godavari which facilitates irrigation throughout the existing command area for Rabi season. The command area of the proposed project is already irrigated with healthy vegetation and fresh water tanks supporting various floral and faunal species.

In Command area a total of 26 tree species were recorded during the study. In addition to this, 85 species of herbs, 13 species of shrubs and 10 species of climbers were recorded during Monsoon season. A total of 57 species of herbs, 13 species of shrubs and 7 species of climbers were recorded during Post Monsoon season. Similarly, 69 species of herbs, 13 species of shrubs and 9 species of climbers were recorded during Pre Monsoon season. All the species recorded were common to the region and no RET species were observed during the study.

Near barrage site a total of 39 tree species were recorded during the study. In addition to this, 76 species of herbs, 10 species of shrubs and 7 species of climbers were recorded during Monsoon season. A total of 34 species of herbs, 10 species of shrubs and 4 species of climbers were recorded during Post Monsoon season. Similarly, 62 species of herbs, 10 species of shrubs and 5 species of climbers were recorded during Pre Monsoon season. All the species recorded were common to the region and no RET species were observed during the study.

Similarly, in barrage site a total of 29 avifaunal species and 46 butterfly species were recorded during monsoon season, 29 avifaunal species and 34 butterfly species were recorded during Post monsoon season and 61 avifaunal species and 34 butterfly species were recorded during the Pre monsoon season. Jerdon's courser, Finn's weaver, Purple wood pigeon, Black necked stork, Black tailed godwit and Darter oriental are the avifaunal species belonging to Critically Endangered, Vulnerable and Near Threatened category as per IUCN conservation status, 2018.

- Srinivasulu, C., Venkateshwarlu, D., & Seetharamaraju, M. (2009). Rediscovery of the Banded Krait Bungarus fasciatus (Schneider 1801) (Serpentes: Elapidae) from Warangal District, Andhra Pradesh, India. *Journal of Threatened Taxa*, 353-354.

Common Buzzard, Indian peafowl, Shikra and Jerdon's courser are the avifaunal species belonging to Schedule I of Wildlife (Protection) Act, 1972. Butterflies such as Common pierrot, Blue pea, Common gull and Common crow are the only species belonging to Schedule I, II and IV of Wildlife (Protection) Act, 1972. All other species are common to region.

Similarly, in Command area a total of 61 avifaunal species and 34 butterfly species were recorded during monsoon season, 29 avifaunal species and 20 butterfly species were recorded during Post monsoon season and 60 avifaunal species and 34 butterfly species were recorded during the Pre monsoon season.

Mega faunal species such as sloth bear, wild boar, fox, barasingha, nilgai, sambar deer, jungle cats etc are the commonly recorded species in the study area due to the presence of Eturnagaram WLS nearby. As per IUCN Conservation status, 2018; Sambar deer, Four horned antelope, sloth bear, Indian rock python, Star tortoise belongs to Vulnerable Category and Rhesus Macaque, Black Buck, Indian pond terrapin belongs to Near Threatened category. Of which, Rock python, Black buck, Four horned antelope, Indian wolf and Sloth bear belongs to Schedule-I of Wildlife (Protection) Act, 1972. However, Oriental garden lizard, Chital, Nilgai and Indian Giant squirrel were noticed no other mega faunal species were recorded during the study.

3.4.4.4 Photographs

Near Gopalpur 18° 6'30.23"N, 79°24'27.77"E	Near Bommakur Tank 17°51'15.94"N, 79° 9'20.80"E

Near proposed barrage 18°35'24.09"N, 80°23'15.34"E	Near Bommakur Tank 17°51'15.94"N, 79° 9'20.80"E
Near Bommakur Tank 17°51'15.94"N, 79° 9'20.80"E	Upstream of River Godavari 18°35'36.29"N, 80°23'9.75"E
Near Raghunathpally RF 17°45'47.43"N, 79°16'31.46"E	Near Raghunathpally RF 17°45'47.43"N, 79°16'31.46"E
Field Visit	

3.5 Aquatic Environment

3.5.1 Scope of work

The Scope of Environmental Impact Assessment (EIA) studies with particular emphasis on the Aquatic life –fish germplasm in particular, covers the following points:

- Physico – Chemical features of the river water samples.
- Assessment of plankton and litteral faunal elements.
- Survey of the Godavari River, in and around the project site to record the prevailing aquatic life.
- To record, any rare endangered or threatened fish species in particular on the commissioning of the project envisaged and to
- Suggest measures to protect and to facilitate fish conservation and also to carry-out fisheries development programmes in the area.

3.5.2 Methodology

Taking note of the topography and the prevailing riverine conditions, at the site and connected strategic points, sampling stations for carrying-out the limnological and Fisheries investigations were fixed. The lotic water bogy at the site covered is around 1 to 4 Km wide.

3.5.2.1 Hydrological studies

- Water: The Physico – Chemical features of the surface water samples such as Ambient and water temperature, colour, Odour, Turbidity, pH, dissolved oxygen, Free carbon-di-oxide, free ammonia, total alkalinity, total Hardness, Phosphate, Nitrate, solocate, Iron, Calcium, Potassium and specific conductivity were assessed in the field and the laboratory by following the methods suggested by the American public Health Association (APHA)

3.5.2.2 Biological studies

- **Plankton**: For the Assessment of the plankton biomass,100 its of the surface water samples from representative portion of the river, in and around the project site was strained through a plankton net made 21 nylobolt silk cloth (70 meshes*cm with aperture size of 0.067 mm) in terms of catching efficiency of the phyto- and the zooplankton constituents. The plankton samples collected were fixed in 5.0% formaldehyde solution and subjected to both the qualitative and quantitative analysis by utilizing a microscope and sedgewick Rafter plankton counting cell.

- **Littoral Fauna** : The litteral organisms were collected by operating a 'D' frame net in the shallow margical area of the River Godavari at the sites by covering a distance of 20 ft. The Collection was sieved through a no 40 sieve and the fauna obtained were fixed in 5.0% formaldehyde Solution and subjected to detailed systematic analysis.
- **Fish Species**: Fisheries operations in the riverine sectors in and around the project site were organised with the help of the local fisherman of the respective areas. Castnets Gillnets, Uduvala ets of varied mesh sizes were employed for harvesting of the fish specimens.
- **Fisherman & Fisherwomen Cooperative Societies**: Locals as also the migratory fisherman are engaged in the fishing and marketing professions Fisherman belonging to native and migrants formed the core group.

3.5.3 Results and discussions

3.5.3.1 Limno-Chemistry

Water: Water be it from a pond, tank, stream, river or reservoir, is an essential natural resource for sustaining the life and the environment which most of us thought it to be available in abundance and mere so, as a free GIFT of nature. Water constitutes around 70% of the body weight of almost all living organism. Water a natural resource which has been in use since centuries for multipurpose utilities viz drinking, domestic needs irrigation, industrial etc. Mainly depends on its intrinsic quality hence it is of prime importance to have prior information on the quality while planning any developmental projects. Good/ Quality resource depends upon a large number of physic-chemical parameters and the impact, if any pollution load to be assessed. These factors, particularly the pollution effects do influence the quality of the medium warranting right decisions to be initiated before-hand. Scarcity of clean and potable water has emerged in the recent past as one of the most serious developmental issue in good many parts of the country.

It is stated that this mighty and one of the largest lotic water body in the country, always, during the study period, presented, quite disappointingly, a very 'grim' picture since always presented quite 'low' levels of water in flow-regime. Almost 80-90 percent of its fluviatile area was always found exposed with dry bed and sand. The physico-chemical features of the surface water samples of the River Godavari are as given below and annexed as Annexure 19;

- Colour and Odour

The river water was found to be clear, transparent and also odourless, at the project site, also in the up and the downstream stretches.

- Air and water Temperature

Of the physical features, in a given situation, heat and light are essential for photosynthetic activities which depends on the latitude and the altitude, also on the depth of the water column which was, as noted earlier, was always found to be in the range of 2 – ¾ ft. Prevailing water temperature plays a significant role in water metabolism and in regulating different physiological processes in living organisms, including fish germplasm. The rate of decomposition of temperature releasing available nutrients into the water phase.

Air temperature values ranged between 24.2^{0}C to 33.2^{0}C and that of the medium was from 23.7^{0}C to 31.8^{0}C which lower than that of the former.

- Turbidity

A productive water body should be a little bit turbid. Normally, transparency gets decreased during the monsoon season on account of inflow of water mass being leaded with dissolved and suspended organic and inorganic particles which, subsequently, gets stabilized in post-monsoon period. Turbidity due to organic and inorganic colloides is of paramount importance as these, by virtue of their extensive surface area, coupled with electrical charge, keep nutrients ions in water phase. Hence, clear water is as much undesirable as highly turbid water. In the present study, the value recorded ranged from 1.02 to 36.8 NTU.

- pH

The hydrogen-ion concentration of natural waters is an important environmental factor, the variations of which, among other causes, are linked with the species composition and life-processes of aquatic floral and faunal communities inhabiting them. pH in the alkaline side of neutrality ranging from 7.0 to 8.0 is ideally suited for sound productive norms. Acidic waters with values below 6.5 and alkaline medium above 8.5 tend to bear 'low' productive status. The river water studied with values ranging from 7.12 to 8.14 is well within the permissible limits.

- Dissolved Oxygen

Of all the dissolved gases, oxygen is the most important in natural waters for the life of the fish species. The biotopes receive oxygen mainly through two sources – (i) by absorption from the atmosphere at the surface and (ii) by photosynthetic activity of the chlorophyll bearing organisms inhabiting. Oxygen consumption in a body of water occurs by the respiration of animals and aquatic plants, as well as by the putrefaction of organic matter, also other causes. The oxygen available in the medium at a given time is the balance of the above processes. Ideally, the oxygen-producing and oxygen-consuming processes in natural waters should be balanced so as to keep the dissolved oxygen concentration within a range congenial to all floral and faunal elements alike. Oxygen regime when monitored over a period of time will provide data on the nature of the medium and its productive potential.

Oxygen profile in the River Godavari at the site value ranging between 4.3 and 6.3 mg/L was moderate in nature.

- Free carbon-di-oxide

Though the Carbon-di-oxide is highly soluble in natural waters, it is a minor constituent of the atmosphere and the atmosphere and maintains presence in equilibrium concentrations giving acidic reactions in the medium. Its presence is noticed in surface and sub-surface waters, mostly in monsoon due to rain and, generally, present all-through the year at the bottom with more concentration during the active phase of degradation of bottom organic lead in summer. Free Carbon-di-oxide value recorded 'Below detection level to 1.76mg/l indicated that the medium is free from pollution threat.

- Free Ammonia

Generally, in unpolluted waters ammonia and ammonium compounds occur relatively small quantities, usually on the order of 1.0 mg/l or less. With the uptake of oxygen, as in pollution, the concentration of ammonia may increase; Free Ammonia in concentrations over 2.5 mg/l in neutral or alkaline waters is apt to be harmful to good many fresh waters species. The medium at the sites sampled indicated 'non-pollution' feature the value ranging from 'Below detection level to 0.43 mg/l hence the desirable limit is close to 0.5mg/L

- Total Alkalinity

Alkalinity the acid combining capacity of natural waters is general is caused by carbonates and bicarbonates of calcium and magnesium: With dissolved carbon-di-oxide the carbonate and the bicarbonate form an equilibrium which is of prime importance for the productivity in a given situations. Natural waters containing 40.0mg/l or more it are considered as more productive. Waters with low alkalinity – less than 20.0 mg/l, have a low buffering capacity and are Vulnerable to rapid fluctuations in pH, especially, during rainfall with Phyto-plankton blooms which is directly harmful to fish life. The river studied indicated that it's on the 'ascending' trend, the values ranged from 58 to 124.0 mg/L

- Total Hardness

An important parameter of the water quality be it is being used for domestic, agricultural or industrial purposes. Hardness of the medium is the property attributed to the presence of alkaline earth. Water can be classified into soft (<75.0 mg/l), moderately hard (75 – 150 mg/l), Hard (150 – 300 mg/l) and very hard (>300 mg/l) based on hardness. The total hardness of the surface water samples of the study area, recorded values ranging from 57.0 to 118.0 mg/l indicating that the medium is soft to moderately hard. The analytical data indicates that 29% of surface water samples are soft, 14% moderately hard, 50% hard and 7% very hard. The high hardness may cause encrustation on water supply distribution systems. There is also some

suggestive evidence that long term consumption of extremely 'hard' water might lead to an increased incidence of urolithiasis, anencephaly, pre-natal mortality, some types of cancer and cardio vascular disorders.

- Phosphate

The role and importance of phosphate in aquatic productivity has been recognized quite adequately. A Concentration of 0.05 – 0.2 mg/l has been considered to be 'quite favorable' for medium to high level of productivity. Lack of phosphorus is often the chief cause of poor productivity of waters. Excess of phosphate in open waters is a sign of heavy organic pollution. The Nutrients status of Godavari River water studies at the sites with values of 0.35 mg/l appears to be in the 'optimum' Level.

- Nitrate

Like, Phosphate, Nitrate also is a major constituent of protein occupying an important position in the aquatic system. A concentration of 0.2 - 05 mg/l of inorganic nitrogen has been recognized being favorable for medium to high levels of productivity norms. In the present study, the values ranged from values ranging from BDL to 6.13 mg/l, appears to be on the 'normal' side.

- Silicate

In natural waters, silicon remains in silicate form which is reachable. Normally, silicate-silicon (1-30 mg/l) remains in natural waters. At high temperature and pH, the solubility of silicate greatly increases. As silica has been an important structural constituent of diatoms (Bacillariophyceae), it is able to regulate their growth. In the Studies carried-out in the river Godavari, the nutrient status of the river water studied recorded values ranging between BDL to 10.83 mg/L.

- Iron

Iron is of particular interest because of its importance as a vital element in respiratory pigments of many animals. The values recorded in the studies undertaken – BDL to 2.16mg/l infers it being in 'poor' concentration and its role in the productivity of the medium appears quite inadequate.

- Calcium

Calcium and Magnesium are the dominant cat-ions in the surface waters. The concentration of calcium varies from a minimum of 8.0 mg/l to a maximum of 92.0 mg/l, with an average value of 37.0 mg/l. Weathering and dissolution of calcium carbonate ($CaCo_3$) - Limestone and Dolomite and Calc-Silicate minerals are the most common source of calcium in the water bodies. Calcium, the essential nutrient for the plant growth and in animals plays an important

role on the development of bones, nervous system and cell structures. One possible adverse effect from ingesting high concentrations of calcium for long periods may be an increased risk of kidney stones. The values recoded in the present case are ranged between 9.6 to 21.6 mg/l, falls within the maximum permissible limit of 200.00mg/L.

- Potassium

Potassium, in effect, is an important ingredient for all Algae and, under low concentrations, the growth and photosynthesis of the algae is poor and respiration high. The values observed in the studies carried- out in the River Godavari being in the range of 2.0 to 5.2 mg/l impacted, negatively, on the over-all floral pattern of the river in general.

- Specific conductivity

Specific conductivity is an index of the amount of the water soluble salts present in the medium. Measurements of dissolved salts in the medium indicate the total concentrations of dissolved salts having wide bearing on the over-all productivity of the system. It provides also symptoms of state of mineralization in any aquatic eco-system. Its values for fresh waters range from 25.00 to 500.00 micro mhos/cm. In the present case, the value recorded ranged from 158.1 to 351.0 micro mhos/cm, appears to be in the optimum level. In general, the Godavari River water studied at the project site and related sites indicated 'Alkaline character, Optimum nutrient status and is free from any pollutional threats'.

3.5.3.2 Plankton

Plankton, constituted by Phyto-and Zooplankton is an important link in the food-chain for all living organisms present in a water body and knowledge of its abundance might well indicate the productive capacity of the biotope. Plankton samples were collected from the Godavari River during the period of study – (August to December, 2017) and have been detailed in the Annexure 19.

The plankton diversity and its richness represented by Phyto-and Zooplankton constituents, particularly, in a lotic environment, depend, primarily, on the prevailing local conditions and the seasons. Although, in the present instance, the studies carried out between August – December, 2017 (monsoon, post monsoon and winter season), the situation in the river Godavari, all along the sites covered in its stretch, were not in accordance with the natural phenomena/phases likely to prevail. The river bed, during the period was always found dry and exposed (90-95%) with dried-up bed, sandy beach like situation, dry spell etc. The stream like fluviatile water body of this mighty river in the present context was highly disappointing and frustrating too. The overall productivity in such situations will have a direct bearing, particularly, on the piscine fauna present.

The plankton constituents of the Godavari River, at the project site, upstream and downstream sites sampled presented a 'poor' picture. It is also true to state that Pre-monsoon and monsoon seasons could be categorized being 'poor' plankton production periods and the studies carried out falls within the very seasons. As data indicates Phytoplankton, by species-wise (and percentage (21-310 u/1 / 7.86-94.87%) dominated ever Zooplankton (4-258 u/1-1.28-98.14%) and the miscellaneous group (2-14u/1-1.47-8.00%).

The Phytoplankton is represented by *Anacystis cynea, Oscillatoria tenuis, Spirulina major, Chlrogonium elongatum, Platydorina caudate, Schrooderia setigera, Coolastrum chodati, Pachycladon umbrinus, Penium margaritaceum, Spirogyra varians, Radieflum conjunctivum, Ulothrix zonata, Cladophora glomerata, Fragilaria capucina, Synedra ulna, Asterionella formesa, Opephora martyi, Navicula radios and Denticula thermalis.*

The Zooplankton is represented by *Arcella mitrata, Brachienus calciflorus, Keratella quadrata, Filinia lengiseta, Diaphnosoma brachyurum, Daphnia magna, Bypris subglobosa, Cyclops and nauplius.* The miscellaneous group is represented by Insect remains, Nematodes and Vegetative remnants.

3.5.3.3 Littoral Fauna

An important biological component of a lotic and also a lentic water body is its faunal representation which is quite adopted to face natural hazards such as sudden water gushing, periodic floods of varied intensities, Flass-floods and rolling /dislodging actions of gravel, stones, boulders etc. The qualitative faunistic elements Collected from the expressed dry bed of the Godavari river during the period of the study at the project site/s and close by locations of the riverine stretches are detailed in the Annexure 19, other than the Molluscan fauna no other organisms could be encountered since the river in question hold very little water bearing much shallowness.

The Molluscan fauna (dead specimens) collected belongs to order-Mesogastropoda- *Bellamya bengalensis*, *B. Crass & B. dissimilis, Pila glodosa, Gabbia stenothyroides, Digoniostoma pulchella, Thiara* (Thiara) *scabra* & *T.* (Melanoides) *tuberculata*; Order- Bassomatophora-*Lymnaea acuminate & L.lutoola, Indoplanorbis exustus* & *Gyraulus convexiusculus*; Order-unionida-*Lamollidens corianus, L.marginalis* & *Parreysia corrugate* & *P. (Parrosia)* corrugate-sub-species *Parreysia nagpoorensis* and Order-Veneroida- *Cerbicula striatella*.

Pangasius pangasius – the only non predatory catfish could profitably used by introducing it in different pockets/locations of the river Godavari where the Molluscan fauna is found adequately as it forms the main food the Species. Also, species such as *Rita pavimentata, R. Gogra and Mystus vittaus* could also be stocked along with P.*pangasius. Bellamya bengalensis,*

Lamellidens marginalis, L.corianus and Pila globosa are favoured food by people from Bihar, West Bengal and Mizoram.

3.5.3.4 Fish and fisheries

The first comprehensive publication to deal exclusively with the fishes of any Indian River system, as a whole, is that of Francis Hamilton (1822) who described 269 species of fishes found in the Ganga and its tributaries. Such a monographic treatment of any other Indian River system did not come for another hundred and fifty years or more. David (1963) published his investigations on the 'fish and fisheries' of the Godavari and the Krishna river systems and listed 131 species of fish as occurring in the Krishna alone and as the records indicate, including the studies carried – out in the recent past, the river Godavari found harbouring 105 species (Annexure 19). The principal fish groups which support the commercial fishery in particular of the Godavari River are Carps – *Gibelion catla, Cirrhinus mirgala, Labeo calbasu & Labeo fimbriatus,* Catfish – *Sperata aor, Sperata seenghala, Silenia children, Wallago attu, Pangasius pangasius & Bagarius yarrelli*. Indian Shad – *Hilsa (Tenualesa) ilisha & Hisa (Hilsa) kelee,* Prawns – *Macrobrachium malcolmsoni* and Miscellaneous group- Wed fishes, minor catfishes, Loaches etc.,

The fishing gears which are being employed in the river Godavari fall under two categories viz; gill nets which also include 'set gill nets, drift gill nets, drag gill nets (Bendu vala) and the barrier gill net (Katu vala), seines which comprise share seine (Jarugu vala), large seine (Alivi vala) and drag net (Konte vala). Cast nets are also employed for fishing. Gill net operations, which constitute around 40% of the total fish yield. Bandu vala operations are confined to a small section of the river around Dummagudem and Tekalagudem village. Alivi vala, a major gear, next in importance only to gill nets, is mostly operated in areas devoid of any type of obstructional disadvantage such as boulders etc.,

With all-out efforts by fishermen in the area, as observed and also based on the reports available, total catches of commercial species of carps and catfishes have greatly decline. Accompanied by decrease in total catches and catch per unit of effort, large-sized fishes have greatly decreased in abundance, also reduction in average size fish has taken place.

Fish landed in different pockets of the riverine stretches, mostly, is marketed locally. Prawn – *M.malcolmsoni* is, which fetches around Rs. 300-400 kg at the markets close – by are collected by fish merchants[58].

- [58] Anon, 1972. Methodology for Pre-impoundment survey technique for Preparation of reservoirs for fish culture. CIFRI(ICAR), Barrackpore (WB), India, Misc Contribution No.8:1-59
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A total of 105 species of fishes were recorded during the study the details are enclosed as Annexure 19.

Table 3.34 Checklist of the fish species recorded from the Godavari River (Project site & its Vicinity)

Sl.No.	Scientific name	Vernacular name	IUCN Red-list 2018
1	*Notopterus notopterus* (Pallas, 1769)	Mangali katti	LC
2	*Anguilla bengalensis* (Gray, 1831)	Malugu	NT
3	*Anguilla bicolour* McClelland, 1844	Malugu	NT
4	*Hilsa* (Tenualosa) *ilisha* (Hamilton)	Polasa	LC
5	*Hilsa* (Hilsa) *kelee* (Cuvier)	Polasa	LC
6	*Hypothalichthys molitrix* Valenciennes, 1842	Vendi-chapa	LC
7	*Salmophasia acinaces* (Valenciennes, 1844)	Chela	LC
8	*Salmophasia balookee* (Sykes, 1839)	Chela	LC
9	*Salmophasia novacula* (Valenciennes, 1840) Chela	Chela	LC
10	Aspidoparia morar (Heckel, 1847)	-	LC
11	*Barilius barila* (Hamilton, 1822) Kodipe	Kodipe	LC
12	*Barilius bendelisis* (Hamilton, 2007)	-	LC
13	*Chela cachius* (Hamilton, 1812)	Getchu	VU
14	*Chela (Chela) laubuca* (Bleeker, 1959)	Getchu	VU
15	*Esomus danrica* (Hamilton, 1822)	Asta-pakke	LC
16	*Devario aequipinnatus* (McClelland, 1839)	Nooltu	LC
17	*Danio devario* (Hamilton, 1822)	Nootlu	LC
18	*Dania rerio* (Hamilton, 1822)	Chintaku-parega	LC
19	*Rasbora daniconius* (Hamilton, 1822)	Katte-dodipe	LC
20	*Amblypharyngodon mola* (Hamilton, 1822)	Kodipe	LC
21	*Ctenopharyngodon idella* (valenciennes, 1844)	Gaddi-chepa	NE
22	*Cyprinus carpio* Linnaeus, 1758	Bangaru-teega	NE
23	*Thynnichthys sandkhol* (Sykes, 1859)	-	VU
24	*Tor Khudree* (Sykes, 1839)	Aku-chepa	EN
25	*Neolissochilus hexagonolepis* (McClelland, 1839)	-	NT
26	*Osteobrama cunma* (Day, 1888)	Kagitum-paraka	LC
27	*Osteobrama peninsularis* (Silas, 1952)	Khira	DD
28	*Osteobrama vigorsii* (Sykes, 1839)	Khira	LC
29	*Rohtee ogilbii* Sykes, 1839	Aku-chepa	LC
30	*Puntius amphibious* (Valenciennes, 1842)	Parka-chapa	DD
31	*Puntius chola* (Hamilton, 1822)	Pakki	DD

Sl.No.	Scientific name	Vernacular name	IUCN Red-list 2018
32	*Puntius sophore* (Hamilton, 1822)	Budda-pakke	LC
33	*Pethia ticto* (Hamilton, 1822)	Budda-parke	LC
34	*Systomus sarana* (Hamilton, 1822)	Gende-paraka	LC
35	*Hypselobarbus kolus* (Sykes, 1839) Nilusu	Nilusu	LC
36	*Hypselobarbus pulchellus* (Day, 1870)	Parka	LC
37	*Osteochilichthys godavariensis*	-	DD
38	*Cirrhinus cirrhosus*	Aruza	LC
39	*Cirrhinus macrops* Steindachner,	-	LC
40	*Cirrhinus mrigala* (Hamilton, 1822)	Yerra mosu	LC
41	*Cirrhinus reba* (Hamilton, 1822)	Chittrai	LC
42	*Gibelion catla* (Hamilton, 1822)	Botcha	LC
43	*Labeo bata* (Hamilton, 1822)	Mosu	LC
44	*Labeo boga* (Hamilton, 1822)	Mosu	LC
45	*Labeo boggut* (Sykes, 1839)	Nusi-gadu	LC
46	*Labeo calbasu* (Hamilton 1822)	Kaki-paraka	LC
47	*Labeo dero* (Hamilton, 1822)	-	LC
48	*Labeo dyocheilus* (McClelland, 1822)	Paraka	LC
49	*Labeo fimbriatus* (Bloch, 1795)	-	LC
50	*Labeo gonius* (Hamilton 1795)	Paraka	LC
51	*Labeo pabgusia* (Hamilton, 1822)	Done cheap	NT
52	*Labeo porcellus* (Heckel, 1844)	Moyya	LC
53	*Labeo potail* (Sykes, 1839)	Baman-chapa	EN
54	*Labeo rohita* (Hamilton, 1822)	Seelavathi	LC
55	*Schismatorhnychus nukta Skyes, 1855*	Mukkidi-chepa	LC
56	*Garra stenorhynchus* (Jerdon, 1849)	Banda pakiri	LC
57	*Garra mullya* (Sykes, 1839)	Banda pakiri	LC
58	*Oreonectes* (Oreonectes) *evazardi* (Day)	-	LC
59	*Rita bakaluae*	Bondu	
60	*Rita pavimentata* (Valenciennes,)	Bondu	LC
61	*Mystus cavasius* (Hamilton, 1822)	Muti-jella	LC
62	*Mystus vittatus* (Bloch, 1794)	Erra-jella	LC
63	*Hemibagrus maydelli* (Rossel, 1964)	Ponduga	LC
64	*Sperata aor* (Hamilton, 1822)	Mukul- jella	LC
65	*Sperata Seenghala* (Sykes, 1839)	Mukul- jella	LC

Sl.No.	Scientific name	Vernacular name	IUCN Red-list 2018
66	*Ompak bimaculatus* (Bloch, 1794)	Bugga-dumma	NT
67	*Wallago attu* (Bloch & Schneider, 1801)	Valuga	NT
68	*Proeutropiichthyus taakre* (Sykes,1839)	Siriari-jella	LC
69	*Pachypterus khavalchor* (kulkarni, 1952)	Kocha-muthi-jella	DD
70	*Silonia childreni* (Sykes, 1839)	wan-jow	EN
71	*Bagarius yarrelli* (sykes, 1875)	Guddi chpa	EN
72	*Glyptothorax lonah* (Sykes, 1839)	-	EN
73	*Clarias batrachus* Linnaeus	Marpu	LC
74	*Clarias gariepinus* (Burchell, 1822)	Safrican marpu	LC
75	*Heteropneustes fossilis* (Bloch)	Ingilayee	EN
76	*Arius caelatus* Valenciennes	-	LC
77	*Xenontodon cancila* (Hamilton, 1822)	Vodla mukka	LC
78	*Hyporhamphus limbatus* (Valenciennes, 1846)	Konga mukku	LC
79	*Aplocheilus lineatus* (Valenciennes, 1846)	Minnow Chapa	LC
80	*Gambusia affinis* (baird & Girard, 1853)	Gambusia	LC
81	*Poecilia reticulata* Peters, 1859	Guppi	NE
82	*Mastacembelus armatus* (Lacepede, 1800)	Konte-mukku	LC
83	*Chanda nama* Hamilton, 1822	Akurati	LC
84	*Parambassis ranga* (Hamilton, 1822)	Sarawa	LC
85	*Etroplus suratensis* (Bloch, 1790)	Duvenna- chapa	LC
86	*Oreochromis mossambica* (peters, 1852)	Doobotcha	NT
87	*Parachaeturichthys polynema* (Bleeker, 1874)	-	LC
88	*Oxyurichthys microlepis* (Bleeker,)	-	LC
89	*Oxyurichthys formosanus* Nichols,	-	LC
90	*Oxyurichthys tentaculosis* (Valenciennes,)	-	LC
91	*Chiramenu fluviatalis* Rao	-	LC
92	*Silhouetta indicus* Rao, V.V.	-	LC
93	*Gobiopsis macrostomus* Steindachner,	-	LC
94	*Glossogobius biocellatus* Valenciennes,	-	LC
95	*Glossogobius giuris* (Hamilton, 1822)	Isika-dondu	LC
96	*Bathygobius fuscus* (Ruppell)	-	LC
97	*Bathygobius osteicola* (Chaudhuri)	-	LC
98	*Stigmatogobius minima* (Hora)	-	LC
99	*Stigmatogobius sadanundio* (Hamilton, 1822)	-	NE

Sl.No.	Scientific name	Vernacular name	IUCN Red-list 2018
100	*Anabas oligolepis* Bleeker	Goraka chapa	DD
101	*Anabas testudineus* (Bloch, 1792)	Goraka chapa	DD
102	*Channa marulius* (Hamilton, 1822*)*	Poo-meenu	LC
103	*Channa orientalis* (Bloch,Scheneider, 1801)	Guruja	NE
104	*Channa punctatus* (Bloch, 1793*)*	Burudamatta	LC
105	*Channa striatus* (Bloch, 1793*)*	Korra-meenu	LC

NOTE:

- CR = CRITICALLY ENDANGERED: Taxon is Critically Endangered when it is facing an extremely high risk of Extinction in the wild in the near future.
- EN = ENDANGERED: A Taxon is Endangered when it is not Critically Endangered when it is not Critically Endangered or Endangered, but is facing a very high risk of Extinction in the Near Future.
- VU = VULNERABLE: A Taxon is Vulnerable when it is Not Critically Endangered, but, is facing high risk of Extinction in the wild in the Medium-term Future.
- LR = LOWER RISK: A Taxon is in low risk when it has been evaluated and does not qualify for any of the Threatened Categories.

As per the field observations, out of 105 fish species, 6 fish species belongs to Endangered category, 7 fish species belongs to Near Threatened category and 3 fish species belongs to Vulnerable category as per IUCN red list, 2018 and rest of the species are common to the region belonging to Least Concern category.

3.5.3.5 Summary

Limnological and fisheries investigations carried out in the river Godavari, in and around the project site, indicate 'optimum' physico-chemical features of the medium to support and sustain the aquatic life present.

The biological features constituted by phyto and zooplankton presented low values however. Scores of planktivores fish species subsists on this food niche during their developmental stages, as also, in their adult-hood.

Molluscan fauna represented by Gastropoda and Bivalves-in dead conditions were collected from the exposed dry-bed of the riverine stretch studied. During the prime time, when the river holds enough volume of water, efforts made to introduce the non-predatory catfish *Pangasius pangasius* which feeds exclusively these molluscan species.

Efforts are to be made to introduce the giant fresh water prawn- *Macrobrachium malcolmaoni.* The seed is available in very large numbers naturally at downstream anicut across the river Godavari at Rajahmundry (AP).

Although, the Godavari river is reported to harbour 131 fish species in its entire stretch, in the studies carried out, 105 fish species have been listed warranting much more Ichthyological studies to be carried-out.

Impact of the alien fish species such as the African highly predaceous catfish-*Clarias gariepinus,* South America's *Oreochromis mossambica,* alligator catfish- *Atractesteus spatura and serrasalmus natterari* have already made their presence and impacts felt on the fish germplasm indigenous to the system studied. Their absolute elimination from the river Godavari has to be viewed with utmost seriousness and also urgency.

Conservation of certain fish species available only in the Krishna- Godavari Rivers has been highlighted which should be accorded 'top priority' towards their conservation, along with *Bagarius yarrelli* (the giant catfish which grows more than 100 kg) be viewed with at most sincerity and seriousness.

A Monitoring cell be constituted to undertaken detailed Limnological and Fisheries investigations in order to 'Undertake conservation and development programmes in the said riverine stretch, also in the impoundment slated to be formed shortly' on the lines of the Technical know-how available.

Field data collection
Ghanpur tank
17°50'31.64"N, 79°21'6.93"E

Specimens found after fishing
Command area
18° 0'33.02"N, 79°35'49.10"E

Bagarius yarrelli, an endangered species found during the site visit
Downstream of River Godavari
18°34'14.90"N, 80°24'7.03"E

Chapter 4. Anticipated Impacts & Mitigation Measures

Due to the activities of the project, there will be potential impacts on the environment of varying magnitude. Most of the impacts are likely to occur during the construction phase of the project. The following section reveals the prediction of impacts due to the project on the physical, biological and social environment. Impacts have been assessed based on the information collected from the primary and secondary data. Construction activities will be taken place for 2 years.

4.1 Impacts during construction phase

4.1.1 Air Environment

4.1.1.1 Anticipated impacts

The construction of the project is expected to complete by 2 years. The initial site clearing will be followed by site preparation activities, which include;

- Grading
- Excavation of footings and foundations,
- Backfilling operations

Excavation work at site causes disturbance due to the emission of particulate matter in the construction area. Fugitive dust emissions from the construction of the project will result from:

- Air pollution (dust) due to various construction activities, movement of vehicles will pose health concerns to the construction work force in terms of respiratory problems.
- Dust entrained during site preparation and grading/excavation at the construction site
- Dust entrained during onsite travel on paved and unpaved surfaces
- Dust entrained during aggregate and soil loading and unloading operations and
- Wind erosion of areas disturbed during construction activities.

Combustion emissions during construction will result from:

- Exhaust from the Diesel construction equipment used for site preparation, grading, excavation, trenching and construction of onsite structures.
- Exhaust from water trucks used to control construction dust emissions.
- Exhaust from Diesel-powered welding machines.
- Exhaust from pickup trucks and Diesel trucks used to transport workers and materials around the construction site.

- Fugitive emissions from various construction activities including blasting will pose health concerns (respiratory problems) on the neighbouring village residents (Thupakulagudem).
- Exhaust from Diesel trucks used to deliver concrete, fuel, and construction supplies to the construction site.
- Air quality of the region will also get affected due to the movement of vehicles to and from the site carrying construction material brought by truck.

4.1.1.2 Mitigation measures

The following mitigation measures will be proposed to control exhaust emissions from the diesel heavy equipment/transport vehicles and potential emissions of fugitive dust during construction of the project:

- Unpaved roads and disturbed areas in the project construction site to be watered thrice a day to prevent fugitive dust emissions. The frequency of watering can be reduced or eliminated during periods of precipitation.
- The vehicle speed limit restricted to 15-20 kmph within the construction site.
- The construction site entrances posted with visible speed limit signs.
- PPEs like nose mask will be provided to the construction work force.
- Construction equipment vehicle tires inspected and washed as necessary to be cleaned free of dirt prior to entering paved roadways.
- Gravel ramps of at least 20 feet in length provided at the tyre washing/cleaning station.
- Paved exits from the construction site to prevent track out to public roadways.
- Paved roads within the construction site swept at least once daily (or less during periods of precipitation) on days when construction activity occurs to prevent the accumulation of dirt and debris.
- Vehicles used to transport solid bulk material on public roadways and having the potential to cause visible emissions to be provided with a cover, or the materials sufficiently wetted and loaded onto the trucks in a manner to provide at least one foot of freeboard.
- Any construction vehicle not meeting the emission norms standards (PUC) not being allowed within the construction site and emission certificate made mandatory for the same and this is strictly enforced on the transport contractors to abide by the same.
- Water sprinkling (3 times a day) will be done in all the dust generating activities like site clearing, levelling, excavation, material handling etc to suppress the dust.
- Errection of the barricades along the periphery of the construction sites.

- Controlled blasting with water sprinkling will be adopted to suppress the dust generation.
- Vehicles delivering loose and fine materials like sand and fine aggregates covered by tarpaulin sheets to reduce spills on roads so as to avoid fugitive emissions.
- DG sets engaged in the construction site equipped with suitable stack height.
- Monthly Ambient Air Quality Monitoring will be carried out to assess the pollution load during construction phase.
- During excavation, regular water sprinkling will be undertaken to avoid fugitive dust.

There will not be any impacts anticipated during the operation phase of the project.

In order to assess the Ground Level Concentrations of emissions, air quality model was used to draw the isopleths.

- Dispersion Model

Dispersion modelling requires an hourly data of wind speed and direction, and other meteorological parameters. The EPA-approved AERMOD model user interface developed by M/s Envitrans (AERMODcloud) is used to estimate ambient impacts from construction activities of the project. The emission sources for the construction site are grouped into three categories:

- Area source: construction dust emissions.
- Line source: Exhaust emissions from moving vehicles inside the project site
- The study is carried out for the emission of Particulate matter with mitigation measures and without mitigation measures.

The methodology utilized in this analysis is consistent with the general recommendations of the AERMOD Model user's guides for modeling emissions. Models are run with the regulatory default option and hourly meteorological data processed in the AERMET program for use in AERMOD. The isopleths drawn for PM_{10} with and without mitigation measures shows that the predicted GLC for Particulate matter ranges from 48.5 µg/m^3 - 1.0 µg/m^3 (without mitigation measures); 31.7 µg/m^3 - 0.08 µg/m^3 (with mitigation measures) and the isopleths are as given below. The expected increase in concentration will be (60.4 µg/m^3 + 48.5 µg/m^3) in the core area thereby causing discomfort in breathing, eye and nose irritation to the labours. With the water sprinkling activity, covering of vehicles delivering loose materials with tarpaulin sheets will reduce the GLC of particulate matter from the project to 31.7 µg/m^3. However the GL concentration in the study area will be in the range of 19.77 µg/m^3 to No effect zone. GLC of 0.11 µg/m^3, 0.4 µg/m^3, 0.05 µg/m^3 can be observed in the Devadula, Thupakulagudem and Chandrupatla respectively.

As per the model isopleths (with mitigation), the maximum incremental concentration of 31.7 µg/m^3 is expected in the core zone of the project, if the mitigation measures are implemented resulting in

the total concentration of 92.1 µg/m^3 within the standard of CPCB. This dust is expected to be depositing on 3,42,300 trees (considering 700 trees / ha). However, this concentration does not affect the transpiration of these trees. A M. Farmer (1993)[59] argued that, trees shall have the capacity to withstand the dust concentration in the range of 25-100 µg/m^3. The Study area GLC observed to be in the range of 13.02 µg/m^3 to No effect, resulting in no damage to human health of the neighboring population. GLC of 0.08 µg/m^3, 0.32 µg/m^3 and 0.03 µg/m^3 can be observed in the Devadula, Thupakulagudem and Chandrupatla respectively. Hence, this impact is very minimum.

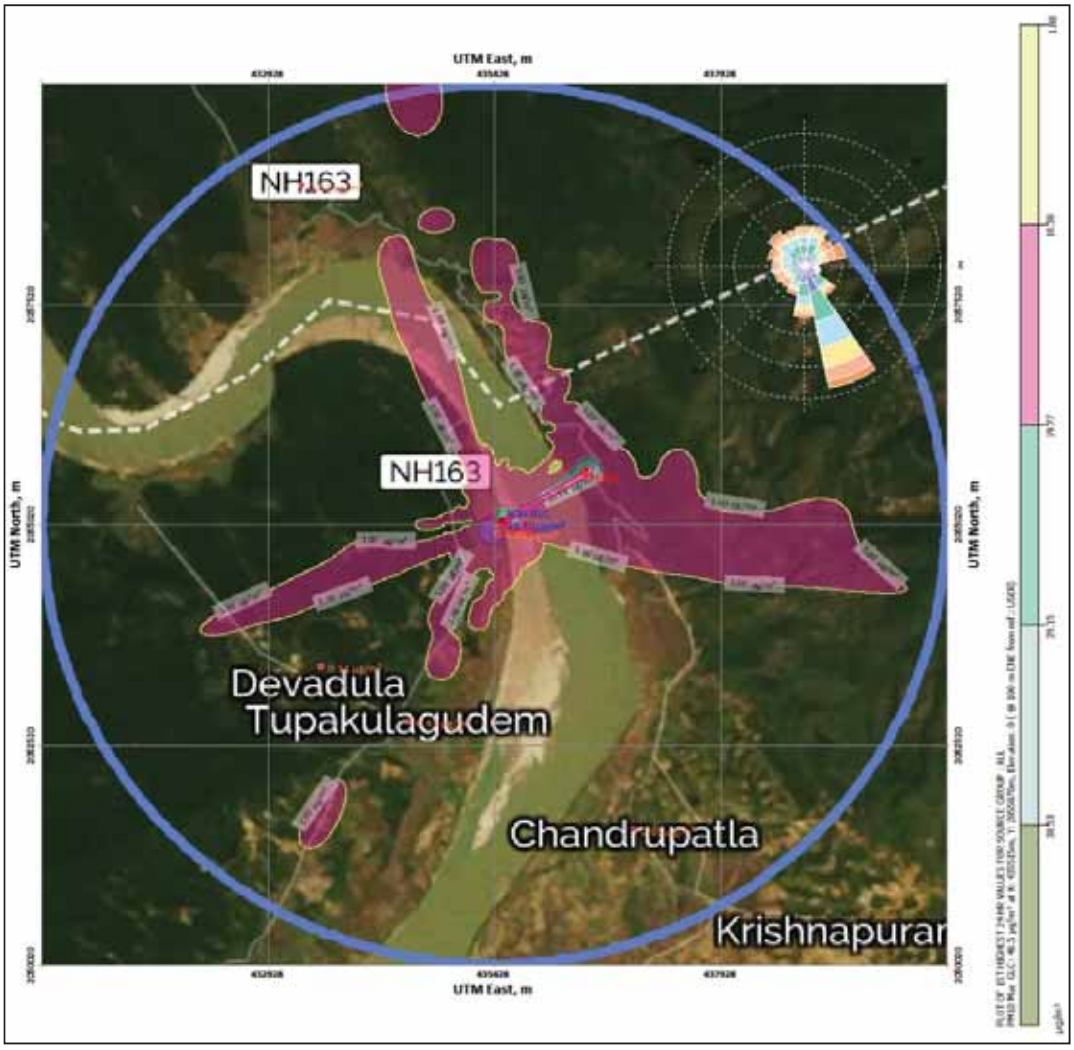

Fig 4.1 Isopleth drawn for PM without mitigation measures

[59] Andrew M. Farmer (1993), The Effects of Dust on vegetation - A Review, *Environmental Pollution*. 79, 63-75

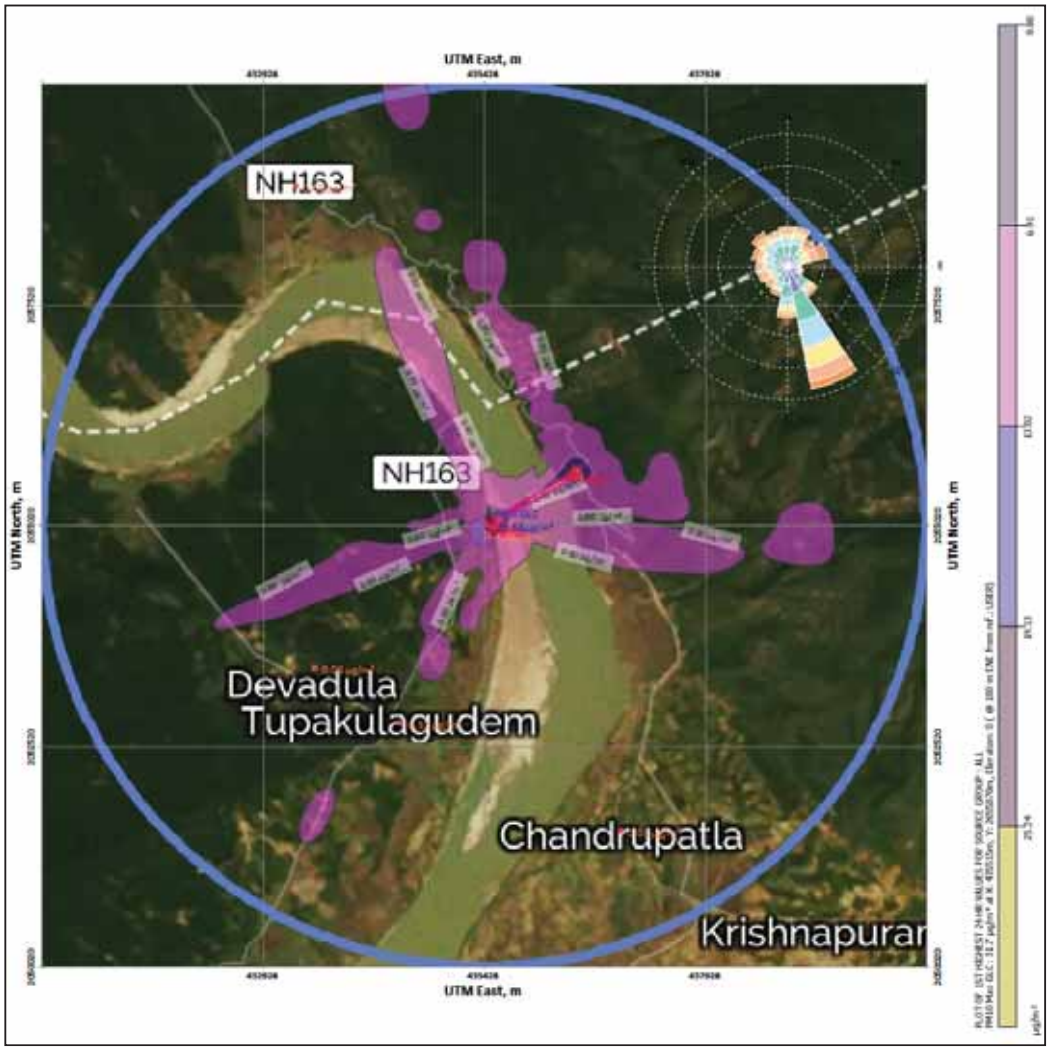

Fig 4.2 Isopleth drawn for PM with mitigation measures

4.1.2 Noise Environment

4.1.2.1 Sources of noise pollution

- During construction phase, various sources of noise pollution arise due to Concrete Batch Plant, Crane, Generator, Tractor, Welder, Vibrating Hopper etc. This will increase ambient noise levels (75-85 dB (A)) and causes discomfort in residents of Thupakulagudem village located at 0.58 km.
- Other source of noise pollution includes movement of vehicles for unloading of construction materials, fabrication, handling of equipments.
- Construction activities are expected to produce noise levels in the range of 80 – 95 dB (A).

4.1.2.2 Prediction of noise levels by using dhwaniPRO Noise Model

dhwaniPRO noise model is developed to undertake construction, industrial and traffic noise propagation. The model is used to predict the impact of noise on receptors from the noise generation source. It is also used to predict impact due to group noise sources in the industrial complex (multiple sound sources) and traffic[60]. Various noise source and receptors were considered within 10 km radius of study area.

For every one point source the nearest habitat area is considered as receptor. And the predicted noise level at source and the predicted noise level at receptor site are as follows.

Table 4.1 Results of Noise prediction model

Sl. No.	Name of The source location	Name of the receptor location	Model noise level in dB(A) at receptor	CPCB std day time in dB(A)
1	Barrage location	Within project site	32.35	55
		Eturnagaram Wild life sanctuary – ESZ boundary	25.74	
		Thupakulagudem village	19.93	

Based on the model results, the noise levels at various sensitive receptors during construction period will be within the CPCB standards. However, due to movement of vehicles and operation of larger construction equipments, the increasing noise levels affect Thupakulagudem village (601 populations). Further, the increasing noise levels of about (85-90 dB(A)) due to drilling and blasting will disturb the avi-fauna and faunal habitats residing in the buffer zone of the WLS upto 1 Km. Continual exposure to increased noise levels will create mental stress in construction laborers and villagers of Thupakulagudem.

[60] Environmental Impact Assessment, A practical guide for Professional practice, 2016, A K A Rathi, PP110

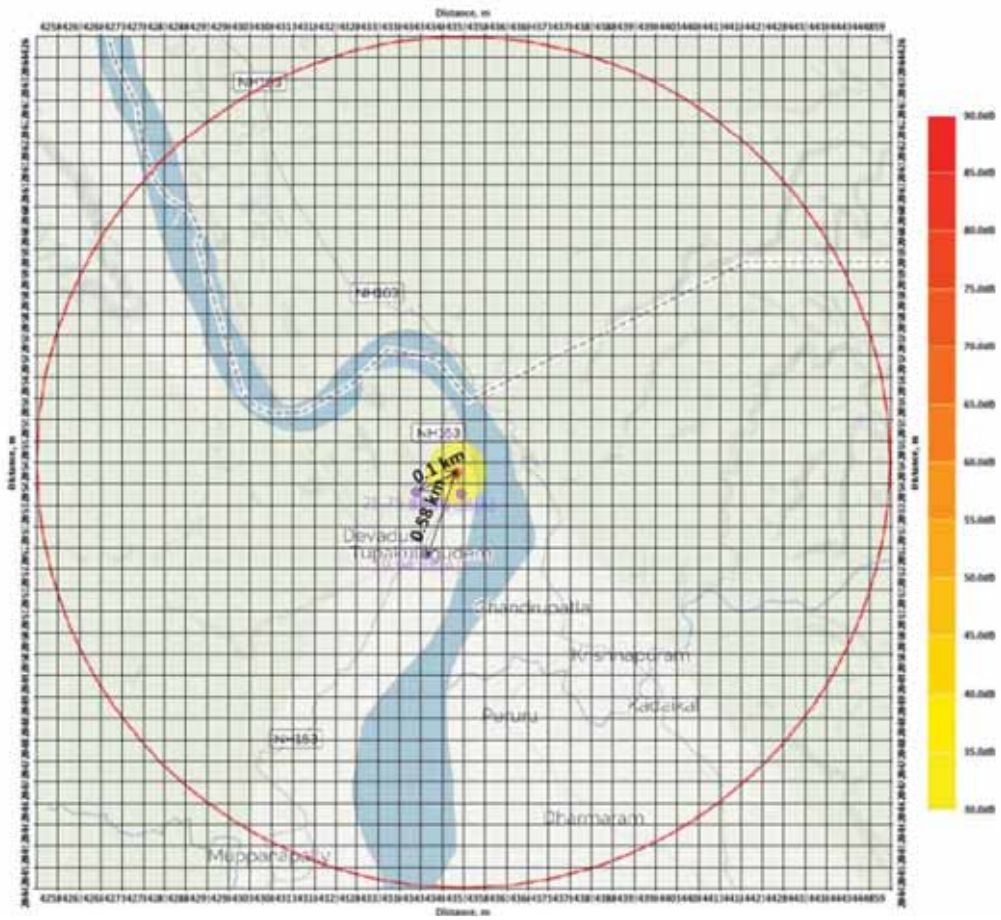

Fig 4.3 Isopleth drawn using dhwaniPRO software

4.1.2.3 Mitigation Measures

- DG sets will be placed on the rubber cushion padding, enclosed and maintained well in good condition. It will be encased and barricaded & taken to all places where it will be used. This reduces the noise level in and around the source by at least 4 dB (A). Mobile DG sets are more advantageous and preferred here.
- Ear plugs will be provided to all employees and laborers while working, irrespective of the noise levels as protection, to receive the noise and as well as exposure of the same for a longer period.
- Barricades will be provided around the construction areas. Speed limit of vehicles will be restricted to 15-20 kmph in and around the construction site. No honking boards will be displayed within the construction areas.
- During construction time, possible chances of number of trucks coming to the project area is more carrying construction debris and other materials, muck etc and the drivers of these

vehicles will be instructed with sign boards and not to use shrill horns for any purpose and cover the material without any spillage.

- Silent Zone boards will be installed at all places where human activities are there along with proper training to them to handle various equipments, tools and other related items.
- The noise levels will be monitored periodically (monthly) in the project area.
- Construction activities will be carried out only between 6 am to 6 pm and completely suspended during night time to avoid psychological distress on people of Thupakulagudem village and avifauna in the buffer zone.
- Supervisory staff will be advised to check and monitor to ensure the workers to follow all the above said measures while at work.

4.1.2.4 Vibration

- Wherever the heavy equipments are used, which can generate vibration; rubber beadings and proper support to the ground with thick blankets of rubber mats are preferred.
- The moving parts of the equipment will be greased well and covered by rubber sheets to arrest the vibration.
- Controlled blasting will be employed during drilling and blasting to avoid vibrations which can affect structures of Thupakulagudem village and burrow animals and reptiles.

4.1.3 Water Environment

4.1.3.1 Sources of water pollution

- Improper treatment of sewage from labour camps leads to infiltration into the subsurface soil and finally affects the quality of ground water. Labour camp is expecting to generate 30 KLD of sewage (considering 75 lpcd for 400 labors) which is anticipated to pollute ground water in an area of 2 ha from the source at 60-70 m bgl[61]. Further, the source of pollution is at a distance of 500 m to the Thupakulagudem village. Hence, the chances of pollution to drinking water will be nil.
- Improper management of domestic solid waste from labour camps & dumping near water bodies leads to surface water pollution.
- There will be creation of unaesthetic conditions in the site, attracts mosquitoes/flies, thereby chances of deteriorating the health of the workers in unhygienic conditions and it also affects people of Thupakulagudem village.

[61] Ground water Pollution, Environment Agency, Bristol, England, 1-14 (http://ea-lit.freshwaterlife.org/archive/ealit:1635/OBJ/20000566.pdf)

- Improper disposal of construction debris, used oil, diesel for DG sets, etc will result in Godavari River water contamination leads to decrease in DO levels and morbidity of aquatic life.
- Improper management of excavated earth (42,52,579.12 cum) and dumping of muck, boulders into the nearby river will create turbidity of water and in turn affects river water quality and aquatic life.

4.1.3.2 Mitigation Measures

- The sewage generated from the labor camps will be treated in mobile STP installed at site. Solid waste from labour camps will be collected in different bins and handed over to nearby municipal authorities.
- There will be no open discharge of sewage from labor camps and the labor camps will be provided with sufficient bathrooms and toilets. Prevention of possible water logging areas through soil filling. Periodical health check-ups (6 monthly once) will be conducted for labors and also to Thupakulagudem village people.
- Construction debris will be reused at site; used oil generated from the DG sets will be stored separately and handed over to TSPCB authorized recyclers. Further, the leakages of oil spills from machinery shall be collected in leak proof barrels and then disposed off to TSPCB authorized dealers.
- During construction of barrage, the river course and the point of contact will be provided with sand bags and rock boulders.
- Implementing Muck Disposal Plan: Further excavated earth will be fully utilized for various construction works such as inspection path, stabilization of embankment, land levelling.

4.1.4 Soil Environment

4.1.4.1 Sources of soil pollution

- Temporary loss of soil will be envisaged during the construction of temporary offices, labour camps, haul roads, stockyards will be located on 26 ha of agriculture lands.
- Improper disposal of Solid waste generated from labour camp (180 Kgs/day) during construction phase will create leaching problems thereby affecting soil biota and ground water. Further, it also creates un-aesthetic conditions to Thupakulagudem village people.

- Leakage of used oil from DG sets on the land will impact the soil biota. Oil spill affects plants negatively by creating conditions which makes essential nutrients like nitrogen, Oxygen etc needs for plant growth unavailable to them from the spilled affected soil[62].

4.1.4.2 Mitigation Measures

- Restoration of 26 ha of land utilized as construction site, temporary offices, workers camps, stockyards will be undertaken soon after the completion of barrage construction.
- Scientific disposal of soild waste will be undertaken and handed over Eturnagaram Mandal panchayat.
- Maintenance and period repairs of machineries will not be taken up in the project site vicinity. Maintenance of DG sets will be done at the vendors place and will not take up near project site.
- Storm water drainages and underground drainage of seepage water from construction area will be provided with retention tanks to hold for at least 2 hours and periodic cleaning of silt collected in the tanks.

4.1.5 Land use assessment

4.1.5.1 Impacts

- The construction of barrage across the river and submergence of 580.18 ha leads to permanent change in land use.
- Present rain fed area will be converted into irrigated area. Hence, possibility of Salinization will be expecting in an area of 830 ha[63].
- Providing irrigation, Tank filling and drinking water increases employment opportunities, ground water recharge, enhances local biodiverisity and health benefits to the project benefitting districts.
- Application of Inorganic fertilizers in the command area will impact on the intrinsic nutrient availability of soil, soil biota, resulting to decline in productivity/yield of soil which in turn changes the agricultural land use pattern in the command area.
- Disturbance to the natural flow of Godavari River is anticipated because of construction of barrage.

[62]oyem, Isama Lawrence Rank, oyem, Isama Lawrence Effects of Crude Oil Spillage on Soil Physico-Chemical Properties in Ugborodo Community, Vol. 3, Issue. 6, Nov - Dec. 2013 pp-3336-3342.

[63] Drip Irrigation in Salt Affected Soil (2013), Blaine Hanson et al., University of California, p.58.

- The present command of JCRDLIS and SRSP are suffering command area of existing irrigation schemes and deprived of irrigation facilities and could not achieve the targets due to scarce water availability. Drinking water demand is also not met.

4.1.5.2 Mitigation Measures

- Treatment of saline and sodic soils will be undertaken in consultation with Agricultural Department.
- Agricultural training programmes will be conducted to the farmers in the command area in association with agricultural department, Govt., of Telangana. Organic farming practices will be promoted.
- To ensure natural flow of water, gated arrangements provision will be made.
- The proposed barrage in the scheme will stabilize the existing schemes there by change in Land use pattern from rain fed to irrigated system. There is also provision of drinking water supply (50 TMC) in the scheme.

4.1.6 Impact on Solid & Hazardous Environment

4.1.6.1 Impacts

- Solid Waste of 180 Kg/day (0.45 Kgs/day/person) will be generated from the labour colony like kitchen waste, garbage, plastic waste, etc. Improper management of solid waste from the labour colony & irregular practice in disposal of waste leads to spread of infectious diseases and un-aesthetic condition.
- Improper storage of solid waste leads to leachate formation of 13.86 Cu.m/year[64] which will affect the surface water quality and aquatic life.
- Indiscriminate plastic waste disposal on land makes the land infertile due to its impervious nature and also affects wild animals of adjacent Eturnagaram WLS.
- Improper management in storage of muck, excavated earth & Boulders will affect the natural flow of water and will result in turbid condition (1 km u/s and d/s of barrage area) of Godavari River affecting aquatic life. Sometimes muck moves along with the runoff creating landslides which leads to sedimentation and also affects yields of neighboring farmers.
- 50 l/annum of used oil is anticipated from the DG Sets of capacity 2 x 500 KVA. Improper storage and disposal affects surface water quality and aquatic life.
- 200 liters of paint is required during construction phase and the improper disposal of containers affects surface water quality and aquatic life.

[64] TNT Ibrahim et.al (2017), Estimation of leachate generation from MSW landfills in Selangor Asian Jounral of Microbiology, Biotechnology and Envi. Sciences, Vol. 19 (1), 43-48

- Welding electrodes and unused iron components including scrap of 105 tonnes (2% of total steel requirement) is anticipated during construction activities. Improper handling of these affects surface water quality and aquatic life.

4.1.6.2 Mitigation Measures

- Soild and hazardous wastes generated will be stored in the leak proof bins. Scientific segregation of solid waste at site and regular disposal to Eturnagaram Mandal municipal authority's landfills. Storage area 5 m x 5 m will be covered with zinc sheets and the ground will be covered with impervious layer to avoid leachate run off. Pest control will be done periodically (quarterly once) in and around labour camps and project site office areas.
- Monthly surface water quality testing as per IS 10500 Drinking Water Quality Standards and quarterly study of aquatic life. Cost has been worked out accordingly.
- Plastic waste will be segregated at source and handed over to TSPCB authorized recyclers.
- Water sprinkling will be done 3 times a day to avoid fugitive emissions and the excavated earth and muck will be stored in designated areas at lower contours.
- Used oil generating from the DG sets and paint containers will be handed over to authorized recyclers.
- Implementation of muck disposal plan.
- Generated muck from the project will be stored and covered with the green mesh in the designated place along with construction of bunds around it and will be reused later.
- The leftovers of welding electrodes and iron components will be handed over to the nearby engineering works centre so as to remould and reuse them for making other iron works.

4.1.7 Impact on Hydrology & Geology

4.1.7.1 Impacts

- Geological Environment: As the proposed project site i.e., Barrage is proposed over the Godavari River the litho unit covering is Sandstone and Shale to store water for strengthening the existing Devadula LIS upstream so that water is available continuously to the project command area. As such there is no disturbance or alteration to the local Geology.
- Seismic tectonics: Seismic activity with respect to the proposed barrage was studied at the possibility during the post project scenario. It was observed that no major earth quakes occurred in the region during the past 49 years. However, the recent recorded major earth quake of magnitude 6.2 on Richter scale to the project site was in Ausa, Maharashtra during 1993. The seismic zoning map has been referred to know the zone in which the project site

is located. The proposed project site is falling in Zone-III which has very moderate risk of damage.

- Changes in hydraulic regime: During the construction phase, no severe affect on a water availability and hydrology is anticipated. Based on the Detailed Project report of WAPCOS Limited for I&CAD Telangana the required water of 100 TMC is available.
- Due to flooding, soil erosion and increasing sedimentation leads to submergence of adjacent lands of 462 ha of villages Thupakulagudem, Gangaram, Thimmaigudem, Venchepally and Mukunur and adjacent forest area.
- Impact on structural stability and breaching of barrage.

4.1.7.1 Mitigation measures

- The maximum flood recorded between 1966-2015 was in the year of 1986 with a discharge of 62,889 cumecs with a water level of 87.42 m. Hence, the occurrence of flood is not frequent. The gates will be operated during high flood season to release downstream. However, suitable emergency action plan will be initiated to restore the area. In order to avoid soil erosion and sedimentation, CAT plan will be implemented (Chapter-9).
- Sub-surface exploration has revealed the occurrence of bed rock below the sand cover is 3.5m to 8.5m and the rock is dark grey schistic Quartzite or Quartzo-schistic rock, in the center of the river bed, the rock is hard and massive, but highly fractured, with low core recovery noted as maximum as 65%, which is good to be tied up the barrage.

4.1.8 Impact on Biological Environment

4.1.8.1 Impacts

- Eturnagaram Wildlife Sanctuary is located at a close proximity from the proposed barrage (<5 Km). However, no rare, threatened, endangered plant species were recorded during the study and all the other species recorded were common to the region. Avifaunal species such as Shikra, Jerdon's courser, Indian peafowl, Common buzzard and Booted eagle; butterfly namely Common pierrot and mammals such as Black buck, Four horned antelope, Indian wolf and Sloth bear were recorded during the study in the project site as well as in the command area which belongs to Schedule I of W(P)A, 1972.
- About 30 ha of land have been identified for carrying out construction activities close to the River Godavari. Out of which, 26 ha are agricultural lands and remaining area is waste land followed by riparian land. Totally, 800 trees of different girth size (<30 cm is 700 and >30 cm is 100) will be removed.
- The project is being proposed in the river bed/private lands only and therefore no requirement of forestland in Eturnagaram Wildlife Sanctuary. But during discussions held

with PCCF (Wildlife), Govt of Telangana, it was mentioned that the project is touching the outer periphery/boundary of ESZ of Eturnagaram Wildlife Sanctuary. Based on the discussions and observations by State forest authorities necessary proposal/permission, if required, will be obtained from Competent Authority. Emission of dust is expected during vehicular movements for transportation of construction material or construction waste during construction phase which would reduce the photosynthetic activity in plants by its deposition on the foliage.

- Mobilization of machineries and workers during construction phase will create disturbance to the mega-faunal species/ wildlife due to the presence of Eturnagaram WLS.
- Construction activities will affect the aquatic biota of River Godavari upto 1 Km and reptiles and burrow animals upto 1 Km due to vibrations generated from machineries and disturbance in the river bed area
- Emission of dust is expected during vehicular movements for transportation of construction material or during construction phase which would reduce the photosynthetic activity of 3, 42,300 trees plants by its deposition on the foliage.
- During the construction of barrage across Godavari River, fish species move towards certain safe locations. However, minor impacts on fish species will be anticipated on either side of the barrage upto 100 m.
- Construction activities will affect the aquatic biota of River Godavari due to vibrations generated from machineries and disturbance in the river bed area.
- While undertaking the construction of the barrage across the River Godavari and related components, controlled blasting and such; other measures are to be adopted. The extracted produce-earth, muck, boulders, etc are normally dumped, as a routine practice in such exercises very close to the lotic water bodies; result being the flow of water in the system gets altered affecting the aquatic life-fish species present in their migration exercises for feed, feeding, breeding and recruitment needs for sustenance and propagation.
- Fish species, as a result of certain changes in the environment at the site, may get locked-up in water–holding pools where these strive to sustain their biological needs. Suggestions to be incorporated have been listed in the Environmental Management Plan.
- There will not be any type of 'Negative' impact/s on the quality and status of the river water during the operation phase.
- Since the present human settlement/ village is located close to the envisaged project site, the quality of the river water getting affected causing medical problems could be in marginal limits during the construction phase. However, the labour force and others being

assembled at the spot/locality in large numbers for the execution of the envisaged project offers opportunities for the spread of communicable health disorders, the prevalence of which may get affected/impacted for days to come.

- While constructing the barrage and related facilities, considerable quantum of rocks, boulders, earth, etc. being extracted which, as a normal/usual practice in such situations, are dumped in close location. In order to prevent the sliding back into the water body affecting normal flow regime, are to be secure appropriately quiet away from the river in particular. Also, screens of desirable mesh–sizes depending upon the height and width etc to cover advantage points are to be installed in order to maintain normal biological processes of aquatic life fish species prevailing.
- There will not be any adverse impact/s on the aquatic life- fish species in particular habitat in the biotope on the implementation of the suggestions made. Flow of river water, as envisaged, to the riparian part of the lotic water body at the site will be maintained quite adequately to keep the pools and such other water- holding facilities harbored with fish species to sustain their biological needs.

4.1.8.3 Mitigation Measures

- Conservation plan for schedule I species will be implemented in the operation phase (Chapter – 9).
- Restoration of vegetation will be carried out to compensate (26 ha) the land identified for carrying out construction activities (Chapter – 9) as well as along the left and right bank of the proposed barrage by carrying out plantations at the ratio of 1:3 so as to improve the ecological environment.
- Periodic sprinkling of water (3 times a day) to the plants for alongside the access roads to the construction site will reduce the deposition of dust on the foliage and thus retaining their photosynthetic activities.
- Utilization of modern equipments during construction phase can produce less sound and vibrations reducing the disturbances to the faunal species including avifauna and wildlife. Construction activities shall be carried out only during the day time so as to reduce the impacts on the nocturnal animals and other mega-faunal species.
- It is proposed to construct the temporary structure to arrest the flow by using rock boulders to avoid turbidity of water and modern technology such as controlled blasting will be used to minimise the vibrations not beyond 100 m.

- Screens of desirable mesh sizes depending upon the height and width to cover advantage points will be installed in order to maintain normal biological processes of aquatic life and fish species prevailing.
- Appropriate measures will be taken with utmost caution and at desired levels to stall flow of the medium suspecting to hold any harmful/un-hygienic extraneous content in order to maintain the quality, potability and related nature of the lotic system.
- The people: work force, business establishments, etc. must shift away from their temporary dwellings and commitment arrived at earlier itself i.e., prior to the establishment of the project envisaged to minimize the spread of communicable health disorders.
- After the commissioning of the project, limnological and fisheries investigations need to be organised for a period of 3-5 years (on quarterly basis) at least to assess the overall picture on the physico-chemical features of the river water at the site and close-by areas, biological aspects such as plankton biomass, benthic/littoral faunistic elements, aquatic vegetation, exotic fish, if present so as to introduce corrective measures to sustain normal ecological features and to introduce effective technical measures based on the data generated during the course of the studies.

4.2 Impacts during Operation phase

- Failure of this project would result in socio-economic sufferings, no assured water for agriculture and farmers would largely experience drought like situations to a greater extent.
- No severe affect on a water availability and hydrology is expected in the downstream areas due to construction of barrage. 100 TMC of water for the proposed project is available and the clearance has been sought. In addition to this, water flows will not be affected as Maner, Pranahita and Indravathi are major contributors to River Godavari.
- Construction of barrage will affect the migratory paths of aquatic fauna of River Godavari leading to depletion of fish population.
- Pollution by pesticides used for crop protection results in surface water pollution affecting aquatic ecosystem.
- Salinization of irrigated land, pollution by pesticides used for crop protection affects the crop yield
- Abstraction of 100 TMC of water will reduce the water availability in the river causing impacts on fish germplasm (aquatic life).
- As the agricultural practices flourish with availability of water, usage of pesticides and application of fertilizers will naturally increase which leads to soil quality deterioration.

- The recharge to aquifer will be boosted once extensive agriculture is practiced a portion of water will be infiltrated in to ground recharging the aquifers. In addition to this, artificial recharge of the aquifers by construction of suitable harvesting structures like farm ponds, nala bunds, check dams and also desilting of tanks.
- As the drawal of water is minimized, the water table will rise and many of the borewell will yield substantial water.
- During the operation phase, no medical/health problems to the residents and the migrant labour, business force on contract for the envisaged project work could be forecast now.

4.2.2 Mitigation measures

- The project has been planned due to persistent demands of local people keeping in view of water availability at Godavari River. As such, failure will not be anticipated due to water availability.
- Special Land Acquisition Officers for this project will be engaged to resolve the matters related to land acquisitions and compensations.
- Restrictions on time, method and rate of application of fertilizers and pesticides will be imposed to avoid surface run-off and leaching on to the groundwater regime.
- Organic farming related agricultural extension activities will be undertaken with the support of Agriculture Dept., to ensure optimal use of Fertilizers and Pesticides in the command area so as to minimize the impact on aquatic ecosystem.
- Reclamation of salt affected soils and optimum use of pesticides will be encouraged to reduce the impacts.
- The construction of barrage does not affect the migratory paths of the fishes as the sluice gates of the barrage provide an access for the fishes to cross the barrier.
- Minimum environmental flow (e-flow) will be maintained during lean season and as per the Global Environmental Flow Calculator Model (GEFC) results reveal that, 64% of the river condition will be maintained 'natural', 39% with slightly modified condition and there will be minimum seriously modified (7%) and critically modified condition (4%).
- Desired medical facilities are to be organised to meet any emergency.

4.3 Evaluation of Impacts

Matrix method was used to identify interactions between various project activities and environmental parameters and components. Later, a weightage of 1-10 will be given to the impacts based on the significance of the impacts. The impacts are quantified 'with' and 'without' EMP.

Table 4.2 Criteria for evaluation of impacts

Sl.No	Criteria	Score
1	Minor impact	1-2
2	Medium impact	3-4
3	Significant impact	5-8
4	Major impact	9-10

Table 4.3 Evaluation of Impacts

Sl. No.	Environmental Attributes	Project Activities	Nature of Impacts										
			Magnitude	Reversible	Irreversible	Long Term	Short Term	Direct	Indirect	Positive	Negative	Without EMP	With EMP
A. Construction Phase													
1. Impacts on Air Environment													
1	Increase in dust concentration	Construction equipments, Operation of DG sets.	M	✓			✓	✓			✓	3	1
		Excavation	H	✓			✓	✓			✓	10	4
		Rate of transpiration of trees	L	✓			✓	✓			✓	4	1
2	Fugitive Emissions from various sources	Vehicular movement	H	✓			✓	✓			✓	8	4
		Loading and dislodging, Use of sand, fine aggregates	M	✓			✓	✓			✓	6	4
		Batching plant	M	✓			✓	✓			✓	7	3
		Improper Storage of muck	H		✓	✓		✓			✓	9	6
3	Increase in SO_2, PM, NOx	Vehicular movement	M	✓			✓	✓			✓	6	3
		Operation of DG sets	M	✓			✓	✓			✓	6	3
		Fuel Combustion in equipments and Vehicles	M	✓			✓	✓			✓	5	4
		Burning of fuels from construction workers	M	✓			✓	✓			✓	5	3

Sl. No.	Environmental Attributes	Project Activities	Nature of Impacts										
			Magnitude	Reversible	Irreversible	Long Term	Short Term	Direct	Indirect	Positive	Negative	Without EMP	With EMP
4	Impact on Human Health	Emission of Dust particles	M	✓			✓	✓			✓	7	4
2.	**Impact on Noise Environment**												
1	Increase Noise Level	Movement of vehicles	M	✓			✓	✓			✓	6	4
		Operation of D.G sets	L	✓			✓	✓			✓	4	1
		Movement of vehicles carrying raw materials	M	✓			✓	✓			✓	6	4
3.	**Impacts on Water Environment**												
1	Eutrophication	Sewage from labor camp	H	✓			✓	✓			✓	10	2
2	Change in River Water Quality	Construction of proposed barrage	M	✓			✓		✓		✓	8	2
		Diversion of river water	H		✓	✓		✓		✓		10	2
		Decomposition of sediments and deposition of organic matter	M		✓		✓	✓			✓	6	2
		Washing of equipments	L	✓			✓	✓			✓	4	2
		Disposal of construction debris, used oil, diesel for DG sets	M	✓			✓	✓			✓	6	2
		Muck disposal	M	✓			✓	✓			✓	7	2
3	Change in ground water quality	Sewage from labor camp	M	✓			✓		✓		✓	7	2
4	Impact on human health	Unaesthetic conditions & water logging	M	✓			✓		✓		✓	6	2

Sl. No.	Environmental Attributes	Project Activities	Nature of Impacts										
			Magnitude	Reversible	Irreversible	Long Term	Short Term	Direct	Indirect	Positive	Negative	Without EMP	With EMP
5	Sedimentation	Movement of Muck along with Runoff	M		✓	✓		✓			✓	7	2
4. Impacts on Land Environment													
1	Land	Construction of proposed barrage	M		✓		✓	✓			✓	7	4
		Excavation for proposed barrage	H		✓	✓		✓			✓	10	4
		Vehicular movement	M	✓			✓	✓			✓	3	1
2	Change in Topography	Submergence	H		✓	✓		✓			✓	10	7
3	Change in natural flow of water	Storage of excavated earth and Boulders	H		✓	✓		✓			✓	9	7
4	Loss of Productive Soil	Construction site, temporary offices, workers camps, stockyards	M	✓			✓		✓		✓	7	4
		Construction of Haul roads	L	✓			✓	✓			✓	4	2
		Excavation for proposed barrage	H		✓	✓		✓			✓	10	2
5	Compaction of Soil	Site Clearance	L	✓			✓	✓			✓	4	2
		Movement of vehicles	L	✓			✓	✓			✓	4	2
6	Contamination of Soil	Machinery and operation of the Diesel Generator Sets	M		✓		✓		✓		✓	5	2
		Labor camps/ Improper practices in disposal of waste	M		✓		✓	✓			✓	5	2
5. Impact on Soil Environment													

Sl. No.	Environmental Attributes	Project Activities	Nature of Impacts										
			Magnitude	Reversible	Irreversible	Long Term	Short Term	Direct	Indirect	Positive	Negative	Without EMP	With EMP
1	Soil pollution	Temporary loss of soil may be envisaged during the construction phase	M	✓			✓	✓			✓	4	2
		Leaching of solid waste generated from labour camps	H	✓			✓		✓		✓	9	4
		Leakage of used oil from DG sets on the land	H	✓			✓	✓			✓	9	6
		Improper handling of excavated earth	H	✓		✓			✓		✓	10	4
6. Impact due to Solid and Hazardous environment													
1	Land pollution	Improper maintenance and storage of excavated earth, dumping of muck, boulders, etc and oil from DG sets into the river affects natural flow regime	H		✓	✓		✓			✓	10	6
		Improper management of domestic solid waste from labour camps and dumping near water	M	✓			✓		✓		✓	7	4
		Impact on wildlife	M	✓			✓		✓		✓	7	2
		Paint and iron remains	H	✓			✓		✓		✓	9	6
7. Impact on Biological Environment													

Sl. No.	Environmental Attributes	Project Activities	Nature of Impacts										
			Magnitude	Reversible	Irreversible	Long Term	Short Term	Direct	Indirect	Positive	Negative	Without EMP	With EMP
1	Pressure on existing natural resources	Immigration of labour population	L		✓	✓		✓			✓	4	1
2	Pressure on biodiversity of Eturnagaram WLS	Construction activities	L		✓	✓		✓			✓	4	2
3.	Reduced Photosynthetic activity, Wilting of plants	Transportation of construction materials	M		✓		✓		✓		✓	4	2
		Site Clearance	M		✓	✓		✓			✓	4	2
4	Impacts on Fishes and Aquatic Ecosystem	Changes in the physical environment at the site	H		✓	✓		✓			✓	9	6
		Change in quality of River water	H		✓	✓		✓		✓		4	2
		Increase in turbidity of water due to Washing of machineries	M	✓			✓	✓			✓	4	2
		Sewage from labour camp	H	✓			✓	✓			✓	6	4
		Entering of Boulders to river	H		✓	✓		✓			✓	9	6
		Dumping of extracted produce-earth, muck, boulders, etc	H		✓	✓		✓			✓	10	6
5	Schedule I species in the study area	Construction activities	M		✓		✓		✓		✓	6	2
6	Nearby agro-ecosystems	Construction activities	H		✓	✓		✓			✓	9	6
8.	**Impact on hydrology and geology**												
1	Geological Environment	Construction of barrage	L		✓	✓		✓			✓	4	2

Sl. No.	Environmental Attributes	Project Activities	Nature of Impacts										
			Magnitude	Reversible	Irreversible	Long Term	Short Term	Direct	Indirect	Positive	Negative	Without EMP	With EMP
2	Seismic tectonics	Construction of barrage	L		✓	✓		✓			✓	3	1
3	Changes in hydraulic regime	Water availability due to construction of barrage	L		✓	✓		✓			✓	3	1
9. Impact on Socio-economic Environment													
1	Land acquisition	Affecting livelihood	H		✓	✓		✓			✓	10	7
2	Impact on Human Health	Due to water/air borne diseases, traffic movement	H	✓			✓		✓		✓	9	4
B. Operation Phase													
1	Impacts on Land Environment	Application of natural fertilizers and pesticides	H		✓	✓		✓		✓		9	4
		Salinity of irrigated land	M	✓		✓		✓			✓	4	2
		Solid and hazardous waste generated during operation phase is negligible.	M	✓		✓		✓		✓		5	3
2	Land use	Rain fed area is converted into irrigated area	H	✓		✓		✓		✓		9	3
		Ground water recharge	M	✓		✓		✓		✓		5	2
		Enhances local biodiversity	H	✓		✓		✓		✓		9	1
		Increase in employment opportunities	H	✓		✓		✓		✓		10	1

Sl. No.	Environmental Attributes	Project Activities	Nature of Impacts										
			Magnitude	Reversible	Irreversible	Long Term	Short Term	Direct	Indirect	Positive	Negative	Without EMP	With EMP
3	Impact on water environment	Application of fertilizers and pesticides	M		✓	✓			✓		✓	7	4
4	Impact on Aquatic life	Construction of barrage	H		✓	✓		✓			✓	9	4
5	Impact due to project failure	Land acquisition and lack of Power supply	H		✓	✓		✓			✓	9	4

Chapter 5. Analysis of Alternatives

The alternative alignments study was carried out and suitable location for barrage was proposed based on the factors like less damage to the environment, less forest area requirement, less land acquisition, techno-economic considerations etc. Based on the reconnaissance survey, environment considerations and detailed hydrological studies the final alternative intake site and the corresponding water conductor alignments have been finalized. Geological Investigation study was carried out for the barrage. The merits and demerits of the barrage alternative have been studied in detail.

Proposed Barrage: Two alternative alignments were considered for construction of the barrage. The comparison of alternatives with respect to environment is discussed below:

Table 5.1 Details of alternatives for the proposed barrage

Sl.No.	Components	Alternative Alignment I (Kanthanapally site)	Alternative Alignment II (Thupakulagudem site)
1	Location	Barrage Alignment-I is 17 km downstream of the existing Devadula project intake. Pond level is at 85.0 m. Godavari River at this site flows through a narrow gorge.	The proposed barrage alignment is 3 km downstream of the existing Devadula project intake. Pond level is at 77.0 m. Godavari River at this site flows through a narrow gorge.
2	Latitude and Longitude	18^0 27′ 40.22′′ N, 80^0 24′ 35.24′′ E	18^0 35′ 10′′ N, 80^0 23′ 36′′ E
3	Submergence	At the proposed pond level, there will be submergence of about 4 villages fully and 11 villages partially.	At the proposed pond level, there is no land submergence. Only river portion of about 580.18 ha of river bed area will be submerged.
4	Land Acquisition	As major part of barrage alignment rests on the river bed, the acquisition of land for construction of barrage is 7789.42 ha of land.	As major part of barrage alignment rests on the river bed, the acquisition of land for construction of barrage is 94 ha.

In view of the above reasons and Geo-technical considerations, the Alternative alignment -II is proposed as barrage axis for Thupakulagudem.

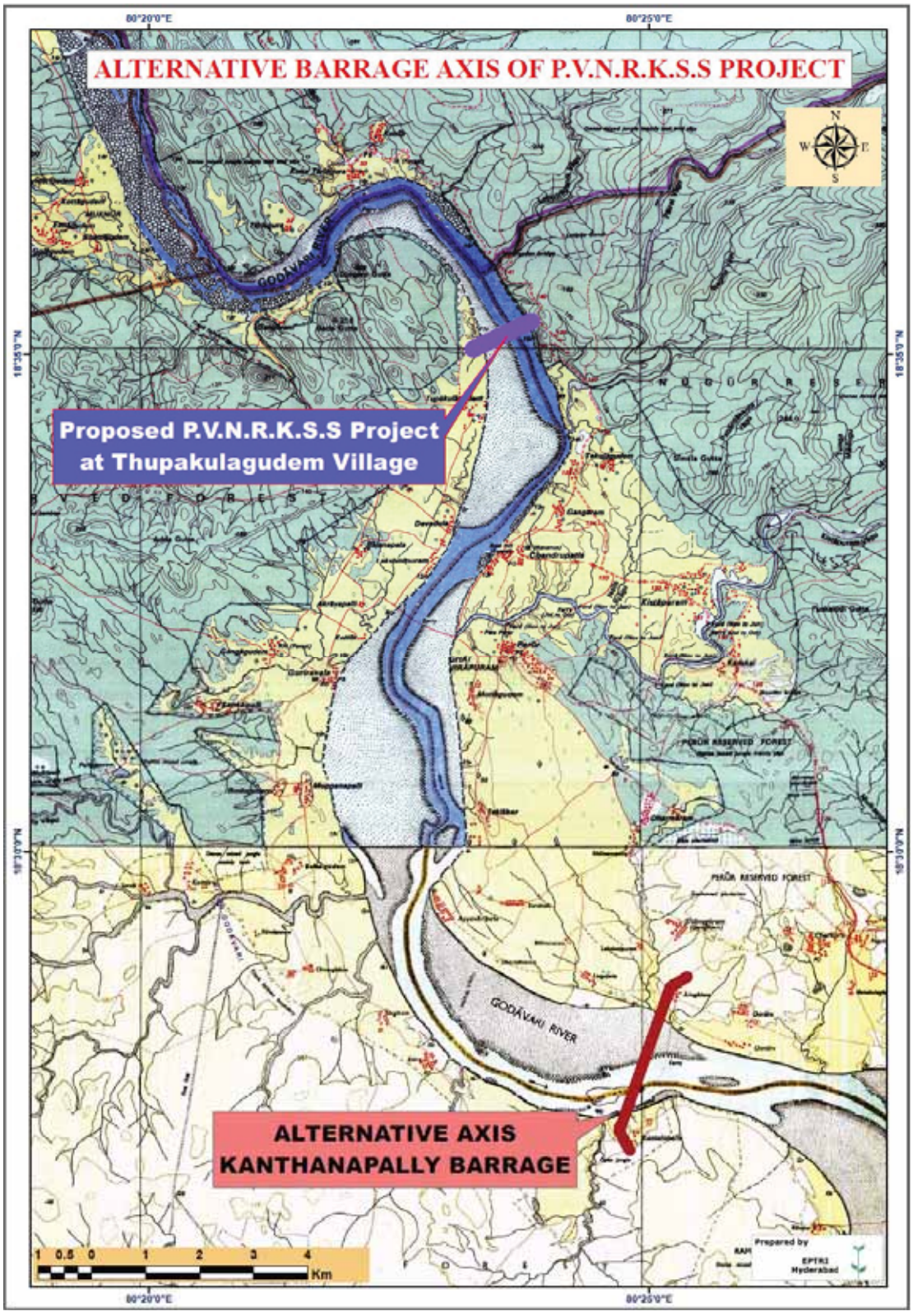

Fig 5.1 Map showing alternative sites for the proposed barrage

Chapter 6. Environmental Monitoring Program

The purpose of the monitoring programme is to ensure that the objectives of the project are achieved through the mitigation measures and result in desired benefits to environment and local population of the region. To ensure the effective implementation of the EMP, it is essential to carryout environment monitoring programmers given below.

Table 6.1 Environmental Monitoring Program for Construction phase (2 years)

Environmental Parameters	Parameters to be Monitored	Frequency of Monitoring	Locations	Responsibility	Estimated Cost in Rs.
Surface water quality of Godavari River	pH, Temperature, EC, TDS Alkalinity, TH, DO, BOD, COD, NO3, PO4, Cl, SO4, Na, K, Ca, Mg, Silica, Oil & grease and Total Coliform	Monthly once	Near Proposed Barrage Site, Downstream and Upstream of Godavari River (3 Nos.)	Irrigation & CAD Department Govt. of Telangana	19,560/-
Ground water quality	pH, Temperature, EC, TDS Alkalinity, TH,NO3, PO4, Cl, SO4, Na, K, Ca, Mg, Silica, Oil & grease &Total Coliform	Monthly once	Near Labour Camp (1 No.)	Irrigation & CAD Department Govt. of Telangana	4,670/-
Soil Quality	pH, EC, Mg, Ca, Alkalinity, Cl, Na, K, Organic Carbon, PO4, SAR, N and Salinity	Monthly once	Near Proposed Barrage (1 No.)	Irrigation & CAD Department Govt. of Telangana	5,470/-
Air Quality	PM10, PM2.5, NO2 and SO2	Monthly once	Near Proposed Barrage (1 No.)	Irrigation & CAD Department Govt. of Telangana	10,500/-

Environmental Parameters	Parameters to be Monitored	Frequency of Monitoring	Locations	Responsibility	Estimated Cost in Rs.
Noise Levels	Leq Day, Leq Night in dB(A)	Monthly once until completion of construction works	Near Proposed Barrage (1 No)	Irrigation & CAD Department Govt. of Telangana	7,000/-
				Sub-Total / month	**47,200/-**
				Sub-Total A - For 24 months	**11,32,800/-**
Aquatic life	Limnological and biological studies	Six monthly once until completion	Near Proposed Barrage (1 No.)	Irrigation & CAD Department Govt. of Telangana	1,00,000/-
Health check ups	Spirometry, Pulse Oxymetry, Blood Test, Lung Function Test, Eye test, Physical fitness tests	Six monthly once until completion	Labor camps (1 No.)	Irrigation & CAD Department Govt. of Telangana	1,50,000/-
				Sub-Total / 6 months	**2,50,000/-**
				Sub-Total B - For 24 months	**10,00,000/-**
				Total (A+B)	**21,32,800/-**

Table 6.2 Environmental Monitoring Program for Operation phase (3 years)

Environmental Parameters	Parameters to be Monitored	Frequency of Monitoring	Locations	Responsibility	Estimated Cost in Rs.
Surface water quality of Godavari River	pH, Temperature, EC, TDS, Alkalinity, TH, DO, BOD, COD, NO3, PO4, Cl, SO4, Na, K, Ca, Mg, Silica, Oil & grease, & Total Coliform	Quarterly once	Near Proposed Barrage Site, Downstream and Upstream of Barrage (3 Nos.)	Irrigation & CAD Department Govt. of Telangana	19,560/-
Soil Quality	pH, EC, Mg, Ca, Alkalinity, Cl, Na, K, Organic Carbon, PO4, SAR, N and Salinity	Quarterly once	Near Barrage Site (1 No.)	Irrigation & CAD Department Govt. of Telangana	5,470/-
				Sub-Total /3 months once	**25,030/-**
				Sub-Total A-for 3 years	**3,00,360/-**
Aquatic life	Limnological and biological studies	6 Monthly once for 3 years	Near Proposed Barrage Site (1 No.)	Irrigation & CAD Department Govt. of Telangana	1,00,000/-
				Sub-Total /6 months once	1,00,000/-
				Sub-Total B-for 3 years	**6,00,000/-**
				Total (A+B)	**9,00,360/-**

Chapter 7. Additional Studies

7.1 Social Impact Assessment

The idea of utilizing Godavari water to irrigate the water deficit and drought prone areas in the Telangana state was a long cherished dream gaining momentum subsequent to the formation of the new State. The general scarcity of water midst the large-scale canal irrigation development in neighbouring areas has further added to the long persisting demand of the local farmers for a reliable source of irrigation supply. P.V.Narasimha Rao Kanthanapally Sujala Sravanthi Project (PVNRKSSP) envisages construction of 1,132 meter long barrage across Godavari River near Thupakulagudem village, 3 km downstream of existing J.Chokka Rao Devadula Lift Irrigation Scheme. This is expected to stabilize existing scheme having command area of 2,51,310 ha and provide irrigation facility to a command area of 3,04,000 ha, besides providing 50TMC of drinking water to the enroute villages. Total land required for the project is 674.18 ha out of which 580.18 ha of river bed area and 94 ha of private land.

7.2 District highlights

- Jayashankar Bhupalapally District, with population of about 6.2 lakh is Telangana's 9th least populous district. There are 12 sub districts in the district, among them Ghanpur station is the most populous sub district with population of about 92000 and Tadavi is the least populous sub district with population of about 23000.
- The district is home to about 6.2 lakh people, among them about 3.1 lakh (50%) are male and about 3.1 lakh (50%) are female. 67% of the whole population are from general caste, 19% are from schedule caste and 14% are schedule tribes. Child (aged under 6 years) population of Jayashankar Bhupalapally district is 9%, among them 52% are boys and 48% are girls. There are about 1.6 lakh households in the district with an average 4 persons per family.
- In the district, nearly 88% (about 5.5 lakh) of the population lives in rural areas and remaining 12% (about 73 thousand) live in the urban areas.
- Hindus contribute 96% of the total population followed by Muslims (3%). Female Sex ratio per 1000 male in Hindus are 1003 in Muslims are 995.
- As of 2011 census there are 1003 females per 1000 male in the district. Sex ratio in general caste is 1003, in schedule caste is 980 and in schedule tribe is 1031. There are 932 girls under 6 years of age per 1000 boys of the same age in the district.

- Total about 3.5 lakh people in the district are literate, among them about 2 lakh are male and about 1.5 lakh are female. Literacy rate (children under 6 are excluded) is 62% with 71% male and 52% female literates.
- The district has 53% (about 3.3 lakh) population engaged in either main or marginal works. 56% male and 49% female population are working population. 51% of total male population is main (full time) workers and 6% are marginal (part time) workers. For women 39% of total female population is Main and 10% are marginal workers.

7.3 Demographic profile of the project influence area

The brief socio-economic profile of the Study area villages is given in the following sub-sections.

7.4 Data collection

The social profile of the project influence area was established through primary survey conducted in the area and secondary data. Socio-Economic survey was carried out on the PIA villages during December 2017–January 2018 and since the land to be acquired is nonresidential agricultural areas and hence titleholders were not available for responding. Some of them are living in faraway places and the survey team could not meet them. But maximum care was taken to meet the titleholders in person and interview them using the survey form attached (Annexure 20) and extract primary details. Besides this, all available secondary data sources including census survey data were analyzed to assess the socio economic, cultural and health status of the people living in these villages and those affected by the project, as discussed below.

- District Census Handbook, 2011- series30, part XII B
- Official Websites of Jayashankar Bhupalapally District and Departments
- Jayashankar Bhupalapally -Know your district published by Government of Telangana Planning Department, December, 2016.
- Demographic and Health Profile of Telangana state published by Indian Institute of Health and Family Welfare in November, 2015.
- Tribes of Telangana by Dr.Dyavanapalli Satyanarayana.

7.5 Project influence area

Project Impact Villages includes 5 villages – Thupakulagudem and Gangaram, of Kannaigudem, Thimmaigudem, Venchepally and Mukanuru of Palimela Mandal in Jayashankar Bhupalapally district were the PIA villages, as detailed in the Table 7.1 below. The people of these villages are directly impacted by the project due to land acquisition.

These 5 villages are Scheduled tribe dominant areas but are not classified under "Scheduled areas".

Table 7.1 List of villages and taluks covered for SIA study

Sl.No.	District	Mandal	Village Name
1	Jayashankar Bhupalapally	Kannaigudem	Thupakulagudem
2		Palimela	Thimmaigudem
3		Palimela	Venchepally
4		Kannaigudem	Gangaram
5		Palimela	Mukanuru

7.6 Demographic profile of PIA villages (census data 2011)

Demographic picture of the Project villages based on Census data 2011 was initially attempted as discussed below

7.6.1 Area and households

Total area of these 5 villages is 3667 ha and there are 473 houses there, as detailed in the Table 7.2.

Table 7.2 Area and households

Name of the village	Area in Hectares	Total Households
Thupakulagudem	255	176
Gangaram	180	45
Venchepalle	133	69
Muknur	2,928	122
Thimmatigudem	171	61
Total	**3667**	**473**

The total land area of villages and number of houses there gives the clue that on an average there is 7.8 ha of land per family, which also means that most of the land is agricultural land with few settlements in these villages.

7.6.2 Population and sex ratio

Total Population of these five villages together is 1852 and the sex ratio is 1049 for adults and 1056 among under five children, which is in favour of females. The sex ratio is defined as the number of females per 1,000 males in the population. This ratio for the State is 988 according to 2011 Census.

Table 7.3 Population and sex ratio

Name of the village	Total Population	Total male	Total female	adult sex ratio	Child (0-6)	Male	Female	child sex ratio
Thupakulagudem	601	277	324	1170	58	27	31	1148
Gangaram	160	86	74	860	16	10	6	600
Venchepalle	252	123	129	1049	27	12	15	1250
Muknur	640	324	316	975	55	29	26	897
Thimmaigudem	199	94	105	1117	27	11	16	1455
Total	**1852**	**904**	**948**	**1049**	**183**	**89**	**94**	**1056**

There is variation among these villages as shown In Table 7.3. Gangaram village have the lowest sex ratio of 860 among adults and 600 among children. Thupakulagudem shows the highest ratio of 1170 among adults. Generally the picture is better compared to the state average.

7.6.3 Social Composition of the population

As per 2011 Census, Telangana is the only south Indian state with tribal population of 9.34 percent out of its total population. The population consists of 15.45% scheduled castes, 9.34% scheduled tribes and others.

The villages under project implementation are Tribal areas with 81.2 % of tribes among total population. SC population is 9.3 percent and this status varies from village to village as detailed in the Table 7.4.

Table 7.4 SC and ST population

Name of the village	Total Population	Total SC Population	SC %	Male	Female	Total ST Population	ST%	Male	Female
Thupakulagudem	601	75	12.5	33	42	481	80.0	228	253
Gangaram	160	2	1.3	1	1	155	96.5	83	72
Venchepalle	252	9	3.6	6	3	228	90.5	109	119
Muknur	640	84	13.1	46	38	443	69.2	224	219
Thimmatigudem	199	3	1.5	2	1	196	98.5	92	104
Total	**1852**	**173**	**9.3**	**88**	**85**	**1503**	**81.2**	**736**	**767**

As per the data these are mostly Tribal villages and in Thimmatigudem village, 98.5 percent of the population belongs to ST category.

7.6.4 Tribal categories of the state and project area

Following 9 were declared as Scheduled Tribes in Telangana State under the Constitution (Scheduled Tribes) Order, 1950 (Published in the Gazette of India, New Delhi, dated September 6, 1950) with the assent of the President of India.

1. Andh
2. Bhil
3. Chenchu or Chenchwar.
4. Gond (including Naikpod and Raj Gond).
5. Hill Reddis or KondaReddis.
6. Kolam (including Mannarvarlu).
7. Koya (including BhineKoya and RaiKoya).
8. Pardhan.
9. Thoti.

In Karimnagar, Warangal and Khammam districts which constitute Jayashankar Bhupalapally District, the main Tribes are Koyas and Konda Reddis. Koyas live in symbiosis with Konda Reddis in the hilly and river interacts of Koya land. They are as a whole more progressive than other tribal groups in the field of economic activity.

Konda Reddy tribes are recognized as Primitive Tribal Group and they are divided into exogamous septs for regulating matrimonial relations. Like other Telugu speaking people their surnames are pre-fixed to individual names.

7.6.5 Literacy status

A literate is a person above 7 years of age, capable to read and write in any one language and literacy rate is the percentages of literates in the total population excluding those below 7 yrs. Telangana State have a literacy rate of 66.54% as per 2011 census. Male literacy is 75.04% and female literacy is 57.99%. Tribal literacy status general is 49.79% with female literacy status as 39.54% and male literacy status as 59.93%. The data from the Project villages shows an average literacy rate of 46.8% with a male literacy rate of 57% and female literacy rate of 43% which is very much in tune with the tribal statistics. Village wise details are furnished in Table 7.5.

Table 7.5 Literacy status of the Project villages

Name of the village	Total Population	Total Literates	%	Male	%	Female	%
Thupakulagudem	601	315	52.4	180	57.1	135	42.9
Gangaram	160	79	49.4	54	68.4	25	31.6
Venchepalle	252	75	29.8	44	58.7	31	41.3
Muknur	640	334	52.2	181	54.2	153	45.8
Thimmatigudem	199	63	31.7	35	55.6	28	44.4
Total	**1852**	**866**	**46.8**	**494**	**57.0**	**372**	**43.0**

7.6.6 Composition of workforce

Workforce means persons engaged in any economically gainful activity and Work participation rate is the percentage of economically gainful active persons to total population. The economy of Telangana is mainly driven by agriculture especially in the rural areas which constitute 73% of the population .In the economy of the state, agriculture contributes about 50% of the state's income and about 70% of the work force. Since agriculture is the main activity, it has close links with the development in other sectors for overall economic progress of the state. Achieving faster agricultural growth is hence important for increasing food production to meet the demands of increasing population as well as for providing rural employment.

In the Project influence villages, the work participation rate, on an average, is 63% with Muknur village showing the lowest WPR of 51% and Gangaram village the highest of 80%. Main workers constitute very low percentage ranging from zero percent in Venchepalle village to 90% in Thupakulagudem village. Hence marginal workers with seasonal employments are common in these tribal villages. Details are shown in Table No 7.6.

Table 7.6 Composition of work force in PIA villages

Village Name	Total Population	Total workers	%	Main workers	%	Marginal workers	%
Thupakulagudem	601	446	74.2	402	90.1	44	9.9
Gangaram	160	128	80.0	8	6.3	120	93.8
Venchepalle	252	150	59.5	0	0.0	150	100.0
Muknur	640	327	51.1	7	2.1	320	97.9
Thimmatigudem	199	115	57.8	2	1.7	113	98.3
Total	**1852**	**1166**	**63.0**	**419**	**35.9**	**747**	**64.1**

7.6.7 Main workers and Marginal workers

Main Workers are persons engaged in any economically gainful activity for 183 days or more in a year. As per 2011 Census, In Telangana state, there are 137.20 lakh main workers, of which 22.42 lakhs belong to scheduled castes and 14.58 lakhs belongs to scheduled tribes.

Marginal workers are persons engaged in any economically gainful activity for less than 183 days. As per 2011, Census there are 26.22 lakh marginal workers, of which 4.96 lakhs belong to scheduled castes and 2.93 Lakhs belongs to scheduled tribes. As detailed earlier, the main occupants of these villages are tribal people who do seasonal employment. Some depends on forest goods also.

Main workers as well as marginal workers are engaged in various activities as cultivators, Agricultural labourers, Household workers, and in other works are furnished in the Tables 7.7 & 7.8 below.

Table 7.7 Occupational groups of main workers

Village Name	Main workers	Cultivators	Agricultural labourers	HH workers	Other workers
Thupakulagudem	402	158	214	3	27
Gangaram	8	3	1	0	4
Venchepalle	0	0	0	0	0
Muknur	7	0	5	0	2
Thimmatigudem	2	0	2	0	0
Total	**419**	**161**	**222**	**3**	**33**
Percentage	**35.9**	**38.4**	**53.0**	**0.7**	**7.9**

Marginal workers are more in these villages and a good number of them are engaged in agricultural operations. Cultivators are few but agricultural labourers are more. Details are furnished in Table 7.7.

Table 7.8 Occupational groups of marginal workers

Village Name	Marginal Workers	Cultivators	Agricultural Labourers	Household Industries	Other Workers
Thupakulagudem	44	1	13	0	30
Gangaram	120	74	37	1	8
Venchepalle	150	0	146	0	4
Muknur	320	3	260	29	28
Thimmatigudem	113	5	98	7	3
Total	**747**	**83**	**554**	**37**	**73**

Percentage	**64.1**	**11.1**	**74.2**	**5.0**	**9.8**

- Cultivators are those engaged in cultivation of various crops on their own land as employer or worker. Total number of cultivators in the State, as per 2011 census is 31.51 lakhs. In the Project villages 38.4% of the main workers and 11.1% of the marginal workers are cultivators.
- Agricultural labourers are those working in another person's land for wages in cash or kind. Total number of agricultural labourers as per Census 2011 in the State is 59.15 lakhs. 53% of the main workers and 74.2% of the marginal workers in the Project villages are agricultural labourers.
- Household industry relates to production, processing, servicing, repairing or making and selling of goods. In the state, there are 7.77 lakh persons engaged in household industry. In the Project villages only 0.7% of the main workers and 5% of the marginal workers are in Household industries.
- Other worker is those persons engaged in the activities other than cultivation, agricultural labour and household industry. There are as many as 64.99 lakh other workers in the State. In the Project villages 7.9 % of the main workers and 9.8% of the marginal workers are engaged in other works

7.6.8 Gender status in work participation

When the gender status of the working categories are analyzed, surprisingly women participation is not far behind, but very close to their counter parts as shown in the Table 7.9.

Table 7.9 Gender participation among workers

Village Name	Main Workers			Marginal workers		
	persons	Male	Female	Persons	Male	Female
Thupakulagudem	402	203	199	44	17	27
Gangaram	8	4	4	120	64	56
Venchepalle	0	0	0	150	84	66
Muknur	7	3	4	320	164	156
Thimmaigudem	2	1	1	113	53	60
Total	**419**	**211**	**208**	**747**	**382**	**365**
Percentage	**35.9%**	**50.4**	**49.6**	**64.1%**	**51.1**	**48.9**

As shown above, among the Main workers 49.6% are women and among the marginal workers 48.9% are women who is more or less on equal grounds. This mean that women also take equal role to shoulder the responsibilities to earn their livelihood.

7.6.9 Non workers

Non worker is a person without any gainful activity. In Telangana state, there are 186.62 lakh non workers as per 2011 Census. In the Project villages, 37 percent of the population is non-workers and among them 20.2% are women and 16.8% are men. This is the dependent class and also includes children, students, house wives, aged and sick persons who will have to depend on the earning members for their needs. Table 7.10 below gives the village wise details.

Table 7.10 Non working category

Village Name	Total Population	Non-Working Population		
		Total	Male	Female
Thupakulagudem	601	155	57	98
Gangaram	160	32	18	14
Venchepalle	252	102	39	63
Muknur	640	313	157	156
Thimmatigudem	199	84	40	44
Total	**1852**	**686**	**311**	**375**
Percentage	**-**	**37.0**	**16.8**	**20.2**

7.7 Description of Socio Economic Environment

In the field of economic activity among the tribal groups, Koyas as a whole are more progressive than other tribal groups. They initiated plough cultivation in the tract. Both Koyas and Konda Reddis produce same food stuffs and they exchange certain house-hold articles, and agricultural implements through Barter system. Some Koyas work as Blacksmiths and furnish the Konda Reddis with iron implements and some Konda Reddis manufacture baskets and winnowing fans and supply to Koyas. Koyas characteristic settlement is groups of hamlets scattered over the village land at places convenient for cultivation of their fields and seldom are the houses concentrated in a large compact village.

Konda Reddis are shifting cultivatiors and largely depend on flora and fauna of forest for their livelihood. They eat variety of tubers, roots, leaves, wild fruits etc., They collect and sell non timber forest produce like tamarind, adda leaves, myrobolan, broom sticks etc., to supplement their meagre income. They cultivate largely jowar, which is their staple food. They also grow chodi, red gram, bajra, beans, paddy and pulses.

7.8 Health infrastructure

Health infrastructure available in the district is mainly obtained from Government sources. As per the data in Planning Department reports (2016), following infrastructure is available for the people in the District. Several Private hospitals also are available, but details were not available for reference.

Table 7.11 Health infrastructure

SL No	Infrastructure available –District level	Numbers
1	Allopathic Hospitals (Govt)	
A	Health Sub-Centers	179
B	Primary Health Centers	25
C	Community Health Centers	4
2	Ayurveda Hospitals (incl. Dispensaries)	10
3	Homeopathic Hospitals (incl. Dispensaries)	5
4	Unani Hospitals (incl. Dispensaries)	4
5	Doctors in all Hospitals	51
6	Beds in all Hospitals	332

A survey conducted by Health and Family Welfare dept shows that 86.3% of the villages in Telangana state have Sub Health care facilities within 3 Km radius and 64.6% have Primary health Care facilities within 10 Km radius. There are several Private Hospitals operating in the area but details of the same are not available.

7.9 Health profile

Over the years the health profile of the people have improved substantially and some of the recent highlights are furnished below

- Birth rate as per 2013 statistics is 17.4 per 1000 population
- Death rate declined to 7.3 per 1000 population
- Maternal Mortality Rate(MMR) is 92 per one lakh births while all India MMR is 167/100000 births
- Infant Mortality Rate (IMR) is 39 per 1000 live births.
- Institutional deliveries are universal in Telangana state
- In terms of full immunization coverage to children below 24 months Telangana could achieve only 47.5% which is far behind Kerala (82%)

- Nutritional Status of less than 5 year age group is not credible as 30percent of suffering from malnutrition. Many of them are anemic (71%).
- Among women below 50 years 58% are anemic. 62% of the pregnant women too are anemic which will impact the new born badly.
- Life style diseases among adults (blood sugar level, hypertension) are on the increase, especially in urban areas.

7.10 Social infrastructure

In the proximity of the project site, educational, religious and transportation facilities are available. The habitants have a good transportation facility as they are accessible easily.

The project is approachable by land at a distance of 400 m from Thupakulagudem village and National High way (NH-202) at a distance of 200 m. Minor roads are connected to the villages within the project area. Road head: Eturnagaram (27 km)

- The nearest railway station is at Warangal at a distance of 107 km.
- The nearest airport is Hyderabad at a distance of 255 km.

7.10.1 Cultural practices among tribes

Tribes of Telangana are known for cultural diversity which is to be preserved for the sustainable wellbeing of whole mankind. Their social cultural practices and religious are unique not only from Non-Tribals but also from tribe to tribe. They are symbiotic in nature. Tribal dances of Lambada, Gonds, Koyas etc., and their festivals like Sammaka-Saralamma fair, Nagoba fair, Gandhari fair, Salesvaram-Loddi fairs are attracting lakhs of people not only from tribal stock but Non-Tribals too. Hence there is an urgent need to take measures to preserve the tribal cultural diversity by giving fillip to Tribal Research Institutes/Schools/Tribal Artists to propogate their cultural performances. The Governments have to promote tribal tourism as it was already proposed by the expert committee some three decades back there is an urgent need to preserve and promote their diversified cultures by giving encouragement to tribal tourism and tribal arts like dances, songs, embroidery and paintings. Governments have to see that the projects like Indira Sagar (Polavaram) and Kawal Tiger Reserve would not replace their traditional habitations whose cultural diversity is supposed to be protected to assure sustainable diversity / living of mankind in general and Telangana in particular.

7.10.2 Landform, Land use & Land ownership

The proposed project envisages lifting of water from Godavari will stabilize the command area of 251310 ha existing under Devadula Lift Irrigation Scheme and SRSP Stages I & II of command area of 3,04,000 ha. These are mostly agricultural area under cultivation.

7.10.3 Positive and negative impacts of the project

- Demand-Supply Gap- out of 7,75,21,000 ha of cultivable land in Telangana state, only 30 -35 % is irrigated and hence fully utilized. This project will help to increase in the irrigated areas, leading to higher productivity and better yield. This will help to reduce the demand- supply gap
- Imports Vs Indigenous Production- The project leads to enhancement of indigenous food grain production snowballing the local production which in turn will lead to export excess food grains adding to more income. This will have a favorable impact on domestic and export markets.
- Employment Generation- The implementation of Irrigation scheme will create employment opportunities in the project area. The employment is associated with improved farming practices as well as the construction of the irrigation scheme. Temporary labour (about 400) will be hired during construction of barrage. With this irrigation project, additional farm labour would also be required which in turn will result in higher cropping intensity by providing employment opportunities to local people within and outside the vicinity of the project area.
- **Population Projection-**Influx of about 400 labours will be there during construction phase of the project. This labour will be hired from local villages
- The negative impact of the project is that some land owners will lose their land for construction of the project which in turn will impact their livelihood. This will be compensated providing compensation vide LA rules applicable in the State. For the loss of land, "Land for land" compensation will be considered for people who wish to pursue their agricultural occupations
- Land acquisition of 94 Ha of Private land will be done for the implementation of the project. This will affect 236 families in terms of livelihood. Compensation will be provided as per RTFC&LARR act, 2013 and a cost of 2.53 crores is ear marked for the purpose as part of Land Acquisition Rehabilitation and Resettlement Plan.
- Construction workers are exposed to poor living conditions at the site resulting health concerns. Labour camps will be provided with all the basic arrangements viz.,

sanitation arrangements, drinking water supply, occupational health centre, rest rooms, and canteen facilities. Budget of 10.25 Lakhs is earmarked for the same.

- The command area is deprived of water availability which is affecting yield/ productivity. Providing assured water supply by constructing barrage near Thupakulagudem village across Godavari River, meeting the irrigation potential area of 5.55 Lakh ha and 50 TMC of drinking water supply to enroute villages.

7.10.4 Tribal villages and PESA Act

Some Tribal villages are in scheduled area such hence PESA Act (The Provisions of the Panchayats (Extension to Scheduled Areas) **Act**) 1996 is applicable here. The key objectives of the PESA Act are to ensure local governance with participatory democracy to make the gram sabha the fulcrum of all activities, and safeguard and preserve the traditions and customs of tribal communities.

7.11 Land acquisition in Scheduled Areas

Section 41 of the Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act, 2013 (LARR 2013) provides for consent of Gram Sabhas before the process of land acquisition in Scheduled areas. Section 41 and 42 also provide certain protections to Scheduled areas, in case the land acquisition is unavoidable, as listed below.

- As far as possible, no acquisition of land shall be made in the Scheduled Areas. Where such acquisition does take place it shall be done only as a demonstrable last resort.
- Prior consent of the concerned Gram Sabha or the Panchayats or the autonomous District Councils, shall be obtained, in all cases of land acquisition in such areas. Consent of the Panchayats or the Autonomous Districts Councils shall be obtained in cases where the Gram Sabha does not exist or has not been constituted.
- In case of a project involving land acquisition and involuntary displacement of the Scheduled Castes or the Scheduled Tribes families, a Development Plan shall be prepared, in specified form with details of procedure for settling land rights due, but not settled and restoring titles of the Scheduled Tribes as well as the Scheduled Castes on the alienated land by undertaking a special drive together with land acquisition.
- The Development Plan shall also contain a programme for development of alternate fuel, fodder and, non-timber forest produce resources on non-forest lands within a

period of five years, sufficient to meet the requirements of tribal communities as well as the Scheduled Castes.

- In case of land being acquired from members of the Scheduled Castes or the Scheduled Tribes, at least one-third of the compensation amount due shall be paid to the affected families initially as first installment and the rest shall be paid after taking over of the possession of the land.
- The affected families of the Scheduled Tribes shall be resettled preferably in the same Scheduled Area in a compact block so that they can retain their ethnic, linguistic and cultural identity.
- The resettlement areas predominantly inhabited by the Scheduled Castes and the Scheduled Tribes shall get land, to such extent as may be decided by the appropriate Government free of cost for community and social gatherings.
- Any alienation of tribal lands or lands belonging to members of the Scheduled Castes in disregard of the laws and regulations for the time being in force shall be treated as null and void, and in the case of acquisition of such lands, the rehabilitation and resettlement benefits shall be made available to the original tribal land owners or land owners belonging to the Scheduled Castes.
- The affected Scheduled Tribes, other traditional forest dwellers and the Scheduled Castes having fishing rights in a river or pond or dam in the affected area shall be given fishing rights in the reservoir area of the irrigation or hydel projects.
- Where the affected families belonging to the Scheduled Castes and the Scheduled Tribes are relocated outside of the district, then, they shall be paid an additional twenty-five per cent, rehabilitation and resettlement benefits to which they are entitled in monetary terms along with a one-time entitlement of fifty thousand rupees.
- All benefits, including the reservation benefits available to the Scheduled Tribes and the Scheduled Castes in the affected areas shall continue in the resettlement area.
- Whenever the affected families belonging to the ST in the Scheduled Areas are relocated outside those areas, all the statutory safeguards, entitlements and benefits being enjoyed by them under this Act shall be extended to the new area.
- Where the community rights have been settled under the provisions of the Scheduled Tribes the same shall be quantified in monetary amount and be paid to the individual concerned who has been displaced due to the acquisition of land in proportion with his share in such community rights."

7.12 Land requirement of the project

The land requirement for the Project is 674.18 ha, out of which 94 ha is Private/Patta land with around 300 owners and 580.18 ha is river portion. Details are furnished below.

Table 7.12 Land requirement for the project

Sl.No.	Village Name	District	Taluk	Private land (ha)
1	Thupakulagudem	Jayashankar Bhupalapally	Warangal	65.87
2	Thimmaigudem			5.58
3	Venchepally			-
4	Gangaram			12.96
5	Mukanuru			9.86
			Total	**94**

7.13 Project Affected Persons (PAPs)

Project affected persons (PAPs) are those lost their land due to land acquisition for the project. To study the impact on the socio economic profile of these people and families were assessed through social surveys and consultations in the area. The socio economic profile of the PAPs were analysed further to assess the positive and negative impacts on them, so as to suggest appropriate mitigative measurers. Out of 300 titleholders, only 121 families could be accessed. Though they own these agricultural farms none of them are staying there. So there are only Project Affected persons (PAPs) and no Project Displaced Persons (PDPs). Hence 100% survey could not be done among them, but the sample accessed gives a representative picture of the PAPs.

7.14 Land as a source of livelihood

Majority of the PAPs are farmers and these agricultural lands are their chief source of livelihood. None of them are staying in these lands and hence there are no buildings. The only structures seen are some bore wells dug for the purpose of irrigating the land. Water scarcity is a main issue faced by the farmers here and agriculture is a dwindling business depending on the rains which is very scarce. Hence all of them, except a few, welcomed this irrigation Project, even if they lose their land. They hope to do better cultivation in their remaining land, once irrigation facilities are operational. Those who opposed the Project is not happy about losing the land as they cannot live without farming in these lands and wanted "land to land "compensation. Others are happy to give the land for the project taking monetary compensation and many of them who are losing more land would like to

have a 'land to land compensation offer or allocation of cultivable land in the vicinity, as agriculture is their only source of subsistence.

7.15 Demographic profile of PAPs

Demographic profile of the project affected families as found in the social survey is summarized below

Table 7.13 Demographic profile of PAPs

Details	Number	Remarks/ Percentage
Title holders covered for the survey	121/300	40.33%
Total Population	437	3 to 4 members /family
No of male members	250	57.20%
No of female members	186	42.56%
Sex ratio	-	744
Religious categories		
Hindu	119	98.35%
Christian	2	1.65%
SC	31	25.62%
ST	85	70.25%
OBC	5	4.13%
Higher castes	0	0
Age groups		
Below- 7yrs	17	3.89%
7 to 18 yrs	79	18.70%
19 to 30 yrs	122	27.92%
31 to 50 yrs	112	25.63%
51 to 60yrs	72	16.48%
61 to 80 yrs	35	8%
above 80yrs	0	0%

As shown in the Table 7.13 above only 40% of the Project impacted families could be covered under the primary survey in the area, and the remaining were not available for responding. As these impacted areas are agricultural land belonging mostly to Scheduled caste and Scheduled tribe families who are staying in distant hamlets, most of them were not available for the survey.

Demographic details of the families show an average of 3 to 4 members in each family. Sex ratio is 744 females against 1000 males only which may not be representative of the area.

Since the land acquisition for the canal portion etc is linear the population features may not be represented accurately and hence such variations are seen. But unless cross verification is done, this cannot be conclusively finalized.

Religion and caste of the PAPs shows that 98 .4 % are Hindus and the rest Christians. No Muslim families are reported here. Caste wise classification shows that 70% are Scheduled tribes and 25% are Scheduled castes. The remaining are OBC categories and there are no upper casts reported.

Age group clusters are 22.6% are children below 18 years of age, 53.55% belongs to the age category of 19 to 50 years, the most productive earning groups and 24.48% belongs to age category 51 t 80 years who are elderly people. And there are none above 80 years.

Table 7.14 Educational status of the people shows the following status

Educational status	No.s	Percentage
Illiterate	161	38.3
Literate	27	6.4
Primary	25	6.0
Middle school	29	6.9
High school	31	7.4
SSLC pass	52	12.4
PUC	50	11.9
Graduation	38	9.0
Post graduate	7	1.7
Professional	0	0.0
Diploma	0	0.0
Others	0	0.0

As shown in Table 7.14, 38.3 % of the people are illiterates and 6.4% are literates.20.3% of the persons attended primary to 10^{th} standard classes. 12.4% passed SSLC and 11.9% passed PUC.10.7 % are graduates and Post graduates. There are no technically or professionally qualified people in these villages.

Occupational status as shown in Table 7.15 shows that only 47.6 % of the population is working and among the non- workers 27.64 % are house wives and 24.76 % are students. Among the working categories, 94 % are Farmers and the remaining works as labourers, teacher and in Private jobs.

Table 7.15 Occupational status of PAPs

Occupation	Nos.	Percentage
Farmer	186	44.71
Petty shop owner	0	0.00
Labourer	3	0.72
Teacher	3	0.72
Government job	3	0.72
Pvt Job	3	0.72
Professional	0	0.00
Retired employees	0	0.00
House wife	115	27.64
Student	103	24.76
Business men	0	0.00
Others	0	0.00

It is clear from the above Table that agriculture is the main occupation of the People. So this project is a boon and a bane to the people. Boon in the sense that they can irrigate their agricultural lands when the project materializes and bane as they will lose the land fully or partially for the project. Many of the people in the impacted area commented that "We are depending on our land for livelihood. If we lose this land it will impact our livelihood". So adequate measures are required to compensate such livelihood issues of the people impacted.

Income of these PAPs was assessed and the following results obtained. 41.2 % gets 15000 to 20000 annually, 16% gets below that and remaining above. None of them have income above 50000/- Details are furnished in Table No 7.16.

Table 7.16 Income groups of PAPs

Income groups	Numbers	Percentage
Less than Rs 5000	0	0.0
Rs 5000 to 10000	0	0.0
Rs 10000 to 15000	19	16.0
Rs 15000 to 20000	49	41.2
Rs 20000 to30000	25	21.0
Rs 30000 to 40000	22	18.5
Rs 40000 to 50000	2	1.7
More than Rs 50000	2	1.7

If these figures represent them truly all of them comes under the poverty lane without adequate means of living. But these figures may not be correct too as often the correct income is not furnished by people of will report only the income of the head of the family alone and that too from the main income source.

7.16 Land acquistion

The land requirement for the Project is 674.18 Ha, out of which 94 Ha is Private land with around 300 owners and 580.18 Ha is river portion.

7.17 Entitlement matrix

Land acquisition will be done on the basis of The Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act (RTFCTLARR), 2013, issued by Govt of India. RFCTLARR 2014 rules specify a higher compensation to the land, based on the prevalent market value, a multiplying factor (ranging from 1-2) and a 100% solatium. Compensation was paid to the affected parties as per the Entitlement matrix below

Table 7.17 Entitlement matrix

Sl. No.	Component of Compensation	Provision of for determination of value of land as per RTFCTLARR Rules 2014
1	Market value of land	Whichever of the following is higher: • Market value, if any, specified in the Indian Stamp Act, 1889 for the registration of sale deeds or agreements to sell in the area where the land is situated; or • The average sale price for similar type of land situated in the nearest village or nearest vicinity area; or • Consented amount of compensation as agreed in case of acquisition of lands for private companies or for public private partnership project.
2	Factor by which the market value is to be multiplied	In case of rural areas (other than Scheduled Areas) a multiplication factor of 1.25 will be applied • In case of Scheduled (Tribal) Areas, a multiplication factor of 1.50 will be applied • In case of urban areas, a multiplication factor of 1.00 will be applied.
3	Value of assets attached to land or building	--
A	Market value of the	The Collector shall use the services of a competent engineer

	building and other immovable property or assets attached to the land or building that is to be acquired	to fix up the value
B	Damage sustained to standing trees and plats	• For fruit bearing trees, the value of compensation per tree will be determined from time to time by the Horticulture Department based on the species of tree • For non-fruit bearing trees, the value of compensation will be determined by the Forest Department
C	Damage sustained to standing crops	• For standing crops, the compensation will be determined by the Agricultural Officer on a case by case basis
4	Solatium	• The solatium shall be equivalent to one hundred percent of the market value of the land mentioned against serial number 1 multiplied by the relevant factor mentioned against serial number 2 plus the value of assets attached to land or building mentioned against serial number 4A, 4B and 4C.
6	Total Compensation	The total compensation = Market value of land mentioned against serial number 1 X relevant factor mentioned against serial number 2 + Value of assets as mentioned against serial number 3 + Solatium mentioned against serial number 4

7.18 Status of land acquisition

Land acquisition for the Project is completed in one village viz Thupakulagudem village which fulfills 70% of the land requirement. Remaining 30 % of the land is spread across 4 villages and the acquisition process is progressing.

The proposed project requires 94 ha of private/patta land and remaining 580.18 ha required is of river portion. Of which, land of 176.24 Ac is acquired from Thupakulagudem village.

The loss of land incurred by the 236 PAPs in Thupakulagudem was further analyzed to see the extent of loss incurred by each family and the details are summarized in Table 7.19.

Table 7.18 Extent of land lost by PAPs

Extent of land	No of PAPs	Percentage
Less than one acre	156	66
1 to 2 acre	31	13
2 to 3 acre	7	3
3 to 4 acre	7	3
4 to 5 acre	2	1
5 to 6 acre	3	1
temple land	1	0
Govt land occupied	29	12

156 persons (66%) loses less than one acre of land from among these 236 PAPs. 31 persons (13%) loose one to 2 acre and the remaining 19 Persons (8%) lose 2 to 6 acres. The total extent of land here is 176 Ac 24 Gts and out of this 33 Acre and 18 guntas is Government land occupied by 29 families. Remaining 143acre and 16 Guntas is Private land owned by 207 PAPs.

7.19 Land value fixation

The District Collector fixes up the market value of the land in each village considering the land transactions in the area for the last three years and on mutual discussion with the land owners. Realistic cost estimation can be done only on the basis of this. But to work out rough estimation of the cost, the market value of the land estimated by the Irrigation Department (8,64,500/- per ha) is considered and worked out as shown in Table 7.20

Table 7.19 Cost Estimates of land

Total land required for the project (ha)	Compensation already paid as per LA, 1894		Balance land to be acquired as per RFC&TLA, 2013	
	Extent (ha)	Amount in Crores	Extent (ha)	Amount in Crores
94	65	18.03	29	2.53

7.20 Valuation of other immovable properties

- For the purpose of determining the value of trees and plants attached to the land acquired, the collector can use the services of experienced persons in the field of agriculture, forestry, horticulture, sericulture, or any other field, as may be considered necessary by him.

- For the purpose of assessing the value of the standing crops damaged during the process of land acquisition, may use the services of experienced persons in the field of agriculture as may be considered necessary by him.
- The Collector having determined the total compensation to be paid, shall, to arrive at the final award, impose a 'Solatium,' amount equivalent to one hundred per cent of the compensation amount. Solatium amount shall be in addition to the compensation payable to any person whose land has been acquired.
- The Collector shall issue individual awards detailing the particulars of compensation payable and the details of payment of the compensation as specified in the First Schedule.
- In addition to the market value of the land provided, the Collector shall, in every case award an amount calculated at the rate of twelve percent per annum on such market value for the period commencing on and from the date of the publication of the L.A notification, in respect of such and, till the date of the award of the Collector or the date of taking in possession of the land, whichever is earlier.

7.21 Land to land compensation

As per the provisions of the LARR act land for land compensation is an option to those who lose their agriculture land, especially when they belong to the SC/ST community as state in the Act quoted below. "In the irrigation projects as far as possible and in lieu of the compensation to be paid for the land acquired, each agricultural family owning land in the affected area and whose land has been acquired or lost or who has, as a consequence of the acquisition or loss of land been reduced to the status of a marginal farmer or landless shall be allotted ,in the name of each person included in the records of rights with regard to the affected family , a minimum of one acre land in the command area of the project for which is land is acquired. Provided that in every project those persons losing land and belonging to the scheduled caste or scheduled tribe will be provided land equivalent to land acquired or two and a one half acre land whichever is lower".

Land for land option as a compensation for the loss of land which is the main source of their livelihood is a requirement in this ST-SC predominant back ward areas, which Government will have to provide in this project too. Since no residential properties are impacted no R&R packages are required.

7.22 Environmental Public Consultation

As per ToRs, Telangana State Pollution Control Board has conducted Environmental Public Consultation at Zilla Parishad High School, Eturnagaram, Jayashankar Bhupalapally District on

27.09.2018. The proceedings of the Environmental Public Hearing are given as Annexure 21. Compliance to public hearing proceedings is given below;

EPH at Zilla Parishad High School, Eturnagaram, Jayashankar Bhupalapally District

7.22.1 Compliance to EPH proceedings

Sl.No.	Observations	Compliance
1	**Shri. B Mallaiah, Superintending Engineer (Retd.), Hanumakonda** has expressed the following; i. He welcomed the project and suggested to increase the water sprinkling frequency to reduce fugitive dust emissions. ii. While construction of embankment, water sprinkling shall be carried out to reduce the dust emissions. iii. Speed limit restrictions to maintain in the construction area and over taking of vehicle should be avoided in the interest of villagers safety and traffic management. iv. He suggested implementing the CAT plan, CAD plan, plantation, Sanitation arrangements for the labourers. v. He suggested that this project is very much	Positive response. All the suggestions will be incorporated in the project.

Sl.No.	Observations	Compliance
	necessary as SRSP project storage capacity has been reducing and hence couldn't supply the water to the complete ayacut as planned earlier. Hence, by implementing this project, judicious use of water allocated for the state shall be ensured in the command area.	
2	**Shri. Ponnala Ramaiah, Chief engineer (Retd.), Warangal** has expressed the following i. He welcomed the project in view of non-submergence of villages and no forest land involved in the project. ii. All the mitigation measures and environment management plan stated in the EIA/EMP report shall be implemented in right spirit.	Positive response. All the suggestions will be incorporated in the project.
3	**Shri. K Prakashchary, Executive Engineer (Retd.) and Researcher on Irrigation. Warangal** has expressed the following; i. He welcomed the project in the view of good project design which does not involve any submergence of villages, no rehabilitation and resettlement and no forest land requirement for the project. ii. He also stated that due to the gated arrangements for the barrage, there are no chances of siltation iii. He stated that, SRSP project storage capacity has reduced due to siltation and hence this project is technically feasible to cater the existing command area irrigation needs. iv. The Godavari basin has variation in rainfall pattern and hence this project is necessary and beneficial to cater the irrigation and drinking water needs.	Positive response.

Sl.No.	Observations	Compliance
4	**Shri. B Yalla Reddy, Chief Engineer (Retd.), Hanumakonda** has expressed the following; i. He welcomed the project in view of no forest land involved in the project. ii. All the mitigation measures and environmental management plan stated in the EIA/EMP report shall be implemented in right spirit.	Positive response. All the suggestions will be incorporated in the project.
5	**Shri. Dhavaleshwara Rao, Executive Engineer (Retd.), Warangal** has expressed the Following i. He welcomed the project and he suggested looking into the issues of Fish migration, increase in Carbon dioxide, sedimentation and soil erosion. ii. He Suggested mitigation of water logging issues in the upstream area. iii. He stated that this project is harmless to environment and with the implementation of this project, flora and fauna will be benefited by large due to water availability.	Positive response. Shri. B Nagendra Rao, Chief Engineer, Kanthanapally project, also clarified that during monsoon season; barrage gates will be kept open and during lean season and sluice gates will be kept open for release of water downstream. Environmental flows will be maintained or ensure downstream aquatic flora fauna are protected. Fish culture / aquaculture are part of the project plan to ensure fisheries conservation and management.
6	**Shri. Damodar Reddy, Superintending Engineer (Retd.), Warangal** has expressed the following; i. He welcomed the project and he stated that this project does not pose any impacts and further enhances the positive benefits to the region in terms of water availability.	Positive response
7	**Shri. Nagaraju, Thupakulagudem (V)** has expressed the following; i. Other villages might have benefitted from the project but not their village. Earlier officers promised us with jobs and double bed room houses but nothing happened till now. ii. He stated that some of them had received compensation whereas few people had not	Shri. B Nagendra Rao, Chief Engineer, Kanthanapally project, clarified that Thupakulagudem is one of the benefited village under this project and compensation for land acquisition will be provided as per the Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act, 2013 and Telangana

Sl.No.	Observations	Compliance
	received any compensation and requested to settle the compensation issues at the earliest.	state rules 2014.
8	**Shri. S. Chandramouli, Chief Engineer, (Retd.), Warangal** has expressed the following; i. He stated that, this project has larger positive benefits to the environment and to the farmers. ii. He stated that, Godavari river water shall be utilized for the benefit of local people. iii. He stated that, by stabilizing the command area of the project, socio-economic conditions of the farmers and the region will be improved. iv. He urged that, water retention in the soil will improve the fertility status of the soil. v. Unlike factories and industries, this project has no negative impact on environment, local people, flora and fauna.	Positive response.
9	**Shri. G Devdas, Hanumakonda** has expressed the following; i. He welcomed the project and informed that there are no negative impacts from the project. ii. He suggested installing the sewage treatment facilities during construction phase in the labour camps and strict implementation of mitigation measures and EMP as stated in the EIA/EMP report. iii. He suggested focusing on the periodical water sprinkling to be undertaken to avoid fugitive dust emissions due to movement of vehicles carrying construction materials.	Positive response. The sewage generated from the labor camps will be treated in mobile STP installed at site. Solid waste from labour camps will be collected in different bins and handed over to nearby municipal authorities. All the environment mitigation and management measures will be implemented to make the project environment friendly. Water sprinkling will be carried out thrice a day in the unpaved roads and disturbed areas in the project construction site so as to reduce the fugitive dust emissions due to movement of vehicles and the private land required for the dumping yard will be provided with protection measures to ensure no pollution.

Sl.No.	Observations	Compliance
10	**Shri. D. Sambaiah, Chief Engineer (Retd.), Warangal** has expressed the following; i. He welcomed the project and stated that this project will help in improving the agricultural yield. ii. He also stated that, this project will have substantial positive benefits on environment, flora and fauna, fisheries, etc. iii. He requested the Collector to support the project for early implementation.	Positive response.
11	**Shri. Ratnam, Ex-Sarpanch, Thupakulagudem (V)** has expressed the following; i. He stated that, many more people of Thupakulagudem Village shall present in this type of meetings. ii. He stated that, the assurance given by the Government during land acquisition shall be fulfilled at the earliest. iii. He also sought clarification from the project authorities on whether any other project is being planned in this region in the acquired land.	Shri. B Nagendra Rao, Chief Engineer, Kanthanapally project, informed that the compensation for land acquisition will be provided as per the Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act, 2013 and Telangana state rules 2014. It was also clarified that no other project is proposed in the region except the present project and hence the farmers need not worry on this aspect.

7.22 Risks and Hazards associated with the project

It is the major construction activity that includes majority of work of excavation, followed by construction of barrage. All activity will be coordinated in staggered manner and in sync. All activities are hazardous in nature due to major construction having inherent risk. Catastrophic events like cloud bursts and flash floods, earthquake or any act of god, arson, sabotage, etc which is beyond control of I & CAD Department, GoT, management shall be in the purview of District administration to control and mitigate. They will assess and appraise the offsite DMP prepared by I & CAD Department, GoT and hence take lead at times with discretion. Under NDMA 2007 guideline district authority shall be well equipped to deal with aforesaid eventualities, they mobilize resources and enact all stakeholders to perform with due diligence. In project when conceived and technically through w.r.t statutory clearance subsequent activity in field work will be planned and arranged. In the irrigation project major activities excavation and construction of the proposed barrage for stabilizing and providing

drinking water for en route villages of the existing command areas of JCRDLIS and SRSP Stage I and II.

Towards hazard mapping in this project, summarily following hazards are being identified;

7.22.1 Risk and hazards due to structural components of the proposed project

Heavy rainfall/ flash floods leading to flooding of 462 Ha in the project area. Automated gates (SCADA) will be installed for release of water to downstream.

7.22.2 Physical hazards

Exposure to strong and continuous noise in work areas (emanating from compressors, pneumatic hammers, vibrators, and similar sources) Exposure to various environmental factors, extreme heat or cold, strong solar radiation, heat-load, drying, excessive moisture content, increased or reduced environmental air-pressure, etc. Blasting will also cause an impact on nearest Thupakulagudem village. For which controlled blasting will be employed so as to reduce the impact on villagers.

7.21.3 Chemical hazards

Potential hazard of being exposed to noxious dust when staying on the work site. Dermatitis caused by contact with irritating and allergenic materials (e.g.–cement dust). While visiting the work site an engineer may be exposed to hazards created by other workers for example: exposure to organic solvents, thinners and paint removers when at the same time a paint job is being performed at the site.

7.22.4 Biological hazards

There are no specific biological hazards, except potential exposure to infectious diseases, like influenza, as a result of close contact with construction workers that contracted such diseases; or development of dermatitis and irritation as a result of drinking polluted water at the site, contact with allergenic vegetation or with insects (inc. wasps and bees), snakes and similar creatures located on the work site.

7.22.5 Protective Systems

There are different types of protective systems. Sloping involves cutting back the trench wall at an angle inclined away from the excavation. Shoring requires installing aluminium hydraulic or other types of supports to prevent soil movement and cave ins. Shielding protects workers by using trench boxes or other types of supports to prevent soil cave ins. Designing a protective system can be complex because to consider many factors: soil classification, depth of cut, water content of soil, changes due to weather or climate,

surcharge loads (eg., spoil, other materials to be used in the trench) and other operations in the vicinity.

7.22.6 Competent Person / Safety Engineer

As per standards require that trenches be inspected daily and as conditions change by a competent person prior to worker entry to ensure elimination of excavation hazards. A competent person is an individual who is capable of identifying existing and predictable hazards or working conditions that are hazardous, unsanitary or dangerous to employees/labors and who are authorized to take prompt corrective measures to eliminate or control these hazards and conditions.

7.22.7 Access and Egress

It requires safe access and egress to all excavations, including ladders, steps, ramps, or other safe means of exit for employees working in trench excavations 4 feet (1.22 meters) or deeper. These devices must be located within 25 feet (7.6 meters).

7.22.8 General Trenching and Excavation Rules

- Keep heavy equipment away from trench edges.
- Keep surcharge loads at least 2 feet (0.6 meters) from trench edges.
- Know where underground utilities are located.
- Test for low oxygen, hazardous fumes and toxic gases.
- Inspect trenches at the start of each shift.
- Inspect trenches following a rainstorm.
- Do not work under raised loads.

7.22.9 Work at Height Hazards

Cranes are remarkable and invaluable tools for hoisting and carrying, but they are heavily represented in the industrial injury and fatality statistics. Most of them occur in the construction industry. Crane fatalities occur in the construction industry. An identified five crane-related hazards:

- Overturning of a crane or the structural failure of its parts
- Dropping of the suspended load
- Electrocution
- Trapping of people and
- Accidents during erection and dismantling as well as loading and unloading.

The causes of different crane failures have been infers that the overturning of a crane or parts of it occur due to overloading, differential settlement of the crane support or foundation, operating on slope (for mobile cranes) and/or operating method. It has been reported that basic causes of dropping the load are overloading and improper maintenance of the crane and its parts. Finding also infers that electrocution and trapping are caused due to lack of communications between the operator, slingers and flagman/supervisor whereas erection and dismantling injuries are caused by unsafe work practice of erectors and lack of supervision.

7.22.10 Construction machinery and tools hazards

Of all the construction industry fatalities may also occur with construction machinery The types of machinery involved in accidents include excavators and shovels, earthmoving equipment (i.e. crawler tractors and bulldozers, scrapers and graders), dumpers and dump trucks, forklift trucks, road rollers and lorries. Accidents in construction machinery usage occur in one of the following modes;

- Workers being run-over or struck by machinery moving forward or reversing;
- Collision between machinery or with fixed objects such as false works or scaffoldings; Overturning of machinery while in operation; and Workers falling from machinery.
- These accidents are caused by the following major factors:
- Failure of machinery- inoperative back-up alarms, brake failures, etc
- Over turning of crane or its failure will cause fatality. Overloading of cranes will be avoided. Trained crane operator will be deployed.
- Inadequate site planning resulting in poor visibility, inadequate man oeuvre space, inadequate signboards and poor site traffic control;
- Lack of supervision and training of workers and operators; and Construction noise that masks the sound of back-up alarms and the sound of plant.
- It is also observed that in some of event in accidents the primary external factor was hand-held tools as sorted construction tools in descending order of hazard, viz: (1) Knife; (2) Hammer, sledge hammer, etc., (3) Grinding/cutting machine; (4) Jackhammer; (5) Drill; (6) Manual saw; (7) Crowbar, spit, etc.; (8) Tools for screwing; (9) Welding equipment – gas; (10) Axe; (11) Spade/excavation tools; (12) Gripping, holding, pinching, pulling tools; (13) Chainsaw; (14) Nail gun; (15) Compass saw, hole saw, etc.; (16) Welding equipment–electrical; (17) Circular saw; (18) Cutting tools; and (19) Other tools. Use of construction tools cause injuries and fatalities to workers by the following ways;

- Eye injuries caused by foreign objects getting into eyes by operations such as grinding, welding, cutting, drilling and breaking;
- Finger/hand injuries by cut and burns;
- Injuries caused by moving/broken machine parts;
- Electrocution; and Vibration from powered hand-held tools, causing a group of diseases. One of them is blood circulation disturbance known as "vibration white finger".
- Specialty systems.
- Most of the hazards are the result of faulty tools and/or unsafe handling of tools. Moreover, the type of tools and duration of use also dictate the hazard.

Major hazards and mitigation measure shall be delineated and shall be considered in OHS management towards safety in all respect due to multidiscipline activity. It also need extremely well coordination and sync in activity under project leader. All contractors, team, stakeholders shall comely with OHS policy prepared exclusively. It will be a duty of employer to get all employees aware of hazards and risk they may be vulnerable and ensure that it to be his conscious decision as being instrumental in part of project activity. Mock drill shall also be planned to bring alertness as well as preparedness for the mishaps we have considered all hazards and risk associated with projects. However it can be checked and stalled with OHS plan in place before and during execution. It should be specific to this particular activity and shall be evaluated at regular interval during construction as well as after construction. Post installation an offsite DMP shall be prepared in line with district authority requirement and shall be approved.

Table 7.20 Emergency contact numbers

Sl.No.	Name of the department	Contact No.
1	Police	100
2	Fire	101
3	Ambulance	108

Table 7.21 Emergency contact numbers of I&CAD, Government of Telangana

Sl.No.	Name of the Dept.	Contact No.
1	Office of the Spl. Chief Secretary, I&CAD, Telangana	040-23450436
2	Office of the Principal Secretary, I&CAD, Telangana	040-29801057
3	Office of the Chief Engineer, K.C colony, Chintagattu camp, Warangal, Telangana	7702388805

Chapter 8. Project Benefits

The PVNRKSSP is proposed to provide economically viable and socially acceptable irrigation practices for the command area. Irrigation is important to the health of the agricultural industry. Improving the viability of individual farming and increasing the efficiency and economic stability of the command area and also contributing to the economic and social objectives of the Telangana State are the expected outcomes of the proposed scheme. Some of the important project benefits are given below:

Ecological benefits:

- The project involves felling of 800 trees. The restoration activities involving plantation of tree species in the ratio of 1:3 along the left and right bank side of the proposed barrage and the restoration of construction site will be carried out to improve the ecological activities of faunal species.
- Construction of barrage across River Godavari acts as a reservoir thereby supporting proliferation of fish species.

Techno-economical benefits:

- Existing irrigation schemes will be stabilized by providing assured water for irrigation.
- Providing Drinking water is essential as per National Water Policy, 2012. In this direction, this project aims at providing drinking water to a large no. of villages, which has lot socio-economic concern.
- Agricultural linkages will be considerably improved.
- The project improves total farm output and hence raises farm income.
- Project improves yields through reduced crop loss due to erratic, unreliable or insufficient rainfall.
- Extensive agricultural production supplies raw materials to the nearby small scale industries thereby increasing the economy in the region.

Social benefits:

- Health benefits to the people towards use of safe drinking water.
- Altogether, 518 villages will be benefitted directly under the scheme.
- Direct employment opportunities for 400 members (50 Technical and 350 construction laborers) will be provided during construction phase. Further, indirectly labor opportunities will be substantially improved since larger area will be brought

under irrigation. It improves fodder crops and in turn dairy farming in the command area.

- The project requires a total land of 674.18 ha, of which, 94 ha of private/patta land and 580.18 ha of river bed area alongside River Godavari near the proposed barrage for implementation of the scheme and does not envisage rehabilitation and resettlement.

Chapter 9. Environment Management Plan

EMP provides a delivery mechanism to address the adverse environmental impacts of a project during its execution, to enhance project benefits, and to introduce standards of good practice to be adopted for all project related work[65].

Integrated approach during project planning, design, construction and operation work acts as a better tool for implementation of Environmental Management Plan. The EMP measures include mitigation or enhancement measures as appropriate to the nature of impacts and are explained in the following sections. These include:

- Catchment area treatment plan
- Command area development
- Green belt development
- Reservoir Rim treatment
- Fisheries conservation and management plan
- Muck disposal plan
- Restoration of quarry sites and landscaping
- Groundwater management plan
- Public health delivery system and provision of drinking water supply to local community
- Sanitation and Solid Waste Management Plan in labour camps
- Local Area Development Plan
- Environmental Safeguards during construction activities
- Environmental monitoring programme

[65] https://www.adb.org/sites/default/files/institutional-document/33739/files/environment-safeguards-goodpractices-sourcebook-draft.pdf

9.1 Catchment Area Treatment (CAT) plan

9.1.1 Strategy for Cropping Pattern

Cropping patterns and land use is governed by;

I. Topography

II. Climate

III. Soils

IV. Food habits of the people

The annual rain fed crops, such as Paddy, Maize, cotton, sugarcane and pulses constitute the major crops in the area. Important irrigated crops are Cotton and maize. The farmers are more enthusiastic in the irrigated area to go for improved, high yielding and commercial crops. Generally the irrigated farmers take risks in following package of practices and also its management.

Avenues to increase the crop productions: It is clear from the above discussion that the scope for bringing in additional land under net sown area in India is limited. There is, thus, an urgent need to evolve and adopt land-saving Technologies. Such technologies can be classified under two heads – those which raise the yield of any particular crop per unit area of land and those which increase the total output per unit area of land from all crops grown over one agricultural year by increasing land-use Intensity. The advantage of the latter kind of technology is that along with increasing output from limited land, it also increases the demand for labour significantly. For a land scarce but labour abundant country like India, a high cropping intensity is desirable not only for fuller. The population pressure needs doubling of food production and the avenues for increasing production are:

- Through adoption of recommended technologies in full.
- Increasing the cropping intensities
- Inter and mixed cropping practices to achieve higher land equivalent ratios (LER)

9.1.2 Scope for intensive cropping

There is good scope for inter-cropping, which is now practiced. For e.g., Ginger, turmeric and chillies can be raised as an intercrop. Seasonal leguminous crops, such as pulses, soybean etc., can also be raised as an intercrop with many agricultural crops & horticultural trees/plants. The practice of relay cropping was in vogue in the past in some areas, it is, however, possible to cultivate lentil or pea etc., as relay cropping. Various forms of multiple cropping can be practiced, depending on whether the land available is irrigated, rain fed, lowland, upland etc.

- Intensive Farming Systems

Since agricultural land is shrinking with growth of population and development the size of the holding also gets reduced, it has become essential to adopt intensive farming systems to increase the productivity. Various forms of agro-forestry based farming systems are feasible in the study area. Such a farming system may include silvi-pastoral, horti-pastoral, agri-horti-pastoral; land-livestock based farming systems, etc. An integrated approach to farming systems through scientific management of land and water on the principles of watershed management is also feasible.

- Multilayer Cropping

Various forms of multi-layer cropping, particularly in respect of horticulture and plantation crops, can be developed and practiced as a measure of intensive farming. A few examples of such feasible multi-layer cropping are:

- Ginger, turmeric and chilies as intercrops.
- Papaya/lime-pineapple/ginger
- Banana-cucumber-cowpea.

Agriculture in the area is primarily rain fed; watershed wise activities are required for sustainable development of land and water. Integrated development on watershed basis paves way for holistic improvement of the entire area. Conservation of surface soil and erosion control measures paves scope for preserving the surface soil fertility and also facilitates in impounding run off in the form of farm ponds, Nala bund, check dam and other suitable harvesting structures are helpful in providing protective irrigations in times of long dry spells. Watershed management is important in this regard. It would be evident from the preceding discussions, that there is ample scope for diversification of cropping systems and patterns with immense potentialities to increase agricultural production. However, on farm research, effective extension activities and appropriate public policies which continuously back-up the agricultural production systems should be adopted. Similarly, certain infrastructural facilities will have to be catered following intensive cropping. These include rural storage structures, regulated market, effective institutional credit, timely supply of other inputs etc, In the case of horticultural crops, crop wise associations have to be made and to link up with processing plants and markets etc., so that the community at large is benefitted.

Among various natural resources, soil is one of the most vital components, on which living beings depend for shelter and food security. During the management of soil resources it is important to understand the soil type, its distribution, and their characteristics which are a pre-requisite for appropriate land use practices, based on the suitability of soil for various

applications. Reclamation of degraded soil also needs to be undertaken during the conservation process.

9.1.3 Estimation of Soil Loss

A number of methods for assessing soil loss have been developed. They range from simple, qualitative models to elaborate watershed simulations. Qualitative models rely on subjective evaluation of a series of criteria. Watershed simulation models are often very theoretical. Several empirical models also are available and most models are best suited for estimating erosion from very large areas (more than 1 sq mile) and lack precision for use on small sites such as construction sites. The universal soil loss equation (USLE) is given by,

A = RKLSCP --------- Eqn (1)

Where,

A = is computed Soil loss per unit area expressed in the units selected for K and for the period selected for R. In practice, these are usually so selected that they compute A in m tons /ha/year, but other units can be selected.

R = the Rainfall erosivity, is the number of rainfall erosion index units for a particular location.

K = the Soil erodability is the soil loss rate per erosion index unit for a specified soil as measured on a unit plot , which is defined as 21.13 mtr (72.6 ft)length of uniform 9 percent of slope continuously in cleaned tilled fallow.

L = The Slope Length factor, is the ratio of soil loss from the field slope length to that from 21.13 mtr (72,6 ft) under identical conditions.

S = the slope steepness factor, is the ratio of soil loss from field slope gradient to that from a 9 percent of slope under otherwise identical conditions.

C = the Cover and management factor is the ratio of soil loss from an area with specified cover and management to that from an identical area in tilled continuous fallow.

P = the support practice factor, is the ratio of soil loss with a support practice like contouring, strip cropping or terracing to that with straight row farming up and down the slope.

9.1.4 Erosion Index (EI30) Values on Storm Basis

The rainfall erosion index R is a measure of the erosive force and intensity of rain in a normal year. The two components of the factor are the total energy E and the maximum 30-minutes intensity (I_{30}) for all the storms in an area during an average year. Values of R have been computed for the various regions in India and abroad from rainfall records and

probability statistics, and hence R should not be considered as a precise factor for any given year or location.

The energy of the rainstorm is a function of the amount of rain and all the storms component intensities. Median raindrop size increases with the rain intensity and terminal velocities of free falling water drops increases with increased drop size. Since the energy of the given mass in motion is proportional to velocity-squared, the rainfall energy is directly related to rain intensity. The relationship in metric units is expressed by the equation, where KE is the kinetic energy in meter tones / ha-cm and is the rainfall intensity in cm /hr.

The index values (EI_{30}), for each storm was determined. The product term EI was expressed as:

EI_{30} = (KE x I_{30}) / 100 ---------- Equation (1)

Where EI_{30} = Erosion Index

KE is Kinetic Energy of the storm

I30 = maximum 30 minutes Rainfall intensity of the storm

For computing Kinetic Energy of Rain storm the equation proposed by Wishmeier (1959) is

KE=916+331 log I ----------Equation (2)

Where KE = Kinetic Energy of the storm in foot tons per acre inch and

I = Rainfall intensity in inch per hour

The Equation (2) has been modified into metric units by Wishmeier & Mannering (1965) and Ranganath, et al., (1970) the equation in metric units is:

KE = 210.3 + 89 log I ---------- Eqn (3)

Where,

EI_{30} is the erosion index

KE is the total storm kinetic energy in tonnes – m/ha

I_{30} is the maximum 30 minutes intensity of rainstorm.

The monthly, seasonal and yearly EI values will be determined by adding the storm EI values for that length of period.

9.1.5 Soil Erodibility Factor (K)

The soil erodability factor K is a measure of the susceptibility of soil particle detachment and transport by rainfall and runoff. Texture is the principal factor affecting K, but structure, organic matter and permeability also contribute K values ranging from 0.45 to 0.59.

9.1.6 Nomograph Method

The United States Department of Agriculture (1978) has suggested a Nomograph and the following equation for the determination of soil erodability for soils containing less than 70% silt and very fine sand:

$100K = 2.1M^{1.14} \times 10^{-4} (12-a) +3.25 (b-2) +2.5(c-3)$ -------- Eqn (4)

Where, K is the soil erodability factor,

M is the particle size parameter which is equal to: (percent silt + very fine sand) / (100% clay),

'a' is the percentage of organic matter content,

'b' is the soil structure and

'c' is the profile permeability class.

The preferred method for determining K values is the nomograph method. Use of the nomograph requires a particle size. The Soil sample code collected from the field were characterizes carefully for estimating, the K values.

9.1.7 Determination of LS

Since the LS factor has a considerable effect on predicted erosion, care in figuring values for the factor is warranted. In particular, results of the soil loss calculation will be more accurate if the USLE is individually applied to portions of a site with similar slopes (similar gradient and length) and summing the individual soil loss estimates. Slope gradient is the field or segment slopes, usually expressed as percentage. The topographic component, LS, was evaluated by using the contour length method for large watersheds.

LS was calculated base on the following equation

$LS = (L)^m / 22.1(0.065 + 0.0454S + 0.0065 S^2)$ --------- Eqn (5)

Where,

LS = Average length slope component

L = Slope length in meters

S = Average watershed slope in percent and

m = Exponent (m= 0.2 if slope < 1%)

9.1.8 Evaluation of Cropping Management Factor (C)

The cover factor C is defined as the ratio of soil loss from land under specified crop or mulch conditions to the corresponding loss from tilled, bare soil. In the USLE, the C factor

reduces the soil loss estimate according to the effectiveness of vegetation and mulch at preventing detachment and transport of soil particles. On activity sites, recommended control practices include the seeding of grasses and the use of mulches. These measures are often considered "temporary" -they are designed to control erosion primarily during the activity period. Permanent landscaping may be added later, or temporary erosion control plants may be left as a permanent cover. Any product that reduces the amount of soil exposed to raindrop impact will reduce erosion.

The cropping management factor, C is computed as follows:

$C = \Sigma^{n} Ci\ Ai / A$ ------- Eqn (6)

Where,

C is the cropping management factor for the watershed

Ci is the cropping management factor for crop i,

Ai is the drainage basin area growing crop i with a particular management level,

n is the number of land use areas in the watershed, and

A is total watershed area.

9.1.9 Evaluation of Support Practice Factor (P)

The erosion control practice factor P is defined as the ratio of soil loss with a given surface condition to soil loss with up and down hill plowing. Practices that reduce the velocity of runoff and the tendency of runoff to flow directly down slope reduce the P factor. In agricultural uses of the USLE, P is used to describe plowing and tillage practices. In activity site applications, P reflects the roughening of the soil surface by tractor treads or by rough grading. In computing the P factor, land cover conditions are considered depending upon the cultivated and uncultivated area of the watershed. In addition, slope is also considered as a key factor in assigning the value. For the study area, a P factor considered is 0.6 for terraced agricultural land having slope less than 2% and for the rest of the land having a slope more than 2%, a value of 0.5 is assigned.

The soil loss estimated for the watershed covering under PVN project

Total Nos.: 7 sub-watersheds (27 Micro-watersheds). The soil loss estimated for the watershed covering under water re-circulation and sustainability project of P V Narasimha Rao Kanthanapally Sujala Sravanthi Project; Jayashankar Bhupalapally District is tabulated in the Table below. Table indicating Sub catchment/Watershed and codification of the P V Narasimha Rao Kanthanapally Sujala Sravanthi Project (PVNRKSSP) Jayashankar Bhupalapally District; Telangana State

Table 9.1 Sub catchment/Watershed and codification of PVN project

Region	Basin	Catchment	Sub-catchment	Watershed Name	Sub-Watershed Code	Micro watershed Code
Bay of Bengal (4)	Godavari (4E)	Godavari delta with confluence of Indravati	4E1C	4E1C8	4E1C8K	4E1C8K1
						4E1C8K2
						4E1C8K3
						4E1C8K4
						4E1C8K5
						4E1C8K6
					4E1C8m	4E1C8m1
						4E1C8m2
						4E1C8m3
			4E1G	4E1G8	4E1G8g	4E1G8g1
						4E1G8g2
						4E1G8g3
						4E1G8g4
					4E1G8h	4E1G8h1
						4E1G8h2
						4E1G8h3
						4E1G8h4
						4E1G8h5
					4E1G8J	4E1G8J1
					4E1G8m	4E1G8m1
						4E1G8m2
						4E1G8m3
						4E1G8m4
					4E1G8n	4E1G8n1
						4E1G8n2
						4E1G8n3
						4E1G8n5

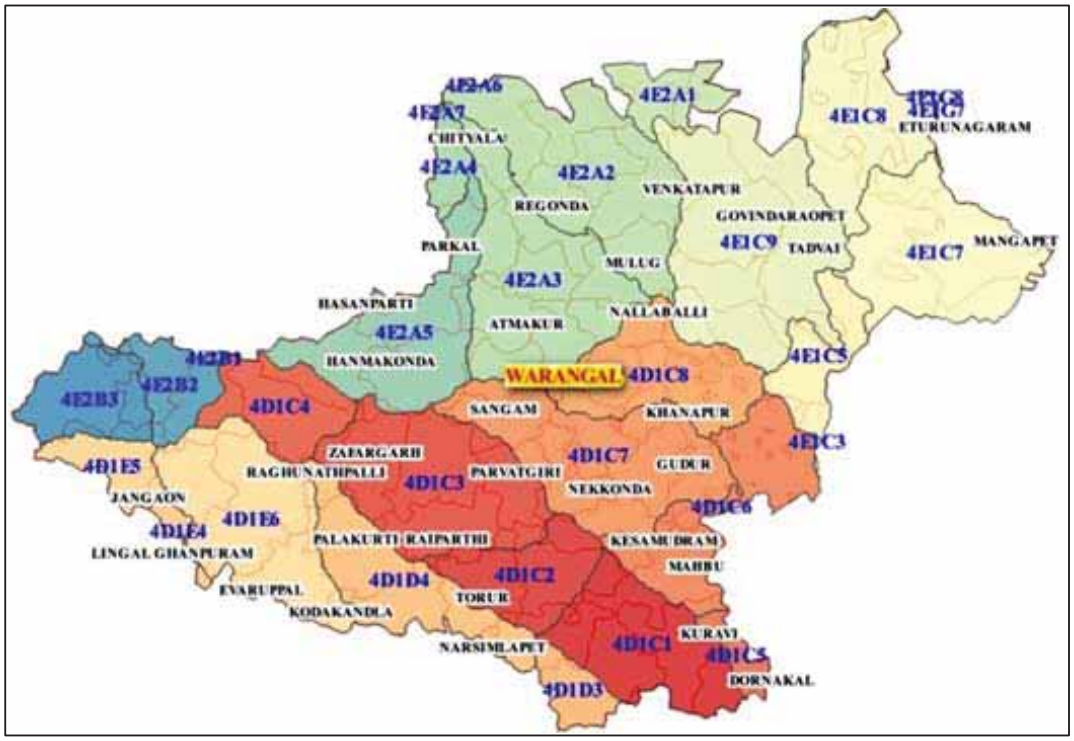

Fig 9.1 Watersheds delineated in Warangal district

Table 9.2 Showing the computed values of Factors of soil loss in PVNSSR

	R	K	LS	C	P	A(Tons/ha)
4E1C8K1	2.65	0.49	0.536	0.278	0.5	0.096743444
4E1C8K2	2.68	0.42	0.851	0.28	0.555	0.148855422
4E1C8K3	2.58	0.52	0.862	0.292	0.5	0.168843043
4E1C8K4	2.64	0.54	0.702	0.286	0.5	0.143110282
4E1C8K5	2.56	0.52	1.221	0.258	0.5	0.209675981
4E1C8K6	2.62	0.53	0.732	0.282	0.55	0.157652202
4E1C8m1	2.74	0.45	1.483	0.27	0.55	0.271538042
4E1C8m2	2.12	0.46	1.411	0.28	0.52	0.200346648
4E1C8m3	1.94	0.45	1.428	0.311	0.55	0.213238456
4E1G8g1	2.39	0.59	1.323	0.276	0.6	0.308937117
4E1G8g2	2.32	0.56	1.123	0.281	0.51	0.209089519
4E1G8g3	2.26	0.45	1.423	0.283	0.52	0.212968628
4E1G8g4	2.38	0.5	0.781	0.272	0.51	0.128924981
4E1G8h1	2.55	0.56	0.702	0.266	0.53	0.141326247
4E1G8h2	2.6	0.53	1.211	0.274	0.52	0.23776464
4E1G8h3	2.68	0.52	0.792	0.262	0.55	0.159047666

	R	K	LS	C	P	A(Tons/ha)
4E1G8h4	2.56	0.48	1.33	0.28	0.55	0.251682816
4E1G8h5	2.48	0.51	0.892	0.29	0.5	0.163589232
4E1G8J1	1.82	0.47	1.478	0.322	0.55	0.223904201
4E1G8m1	2.48	0.51	0.882	0.29	0.5	0.161755272
4E1G8m2	2.45	0.51	0.732	0.282	0.55	0.141859733
4E1G8m3	2.31	0.45	1.43	0.283	0.52	0.218751133
4E1G8m4	2.41	0.53	0.732	0.282	0.55	0.145015956
4E1G8n1	2.11	0.51	0.892	0.29	0.5	0.139182774
4E1G8n2	2.26	0.45	1.42	0.283	0.52	0.212519642
4E1G8n3	2.12	0.53	0.732	0.282	0.55	0.127565904
4E1G8n5	2.48	0.51	0.89	0.29	0.5	0.16322244

Table 9.3 Estimation of soil loss in Watersheds in PVNRKSSP

	R	K	LS	A (Tons/ha)
4E1C8K1	2.65	0.49	0.536	7.19
4E1C8K2	2.68	0.42	0.851	6.44
4E1C8K3	2.58	0.52	0.862	6.85
4E1C8K4	2.64	0.54	0.702	6.99
4E1C8K5	2.56	0.52	1.221	7.75
4E1C8K6	2.62	0.53	0.732	6.45
4E1C8m1	2.74	0.45	1.483	6.73
4E1C8m2	2.12	0.46	1.411	6.87
4E1C8m3	1.94	0.45	1.428	5.85
4E1G8g1	2.39	0.59	1.323	6.04
4E1G8g2	2.32	0.56	1.123	6.98
4E1G8g3	2.26	0.45	1.423	6.80
4E1G8g4	2.38	0.5	0.781	7.21
4E1G8h1	2.55	0.56	0.702	7.09
4E1G8h2	2.6	0.53	1.211	7.02
4E1G8h3	2.68	0.52	0.792	6.94
4E1G8h4	2.56	0.48	1.33	6.49
4E1G8h5	2.48	0.51	0.892	6.90
4E1G8J1	1.82	0.47	1.478	5.65
4E1G8m1	2.48	0.51	0.882	6.90
4E1G8m2	2.45	0.51	0.732	6.45

	R	K	LS	A (Tons/ha)
4E1G8m3	2.31	0.45	1.43	6.80
4E1G8m4	2.41	0.53	0.732	6.45
4E1G8n1	2.11	0.51	0.892	6.90
4E1G8n2	2.26	0.45	1.42	6.80
4E1G8n3	2.12	0.53	0.732	6.45
4E1G8n5	2.48	0.51	0.89	6.90

Estimated potential soil erodability is 6.74, which is less than 8 and therefore it is inferred that this is a moderately erodible land.

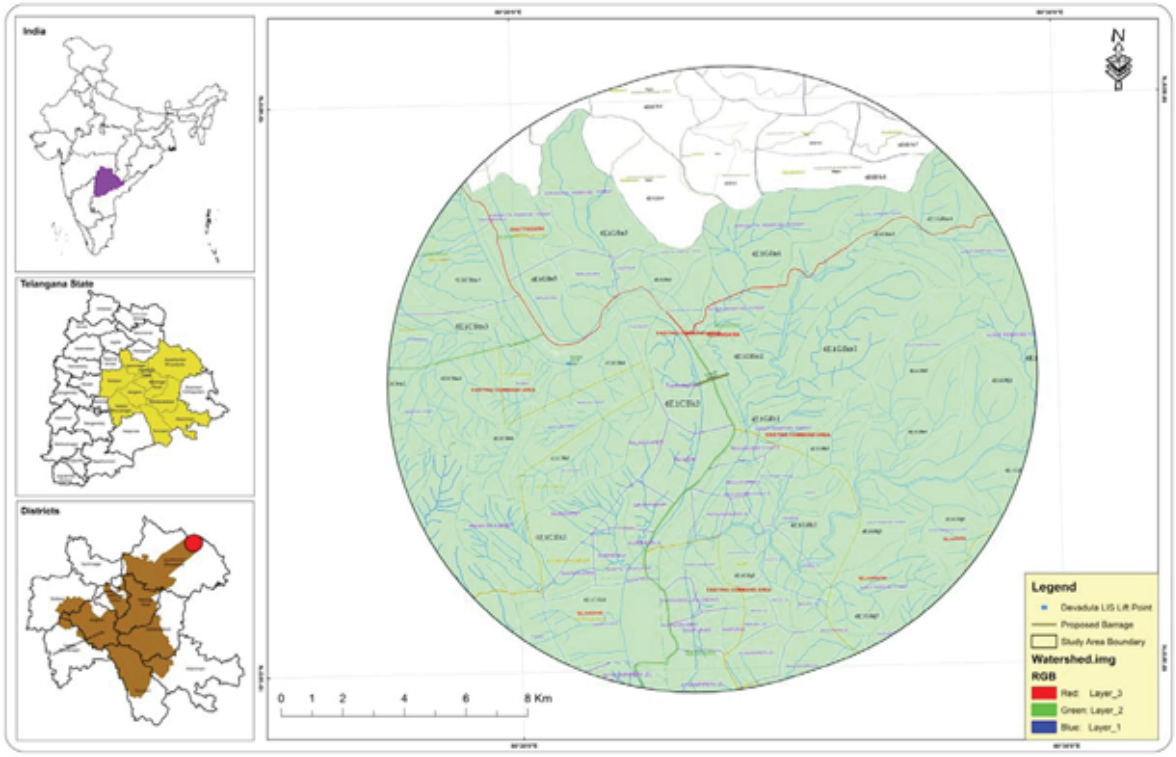

Fig 9.2 Watersheds delineated in PVNKSSP

9.1.10 Sedimentation Studies

Erosion, transportation and deposition of sediments are natural processes controlled by geological, climatic, physical, vegetative and other related conditions all through the geological times. However, during the present century, because of deforestation and urbanization the rate of transport of sediments from the watersheds and siltation pose substantial environmental problems and before equilibrium conditions are reached, additional problems are likely to arise.

One of the major problems noticed in agricultural watersheds is that the crop productivity reduces to zero or becomes uneconomical, because of soil erosion. There are many theories which can be used to evaluate sediment movements in rivers. It is essential that functional relationship between various physical, geomorphic and sediment related parameters are developed, such that the magnitude of sediment eroded from watershed can be estimated. The increase in sediment yield from the watershed will have an impact on the watershed itself and on the river system and associated reservoirs. The impact of eroded soil on natural system is varied and widespread. The sediment particulates eroded from the watershed move in the downstream directly and in the process influence the drainage channels, flood plains, river beds, wetlands and lakes.

The key factors which affect the sediment yield from drainage basin are:

- Hydrology: Rainfall and runoff
- Catchment characteristics: Size of the catchment, slope of the catchment and length of the overland flow.
- Soil characteristics: Soil erodability, soil transportability, soil texture and structure.
- Nature of drainage network and drainage density.
- Land use cover: Plant canopy, mulches and plant residues.
- Management practices: Tillage, soil conservation structures, terraces, diversions and bunds.

Of all the factors listed above rainfall and runoff provide the basic energy input to drive the erosion process. Steepness of slope plays an important role in the process of erosion. Soil properties such as soil texture, structure and the land cover, i.e., plant residue, mulches etc have a major role in erosion process.

At the outset, it is clear that, the process of sedimentation is a matter of serious concern in irrigation projects, because it reduces the storage capacity, water supply capability, power generation, discharge control etc of reservoirs, rivers/catchments. The erosion of the catchments changes the ground water regime and results in lowering of water table in some

places and rise at the formation of arid zone and marshes respectively. The fertility of the soil, its chemical composition also changes due to catchment erosion.

9.1.11 Sedimentation index

An estimate of sediment index must be developed to provide a basis for comparison with management induced sediment yield predictions. The best source of this information is actual long term real data of sediment yield. Another possible source is data from similar or related watersheds.

9.1.12 Stream Flow and Suspended Sediment Load

Although there is a definite variation in sediment transport rate in a natural stream at a particular location, still there exists a good relationship between the sediment load of the stream and certain hydro- morphological factors. The factors which are considered important in estimating sediment yield of a catchment are drainage area, annual water discharge, relief ratio, mean stream length and total stream length etc.

Regression analysis was carried out to know the relation between discharges and sediment load in PVNRKSSP area. The relationship has been found to be,

$Y=7.47*10^{-6}$ x+3401.28, with r=0.97

Where, Y= suspended sediment load in tones/year

X=stream flow in m^3/year (post-monsoon flow only).

9.1.13 Soil Erosion

Soil erosion is the removal of surface material by wind or water. When raindrop falls on a soil surface, the soil particle are splashed and, higher is the velocity of impact, greater is the amount of soil splashed. Drop impact is more effective when a thin film of water covers the soil surface and the maximum dispersion of soil particles occur when the depth of water is about the same as diameter of raindrop. The detached soil particles are then carried further either by runoff or wind. This whole process is known as erosion. Soil conservation practices shall be on the basis of the following inventories,

- Extent of the soil and nutrient losses and sediment transports in various environments.
- Land use/Land Cover details, provides basis for implementation of different soil conservation measures on soil losses and sediment yields.
- A better understanding of the soil erosion processes the dynamic and relative importance of the single processes and their interactions.

9.1.14 Soil Conservation Practices

Soil and Water are the two most important Natural resources which have a direct bearing on agricultural production. These resources have to be used judiciously to obtain optimum of yield of crops. Therefore utmost care has to be exercised in management of these resources, not only to prevent soil degradation but also to improve the productivity of the soil for sustained agricultural development. Measures to conserve soil *in-situ,* allow more infiltrations opportunity time for rain water and safe disposal of runoff water from arable lands are of prime concern in rain fed areas, since they directly affect soil erosion rates and consequent crop productivity. The recommended soil and moisture conservation measures for Hilly zone are as follows:

- Contour bunds with waste weirs.
- Graded bunds/Graded border strips.
- Zing terraces with raised waste weirs.
- Diversion Drains/Water ways.
- Reducing wind erosion of soil by growing wind breaks (vegetation cover).
- Gully plugging.
- In over-grazed land silvi pastoral systems, which in irrigated land yield enough green fodder to cattle population.
- Grazing animals should be kept in stalls.
- Agro forestry and Agro horticulture systems to meet various needs of farmers, crop residue of this adds to the soil and increases carbon content and biotic activity.
- Harvesting of runoff and impounding through appropriate structures.
- Drainage line treatments to improve the flow and avoid nala course clogging.
- Barrage

9.1.15 Soil Conservation Practices for Catchment Area Treatment

All India Soil Survey & Land Use Planning (AISS&LUP), Ministry of Agriculture, Govt of India have made inventory of soil resources in the catchments of major Reservoirs and prepared priority fixation soil survey and categorized into severe, medium and low priority areas for treatment and micro catchments contributing high sediments are included for soil conservation treatments which include treatment holistically to arrest the sediments flow into Nala, Rivulet and Rivers and onward deposition in the major Reservoirs. Adoption of appropriate soil and water conservation practices is considered to be the only way of

conserving and improving land resources and environment. Large scale soil and water conservation activity in India began in 1934. Realizing the importance of soil conservation, the state government had formulated scheme as early as in 1942. As per the estimates of state government, about 27.06 lakh ha of arable land in the state needs protection. As per the estimates of state government, about arable land in the state needs protection. Out of the 62.88 lakh hectares of cultivable area in the state, 35 lakh hectares (55.65%) needs soil conservation measures.

Telangana is a pioneer State in implementing watershed programmes. Rain fed area accounts for about 63.6%. Various conservation measures were undertaken to combat soil erosion through model watersheds, district level macro watershed programs, DPAP, DDP, IWDP, WGDP, RVP, NWDPRA and more recently from April 2008 Integrated Watershed Development Programme (IWMP).A state level perspective and Strategic Plan (SPSP) is prepared for the state and entire area (62.88 lakh ha) is contemplated to be treated by the end of XIV th plan period, on 90:10 ratio between centre and state by implementing Prime Ministers Krishi Sinchayee Yojan (PMKSY) to provide twin benefits of "Har Khet Ko Pani and More crops per Drop" of rain water.

In the district of Jayashankar Bhupalapally already good amount of area is being treated under soil conservation and the entire catchment has to be treated to protect the rain fed area by implementing appropriate catchment area protection works.

Some of the methods suggested for soil conservation for P V Narasimha Rao Kanthanapally Sujala Sravanthi Project (PVNRKSSP) area and other details are provided below:

- Gully plugging

This prevents the eroding and down-cutting of gully beds headwords while they encourage the deposition of silt load and create a micro-environment for the establishment of vegetative covers. Gully plugs act as grade stabilization structures. The specifications for gully plug are as follows.

Table 9.4 Specifications for gully plugs

Slope of gully bed (off)	**Width of gully bed (m)**	**Location**	**Type of gully plug**	**Vertical interval (m)**
	Upto 4.5	Gully bed	Brush wood	Upto 3
	4.5 – 10.5	Gully bed & ride branch	Earthen	2.25 to 3.0

Slope of gully bed (off)	Width of gully bed (m)	Location	Type of gully plug	Vertical interval (m)
0-5%	7.5 to 15.0	At the confluence of two gullies	Sand bags	2.25 to 3.0
10-20%	Upto 4.5	Gully bed	Brush wood	Upto 3.0
	4.5 to 6.0	Gully bed	Earthen and side branch	Bet 1.5 to 3.0

The gullies would be treated with engineering/mechanical as well as vegetative methods. Check dams are recommended for some areas to promote growth of vegetation that will consequently lead to the stabilization of the slopes area and prevent further deepening of gullies and consequent erosion. For controlling the gullies, the erosive velocities are reduced by flattening out the steep gradient of the gully. This is achieved by constructing a series of check dam which transform the longitudinal gradient into a series of steps with low risers and long flat treads. Different types of check dams would be required for different conditions comprising different materials, depending upon the site conditions and by using the locally available materials. This is often the most acceptable soil conservation measures that can easily establish and should form a dense thicket near the ground level when planted in close vicinity. The following materials are recommended for the purpose.

- Brushwood check dam
- Dry rubble stone masonry (DRSM)
- Check dams with stones available at the site
- Combination of DRSM and crate works – for moderate to deep gullies with locally available stones at sites

The advantage of brushwood check dams is that they are quick and easy to construct and are inexpensive as they are constructed by using readily available materials at the site. In addition to the vegetative measures used for stabilization of gullies, temporary or permanent mechanical measures are used as supplementary measures to prevent the washing away of young plantations by large volume of runoff. The gullies get stabilized over a period of time with the establishment of vegetative cover. With passage of time mechanical structures weaken and vegetative measures get strengthened.

The drainage basin of the river, usually referred to as catchment area needs some kind of treatment in the overall interest of the development of the area extending along the river with a view to improve land management through biological and engineering measures, with

the objective of arresting soil erosion and improve its vegetation, and control over grazing by cattle.

The catchment area treatment involves intensive and highly technical measures, which require the expertise of technical skill. The watershed committees have to be constituted at the panchayat level in the Panchayats covered in the proposed project areas of The water re-circulation and sustainability project of P V Narasimha Rao Kanthanapally Sujala Sravanthi Project (PVNRKSSP) spread over in the jurisdiction of Jayashankar Bhupalapally District with the objective of an integrated approach involving multi disciplinary experts dealing with forest, agriculture, horticulture, watershed, sociologists, besides local panchayat members and community members. The area under each watershed has been planned on the basis of Landuse / land cover and topographic conditions. The total area proposed for treatment is 85000 ha, in the water re-circulation and sustainability project of P V Narasimha Rao Kanthanapally Sujala Sravanthi Project (PVNRKSSP).

- Soil Conservation Practices

For the plain regions, Watershed Development programmes are implemented, Telangana, Development wing in Telangana, and CRIDA and ICRISAT has suggested the following soil conservation practices. The most important practice among those mentioned below, is contour and broad based bunding.

Table 9.5 Soil conservation Measures and Practices Recommended for PVNRKSSP

Sl. No.	Type of soil conservation	Practices recommended
1	Contour bunds with open ends	<750mm Rain fall, Red soils areas; slopes of 1-6%
2	Zing terraces with raised waste weirs(15 to 23 cms)	Red soils(Medium and Deep) Rain fall 600-750 mm Land slopes, 1-5 % Infiltration rate >6 mm h^{-} ⅓
3	Water ways	Surplus storm water due to high intensity rains
4	Compartment bunds	For medium Black soils
5	Broad Bed and Furrow	Deep black soil, with rain fall upto 750 mm
6	Land leveling	Low (bottom) flat deep areas leveled. Bench terraces are also leveled by cut and fill.
7	Check dams/Nala bunds/Percolation tanks	Gully sites having restricted width and considerable depth, all types of soils. Gullies with low permeability stable beds.

Sl. No.	Type of soil conservation	Practices recommended
		Rain fall of 600-1200 mm
8	Farm ponds	Areas with high intensity rains. Low permeability locations
9	Plantations	Horticulture and timber value seedlings as block plantations.

Table 9.6 Micro-watersheds of PVNRKSSP

Watershed area in Ha	Treatable Area	Area already Treated (ha)	Area proposed for treatment (ha)	No. of. Check dams (ha)	Contour bunding/Bench terracing (ha)	Farm forestry (ha)
85000	85000	10000	75000	750	25000	15000

Table 9.7 Cost Estimates as per Soil conservation treatments suggested

Area to Treated (ha)	**No. of Check dams (ha)**	**Cost (Rs. Lakhs)***	**Contour bunding/Bench terracing (ha)**	**Cost (Rs. Lakhs)****	**Plantations (Agro Horti 5000 ha +25000 ha of Agro-forestry) (ha)**	**Cost (Rs. Lakhs)*****
85000	750	3750	42500	6375	1750+3750	15625
Total (Rs.Lakhs)	15625 Lakhs					

*Cost of each check dam being Rs.5.00 Lakhs

**Cost of bench terrace construction/Bunding is Rs. 15,000/ha

***Cost for Agro Horticulture is Rs. 35000/ha.

****Cost for Agro forestry is Rs. 15000/ha

Total cost for catchment area treatment is = 15625 Lakhs

Table 9.8 Area and Cost Estimate for Catchment Area Treatment

Year	Physical (ha)	Financial Outlay (Rs. In Lakhs)
2018-19	17000	3125
2019-20	17000	3125

Year	Physical (ha)	Financial Outlay (Rs. In Lakhs)
2020-21	17000	3125
2021-22	17000	3125
2022-23	17000	3125
Total	**85000**	**15625**

Table 9.9 Species recommended for plantation

Sl. No	Botanical Names	Common name	Family	Uses	Height (m)
1	*Annona squamosa*	Sitaphalamu	Annonaceae	Fruiting	7
2	*Artocarpus heterophyllus*	Panasa	Moraceae	Fruiting	12
3	*Azadirachta indica*	Vepachettu	Fabaceae	Fruiting	12
4	*Cassine glauca*	Beera	Celastraceae	Medicinal	5
5	*Ficus amplissima*	Gardabhaande	Moraceae	Fodder	11
6	*Ficus bengalensis*	Bhandiramu	Moraceae	Medicinal	15
7	*Ficus glomerata*	Attimanu	Moraceae	Fruiting	20
8	*Ficus racemosa*	Atthichettu	Moraceae	Fruiting	9
9	*Ficus religiosa*	Arasum	Moraceae	Food, Medicinal	18
10	*Gliricidia sepium*	Madri	Fabaceae	Manure	7
11	*Holoptelea integrifolia*	Naali	Ulmaceae	Medicinal	25
12	*Madhuca indica*	Mahua	Sapotaceae	Fruiting	8
13	*Madhuca longifolia*	Adaviyippa	Sapotaceae	Medicinal	15
14	*Mangifera indica*	Amramu	Anacardiaceae	Fruiting	12
15	*Manilkara zapota*	Sapota	Sapotaceae	Fruiting	12
16	*Michelia champaca*	Campakamu	Magnoliaceae	Flowering	13
17	*Millingtonia hortensis*	Aakaashamalle	Bignoniaceae	Flowering	20
18	*Pithecellobium dulce*	Seemachinduga	Fabaceae	Fruiting	12
19	*Pongamia pinnata*	Kaadepathige	Leguminosae	Flowering	10
20	*Premna tomentosa*	Kampugumadu	Verbenaceae	Medicinal	4
21	*Psydrax dicoccos*	Nalla balasu	Rubiaceae	Medicinal	4
22	*Semecarpus anacardium*	Bhallaathakai	Anacardiaceae	Food, Medicinal	15
23	*Shorea roxburghii*	Himsra	Dipterocarpaceae	Fodder	15
24	*Simarouba glauca*	Paradise-tree	Simaroubaceae	Fruiting	13
25	*Strychnos potatorum*	Andugu	Loganiaceae	Medicinal	12
26	*Syzygium cumini*	Jambu	Myrtacecae	Fruiting	15
27	*Tamarindus indica*	Aamlika	Fabaceae	Fruiting	18
28	*Terminalia bellirica*	Vibhitakamu	Combretaceae	Medicinal	20

Sl. No	Botanical Names	Common name	Family	Uses	Height (m)
29	*Terminalia chebula*	Alsikaayi	Combretaceae	Medicinal	12
30	*Terminalia paniculata*	Chirimanu	Combretaceae	Medicinal	35
31	*Wrightia tinctoria*	Akupala	Apocynaceae	Medicinal	8

9.1.16 Reclamation of salt affected soils and management of saline and sodic soils

- The land should be level or contour farmed so that the surface of the soil will be soaked uniformly by water
- Selection of crops or crop varieties that have higher tolerances for salt or sodium
- Use of special planting procedure that minimizes salt accumulation around the seed otherwise lowers Germination percentage.
- Use of the appropriate irrigation method for the root characteristics of the crop
- Use of sloping beds and other special land preparation procedures and tillage methods to provide a low salt environment
- Use of canal or surface irrigation water to dilute the salts and to leach out the salts from the root zone for good germination.
- Application of amendments such as manure, compost, etc. for improving soil structure and tilt. Conservation tillage to incorporate crop residues will help create drainage.
- Deep ploughing of soil to break up sodic and other hardpans or other impervious layers to provide internal drainage.
- Use of chemical amendments as described.
- Good, sound agronomic farming practices and careful need based fertilizer management.

Table 9.10 Cost Estimate for Catchment Area Treatment

Sl. No.	Item	Time period	Cost in Rs.	Implementing agency
1	Soil conservation measures and implementation of CAT plan for 3 years	During operation phase	156,25,00,000/-	I&CAD Dept., & Forest Dept., and Agriculture Dept., GoT
2	Reclamation of affected soil for 3800 Ha		1,90,00,000/-	
		Total	**158,15,00,000/-**	

9.2 Command area development plan

9.2.1 Communication network

Improved communications in and around command area is necessary for integrated development of the project. These are described as under:

(a) Ayacut Roads: These are required within the Command Area for transport of inputs and produce.

(b) Link Roads: These are necessary to connect the command area to ayacut roads. These also include improvement and reconstruction of existing roads to bring them to project standards.

(c) Transmittal of messages from command areas: A radio/telegraph/telephone network in the command areas is necessary to quickly convey messages, concerning rainfall, demand for canal waters, regulation orders, stage

9.2.2 Water Users' Association (WUA)

The modern irrigation management aims at high efficiency of water conveyance and appropriate methods of water application, through participatory irrigation management at each stage of irrigation development. In Telangana, it is essential to promote and implement the theme of participatory irrigation management in all the Irrigation projects through formation of Water Users' Association.

Since the proposed project benefits the existing command areas of JCRDLIS and SRSP Stage I&II Water user's association has been formed in the command area and hence there is no scope for formation of new WUA's.

9.2.3 Training and Agriculture Extension Program

It is important to disseminate information about new technologies so that the farmer is able to make use of the latest agricultural developments. There also exists a gap between research findings and the needs of farmers. For technology to be successful, it is important that it should serve a useful purpose to the end user. The institution that bridges the gap between farmers and agricultural research scientists is the Agricultural Extension Service.

This service works through an Agricultural Research System in the States. Agriculture is a lot more than mere cultivation. Agriculture today is a science that is based on continuing research and a solid foundation of proven data. The more the growers know, the better they cultivate; the more people they can feed, the healthier populations become. There is need to provide farmers training with advanced Agronomy solutions for raising yields, cutting costs and improving quality. In the Training centers experts share knowledge with the farmers.

Hence it is proposed that in the project a training centre to be established to train the stakeholders and line departments/extension workers. The basic infrastructure like building for training class will be provided by Govt. of Telangana and the trainers and faculty will be Experts from Drip Industry. A curriculum prepared based on the farmers requirement is given below.

9.2.3.1 Technical Training

- Introduction to drip Irrigation - Basic drip agronomy and advantages of drip irrigation, Drip irrigation Components, Fertigation and how to Fertigate, Crop wise water requirement and irrigation scheduling
- Maintenance of Drip Irrigation system and chemical treatments (acid ,Chlorination)
- Field visit and practical demonstration on system maintenance
- Crop wise drip protocols & crop production technology with drip irrigation

9.2.3.2 Engineering Training

- Training in Rotation of crops.
- Training in maintenance of Drip system.
- Training in maintenance of Records & Financial aspects.
- Training in Conducting Election of WUA.
- Farmers Interaction with Agricultural department.
- Training in Women's role in Participatory Irrigation management.
- Training on Social behaviour.

9.2.3.3 Agronomical Training

- Training and guidance in Selection of proper plant materials
- Training and guidance in adopting suitable cropping pattern to suit drip irrigation system.
- Training and guidance in Irrigation scheduling through drip Irrigation
- Training and guidance in Fertigation application and scheduling through drip irrigation
- Training and guidance in Selection of proper fertilizers to enhance productivity.
- Training and guidance in Plant protection practices.
- Training and guidance in Best Management Practices.

- Training and guidance in Harvesting
- Training and guidance in Post-Harvest Practices.
- Training and guidance in export packing practices.
- Training and guidance by crop experts in specialized Crops.
- Arranging farmer's field days.
- Arranging farmer's field visits.
- Sharing farmer's experiences.
- Exposure Visits to Progressive Farmers.

9.2.3.4 Mechanical Training

- Training in maintenance aspects of pumping unit.
- Training in maintenance of Centrifugal pumps, Engines and motors.
- Training in installation and adjustments of pumps.

Table 9.11 Cost Estimate for Command Area Development Plan

Sl. No.	Item	Time period	Cost in Rs.	Implementing agency
1	Awareness and training for agriculture extension	During operation phase	70,00,000/-	Irrigation and CAD Dept., and Agriculture Dept., Telangana
		Total	**70,00,000/-**	

9.3 Restoration of construction site

About 800 tree species shall be removed during construction of proposed barrage near Thupakulagudem village, restoration of construction site involving plantation of tree species in the ratio of 1:3 along the left and right bank side of the proposed barrage shall be carried out. The restoration activities shall improve the ecological activities of faunal species. Since, the proposed barrage is the only new project component restoration activities shall be focused near the proposed barrage. The restoration activities shall be handed over to the Forest and Agriculture Department, Government of Telangana in order to obtain sustainable results. List of species proposed for plantation given in Table 9.9.

Table 9.12 Restoration activities near the proposed barrage

Area proposed for restoration activities	No. of saplings	Source for saplings	Time period	Implementing agency
Left and right banks of the proposed barrage	400	Warangal FD Nursery	After completion of site works	I&CAD Dept., GoT and Telangana Forest Department
Restoration of 26 Ha of land to be utilized for construction activities	2000			
Total	**2400**			

9.3.1 Conservation Plan for Schedule-I species

As per the baseline survey, avifaunal species such as Shikra, Jerdon's courser, Indian peafowl, Common buzzard and Booted eagle; butterfly namely Common pierrot and mammals such as Black buck, Four horned antelope, Indian wolf and Sloth bear were recorded during the study in the project site as well as in the command area which belongs to Schedule I of W(P)A, 1972.. Hence, the conservation plan for these species is as follows;

- Protecting all the above species from unlawful killing, including poisoning, shooting, persecution and unsustainable exploitation by construction labours and project authorities.
- The project is being proposed in the river bed/private lands only and therefore no requirement of forestland in Eturnagaram Wildlife Sanctuary. But during discussions held with PCCF (Wildlife), Govt of Telangana, it was mentioned that the project is touching the outer periphery/boundary of ESZ of Eturnagaram Wildlife Sanctuary. Based on the discussions and observations by State forest authorities necessary proposal/permission, if required, will be obtained from Competent Authority.

Protecting and/or appropriately managing important sites especially where Schedule species are reported and all migration bottlenecks.

- Raising awareness about the importance of Schedule I species (Shikra, Jerdon's courser, Indian peafowl, Common buzzard and Booted eagle; butterfly namely Common pierrot, Black buck, Four horned antelope, Indian wolf and Sloth bear), birds of prey, their current plight and the threats that they face, and the measures that need to be taken to conserve them to project authorities and labours by experts in the relevant field.
- Construction during night time will be suspended to ensure no disturbance to nocturnal animals and other mega-faunal species.

Table 9.13 Cost estimate for restoration of construction site

Sl. No.	Item	Time period	Particulars	Cost in Rs.	Implementing agency
1	Plantation along the left and right banks of the proposed barrage	During construction Phase	400 saplings X Rs. 250/-	1,00,000/-	I&CADD, Govt. of Telangana and Telangana Forest Department
2	Restoration of 26 Ha of land to be utilized for construction activities		2000 saplings x Rs. 250/-	5,00,000/-	
3	Plantation maintenance for 3 years	During operation Phase	Lumpsum	6,00,000/-	
4	Conservation of Schedule – I species		Lumpsum	2,00,000/-	
			Total	**14,00,000/-**	

9.4 Reservoir RIM treatment

Reservoir RIM treatment plan is formulated to mitigate the geo-environmental hazards in the project areas especially reservoir. Geo-environment hazards may be defined as those extreme events induced by geological setup of the region, which exceed the tolerable magnitude within or beyond certain time limits, make adjustment difficult, result in catastrophic losses of property, income and lives. In any development project, planning of geo-environment hazard is as important as the construction of the project structures. Therefore, the main objectives behind the Reservoir RIM Treatment action plan is to check the sedimentation in the reservoir caused by the loose debris on critical slopes, landslides and for stabilizing the foundations of the dwelling structures along the Reservoir Rim in due course of time[66].

Aims and objectives of Reservoir RIM Treatment Plan is to check sedimentation in the reservoir, and therefore to mitigate the effects of debris flows on extreme slopes, extreme events such as landslides. In general the aims and objectives for Reservoir Rim Treatment Plan are as follows:

- To prevent land degradation / soil erosion
- To prevent the structure / settlements from subsidence and to provide stability
- To augment the life on the reservoir by reducing siltation
- To stabilize the landslides and landslip zones around the reservoir.
- Generally the mitigation measures include:
- Filling and compacting the fill in all open cracks and crevices with cemented spray and other compact materials.
- The impact of landslide on the project could be managed by arresting the potential landslides zones through suitable engineering treatments, afforestation etc.
- Landslide Control with Coir-Geotextile.
- Biological measures including vegetation cover

The proposed scheme involves construction of barrage across River Godavari in order to store water and utilize it during the Rabi season. However, the scheme involves submergence of only river bed area (FRL +77 m) with slope ranging from 0%-10.16% and 10.17%-21.03% and the either sides of the proposed barrage is covered with forest areas with a slope range of 21.04%-34.7% on left bank and 34.71%-56.07% on the right bank of the river. The elevation along the right bank is quite high with rocky strata and the forest vegetation is

[66] Reservoir Rim Treatment Plan (2011), Environmental Management Plan, http://apspcb.org.in

observed on either sides of the project component. These characteristics acts as natural mitigatory measures and avoids sedimentation and landslides. Therefore, the Reservoir RIM Treatment for the proposed project includes only maintenance of the existing environmental components during the construction phase and the implementation of vegetation cover along the left and right bank of the proposed barrage is already covered in Restoration of vegetation section given below;

Table 9.14 Cost estimate for reservoir RIM treatment

Sl. No.	Items	Time period	Cost in Rs	Implementing agency
1	Maintenance of barrage and sedimentation prevention	During operation phase	10,00,000/-	I&CAD Dept., GoT
	Total		**10,00,000/-**	

18°35'26.75"N, 80°23'14.67"E

18°35'26.75"N, 80°23'14.67"E

Vegetation cover on the left bank of the proposed barrage

18°35'29.09"N, 80°23'41.96"E

18°35'29.09"N, 80°23'41.96"E

Rocky strata and vegetation cover on the right bank of the proposed barrage

9.5 Fisheries Development Plan

9.5.1 Migratory corridors and breeding locations

With the productive agricultural innovation and rapid industrialization of India and implementation of several important programmes, several river systems have been developed by establishing dams and barrages to cater to the agricultural/horticultural needs, floods controls, navigation, hydel-power generation etc. As time advances, to satiate the respective needs, more and more such structures will be commissioned. The river valley projects, in reality, interfere with the riverine environment, inevitably affecting the fishery resources of the concerned lotic water body. The effects of the interference may be beneficial, indifferent or harmful depending upon the particular situation and fish species harboured in such environment. Effects of dams/ barrages on fish population can be categorised under two 'heading – Viz: Obstructional and Ecological. Dams weirs and barrages act as physical barrages to migration, tending to prevent access of the fish to their usual compatible breeding, rearing and feeding grounds. The denials/prevention of such endeavours in its life span may result in permanent and irreversible reduction of its stock ranging from lowering the levels of abundance to absolute extermination.

The ecological changes brought about by river valley developmental programmes adversely affect both the migratory and the non migratory fish species. Consequent substantial morpho-ecological changes occur in the creation of an impoundment, substantial morpho-ecological changes occur in the original lotic water body, both above and below the dam/barrage site. These include conversion of the fluviatile system into water body of slow manoeuvred discharge characteristics and radical transformation of long- established ties and inter-relationships amongst the biotal faunal elements. Fluviatile biocoenosas are replaced by new ones; some species shift to new spawning and migration range; anadromous fish tend to settle down; local stocks of fish form; inter-specific biological differentiation of fish occurs and egg laying substrate change. Other substitutions also occur such as inundation of spawning or ineffective spawning of good many important fish species.

Considerable reduction of flow in the residual rivers tailing below the dam/ barrage, significantly alters the ecology of the spawning grounds, which may, even dry up, Reduction of water levels in the residual rivers results in formation of shallow areas which impede or even movements. In instances where dams, Weirs, barrages are constructed in estuarine eco-system due to reduction and salinity regimes of brackish waters/estuaries and of current velocities as also directions at the mouths of the rivers. The latters essentially constitutes the directive factors for migration of fish species – both the anadromous as also the catqdromous varieties resulting in unsuccessful migration at even total failure of runs.

Effects of barrages on fisheries are not always deleterious. The construction of a barrage across a river, results in creation of a reservoir which makes available an expansive water area for production and exploitation of varieties of fish suitable for such environments. Wherever barrages are constructed in regions beyond the areas of naturals occurrence of economics species, whether migratory or non migratory habits, or located far above the routes of migration of anadromous or catadromous fish, the effects of such constructions are of no consequences to fisheries.

From the point of view of migratory habits, fish species lodged in the Indian Rivers may be classified as (i) Resident species, which prefers to remain confined within the local territories (*Puntius, Labeo, Cirrhinus, Notopterus, Channa, Carra mastacembelus, Mystus* etc) (ii) short-distance migrants – *Bagarius, Mahseer* etc and (iii) long-distance migrants – *Hilsa* an*d Anguilla spp*.)

The fish species of the Godavari river comes under 'Resident and short-distance migratory' ones. The Long-distance migratory fish which been recorded from the River Godavari are the fresh water Eel – *Anguilla bengalensis* and *A. bicolour* and the Anadromous Indian Shad, *Hilsa ilisha*.

Earlier workers (Ichthyologists), based on the collection of large number of elvers of A*. Nebulous* measuring 152 mm in long that Nizamsagar dam in the river Godavari, around 725 km from the sea, opined that these, probably, breed in fresh waters (Rahimulla *et. al.* , 1994). Later researches, however, disproved this assumption based on the monthly growth rate of elvers (Pantulu, 1956) and regykar migration of elvers recorded at different upstream stretches of the river Godavari (Ibrahim, 1961). In the river Bann, Northern Ireland, elvers were caught almost at regular intensities; the chief factor for their migration is attributable to the river discharge into the estuary, as also, on the abundance of the elvers present at the time (Lowe, 1951). Further, the rugged Eels are quite capable of climbing vertical walls provided the surface is damp enough, over-coming walls/falls including vertical walls of 25 m (Frost, 1954) and negotiable the highest and steepest waterfalls in the country, and even travel across land in heavy rains or if the grass is wet with dew. The recording of the species in the Krishna River, the Tungabhadra reservoir/river and at Tunga River in Karnataka, located close-by, evokes interest from ichthyological considerations and calls for undertaking in depth studies on the subjects.

The Indian Shad, *Hilsa ilisha* was considered a typical long distance migratory fish of the Indian waters of high economic value. In recent years, however, evidence of the existence of some non-migratory resident stock of *Hilsa sp.* has been gathered. *Hilsa sp*. Ascends for breeding in sheals from sea into the Ganga-Bhramaputra, Mahanadi, Godavari, Krishna, Cauvery, Narmada and other streams. Two runs are recognized – one, the post –monsoon

run and the other, late winter run- the former bring the major one. In both cases, the fish returns to the estuary after breeding in freshwaters and so do the young which require semi-saline environment for growth and survival.

In India, Several fish passes were constructed without due regards to the effective performance of the species that might makes use of them. These fish passes have proved unsuccessful. These, in effect, serve as 'traps' for fishes rather than facilitate their migration. Lack of knowledge of the fish behaviour and leaping capacities of the migratory fish, combines with exorbitant cost of fish passes have prevented the construction of right type of fish passes. As the reports indicate that the contribution towards the fishery of the river Godavari by the species *Anguilla* and *Hilsa* is, as such, 'poor' warranting avoiding any inclination towards the construction of a fish pass at the project site envisaged.

A major threat faced by the mainstream River is the prevention to the fish stocks from ascending to the upstream stretches and also to descend to the lower reaches for sustainable needs. Every care should hence be taken by the Authorities concerned to allow a minimum of 4ft of water column in the lower stretch of the river below the dam during the lean season in order to secure the fish species present; else, large scale fish mortality occurs which effects the entire stock. It is to be noted that by man-induced destructive means or by predation, once a species becomes EXTINCT, it is LOST to the society together with its potential contribution towards sustainable development. The precautionary PRINCIPLE hence is an important part of the rationale for sound CONSERVATION principles[67].

9.5.2 Enrichment of riverine fish fauna

The richness of the wide spectrum of native flora and fauna in the lotic and lentic water bodies is governed by their zoogeographical locations. Majority of the fluviatile systems in the country, based on such precise identities, inherently do not harbor the fast-growing fish species of commercial importance. Thus, in order to enrich the fish fauna of the systems and also to augment considerable fish production from such resources, efforts to transplant several native as well as the exotic fish species, from one river to the other or from river to the impounded waters such as tanks, natural – and manmade lakes are in practice. Often, selected fish of economic importance are transplanted from one river to the other. Farm – grown fish fingerlings of the Indian major carp, *Gibelion catla, Labeo rohita and Cirrhinus*

[67] Rahmulla, M., S. Mahmood and S.A.Kabir. 1944. Proc. Indian Acad. Sci., 19B (1):16-18.
Pentulu, V.R. 1956. Proc. Nat. Inst. Sci. India, 22B(5):259-280.
Ibrahim, K. H. 1961. J. Bombay NAT. Hist. Soc.,58(3):810-812
Lowe, R.H. 1951. J. Cons. Perm. Int. Explor. Mer., 17(3):299-315.
Frost, W.E. 1954. Colonial Office Fishery Publication, No. 6.
Sinha, VR.P. and J.W. Jones 1966. J. Zool. Dept., 150:371-385.
Jhingram, V.G. 1975. Fish and Fisheries of India. Hindustan Publg. Corpn., Delhi: 148.

mirgala and the exotic carp, *Cyprinus caris, Ctenopharyngodon idella, Hypophthalmichtya moltrix* are also stocked in both the lentic and lotic water bodies so as to improve the stock, better utilization of the fish feed available and to retard the extinction of native fish species. To a large extent, it is quite possible to enhance the productivity of a water mass by introducing and acclimatization process through supplanting a more viable and valuable commercially important fish species into the biotope which uses the same feed web as the less valuable members of the fauna indigenous to the system. This leads to establishment new food – niches resulting, considerably, in high fish yield. Transplantation of indigenous – and the exotic fish species in the state, however, appears, not so common. Proper attention in this sphere has to be directed by transplanting fast – growing compatible fish species, Sport-fish and the non-predatory catfish *Pangasius pangasius* after studying the environmental ad zoogeographical distribution patterns of each. On the lines of stocking of fish fingerlings of commercially importance in certain water sheets, be they thanks or reservoirs, the Department of fisheries in the state of Telangana and also the project proponent could explore the possibility of stocking such fish components, in good many lotic water bodies too which, profitably, boost the fish production facilitating scores of fishermen/ fisherwomen engaged in the profession since decades to ekk-out their livelihood honorably. It is quite knowledgeable, particularly for the persons in the Department of Fisheries and the like that 'no class of workers in the country and elsewhere too, earn their livelihood at greater risk and hardship than do the fishermen/fisherwomen. Depending entirely for their earnings on conditions in the various markets and such other outlets and with no guaranteed income, on many occasions, their living in recent years has been the most precious. Facing the searching sun, rains, chill, wind and rough rivers, reservoirs and also marine environment, they do not complain however. Bad weather which damages their fishing gears and prevents them from earning a single rupee, quite often, is accepted bravely as a part of the business. It is, therefore, our humble submission is to look – into their problem=ms for the production of enough fish wealth through the transplantation of commercially important fish fingerlings in the River Godavari and other lotic water systems of the state of Telangana. The positive steps in this regard will definitely help the scores of fisher folk of the State to shape their, inclusively of their families, to ekk – out their livelihood honorably.

As a recourse to this very 'Objective', around 10 lakhs of fish fingerlings of every 75 mm in length, comprised of Catla – *Gibelion catla,* ROHU – *Labeo rohita* and MRIGAL – *Cirrhinus mirgala* be introduced annually accounting to be 40% Catla, 30% Rohu and 30% Mrigal in the Godavari River, above the dam and, in the reservoir to be established around 5 lakhs fish fingerlings be introduced. Studies in widely-separated regions of the world have revealed a constant pattern in the productivity cycle of reservoirs. Immediately after filling, there is an

initial period of high productivity accompanied by steep increases in the fish food reserves on the account of fertilising action of the submerged vegetation, decay products from the forest and increase soil substratum. This initial spurt of high productivity last for a few years and the only obvious way to take advantage of this initial phase of high productivity is to stock large quantities of fish of desirable species during first year of filling since the indigenous fish stocks present in area would not be numerically adequate, to populate and exploit the food resources of the enormously–increased area. The survival rate of the generation of first year of filling exceeds ten-folds and sometimes hundred- folds that of the fry of merging rivers and the generation of the first year forms a robust basis for fishing for many years to come. The fish seed stocking in the river Godavari and the reservoir complex to be commissioned need to be implemented annually to ensure supply of fish stocks to the scares of fishermen depending upon the profession since long.

Departmental fish farms located at Khammam, Nizambad, Warangal, Adilabad and Karimnagar could be approached to affect the supply. A formal letter with the request to supply the seed required to be addressed to the Departmental Officers based at these fish farms in the State of Telangana be addressed by about March – April each year with the request to affect the supply of the stock as requested by around September – October of the every year.

In the Godavari River, above the dam and, in the reservoir to be established around 5 lakhs fish fingerlings be introduced. Studies in widely-separated regions of the world have revealed a constant pattern in the productivity cycle of reservoirs. Immediately after filling, there is an initial period of high productivity accompanied by a steep increases in the fish food reserves on the account of fertilising action of the submerged vegetation, decay products from the forest and increase soil substratum. This initial spurt of high productivity last for a few years and the only obvious way to take advantage of this initial phase of high productivity is to stock large quantities of fish of desirable species during first year of filling since the indigenous fish stocks present in area would not be numerically adequate, to populate and exploit the food resources of the enormously–increased area. The survival rate of the generation of first year of filling exceeds ten-folds and sometimes hundred- folds that of the fry of merging rivers and the generation of the first year forms a robust basis for fishing for many years to come. The fish seed stocking in the River Godavari and the reservoir complex to be commissioned need to be implemented annually to ensure supply of fish stocks to the scares of fishermen depending upon the profession since long.

9.5.3 Conservation, Management and Stocking

Protection to breeders migrating upstream into the river above during monsoon months is to be afforded to by 'Legislation'. If a reservoir is tax to be enriched by the fast – growing

commercially important fish species during the major part of the year, proper protective measures are to be provided. No Closed season for migrating fish or protection to congregation centers spots below dam reservoir is being practiced endangering complete depletion of the fishery wealth from such stretches close to dam, barrages and weirs. Fish species migrating upstream for spawning are indiscriminately captured without any remorse. The process depletes the fish life in such Impoundments – presents and the one to be commissioned shortly.

The development of 'intensive fish management' is impossible at the present day without the artificial culture of food fishes. River systems are also 'farmed' and their fisheries can be categorised under 'CULTURE FISHERIES'. In fact, it is here that 'Culture and capture' fishery techniques join hands. Extensive stocking with fast growing carps can solve the problems of low production in lotic biotopes to a very great extent. Such stockings, perhaps, by well – grown fingerlings is, normally, not being practiced and, also, has not received due attention still. Major and other economic fish species should be encouraged to spawn above or in the rivers as artificial stockings by fingerlings produced elsewhere is a costly affair.

9.5.4 Fresh water fish species in the light of the IUCN categorisation

Fresh water fish species, in effect, are a poorly studied group since the data on their occurrence, distribution, population, dynamics and threats, to a considerable extent, is somewhat incomplete. Threats to the indigenous fresh water fish species in particular are mostly physical in nature, such as degradation of their habitats, fragmentation, pollution, poisoning, pesticide impact, destructive fishing methods and related human interferences. Trade also is an important destructive contributing factor, especially, from the Private Aquarium agencies in threatening majority of fish taxa preset in the lotic and the lentic water bodies in the country, in general.

The International Union for conservation of Nature and Natural Resources – IUCN, the world scientific body/ institution for the 'Conservation of the Animals and Plants, have published lists of the species of fish, Amphibians, birds, reptiles and mammals (Faunal elements) considered to be Globally under Endangered, Threatened or Rare categories in their Red data book, 2017, a follow up of such an exercise formulated earlier in the year 1994. At that time (1994) as a follow-up, 'Conservation Assessment of Management Plan' workshop was organised from 22nd to 26th September, 1997 at Lucknow (UP) for 329 taxa of fresh water fish species of India" to 'critically assess their respective *Status* in the wild'. The workshop was hosted by the National Bureau of Fish Genetic (NBFGR), Indian council of Agricultural research; Technical calibration was from Zoological Survey of India (ZSI), Central Inland

Fisheries Research Institute (CFTRI) and National Research Centre on Cold Water Fisheries (NRCCWF). Approximately 50% of all Indian fresh water fishes were assessed at the workshop referred and discussed extensively on the check-list of the Indian Fresh Water Fishes prepared by NBFGR, Lucknow containing 650 fish species and sub-species. The check – list was scrutinized at the workshop and only these fish species/ sub-species that were known to have occurred or currently present in the country were evaluated.

The CAMP process methodology adopted for 'Rapid Assessment' of taxa in the wild proved quite effective which has been, technically and scientifically, recognized by the IUCN specialists group, Governmental & Non-Governmental institutions, Conservation Action Plan and Policy makers all over the world. The guidelines incorporated in the said report have been adopted while listing – out the fish species under particular 'status' in the studies carried-out in the Godavari River in the recent past.

9.5.5 Fishermen/fisherwomen co-oprative societies

The Telangana state situated in the Central stretch of the seaboard of the Indian Peninsula command an area 114800 sq.km. with nine districts – Adilabad, Karimnagar, Khammam, Mahabubnagar, Nalgonda, Nizamabad, Rangareddy, Sangarareddy and Warangal. The River Godavari, in effects, flows close to Nizamabad, Adilabad, Karimnagar and Warangal districts in the state. The rivers and canals commands a length of 1808 km, the tanks – 4324 nos. with water spread area of 2,62,187.55 Ha (departmental tanks), 19,476 tanks with water spread area of 1,55,408.69 Ha and the reservoirs numbering 74 with their total water spread area accounting to 1,77,607.60 Ha.

While the Fishermen cooperative societies in the state of Telangana commands a membership of 2,86,844 nos. coming under 3513 societies, the fisherwomen societies, numbering 437, commands a total strength of 20,420 members. There are also district Fishermen cooperative societies numbering 10 with membership strength of 2736. While the total fishermen/fisherwomen population in the state accounts to be 19,04,281 nos. active fishermen/ fisherwomen are only around 3,07,234 nos. There are, likely to be functional in the state, 55 fish markets and 244 community halls

The department of fisheries in the State Telangana leases – out water bodies for the development of fisheries, stocking of fish seed, harvesting and marketing.

The Government of Telangana, through the Department of fisheries, has undertaken welfare schemes towards Group Accident Insurance Scheme to fishermen/fisherwomen and ex-gratia-payments to the needy ones; also relief – cum – savings scheme is provided; assistance towards construction of houses to fishermen/fisherwomen and many more welfare

schemes are being implemented to the deserving fisher folk by the Government through the Department of Fisheries and the Fishermen/ Fisherwomen cooperative societies.

The State Government, through the Department of fisheries, also undertake Extension Programme such as (i) conducting awareness programmes to Fishermen/ Fisherwomen, Fish farmers, entrepreneurs and stake holders; organizes capacity building programmes to field functionaries to transfer the fish and fisheries knowledge to the fish farmers, fishermen/ fisherwomen. Also arranges field visits to educate the farmers, fishermen and fisherwomen Also organize state/ National level workshops, seminars, field trips in coordination with other fisheries related organizations such as KVK, ATMA, NGOs etc.,

9.5.6 A matter of concern

Perhaps no other area of aquatic ecology a serious and mere inter-disciplinary approach than the stream/ river ecology. Geology, Geomorphology, Fluid mechanisms, Hydrology, Biochemistry, nutrient dynamics, microbiology, botany, invertebrate zoology, fish and fish biology, food-web analysis, bio-production and bio-monitoring are but a few of the disciplines from which stream/ river ecology has drawn scientists, Government agencies, Resource managers and also General public to assemble on a common platform. Consequently, the above institutions and the individuals have felt keenly about the 'Status' of streams/river ecology as an integrative science that can help societies and the like around the glove grappling with the environmental degradation of their water resources. Indeed, streams and rivers are fundamental to the human, floral and faunal part of the 'Biodiversity' existence, on compatible and supportive grounds and many institutions and user groups have come to a common platform to protect these unique habitats that are so vital to global biodiversity and its sustainability. Needless, to add, of-late, the lotic and the lentic water bodies, all over the areas of their existence, have, ecologically experienced many instances of advancing degradations prompting research, have, ecologically experienced many instances of advancing degradation prompting research, methodologies coupled with feasible technologies in order to put them again on the right tracts adhering to the quality and hygiene standards.

In order to maintain desirable ecological/biological parameters, as also, the aquatic life present in the Godavari River at the site and elsewhere too, attention is drawn to the following points for achieving long-term benefits.

1. Prevention of flow of domestic and industrial pollutants into the Godavari River: The human population explosion and the rapid industrialization in the country have resulted in the generation, correspondingly, of greater volume of domestic sewage and industrial wastes. These being discharged, indiscriminately, into the rivers, streams, lakes, tanks and other inland water bodies, alter, Physically, Chemically and Biological quality of waters by the

addition of substance or a mixture of these which interfere by the use of medium by creating a condition known as POLLUTION. Pollution is an act akin the murder, charged the Government Environmental Officer, who argued that the Tax-payers money should not used to bail-out an Industrial polluter (Jun Ui, 1920). Besides, flow of municipal and industrial wastes, domestic sewage all the time and the extensive use of pesticides and related ingredients for greater yield of crops and protection of food grains and their entry subsequently during monsoon season into the river streams and such other water masses also cause pollution of both the water and the soil. Also clean drinking water is an essential human and other form of lives requisite for sustenance of life/ lives. Clean water is also a *sino qua non* for the development of fishery resources. With the country's rapidly growing population, accompanied by increasing hazards of domestic and industrial pollution to the inland waters of the country, scientists, as also, the man on the street, envisage a severe and rapid degradation of water quality unless concrete steps are taken to immediately abate pollution. The western countries have oblate, exercised deep concern both about air and aquatic pollutions and are adopting stringent measures to maintain their environment clean. As the human population rises and industrialization increases, water requirement rapidly approach the limits of available supply and in a short time, exceed the supply in most cases. This is how the present aquatic pollution in the country has come to be localized at particular stretches of the different river systems of the country. Should the water quality of the Indian rivers and streams, in general, get degraded beyond certain limits, the situation may go out of control, which, may not get degraded beyond certain limits, the situation may go out of control, which, may not adversely affect all uses water is put-to, such as domestic, agriculture, aquaculture, industrial, recreational, aesthetic, navigational and power generation etc., but the entire aquatic system may be thrown out of gear and may head towards a severe biological imbalance. The latter, if it happens, would be an Ecological disaster.

The waters of the River Godavari and its tributaries are utilized for very many purposes all along the courses in which these traverses. Mostly, the medium is used for community water supply, irrigation, industrial water supply, bathing of humans/cattle, washings of cloths and as a recipient of industrial effluents and domestic sewage. Pollution of the river water takes place to a varying degree, on the manner of transport of the waste generated in liquid or solid format, whether it is directly discharged or indirectly. Sewage containing oxidizable organic matter, when discharged into the river, decomposes through the activity of micro – organism and exert a greater demand on the DO in the medium. Depending upon the degree of self-purification in such a situation in a biotope, the residual pollutant either diminishes or remains constant. Godavari River, in effect is no exception to Indian Rivers in being 'polluted', especially, when its waters are rich used for cash and agri based crops cultivation; also for industrial uses. Studies carried-out of the River Godavari at Rajahmundry

during sixteen on the discharge of effluent of Andhra Paper mills, indicated, over-all, degrading water quality and also of biological faunal elements.

Every water body affirms certain inbuilt capacity of 'self-purification' and 'self-cleaning' within which, it is perfectly capable of cleaning itself. However, over-increasing population, land-usage, industrialization etc., are causing increased water pollution and thus, the amount of polluted water discharge in the systems are constantly exceeding their self – purification capabilities and, being so, the external purification process cannot effect treatment of the water entirely. Caution should be exercised to release only the treated waters into the rivers and such other water sheets.

2. Over-fishing problems: All animals produce a greater number of offspring's than would be necessary to perpetuate themselves as these entire have a natural tendency, based in-built capacity and genetical capabilities, to increase their respective population. In fact, of course, no single kind of animal has the world to itself and its rate of increase is modified, very much, by the presence of other compatible and complimentary inhabitants in nature. Most of these merely compete for food, water, breeding grounds and the like that makes life possible. There are no animals existing that are free from adversaries or competitors and, as a rule, in fact, normally, the population of any kind of animal is in equilibrium, at any given time. But when the enemies, need-based or selfish, are so powerful that there is a decrease each year of the number of specimens reaching 'maturity', then, the stock is threatened with destruction.

Fish like all other animals, show a natural tendency to increase in numbers and some species produce as much as 10,00,000 eggs at each spawning. Bur life is very dangerous for fish, particularly when young and in certain instances, as much as around 99.99% of the eggs may perish, due mainly to pollutional or ecological imbalances. Amongst the many animals which are the enemies of fish, is the fisherman himself. Although, in oceans and such other expansive water areas, he may only be a slight nuisance to the fish and its habitat; in small and larger fluviatile and impounds water bodies, he is, often the 'worst' enemy who can destroy at will, the entire stock. If one is a good fisherman – an autodidact - , he will farm the stock by taking a rational yield only so that his supply of the fish lasts for days to come. And, if he is bad professional, he will grab all he can get, and, if there are many others like him, they will, amongst themselves, ever-fish the stock, result being, ultimately, the natural or even the 'farmed' ones gets harvested faster that it can hardly be replenished by natural production. If persisted to continue in this format, rapidly, the numbers gets reduced and may, in extreme cases, the entire stock gets destroyed.

Over-fishing may be brought about simply by fishing se intensively that not enough numbers are left to produce young ones to make good the loss or it may be caused by

exploiting the available stock of all sizes by unsuitable, unethical and most unscientific methods like poisoning, dynamics, operation of small-method notes etc. So that a large proportion of young specimens – juveniles – are taken out which have not yet had time to reproduce themselves. This is 'precisely' what is being done by the local- and the migratory fishermen at the site/s studied and also in close – by the locations of the River Godavari. In such instances, as soon as the power of reproduction of the stock is reduced, it deduces as an act of over-fishing. Farming of fish in nature (Fish Sanctuaries) other than the fish farms, is possible for long-term gains. Nevertheless, it can be done as in fish sanctuaries located across many rivers in the country, though, of course, the results are slower to get recognition and appreciation for the over-all benefits of the society at large. For this very reason however if for no other, there is nearby, always, intense opposition to any scheme to save the stock by declaring the "Breeding season as closed season" to facilitate fish to breed and to improve its stock. This opposition, unfortunately, invariably, comes from the fishermen themselves and such as the losses, fish merchants, fish contractors directly concerned in the fishery and is the reflection of their own ignorance, conservation aptitude and also inability to look into the future.

In order to derive lift-long benefits, one has Martin H.Fisher (1879-1962) puts "Just go into the partnership with the nature, she does more than half the work and asks none of the fee".

3. Occurrence and proliferation of Alien fish species:

The exotic fish species *Oreochromis mossambica* (South America) and Claries gariepinus (Africa) are recognized the world-ever as 'Flag-ship' species in aquatic ecosystems due to their destructive efficiency in establishing themselves in the most shortest possible time ever. Their total extermination becomes a very serious challenge, especially, in larger water bodies where these are already well-established. The species have been recorded/reported to occur in the River Godavari in different areas, all along its course. Their inadvertent/accidental entry in majority of the water bodies in the country and the very serious influence – Negative – on the piscine – and also other faunal elements is very well documented. Very serious and concrete efforts are to be made for their total annihilation in order to secure all other fish species present in the lotic and lentic water sheets. The species may be a cause for good many aquatic organisms loss where these have been recorded. It is on record that unequivocal scientific evidence exists to prove the ill-effects of culture of alien fish species on the aquatic biodiversity of a given systems. It is to be noted that "once a species becomes EXTINCT, it is LOST to the society together with its potential contribution towards sustainable development". As Gerald Durrel aptly states that" I believe that the world is a poor place for each species that we lose. Extinction is not just a moral issue, involving responsibility for the loss of an individual species; each represents a loss of unique genetic

material; The unfettered proliferation of the African catfish – *Clarias gariepinus* (1770 mm – 59.00 kg) in particular, has undoubtedly, exerted immense pressure on the native/indigenous fish germplasm, result being their depletion majority of the biotopes where these are present.

As if the devastating ill-effects of the fish species detailed just earlier is to enough, there are reports on the occurrence of Alligator catfish – *Atractosteus spatula* (Deccan chronicle, August 06, 2016) that the species has established in the Telangana and Andhra Pradesh water bodies. The species is the largest one in Texas (North America), considered as a threat to sport fish in the United States of America. The species has been recorded in ponds, rivers and other natural water bodies located in the states Telangana and Andhra Pradesh. Its source supply and clandestine entry into the Krishna is from Aquarium Outlets based in the states Telangana and Andhra Pradesh. Urgently preventive measures to check its established in the water areas observed is to be taken at the earliest before the species create insurmountable problems in the days to come.

One of the most dreaded fish in the world, the red-bellied PIRANHA, *Serrasalmus natterari* has been recorded from the Godavari River, Andhra Pradesh. The species is a native of rivers traversing through South American Nations like Argentina, Brazil and Venezuela. The fish was first recorded from the Dowleswaram barrage in Rajahmundry, and Akividu, west Godavari. In view of the linking of the Krishna and the Godavari Rivers in the recent pasts, fisherman in Guntur district's Tadepalli village located on the banks of the River Krishna is worries-lot. The species has been observed near the Prakasam barrage.

9.5.7 Rehabilitation of Endangered and Threatened fish species

Dr. Rodolfo Dirzo *et. al.* (Proc. NAT. Acad. Sci., July 2017), have published an article stating that the "Sixth mass extinction of life on Earth is unfolding more quickly than feared". Over30% of animals – fish, birds, amphibians and reptiles are declining alarmingly, both, in range and population. The man-induced processes are also contributing towards this annihilation of fish germplasm in particular from our good many water bodies. On an average, two vertebrate species disappear every year. Tropical regions have seen the highest number of declining species. As many as half of the number of animals that once shared our planet are no longer here – a loss, as a 'massive erosion of the greatest biological diversity in the history of the Earth'. The main drivers of wild-life decline are habitat loss, over-fishing/consumption, degradation/pollution, invasive species, disease, as also, illegal activities. The massive loss of our fish populations from our Rivers, reservoirs, tanks, etc., compared to sixtees/seventees, reflects our total lack of 'EMPATHY towards these, who, incidentally, are our companions since origin.

Are we justified in assuming that the impact of the un-checked, un-controlled onslaught on the fish germplasm indigenous, also, the economic carps introduced for production and economic gains may not be so devastating? The introduction of exotic fish species, *Cyprinus carpio*, *Hypophthalmichthys molitrix*, *Aristichthys nobilis, Oreochromis mossambica, O.nilotica* and *Clarias gariepinus* have left irreparable devastating impact on all aquatic life-particularly-the fish germplasm. Has not man's observation period- brief, incidental, or long-term, on the negative impact of these forces been 'very casual' to the knowledge data from all-over the world available on the subject. In studying the vastly scientific literature available, it becomes clear that, though there is one of comparative quietude and slow-change.

While a great deal of work has been done on the subject, much remains yet to be accomplished. Problems which appeared to be relatively simple, gather greater complexity and knowledge progresses, but, with patient work seemingly insurmountable obstacles, can be surpassed/over-come. "Advance in Science comes by "laying brick upon brick, not by the sudden erection of fairy palaces".

According to the International Union for Conservation of Nature and Natural Resources (IUCN), fish species have been categorized as Extinct, Critically Endangered and Endangered, Vulnerable and at Lower Risk. To categorize the fish from the inland water bodies of the State of Telangana according to the IUCN standards, long term studies are required to be carried out for a period of 5-10 years covering all the major resources. However, based on the observations carried out and the literature available, a list of 'threatened fish species' is documented here. It could, however, be stated that, till date, it appears, no efforts have been made to 'rehabilitate these threatened fish species' in the State and elsewhere too in the country. The Godavari River, as published records indicate, harbors, around 105 fish species, of which, to begin with, if the following ones are collected from the River Godavari, also its tributaries located in the State and taken care of in certain fish farms for further growth, development, breeding and transplanted in the lotic/lentic water bodies, it will be a 'yeeman' service from the concerned towards the laudable efforts, which, warrants immediate attention, interest and execution.

Fish seeking rehabilitation and conservation measures:

Tor Khudree, Neolissochilus hexagonolepis, Systomus sarana, Hypselobarbus kolus, Hypselobarbus pulchellus, Cirrhinus cirrhosus, Labeo bata, Labeo calbasu, Labeo fimbriatus, Schismatorhynchus (Nukta) Nukta, Hemibagrus maydelli, Sperata aor, Sperata Seenghala, Ompok bimaculatus, Wallago attu, Proeutropiichthys taakre, Silonia childreni, Bagarius yarrelli, Glyptothorax lonah, Channa marulius and *Channa striatus*

The Research Institutes (Govt. of India/ ICAR), Department of Fisheries and such other Research and Development Establishments could be roped in for the implementation of the submission made.

9.5.8 Fisheries Conservation and Management Plan

The over-all activities of the PNVRKSSP across the Godavari River, at the site in particular, involve the construction of a barrage, intake water distribution components and related other facilities. The mitigation measures to be accessed to ward off unpalatable/hindering impacts, if any, during the 'construction and Operation' phases have been detailed in the following format. It is to be considered, however, that the 'potential' impacts scripted earlier, are just the 'predicted' ones considering the 'Mitigation' measures to be adopted to assess, if any, the 'Negative' influences while undertaking construction of all the components connected with the envisaged project.

9.5.9 Post project environmnetal monitoring

- A 'Monitoring Cell' will be constituted with representatives from fish and fisheries disciplines to oversee/guide for the effective implementation of the suggestions made.
- The limnological and fisheries investigations be organised on quarterly-basis for a period of 3-5 years to assess the ecological changes, if any, in order to introduce desired measures for overall sustainable development and processes of the aquatic life-fish species in particular-prevailing based on the scientific know-how available.

Towards development of indegenous, endangered, vulnerable and near threatened fish fauna in the Godavari riverine system, proper attention has to be directed towards large sized fish species, sport fish, cold water fish, after studying the environmental factors and zoogeographical distribution pattern of each species. These species will be released into the Godavari River at the barrage site for propagation of fisheries.

Table 9.15 Cost estimate for implementation of fisheries management plan

Sl. No.	Items	Time period	Cost in Rs	Implementing agency
1	Cost of sluice gates for fish movement	During construction	Cost included in DPR	Department of Fisheries and I&CAD Dept., GoT
2	Stocking of fingerlings (5,00,000)	During operation	25,00,000/-	
3	Miscellaneous (transportation, research and training)		2,50,000/-	

Sl. No.	Items	Time period	Cost in Rs	Implementing agency
4	Establishment of Fisheries Monitoring Cell	During operation	--	
		Total	**27,50,000/-**	

9.6 Muck Disposal plan

All the muck and boulders generated (42,52,579 cum) from the project activities will be reused for covering the project components after construction phase along the foundation of the barrage and the details are given below;

Table 9.16 Muck disposal plan

Sl.No	Project activity	Type of excavation	Volume of excavation in Cum.	Implementing agency
1	Coffer dam	Underground	664472	I&CAD Dept., GoT
2	Barrage	Underground	2390445	
3	Abutment, Wing wall and Flank Wall	Underground	214252	
4	Guide bunds	Underground	157730	
5	Excavation for foundation	Underground	21000	
6	Residential Building	Underground	14855	
		Total Excavated earth	**3272754**	
1	Excavation for foundation in ordinary rock	Underground	478088.96	
2	Excavation for foundation in Hard rock	Underground	501436.16	
		Total Boulders	**979525.12**	

The muck generated will be completely reused for filling of tie bunds and guide bunds of left and right flanks, cut-off trenches, service paths etc., and the boulders shall be reused for slope protection and remaining will be handed over to rock crushers in consultation with TSPCB the details of muck required for each activity is given below:

Table 9.17 Quantiication for volume of muck reused

Total muck generated Cum.	Earthworks in filling			
	Guide bunds & tie bunds Cum.	Service paths Cum.	Cut-off trenches Cum.	Restoration of 26 Ha of land identified for construction activities Cum.
32,72,754	6,54,550.8	6,54,550.8	11,45,464	8,18,188.5

9.7 Ground Water Management Plan

It is proposed to stabilize the existing Devadula LIS & SRSP Stage-I and II and also filling of tanks by rejuvenating them by way of desilting the water holding capacity of tanks considerably increase. As such water budgeting for command area is essential for increased agricultural practices. Considerable recharge to groundwater takes place due to increased agricultural practices and also quality deterioration is expected.

Regular monitoring & recording of groundwater levels in the command and downstream area is suggested with piezometers installed in consultation with State Groundwater Authority, Telangana after the completion of project while in operation. The cost for the same has been included in Environmental monitoring programme. Conjunctive use of surface and ground water will be followed to conserve surface water.

9.8 Public Health Delivery and Labor Management Plan

A periodical health checkup (once in 6 months) is proposed for construction labors. District Health Hospital of Jayashankar Bhupalapally will be consulted and necessary arrangements will be done to consult the Hospital.

Table 9.18 Cost estimate for Public health

Sl. No.	Items	Cost (Rs.)	Time period	Implementing agency
1	Periodical health check up for labors	1,00,000/-	Construction phase	I&CAD Dept., Health Dept., & Education Dept., GoT
2	Medical facility in case on emergency	75,000/-		
3	Personal Protected Equipments	1,50,000/-		
4	Maintenance in prevention of water logging areas to prevent rise of water borne diseases	2,00,000/-		
5	Creches for labor's Children	5,00,000/-		
	Total	**10,25,000/-**		

9.9 Sanitary and Solid Waste Management Plan

The project authority shall be responsible for the implementation of solid waste management at the labour colony. Considering a total number of workers staying in the labour colony as 400, adequate facilities for the collection, conveyance of and disposal solid waste will be developed.

- 20 Number Toilets & 15 bathrooms will be provided to maintain hygiene condition and avoid open defecation in the labour colony
- Provide effective sewerage system with mobile STP.
- Carry out pest control in different areas regularly.
- Total quantity of waste generated from the proposed project will be 56 kg/day.
- Source and type of solid waste: kitchen waste, garbage, plastic, Organic & Inorganic waste will be separated at the source itself.
- Solid waste generated at the labor camps will be collected in different colour coded bins and the recyclable waste will be handed over to the Municipal authority.
- Dispose of the garbage on regular basis with respected colour coding Bins.
- Maintenance of clean and hygienic condition around the Drinking water tanks

Table 9.19 Cost estimate for Solid and hazardous waste management

Sl. No.	Items	Cost (Rs.)	Time period	Implementing agency
1	Solid waste bins with concrete shed and storage facilities (zinc sheets and impervious layer)	1,00,000/-	Construction phase	I&CAD Dept., GoT
2	Hazardous waste collection drums /barrels with shed and storage facilities (zinc sheets and impervious layer)	1,00,000/-		
3	Mobile STP's and pest control	5,00,000/-		
	Total	**7,00,000/-**		

9.10 Restoration of Quarry sites

All the construction materials required for the construction activities will be sources from the Government approved quarries.

9.11 Local Area Development

Local area development plan is proposed to extend benefits to affected villages and also to residents of villages covering under project study area. Aspects like improving educational facilities, Health care and medical facilities, folk and art, culture etc., will be covered under LAD.

Table 9.20 Cost estimate for Local Area Development

Sl. No.	Items	Cost (Rs.)	Time period	Implementing agency
1	Upgradation of existing schools by providing furnitures	10,00,000/-	Operation phase	I & CAD Department and Education Dept., Telangana
2	Identification of folk, art and cultural activities	10,00,000/-		
3	Smart classes	10,00,000/-		
5	Up gradation of Primary health centres (10 nos. in Eturnagaram Mandal)	10,00,000/-		
	Total	**40,00,000/-**		

9.12 Energy conservation measures

Project requires 484 MW (JCRDLIS only) for pumping the water. As part of utilization of solar energy, provision for harnessing 20 MW through installation of solar panels will be undertaken with the support / subsidy of GoI and TSREDCO. MOU will be entered with private agencies to encourage canal top solar projects in JCRDLIS and SRSP Stage- I and II:

Table 9.21 Cost estimate for Energy Conservation Measures

Sl. No.	Items	Cost (Rs.)	Time period	Implementing agency
1	Solar energy conservation (20 MW)	65,00,000/-	Operation phase	I & CAD department, Telangana
	Total	**65,00,000/-**		

9.13 Environmental Monitoring Programme

Table 9.22 Cost estimate for Environmental Monitoring

Sl. No.	Items	Cost (Rs.)	Time period	Implementing agency
1	Environmental monitoring programme	21,32,800/-	Construction phase	I & CAD department, Telangana
2		9,00,360/-.	Operation Phase	
	Total	**30,33,160/-**		

Detailed Environmental monitoring programme cost for construction and operation phase is provided in Chapter-6.

9.14 Land Acquisition

The project do not envisages rehabilitation and resettlement. The project requires 674.18 Ha of land for various construction activities. Out of which, 94 ha of private land is required for the project. Out of which, 65 ha is already acquired and remaining 29 ha has to be acquired. The land will be acquired as per the provisions of RFC&TLA, 2015. The estimated cost for land acquisition is given below.

Table 9.23 Cost estimate for land acquisition

Sl. No.	Items	Cost (Rs.)	Time period	Implementing agency
1	Land acquisition cost	2,53,03,915/-	Construction phase	I & CAD department, Telangana
	Total	**2,53,03,915/-**		

9.15 Environmental safeguards

During construction phase of the proposed project following measures will be taken to control Air, Noise and Water pollution.

Table 9.24 Environmental safeguards during construction phase

Sl. No.	Item wise activity	Anticipated pollution (Importance of concern)	Proposed Environment safeguards	Frequency	Cost	Implementing agency
1	Site clearing/ leveling	Air pollution due to dust	Water sprinkling	3 times a day	4,00,000/-	I & CAD department, Telangana
2	Excavation works / foundation works / cut and fill works		Water sprinkling, erecting of barricades construction sites	3 times a day	2,00,000/-	
3	Road formation works		Water sprinkling	3 times a day	2,50,000/-	
4	Construction vehicles movement	Air pollution due to dust	Water sprinkling	3 times a day	2,00,000/-	
5	Loading and unloading works		Water sprinkling	3 times a day	2,00,000/-	
6	Erection works/fabrication works/concreting works	Air pollution due to dust and noise pollution	Water sprinkling and errection of barricades	3 times a day	5,00,000/-	
7	Stacking of excess excavated earth	Air pollution due to dust	Water sprinkling, covering by green mesh/ sheets	3 times a day	3,00,000/-	
8	Operation of temporary DG sets (2 × 500 KVA)	Air and noise pollution	Provision of stack and acoustic enclosed for DG	--	25,000/-	
9	Operation of heavy earth movers		Water sprinkling, barricading and temporary fencing	3 times a day	2,50,000/-	
				Total	**23,25,000/-**	

9.16 Cost estimates for implementation of EMP

The total amount to be spent for implementation of Environmental Management Plan (EMP) is as follows.

Table 9.25 Cost for Implementing Environmental Management Plan

Sl. No.	Particulars	Cost in Rs.
A. Construction Phase		
1	Environmental safeguard measures to control air, noise and water pollution	23,25,000/-
2	Land acquisition	2,53,03,915/-
3	Restoration of construction site (Green belt development)	6,00,000/-
4	Public health delivery system	10,25,000/-
5	Sanitation and Solid waste management plan	7,00,000/-
6	Environmental monitoring programme	21,32,800/-
	Total	**320,86,715/-**
B. Operation Phase		
1	Catchment area treatment plan	158,15,00,000/-
2	Command area development	70,00,000/-
3	Local area development plan	40,00,000/-
4	Restoration of construction site (Green belt development)*	8,00,000/-
5	Fisheries conservation and management plan	27,50,000/-
6	Environmental monitoring programme*	9,00,360/-
7	Reservoir RIM Treatment	10,00,000/-
8	Energy conservation measures	65,00,000/-
	Total	**160,44,50,360/-**

*Details of recurring cost for the operation phase is given below

Table 9.26 Annual cost during operational phase during first three years (Recurring Cost)

Sl.No.	Particulars	Cost (Rs./-)	Remarks
Environmental monitoring programme			
1	Surface Water Quality Monitoring of River Godavari	2,34,720/-	Rs 19,560/- for quarterly once for 3 years
2	Soil Quality Monitoring	65,640/-	Rs 5,470/- for quarterly once for 3 years

Sl.No.	Particulars	Cost (Rs./-)	Remarks
3	Fisheries management	6,00,000/-	Rs 1,00,000/- for 6 monthly once for 3 years
	Sub total 1	**9,00,360/-**	
Restoration of construction site (Green belt development)			
4	Plantation maintenance for 3 years	6,00,000/-	Rs 2,00,000/- per year for 3 years
5	Conservation of Schedule – I species	2,00,000/-	Rs 66,666/- per year for 3 years
	Sub total 2	**8,00,000/-**	
	Total (1+2)	**17,00,360/-**	

Chapter 10. Summary and Conclusion

- The proposed PVNRKSSP involves construction of 1,132 m long barrage near Thupakulagudem village across River Godavari located 3 Km downstream of existing J.Chokka Rao Devadula Lift Irrigation Scheme (JCRDLIS).
- The proposed project stabilizes and provides irrigation facilities to existing 5,55,310 ha of command area belonging to J. Chokka Rao Devadula LIS (2,51,310 ha) and Sri Ram Sagar Project (SRSP) - Stage I & II (3,04,000 ha).
- 50 TMC of water will be utilized for stabilizing the existing command area and 50 TMC of water will be utilized for drinking water purpose for enroute villages.
- The command area is already benefitted by the existing irrigation facilities for the Khariff and bi-seasonal crops and the proposed scheme facilitates irrigation only during Rabi season.
- The boundary of Eturnagaram Wildlife Sanctuary is located at the close proximity from the proposed barrage. However, no project activities will be carried out in the Eturnagaram WLS.
- The project is being proposed in the river bed/private lands only and therefore no requirement of forestland in Eturnagaram Wildlife Sanctuary. But during discussions held with PCCF (Wildlife), Govt of Telangana, it was mentioned that the project is touching the outer periphery/boundary of ESZ of Eturnagaram Wildlife Sanctuary. Based on the discussions and observations by State forest authorities necessary proposal/permission, if required, will be obtained from Competent Authority.
- The proposed project involves submergence of 580.18 ha of river bed area alongside River Godavari near the proposed barrage at an FRL of 77 m.
- The proposed project requires a total land of 674.18 ha, of which, 94 ha of private land for implementation of the project. The land required is only for construction of the proposed barrage and submergence of river bed area and there is no R&R due to the project.
- BC Ratio of the proposed project is 1.53.
- Air pollution: The expected increase in concentration in the core area causes discomfort in breathing, eye and nose irritation to the labours.
- Noise pollution: The movement of vehicles and operation of larger construction equipments increases the noise levels which affect Thupakulagudem village. Further, the increasing noise levels generated due to drilling and blasting will disturb the avi-

fauna and faunal habitats residing in the buffer zone of the WLS upto 1 Km. Continual exposure to increased noise levels will create mental stress in construction laborers and villagers of Thupakulagudem.

- Water pollution: Improper treatment of sewage from labour camps, improper management of domestic solid waste from labour camps & dumping, creation of unaesthetic conditions in the site, improper disposal of construction debris, used oil, diesel for DG sets, improper management of excavated earth and dumping of muck, boulders, etc leads to deteriorating health of the workers, decrease in DO levels of river water and morbidity of aquatic life create turbidity of water.
- Soil pollution: Improper disposal of Solid waste generated from labour camp, leakage of used oil from DG sets, Oil spill, etc will create leaching problems, affects soil biota and ground water.
- Land use impact: The construction of barrage across the river and submergence of 580.18 ha leads to permanent change in land use.
- Impact due to solid and hazardous waste: Improper management and storage of solid waste from the labour colony & irregular practice in disposal of waste leads to spread of infectious diseases and un-aesthetic condition and affects the surface water quality and aquatic life.
- Biological Environment: Removal of 800 trees, reduction of the photosynthetic activity in plants by its deposition on the foliage, disturbances due to mobilization of machineries and workers, noise and vibration generated due to construction activities, are the major sources of impacts on terrestrial and aquatic biological environment.
- No rare, threatened, endangered plant species were recorded during the study. Avifaunal species such as Shikra, Jerdon's courser, Indian peafowl, Common buzzard and Booted eagle; butterfly namely Common pierrot and mammals such as Black buck, Four horned antelope, Indian wolf and Sloth bear were recorded during the study in the project site as well as in the command area which belongs to Schedule I of W(P)A, 1972. Implementation of conservation plan for the above species will be carried out as part of EMP.
- Environmental Monitoring is proposed during the construction and operation phase of the project. Rs. 21,32,800/- was estimated for environmental monitoring during construction phase (24 months) and Rs. 9,00,360/- is estimated for operation phase (36 months) of the project.
- The only negative impact is that 94 ha of private land will be acquired for the project construction purposes. Land acquisition will have to be done as per the Right to Fair

Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement (Compensation, Rehabilitation and Resettlement, Development Plan) Rules, 2015 published in the Govt. of India Gazette on 18th December, 2015.

- Direct employment opportunities for 400 people (50 Technical and 350 construction laborers) for the construction of proposed barrage.
- Effective EMP is proposed to mitigate the impacts during construction and operation phase of the project on various environmental components such as air, water, noise, soil, solid and hazardous waste, biological and social environment.
- Catchment area treatment plan, command area development plan, restoration of construction site, muck disposal plan and fisheries development plan is also proposed for implementation.
- Overall, the project will have minor impacts during construction phase but the project will bring substantial improvement on the social environment and economical aspects.

Chapter 11. Disclosure of Consultants

M/s Environmental Health and Safety Consultants Pvt. Ltd is located at Rajajinagar, Bengaluru have been involved in obtaining environment clearances for various developmental projects from the Ministry of Environment, Forests& Climate Change (MoEF), New Delhi since 2002.

In accordance with the orders and notifications of the MoEF, Govt. of India, the organization is ISO 9001:2015 certified and accredited as 'A' category organization from National Accreditation Board for Education and Training (NABET) in eight sectors viz., River valley, Hydel, Drainage and Irrigation projects, Thermal Power plant, Metallurgical industries, Distilleries, Sugar industry, Highways, Building and large construction projects and Townships and area development projects.

The company comprises of highly dynamic and well qualified team of Environmental Engineers and subject experts, both in-house and empanelled in various fields such as Ecology and Biodiversity, Socio-economics, Soil Conservation, Land Use studies, Hydrology, Geology, Risk Assessments, etc.

The organization has state of art in-house environmental laboratories at Bengaluru and Belagavi capable of conducting all types of sampling and analysis related to Air, Water, Noise and Soil. Bengaluru laboratory is accredited by National Accreditation Board for Testing and Calibration Laboratories (NABL) for 419 parameters and recognized from MoEF under the E(P) Act, 1986 and also certified for ISO 9001:2015, 14001:2015 and OHSAS 18000:2007. Whereas, the Belagavi Laboratory is recognized from MoEF under the E (P) Act, 1986.

Chapter 12. Compliance to Terms of Reference

Sl. No.	TORs	Compliance with respect to Final EIA Report
1.	**Scope of EIA**	
	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.	Baseline data used in this report were collected for 3 seasons (July 2017 – March 2018) for preparation of EIA report. Details of baseline data are furnished in Chapter - 3. Based on this the impacts are identified and mitigation measures are suggested in Chapter-4.
2.	**Details of the Project and Site**	
	General introduction about the proposed project.	The proposed project stabilizes and provides irrigation facilities to existing 5,55,310 ha of command area belonging to J. Chokka Rao Devadula LIS (2,51,310 ha) and Sri Ram Sagar Project (SRSP) - Stage I & II (3,04,000 ha). Described in Section 1.3 of Chapter 1 in Page 1.2
	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.	The details are given in Section 2.1.4 & 2.1.5 of Chapter 2 in Page 2.5 & 2.16
	A map of boundary of the project site giving details of protected areas in the vicinity of project location.	The detailed map showing the project site boundary and protected areas is given as Fig 2.3 of Chapter 2 in Page 2.20
	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	Location map and map of the project area with contours indicating main project features is

Sl. No.	TORs	Compliance with respect to Final EIA Report
	showing main project features (viz. location of dam, Head works, main canal, branch canals, quarrying etc.) shall be depicted in a scaled map.	given as Fig 2.3 of Chapter 2 in Page 2.20
	Layout details and map of the project along with contours with project components clearly marked with proper scale maps of at least 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	The detailed map showing the Eturnagaram WLS is given as Fig 3.25 of Chapter 3 in Page 3.83
	Drainage pattern and map of the river catchment up to the proposed project site.	The map showing drainage pattern and river catchment is given as Fig 3.23 of Chapter 3 in Page 3.75
	Delineation of critically degraded areas in the directly draining catchment on the basis of silts Yield Index as per the methodology of All India Soil and Land Use Survey of India.	The details are given in Section 9.1 of Chapter 9 in Page 9.1
	Soil characteristics and map of the project area.	The soil characteristics are described in Section 3.2.7 of Chapter 3 in Page 3.45 and the soil map is given as Fig 3.16 of Section 3.2.7 in Page 3.51
	Geological and Seismo-tectonic details and maps of the area surrounding the proposed project site showing location of dam site and powerhouse site.	The details of geological investigations and seismic analysis is given in Section 2.2.5.4 & 2.2.5.7 of Chapter 2 in Page 2.31 & 2.40 respectively
	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	The maps generated from satellite data of the project area are given as Fig 3.8-3.13 & 3.18-23 of Chapter 3 in Page 3.24-3.31 & 3.68-3.75

Sl. No.	TORs	Compliance with respect to Final EIA Report
	Land details including forests, private and other land.	The proposed project involves submergence of 580.18 ha of river bed area and 94 Ha of private land. The details are enclosed in Section 3.3.3.2 of Chapter 3 in Page 3.67.
	Demarcation of snow fed and rain fed areas for a realistic estimate of the water availability	The whole region is coming under rainfed area.
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, socioeconomic status etc. should be collected within 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 studies 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 dam site • Submergence area • Project area or the direct impact area should comprise of area falling within 10 Km radius from the periphery of the reservoir, land coming under submergence and area downstream of dam up to the point where Tail Race Tunnel (TRT) meets the river. • Downstream upto 10km from tip of Tail Race Tunnel (TRT)	Description of the study area and study period is given in Chapter 2. The base line data with respect to environmental components air, water, noise, soil, land and biology & biodiversity (flora & fauna), wildlife, socioeconomic status etc. are collected within 10 km radius from the proposed barrage and enclosed in Chapter 3.
4	**Details of Methodology**	
	• The methodology followed for collection of base line data along with details of number of samples	The methodology involved in the selection of sampling sites is

Sl. No.	TORs	Compliance with respect to Final EIA Report
	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) methodology should be followed.	given as section AAQM-3.2.3 in Page 3.11, Noise-3.2.4 in Page 3.17, Hydrology & Geology-3.2.5.1 in Page 3.21, Water quality-3.2.6 in Page 3.36, Soil-3.2.7.7 in Page 3.49, Land use-3.3.2 in Page 3.66, Biological environment-3.4.3 in Page 3.79, Aquatic environment-3.5.2 in Page 3.114 of Chapter 3
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).	Sampling locations are adequate in number to get a reasonable idea of diversity and other attributes of flora and fauna and mentioned in section 3.4.3 of Chapter 3 in Page 3.79
	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. quadrates 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	The details of size and number of sampling units are described in Section 3.4.3 of Chapter 3 in Page 3.79

Sl. No.	TORs	Compliance with respect to Final EIA Report
	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 behavior. 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	In Command area a total of 26 tree species were recorded during the study. In addition to this, 85 species of herbs, 13 species of shrubs and 10 species of climbers were recorded during Monsoon season. A total of 57 species of herbs, 13 species of shrubs and 7 species of climbers were recorded during Post Monsoon season. Similarly, 69 species of herbs, 13 species of shrubs and 9 species of climbers were recorded during Post Monsoon season. All the species recorded were common to the region and no RET species were observed during the study. Near barrage site a total of 39 tree species were recorded during the study. In addition to this, 76 species of herbs, 10 species of shrubs and 7 species of climbers were recorded during Monsoon season. A total of 34 species of herbs, 10 species of shrubs and 4 species of climbers were recorded during Post Monsoon season. Similarly, 62 species of herbs, 10 species of shrubs and 5 species of climbers were recorded during Post Monsoon season. All the species recorded were common

Sl. No.	TORs	Compliance with respect to Final EIA Report
		to the region and no RET species were observed during the study. The details are enclosed in Section 3.4.4 of Chapter 3 in Page 3.85
	The RET 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)	No RET species were recorded in the study area during the study period. the details of Scheduled species are given in Section 3.4.4 of Chapter 3 in Page 3.85
6	**Components of EIA study**	
	Various aspects to be studied and provided in the EIA/EMP report are as follows:	
A	**Physical and Chemical Environment**	
	Geological & Geophysical Aspects and Seismo- Tectonics:	Details of geological & geophysical aspects and seismo tectonics are given in Section 2.2.5.4 & 2.2.5.7 of Chapter 2 in Page 2.31 & 2.40
	Physical geography, Topography, Regional Geological aspects and structure of the Catchment.	The details are given in Section 2.2.5.4, 2.2.5.7 & 3.2.1 of Chapter 2 & 3 in Page 2.31, 2.40 & 3.1
	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.	The details are given in Section 2.2.7 of Chapter 2 in Page 2.42
	Landslide zone or area prone to landslide existing in the study area should be examined.	
	Presence of important economic mineral deposit, if any,	The details are enclosed in Section 3.2.5.7 of Chapter 3 in Page 3.25
	Justification for location & execution of the project in relation to structural components (dam height)	Justification for location & execution of the project in relation to structural components

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		are given in Section 2.2 of Chapter 2 & 5 in Page 2.18 & 5.1
	Impact of project on geological environment.	Barrage is proposed over the Godavari River the litho unit covering is Sandstone and Shale to store water for strengthening the existing Devadula LIS upstream so that water is available continuously to the project command area. As such there is no disturbance or alteration to the local Geology. The details are furnished in Section 4.1.7 of Chapter 4 in Page 4.12
	Meteorology, Air and Noise	
	Meteorology (viz. Temperature, Relative humidity, wind speed/direction etc.) to be collected from nearest IMD station.	Temperature, Relative humidity, wind speed/direction etc. are collected from nearest IMD station in Ramagundem. Details are furnished in Section 3.2.2 & 3.2.3 of Chapter 3 in Page 3.1-3.11
	Ambient Air Quality with parameters viz. Suspended Particulate Matter (SPM), Respirable Suspended Particulate Matter (RSPM), i.e., particulate matters <10 microns, Sulphur dioxide (S02) and Oxides of Nitrogen (NO x) in the study area at 6 Locations.	Details of Ambient Air Quality are discussed in Section 3.2.3, Table 3.5-3.8 of Chapter 3 in Page 3.15-3.16
	Existing Noise Levels and traffic density in the study area at 6 Locations.	Details of Ambient Noise Levels are discussed in Table 3.13 of Chapter 3 in Page 3.20
	Soil Characteristics	
	Soil classification, physical parameters (viz., texture, Porosity, Bulk Density and water holding capacity) and chemical parameters (viz. pH, electrical conductivity, magnesium,	Details of Soil Quality are discussed in Section 3.2.7 of Chapter 3 in Page 3.45

Sl. No.	TORs	Compliance with respect to Final EIA Report
	calcium, total alkalinity, chlorides, sodium, potassium, organic carbon, available potassium, available phosphorus, SAR, nitrogen and salinity, etc.) 6 locations	
	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.	Slope (Relief) map, drainage map, soil map, land use and land cover map, etc. are given as Fig 3.8-3.13 & 3.18-23 of Chapter 3 in Page 3.24-3.31 & 3.68-3.75
	New configuration map to be given in the EIA report	No change in configuration.
	Water Quality	
	History of the ground water table fluctuation in the study area.	The details of ground water table in the study area is furnished in Section 3.2.5 of Chapter 3 in Page 3.21
	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, N03, P04, Cl, S04, 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) (35 locations).	Water Quality for both ground water and surface water for all parameters are analysed are found to be within the permissible limit and are given in Section 3.2.6 of Chapter 3 in Page 3.36 and also in Annexure 16
	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.	Land use/land cover pattern of the study area is discussed in Section 9.1 of Chapter 9 in Page 9.1
B	**Water Environment and Hydrology**	
	Hydro-Meteorology of the project viz. precipitation (snowfall, rainfall), temperature, relative humidity, etc. Hydro-meteorological studies in the catchment area should be established along-with real time telemetry and data acquisition system for inflows monitoring.	The details of Hydro-meteorological studies in the catchment area is given in Section 3.22 of Chapter 3 in Page 3.1

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	Run off, discharge, water availability for the project, sedimentation rate, etc.,	Water availability details are enclosed in Section 2.2 of Chapter 2 in Page 2.18
	Basin characteristics	The details of basin characteristics are given in Section 2.1.2 of Chapter 2 in Page 2.1 and is represented in Fig 2.1 & 2.2 of Chapter 2 in Page 2.3 & 2.4
	Catastrophic events like cloud bursts and flash floods, if any, should be documented.	Details are furnished in Section 2.2 of Chapter 2 in Page 2.18
	For estimation of sedimentation rate, direct sampling of river flow is to be done during the EIA study. The study should be conducted for minimum one year. Actual silt flow rate to be expressed in ha-m km^2 year-1.	
	Sedimentation data available with CWC may be used to find out the loss in storage over the years.	
	Set-up a G&D monitoring station and a few rain gauge stations in the catchment area for collecting data during the investigation.	
	Flow series, 10 daily with 90%, 75% and 50% dependable years discharges.	
	A table of 10 daily water discharges corresponding to 90% dependable year showing the intercepted discharge at the barrage, the environmental flow to be released and the other flow releases downstream of the barrage and spills to be provided in hydrology section of EIA	
	Norms for release of Environmental flows, i.e. 30% in monsoon season, 20% in lean season and 25% in non-monsoon & non-lean season to be followed corresponding to 90% dependable year. A site-specific study on minimum environment flow should be carried out.	
	Hydrological studies/data as approved by CWC shall be utilized· in the preparation of EIA/EMP report. Actual hydrological annual yield may also be given in the report.	
	A minimum of 1 km distance from the tip of the reservoir	

Sl. No.	TORs	Compliance with respect to Final EIA Report
	to the tailrace tunnel should be maintained between upstream and downstream projects	
	Release of environmental flows	
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.	Details of forest types, documentation of species, floral diversity, diversity indices, protected areas, endemic species, RET and scheduled species are enclosed in Section 3.4.4.1.1 & 3.4.4.2.1 of Chapter 3 in Page 3.85 & 3.99 and also given as Annexure 18.
	Documentation of all plant species i.e. Angiosperm, Gymnosperm, Pteriodophytes, Bryophytes, Lichens (all groups). All species list may be provided.	
	General vegetation profile and floral diversity covering all groups of flora including Lichens and Orchids. A species wise list may be provided.	
	Assessment of plant species with respect to dominance, density, frequency, abundance, diversity index, similarity index, importance value index [IVI], Shannon Weiner Index etc. of the species to be provided. Methodology used for calculating various diversity indices along with details of locations of quadrates, size of quadrates etc. to be reported within the study area in different ecosystems.	
	Existence of National Park, Sanctuary, Biosphere Reserve etc. in the study area, if any, should be detailed.	
	Economically important species like medicinal plants, timber, fuel wood etc.	
	Details of endemic species found in the project area.	
	Flora under RET categories should be documented using International Union for the Conservation of Nature and Natural Resources (IUCN) criteria and Botanical Survey of India's Red Data list along with economic significance. Species diversity curve for RET species should be given.	
	Biodiversity study, a sub component of EIA study, is to be carried out by associating a reputed organization/institution	

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	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.	The cropping pattern and horticultural practices are given in Section 3.2.7.5 and 3.2.7.4 of Chapter 3 in Page 3.46
	(ii)Fauna	
	Fauna study and inventorization should be carried out for all groups of animals including reptiles and nocturnal animals in the study area. Their present status along with Schedule of the species.	Documentation of faunal, avifaunal, plankton, periphyton, benthos and fish species; its habitat status; RET species, IUCN status, scheduled species are furnished in Section 3.4.4.1.2 & 3.4.4.2.2 of Chapter 3 in Page 3.92 & 3.104
	Documentation of fauna plankton (phyto and zooplankton), periphyton, benthos and fish should be done and analysed.	
	Information (authenticated) on Avi-fauna and wild life 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.	The restoration activities/compensatory afforestation shall improve the ecological activities of faunal species. Since, the proposed barrage is the only new project component restoration activities shall be focused near the proposed barrage. The restoration activities shall be

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		handed over to the Forest and Agriculture Department, Government of Telangana in order to obtain sustainable results. The details are given in Section 9.3 and the list of species proposed for plantation in Table 9.9 of Chapter 9 in Page 9.20
	Collection of primary data on agricultural activity, crop and their productivity and irrigation facilities components.	The details are furnished in Section 9.1.1 & 9.1.2 of Chapter 9 in Page 9.2
D	**Aquatic Ecology**	
	Documentation of aquatic fauna like micro-invertebrates, zooplankton, phytoplankton, benthos etc.	Documentation of aquatic fauna like micro-invertebrates, zooplankton, phytoplankton, benthos etc are enclosed as Annexure 19
	Fish and fisheries, their migration and breeding grounds.	Fish and fisheries, their migration and breeding grounds, Fish diversity, composition and maximum length & weight are given in Section 3.5 of Chapter 3 in Page 3.115 and also in Annexure 19
	Fish diversity, composition and maximum length & weight of the measured populations to be studied for estimation of environmental flow	
	Conservation status of aquatic fauna.	Conservation status of aquatic fauna is enclosed in Annexure 19
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 surrounding population.	Baseline data on human settlements, existing infrastructure facilities etc. is enclosed as Chapter 7 from Page 7.1
	Collection of information with respect to social awareness about the developmental activity in the area and social welfare measures existing and proposed by project	Social awareness about the project was discussed with public. Social welfare measures are

Sl. No.	TORs	Compliance with respect to Final EIA Report
	proponent.	proposed during public consultation by project proponent.
	Collection of information on sensitive habitat of historical, cultural and religious and ecological importance.	Information on sensitive habitat of historical, cultural and religious and ecological importance is provided in Section 7.7 & 7.10 of Chapter 7 in Page 7.9 & 7.11
	The Socio-economic survey/profile within 10 Km of the study area for Demographic profile; Economic Structure; Development Profile; agricultural practices; Infrastructure; education facilities; health and sanitation facilities; available communication network; etc	Demographic profile; Economic Structure; Development Profile; agricultural practices; Infrastructure; education facilities; health and sanitation facilities; available communication network, etc are given in Chapter 7 & Page 7.1
	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.	Impact prediction and mitigation measures are given in Section 4.1 of Chapter 4 in Page 4.1
	(i) Air Environment	

Sl. No.	TORs	Compliance with respect to Final EIA Report
	Changes in ambient and ground level concentrations due to total emissions from point, line and area sources	Deterioration of air quality due to various construction activities and the mitigation measures along the project site is provided in section 4.1.1 of chapter-4 in Page 4.1. Vehicular pollution may rise due to vehicular movement during operation phase but due to use of low sulphur fuel and strict regulation of vehicular pollution norms such rise in air pollution may not be significant
	Effect on soils, material, vegetation and human health	
	Impact of emissions from DG sets used for power during the construction, if any, on air environment.	
	Pollution due to fuel combustions in equipments & vehicles	
	Fugitive emissions from various Sources.	
	Impact on micro climate.	
	(ii)Water Environment	
	Changes in surface & ground water quality.	Impacts due to Water environment is given in Section 4.1.3 of Chapter 4 in Page 4.8
	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.	
	(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.	Land environment will be deteriorated due to excavation, disposal of solid waste, erosion etc. Impacts due to Land environment is given in Section 4.1.5 of Chapter 4 in Page 4.10
	Changes in land use/land cover and drainage pattern.	
	Immigration of labour population.	
	Quarrying operation and muck disposal	Details w.r.t muck and waste disposal and its impacts are given in Section 4.1.6 of Chapter 4 in Page 4.11
	Changes in land quality including effects of waste disposal	
	River bank and their stability.	
	Impact due to submergence	
	(iv)Biological Environment	

Sl. No.	TORs	Compliance with respect to Final EIA Report
	Impact on forests, flora, fauna including wildlife, migratory Avi-fauna, rare and endangered species, medicinal plants etc.	The project is being proposed in the river bed/private lands only and therefore no requirement of forestland in Eturnagaram Wildlife Sanctuary. But during discussions held with PCCF (Wildlife), Govt of Telangana, it was mentioned that the project is touching the outer periphery/boundary of ESZ of Eturnagaram Wildlife Sanctuary. Based on the discussions and observations by State forest authorities necessary proposal/permission, if required, will be obtained from Competent Authority. Only 580.18 Ha of River bed area will be involved in the submergence. The impacts and mitigation measures for fish migration and habitat degradation is given in Section 4.1.8 of Chapter 4 in Page 4.13
	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 & 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 Environment	
	Impact on local community including demographic profile.	The details of the Socio-Economic Environment is given in Chapter 7, Page 7.1
	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 lead to landslides, damage to properties and drying up of natural	Impacts of blasting activity during project construction activities are given in Section 4.1 of Chapter 4

Sl. No.	TORs	Compliance with respect to Final EIA Report
	springs and cause noise pollution will be studied. Proper record shall be maintained of the base line information in the post project period.	in Page 4.1
	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 (CAT) Plan should be prepared micro-watershed wise. Identification of free draining/ directly draining catchment based upon Remote Sensing and Geographical Information System (GIS) methodology and Sediment Yield Index (SY!) method of AISLUS, Dept. 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.	Catchment Area Treatment (CAT) Plan is given as Section 9.1 of Chapter 9 in Page 9.2
	Command Area Development (CAD) Plan giving details of implementation schedule with a sample CAD plan.	Command Area Development (CAD) Plan is furnished in Section 9.2 of Chapter 9 in Page 9.22
	Compensatory Afforestation shall be prepared by the State Forest Department in lieu of the forestland 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.	About 30 ha of land have been identified for carrying out construction activities close to the River Godavari. Out of which, 26 ha are agricultural lands and remaining area is waste land followed by riparian land. Totally, 800 trees of different girth size will be removed. Therefore, restoration of construction site will be implemented in Section

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		9.3 of Chapter 9 in Page 9.25
	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.	Biodiversity and Wildlife Conservation and Management Plan for the conservation and preservation of rare, endangered, endemic and scheduled floral/ faunal species is given in Section 9.3 of Chapter 9 in Page 9.25
	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.	Fisheries Conservation and Management is furnished in Section 9.5 of Chapter 9 in Page 9.29
	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 on 01.01.2014.	There is no R&R activities involved in the proposed project
	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	About 30 ha of land have been identified for carrying out construction activities close to the River Godavari. Out of which, 26

Sl. No.	TORs	Compliance with respect to Final EIA Report
	suitable for greenbelt should be selected.	ha are agricultural lands and remaining area is waste land followed by riparian land. Totally, 800 trees of different girth size will be removed. Therefore, Restoration of construction site has been proposed in Section 9.3 of Chapter 9 in Page 9.25
	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.	Reservoir Rim Treatment Plan for stabilization of land slide/ land slip zones has been proposed in Section 9.5 of Chapter 9 in Page 9.29
	Muck Disposal Plan- suitable sites for dumping of excavated material should be identified in consultation with the State Pollution Control Board and Forest Department. All Muck disposal sites should be minimum 30 m 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.	Muck Disposal Plan has been proposed in Section 9.6 of Chapter 9 in Page 9.44
	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-a-vis other project components should be prepared.	About 30 ha of land have been identified for carrying out construction activities close to the River Godavari. Out of which, 26 ha are agricultural lands and remaining area is waste land followed by riparian land. Totally, 800 trees of different girth size will be removed. Therefore, Restoration of construction site has been proposed in Section 9.3 of Chapter 9 in Page 9.25

Sl. No.	TORs	Compliance with respect to Final EIA Report
	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.	Details of site specific earthquake studies has been given in Section 2.2.7.2 of Chapter 2 in Page 2.42
	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.	Not applicable
	Water and Air Quality & Noise Management Plans to be implemented during construction and post-construction periods.	Water, Air and Noise Management plans are elaborated in Section 9.13 of Chapter 9 & 6 in Page 9.50 & 6.1
	Mitigating measures for impacts due to Blasting on the structures in the vicinity.	Impacts due to blasting is described in Section 4.1 of Chapter 4 in Page 4.1
	Ground Water Management Plan	Regular monitoring & recording of groundwater levels in the command and downstream area is suggested with piezometers installed in consultation with State Groundwater Authority, Telangana after the completion of project while in operation. The details are enclosed in Section 9.7 of Chapter 9 in Page 9.45
	Public Health Delivery Plan including the provisions for drinking water facility for the local community.	Public Health Delivery Plan and Labour Management Plan for the local community has been proposed in Section 9.8 of Chapter 9 in Page 9.46
	Labour Management Plan for their Health and Safety.	

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	Sanitation and Solid Waste Management Plan for domestic waste from colonies and labor camps etc.	The detailed Sanitation and Solid Waste Management Plan is furnished in Section 9.9 of Chapter 9 in Page 9.47
	Local Area Development Plan to be formulated in consultation with the Revenue Officials and Village Panchayats. Local skill development schemes should be given. Details of various activities to be undertaken along with its financial out lay should be provided.	Local Area Development Plan has been given in Section 9.11 of Chapter 9 in Page 9.48
	Environmental safeguards during construction activities including road construction.	Environmental safeguards measures to be taken up during construction activities are given in Section 9.15 of Chapter 9 in Page 9.52
	Energy Conservation Measures.	Energy Conservation Measures is given in Section 9.12 of Chapter 9 in Page 9.49
	Environmental Monitoring Programme with physical & financial details covering all the aspects of EMP. A summary of cost estimate for all the plans, cost for implementing all Environmental Management Plans.	Environmental Monitoring Programme and Environmental Management Plans is given in Section 6 & 9.13 of Chapter 6 & 9 in Page 6.1 & 9.50
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.**	CAD plan is furnished as Section 9.2 of Chapter 9 in Page 9.22
10	**Additional Conditions:**	
	Recycle water be used/utilized for industries and horticulture purpose.	Noted
	The irrigation efficiency should also be worked out during the study	The irrigation efficiencies of the existing JCR Devadula LIS and SRSP Stage I&II is given in

Sl. No.	TORs	Compliance with respect to Final EIA Report
		Section 2.1.5 of Chapter 2 in Page 2.16
	The project envisages stabilization of existing Devadula LIS of command area of about 2.5 lakhs Ha by constructing a barrage across river Godavari near the confluence with river Indravati.	The stabilization details of the existing irrigation schemes is given in Section 2.1.4 of Chapter 2 in Page 2.5
	The performance report of the LIS may also be prepared based on the ground realities.	Performance evaluation of existing irrigation schemes is given in Section 2.1.4 & 2.1.5 of Chapter 2 in Page 2.5 & 2.16 and also enclosed as Annexure 7
	The solar power also may not be a cheaper alternative for running such high head LIS. This aspect may be looked into in details.	The details of energy conservation measures are given in Section 9.12 of Chapter 9 in Page 9.49
	The arguments Viz need for providing employment to large number of people who are residing in rural areas and dependent on agriculture, overlooking the norms of benefit – cost ratio in light of erratic changes in the prices of agriculture produce, supplying water to agriculture lands at high altitudes, achieving self sufficiency to the state in food grains and so on in justification may not be tenable in the context of economic returns/improving the economy of the state. Water is not a solution everywhere.	Noted
	Land acquired for the project shall be suitably compensated in accordance with the law of the land with the prevailing guidelines.	Land acquisition and compensation details are enclosed in Section 7.20 & 9.14 of Chapter 7 & 9 in Page 7.21 & 9.51

Chapter 13. Photographs

<table>
<tr><td> </td><td> </td></tr>
<tr><td>Near the proposed barrage
18°35'6.10"N, 80°23'20.42"E</td><td>Near the proposed barrage
18°35'7.25"N, 80°23'13.33"E</td></tr>
<tr><td> </td><td> </td></tr>
<tr><td>Near the proposed barrage
18°35'6.10"N, 80°23'20.42"E</td><td>Near the proposed barrage
18°35'6.10"N, 80°23'20.42"E</td></tr>
<tr><td colspan="2">Experts site visit</td></tr>
<tr><td> </td><td> </td></tr>
<tr><td>Meteorological station near the proposed barrage
18°35'6.10"N, 80°23'20.42"E</td><td>Air quality monitoring
Mallapura village
18°58'5.68"N, 78°42'18.26"E</td></tr>
</table>

Near the proposed barrage 18°35'6.10"N, 80°23'20.42"E	Near Rampur 18°27'33.31"N, 80° 0'13.19"E
Air quality monitoring	
Near the proposed barrage 18°35'6.10"N, 80°23'20.42"E	Near the proposed barrage 18°35'6.10"N, 80°23'20.42"E
Near Rampur 18°27'33.31"N, 80° 0'13.19"E	Odela Village 18°27'19.62"N, 79°26'50.57"E
Noise level monitoring	

Mylaram cheruvu 17°40'14.39"N, 79°34'38.33"E	Chokkarao cheruvu 17°45'12.11"N, 79° 9'22.41"E
Noonegudem cheruvu 17°31'48.86"N, 79°18'23.45"E	Musi reservoir 17°15'33.76"N, 79°30'0.84"E
Surface water sampling	
Nekkonda village 17°47'41.42"N,79°48'5.32"E	Medaramatla village 18°16'17.58"N,79°40'47.71"E

Dharmasagara village 17°59'36.42"N, 79°26'33.89"E	Gadepally village 17°55'4.48"N, 79°38'1.80"E
Ground water sampling	
Jangaon 17°43'11.74"N, 79°10'46.56"E	Bommannaplly 18°12'23.89"N, 79°14'19.75"E
Jangaon 17°43'11.74"N, 79°10'46.56"E	Bachannapet 17°47'25.36"N, 79° 2'29.21"E
Soil sampling	

Thupakulagudem Village 18°34'45.94"N, 80°23'2.26"E	Thupakulagudem Village 18°34'4.57"N, 80°22'18.58"E
Thupakulagudem Village 18°34'4.57"N, 80°22'18.58"E	Thupakulagudem Village 18°34'4.57"N, 80°22'18.58"E
Interaction with PAPs	

Consultants

Environmental Health & Safety Consultants Pvt. Ltd.,

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IRRIGATION & CAD DEPARTMENT

Government of Telangana

P. V. NARASIMHA RAO KANTHANAPALLY SUJALA SRAVANTHI PROJECT

Thupakulagudem village, Eturnagaram Mandal, Jayashankar Bhupalapally District

REVISED FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT FOR ISSUE OF ENVIRONMENTAL CLEARANCE

Volume –II

Schedule 1 (c) of EIA Notification, 2006, Category – A, Project Cost: Rs. 2121 Crores

Study Period : July, 2017 to March, 2018; Command Area : 5, 55, 310 ha

Project by

The Chief Engineer
I & CAD Department
Kanthanpally Project
KC Colony, Chintagattu
Warangal - 506015

NABET/EIA/1821/RA 0107

Consultants

Environmental Health & Safety
Consultants Pvt. Ltd
Bangalore, Karnataka
(Accredited by QCI-NABET)
080 - 23012100

APRIL 2019

Document No. EHSC/I&CAD/KCC/ETR/2017-18/PVNKSSP

REVISED FINAL ENVIRONMENTAL IMPACT ASSESSMENT REPORT

ANNEXURES

Of

P V NARASIMHA RAO KANTHANAPALLY SUJALA SRAVANTHI PROJECT

In

JAYASHANKAR BHUPALAPALLY DISTRICT, TELANGANA

Project By

CHIEF ENGINEER
IRRIGATION & CAD DEPT.,
K. C COLONY, CHINTAGATTU,
WARANGAL - 506002, TELANGANA.

Consultants

ENVIRONMENTAL HEALTH & SAFETY CONSULTANTS PVT LTD No.13/2, 1st Main Road, Industrial Town, Near Fire Station, Rajajinagar Bengaluru - 560 010, Karnataka	NABET/EIA/1821/RA 0107 Dated: 19.11.2018

DOCUMENT NO. EHSC/I&CAD/KCC/ETR/2017-18/PVNRKSSP

APRIL 2019

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ANNEXURE-1

ANNEXURE -1

No. J-12011/1/2010-IA-I (Part)
Ministry of Environment, Forest & Climate Change
Government of India
(IA-I Division)

Indira Paryavan Bhavan
3rd Floor, Vayu Wing
Jor Bagh Road
New Delhi – 110 003

Date: 3rd April, 2017

To

The Chief Engineer
I & CAD Department,
Godavari Lift Irrigation Scheme,
KC Colony, Chinthagattu,
Warangal, Talangana -506 015.

Subject: P.V. Narasimha Rao Kanthanapally Sujala Sravathi Project (PVNRKSSP) in Warangal District of Telangana by Irrigation & CAD Department, Government of Telangana for Scoping/ToR clearance - regarding.

Sir,

This is with reference to your letter No. CE/GLIS/Wgl/DCE/OT1/TS-5/F-197/527 dated 22.2.2017 on the above mentioned subject.

2. The said proposal was appraised by the Environment Appraisal Committee (EAC) for River Valley and Hydro Electric Projects (RV&HEP) in its meetings held on 2-3rd March, 2017. The comments and observations of EAC may be seen in the minutes of the meeting which are available on the Ministry's web-site.

3. The project envisages construction of a 1132 m long barrage across Godavari river near Thupakulagudem on River Godavari, 3 km downstream of existing J. Chokka Rao Devadula Lift Irrigation Scheme. The proposed project will stabilize the existing Devadula LIS having command area of 2,51,310 ha and also provide irrigation facility for a command area of 3,04,000 ha of Sriram Sagar Project (SRSP) Stage I & II. 50 TMC of water will be utilized for stabilising the existing command area & 50 TMC utilized for drinking water purpose for enroute villages. Total land requirement is about 674.18 ha. Total submergence area is 580.18 ha which is in the river bed only. The project is at a distance of 2.5 km from boundary of Chattisgarh state. The estimated cost of the project is Rs. 2121 crores.

4. Based on recommendations of the EAC, the Ministry of Environment Forest & Climate Change hereby accords a Terms of Reference for pre-construction activities at the proposed site as per the provisions of the Environmental Impact Assessment Notification, 2006 and

subsequent amendment in 2009 along with the following conditions for 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) Consultants shall include a "Certificate" in EIA/EMP report regarding portion of EIA/EMP prepared by them and data provided by other organization(s)/ laboratories including status of approval of such laboratories.

(d) The draft EIA/EMP report prepared as per the **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 closed 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 time 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, shifting of dam site, change in submergence, etc., fresh scoping clearance has to be obtained by the project proponent.

(h) Approval of Forest Clearance Stage-I for the forest area involved in the project is one of the mandatory pre-requisites for grant of Environmental Clearance.

(i) The PP shall submit a copy of TEC of the DPR along with EIA/EMP report.

(j) Information pertaining to Corporate Environmental Responsibility and Environmental Policy shall be provided in the EIA/EMP Report as per this Ministry's OM No.J-11013/25/2014-IA-I dated 11.8.2014 (**Reference as Annexure-II**).

(k) 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.

(l) 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

Copy to:

1. The Secretary, Ministry of Water Resources, Shram Shakti Bhawan, Rafi Marg, New Delhi -1.
2. The Principal Secretary (Irrigation), Government of Telangana, Secretariat, Hyderabad - 500 001.
3. The Secretary, Department of Environment & Forests, Government of Telangana, Secretariat Hyderabad - 500 022.
4. The Chief Engineer, Project Appraisal Directorate, Central Water Commission, Sewa Bhawan, R. K. Puram, New Delhi - 110 066.
5. The Addl. PCCF (C), Ministry of Environment, Forest and Climate Change, Regional Office (SEZ), Pt and End Floor, Handloom Export Promotion Council, 34, Cathedral Garden Road, Nungambakkam, Chennai – 600034
6. The Member Secretary, Telangana State Pollution Control Board, Payavaran Bhawan, Industrial Estate, Sanath Nagar, Hyderabad.
7. NIC Cell - for upload on the MOEF website.
8. PPS to JS(GB)/Director(SKK)/Sci-C(SP)
7. Guard File.

(Dr. S. Kerketta)
Director

Annexure-1

TERMS OF REFERENCE FOR CONDUCTING ENVIRONMENT IMPACT ASSESSMENT STUDY FOR 'A' CATEGORY RIVER VALLEY PROJECTS AND INFORMATION TO BE INCLUDED IN EIA/EMP REPORT

(1) Scope of EIA Studies

The EIA Report should identify the relevant environmental concerns and focus on potential impacts that may change due to the construction of proposed project. Based on the baseline data collected for three (3) seasons (Pre-monsoon, Monsoon and Winter seasons), the status of the existing environment in the area and capacity to bear the impact on this should be analyzed. Based on this analysis, the mitigation measures for minimizing the impact shall be suggested in the EIA/EMP study.

(2) Details of the Project and Site

- General introduction about the proposed project.
- Details of project and site giving L-sections of all u/s and d/s projects of River with all relevant maps and figures. Connect such information as to establish the total length of interference of Natural River and the committed unrestricted release from the site of diversion into the main river.
- A map of boundary of the project site giving details of protected areas in the vicinity of project location.
- Location details on a map of the project area with contours indicating main project features. The project layout shall be superimposed on a contour map of ground elevation showing main project features (viz. location of dam, Head works, main canal, branch canals, quarrying etc.) shall be depicted in a scaled map.
- Layout details and map of the project along with contours with project components clearly marked with proper scale maps of at least a 1:50,000 scale and printed at least on A3 scale for clarity.
- Existence of National Park, Sanctuary, Biosphere Reserve etc. in the study area, if any, should be detailed and presented on a map with distinct distances from the project components.
- Drainage pattern and map of the river catchment up to the proposed project site.
- Delineation of critically degraded areas in the directly draining catchment on the basis of silts 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.
- Downstream upto 10 km from tip of Tail Race Tunnel (TRT).

(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 land-scapes which include the study area for the concerned project must be referred to since most species from adjoining catchments is likely to be present in the catchments in question. In fact such literature form the entire state can be referred to. Once a listing of possible R.E.T. species form the said area is developed, species specific methodologies should be adopted to ascertain their presence in the study area which would be far more conclusive as compared to the conventional sampling. If the need be, modern methods like camera trapping can be resorted to, particularly for areas in the eastern Himalayas and for secretive/nocturnal species. A detailed listing of the literature referred to, for developing lists of R.E.T. species should be provided in the EIA reports.
- The R.E.T. species referred to in this point should include species listed in Schedule I and II of Wildlife (Protection) Act, 1972 and those listed in the red data books (BSI, ZSI and IUCN).

(6) Components of the EIA Study

Various aspects to be studied and provided in the EIA/EMP report are as follows:

A. Physical and Chemical Environment

(i) Geological & Geophysical Aspects and Seismo – Tectonics:

- Physical geography, Topography, Regional Geological aspects and structure of the Catchment.
- Tectonics, seismicity and history of past earthquakes in the area. A site-specific study of the earthquake parameters will be done. The results of the site-specific earthquake design shall be sent for approval of the NCSDP (National committee of Seismic Design Parameters, Central water commission, New Delhi for large dams.
- Landslide zone or area prone to landslide existing in the study area should be examined.
- Presence of important economic mineral deposit, if any.

- Justification for location & execution of the project in relation to structural components (dam height).
- Impact of project on geological environment.

(ii) Meteorology, Air and Noise:

- Meteorology (viz. Temperature, Relative humidity, wind speed/direction etc.) to be collected from nearest IMD station.
- Ambient Air Quality with parameters viz. Suspended Particulate Matter (SPM), Respirable Suspended Particulate Matter (RSPM) i.e. suspended particulate materials <10 microns, Sulphur Dioxide (SO_2) and Oxides of Nitrogen (NOx) in the study area at 6 locations.
- Existing noise levels and traffic density in the study area at 6 locations.

(iii) Soil Characteristics

- Soil classification, physical parameters (viz., texture, porosity, bulk density and water holding capacity) and chemical parameters (viz. pH, electrical conductivity, magnesium, calcium, total alkalinity, chlorides, sodium, potassium, organic carbon, available potassium, available phosphorus, SAR, nitrogen and salinity, etc.) (6 locations).

(iv) Remote sensing and GIS Studies

- Generation of thematic maps viz., slope map, drainage map, soil map, land use and land cover map, etc. Based on these, thematic maps, an erosion intensity map should be prepared.
- New configuration map to be given in the EIA Report.

(v) Water Quality

- History of the ground water table fluctuation in the study area.
- Water quality for both surface water and ground water for (i) Physical parameters (pH, temperature, electrical conductivity, TSS); (ii) Chemical parameters (Alkalinity, Hardness, BOD, COD, NO_2, PO_4, Cl, SO_4, Na, K, Ca, Mg, Silica, Oil & Grease, phenolic compounds, residual sodium carbonate); (iii) Bacteriological parameter (MPN, Total coliform) and (iv) Heavy Metals (Pb, As, Hg, Cd, Cr-6, total Cr, Cu, Zn, Fe) (35 locations).
- Delineation of sub and micro-watersheds, their locations and extent based on the All India Soil and Land Use Survey of India (AISLUS), Department of Agriculture, Government of India. Erosion levels in each micro-watershed and prioritization of micro-watershed through silt yield index (SYI) method of AISLUS.

B. Water Environment & Hydrology

- Hydro-Meteorology of the project viz. precipitation (snowfall, rainfall), temperature, relative humidity, etc. Hydro-meteorological studies in the catchment area should be established along-with real time telemetry and data acquisition system for inflows monitoring.
- Run off, discharge, water availability for the project, sedimentation rate, etc.
- Basin characteristics
- Catastrophic events like cloud bursts and flash floods, if any, should be documented.
- For estimation of Sedimentation Rate, direct sampling of river flow is to be done during the EIA study. The study should be conducted for minimum one year. Actual silt flow rate to be expressed in ha-m km^2 year-1.
- Sedimentation data available with CWC may be used to find out the loss in storage over the years.
- Set up a G&D monitoring station and a few rain gauge stations in the catchment area for collecting data during the investigation.
- Flow series, 10 daily with 90%, 75% and 50% dependable years discharges.
- A table of 10-daily water discharges corresponding to 90% dependable year showing the intercepted discharge at the barrage, the environmental flow to be released and the other flow releases downstream of the barrage and spills to be provided in hydrology section of EIA.
- Norms for release of Environmental flows, i.e. 30% in monsoon season, 20% in lean season and 25% in non-monsoon & non-lean season to be followed corresponding to 90% dependable year. A site specific study on minimum environment flow should be carried out.
- Hydrological studies/data as approved by CWC shall be utilized in the preparation of EIA/EMP report. Actual hydrological annual yield may also be given in the report.
- A minimum of 1 km distance from the tip of the reservoir to the tail race tunnel should be maintained between upstream and downstream projects.

C. Biological Environment

Besides primary studies, review of secondary data/literature published for project area on flora & fauna including RET species shall be reported in EIA/EMP report.

(i) Flora

- Characterization of forest types (as per Champion and Seth method) in the study area and extent of each forest type as per the Forest Working Plan.
- Documentation of all plant species i.e. Angiosperm, Gymnosperm, Pteriodophytes, Bryophytes, Lichens (all groups). All species list may be provided.
- General vegetation profile and floral diversity covering all groups of flora including lichens and orchids. A species wise list may be provided.

- Assessment of plant species with respect to dominance, density, frequency, abundance, diversity index, similarity index, importance value index (IVI) , Shannon Weiner index etc. of the species to be provided. Methodology used for calculating various diversity indices along with details of locations of quadrates, size of quadrates etc. to be reported within the study area in different ecosystems.
- Existence of National park, Sanctuary, Biosphere Reserve etc in the study area, if any, should be detailed.
- Economically important species like medicinal plants, timber, fuel wood etc.
- Details of endemic species found in the project area.
- Flora under RET categories should be documented using International Union for the Conservation of Nature and Natural Resources (IUCN) criteria and Botanical Survey of India's Red Data list along-with economic significance. Species diversity curve for RET species should be given.
- Biodiversity study, a sub-component of EIA study, is to be carried-out by associating a reputed organisation/institution as recommended by WII, Dehradun or by ICFRE, Dehradun. A list of such institutes is available on MoEF"s website.
- Cropping pattern and Horticultural Practices in the study area.

(ii) Fauna

- Fauna study and inventorization 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, phytoplanktons, benthos, etc.
- Fish and fisheries, their migration and breeding grounds.
- Fish diversity composition and maximum length & weight of the measured populations to be studies for estimation of environmental flow.
- Conservation status of aquatic fauna.

E. Socio-Economic

- Collection of baseline data on human settlements, health status of the community and existing infrastructure facilities for social welfare including sources of livelihood, job opportunities and safety and security of workers and surroundings population.
- Collection of information with respect to social awareness about the developmental activity in the area and social welfare measures existing and proposed by project proponent.
- Collection of information on sensitive habitat of historical, cultural and religious and ecological importance.
- The socio-economic survey/ profile within 10 km of the study area for demographic profile; Economic Structure; Developmental Profile; Agricultural Practices; Infrastructure, education facilities; health and sanitation facilities; available communication network etc.
- Documentation of demographic, Ethnographic, Economic Structure and development profile of the area.
- Information on Agricultural Practices, Cultural and aesthetic sites, Infrastructure facilities etc.
- Information on the dependence of the local people on minor forest produce and their cattle grazing rights in the forest land.
- List of all the Project Affected Families with their name, age, educational qualification, family size, sex, religion, caste, sources of income, land & house holdings, other properties, occupation, source of income, house/land to be acquired for the project and house/land left with the family, any other property, possession of cattle, type of house etc.
- In addition to socio-economic aspects of the study area, a separate chapter on socio-cultural aspects based upon study on Ethnography of the area should be provided.

(7) Impact Prediction and Mitigation Measures

The adverse impact due to the proposed project should be assessed and effective mitigation steps to abate these impacts should be described.

(i) Air Environment

- Changes in ambient and ground level concentrations due to total emissions from point, line and area sources.
- Effect on soil, material, vegetation and human health.
- Impact of emissions from DG set used for power during the construction, if any, on air environment.
- Pollution due to fuel combustion in equipments and vehicles
- Fugitive emissions from various sources
- Impact on micro-climate

(ii) Water Environment

- Changes in surface and ground water quality
- Steps to develop pisci-culture and recreational facilities
- Changes in hydraulic regime and downstream flow.
- Water pollution due to disposal of sewage
- Water pollution from labour colonies/ camps and washing equipment.

(iii) Land Environment

- Adverse impact on land stability, catchment of soil erosion, reservoir sedimentation and spring flow (if any) (a) due to considerable road construction / widening activity (b) interference of reservoir with the inflowing stream (c) blasting for commissioning of HRT, TRT and some other structures.
- Changes in land use / land cover and drainage pattern.
- Immigration of labour population.
- Quarrying operation and muck disposal.
- Changes in land quality including effects of waste disposal.
- River bank and their stability.
- Impact due to submergence.

(iv) Biological Environment

- Impact on forests, flora, fauna including wildlife, migratory avi-fauna, rare and endangered species, medicinal plants etc.
- Pressure on existing natural resources.
- Deforestation and disturbance to wildlife, habitat fragmentation and wild animal's migratory corridors.
- Compensatory afforestation-identification of suitable native tree species for compensatory afforestation and green belt.
- Impact on fish migration and habitat degradation due to decreased flow of water.
- Impact on breeding and nesting grounds of animals and fish.

(v) Socio-economic aspects

- Impact on local community including demographic profile.
- Impact on socio-economic status.
- Impact on economic status.
- Impact on human health due to water / vector borne disease
- Impact on increase traffic.
- Impact on Holy Places and Tourism.
- Impacts of blasting activity during project construction which generally destabilize the land mass and leads to landslides, damage to properties and drying up of natural springs and cause noise population will be studies. Proper record shall be maintained of the baseline information in the post project period.

- Positive and negative impacts likely to be accrued due to the project are listed.

(8) Environmental Management Plans

- **Catchment Area Treatment (CAT) Plan** should be prepared micro-watershed wise. Identification of free draining/ directly draining catchment based upon Remote Sensing and Geographical Information System (GIS) methodology and Sediment Yield Index (SYI) method of AISLUS, Deptt. of Agriculture, Govt. of India coupled with ground survey. Areas or watersheds falling under 'very severe' and 'severe' erosion categories should be provided and required to be treated. Both biological as well as engineering measures should be proposed in consultation with State Forest Department for areas requiring treatment. Year-wise schedule of work and monetary allocation should be provided. Mitigation measures to check shifting cultivation in the catchment area with provision for alternative and better agricultural practices should be included.

- **Command Area Development (CAD) Plan** giving details of implementation schedule with a sample CAD plan.

- **Compensatory Afforestation** shall be prepared by the State Forest Department in lieu of the forestland 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 on 01.01.2014.*

- **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 Panchayat. Local skill development schemes should be given. Details of various activities to be undertaken along with its financial out lay should be provided.
- Environmental safeguards during **construction activities including Road** Construction.
- **Energy Conservation Measures.**
- **Environmental Monitoring Programme** with physical & financial details covering all the aspects of EMP. A summary of Cost Estimates for all the plans, **c**ost for implementing all the Environmental Management Plans.

(9) In the EMP, a sample CAD plan for a distributary outlet command is also included. Such a plan is to show the alignment of irrigation and drainage channels. The components of the On Farm Development (OFD) works to be undertaken may be clearly mentioned along with a time schedule for their completion vis-&-vis the progress of irrigation development.

(10) Additional Conditions:

- Recycle water be used/ utilized for industries and horticultural purpose.
- The irrigation efficiency should also be worked out during the study.
- The project envisages stabilization of existing Devadula LIS of command area of about 2.5 lakh ha by constructing a barrage across river Godavari near the confluence with river Indravati.
- The performance report of the LIS may also be prepared based on the ground realities.
- The solar power also may not be a cheaper alternative for running such high head LIS. This aspect may be looked into in details.
- The arguments, viz. need for providing employment to large number of people who are residing in rural areas and dependent on agriculture, overlooking the norms of benefit- cost ratio in light of erratic changes in the prices of agricultural produce, supplying water to agricultural lands at high altitudes, achieving self sufficiency to the state in food grains and so on in justification may not be tenable in the context of economic returns/improving the economy of the state. Water is not a solution everywhere.
- Land acquired for the project shall be suitably compensated in accordance with the law of the land with the prevailing guidelines.

*****

Annexure – II

No.J-11013/25/2014-IA.I
Government of India
Ministry of Environment & Forests

Indira ParyavaranBhawan,
JorBagh Road, Ali Ganj,
New Delhi-11003

Dated the 11th August, 2014

OFFICE MEMORANDUM

Subject: Environment sustainability and CSR related issues-guidelines

The Environment Impact Assessment (EIA) Notification 2006, issued under the Environment (Protection) Act 1986, as amended from time to time, prescribes the process for granting prior environment clearance (EC) in respect of certain development projects / activities listed out in the Schedule to the notification.

2. Sustainable development has three components, viz., social, economic and environmental. All the three components are closely inter-related and mutually re-enforcing. Considering this, 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. It is noticed that while there is clarity on the guidelines on EMP, as regards sustainability related issues, different formulations have been prescribed in the conditions in EC letters for the projects under different sectors listed out in Schedule to the EIA Notification, 2006. Thus, there is a need to issue guidelines on the subject.

4. Section 135 of the Companies Act, 2013 deals with corporate social responsibility and Schedule-VII of the Act lists out the activities which may be included by companies in their CSR Policies. The activities relating to "ensuring environmental sustainability", are listed in this schedule. Further, Ministry of Corporate Affairs has also notified the Companies (Corporate Social Responsibility Policy) Rules, 2014.

5. 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. Obviously, in such cases, the provisions of aforesaid Act and Rules will not apply.

6. The matter has been further examined in the Ministry of Environment, Forests & Climate Change (MoEF&CC). It has been decided that in respect of valid concerns expressed during the public consultations, mitigation issues emerging from social impact assessment and R&R Plan, the project proponents, in EIA / EMP report will clearly state the activity-wise costs involved (both capital as well as recurring costs), the phasing of these activities along with costs and also as to how such expenditure would be met. The costs and the timelines for various activities as prepared by the project proponent may be looked into by the concerned Expert Appraisal Committee (EAC) for their reasonableness and appropriate recommendations in the matter reflected in the minutes of EAC meeting. In case these activities (or some of these activities) are proposed to be covered by the project proponent under CSR activities, the project proponent should commit providing for the same. In either case, the position regarding the agreed activities, their funding mechanism and the phasing should be clearly reflected in the EC letter.

7. The obligation on part of the project proponents, as mentioned in para5 above, should be stated at the TOR stage itself as one of the TORs for the project.

8. All Sectoral EACs will follow the aforesaid procedure on environment sustainability and CSR related issues while appraising the projects and do away with the existing practices being followed on the subject, if any.

9. These guidelines will apply mutatis mutandis to SEACs/SEIAAs.

10. This issues with the approval of the Component Authority.

(Dr. Satish C.Garkoti)
Scientist 'F'

To

1. All the Officers of IA Division
2. Chairpersons / Member Secretaries of all the SEIAAs / SEACs
3. Chairman, CPCB
4. Chairpersons / Member Secretaries of all SPCBs / UTPCCs

Copy to:

1. PS to MEF
2. PPS to Secretary (EF&CC)
3. PPS to AS(SS)
4. PPS to JS(AT)
5. Website of MoEF&CC
6. Guard File

ANNEXURE-2

ANNEXURE -2

GOVERNMENT OF TELANGANA
ABSTRACT

I&CAD Dept - P.V.Narsimha Rao Kanthanapally Sujala Sravanthi Project Phase-I-Package-I (Tupakulagudem Barrage):- construction of barrage at Tupakulagudem with Radial Gates including hoisting arrangements, construction of guide bunds on right flank, construction of Head Regulator for Power channel with vertical gates including hoisting arrangements across River Godavari near Tupakulagudem (V), Eturunagaram (M), Warangal District for an amount of Rs. 2121.00 Crores – Administrative approval - Accorded – Orders – Issued.

==========

IRRIGATION AND CAD (PROJECTS-III) DEPARTMENT

G.O. Ms. No.14 **Dated:13.02.2017**
Read:

From the Engineer-in-Chief(Irri), Hyderabad, Lr.No.ENC(I)/DCE IV/OT4/AEE II/Tupakulagudem, dt.20.09.2016.

*****

ORDER:

In the reference read above, the Engineer-in-Chief(Irrigation), Hyderabad has requested the orders of the Government for the following:

1. To accord approval for total cost of Rs. 2121.00 Crore for construction of barrage at Thupakulagudem (v), Eturunagaram (M) and to meet the expenditure from the revised administrative approval already accorded vide G.O.Ms No.38, Dt.24-04-2013 for Rs.2345.00 Crore.

2. To accord approval for entrustment of Construction of Barrage work at Thupakulagudem (V) to the existing agency executing the work of P.V.Narsimha Rao Kanthanapally Sujala Sravanthi with SSR 2012-13 rates with tender discount of (-) 9.1389 % in **EPC mode** with the following recommendations.

   i) Waiver of interest on mobilization advance from 29-3-2015 i.e., the date from which the work was stopped till the resumption of the work.

   ii) Payment of bills for a minimum amount of Rs 1.00 Crore per month as against the agreement condition vide clause no 41.6 of general conditions of contract of volume I of agreement which stipulates minimum bill at 0.5 % on agreement amount.

   iii) To accord permission to conclude supplemental agreement for the change of location, parameters, specifications and standards, if any.

P.T.O.

2. After careful examination of the proposal of the Engineer-in-Chiief(Irrigation), Hyderabad hereby accord Administrative Approval for the following:

1. Approval for total cost of Rs. 2121.00 Crore **(Rupees two thousand one hundred and twenty one crores only)** for construction of barrage at Thupakulagudem (v), Eturunagaram (M) and to meet the expenditure from the revised administrative approval already accorded vide G.O.Ms No.38, Dt.24-04-2013 for Rs.2345.00 Crore.

2. Approval for entrustment of Construction of Barrage work at Thupakulagudem (V) to the existing agency executing the work of P.V.Narsimha Rao Kanthanapally Sujala Sravanthi with SSR 2012-13 rates with tender discount of (-) 9.1389 % in **EPC mode** with the following permissions.

   i) Waiver of interest on mobilization advance from 29-3-2015 i.e., the date from which the work was stopped till the resumption of the work.

   ii) Payment of bills for a minimum amount of Rs 1.00 Crore per month as against the agreement condition vide clause no 41.6 of general conditions of contract of volume I of agreement which stipulates minimum bill at 0.5 % on agreement amount.

   iii) Permission to conclude supplemental agreement for the change of location, parameters, specifications and standards, if any.

3. The Engineer-in-Chief(Irrigation), Hyderabad shall take necessary action accordingly.

4. This order issues with the concurrence of Finance (W&P) Department, vide their U.O. No.13598/216/WP/A1/2016, Dated.21.12.2016.

(BY ORDER AND IN THE NAME OF THE GOVERNOR OF TELANGANA)

DR. SHAILENDRA KUMAR JOSHI
SPECIAL CHIEF SECRETARY TO GOVERNMENT

To
The Engineer-in-Chief(Irrigation), Hyderabad.

Copy to:

The Chief Engineer, GLIS, Warangal.
The Accountant General, T.S., Hyderabad.
The Director of Works & Accounts, Hyderabad.
The Finance (WP) Dept.
The OSD to Minister for Irrigation.
The P.S. to Spl. Chief Secretary.

//FORWARDED :: BY ORDER//

SECTION OFFICER

ANNEXURE-3

ANNEXURE - 3

No.J-12011/79/2005-IA-I
Government of India
Ministry of Environment & Forests

Paryavaran Bhawan,
C.G.O. Complex,
Lodi Road,
New Delhi-110003

6th December, 2005

The Secretary (Irrigation)
I&CAD Department
A.P. Secretariat
Hyderabad.

Subject – J. Chokka Rao Godavari Lift Irrigation Scheme in District Warangal, Andhra Pradesh – Environmental Clearance reg.

Sir,

This has reference to your letter No. CE/J.C.R.G.L.I Project dated 07.11.2005 & subsequent letter dated 18.11.2005 on the subject.

2. The above referred proposal was considered by the Expert Committee for River Valley & Hydroelectric projects at its meeting held on 16.11.2005. It has been noted that under the proposed lift irrigation scheme, water from river Godavari to be lifted from elevation 70 m during monsoon (June-December) near Gangaram village up to an elevation of 470 m and conveyed through a pressurized pipeline. The water conductor system is integrated with eight numbers of existing balancing reservoirs and lift the water to desired elevation in 10 stages and irrigate command area of 2.62 lakh ha. beside supply of drinking water and industrial use. Total land requirement is 5160 ha. Out of that 344 ha. is forest land. Forest clearance issued on 14.09.2005. No person will be displaced due to this project. There is no National Park, Wildlife Sanctuaries, Tiger / Elephant reserves within 7 Km. from the periphery of the project area. Public Hearing was conducted in four district of Warangal, Karimnagar, Nalgonda & Medak on 19.07.2005, 05.08.2005, 12.08.2005 & 27.08.2005 respectively. The total cost of the project is 5,216.60 Crores.

3. The Ministry of Environment and Forests hereby accords environmental clearance as per the provision of Environmental Impact Assessment Notification-1994, subject to the strict compliance of the terms and conditions mentioned below –

Part – A: Specific conditions

i) Catchment area treatment plan as proposed in the EIA report as reproduced below should be completed in three years. The year-wise break-up is given below along with financial implications -

Sl. No.	Treatment Measures	Unit	1st Year	2nd Year	3rd Year	Total
I	BIOTIC TREATMENT MEASURES					
A	Social Forestry, Agro Forestry, Silvipasture	Ha.	295	Maintenance		
B	Soil and Moisture conservation measures with vegetative barriers and horticulture	Ha.	3521			
II	ENGINEERING/GULLY CONTROL WORKS					
A	Gully Plug	No.s	24			
B	Rockfill Dam	No.s	20			
C	Check dam	No.s	10			

ii) A firm ground water monitoring mechanism should be in place before application of irrigation water commences in the command area.

iii) A multidisciplinary environmental monitoring cell inclusive of the experts from ground water management should be constituted immediately before the field activities of the project are undertaken.

iv) Water user association / Co-operative and involvement of the whole community for disciplined use of available waters should be formed.

v) The ground water salinity greatly increases in irrigated command with poor drainage facilities due to close nature of the basin and high evapo-transmission rates. Command area development plan must include improvement of drainage facility to have better management of water

vi). Any other clearance from any other organization if required should be obtained .

(2)

vii). Commitment made during Public hearing by the project authority on different issues should be fulfilled.

viii) Occurrence of stagnant pools/slow moving water channels during construction and operation of the project providing breeding source for vector mosquitoes and other parasites. The river should be properly channelised so that no small pools and poodles are allowed to be formed. Even after taking precaution, due to unforeseen situations, breeding of mosquito and resultant malaria or mosquito borne diseases can increase. If such a situation arises, it will be the responsibility of project authorities to take all corrective steps i.e. residual insecticidal spray in all the project impact area and surrounding 3 Km. area, keeping the flight range of mosquitoes in consideration.

Part –B. General conditions

i) Provision of supplying kerosene or cooking gas / Pressure Cooker to the labourers should be kept instead of supplying fuel wood.

ii) Fuel depot may be opened at the site to provide the fuel (kerosene/wood /LPG). Medical facilities as well as recreational facilities should also be provided to the labourers.

iii) All the labourers to be engaged for construction works should be thoroughly examined by health personnel and adequately treated before issue the work permits.

iv) Restoration of construction area including dumping site of excavated materials at dam site & power house site should be ensured by leveling, filling up of borrow pits, landscaping etc. The area should be properly afforested with suitable plantation.

v) A multidisciplinary committee should be constituted with representative from the disciplines of forestry, ecology, wildlife, soil conservation, NGO etc. to oversee the effective implementation of the suggested safeguard measures.

vi) Financial provision should be made in the total budget of the project for implementation of the above suggested safeguard measures.

vii) Six monthly monitoring reports should be submitted to the Ministry and its Regional Office, Bangalore for review.

4. Officials from Regional Office MOEF, Bangalore would be monitoring the implementation of environmental safeguards should be given full cooperation, facilities and documents / data by the project proponents during their inspection.

5. The responsibility of implementation of environmental safeguards rests fully with the Irrigation Department and Government of Andhra Pradesh.

6. In case of change in the scope of the project, project would require a fresh appraisal.

7. The Ministry reserves the right to add additional safeguard measures subsequently if found , necessary and to take action including revoking of the clearance under the provisions of the environmental (Protection) Act, 1986, to ensure effective implementation of the suggested safeguard measures in a time-bound and satisfactory manner.

8. This clearance letter is valid for a period of five years from the date of issue of this letter for commencement of construction work.

9. A copy of the clearance letter will be marked to concerned Panchayat, if any, from whom any suggestion/representation has been received while processing the proposal.

10. State Pollution Control Board / Committee should display a copy of the clearance letter at the regional office, district industries centre and collector's office / tehsildar's office for 30 days.

11. The project proponent should advertise within seven days, at least in two local newspapers widely circulated in the region around the project, one of which shall be in the vernacular language of the locality concerned informing that the project has been accorded environmental clearance and copies of clearance letters are available with the State Pollution Control Board/Committee and may also be seen at Website of the Ministry of Environment and Forests at http:// www.envfor.nic.in/.

(Dr. S. Bhowmik)
Additional Director

Copy to: -

1. The Secretary, Ministry of Water Resources, Shram Shakti Bhawan, Rafi Marg, New Delhi - 110001.
2. Secretary, Department of Environment, Government of Andhra Pradesh, Hyderabad.
3. Dr. Ravi Mallu, Special Representative of Government of Andhra Pradesh,Andhra Bhawan, 1, Ashoka Road, New Delhi .
4. The Advisor (I & CAD) Planning Commission, Yojana Bhawan, New Delhi -110 001.
5. The Chief Engineer (PAD), Central Water Commission, Sewa Bhawan, R.K. Puram, New Delhi - 100062.
6. Member Secretary, Andhra Pradsh Pllution Control Board, Hyderabad.
7. CCF, Regional Office, Ministry of Environment & Forests, Bangalore.
8. EI - Division, MOEF, New Delhi - 110001.
9. Guard file.

ANNEXURE - 4

ANNEXURE – 4

Technical details of JCRDLIS project

Table 1 Hydrology details of JCRDLIS project

Catchment	
Basin	Godavari
Sub Basin	G10
Catchment area at Head work site (Sq.km)	2,69,000
Catchment area Classification according to mode of Precipitation (Sq.km)	
a) Rain fed	Entirely rain fed
b) Snow Fed (Not applicable to our State)	N.A
Annual yield calculated at the proposed site	
75% Dependability	12027 M.cum. (425 TMC)

Table 2 Scope of JCRDLIS project

Sl. No.	Description	Phase-I	Phase-II	Phase-III	Total
1	Water to be lifted (TMC)	5.18	7.25	25.75	38.18
2	Discharge (No of Pumps x Cumecs)	2 x 5 =10 (353 Cusecs)	2 x 7=14 (495 Cusecs)	6 x 8.27=49.60 (1752Cusecs)	73.60 (2600 Cusecs)
3	No. of Lifts (Nos)	4	7	10	-
4	Static Head (Mts)	268	470	510	-
5	Power requirement (MW)	56	123.6	304.4	484

Table 3 Benefitting Districts and Mandals of JCRDLIS project

Districts	Mandals
Warangal	Hasanparthy, Hanamkonda, Dharmasagar, Sangem, Geesukonda, Wardhannapet, Jaffergadh, Ghanpur, Raghnadhapally, Palakurthy, Devaruppala, Lingala Ghanpur, Cherial, Maddur, Bacchanapet, Kondapaka. Jangaon, Nallabelly, Duggondi, Narsampet and Rayaparthi.
Karimnagar	Bheemdevarapally, Elkaturthy, Huzurabad and Maha Mutharam.

Nalgonda	Gundala, Aler and Tirumalagiri.
Medak	Kondapaka and Gajwel.
Total No. of Villages benefitting	364

Table 4 Components of JCRDLIS project

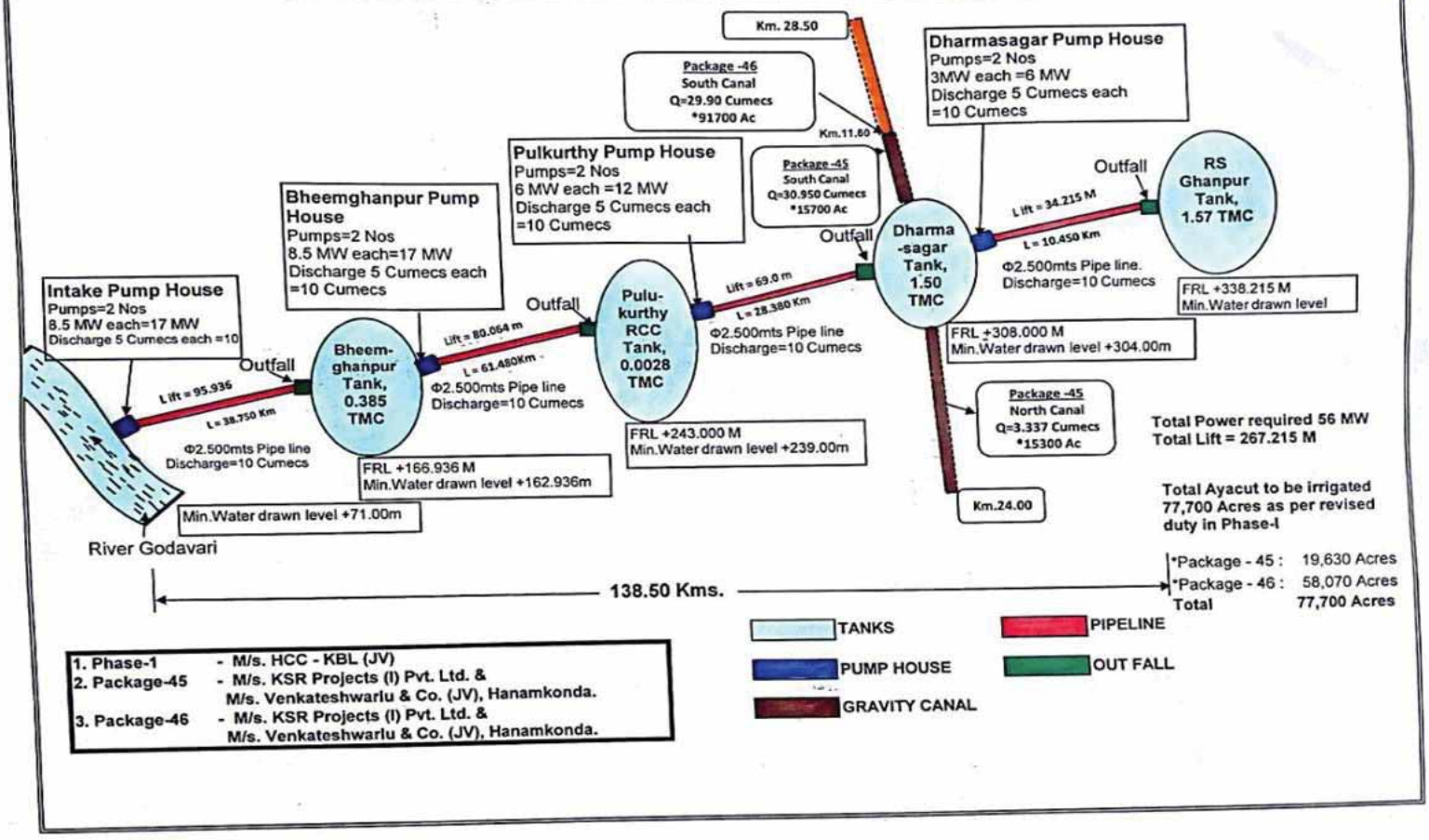
Sl. No.	Description	Phase-I	Phase-II	Phase-III	Total
1	No. of Pump Houses	1) Intake at G.Gangaram 2) Bheemghanpur 3) Nagaram (Pulkurthy) 4) Dharmasagar	1) Intake at Gangaram 2) Bheemghanpur 3) Salivagu 4) Dharmasagar 5) R.S.Ghanpur 6) Gandiramaram 7) Bommakur	1) Intake at Gangaram 2) Ramappa PH-Pkg-V 3) Ramappa Tunnel P.H – Pkg-II 4) Dharmasagar Tunnel PH-Pkg -III 5) Dharmasagar PH=Pkg-IV 6) R.S.Ghanpur PH=Pkg-IV 7) R.S.Ghanpur Tunnel PH=Pkg-IV 8) Gandiramaram PH=Pkg-IV 9) Bommakur PH=Pkg-IV	20
2	Length of Pumping Main(km)	138.5	196	113	447.5
3	Length of Tunnel (km)	-	-	84.595	84.595
4	Formation /Improvements to the Tanks	1) R.C.C Tank at Pulkurthy (New) 2) Dharmasagar	1) Narsingapur (Imp) 2) R.S.Ghanpur (Imp) 3) Ashwaraopally (Imp)	1) Rangaiah & Yerraiah Cheruvu(Imp) 2) Nashkal Tank(New) 3) Palakurthy Tank(Imp) 4) Chennur Tank(Imp) 5) Jaffergadh	20

Sl. No.	Description	Phase-I	Phase-II	Phase-III	Total
			4) Chittakodur (New) 5) Gandiramaram (Imp) 6) Bommakur (New) 7) Veldanda(Imp) 8) Tapaspally (New)	Tank(Strength) 6) Nawabpet Tank(New) 7) Laddunur (New) 8) Kannaboinagudem (New) 9) Maa reddy Cheruvu(Imp) 10) Inapur Tank(Imp)	
5	No of Packages	3	5	Package-V – Rangaiah and Erraiah cheruvu	16
6	Name of the Distributory System	Package-45 Package-46	1. RS Ghanpur Distributory System 2. 4L Disributory System of RFMC of RS Ghanpur Reservoir 3. Tapaspally Distributory System 4. Aswaraopally & Chittakodur Distributory system	Package-VI – Nashkal, Palakurthy and Chennur canals Package-VII – Nawabpet Distributary System Package-VIII - Distributary System	
7	Ayacut (ha)	49655	72544	97849	2,20,048

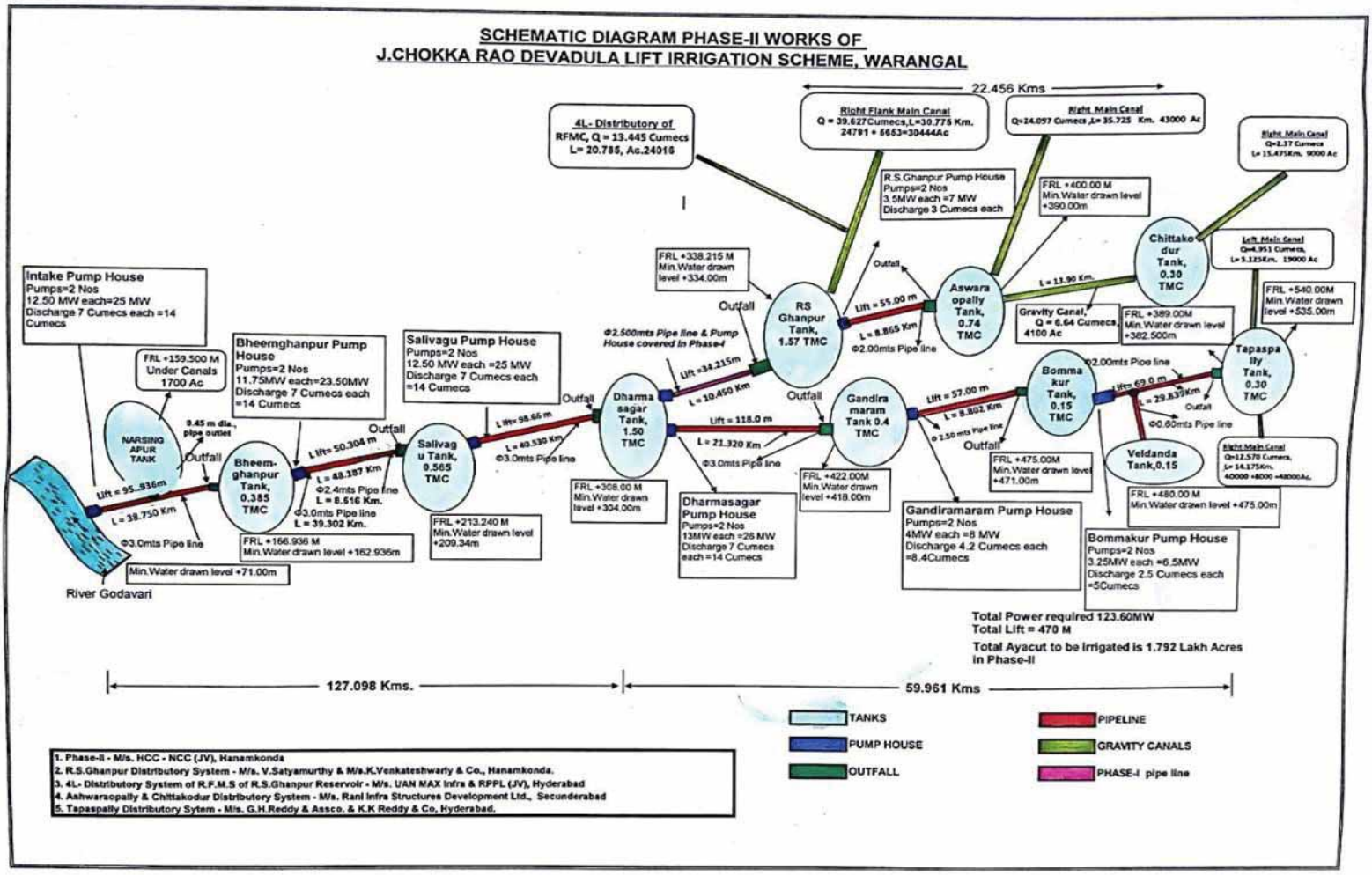
Table 5 Land acquisition and R&R details of JCRDLIS project

Sl.No.	Particulars	Quantity (ha)
1	Lands required	12558
2	Lands Acquired	9341
3	Balance to be Acquired	3215

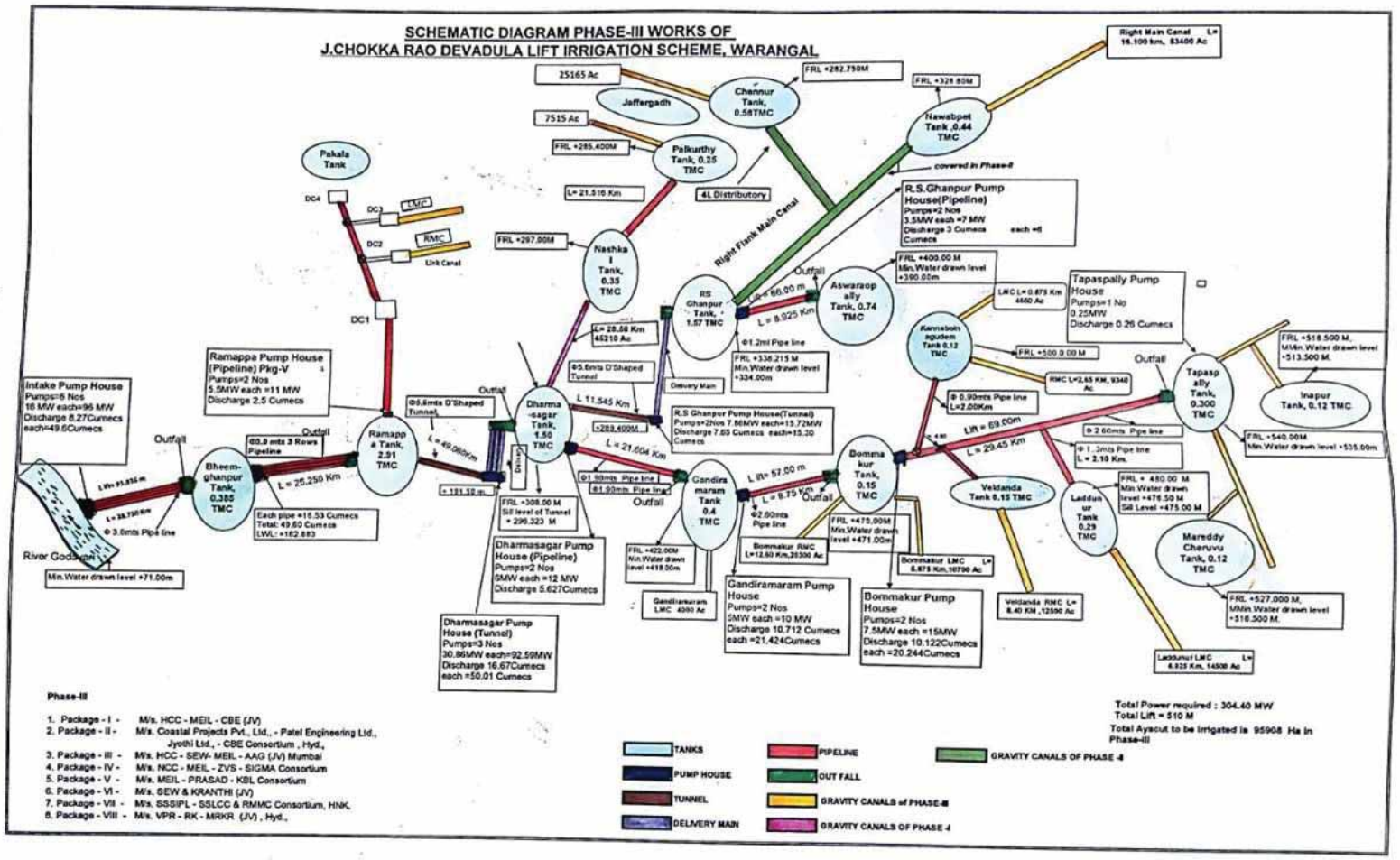
SCHEMATIC DIAGRAM PHASE-I WORKS OF
J.CHOKKA RAO DEVADULA LIFT IRRIGATION SCHEME, WARANGAL



SCHEMATIC DIAGRAM PHASE-II WORKS OF
J.CHOKKA RAO DEVADULA LIFT IRRIGATION SCHEME, WARANGAL



1. Phase-II - M/s. HCC - NCC (JV), Hanamkonda
2. R.S.Ghanpur Distributory System - M/s. V.Satyamurthy & M/s.K.Venkateshwarly & Co., Hanamkonda.
3. 4L- Distributory System of R.F.M.S of R.S.Ghanpur Reservoir - M/s. UAN MAX Infra & RPPL (JV), Hyderabad
4. Ashwaraopally & Chittakodur Distributory System - M/s. Rani Infra Structures Development Ltd., Secunderabad
5. Tapaspally Distributory Sytem - M/s. G.H.Reddy & Assco. & K.K Reddy & Co, Hyderabad.


SCHEMATIC DIAGRAM PHASE-III WORKS OF
J.CHOKKA RAO DEVADULA LIFT IRRIGATION SCHEME, WARANGAL
Intake Pump House
Pumps=6 Nos
16 MW each=96 MW
Discharge 8.27Cumecs
each=49.6Cumecs
Outfall
Bheemghanpur Tank, 0.385 TMC
Ramappa Tank, 2.91 TMC
Ramappa Pump House (Pipeline) Pkg-V
Pumps=2 Nos
5.5MW each =11 MW
Discharge 2.5 Cumecs
Each pipe =16.53 Cumecs
Total: 49.60 Cumecs
FRL: +182.883
River Godavari
Min.Water drawn level +71.00m
Dharma-sagar Tank, 1.50 TMC
FRL +308.00 M
Sill level of Tunnel
+ 299.323 M
Dharmasagar Pump House (Pipeline)
Pumps=2 Nos
5MW each =12 MW
Discharge 5.627Cumecs
Dharmasagar Pump House (Tunnel)
Pumps=3 Nos
30.86MW each=92.59MW
Discharge 16.67Cumecs
each =50.01 Cumecs
Ramappa Pump House (Pipeline) Pkg-V
Pumps=2 Nos
5.5MW each =11 MW
Discharge 2.5 Cumecs
Jaffergadh
25165 Ac
7515 Ac
Pakala Tank
Pelkurthy Tank, 0.25 TMC
FRL +285.400M
L= 21.515 Km
4L Distributory
Chennur Tank, 0.58TMC
FRL +282.750M
Nashkal Tank, 0.35 TMC
FRL +297.00M
DC1
DC2
DC3
DC4
LMC
RMC
Link Canal
Right Flank Main Canal
RS Ghanpur Tank, 1.57 TMC
L= 8.925 Km
L= 66.00 m
Outfall
Aswaraopally Tank, 0.74 TMC
FRL +400.00 M
Min.Water drawn level +390.00m
Nawabpet Tank ,0.44 TMC
FRL +328.80M
covered in Phase-II
Right Main Canal L= 16.100 km, 83400 Ac
R.S.Ghanpur Pump House(Pipeline)
Pumps=2 Nos
3.5MW each =7 MW
Discharge 3 Cumecs each =8 Cumecs
Tapaspally Pump House
Pumps=1 No
0.25MW
Discharge 0.26 Cumecs
Kannaboinagudem Tank 0.12 TMC
FRL +500.0 00 M
LMC L= 0.875 Km 4460 Ac
RMC L=2.65 KM, 9340 Ac
Tapaspally Tank, 0.300 TMC
Outfall
Inapur Tank, 0.12 TMC
FRL +518.500 M, MMin.Water drawn level +513.500 M.
FRL +540.00M Min.Water drawn level +535.00m
Mareddy Cheruvu Tank, 0.12 TMC
FRL +527.000 M, MMin.Water drawn level +516.500 M.
Laddunur Tank 0.29 TMC
FRL + 480.00 M Min.Water drawn level +476.50 M Sill Level +475.00 M
Laddunur LMC L= 4.525 Km, 14500 Ac
Veldanda Tank 0.15 TMC
Veldanda RMC L= 8.40 KM ,12590 Ac
Bommakur Tank, 0.15 TMC
FRL +475.00M Min.Water drawn level +471.00m
Bommakur LMC L= 6.875 Km,10790 Ac
Bommakur RMC L=12.60 Km,25300 Ac
Bommakur Pump House
Pumps=2 Nos
7.5MW each =15MW
Discharge 10.122Cumecs
each =20.244Cumecs
Gandiramaram Tank 0.4 TMC
FRL +422.00M Min.Water drawn level +418.00m
Gandiramaram LMC 4000 Ac
Gandiramaram Pump House
Pumps=2 Nos
5MW each =10 MW
Discharge 10.712 Cumecs
each =21.424Cumecs
R.S Ghanpur Pump House(Tunnel)
Pumps=2Nos 7.86MW each=15.72MW
Discharge 7.65 Cumecs each=15.30 Cumecs
Delivery Main
FRL +336.215 M
Min.Water drawn level +334.00m
Ø1.2mt Pipe line
Ø5.6mts D'Shaped Tunnel
Ø3.9 mts 3 Rows Pipeline
Ø 3.0mts Pipe line
Ø 0.90mts Pipe line L=2.00Km
Ø 2.60mts Pipe line
Ø 1..3mts Pipe line L = 2.10 Km.
L = 11.545 Km
L = 21.604 Km
L = 25.250 Km
L = 49.060 m
L = 69.00m
L = 29.45 Km
L = 57.00 m
L = 8.75 Km
+283.600M
+181.10 m
Ø2.60mts Pipe line
Total Power required : 304.40 MW
Total Lift = 510 M
Total Ayacut to be irrigated is 95908 Ha in Phase-III
Phase-III
1. Package - I - M/s. HCC - MEIL - CBE (JV)
2. Package - II - M/s. Coastal Projects Pvt., Ltd., - Patel Engineering Ltd., Jyothi Ltd., - CBE Consortium , Hyd.,
3. Package - III - M/s. HCC - SEW- MEIL - AAG (JV) Mumbai
4. Package - IV - M/s. NCC - MEIL - ZVS - SIGMA Consortium
5. Package - V - M/s. MEIL - PRASAD - KBL Consortium
6. Package - VI - M/s. SEW & KRANTHI (JV)
7. Package - VII - M/s. SSSIPL - SSLCC & RMMC Consortium, HNK
8. Package - VIII - M/s. VPR - RK - MRKR (JV) , Hyd.,
TANKS
PUMP HOUSE
TUNNEL
DELIVERY MAIN
PIPELINE
OUT FALL
GRAVITY CANALS of PHASE-III
GRAVITY CANALS OF PHASE-I
GRAVITY CANALS OF PHASE -II

Central Water Commission
Project Appraisal(South) DTe.

....

Sub: Godavari Lift Irrigation Scheme : Andhra Pradesh

Please find enclosed the letters of clearance from HCD dte., ISM dte. and CMC dte. on the subject cited. This is for your kind information and further necessary action.

Encl: As above.

N.M. Saha 1/11/06.

(N.M. Saha)
Director PA(S)

Director, Cost Appraisal (I), CWC, Sewa Bhavan, New Delhi..
CWC U.O.No. 6/235/2005-PA(S)/ 1443 Dt. 1st November 2006..

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Government of India
भारत सरकार
Central Water Commission
केंद्रीय जल आयोग
HCD (NW&S) Directorate
जल विद्युत सिविल अभिकल्प निदेशालय

West Block II, RK Puram
New Delhi

Sub: Technical Examination of Godavari Lift Irrigation Scheme (A.P.)

Reference is invited to your office UO letter No 6/235/2001-PA(S) 1138 dated 23.11.2004 forwarding the report of Godavari Lift Irrigation Scheme.(AP). The reports have been examined from HCD point of view and comments of this office are as under:

1. The power requirement of the scheme is estimated to be 485 MW. It is mentioned in the report that sufficient off peak power is not available for pumping of water from lower to upper reservoir. A firm proposal to meet this requirement of power has not been mentioned. Since availability of power is a prerequisite for a lift irrigation scheme, this aspect needs clarification.

2. The analysis and design of the scheme is generally in order for planning purpose. However, the design may be firmed up by the project authorities during construction stage, using the parameters obtained after detailed investigation.

The scheme may be considered technically cleared from this Directorate's point of view, subject to satisfactory clarification in respect of comment 1 above.

25/1/05

(PK Saxena)
Director

Director, PA(S) Central Water Commission
CWC UO No 27/1/05-HCD(NW&S)/ 71 dated 25.01.05

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Central Water Commission
Construction Machinery Consultancy Dte.
****

Sewa Bhawan,
R.K. Puram, New Delhi-66.

Sub: Godavari Lift Irrigation Scheme (Devadula) – Andhra Pradesh.

Ref: CWC (CMC) No. 6/235/2001 – PA(S)/275, dated 21.03.2005.

The replies of the project authorities vide letter under above reference from PA(S) Dte. has been examined from Plant Planning angle. The project authorities were advised/ suggested to furnish some details regarding Plant Planning aspect. Project authorities have mostly accepted our suggestion and furnished the details except the list of equipment under sub head O-Spl T&P for Unit-II of the project. It is observed that project authorities have made provision of equipment worth Rs. 1336.75 Lacs under sub head Q-Spl. T&P for Unit-I of the project. The list of equipment for Unit-I is corrected as per CWC guidelines equipment worth Rs. 1054.25 lakhs (as per the list enclosed) found suitable.

Project authorities may therefore, be advised to furnish the list of equipment for the Unit-II of the project at the earliest to enable this office to further examine the detailed project report.

Enclosure: As Above.

15/06

(Jalal-Uddin)
Director, CMC

Director, Project Appraisal (S), CWC, Sewa Bhawan, R.K.Puram
CWC ID No. 01/30/2004-CMC/103 Dated 14th December, 2004
June, 2005

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may be considered acceptable from inter-state angle. However, it may be pointed out that in working out the remaining water availability, the provisions in the agreements mentioned earlier need to be taken into consideration and this aspect may be got confirmed from the Directorate approving the water availability.

General

1. A quantum of 39.49 TMC of water is considered available through regeneration. As per Clause III(B) of the GWDT award, quantity of water available as return flow from irrigation should not be taken into consideration.

2. A quantum of 8.2 TMC of water is considered as available from catchment of tanks. The sub-basin from which this quantum is being diverted may be indicated and this quantum considered against the utilization from that sub-basin.

3. The planned utilization of Andhra Pradesh in lower Godavari sub-basin through existing projects is given as 323.69 TMC in Table 3.5(Vol.I) whereas the same worked out from project-wise utilization given in Annexure 3.2 (Vol.I) is 342.19 TMC. This discrepancy may be noted and incorporated.

4. The quantum of water to be lifted from Godavari river is mentioned as 38.16 TMC in Volume-I of the report whereas the same is mentioned as 50 TMC in Volume-V Chapter-I. It appears that the basic planning aspects are yet to be firmed up even at DPR stage.

5. No proper index map is available in the report. The index map showing location of project given at Plate-1.1, Volume-V is not legible and the project under consideration has not been marked in it.

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

14/02/05

(T.M. VENUGOPALAN)
DIRECTOR (ISM)

Director PA(S) Dte.,CWC. Sewa Bhavan, New Delhi.
CWC U.O. No.7/2/1(AP)/2003-ISM/ 64 dt. 14/2/2005

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Central Water Commission
Inter State Matters Directorate

411-A(S) Sewa Bhavan
R.K. Puram, New Delhi-66

Sub: Godavari Lift Irrigation Scheme (Devadwa) – Andhra Pradesh, estimated cost Rs.5216.34 crores.

Ref: CWC U.O. No 6/235/2001-PA(S)/1136 dated 23.11.2004

...

Project Proposal

The Godavari Lift Irrigation Scheme is proposed to lift 38.16 TMC of water from River Godavari, 12 km downstream of the confluence of Indravati and Godavari. The river intake cum main pump house of the lift component are located on right bank of river Godavari near village Gangaram. The total command area of the scheme is 2.61 lakh ha. covering districts of Warangal, Medak, Karimnagar and Nalgonda. Total water requirement of the scheme is 49 TMC. In addition to the proposed lift of 38.16 TMC of water from Godavari, the project envisages to utilize 8.2 TMC from self catchment from tanks and 5.65 TMC of ground water. For water accounting studies, Andhra Pradesh share of water from sub basin G-7 to G 12 are only considered and it has been stated that water upto G-6 sub-basin is fully committed.

Comments

The project is located in G-10 sub-basin of Godavari. The allocation of Godavari water between co-basin States in G-7 to G-12 sub-basins is regulated as per inter-state agreements dated 6.10.75, 9.12.75, 7.8.78, 15.12.78 and 11.7.79 given in Annexure II & IV of Annexure A, Annexure B, Annexure D and Annexure F of CWDT Award. As per these agreements, Andhra Pradesh is permitted to use the remaining waters of the above sub-basins after providing for the share of Maharashtra, Madhya Pradesh/Chhattisgarh and Orissa as given in these agreements. This quantity (remaining water), for the sub-basins G-7 to G-12 taken together has been worked out by the project authorities as 1010.31 TMC (Table 3.4) and that up to the project site has been worked out as 601.88 TMC (Table 3.6). The utilization through existing, on-going and future projects of Andhra Pradesh in G-7 to G 12 sub-basin have been given as 920.74 TMC (Annexure 3.2/1 to Annexure 3.2/6) and that up to the project site is given as 177.16 TMC (Table 3.6). Thus it has been concluded that water is available for the project.

Since Andhra Pradesh is the lower-most riparian State in the basin and is entitled for the remaining waters as per the agreements mentioned above and the project has been planned on this basis, there are no issues of inter state implication in the project and the project

Contd. AP-2

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ANNEXURE-5

S.No.1(R) EP/121/110 Pt.

ANNEXURE - 5

Telegram : PARYAVARAN,
NEW DELHI

Telephone : 4361606/4360
Telex : (bi-lingual) : W-66185 DOE IN
FAX : 4360678

GOVERNMENT OF INDIA
MINISTRY OF ENVIRONMENT & FORESTS
PARYAVARAN BHAVAN, C.G.O. COMPLEX
LODHI ROAD, NEW DELHI-110003

No.J.12011/7/95-IA.I

4779
2/8/95

Dated the 07th July, 1995.

Subject:- Sriramsagar Project (Kakatiya Canal below Lower Manair Dam), Andhra Pradesh - Environmental Clearance.

***

The Scheme has been examined from environmental [illegible] and accorded approval subject to the effective implementation of the following safeguards and mitigative measures in a time bound manner:-

1. - Adequate free fuel arrangement should be made to labour force engaged in the construction work of project cost. Plan with financial allocation should be submitted with in three months.

2. - The Catchment Area Treatment Plan including green belt around reservoir periphery of Sriramsagar Dam and Lower Manair Dam should be effectively implemented through engineering and biological measures. Year-wise phasing of the physical and financial targets for treatment of Catchment Area should be submitted with in three months to the Ministry.

3. - For protection of wild life and its habitat in the project impact area, a vigilance cell be established as suggested by the Chief Wild Life Warden, Andhra Pradesh. A provision of Rs. 230.00 lakhs made for this purpose should be further detailed and submitted to the Ministry with in three months.

4. - The plan submitted on the health aspects with financial provisions of Rs. 120.0/- lakhs should be strictly implemented with emphasis on community infrastructure facilities, such as mobile health primary health Centre, strengthening of the existing staff etc. In the health management plan, the use of pesticides should be avoided. Alternatively medical and pest control should be used.

30/8/95
Pl. open a file
RD(K)

[illegible] Asst AD(S), MEF 4/7

5. - Detailed Command Area Development Programme should be prepared including the drainage, ground water use, cropping pattern, fisheries etc. A comprehensive programme for training of farmers in water management production technologies, farm forestry, pollution control, environment improvement and awareness would to be undertaken. This could be done by setting up extension centres for a group of 5000 farmers. This centre should be equiped to provide soil and water testing service, farm and advisory service & training to farmers in Water Management, agro-forestry, farm forestry, pollution control and environment improvement specially in controlled use of fertilizers. These details should be submitted with requisite financial requirements of funds with in six months.

6. - Restoration of construction area should be ensured by levelling, filling of borrow pits, land scaping etc.

7. - A Multi-disciplinary Committee should be constituted with representative from various disciplines of Forestry, Ecology, Wild life, etc. to over see the effective implementation of the suggested safeguard measures.

8. - Financial provision should be made in the total budget of the project for implementation of the above suggested safeguard measures, year-wise and item wise.

9. - Six monthly monitoring report should be submitted to the Ministry and its Regional Office at Bangalore for review.

2. The officials from Regional Office, Ministry of Environment & Forests, Bangalore who would be monitoring the implementation of Environmental safeguards should be given full co-operation, facilities and documents/data by project proponents during their inspection.

3. The responsibility of implementation of environmental safeguards rests fully with the department of Irrigation & they should ensure the co-operation with the Central and State Governments.

4. In case of change of the scope of the project, the project would require a fresh appraisal.

5. The Ministry reserves the right to add additional safeguard measures subsequently, if found necessary, and to take action including revoking of the clearance under the provisions of the Environmental (Protection) Act, 1986 to ensure effective implementation of the suggested safeguard measures in a time bound and satisfactory manner.

([illegible])
Joint Director

Shri M. Dharma Rao,
Chief Engineer(I&CAD Deptt.),
Govt. of Andhra Pradesh,
Sri Ram Sagar Project, Malkapuramjadi Road,
HYDERABAD-500001.

Copy to:-

1. The Secretary,
Ministry of Water Resources,
Shram Shakti Bhavan, Rafi Marg,
New Delhi.

2. Adviser (I & CAD),
Planning Commission,
Yojana Bhavan, New Delhi.

3. Shri S. Ray,
Principal Secretary to Government(CAD),
Govt.of Andhra Pradesh, A.P. Secretariat,
HYDERABAD-500022.

4. The Chief Engineer,
Project Appraisal Directorate(PAD),
Central Water Commission, R.K. Puram,
NEW DELHI.

5. CCF, Regional Office,
Southern Zone, Ministry of Environment
& Forests, No. 463, First Main, III Block,
III Stage, Basaveshwarnagar, BANGALORE-560079.

6. Guard File.

(Dr. S.C. Verma)
Joint Director.

222/AP

Regional Office (South)

तार :
Telegram : PARYAVARAN,
NEW DELHI
दूरभाष :
Telephone : & FAX 436 2827
टेलेक्स :
Telex : W-66185 DOE IN
FAX : 4360678

भारत सरकार
पर्यावरण एवं वन मंत्रालय
GOVERNMENT OF INDIA
MINISTRY OF ENVIRONMENT & FORESTS
पर्यावरण भवन, सी. जी. ओ. कॉम्प्लेक्स
PARYAVARAN BHAVAN, C.G.O. COMPLEX
लोदी रोड, नई दिल्ली-110003
LODHI ROAD, NEW DELHI-110003

No.J-12011/26/2000-IA-I June 24, 2002.

Shri D. Chakrapani
Secretary (projects) &
Member Secretary
Godavari Water Utilisation Authority
Irrigation & CAD department.
A.P.Secretariat.
Hyderabad-500022.

Subject:- Flood flow canal project from Sri Rama Sagar– Site clearance for investigation & survey regarding.

Sir,

This has reference to your letter No. 08217/SRSP.I (I)/2002-I dated 17.5.2002 on the subject. It has been noted that the proposal envisages to draw the floodwaters from the SRSP Reservoir through an off-take regulator and carried out through flood flow canal to store in the proposed storage Reservoir-I across Peddavagu-II and Korutlavagu near Konaraopet village of Karimnagar district. The flood flow waters are further proposed to be carried out form this initial storage reservoir to another storage reservoir across Manair river near Manwada(V) of Karimnagar district, through Link canal. The flood waters stored in the second storage reservoir are proposed to be lifted and carried out through lift cum gravity canal into another reservoir proposed at Gouravelli(V) of Karimnagar District. Total area required for the project is 12,930.50 ha. No forest land is involved. 31 villages(17 full & 14 partial) consisting of 9942 houselds will be affected.

The above proposal has been examined taking into consideration the submitted project documents .The Ministry of Environment & Forests hereby accords site clearance as per the provisions of EIA notification, 1994 subject to strict compliance of the following terms and conditions –

1. Comprehensive EIA report comprising the detailed report on ecological study, rehabilitation, catchment area treatment along with year wise physical target indicating on an index map and financial implications, seismicity, disaster management plan, minerals loss, migration path of the wild animals, impact due to construction of infrastructure required for the construction of projects such as roads, opening up of new quarries etc. should be undertaken and submitted to the Ministry within 18 months of issue of this letter.

2. N.O.C from Archaeological Department should be submitted in respect of submergence of certain religious and archaeologically important places under storage reservoir – I across Pedda Vagu – II and Korutle Vagu and also mid – Manair reservoir.

3. Clearance is only for undertaking investigations at the above-mentioned site and for collection of environmental data for preparation of comprehensive EIA report and management plans. This should not in any way be construed as commitment for environmental clearance.

4. Clearance under Forest(Conservation) Act 1980 should be separately obtained.

5. No civil work of permanent nature on the project shall be initiated in anticipation of the final approval of the Ministry. The Project Authority would have to apply for environmental clearance by submitting environmental data and plans.

5. Ministry of Environment & Forests shall assess the proposal on its merit before taking a final view.

6. The fund requirements for environmental aspects should be included in the budget of the project for evaluation of economic feasibility of the project.

7. Ministry reserves the right to suggest additional measures for environmental protection during the investigation stage, if found necessary.

Yours faithfully,

S Bhowmik

(Dr. S. Bhowmik)
Additional Director

Copy to:-

1. Secretary, Ministry of Water Resources, Shram Shakti Bhavan, Rafi Marg, New Delhi.
2. Secretary, Deptt. of Ecology & Environment, Govt. of Andhra Pradesh, Secretariat, Hyderabad.
3. Secretary, Department of Irrigation,Govt. of Andhra Pradesh, Secretariat, Hyderabad.
4. Adviser(I/CAD), Planning Commission, Yojana Bhavan,New Delhi.
5. The Chief Engineer, Project Appraisal Directorate, Central Water Commission, Sewa Bhavan, R.K. Puram, New Delhi-110066.
6. Regional Office, MOEF, Bangalore.
7. EI Division, MOEF, New Delhi.

(Dr.S. Bhowmik)
Additional Director

भारत सरकार
पर्यावरण एवं वन मंत्रालय
GOVERNMENT OF INDIA
MINISTRY OF ENVIRONMENT & FORESTS

197
21.5.03

F. No. J- 12011/23/2002-IA-I. Dated: 14.05.2003.

To,

The Secretary to Govt. of A.P.,
Department of Irrigation & CAD (PW),
A.P. Secretariat,
Hyderabad -
Andhra Pradesh

Subject – **Sri Rama Sagar project (Stage –II) – Extension of Kakatiya Canal from Km 284 Km to 347 Km. in Districts Warangal, Khammam & Nalgonda, Andhra Pradesh – Environmental Clearance - regarding.**

Sir,

This has reference to your letter No. 16058/SRSP-I (2)/2002-1, dated 29.05.2002, 28.09.2002, 16.11.2002 and subsequent letters from Department of Irrigation & CAD No. CE/SRSP-II&FFC/Wgl/TS/AE.4/F.16/2978 dated 18.11.2002, 11.12.2002, 21.12.2002, 06.01.2003 , 24.01.2003 & 17.03.2003 on the subject.

2. The above referred proposal was considered by the Expert Committee for River Valley & Hydroelectric projects at its meeting held on 29.11.2002 & reconsidered on 16.01.2003. The project envisages to irrigate an additional area of 1.781 lakh hectares in the drought affected areas of Warangal , Khammam and Nalgonda Districts. No forest land is involved. There is no displacement involved in this project but in the category of Project Affected Persons (PAP's), the identified 784 persons would be given R & R benefit as per the Government of Andhra Pradesh - 'AP-III Irrigation Policy Guidelines. The total cost of project is Rs 534.05 crores (as per 1995-96 SSR)

3. The Ministry of Environment and Forests hereby accords environmental clearance as per the provision of Environmental Impact Assessment Notification-1994, subject to the strict compliance of the terms and conditions mentioned below –

पर्यावरण भवन, सी. जी. ओ. कॉम्पलेक्स, लोदी रोड, नई दिल्ली-110003
PARYAVARAN BHAVAN, C.G.O. COMPLEX, LODHI ROAD, NEW DELHI-110003

Part – A: Specific conditions

i) In the category of Project Affected Persons (PAPs), 784 persons should be given R & R benefits as per the 'AP-III Irrigation Policy Guidelines', Government of Andhra Pradesh and report submitted to this Ministry.

Part –B. General conditions

i) Provision of supplying kerosene or cooking gas / Pressure Cooker to the labourers should be kept instead of supplying fuel wood.

ii) Fuel depot may be opened at the site to provide the fuel (kerosene/wood /LPG). Medical facilities as well as recreational facilities should also be provided to the labourers.

iii) All the labourers to be engaged for construction works should be thoroughly examined by health personnel and adequately treated before issue the work permits.

iv) Restoration of construction area including dumping site of excavated materials at dam site & power house site should be ensured by leveling, filling up of borrow pits, landscaping etc. The area should be properly afforested with suitable plantation.

v) A multidisciplinary committee should be constituted with representatives from the disciplines of forestry, ecology, wildlife, soil conservation, NGO etc. to oversee the effective implementation of the suggested safeguard measures.

vi) Financial provision should be made in the total budget of the project for implementation of the above suggested safeguard measures.

vii) Six monthly monitoring reports should be submitted to the Ministry and its Regional Office, Bangalore for review.

4. Officials from Regional Office MOEF, Bangalore who would be monitoring the implementation of environmental safeguards should be given full cooperation, facilities and documents / data by the project proponents during their inspection.

5. The responsibility of implementation of environmental safeguards rests fully with the Irrigation Department, Govt. of Andhra Pradesh.

6. In case of change in the scope of the project, project would require a fresh appraisal.

7. The Ministry reserves the right to add additional safeguard measures subsequently if found , necessary and to take action including revoking of the clearance under the provisions of the environmental (Protection) Act, 1986, to ensure effective implementation of the suggested safeguard measures in a time- bound and satisfactory manner.

8. This clearance letter is valid for a period of five years from the date of issue of this letter for commencement of construction work.

9. A copy of the clearance letter will be marked to concerned Panchayat /local NGO, if any, from whom any suggestion/representation has been received while processing the proposal.

10. State Pollution Control Board / Committee should display a copy of the clearance letter at the regional office, district industries centre and collector's office / tehsildar's office for 30 days.

11. The project proponent should advertise at least in two local newspapers widely circulated in the region around the project ,one of which shall be in the vernacular language of the locality concerned informing that the project has been accorded environmental clearance and copies of clearance letters are available with the State Pollution Control Board/Committee and may also be seen at Website of the Ministry of Environment and Forests at http:// www.envfor.nic.in/.

(S. Shiva Kumar)
Director (IA)

Copy to: -

1. The Secretary, Ministry of Water Resources, Shram Shakti Bhawan, Rafi Marg, New Delhi - 110001.
2. Secretary, Department of Ecology & Environment, Govt. of Andhra Pradesh , Secretariat, Hyderabad.
3. Secretary, Department of Irrigation, Govt. of Andhra Pradesh, Secretariat, Hyderabad.
4. The Advisor (I&CAD) Planning Commission, Yojana Bhawan, New Delhi -110 001.
5. The Chief Engineer (PAD), Central Water Commission, Sewa Bhawan, R.K. Puram, New Delhi - 100062.
6. CCF, Regional Office, Ministry of Environment & Forests, Bangalore.
7. EI - Division, MOEF, New Delhi - 110001.
8. Guard file.

(S. Shiva Kumar)
Director (IA)

ANNEXURE-6

ANNEXURE – 6

Technical details of SRSP Stage – I Project

Table 1 Hydrology details of SRSP Stage - I project

Description	SRSP	LMD
Catchment Area at Dam Site	35,425 Sq.Miles (or) 91,750 Sq.Kms.	2,496 Sq.Miles (or) 6,465 Sq.Kms.
Flood Discharge (observed)	25,740 Cumecs	9,910 Cumecs
		(3.50 Lakhs c/s)
Designed Discharge	(45,300 Cumecs)	(14,158 Cumecs)
	16 Lakhs Cusecs	5.0 lakhs Cusecs

Table 2 Scope of SRSP Stage - I project

Sl. No.	Stages	Details
1	SRSP Stage I	The project is envisaged to irrigate an ayacut of 391994 ha covering four Districts viz, Nizamabad, Adilabad, Karimnagar and Warangal. Sriramasagar Project through Kakatiya canal, Laxmi canal and Saraswathi canal.
2	LMD	The Kakatiya canal at KM 146.000 is dropped in to Manair Reservoir and then it take off from the Lower Manair Dam. From Lower Manair Dam, the Kakatiya Canal travel up to Km 284.00(end of Stage -1) and KM 284.00 to km 346.00 (Stage –II) and have been constructed not only to irrigate the ayacut in the Districts of Karimnagar, Warangal, Nalgonda and Khammam but also to cater to the needs of drinking water to the people of Warangal and Karimnagar Municipal Corporations Especially during Summer Season.

Table 3 Benefitting District and Mandals of SRSP Stage - I project

District	Mandal	District	Mandal
Nizamabad	Balkonda	Warangal (Old)	Huzurabad
	Mortad		Venavanka
	Armoor		Kesavapatnam
	Kammarpalli		Jammikunta
Karimnagar	Ibrahimpatnam		Kamalapur
	Mallapur		Yelkaturti
	Metpalli		Hanamkonda
	Raikal		Hasanparthy
	Korutla		Atmakur(DBM-30,31,37&38)
	Kathlapur		Shayampet
	Medipalli		Parkal
	Jagtial		Mogullapalli
	Sarangapur		Kamalapur (KNR)
	Dharmapuri		Gesugonda
	Gollapalli		Regonda
	Medipalli		Chityal
	Peddapally		Bhupalpalli
	Velgatoor		Narsampet
	Dharmaram		Duggondi
	Julapalli		Nallabelli
	Ramagundam		Mulugu
	Peddapally		Ghanpur
	Kalvasrirampur		Venkatapur
	Mutharam		Narsampet
	Manthani		Chennaraopet
	Kamanpoor		Guduru
	Karimnagar		Nekkonda
	Choppadandi		Kesamudram
	Ramadugu		Sangem
	Eligaid		Nellikuduru
	Odela		Kesamudram
	Sultanabad		Mahaboobabad

District	Mandal	District	Mandal
	Thimmapur		Nekkonda
	Manakodur		Parvathagiri
	Veenavanka		Narsimulapet
	Shankarapatnam		Maripeda
	Jammikunta		Korvi
	Huzurabad		Dornakal
	-		Kharmman
	-		Wardhannapet

Table 4 Land acquisition details of SRSP Dam

Sl.No.	Purpose of acquisition	Extent of land acquired (ha)
1	Submergence	39600
2	Kakatiya Canal	605
3	Saraswathi Canal	615
4	Laxmi Canal	224
5	Silt arresting tanks	1544
	Total	42588

Table 5 R&R details of SRSP Dam

Sl.No.	Description	Adilabad	Nizamabad	Total
1	Fully submerged villages	22	16	38
2	Partially submerged villages	05	04	09
3	Back water affected villages	13	11	24
4	Only agricultural lands affected	16	14	30
	Total	**56**	**45**	**101**

Table 6 R&R details of LMD

Sl.No.	Description	Karimnagar
1	Fully submerged villages	12
2	Partially submerged villages	04
3	Only agricultural lands affected	14
	Total	**30**

Technical details of SRSP Stage – II Project

Table 7 Hydrology of SRSP Stage - II project

Required Discharge	95.00 Cumecs (3355 Cusecs)
Design Discharge	123.01 Cumecs (4344 Cusecs)
Bed Width	16.76 m
F.S.D.	4.34 m
F.B.	0.90 m
Side slopes	1.5:1 / 2:1
Bed fall	1 in 9500
Value of n	00:18.0
Velocity	1.216 m/sec
Top Width of Banks	7.750/4.00 m
CCA (Th. ha)	178.066
Annual Irrigation (Th. ha)	193.871
Intensity	109.00%

Scope of SRSP Stage - II project

1. Excavation and Lining of Kakatiya Main Canal from Km.284.00 to 346.00.
2. Excavation of 13 Nos. of Distributaries with minor's, sub-minors and field channels
3. Distributaries are DBM-54,55,56,57, 59,60,61,63,65,67,68,70,71& TE. The DBM-60, 69 & 71 are the Branch Canals.
4. Formation of Mylaram Balancing Reservoir.
5. Formation of Bayyanna Vagu Balancing Reservoir.

Table 8 Benefitting districts and mandals SRSP Stage - II project

Sl. No	District	Mandal
1	Warangal	Kodakandla
		Thorrur
		Maripeda
		Narsimhulapeta
		Wardhanapet
		Raiparthy
		Parvathagiri

2	Khammam	Thirumalayapalem
		Nelakondapally
		Mudigonda
		Kusumanchi
		Khammam (r)
3	Nalgonda	Thirumalagiri
		Thungathurthy
		Jagireddy gudem
		Noothanakallu
		Atmakur (s)
		Suryapet
		Chevumula
		Mothey
		Penpahad
		Nadigudem
		Munagala
		Garedepally

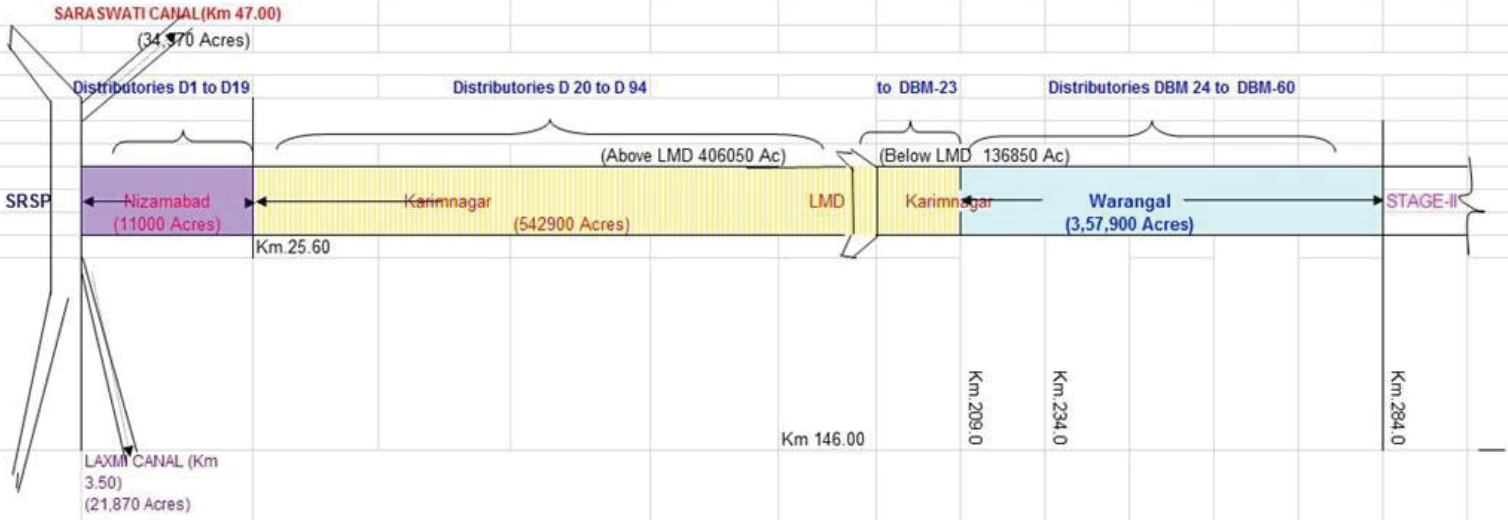
Table 9 Land acquisition details of SRSP Stage - Ⅱ project

Sl.No.	Description	Project target (ha).	Completed up to 07/2016 (ha)	Balance (Ac)
1	Land Acquisition	8340	7748	592

Table 10 R&R details of SRSP Stage - Ⅱ project

No. of affected villages	No. of PAPs	Progress on rehabilitation		Balance rehabilitation		Target date of completion
		Village	PAPs	Village	PAPs	
3	331	3	331	-	-	Work Completed

SCHEMATIC DIAGRAM OF SRIRAMASAGAR PROJECT STAGE-I



SALIENT FEATURES MAIN CANAL

Reach from To	Km (-) 0.370 to Km 68.00	Km 68.00 to Km 146.00	5.00 to Km	Km 191.00 to Km 246.00	Km 246.00 to Km 250.00
Canal Section(B X D)	37.80M x 4.72M	27.00M x 5.00M	27.00 M x	21.34 M x 5.00 M	17.98 M x 5.00 M
Discharge	9700 cusecs	8500 cusecs		6892 cusecs	5960 cusecs

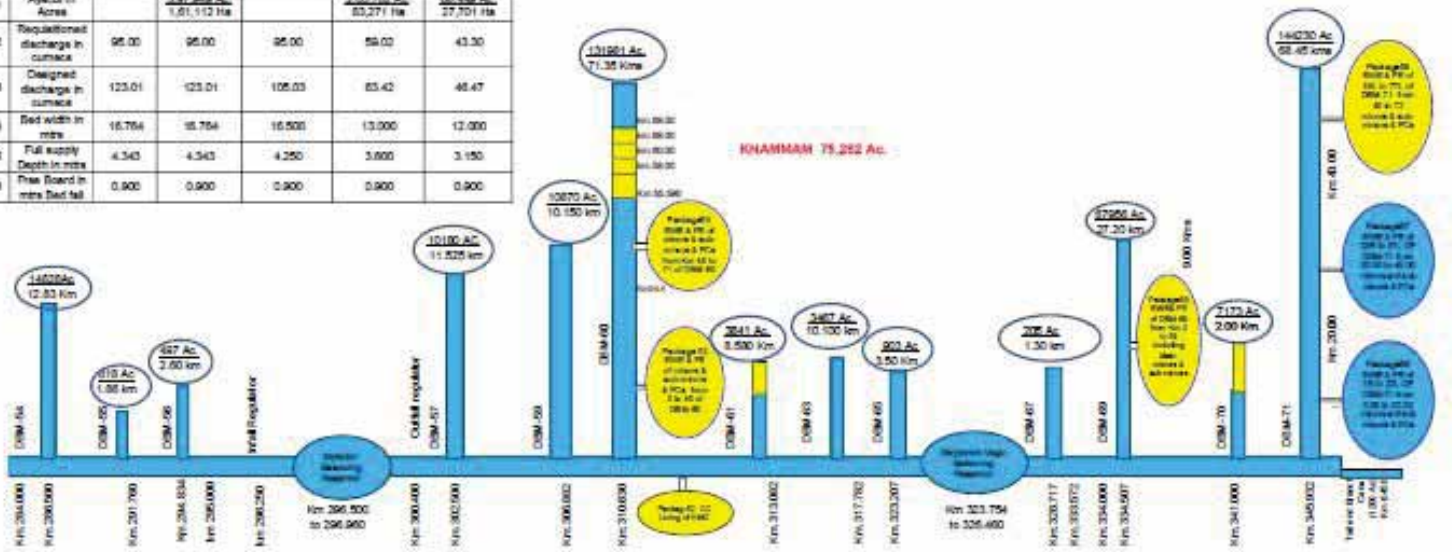
Km 250.00 to Km 284.00
16.76M x 4.34 M
4343 cusecs

Name of the Canal	NZB	ADB	KRMR	WGL	Total
Kakatiya	11000	-	542900	357900	911800
Saraswathi	-	34970	-	-	34970
Laxmi	21870	-	-	-	21870
Grand Total	32870	34970	542900	357900	9,68,640

LINE DIAGRAM SHOWING THE STATUS OF SRSP STAGE-II AS ON 04/2016

Kakatiya Main Canal From Km. 284.00 to 346.00

Sl No.	Particulars	H.P's at CR km 282.7 (SRSP-I)	Reach-I Km. 284 to 295	Reach-I Km. 295 to 310.630	Reach-II Km. 284 to 297	Reach-III Km. 284 to 296
			Normal Section	Normal Section	Normal Section	Normal Section
1	Ayacut in Acres		3,97,949 Ac. 1,61,112 Ha		2,06,782 Ac. 83,271 Ha	68,448 Ac. 27,701 Ha
2	Requisitioned discharge in cumecs	95.00	95.00	95.00	59.02	43.30
3	Designed discharge in cumecs	123.01	123.01	105.03	83.42	46.47
4	Bed width in mtrs	16.764	16.764	16.500	13.000	12.000
5	Full supply Depth in mtrs	4.343	4.343	4.250	3.600	3.150
6	Free Board in mtrs Bed fall	0.900	0.900	0.900	0.900	0.900



WARANGAL 1,38,512 Ac

NALGONDA 2,13,175 Ac

- Works completed
- Works under execution
- LA paid but Work not tackled
- LA to be paid
- Forest
- Bottlenecks/work not tackled

DISTRICT WISE AYACUT OF SRSP STAGE-II

Sl.NO	District	Ayacut in Acres	Length in Kms
1	Warangal (KMC)	138512	41.54
2	Khammam (DSM-60)	75262	26.362
3	Nalgonda (KMC)	213175	13.232
	Total	397949	81.43

ANNEXURE-7

ANNEXURE - 7

IWRS *Journal of Indian Water Resources Society, Vol 33, No. 3, July, 2013*

PERFORMANCE EVALUATION OF SRI RAM SAGAR IRRIGATION PROJECT

Chintalacheruvu Madhusudana Rao[1] and Ravindra Vitthal Kale[2]

ABSTRACT

In this study, the performance evaluation of Sri Ram Sagar Project (SRSP) has been carried out through the formulation of a tri-seasonal (kharif, rabi and summer seasons) linear programming model developed using 396 decision variables and 528 constraint equations using 44 years (1950-1993) of historical data. Based on the long term historical data, a suitable operating policy has been developed for the better performance of SRSP reservoir. The results reveal that the release combination (3, 6), i.e., three irrigation releases for kharif season and six irrigation releases for rabi season gives 33 years of satisfaction with 11 deficit years out of the 44 years, which is said to be well within the 75% dependability condition. Hence, it is a practicable case of optimal release combination. Further, no irrigation releases during summer season can be assured. Subsequently, the verification of water use efficiency of the reservoir has also been carried out using the selected performance indicators.

Key words: *Irrigation, Reservoir operation, Optimization, Performance indicators*

INTRODUCTION

In recent years, the utilization and management of water resources are of top priority, which makes it imperative to go for new projects and to improve the performance of the existing projects for the economic growth of the region. It is a well known fact that water quantity is a limited resource to undertake new irrigation projects in most of the regions in India. Nevertheless, improving the performance of the existing irrigation projects is more preferable to develop new irrigation projects which are sustainable and attractive for the region (Sener et al., 2007). Being faced with ill-timed and insufficient rainfall, agriculture in India is heavily dependent on irrigation. In India, irrigation sector uses nearly 85% of its available water resources (Oza, 2007). The water supply for irrigation is mostly drawn from the surface water reservoirs. The performance of irrigation systems supplying water from the reservoirs are characterized by water scarcity, heterogeneity in soils, crops, climate, and water distribution network and large number of users. Therefore, it is very difficult to meet the growing irrigation water demands when the water resources are limited. To overcome this difficulty, efficient management and operating policies has to be developed for the better performance of the irrigation systems.

The efficient management and operation of the reservoir system calls for complex engineering and mathematical techniques coupled with excellent managerial judgment. Linear Programming (LP) is one of the most popular optimization technique used in water resources systems planning to optimize a set of objectives (Vedula and Kumar, 1996; Vedula and Mujumdar, 2005; Long, 2006). The Linear Programming technique has advantages over other optimization models as it is easy to understand and does not require any initial solution.

Many researchers used the linear programming technique for water resources planning and operation of reservoir systems. Loucks et al. (1981) proposed conceptual procedures of LP technique on reservoir operation, and, subsequently, Chaturvedi (1987) reinstated the conceptual procedures of LP technique on reservoir problems. Yeh (1985) provided a state-of-the-art review of LP technique for reservoir management and operations. Tandaveswara et al. (1992) illustrated a LP model for overdeveloped irrigation system in South India. Pillai et al. (1992) also developed a multi-objective optimization procedure for water resources systems. Mohan and Diwakar (1992) developed a linear multi objective programming model using constraint technique to derive the optimal releases from large-scale multi reservoir system. Lakshminarayana and Rajagopalan (1997) used linear Programming model for maximizing the irrigation benefits for the Bari Doab Basin in North India. Mujumdar and Teegavarapu (1998) developed a deterministic LP model for short-term annual operation of an irrigation reservoir. Duranyildiz et al. (1999) developed a chance-constrained LP model, which accounts for the random nature of inflows to optimize the monthly operation of a real reservoir. Raju and Kumar (1999) developed a multi-criterion decision making based optimization model in irrigation planning. Further, Raju and Kumar (2000) proposed the optimum cropping pattern for Sri Ram Sagar Project (SRSP) using linear programming approach. Raju and Kumar (2004) developed a model for irrigation planning and irrigation scheduling and found that the Genetic Algorithm (GA) and linear programming solution having reasonably same performance. Furthermore, Kumar et al. (2006) presented a GA model for obtaining an optimal operating policy and optimal crop water allocations for the Malaprabha single-purpose irrigation reservoir in Karnataka State of India and again concluded that the optimal operating policy obtained using GA is similar to that of the linear programming. Sener et al. (2007) evaluated the performance of the Hayrabolu irrigation scheme of the Thrace district in Turkey using different comparative indicators. Recently, Pant et al. (2010) developed an optimization model based on linear programming for determining the optimal crop plan for the command area of Pamba-Achankovil-Vaippar (PAV) link project in Kerala state of India.

Comprehensive studies of the earlier research works emphasize on the improvement of the existing projects for the economic growth of the region. The new projects are not encouraged due to limited resource constraint. Therefore, in order to improve the performance of the existing system, the

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present study has been carried out for the Sri Ram Sagar Project (SRSP) to evaluate its performance through the linear programming approach using 44 years of historical data (1950-1993) as this project is facing water scarcity during non-monsoon period. The water use efficiency of the reservoir is also tested using the selected performance indicators. Although, some of the past research work mostly emphasizes the irrigation planning of the SRSP integrating the reservoir operation and canal scheduling, the present study differs from them in terms of the use of comparative indicators while assessing the performance of the system.

THE STUDY AREA

The Sri Ram Sagar Project (SRSP), formerly known as the Pochampadu irrigation project has been built on Godavari River is one of the major peninsular rivers in southern India. This irrigation project is located at Pochampadu village (18 58^o N latitude and 70 20^o E longitudes) in Nizamabad district of Andhra Pradesh (AP) state of southern India. This project has been built to utilize Godavari river water for irrigation and drinking purposes in Telangana regions of Andhra Pradesh state. The regions such as Nizamabad, Adilabad, Krimnagar, and Warangal districts of Andhra Pradesh state are covered under this project. The SRSP dam comprises of concrete spillway sections with 42 gates with flanked non-overflow masonry and earthen embankment structures on either sides. The reservoir has a water spread area of about 435 Million square meters (Msqm) at the Full Reservoir Level (FRL) equal to 332.54 m. The gross storage capacity of the reservoir is about 3172 Million cubic meters (Mcum). As a result of sedimentation, the live storage capacity reduced to 2166.10 Mcum. The Minimum Draw Down Level (MDDL) storage capacity of the reservoir is about 10.10 Mcum. A flood flow canal has been built to utilize flood water and this water is stored in the Lower Manair Reservoir (LMR) which is situated at a chainage of 146 km from the SRSP. The LMR has a net storage capacity of about 310.00 Mcum at the FRL equal to 318.00 m.

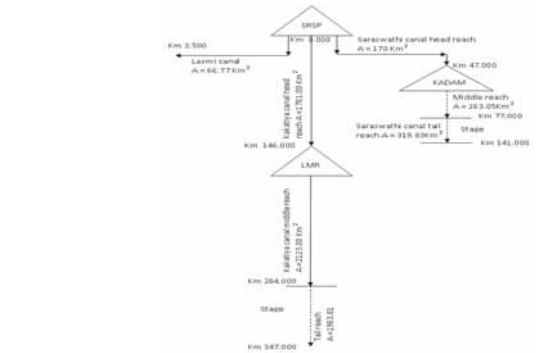
Figure 1 demonstrates the schematic diagram of SRSP. This project has three canals viz., Saraswathi, Lakshmi and Kakatiya canals (see, Figure 1). The first, Saraswathi canal takes off from the left flank of SRSP reservoir and run up to a chainage of 141 km, and in between at a chainage of 47 km, the Kadam reservoir is situated. This canal irrigates an area of about 752.88 km^2 which covers the command area before and after the Kadam reservoir (i.e., stage-I and stage-II of the project). The second, Lakshmi canal takes off from the right flank of SRSP having a length of 3.5 km with a command area of about 66.77 km^2. The third, Kakatiya canal, a major canal running up to a chainage of 347 km has three reaches, such as Reach-I (upper reach), Reach-II (middle reach) and Reach III (tail reach). The Reach-I and Reach-II comes under stage-I, and the Reach III alone comes under stage-II of the project. The upper reach takes off from the right flank of the SRSP and terminates in LMR at a chainage of 146 km. The middle reach runs below LMR up to a chainage of 284 km where the stage-I of the project ends. The tail reach runs up to the end of the stage-II of the project and gets terminated at a chainage of 347 km. The total command area of the Kakatiya canal alone about 5887.81 km^2. Further, when all the three canals are considered, the total command area of the whole project becomes about 6707.46 km^2 (which covers the area under Stage I and II of the project).

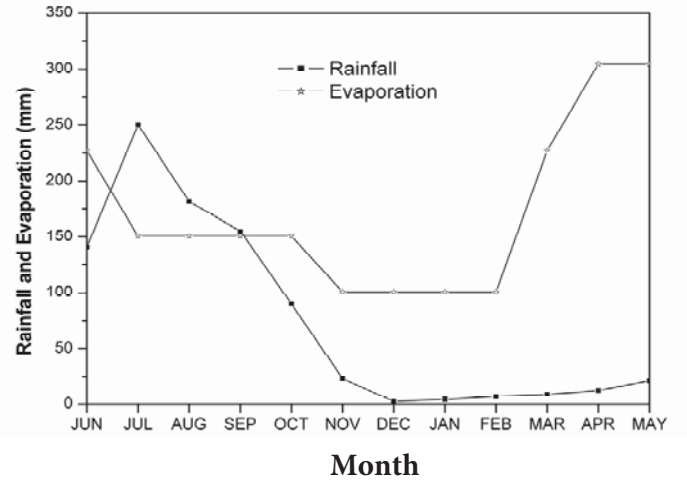
The climatic condition of the command area is subtropical and semi-arid. The average annual rainfall in the command area is around 1000 mm. Because of the influence of the South-West monsoon, *kharif* season (June-September) receives about 80-85% annual rainfall. Deep sandy loam and deep clay loam soils are pre-dominant in the command area. The depth of the sandy

loam soil is about 450-900 mm with a volumetric water holding capacity of 7-8%, whereas, the depth of deep clay loam soil is about 1000-1800 mm with a volumetric water holding capacity of 14-20%. Further, there are a large number of marginal small farmers in the command area. About 60% of farmers hold less than 0.01 km^2 of land, about 20% hold 0.01-0.02 km^2 and 10% hold 0.02- 0.04 km^2. The average size of land holding is about 0.01-0.02 km^2. The main crops grown in command area preferred by the farmers are paddy (rice), sugarcane, maize and groundnut almost in equal proportion followed by pulses, cotton and other crops.

MODEL DEVELOPMENT

Figure 2 reveals the mean monthly rainfall and evaporation details of the SRSP reservoir for a period of 44 years (1950-





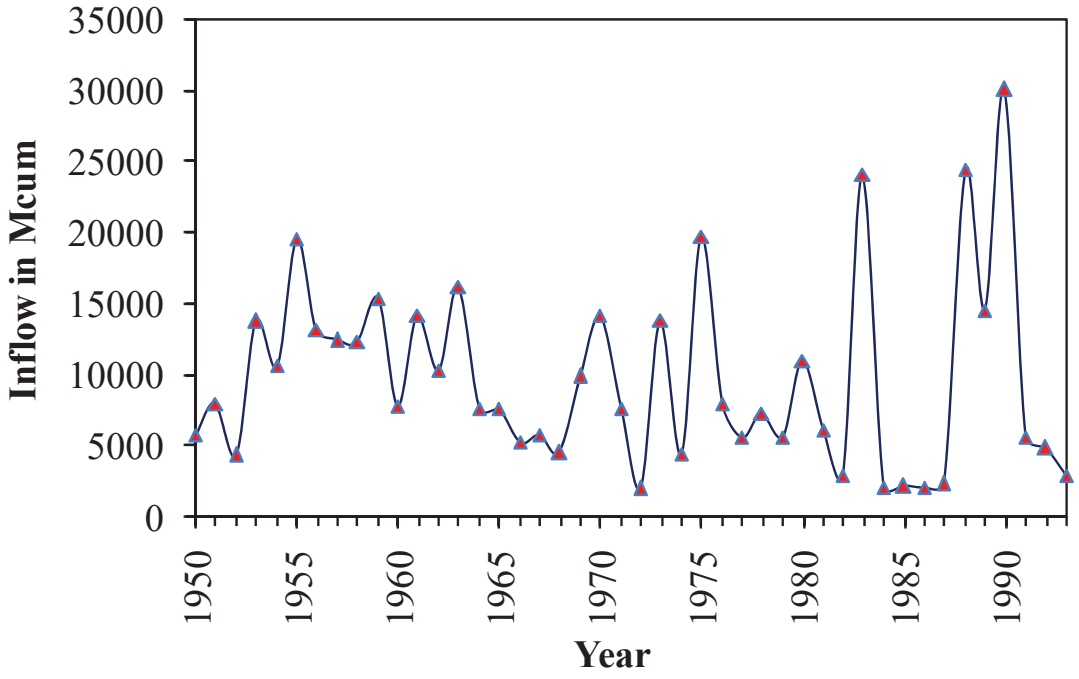


Fig. 3. Annual Inflows into the SRSP reservoir during 1950-1993

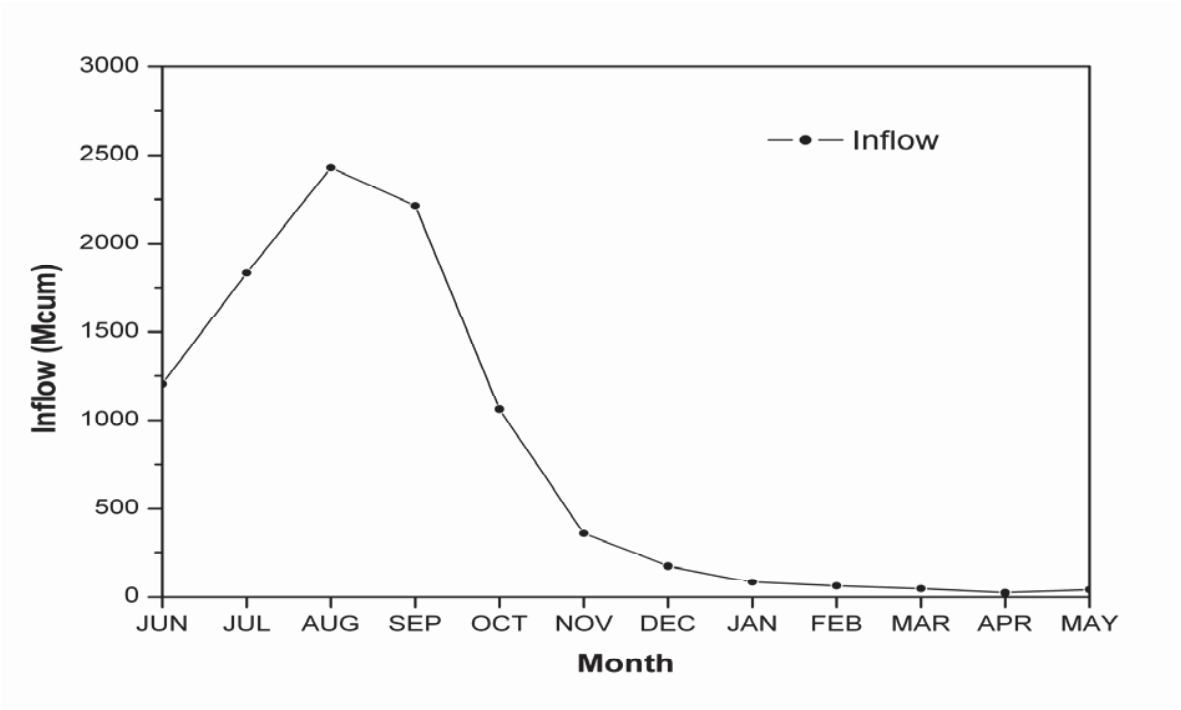


Fig. 4. Mean monthly inflows in to SRSP reservoir during 1950-1993

1993). Figure 3 shows the annual inflows in to the SRSP reservoir for a period of 44 years (1950-1993), while Figure 4 reflects the mean monthly inflows in to the SRSP reservoir for the same period. It is seen from Figure 2 that, the *kharif* (June-September) season receives more rainfall than *rabi* (October-January) season due to the influence of monsoon. It is also evident from Figure 4 that, *kharif* season receives very high inflows due to the influence of South-West monsoon, whereas the *rabi* season receives less inflows due to the lean season. The inflow in to the SRSP reservoir with 75% dependability is about 4473.53 Mcum which is observed in the year 1968. The minimum (1985.30 Mcum) and the maximum (30047.17 Mcum)

inflows were also observed in the years 1972 and 1990, respectively. Further, in many places of the southern parts of India, *kharif* season (June-September) crops are supplemented by rainfall over *rabi* season (October-January) crops. The *rabi* crops are frequently affected by droughts and monsoon failures in this region. Therefore, it is imperative to assure *rabi* irrigation over *kharif* irrigation. Considering the importance of *rabi* irrigation, a suitable methodology has been proposed herein for assessing the performance of the SRSP reservoir.

In the present methodology, the water year starts from 1st June and ends on 31st May of the ensuring year. A tri-seasonal time step is followed to formulate the model. The water year is divided into three seasons namely *kharif* (June-September), *rabi* (October-January) and summer (February-May). A Linear programming (LP) model is formulated to estimate the number of optimal irrigation releases from the SRSP that can be supplied for both the *kharif* and *rabi* seasons. However, for the summer season, it is assumed zero release for irrigation. The command area under all the three canals of the SRSP reservoir is lumped together; consequently, the total command area of the project becomes about 6707.46 km^2 (see, Figure 1). The net irrigation demand has been calculated using CROPWAT software by considering the major cropping practices in the command area and this net irrigation demand is about 402.08 Mcum per week. The National Thermal Power Corporation (NTPC) power demand is about 6.58 Mcum per week. The SRSP system is also expected to meet the drinking water needs on a priority basis over irrigation, and its drinking water demand is about 155.74 Mcum per year. The releases for drinking water and power supply are made concurrently with the irrigation releases from SRSP reservoir. Further, the conveyance efficiency is assumed as 85%. Since the model is developed for seasonal time step, all the monthly data of inflows, irrigation demands, drinking water demands, and evaporation losses are converted to a seasonal data and supplied as an input to the model. The developed model primarily computes the season wise optimal releases from the reservoir. The model also estimates the end storages of the reservoir. The releases are to be planned according to the water availability status in the reservoir at the beginning of each season. Further, the number of farm holders being very large and more than 4 or 5 crops sown in each season, it is not quite possible to plan delivery of water to farmers on the basis of crop water demand. Even in each Water Users Association (WUA), there would be about 250-500 farmers growing different crops. The water demand therefore has necessarily to be averaged out and water deliveries have to be planned on the basis of water availability status. Thus farmers are not eligible to demand water on the basis of crop water requirement. On the basis of equity, the quantity of water to be released for irrigation will be fixed. No partial release will be made. This assumption should be used as a guideline in scheduling the irrigation releases from the reservoir. Therefore, in this context, an attempt has been made to maximize the irrigation releases from the SRSP reservoir through optimality procedure by fixing the six releases for *rabi* season, which are assumed sufficient to meet the *rabi* season demands. Further, the number of releases required for the *kharif* season is estimated by increasing its release count until the system gains the optimality status without affecting the fixed *rabi* seeason release.

Formulation

The performance evaluation of the SRSP is done through the formulation of a tri-seasonal (*kharif*, rabi and summer seasons. Linear programming model with 396 decision variables and 528 constraint equations using 44 years (1950-1993) of historical data. It is assumed that all the relations among the decision variables are linear and certain both, in constraints as well as in objective function. The objective function is to maximize the irrigation releases for both the *kharif* and *rabi* seasons. Note that, the irrigation releases for summer season are assumed to be zero. The following equations (1) to (13) are formulated to optimize the SRSP reservoir system.

Objective function: Maximize, $Z = \sum_{t=1}^{N} IR_t$ (1)

where, IR_t = irrigation release for the season t; and
N = number of time periods in a water year (N = 3 seasons)

Constraints:

(i) Continuity constraints

$$S_{k+1} = S_k + I_k - IR_k - SP_k - E_k - DW_k \quad (2)$$

$$S_{r+1} = S_{k+1} + I_r - IR_r - SP_r - E_r - DW_r \quad (3)$$

$$S_{s+1} = S_{r+1} + I_s - IR_s - SP_s - E_s - DW_s \quad (4)$$

(ii) Irrigation release constraints

$$IR_k \le \eta ID_k \quad (5)$$

$$IR_r \le \eta ID_r \quad (6)$$

$$IR_s = 0 \quad (7)$$

(iii) Storage capacity constraints

$$S_{k+1} \ge S_{\min} \quad (8)$$

$$S_{r+1} \ge S_{\min} \quad (9)$$

$$S_{s+1} \ge S_{\min} \quad (10)$$

$$S_{k+1} \le S_{\max} \quad (11)$$

$$S_{r+1} \le S_{\max} \quad (12)$$

$$S_{s+1} \le S_{\max} \quad (13)$$

Where, the suffixes k, r, and s in all the above equations indicate *kharif*, *rabi* and summer seasons. The notations such as S, I, IR, SP, E, ID and DW indicate storage, inflow, irrigation release, spill, evaporation, irrigation demand, and drinking water releases, respectively, corresponding to their seasons. S_t is the beginning storage and S_{t+1} is the end storage of the season t. S_{min} and S_{max} are the minimum and maximum storage capacity limitations of the reservoir. Further, the

symbol η indicates the conveyance losses considered for analysis. The developed model is solved using simplex algorithm. The model effectively computes the optimal irrigation release combinations from the reservoir for both the *kharif* and *rabi* seasons. Further, water balance study is also carried out for the computed optimal irrigation release combination from which the end storages of the reservoir can be computed.

WATER USE PERFORMANCE INDICATORS

Many researchers (Bos and Nugteren, 1974; Levine, 1982; Pery, C.J., 1996; Molden et al., 1998; Sener et al., 2007) have used various performance indicators such as economic performance, water use performance, agricultural performance and environmental performance on diversified schemes like irrigation and drainage management, agricultural production, economic management, water-use management, physical and environmental management etc. In the present study, the two types of performance indicators such as relative irrigation supply (RIS) and water self-sufficiency (WSS) are used to assess the water use efficiency of the SRSP reservoir. Relative irrigation supply (RIS) is the ratio of total irrigation supply to the total irrigation demand, whereas the water self-sufficiency (WSS) is the ratio between the total input into the reservoir and total output from the reservoir. For this purpose, the LP model result (i.e., the suggested optimal release combination only) is used to get the water balance estimates for 44 years of historical inflows. Then the cumulative values of water balance estimates are used for the application of performance indicators. Earlier, no such investigation has been made on this particular study area. Therefore, this kind of study certainly develops a new strategy and new adjustment for long-term goals under determined system performance.

RESULTS AND DISCUSSION

In order to assess the performance of the SRSP reservoir, six types of trial release combinations such as (1, 6), (2, 6), (3, 6), (4, 6), (5, 6) and (6, 6) are attempted to fix the number of optimal releases to be supplied from the reservoir for both *kharif* and *rabi* seasons. Note that, from the parenthesis, the first number corresponds to the number of irrigation releases to be made for the *kharif* season, and the second number corresponds to the number of irrigation releases to be made for the *rabi* season. In all the above proposed trial release combinations, the *rabi* season irrigation releases are fixed (i.e., six number of irrigation releases) and they are assumed to be adequate to meet *rabi* irrigation demands. Further, the *kharif* season irrigation releases are incremented without affecting the *rabi* release, *viz.,* (1, 6), (2, 6), (3, 6), (4, 6), (5, 6) and (6, 6) from which one best optimal release combination is to be computed. Furthermore, the obtained LP results are analyzed

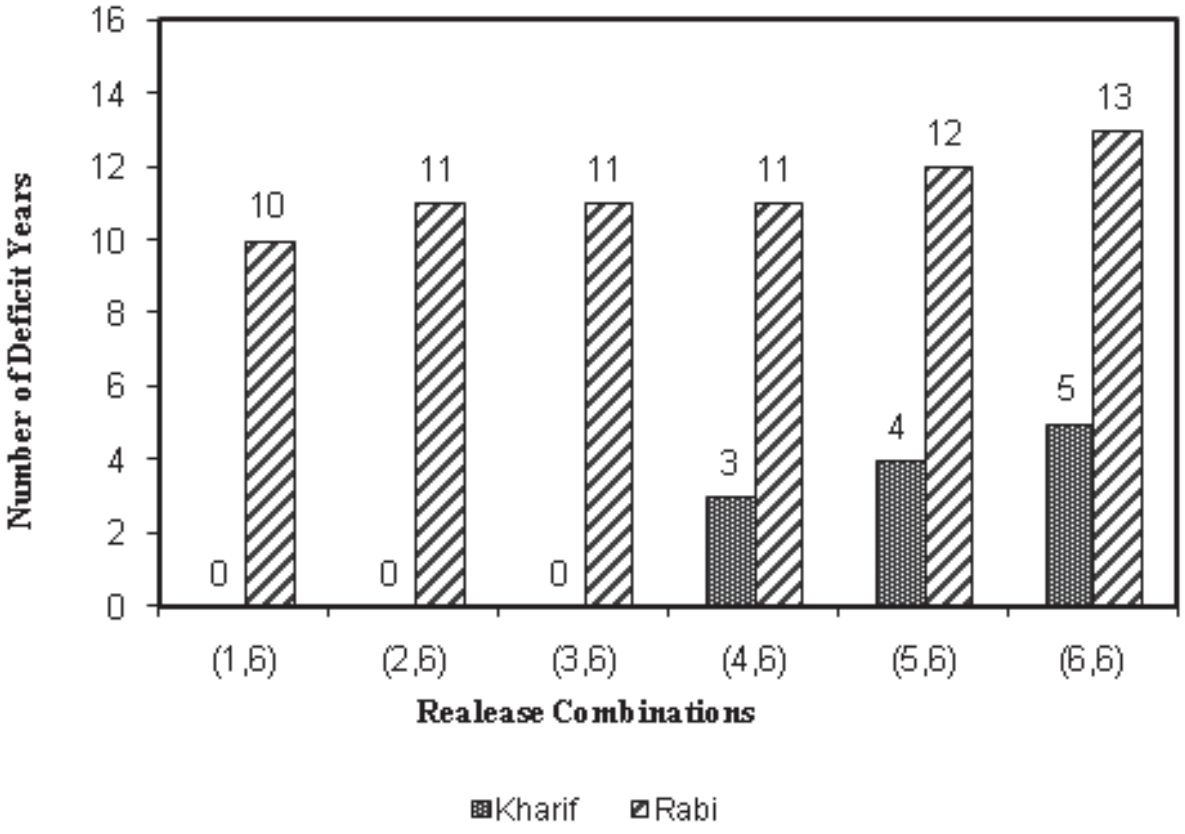


Fig. 5. Total number of deficit years with reference to the season-wise release combinations

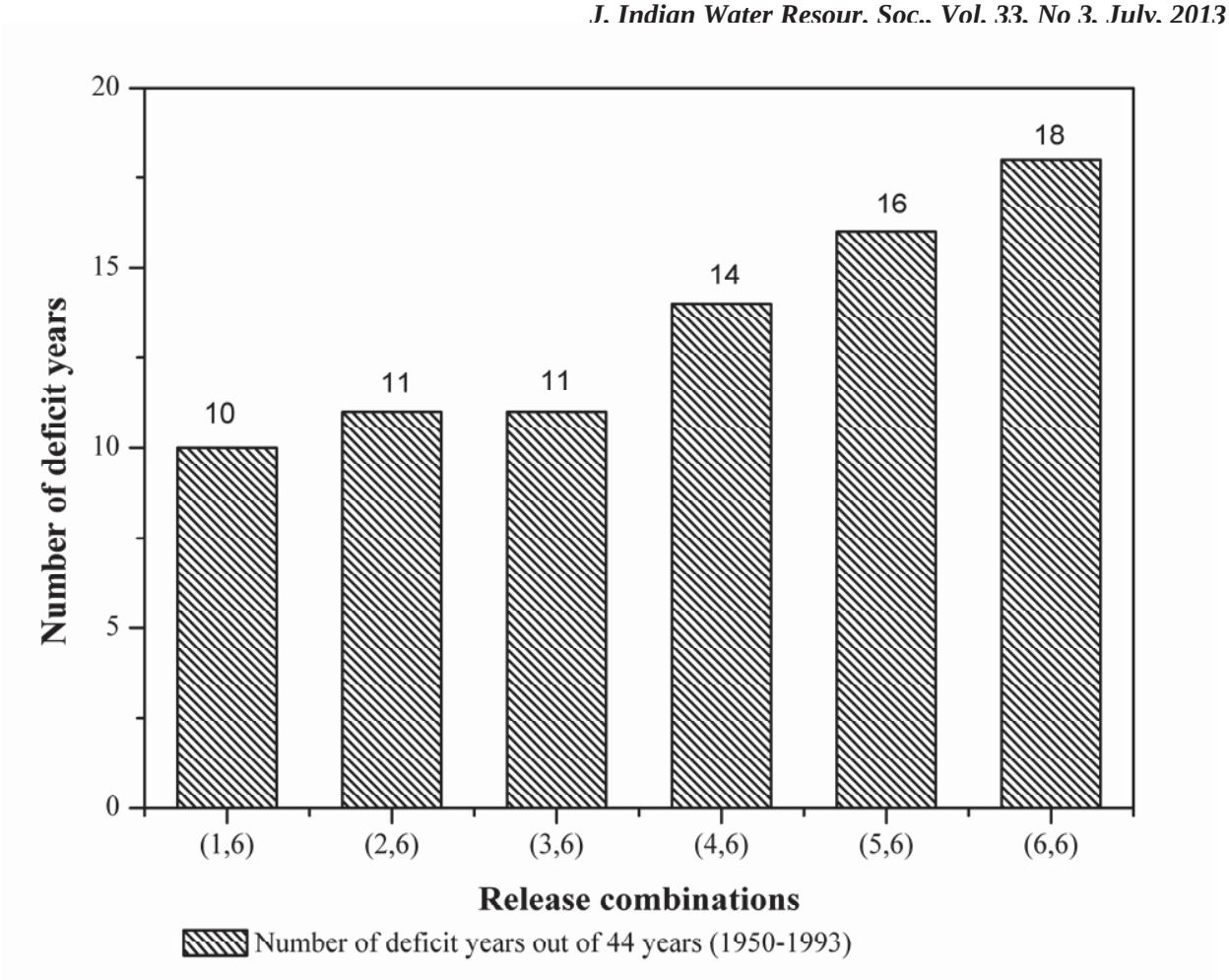


Fig. 6. Release combination-wise total number of deficit years observed during 1950-1993

and presented herein. Figure 5 shows the number of deficit years with reference to the season-wise release combination for a period of 44 years (1950-1993). Figure 6 demonstrates the release combination-wise total number of deficit years observed for a period of 44 years (1950-1993). Figure 7 reveals the total number of years of satisfaction and deficit obtained for the release combination (3, 6). Figure 8 illustrates the year wise beginning storages in the reservoir for a given period of 44 years (1950-1993). Figure 9 demonstrates the annual evaporation losses from the SRSP reservoir for a period of 44 years (1950-1993). Further, Table 1 shows the summary of season-wise pertinent characteristics of various release combinations attempted for optimizing the SRSP reservoir. Table 2 demonstrates the estimated water balance of the SRSP reservoir for a period of 44 years (1950-1993). The failure of the release combination is determined based on the number of deficit years and the cumulative spill calculated for a period of 44 years.

For the release combination (1, 6), *rabi* releases failed in 10 years out of 44 years, however, the *kharif* releases remain unaffected (see Figure 5). It can also be inferred from Table 1 that the water is excessively spilling from the reservoir, *viz.*, cumulative spill is estimated about 276735.04 Mcum and the total deficit is about 5958.30 Mcum for the total duration of 44 years. Optimality cannot be gained when the reservoir is surplus and spilling excessively. Hence, the trial releases combination (1, 6) is not a feasible solution for optimality condition.

For the release combination (2, 6), *rabi* season gets affected by 11 years out of 44 years and *kharif* season remain unaffected. It shows that, *rabi* irrigation releases are well within the 75% dependable limits (i.e., 33 satisfactions out of 44 years). It is again realized from Table 1 that, the estimated total deficit and cumulative spill for this trial release combination (2, 6) was 7929.65 Mcum and 259987.63 Mcum, respectively. When compared with the release combination (1, 6), the release combination (2, 6) shows a considerable reduction in the cumulative spill to an amount of 16747.41 Mcum. However, still, the attainment of optimality cannot be attributed to the release combination (2, 6) until its next release combination (3, 6) is verified. Note that, for this (2, 6) release combination, the deficit value is about 7929.65 Mcum (see Table 1).

For the (3, 6) release combination (i.e., 3 irrigation releases for *kharif* season and 6 irrigation releases for *rabi* season), *rabi* season shows 11 deficit years and *kharif* season shows 33 years of satisfaction out of 44 years (See Figures 5 and 6). Similar to the (2, 6) release combination, the (3, 6) release combination has also been observed well within the 75% dependable limit (i.e., 33 satisfactions out of 44 years), but gains one extra release for *kharif* season compared to that of

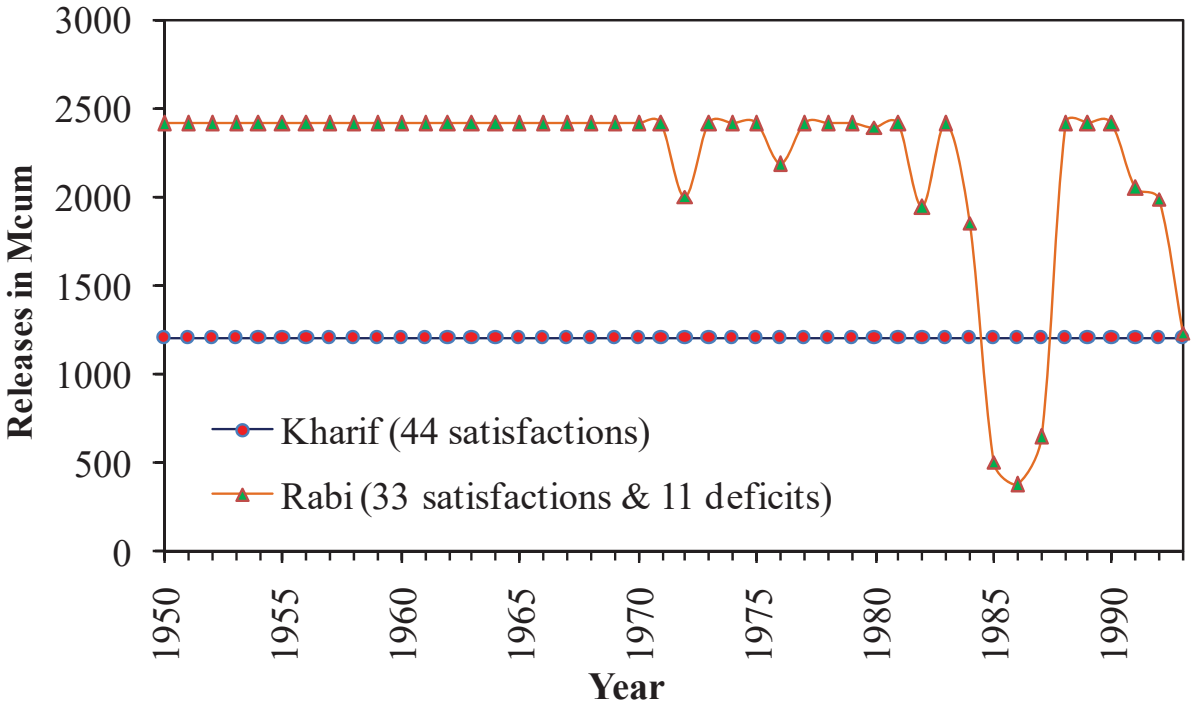


Fig. 7. Total number of years of satisfaction and deficit obtained for (3, 6) release combination

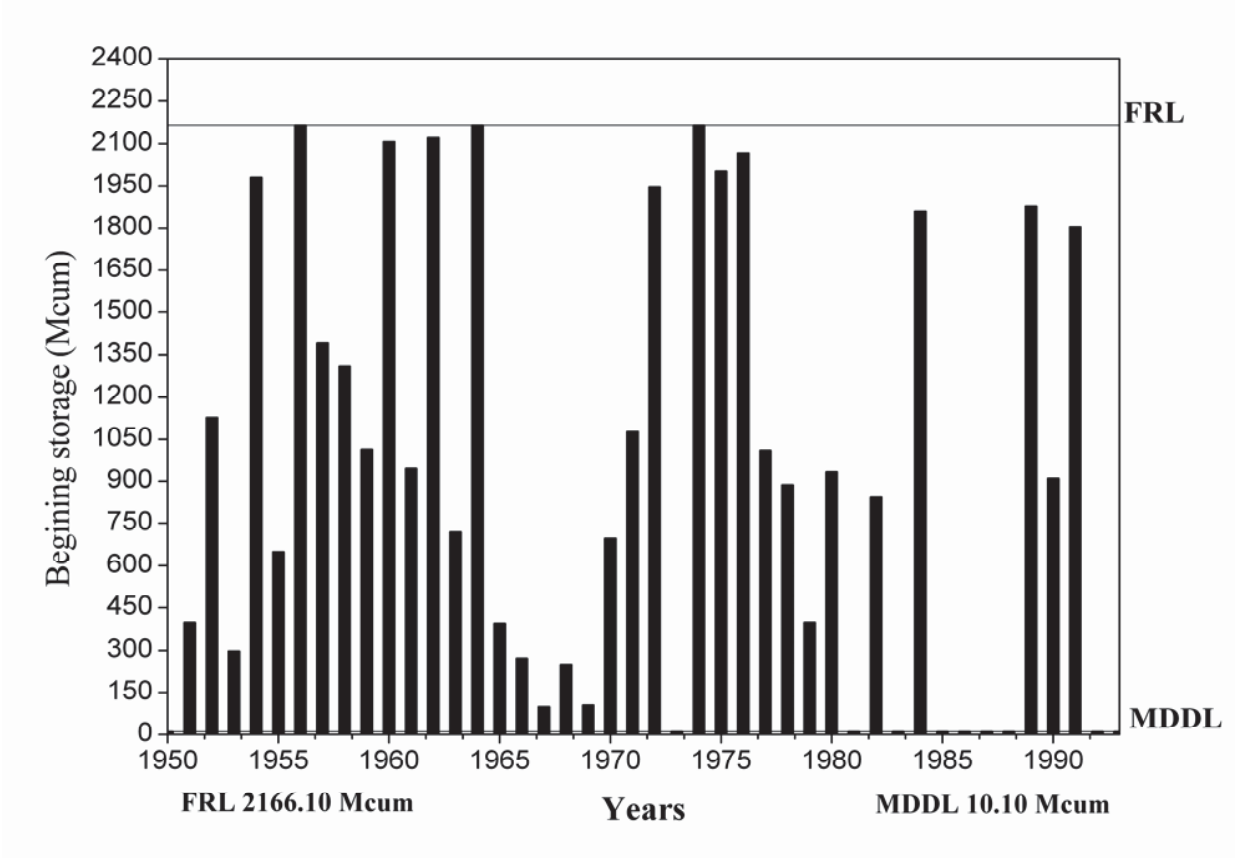


Fig. 8. Year-wise beginning storages in the SRSP reservoir

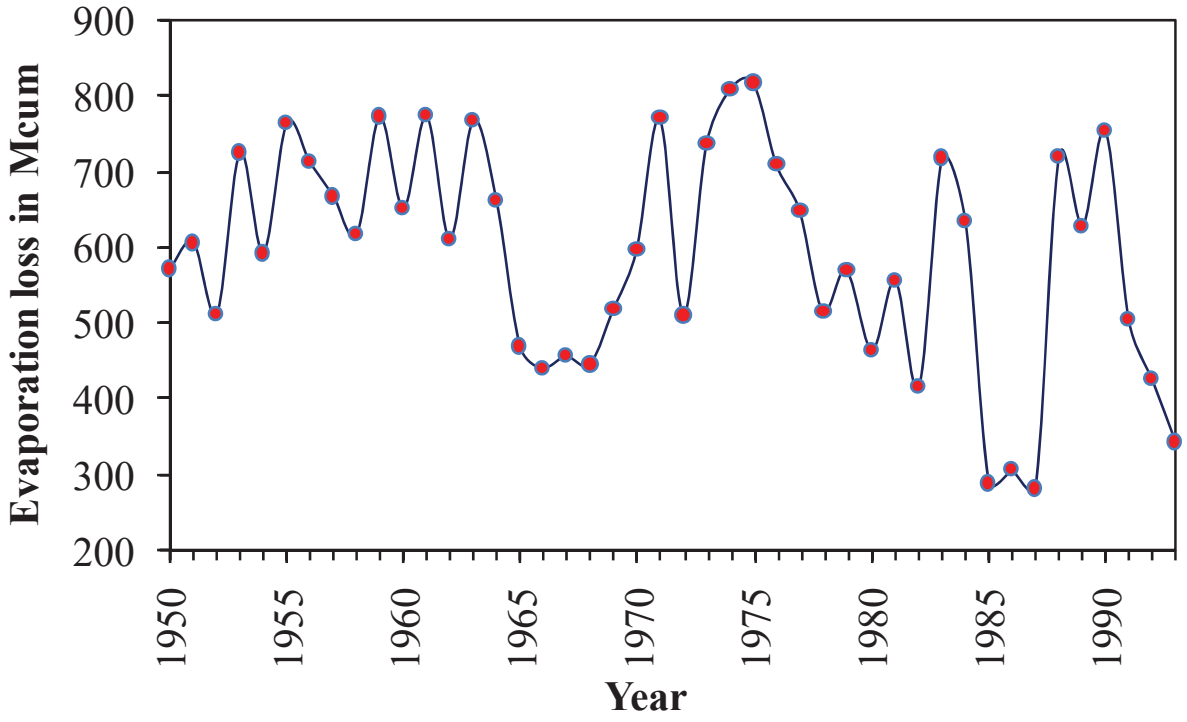


Fig. 9. Annual evaporation losses from the SRSP reservoir

Table 1. Summary of season-wise pertinent characteristics of various release combinations (All values are in Mcum)

Sl. No.	Release combination	Deficit			No. of years of deficit		Total deficit	Cumulative spill for all the years
		Maximum	Minimum	Average	*Kharif*	*Rabi*		
1	(1,6)	1287.12	22.87	595.83	0	10	5958.30	276735.04
2	(2,6)	1661.41	22.87	720.87	0	11	7929.65	259987.63
3	(3,6)	2035.65	22.87	852.28	0	11	9375.11	235692.31
4	(4,6)	2159.75	22.87	895.29	3	11	12534.06	226159.45
5	(5,6)	2412.50	22.87	986.39	4	12	15872.26	216537.73
6	(6,6)	2412.50	5.49	1069.91	5	13	19258.54	202881.70

Table 2. Estimated cumulative water balance of the SRSP reservoir during 1950-1993 (All values are in Mcum)

Water Balance for 44 years	Begenning Storage	Inflow	Evaporation Loss	Release for Irrigation		Drinkingwater Release	Deficit	Spill	End Storege
				Kharif	Rabi				
Cumulative	41246.22	426286.69	26049.61	53072.80	96775.17	6852.56	9374.87	245692.15	39090.62
Mean	937.41	9688.33	592.04	1206.20	2199.44	155.74	213.07	5583.91	888.42

the earlier (2, 6) release combination. The cumulative spill reduces further to an amount of 24295.32 Mcum with slight increase in deficit value of 9375.11Mcum (see Table1). The drinking water demand is about 155.74 Mcum which is met in full for all the 44 years. Further, a total maximum deficit of 2035.65 Mcum and a minimum deficit of 22.87 Mcum were also observed (see Table 1) from this trail run. Therefore, in order to gain the efficient performance of the SRSP reservoir, the computed (3, 6) release combination may be the practical optimal solution. However, the subsequent release combinations such as (4, 6), (5, 6) and (6, 6) failed to give irrigation releases within the 75% dependable limits (see Table 1). Further, it is again evident from Figure 5 and 6 revealing the release combinations (4, 6), (5, 6) and (6, 6) that the *kharif* season is affected by 3, 4 and 5 years, and the *rabi* season is affected by 11, 12 and 13 years, respectively. Hence, all these three release combinations such as (4, 6), (5, 6) and (6, 6), can be treated as infeasible solutions.

After computing the optimal release combination from the LP model developed for SRSP, the annual water balance study has also been carried out for the same (3, 6) optimal release combination and the estimated season beginning storages are shown in Figure 8. The estimated cumulative and mean values of all the pertinent characteristics assessed for the water balance study for a period of 44 years (1950-1993) is summarized and shown in Table 2.

For the release combination (3, 6), the net irrigation demand for *kharif* season comes about 1206.24 Mcum when calculated using per week demand equal to 402.08 Mcum and its cumulative demand for total period of 44 years becomes to be 53072.80 Mcum. Similarly, when analyzed for *rabi* season the net demand is estimated as 2412.50 Mcum and its cumulative demand for the same 44 years is estimated as 106150.00 Mcum. From Table 2, it is realized that, the cumulative *kharif* season demands are met full for the total period of 44 years as there were no failure of *kharif* releases. However, the cumulative *rabi* season demands met only at a quantity of 96775.17 Mcum with a cumulative deficit of 9374.87 Mcum as there were 11 failures noticed. From Table 2, it can be found that the mean evaporation losses, spill and the deficit are 592.04 Mcum, 5583.91 Mcum and 213.07 Mcum, respectively. The annul evaporation losses from the SRSP reservoir for the (3, 6) release combination is also illustrated in Figure 9.

Water Use Performance

The selected comparative indicators are used to assess the water use performance of the SRSP. For this purpose, the LP model result (i.e., (3, 6) optimal release combination) has been used to estimate the annual water balances for the total period considered for analysis. Two types of selected indicators, relative irrigation supply (RIS) and water self-sufficiency (WSS) were used to assess the performance of the SRSP. The RIS value indicates whether there is an adequate supply done or not to meet the demand of water. A RIS values of one or higher indicates adequate while the values smaller than one indicate inadequate supply of irrigation.

Using the cumulative values from Table 2, it is calculated that, for *kharif* season, RIS = 1.0 value which shows the adequate supply of water; whereas, for the *rabi* season, RIS = 0.91 value comes to 0.91which shows slightly inadequate supply of water from the reservoir. Further, the RIS value obtained for the *rabi* season is allowed well within the 75% dependable release limit (i.e., 33 years of satisfaction and 11 deficit years out of 44 years). Therefore, slight inadequacy does not affect the performance of the SRSP reservoir much in a long-term. However, the RIS value of the *rabi* season can be improved by reducing the deficiency of supply by minimizing the spill. The minimization of spill is not included in the objective function for the present study as it is beyond the scope of this work.

Further, the value of WSS is calculated by taking the ratio between all the cumulative inputs in to the reservoir (i.e., inflows, beginning and end storages), to the cumulative outflows (i.e., evaporation losses, *kharif* releases, *rabi* releases, drinking water and spill) to the reservoir. The water self-sufficiency WSS for all the 44 years is estimated as 118.25%, indicating that the SRSP reservoir is self-sufficient, and not in need of any other alternate water sources when the release combination (3, 6) is adapted. Hence, the suggested optimal release combination (3, 6) is a practicable case of optimal release combination for achieving the efficient performance of the SRSP reservoir. Any variation in the RIS and WSS values will affect the optimal release combination (3, 6) and may not generate the same performance.

CONCLUSION

In light of the above study carried out to evaluate the performance of the SRSP reservoir by formulating a tri-seasonal optimization model using 44 years (1950-1993) of historical data, the following conclusions can be drawn:

The drinking water supply demands have been met in all the 44 years.

The release combination (3, 6), i.e., three irrigation releases for the *kharif* season and six irrigation releases for the *rabi* season gives 33 years of satisfaction with 11 deficit years out of the 44 years, which is said to be well within the 75% dependability condition. Hence, it is a practicable case of optimal release combination. No irrigation release is assured during the summer season.

As the developed optimization model accounts for the whole command area of 6707.46 km^2 for simulation, further extension of area is not recommended.

Rabi crop is planned depending on the water availability status at each end of the *kharif* season.

The National Thermal Power Corporation (NTPC) power demands are also met simultaneously with the irrigation releases.

The computed optimal release combination (3, 6) obtained from the LP model is again verified by the selected comparative indicators. For this purpose, the annual water balance study is also performed and their cumulative values are estimated for a period of 44 years. The relative irrigation supply with RIS = 1.00 for the *kharif* season indicates adequate supply of water and a value of RIS = 0.91 for the *rabi* season indicating slightly inadequate supply of water from the reservoir. Further, the water self-sufficiency value with WSS =

118.25% indicates that the SRSP reservoir is self-sufficient which does not need any other source of supply when (3, 6) release pattern is adopted**.**

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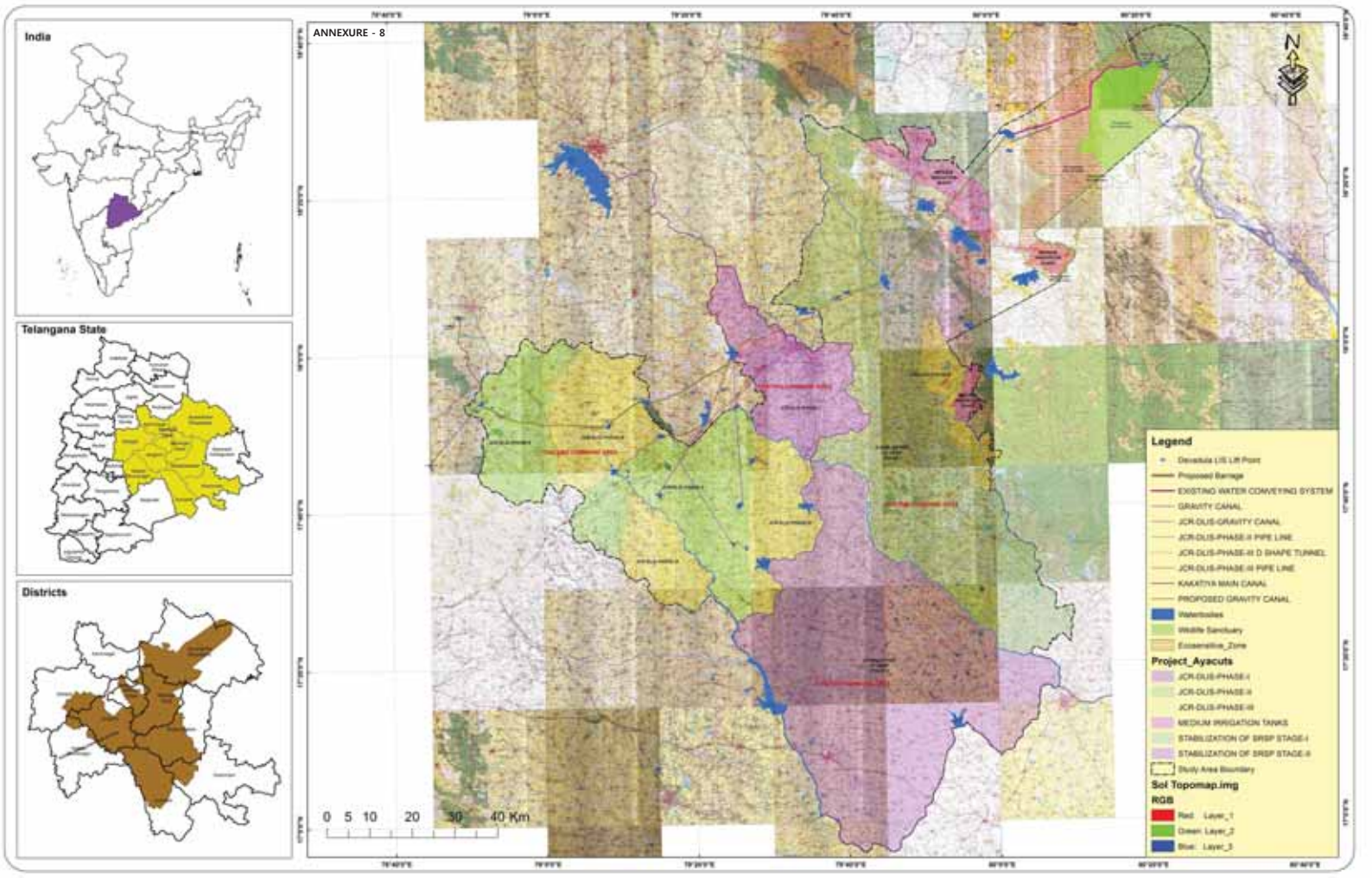
ANNEXURE-8


India
Telangana State
Districts
ANNEXURE - 8
0 5 10 20 30 40 Km
Legend
Devadula LIS Lift Point
Proposed Barrage
EXISTING WATER CONVEYING SYSTEM
GRAVITY CANAL
JCR-DLIS-GRAVITY CANAL
JCR-DLIS-PHASE-II PIPE LINE
JCR-DLIS-PHASE-III D SHAPE TUNNEL
JCR-DLIS-PHASE-III PIPE LINE
KAKATIYA MAIN CANAL
PROPOSED GRAVITY CANAL
Waterbodies
Wildlife Sanctuary
Ecosensitive_Zone
Project_Ayacuts
JCR-DLIS-PHASE-I
JCR-DLIS-PHASE-II
JCR-DLIS-PHASE-III
MEDIUM IRRIGATION TANKS
STABILIZATION OF SRSP STAGE-I
STABILIZATION OF SRSP STAGE-II
Study Area Boundary
Sol Topomap.img
RGB
Red: Layer_1
Green: Layer_2
Blue: Layer_3

ANNEXURE-9

ANNEXURE - 9

Monthly Water Availability at Thupalakudem Project Site

CA at Thupalakudem 268000 sq.km
Catchment Factor 0.999254

Unit:MCM

Water Year	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Total Monsoon (MCM)	(TMC)	Total NonMonsoon (MCM)	(TMC)	Total Annual (MCM)	(TMC)
1966-67	604.5	12743.9	22190.1	25743.4	3368.7	1895.4	1691.3	412.6	221.8	653.0	366.7	94.5	64650.5	2283.1	5335.3	188.4	69985.8	2471.5
1967-68	3026.6	18948.8	32171.8	13196.4	5773.8	947.7	2390.7	993.8	458.7	1006.6	201.9	179.5	73117.3	2582.1	6178.9	218.2	79296.1	2800.3
1968-69	1089.7	8218.4	19503.4	14066.3	7080.4	1386.1	611.7	430.4	251.8	194.6	192.4	194.4	49958.1	1764.3	3261.4	115.2	53219.5	1879.4
1969-70	224.8	15769.1	27296.5	38585.1	4250.6	1922.5	723.5	390.2	268.2	234.5	137.3	97.2	86126.0	3041.5	3773.4	133.3	89899.4	3174.8
1970-71	5207.2	11420.6	50393.2	34339.0	6650.7	1547.8	776.9	530.2	336.6	330.7	217.1	335.0	108010.6	3814.4	4074.4	143.9	112085.0	3958.2
1971-72	3492.6	4888.4	8999.4	14927.9	8853.3	1507.4	587.6	366.3	209.6	138.6	75.1	48.2	41161.7	1453.6	2932.7	103.6	44094.4	1557.2
1972-73	682.2	13309.0	9036.7	8632.3	1718.6	898.5	424.1	174.0	97.4	74.7	54.9	39.5	33378.8	1178.8	1763.1	62.3	35141.9	1241.0
1973-74	297.3	29362.8	35045.3	18045.8	22562.3	5278.3	1212.5	679.3	428.1	272.7	174.8	187.5	105313.6	3719.1	8233.2	290.8	113546.8	4009.9
1974-75	599.8	2377.1	14635.7	2973.8	6970.9	1891.7	702.0	337.7	303.4	237.5	110.7	73.9	27557.4	973.2	3656.9	129.1	31214.2	1102.3
1975-76	4120.8	14221.9	28747.4	37741.6	14469.9	3683.5	928.5	553.1	337.2	227.1	165.6	123.7	99301.5	3506.8	6018.7	212.5	105320.3	3719.4
1976-77	175.4	24313.3	25342.4	28015.2	1763.5	882.8	553.8	311.3	227.4	181.1	139.7	241.1	79609.7	2811.4	2537.1	89.6	82146.7	2901.0
1977-78	1017.9	13400.1	22835.7	18319.3	3568.7	1665.6	1874.5	683.1	518.3	313.4	192.6	225.1	59141.7	2088.6	5472.6	193.3	64614.3	2281.8
1978-79	3779.0	26514.2	42744.6	16398.9	3581.4	1712.0	1135.9	640.0	1198.2	570.4	190.4	136.9	93018.1	3284.9	5583.7	197.2	98601.8	3482.1
1979-80	6437.2	7838.1	31801.8	7675.1	5435.3	973.8	937.8	529.1	383.1	404.9	229.7	174.7	59187.5	2090.2	3633.1	128.3	62820.5	2218.5
1980-81	3385.9	13054.2	37523.8	21843.2	2686.1	1004.8	512.6	539.5	357.7	318.7	217.2	232.3	78493.2	2772.0	3182.8	112.4	81676.0	2884.4
1981-82	1074.8	11580.3	36704.6	20758.6	10242.8	2137.2	799.4	613.2	498.9	248.4	143.2	122.6	80361.0	2837.9	4562.8	161.1	84923.8	2999.1
1982-83	952.4	6693.1	17383.9	8817.9	3979.7	1791.4	621.2	378.2	394.8	290.1	78.9	61.2	37827.1	1335.9	3615.9	127.7	41443.0	1463.5
1983-84	1795.8	10376.7	42396.4	42177.9	21882.3	1927.6	1021.3	815.3	450.6	608.4	379.9	287.7	118629.0	4189.3	5490.8	193.9	124119.8	4383.2
1984-85	1082.9	6786.5	18752.6	4191.9	2762.6	1067.4	516.2	458.5	340.4	262.6	192.5	102.3	33576.4	1185.7	2939.9	103.8	36516.3	1289.6
1985-86	1472.5	8437.7	18714.3	5576.2	5934.0	1162.4	463.5	369.8	482.3	452.4	216.5	169.0	40134.7	1417.3	3315.9	117.1	43450.6	1534.4
1986-87	2032.8	19633.5	40305.2	4787.4	1963.6	1081.5	389.5	468.9	260.5	200.4	91.3	67.8	68722.6	2426.9	2559.9	90.4	71282.5	2517.3
1987-88	387.9	5619.9	8320.2	5295.0	2014.3	1073.4	558.7	293.0	203.3	239.2	100.7	91.0	21637.2	764.1	2559.4	90.4	24196.6	854.5
1988-89	1209.3	25821.3	34593.7	30172.1	16371.3	1483.2	699.3	440.1	285.7	302.4	199.8	90.3	108167.7	3819.9	3500.8	123.6	111668.4	3943.5
1989-90	1351.1	20146.4	21121.3	15623.3	4400.5	828.2	447.9	437.1	269.6	255.6	120.9	793.5	62642.7	2212.2	3152.8	111.3	65795.5	2323.5
1990-91	8524.8	18756.5	54178.7	27250.2	20010.7	5046.4	1052.9	693.5	408.0	331.3	248.4	142.4	128720.9	4545.7	7922.9	279.8	136643.8	4825.5
1991-92	1120.6	10962.9	23106.1	4702.7	2346.2	1355.4	526.7	315.1	205.3	152.4	79.8	54.9	42238.5	1491.6	2689.7	95.0	44928.2	1586.6
1992-93	1954.4	6558.2	34459.2	14897.4	2216.8	961.9	475.8	291.4	221.3	238.0	109.8	59.6	60086.0	2121.9	2357.8	83.3	62443.9	2205.2
1993-94	431.4	7707.9	12404.8	8833.3	4608.2	1211.7	519.4	359.4	329.5	197.8	70.6	39.1	33985.5	1200.2	2727.5	96.3	36713.0	1296.5
1994-95	875.0	32018.6	26591.6	39171.9	6031.7	1804.8	1069.6	1349.8	637.5	618.7	446.0	432.5	104688.8	3697.1	6358.9	224.6	111047.7	3921.6
1995-96	772.3	14998.6	12293.9	19267.5	13224.3	2001.0	839.3	629.3	439.8	393.7	252.0	164.7	60556.7	2138.5	4719.9	166.7	65276.6	2305.2
1996-97	1333.0	4937.5	15880.5	12246.7	4229.6	1331.2	522.3	410.5	279.7	398.6	452.9	165.2	38627.3	1364.1	3560.3	125.7	42187.6	1489.8
1997-98	114.6	3520.6	13895.2	10693.8	2427.0	1864.0	2878.0	1501.8	991.7	301.8	169.9	205.3	30651.2	1082.4	7912.5	279.4	38563.7	1361.9
1998-99	944.8	7372.7	17628.5	21563.6	13053.1	3824.1	822.0	517.1	378.8	283.5	214.2	168.7	60562.6	2138.7	6208.3	219.2	66771.0	2358.0
1999-2000	3969.9	5880.2	20999.9	24909.9	12832.2	2086.9	793.7	506.9	395.3	334.4	179.7	116.6	68592.0	2422.3	4413.5	155.9	73005.4	2578.2
2000-01	2258.9	21978.9	24791.2	10890.8	2061.6	747.2	340.4	235.6	162.8	157.6	168.3	77.4	61981.5	2188.9	1889.3	66.7	63870.8	2255.6
2001-02	9001.9	12976.0	30312.7	4564.7	5614.8	1020.1	472.4	348.7	220.5	155.7	80.1	40.7	62470.1	2206.1	2338.3	82.6	64808.4	2288.7
2002-03	4233.3	2336.1	20922.7	13135.5	1818.2	595.4	363.2	224.0	147.9	108.6	69.2	39.7	42445.8	1499.0	1548.1	54.7	43993.9	1553.6
2003-04	157.5	17871.1	22796.0	13062.6	8006.2	1691.2	699.1	426.9	475.7	173.4	97.7	97.1	61893.4	2185.7	3661.2	129.3	65554.6	2315.0
2004-05	2668.0	2525.3	20040.5	3811.2	2206.1	521.6	236.5	165.7	697.9	157.9	85.9	70.2	31251.1	1103.6	1935.7	68.4	33186.8	1172.0
2005-06	95.1	18720.1	25767.0	25775.3	9320.2	2474.2	656.7	375.1	226.4	255.1	222.0	188.9	79677.7	2813.8	4398.4	155.3	84076.1	2969.1
2006-07	135.3	13644.4	49712.2	29598.4	10727.0	2977.9	813.3	491.8	289.2	171.3	137.2	106.5	103817.4	3666.3	4987.2	176.1	108804.6	3842.4
2007-08	553.9	14337.1	21191.6	18723.6	7250.6	1222.5	473.9	292.9	330.5	258.1	221.3	18.7	62056.8	2191.5	2817.8	99.5	64874.6	2291.0
2008-09	300.5	4869.1	23799.0	8382.1	1961.6	835.1	445.1	184.6	133.9	84.4	52.4	18.5	39312.4	1388.3	1753.8	61.9	41066.2	1450.2
2009-10	16.3	7795.2	6470.6	6144.9	1372.1	677.3	337.8	224.4	135.9	97.0	37.9	22.9	21799.1	769.8	1533.2	54.1	23332.3	824.0
2010-11	186.6	11953.4	35272.2	41018.5	6476.7	2844.7	1056.6	470.9	293.5	311.8	167.2	102.7	94907.3	3351.6	5247.4	185.3	100154.7	3536.9
2011-12	253.4	4529.3	14016.6	29534.1	2365.4	795.2	387.2	341.2	193.1	63.0	33.1	16.9	50698.7	1790.4	1829.7	64.6	52528.4	1855.0
2012-13	398.5	9460.5	31619.9	30149.7	5740.1	1528.3	581.4	370.8	274.7	246.2	108.0	52.2	77368.6	2732.2	3161.6	111.7	80530.2	2843.9
Average	1825.5	12493.3	25632.1	18217.7	6684.8	1684.4	786.0	480.3	354.3	287.4	167.9	139.8	64382.8	2273.7	3977.3	140.5	68753.7	2414.1

50% Dependable flow 65277 MCM 2305.2 TMC
75% Dependable flow 43451 MCM 1534.4 TMC
90% Dependable flow 34751 MCM 1227.2 TMC

ANNEXURE-10

ANNEXURE - 10

STATEMENT SHOWING THE DETAILS OF DISTRICT-WISE, MANDAL-WISE AYACUT & VILLAGE-WISE CONTEMPLATED AYACUT UNDER JCR-DLIS

Sl.No.	Name of the Irrigatin Project	District where located	District to which water planned to be supplied		Name of Mandals to be covered		Names of villages to be covered		Total area proposed to be covered (Acres)
			Districts	Area (Acres)	Mandals	Area (Acres)	Villages	Area (Acres)	
1	J.Chokka Rao Devadula Lift Irrigation Scheme	Warangal (U)	Warangal(U)	88909	Dharmasagar	10519	Devanoor	900	900
2	J.Chokka Rao Devadula Lift Irrigation Scheme	Warangal (U)	Warangal(U)		Dharmasagar		Somadevarapally	2000	2000
3	J.Chokka Rao Devadula Lift Irrigation Scheme	Warangal (U)	Warangal(U)		Dharmasagar		Elkurthy	550	550
4	J.Chokka Rao Devadula Lift Irrigation Scheme	Warangal (U)	Warangal(U)		Dharmasagar		Dharmasagar	4569	4569
5	J.Chokka Rao Devadula Lift Irrigation Scheme	Warangal (U)	Warangal(U)		Dharmasagar		Unikicherla	2500	2500
6	J.Chokka Rao Devadula Lift Irrigation Scheme	Warangal (U)	Warangal(U)		Khazipet	11051	Rampur	400	400
7	J.Chokka Rao Devadula Lift Irrigation Scheme	Warangal (U)	Warangal(U)		Khazipet		Madikonda	2100	2100
8	J.Chokka Rao Devadula Lift Irrigation Scheme	Warangal (U)	Warangal(U)		Khazipet		Kummarigudem	400	400
9	J.Chokka Rao Devadula Lift Irrigation Scheme	Warangal (U)	Warangal(U)		Khazipet		Tharalapalli	1913	1913
10	J.Chokka Rao Devadula Lift Irrigation Scheme	Warangal (U)	Warangal(U)		Khazipet		Rampet	500	500
11	J.Chokka Rao Devadula Lift Irrigation Scheme	Warangal (U)	Warangal(U)		Khazipet		Kadipikonda	800	800
12	J.Chokka Rao Devadula Lift Irrigation Scheme	Warangal (U)	Warangal(U)		Khazipet		Battupally	800	800
13	J.Chokka Rao Devadula Lift Irrigation Scheme	Warangal (U)	Warangal(U)		Khazipet		Ayodhyapuram	400	400
14	J.Chokka Rao Devadula Lift Irrigation Scheme	Warangal (U)	Warangal(U)		Khazipet		Ammavaripet	3738	3738
15	J.Chokka Rao Devadula Lift Irrigation Scheme	Warangal (U)	Warangal(U)		Khila warangal	18884	Gadepally	1114	1114
16	J.Chokka Rao Devadula Lift Irrigation Scheme	Warangal (U)	Warangal(U)		Khila warangal		Bollikunta	14465	14465
17	J.Chokka Rao Devadula Lift Irrigation Scheme	Warangal (U)	Warangal(U)		Khila warangal		Mamnoor	2305	2305
18	J.Chokka Rao Devadula Lift Irrigation Scheme	Warangal (U)	Warangal(U)		Khila warangal		Alipur	1000	1000
19	J.Chokka Rao Devadula Lift Irrigation Scheme	Warangal (U)	Warangal(U)		Hasanparthy	5650	Devannapet	900	900
20	J.Chokka Rao Devadula Lift Irrigation Scheme	Warangal (U)	Warangal(U)		Hasanparthy		Madipalli	1400	1400
21	J.Chokka Rao Devadula Lift Irrigation Scheme	Warangal (U)	Warangal(U)		Hasanparthy		Ananthasagar	1350	1350
22	J.Chokka Rao Devadula Lift Irrigation Scheme	Warangal (U)	Warangal(U)		Hasanparthy		Bheemaram	800	800
23	J.Chokka Rao Devadula Lift Irrigation Scheme	Warangal (U)	Warangal(U)		Hasanparthy		Komatipalli	500	500
24	J.Chokka Rao Devadula Lift Irrigation Scheme	Warangal (U)	Warangal(U)		Hasanparthy		Jagiri	700	700
25	J.Chokka Rao Devadula Lift Irrigation Scheme	Warangal (U)	Warangal(U)		Elkathurthy	8100	Damera	1600	1600

STATEMENT SHOWING THE DETAILS OF DISTRICT-WISE, MANDAL-WISE AYACUT & VILLAGE-WISE CONTEMPLATED AYACUT UNDER JCR-DLIS

Sl.No.	Name of the Irrigatin Project	District where located	District to which water planned to be supplied		Name of Mandals to be covered		Names of villages to be covered		Total area proposed to be covered (Acres)
			Districts	Area (Acres)	Mandals	Area (Acres)	Villages	Area (Acres)	
26	J.Chokka Rao Devadula Lift Irrigation Scheme	Warangal (U)	Warangal(U)		Elkathurthy		Elkathurthy	800	800
27	J.Chokka Rao Devadula Lift Irrigation Scheme	Warangal (U)	Warangal(U)		Elkathurthy		Gopalpur	1800	1800
28	J.Chokka Rao Devadula Lift Irrigation Scheme	Warangal (U)	Warangal(U)		Elkathurthy		Valbapur	600	600
29	J.Chokka Rao Devadula Lift Irrigation Scheme	Warangal (U)	Warangal(U)		Elkathurthy		Kotulanaduma	600	600
30	J.Chokka Rao Devadula Lift Irrigation Scheme	Warangal (U)	Warangal(U)		Elkathurthy		Jeelugula	1800	1800
31	J.Chokka Rao Devadula Lift Irrigation Scheme	Warangal (U)	Warangal(U)		Elkathurthy		Penchikalapet	900	900
32	J.Chokka Rao Devadula Lift Irrigation Scheme	Warangal (U)	Warangal(U)		Inavole	31505	Punnelu	1223	1223
33	J.Chokka Rao Devadula Lift Irrigation Scheme	Warangal (U)	Warangal(U)		Inavole		Panthini	2215	2215
34	J.Chokka Rao Devadula Lift Irrigation Scheme	Warangal (U)	Warangal(U)		Inavole		Vanamala Kanaparthy	2237	2237
35	J.Chokka Rao Devadula Lift Irrigation Scheme	Warangal (U)	Warangal(U)		Inavole		Kondaparthy	5645	5645
36	J.Chokka Rao Devadula Lift Irrigation Scheme	Warangal (U)	Warangal(U)		Inavole		Singaram	2391	2391
37	J.Chokka Rao Devadula Lift Irrigation Scheme	Warangal (U)	Warangal(U)		Inavole		Venkatapur	2095	2095
38	J.Chokka Rao Devadula Lift Irrigation Scheme	Warangal (U)	Warangal(U)		Inavole		Kakkiralapally	6364	6364
39	J.Chokka Rao Devadula Lift Irrigation Scheme	Warangal (U)	Warangal(U)		Inavole		Garimillapalli	1051	1051
40	J.Chokka Rao Devadula Lift Irrigation Scheme	Warangal (U)	Warangal(U)		Inavole		Inavole	4395	4395
41	J.Chokka Rao Devadula Lift Irrigation Scheme	Warangal (U)	Warangal(U)		Inavole		Nandanam	3889	3889
42	J.Chokka Rao Devadula Lift Irrigation Scheme	Warangal (U)	Warangal(U)		Bheemadevaraplli	3200	Kothapalli	2200	2200
43	J.Chokka Rao Devadula Lift Irrigation Scheme	Warangal (U)	Warangal(U)		Bheemadevaraplli		Koppur	700	700
44	J.Chokka Rao Devadula Lift Irrigation Scheme	Warangal (U)	Warangal(U)		Bheemadevaraplli		Manikyapur	300	300
45	J.Chokka Rao Devadula Lift Irrigation Scheme	Warangal (R)	Warangal (R)	58276	Sangem	15997	Sangem	1743	1743
46	J.Chokka Rao Devadula Lift Irrigation Scheme	Warangal (R)	Warangal (R)		Sangem		Kapula Kanaparthy	1849	1849
47	J.Chokka Rao Devadula Lift Irrigation Scheme	Warangal (R)	Warangal (R)		Sangem		Ramachandrapuram	2573	2573
48	J.Chokka Rao Devadula Lift Irrigation Scheme	Warangal (R)	Warangal (R)		Sangem		Lohitha	947	947
49	J.Chokka Rao Devadula Lift Irrigation Scheme	Warangal (R)	Warangal (R)		Sangem		Gavicheral	3159	3159
50	J.Chokka Rao Devadula Lift Irrigation Scheme	Warangal (R)	Warangal (R)		Sangem		Katrapally	2013	2013

STATEMENT SHOWING THE DETAILS OF DISTRICT-WISE, MANDAL-WISE AYACUT & VILLAGE-WISE CONTEMPLATED AYACUT UNDER JCR-DLIS

Sl.No.	Name of the Irrigatin Project	District where located	District to which water planned to be supplied		Name of Mandals to be covered		Names of villages to be covered		Total area proposed to be covered (Acres)
			Districts	Area (Acres)	Mandals	Area (Acres)	Villages	Area (Acres)	
51	J.Chokka Rao Devadula Lift Irrigation Scheme	Warangal (R)	Warangal (R)		Sangem		Shapur	966	966
52	J.Chokka Rao Devadula Lift Irrigation Scheme	Warangal (R)	Warangal (R)		Sangem		Teegarajupally	2747	2747
53	J.Chokka Rao Devadula Lift Irrigation Scheme	Warangal (R)	Warangal (R)		Geesukonda	5633	Geesukonda	5335	5335
54	J.Chokka Rao Devadula Lift Irrigation Scheme	Warangal (R)	Warangal (R)		Geesukonda		Anantharam	161	161
55	J.Chokka Rao Devadula Lift Irrigation Scheme	Warangal (R)	Warangal (R)		Geesukonda		Kommala	137	137
56	J.Chokka Rao Devadula Lift Irrigation Scheme	Warangal (R)	Warangal (R)		Wardhannapet	14043	Chennaram	1171	1171
57	J.Chokka Rao Devadula Lift Irrigation Scheme	Warangal (R)	Warangal (R)		Wardhannapet		Upparapally	997	997
58	J.Chokka Rao Devadula Lift Irrigation Scheme	Warangal (R)	Warangal (R)		Wardhannapet		Ellandu	1695	1695
59	J.Chokka Rao Devadula Lift Irrigation Scheme	Warangal (R)	Warangal (R)		Wardhannapet		Nandanam	1345	1345
60	J.Chokka Rao Devadula Lift Irrigation Scheme	Warangal (R)	Warangal (R)		Wardhannapet		Bandavathapuram	710	710
61	J.Chokka Rao Devadula Lift Irrigation Scheme	Warangal (R)	Warangal (R)		Wardhannapet		Damannapet	1957	1957
62	J.Chokka Rao Devadula Lift Irrigation Scheme	Warangal (R)	Warangal (R)		Wardhannapet		Wardhannapet	4552	4552
63	J.Chokka Rao Devadula Lift Irrigation Scheme	Warangal (R)	Warangal (R)		Wardhannapet		Ramawaram	968	968
64	J.Chokka Rao Devadula Lift Irrigation Scheme	Warangal (R)	Warangal (R)		Wardhannapet		Divitipalli	648	648
65	J.Chokka Rao Devadula Lift Irrigation Scheme	Warangal (R)	Warangal (R)		Nallabelli	8414	Govindapuram	196	196
66	J.Chokka Rao Devadula Lift Irrigation Scheme	Warangal (R)	Warangal (R)		Nallabelli		Gundlapahad	1596	1596
67	J.Chokka Rao Devadula Lift Irrigation Scheme	Warangal (R)	Warangal (R)		Nallabelli		Karnaraopet	211	211
68	J.Chokka Rao Devadula Lift Irrigation Scheme	Warangal (R)	Warangal (R)		Nallabelli		Medipalli	1563	1563
69	J.Chokka Rao Devadula Lift Irrigation Scheme	Warangal (R)	Warangal (R)		Nallabelli		Nagarajpalli	596	596
70	J.Chokka Rao Devadula Lift Irrigation Scheme	Warangal (R)	Warangal (R)		Nallabelli		Nallabelli	1072	1072
71	J.Chokka Rao Devadula Lift Irrigation Scheme	Warangal (R)	Warangal (R)		Nallabelli		Narakkapet	970	970
72	J.Chokka Rao Devadula Lift Irrigation Scheme	Warangal (R)	Warangal (R)		Nallabelli		Rampuram	529	529
73	J.Chokka Rao Devadula Lift Irrigation Scheme	Warangal (R)	Warangal (R)		Nallabelli		Rudragudem	1107	1107
74	J.Chokka Rao Devadula Lift Irrigation Scheme	Warangal (R)	Warangal (R)		Nallabelli		Senigaram	574	574
75	J.Chokka Rao Devadula Lift Irrigation Scheme	Warangal (R)	Warangal (R)		Duggondi	4747	Advi Rampur	589	589

STATEMENT SHOWING THE DETAILS OF DISTRICT-WISE, MANDAL-WISE AYACUT & VILLAGE-WISE CONTEMPLATED AYACUT UNDER JCR-DLIS

Sl.No.	Name of the Irrigatin Project	District where located	District to which water planned to be supplied		Name of Mandals to be covered		Names of villages to be covered		Total area proposed to be covered (Acres)
			Districts	Area (Acres)	Mandals	Area (Acres)	Villages	Area (Acres)	
76	J.Chokka Rao Devadula Lift Irrigation Scheme	Warangal (R)	Warangal (R)		Duggondi		Chalparti	491	491
77	J.Chokka Rao Devadula Lift Irrigation Scheme	Warangal (R)	Warangal (R)		Duggondi		Madira Mandapalli	121	121
78	J.Chokka Rao Devadula Lift Irrigation Scheme	Warangal (R)	Warangal (R)		Duggondi		Mahammadpur	1084	1084
79	J.Chokka Rao Devadula Lift Irrigation Scheme	Warangal (R)	Warangal (R)		Duggondi		Mallampalli	371	371
80	J.Chokka Rao Devadula Lift Irrigation Scheme	Warangal (R)	Warangal (R)		Duggondi		Mandapalli	210	210
81	J.Chokka Rao Devadula Lift Irrigation Scheme	Warangal (R)	Warangal (R)		Duggondi		Nachenpalli	363	363
82	J.Chokka Rao Devadula Lift Irrigation Scheme	Warangal (R)	Warangal (R)		Duggondi		Ponakal	22	22
83	J.Chokka Rao Devadula Lift Irrigation Scheme	Warangal (R)	Warangal (R)		Duggondi		Rekampalli	473	473
84	J.Chokka Rao Devadula Lift Irrigation Scheme	Warangal (R)	Warangal (R)		Duggondi		Thimmampet	524	524
85	J.Chokka Rao Devadula Lift Irrigation Scheme	Warangal (R)	Warangal (R)		Duggondi		Toggarai	155	155
86	J.Chokka Rao Devadula Lift Irrigation Scheme	Warangal (R)	Warangal (R)		Duggondi		Venkatapur	344	344
87	J.Chokka Rao Devadula Lift Irrigation Scheme	Warangal (R)	Warangal (R)		Narsampet	9442	Bhanajpalli	1735	1735
88	J.Chokka Rao Devadula Lift Irrigation Scheme	Warangal (R)	Warangal (R)		Narsampet		Madira	358	358
89	J.Chokka Rao Devadula Lift Irrigation Scheme	Warangal (R)	Warangal (R)		Narsampet		Itikyalapally	1662	1662
90	J.Chokka Rao Devadula Lift Irrigation Scheme	Warangal (R)	Warangal (R)		Narsampet		Kammampalli	793	793
91	J.Chokka Rao Devadula Lift Irrigation Scheme	Warangal (R)	Warangal (R)		Narsampet		Madannapeta	1236	1236
92	J.Chokka Rao Devadula Lift Irrigation Scheme	Warangal (R)	Warangal (R)		Narsampet		Muthojipeta	1051	1051
93	J.Chokka Rao Devadula Lift Irrigation Scheme	Warangal (R)	Warangal (R)		Narsampet		Narsampet	1	1
94	J.Chokka Rao Devadula Lift Irrigation Scheme	Warangal (R)	Warangal (R)		Narsampet		Rajupet	2308	2308
95	J.Chokka Rao Devadula Lift Irrigation Scheme	Warangal (R)	Warangal (R)		Narsampet		Sarvapuram	298	298
96	J.Chokka Rao Devadula Lift Irrigation Scheme	Jayshankar B'pally	Jayshankar B'pally	8886	Mulugu	7186	Ramachandrapur	7186	7186
97	J.Chokka Rao Devadula Lift Irrigation Scheme	Jayshankar B'pally	Jayshankar B'pally		Bhupalapally	164	Bhupalapally	164	164
98	J.Chokka Rao Devadula Lift Irrigation Scheme	Jayshankar B'pally	Jayshankar B'pally		Mahamutharma	1536	Mahamutharma	1536	1536
99	J.Chokka Rao Devadula Lift Irrigation Scheme	Karimnagar	Karimnagar	1100	Huzurabad	1100	Katrapalli/ Dammakapet	400	400
100	J.Chokka Rao Devadula Lift Irrigation Scheme	Karimnagar	Karimnagar		Huzurabad		Narsingapur	700	700

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			Districts	Area (Acres)	Mandals	Area (Acres)	Villages	Area (Acres)	
101	J.Chokka Rao Devadula Lift Irrigation Scheme	Jangaon	Jangaon	285448	Zaffergadh	22578	Kunoor	4456	4456
102	J.Chokka Rao Devadula Lift Irrigation Scheme	Jangaon	Jangaon		Zaffergadh		Raghunathpally	572	572
103	J.Chokka Rao Devadula Lift Irrigation Scheme	Jangaon	Jangaon		Zaffergadh		Thidugu	2105	2105
104	J.Chokka Rao Devadula Lift Irrigation Scheme	Jangaon	Jangaon		Zaffergadh		Uppugal	1878	1878
105	J.Chokka Rao Devadula Lift Irrigation Scheme	Jangaon	Jangaon		Zaffergadh		Thimmampet	1937	1937
106	J.Chokka Rao Devadula Lift Irrigation Scheme	Jangaon	Jangaon		Zaffergadh		Theegaram	1239	1239
107	J.Chokka Rao Devadula Lift Irrigation Scheme	Jangaon	Jangaon		Zaffergadh		Zaffergadh	3765	3765
108	J.Chokka Rao Devadula Lift Irrigation Scheme	Jangaon	Jangaon		Zaffergadh		Suraram	714	714
109	J.Chokka Rao Devadula Lift Irrigation Scheme	Jangaon	Jangaon		Zaffergadh		Konaichelam	926	926
110	J.Chokka Rao Devadula Lift Irrigation Scheme	Jangaon	Jangaon		Zaffergadh		Thammadapally	828	828
111	J.Chokka Rao Devadula Lift Irrigation Scheme	Jangaon	Jangaon		Zaffergadh		Sagaram	707	707
112	J.Chokka Rao Devadula Lift Irrigation Scheme	Jangaon	Jangaon		Zaffergadh		Aliabad	130	130
113	J.Chokka Rao Devadula Lift Irrigation Scheme	Jangaon	Jangaon		Zaffergadh		Thimmapuram	633	633
114	J.Chokka Rao Devadula Lift Irrigation Scheme	Jangaon	Jangaon		Zaffergadh		G.Thammadapalli	912	912
115	J.Chokka Rao Devadula Lift Irrigation Scheme	Jangaon	Jangaon		Zaffergadh		Obulapuram	1776	1776
116	J.Chokka Rao Devadula Lift Irrigation Scheme	Jangaon	Jangaon		R.S.Ghanpur	11434	Namiligonda	1320	1320
117	J.Chokka Rao Devadula Lift Irrigation Scheme	Jangaon	Jangaon		R.S.Ghanpur		Shivunipally	239	239
118	J.Chokka Rao Devadula Lift Irrigation Scheme	Jangaon	Jangaon		R.S.Ghanpur		Thanedarpally	257	257
119	J.Chokka Rao Devadula Lift Irrigation Scheme	Jangaon	Jangaon		R.S.Ghanpur		Vishwanathgudem	161	161
120	J.Chokka Rao Devadula Lift Irrigation Scheme	Jangaon	Jangaon		R.S.Ghanpur		Samudrala	2933	2933
121	J.Chokka Rao Devadula Lift Irrigation Scheme	Jangaon	Jangaon		R.S.Ghanpur		Ippagudem	2524	2524
122	J.Chokka Rao Devadula Lift Irrigation Scheme	Jangaon	Jangaon		R.S.Ghanpur		R.S.Ghanpur	4000	4000
123	J.Chokka Rao Devadula Lift Irrigation Scheme	Jangaon	Jangaon		Raghunathpally	28219	Kanchanapally	2466	2466
124	J.Chokka Rao Devadula Lift Irrigation Scheme	Jangaon	Jangaon		Raghunathpally		Gabbeta	1078	1078
125	J.Chokka Rao Devadula Lift Irrigation Scheme	Jangaon	Jangaon		Raghunathpally		Kodur	2133	2133

STATEMENT SHOWING THE DETAILS OF DISTRICT-WISE, MANDAL-WISE AYACUT & VILLAGE-WISE CONTEMPLATED AYACUT UNDER JCR-DLIS

Sl.No.	Name of the Irrigatin Project	District where located	District to which water planned to be supplied		Name of Mandals to be covered		Names of villages to be covered		Total area proposed to be covered (Acres)
			Districts	Area (Acres)	Mandals	Area (Acres)	Villages	Area (Acres)	
126	J.Chokka Rao Devadula Lift Irrigation Scheme	Jangaon	Jangaon		Raghunathpally		Kannaipalli	931	931
127	J.Chokka Rao Devadula Lift Irrigation Scheme	Jangaon	Jangaon		Raghunathpally		Banojipet	1580	1580
128	J.Chokka Rao Devadula Lift Irrigation Scheme	Jangaon	Jangaon		Raghunathpally		Srimannarayanapuram	1399	1399
129	J.Chokka Rao Devadula Lift Irrigation Scheme	Jangaon	Jangaon		Raghunathpally		Kalvapally	754	754
130	J.Chokka Rao Devadula Lift Irrigation Scheme	Jangaon	Jangaon		Raghunathpally		Ashwaraopally	1130	1130
131	J.Chokka Rao Devadula Lift Irrigation Scheme	Jangaon	Jangaon		Raghunathpally		Khilashapur	5377	5377
132	J.Chokka Rao Devadula Lift Irrigation Scheme	Jangaon	Jangaon		Raghunathpally		Raghunathpally	1349	1349
133	J.Chokka Rao Devadula Lift Irrigation Scheme	Jangaon	Jangaon		Raghunathpally		Veldi	970	970
134	J.Chokka Rao Devadula Lift Irrigation Scheme	Jangaon	Jangaon		Raghunathpally		Kommala	632	632
135	J.Chokka Rao Devadula Lift Irrigation Scheme	Jangaon	Jangaon		Raghunathpally		Madaram	952	952
136	J.Chokka Rao Devadula Lift Irrigation Scheme	Jangaon	Jangaon		Raghunathpally		Ibrahimpuram	1194	1194
137	J.Chokka Rao Devadula Lift Irrigation Scheme	Jangaon	Jangaon		Raghunathpally		Nidigonda	1890	1890
138	J.Chokka Rao Devadula Lift Irrigation Scheme	Jangaon	Jangaon		Raghunathpally		Fateshapur	2385	2385
139	J.Chokka Rao Devadula Lift Irrigation Scheme	Jangaon	Jangaon		Raghunathpally		Mekalagattu	1999	1999
140	J.Chokka Rao Devadula Lift Irrigation Scheme	Jangaon	Jangaon		Jangaon	27020	Chowdaram	930	930
141	J.Chokka Rao Devadula Lift Irrigation Scheme	Jangaon	Jangaon		Jangaon		Yashwanthapur	880	880
142	J.Chokka Rao Devadula Lift Irrigation Scheme	Jangaon	Jangaon		Jangaon		Jangaon	1618	1618
143	J.Chokka Rao Devadula Lift Irrigation Scheme	Jangaon	Jangaon		Jangaon		Chittakodur	686	686
144	J.Chokka Rao Devadula Lift Irrigation Scheme	Jangaon	Jangaon		Jangaon		Shamirpet	190	190
145	J.Chokka Rao Devadula Lift Irrigation Scheme	Jangaon	Jangaon		Jangaon		Yellamla	1352	1352
146	J.Chokka Rao Devadula Lift Irrigation Scheme	Jangaon	Jangaon		Jangaon		Pembarthy	1796	1796
147	J.Chokka Rao Devadula Lift Irrigation Scheme	Jangaon	Jangaon		Jangaon		Goparajupally	1036	1036
148	J.Chokka Rao Devadula Lift Irrigation Scheme	Jangaon	Jangaon		Jangaon		Venkiryala	1290	1290
149	J.Chokka Rao Devadula Lift Irrigation Scheme	Jangaon	Jangaon		Jangaon		Thammadapally	964	964
150	J.Chokka Rao Devadula Lift Irrigation Scheme	Jangaon	Jangaon		Jangaon		Penpahad	295	295

STATEMENT SHOWING THE DETAILS OF DISTRICT-WISE, MANDAL-WISE AYACUT & VILLAGE-WISE CONTEMPLATED AYACUT UNDER JCR-DLIS

Sl.No.	Name of the Irrigatin Project	District where located	District to which water planned to be supplied		Name of Mandals to be covered		Names of villages to be covered		Total area proposed to be covered (Acres)
			Districts	Area (Acres)	Mandals	Area (Acres)	Villages	Area (Acres)	
151	J.Chokka Rao Devadula Lift Irrigation Scheme	Jangaon	Jangaon		Jangaon		Adavikeshapuram	1028	1028
152	J.Chokka Rao Devadula Lift Irrigation Scheme	Jangaon	Jangaon		Jangaon		Chouderpalli	251	251
153	J.Chokka Rao Devadula Lift Irrigation Scheme	Jangaon	Jangaon		Jangaon		Pesaramadla	1650	1650
154	J.Chokka Rao Devadula Lift Irrigation Scheme	Jangaon	Jangaon		Jangaon		Obulakeshavapuram	1817	1817
155	J.Chokka Rao Devadula Lift Irrigation Scheme	Jangaon	Jangaon		Jangaon		Siddenki	1270	1270
156	J.Chokka Rao Devadula Lift Irrigation Scheme	Jangaon	Jangaon		Jangaon		Shairampeta	537	537
157	J.Chokka Rao Devadula Lift Irrigation Scheme	Jangaon	Jangaon		Jangaon		Yerragollapahad	947	947
158	J.Chokka Rao Devadula Lift Irrigation Scheme	Jangaon	Jangaon		Jangaon		Ganupahad	2089	2089
159	J.Chokka Rao Devadula Lift Irrigation Scheme	Jangaon	Jangaon		Jangaon		Marrigadi	1513	1513
160	J.Chokka Rao Devadula Lift Irrigation Scheme	Jangaon	Jangaon		Jangaon		Vadlakonda	1095	1095
161	J.Chokka Rao Devadula Lift Irrigation Scheme	Jangaon	Jangaon		Jangaon		Peddapahad	1844	1844
162	J.Chokka Rao Devadula Lift Irrigation Scheme	Jangaon	Jangaon		Jangaon		Peddaramacherla	1942	1942
163	J.Chokka Rao Devadula Lift Irrigation Scheme	Jangaon	Jangaon		Narmetta	19480	Veldanda	3194	3194
164	J.Chokka Rao Devadula Lift Irrigation Scheme	Jangaon	Jangaon		Narmetta		Bommakur	1019	1019
165	J.Chokka Rao Devadula Lift Irrigation Scheme	Jangaon	Jangaon		Narmetta		Narmetta	5012	5012
166	J.Chokka Rao Devadula Lift Irrigation Scheme	Jangaon	Jangaon		Narmetta		Hanmanthapur	1486	1486
167	J.Chokka Rao Devadula Lift Irrigation Scheme	Jangaon	Jangaon		Narmetta		Machupahad	1956	1956
168	J.Chokka Rao Devadula Lift Irrigation Scheme	Jangaon	Jangaon		Narmetta		Gandiramaram	407	407
169	J.Chokka Rao Devadula Lift Irrigation Scheme	Jangaon	Jangaon		Narmetta		Malakpeta	244	244
170	J.Chokka Rao Devadula Lift Irrigation Scheme	Jangaon	Jangaon		Narmetta		Potharam	1498	1498
171	J.Chokka Rao Devadula Lift Irrigation Scheme	Jangaon	Jangaon		Narmetta		Ammapur	1505	1505
172	J.Chokka Rao Devadula Lift Irrigation Scheme	Jangaon	Jangaon		Narmetta		Thornala	500	500
173	J.Chokka Rao Devadula Lift Irrigation Scheme	Jangaon	Jangaon		Narmetta		Akkarajupalli	800	800
174	J.Chokka Rao Devadula Lift Irrigation Scheme	Jangaon	Jangaon		Narmetta		Solipuram	759	759
175	J.Chokka Rao Devadula Lift Irrigation Scheme	Jangaon	Jangaon		Narmetta		Tharigoppula	950	950

STATEMENT SHOWING THE DETAILS OF DISTRICT-WISE, MANDAL-WISE AYACUT & VILLAGE-WISE CONTEMPLATED AYACUT UNDER JCR-DLIS

Sl.No.	Name of the Irrigatin Project	District where located	District to which water planned to be supplied		Name of Mandals to be covered		Names of villages to be covered		Total area proposed to be covered (Acres)
			Districts	Area (Acres)	Mandals	Area (Acres)	Villages	Area (Acres)	
176	J.Chokka Rao Devadula Lift Irrigation Scheme	Jangaon	Jangaon		Narmetta		Anukushapuram	150	150
177	J.Chokka Rao Devadula Lift Irrigation Scheme	Jangaon	Jangaon		Palakurthy	33593	Gudur	2429	2429
178	J.Chokka Rao Devadula Lift Irrigation Scheme	Jangaon	Jangaon		Palakurthy		Kothulabad	775	775
179	J.Chokka Rao Devadula Lift Irrigation Scheme	Jangaon	Jangaon		Palakurthy		Iravennu (Iranti)	2392	2392
180	J.Chokka Rao Devadula Lift Irrigation Scheme	Jangaon	Jangaon		Palakurthy		Tirmalgiri	587	587
181	J.Chokka Rao Devadula Lift Irrigation Scheme	Jangaon	Jangaon		Palakurthy		Bommera	1982	1982
182	J.Chokka Rao Devadula Lift Irrigation Scheme	Jangaon	Jangaon		Palakurthy		Ayyangaripalli	696	696
183	J.Chokka Rao Devadula Lift Irrigation Scheme	Jangaon	Jangaon		Palakurthy		Tururu	1143	1143
184	J.Chokka Rao Devadula Lift Irrigation Scheme	Jangaon	Jangaon		Palakurthy		Satapuram	1012	1012
185	J.Chokka Rao Devadula Lift Irrigation Scheme	Jangaon	Jangaon		Palakurthy		Palakurthy	2148	2148
186	J.Chokka Rao Devadula Lift Irrigation Scheme	Jangaon	Jangaon		Palakurthy		Visnur	2717	2717
187	J.Chokka Rao Devadula Lift Irrigation Scheme	Jangaon	Jangaon		Palakurthy		Lakshminarayanapuram	200	200
188	J.Chokka Rao Devadula Lift Irrigation Scheme	Jangaon	Jangaon		Palakurthy		Mylaram	718	718
189	J.Chokka Rao Devadula Lift Irrigation Scheme	Jangaon	Jangaon		Palakurthy		Lakshmakkapalli	55	55
190	J.Chokka Rao Devadula Lift Irrigation Scheme	Jangaon	Jangaon		Palakurthy		Kondapuram	1072	1072
191	J.Chokka Rao Devadula Lift Irrigation Scheme	Jangaon	Jangaon		Palakurthy		Vavilala	2200	2200
192	J.Chokka Rao Devadula Lift Irrigation Scheme	Jangaon	Jangaon		Palakurthy		Mallampalli	2088	2088
193	J.Chokka Rao Devadula Lift Irrigation Scheme	Jangaon	Jangaon		Palakurthy		Dardepalli	2759	2759
194	J.Chokka Rao Devadula Lift Irrigation Scheme	Jangaon	Jangaon		Palakurthy		Muttaram	2493	2493
195	J.Chokka Rao Devadula Lift Irrigation Scheme	Jangaon	Jangaon		Palakurthy		Malmidi	1592	1592
196	J.Chokka Rao Devadula Lift Irrigation Scheme	Jangaon	Jangaon		Palakurthy		Chennur	1376	1376
197	J.Chokka Rao Devadula Lift Irrigation Scheme	Jangaon	Jangaon		Palakurthy		Manchupala	2555	2555
198	J.Chokka Rao Devadula Lift Irrigation Scheme	Jangaon	Jangaon		Palakurthy		Tigaram	604	604
199	J.Chokka Rao Devadula Lift Irrigation Scheme	Jangaon	Jangaon		Kodakandla	15951	Yedunutula	1273	1273
200	J.Chokka Rao Devadula Lift Irrigation Scheme	Jangaon	Jangaon		Kodakandla		Regula	1039	1039

STATEMENT SHOWING THE DETAILS OF DISTRICT-WISE, MANDAL-WISE AYACUT & VILLAGE-WISE CONTEMPLATED AYACUT UNDER JCR-DLIS

Sl.No.	Name of the Irrigatin Project	District where located	District to which water planned to be supplied		Name of Mandals to be covered		Names of villages to be covered		Total area proposed to be covered (Acres)
			Districts	Area (Acres)	Mandals	Area (Acres)	Villages	Area (Acres)	
201	J.Chokka Rao Devadula Lift Irrigation Scheme	Jangaon	Jangaon		Kodakandla		Pothireddipalli	1071	1071
202	J.Chokka Rao Devadula Lift Irrigation Scheme	Jangaon	Jangaon		Kodakandla		Autapuram	1497	1497
203	J.Chokka Rao Devadula Lift Irrigation Scheme	Jangaon	Jangaon		Kodakandla		Pochampalli	1052	1052
204	J.Chokka Rao Devadula Lift Irrigation Scheme	Jangaon	Jangaon		Kodakandla		Gundlakunta	1415	1415
205	J.Chokka Rao Devadula Lift Irrigation Scheme	Jangaon	Jangaon		Kodakandla		Chinnavangara	290	290
206	J.Chokka Rao Devadula Lift Irrigation Scheme	Jangaon	Jangaon		Kodakandla		Laksmakkapalli	430	430
207	J.Chokka Rao Devadula Lift Irrigation Scheme	Jangaon	Jangaon		Kodakandla		Ramavaram	3663	3663
208	J.Chokka Rao Devadula Lift Irrigation Scheme	Jangaon	Jangaon		Kodakandla		Pakhala	930	930
209	J.Chokka Rao Devadula Lift Irrigation Scheme	Jangaon	Jangaon		Kodakandla		Mondrai	1352	1352
210	J.Chokka Rao Devadula Lift Irrigation Scheme	Jangaon	Jangaon		Kodakandla		Kodakandla	1939	1939
211	J.Chokka Rao Devadula Lift Irrigation Scheme	Jangaon	Jangaon		Lingalaghanpur	29359	Cheeturu	1771	1771
212	J.Chokka Rao Devadula Lift Irrigation Scheme	Jangaon	Jangaon		Lingalaghanpur		Kundaram	3509	3509
213	J.Chokka Rao Devadula Lift Irrigation Scheme	Jangaon	Jangaon		Lingalaghanpur		Vadicherla	8	8
214	J.Chokka Rao Devadula Lift Irrigation Scheme	Jangaon	Jangaon		Lingalaghanpur		Nellutla	3191	3191
215	J.Chokka Rao Devadula Lift Irrigation Scheme	Jangaon	Jangaon		Lingalaghanpur		Vadicherla	2199	2199
216	J.Chokka Rao Devadula Lift Irrigation Scheme	Jangaon	Jangaon		Lingalaghanpur		Nagaram	923	923
217	J.Chokka Rao Devadula Lift Irrigation Scheme	Jangaon	Jangaon		Lingalaghanpur		Lingalaghanpur	4415	4415
218	J.Chokka Rao Devadula Lift Irrigation Scheme	Jangaon	Jangaon		Lingalaghanpur		Kallem	4073	4073
219	J.Chokka Rao Devadula Lift Irrigation Scheme	Jangaon	Jangaon		Lingalaghanpur		China Rajupeta	98	98
220	J.Chokka Rao Devadula Lift Irrigation Scheme	Jangaon	Jangaon		Lingalaghanpur		Siripuram	2044	2044
221	J.Chokka Rao Devadula Lift Irrigation Scheme	Jangaon	Jangaon		Lingalaghanpur		Jeedikal	2052	2052
222	J.Chokka Rao Devadula Lift Irrigation Scheme	Jangaon	Jangaon		Lingalaghanpur		Gummadavelli	1230	1230
223	J.Chokka Rao Devadula Lift Irrigation Scheme	Jangaon	Jangaon		Lingalaghanpur		Kothapalli	656	656
224	J.Chokka Rao Devadula Lift Irrigation Scheme	Jangaon	Jangaon		Lingalaghanpur		Wanaparthy	3190	3190
225	J.Chokka Rao Devadula Lift Irrigation Scheme	Jangaon	Jangaon		Devaruppula	29229	Kolukonda	1902	1902

STATEMENT SHOWING THE DETAILS OF DISTRICT-WISE, MANDAL-WISE AYACUT & VILLAGE-WISE CONTEMPLATED AYACUT UNDER JCR-DLIS

Sl.No.	Name of the Irrigatin Project	District where located	District to which water planned to be supplied		Name of Mandals to be covered		Names of villages to be covered		Total area proposed to be covered (Acres)
			Districts	Area (Acres)	Mandals	Area (Acres)	Villages	Area (Acres)	
226	J.Chokka Rao Devadula Lift Irrigation Scheme	Jangaon	Jangaon		Devaruppula		Chinna Madur	3754	3754
227	J.Chokka Rao Devadula Lift Irrigation Scheme	Jangaon	Jangaon		Devaruppula		Choudur	680	680
228	J.Chokka Rao Devadula Lift Irrigation Scheme	Jangaon	Jangaon		Devaruppula		Nayalapogula	1881	1881
229	J.Chokka Rao Devadula Lift Irrigation Scheme	Jangaon	Jangaon		Devaruppula		Madapuram	2258	2258
230	J.Chokka Rao Devadula Lift Irrigation Scheme	Jangaon	Jangaon		Devaruppula		Karavendi	2899	2899
231	J.Chokka Rao Devadula Lift Irrigation Scheme	Jangaon	Jangaon		Devaruppula		Pedda Madur	4320	4320
232	J.Chokka Rao Devadula Lift Irrigation Scheme	Jangaon	Jangaon		Devaruppula		Dharmapuram	735	735
233	J.Chokka Rao Devadula Lift Irrigation Scheme	Jangaon	Jangaon		Devaruppula		Manpahad	300	300
234	J.Chokka Rao Devadula Lift Irrigation Scheme	Jangaon	Jangaon		Devaruppula		Devaruppula	3376	3376
235	J.Chokka Rao Devadula Lift Irrigation Scheme	Jangaon	Jangaon		Devaruppula		Singarajpalli	1220	1220
236	J.Chokka Rao Devadula Lift Irrigation Scheme	Jangaon	Jangaon		Devaruppula		Nirmala	2314	2314
237	J.Chokka Rao Devadula Lift Irrigation Scheme	Jangaon	Jangaon		Devaruppula		Khadhavendhi	2007	2007
238	J.Chokka Rao Devadula Lift Irrigation Scheme	Jangaon	Jangaon		Devaruppula		Gollapalli	540	540
239	J.Chokka Rao Devadula Lift Irrigation Scheme	Jangaon	Jangaon		Devaruppula		Ramrajpalli	1043	1043
240	J.Chokka Rao Devadula Lift Irrigation Scheme	Jangaon	Jangaon		Gundala	31019	Anantharam	2436	2436
241	J.Chokka Rao Devadula Lift Irrigation Scheme	Jangaon	Jangaon		Gundala		Velmajala	2641	2641
242	J.Chokka Rao Devadula Lift Irrigation Scheme	Jangaon	Jangaon		Gundala		Maripaduga	1880	1880
243	J.Chokka Rao Devadula Lift Irrigation Scheme	Jangaon	Jangaon		Gundala		Mosanpalli	626	626
244	J.Chokka Rao Devadula Lift Irrigation Scheme	Jangaon	Jangaon		Gundala		Gangapuram	1293	1293
245	J.Chokka Rao Devadula Lift Irrigation Scheme	Jangaon	Jangaon		Gundala		Gundala	4275	4275
246	J.Chokka Rao Devadula Lift Irrigation Scheme	Jangaon	Jangaon		Gundala		Bandakothapalli	1211	1211
247	J.Chokka Rao Devadula Lift Irrigation Scheme	Jangaon	Jangaon		Gundala		Turka Shapuram	1105	1105
248	J.Chokka Rao Devadula Lift Irrigation Scheme	Jangaon	Jangaon		Gundala		Peddapadishala	1847	1847
249	J.Chokka Rao Devadula Lift Irrigation Scheme	Jangaon	Jangaon		Gundala		Vashakondur	1426	1426
250	J.Chokka Rao Devadula Lift Irrigation Scheme	Jangaon	Jangaon		Gundala		Brahmanpalli	1922	1922

STATEMENT SHOWING THE DETAILS OF DISTRICT-WISE, MANDAL-WISE AYACUT & VILLAGE-WISE CONTEMPLATED AYACUT UNDER JCR-DLIS

Sl.No.	Name of the Irrigatin Project	District where located	District to which water planned to be supplied		Name of Mandals to be covered		Names of villages to be covered		Total area proposed to be covered (Acres)
			Districts	Area (Acres)	Mandals	Area (Acres)	Villages	Area (Acres)	
251	J.Chokka Rao Devadula Lift Irrigation Scheme	Jangaon	Jangaon		Gundala		Seetha Rampuram	2321	2321
252	J.Chokka Rao Devadula Lift Irrigation Scheme	Jangaon	Jangaon		Gundala		Parupalli	1157	1157
253	J.Chokka Rao Devadula Lift Irrigation Scheme	Jangaon	Jangaon		Gundala		Ambala	1414	1414
254	J.Chokka Rao Devadula Lift Irrigation Scheme	Jangaon	Jangaon		Gundala		Vangala	871	871
255	J.Chokka Rao Devadula Lift Irrigation Scheme	Jangaon	Jangaon		Gundala		Suddala	941	941
256	J.Chokka Rao Devadula Lift Irrigation Scheme	Jangaon	Jangaon		Gundala		Kommipalli	1158	1158
257	J.Chokka Rao Devadula Lift Irrigation Scheme	Jangaon	Jangaon		Gundala		Ramaram	2495	2495
258	J.Chokka Rao Devadula Lift Irrigation Scheme	Jangaon	Jangaon		Rayaparthy	8709	Gannavaram	543	543
259	J.Chokka Rao Devadula Lift Irrigation Scheme	Jangaon	Jangaon		Rayaparthy		Keshavapuram	870	870
260	J.Chokka Rao Devadula Lift Irrigation Scheme	Jangaon	Jangaon		Rayaparthy		Kolanpalli	1899	1899
261	J.Chokka Rao Devadula Lift Irrigation Scheme	Jangaon	Jangaon		Rayaparthy		Thirumalayapalli	1032	1032
262	J.Chokka Rao Devadula Lift Irrigation Scheme	Jangaon	Jangaon		Rayaparthy		Kondur	2390	2390
263	J.Chokka Rao Devadula Lift Irrigation Scheme	Jangaon	Jangaon		Rayaparthy		Burhanpalli	729	729
264	J.Chokka Rao Devadula Lift Irrigation Scheme	Jangaon	Jangaon		Rayaparthy		Katrepalli	1246	1246
265	J.Chokka Rao Devadula Lift Irrigation Scheme	Jangaon	Jangaon		Bachannapet	28857	Padmatikeshavapur	2692	2692
266	J.Chokka Rao Devadula Lift Irrigation Scheme	Jangaon	Jangaon		Bachannapet		Ramachandrapuram	912	912
267	J.Chokka Rao Devadula Lift Irrigation Scheme	Jangaon	Jangaon		Bachannapet		Nagireddipally	1851	1851
268	J.Chokka Rao Devadula Lift Irrigation Scheme	Jangaon	Jangaon		Bachannapet		Gangaram	689	689
269	J.Chokka Rao Devadula Lift Irrigation Scheme	Jangaon	Jangaon		Bachannapet		Konne	2033	2033
270	J.Chokka Rao Devadula Lift Irrigation Scheme	Jangaon	Jangaon		Bachannapet		Alimpur	1927	1927
271	J.Chokka Rao Devadula Lift Irrigation Scheme	Jangaon	Jangaon		Bachannapet		Bachannpet	3783	3783
272	J.Chokka Rao Devadula Lift Irrigation Scheme	Jangaon	Jangaon		Bachannapet		Pochannapet	4667	4667
273	J.Chokka Rao Devadula Lift Irrigation Scheme	Jangaon	Jangaon		Bachannapet		Katkuru	1523	1523
274	J.Chokka Rao Devadula Lift Irrigation Scheme	Jangaon	Jangaon		Bachannapet		Narayanapuram	1011	1011
275	J.Chokka Rao Devadula Lift Irrigation Scheme	Jangaon	Jangaon		Bachannapet		Lingampally	937	937

STATEMENT SHOWING THE DETAILS OF DISTRICT-WISE, MANDAL-WISE AYACUT & VILLAGE-WISE CONTEMPLATED AYACUT UNDER JCR-DLIS

Sl.No.	Name of the Irrigatin Project	District where located	District to which water planned to be supplied		Name of Mandals to be covered		Names of villages to be covered		Total area proposed to be covered (Acres)
			Districts	Area (Acres)	Mandals	Area (Acres)	Villages	Area (Acres)	
276	J.Chokka Rao Devadula Lift Irrigation Scheme	Jangaon	Jangaon		Bachannapet		Masanpally	132	132
277	J.Chokka Rao Devadula Lift Irrigation Scheme	Jangaon	Jangaon		Bachannapet		Salvapur	650	650
278	J.Chokka Rao Devadula Lift Irrigation Scheme	Jangaon	Jangaon		Bachannapet		Itikyalapally	1795	1795
279	J.Chokka Rao Devadula Lift Irrigation Scheme	Jangaon	Jangaon		Bachannapet		Kesireddypally	668	668
280	J.Chokka Rao Devadula Lift Irrigation Scheme	Jangaon	Jangaon		Bachannapet		Basireddypally	670	670
281	J.Chokka Rao Devadula Lift Irrigation Scheme	Jangaon	Jangaon		Bachannapet		Kodavaturu	1538	1538
282	J.Chokka Rao Devadula Lift Irrigation Scheme	Jangaon	Jangaon		Bachannapet		Bandanagaram	188	188
283	J.Chokka Rao Devadula Lift Irrigation Scheme	Jangaon	Jangaon		Bachannapet		Laksmipuram	351	351
284	J.Chokka Rao Devadula Lift Irrigation Scheme	Jangaon	Jangaon		Bachannapet		Chinnaramancherla	840	840
285	J.Chokka Rao Devadula Lift Irrigation Scheme	Siddipet	Siddipet	80448	Komuravelli	10178	Inapur	2835	2835
286	J.Chokka Rao Devadula Lift Irrigation Scheme	Siddipet	Siddipet		Komuravelli		Ramsagar	682	682
287	J.Chokka Rao Devadula Lift Irrigation Scheme	Siddipet	Siddipet		Komuravelli		Komuravelli	2222	2222
288	J.Chokka Rao Devadula Lift Irrigation Scheme	Siddipet	Siddipet		Komuravelli		Kistampet	2112	2112
289	J.Chokka Rao Devadula Lift Irrigation Scheme	Siddipet	Siddipet		Komuravelli		Gouraipally	503	503
290	J.Chokka Rao Devadula Lift Irrigation Scheme	Siddipet	Siddipet		Komuravelli		Marrimuchal	805	805
291	J.Chokka Rao Devadula Lift Irrigation Scheme	Siddipet	Siddipet		Komuravelli		Posanpally	874	874
292	J.Chokka Rao Devadula Lift Irrigation Scheme	Siddipet	Siddipet		Komuravelli		Guruvannapet	145	145
293	J.Chokka Rao Devadula Lift Irrigation Scheme	Siddipet	Siddipet		Cheriyal	31618	Yesarani	1477	1477
294	J.Chokka Rao Devadula Lift Irrigation Scheme	Siddipet	Siddipet		Cheriyal		Cheriyal	7885	7885
295	J.Chokka Rao Devadula Lift Irrigation Scheme	Siddipet	Siddipet		Cheriyal		Dumata	2510	2510
296	J.Chokka Rao Devadula Lift Irrigation Scheme	Siddipet	Siddipet		Cheriyal		Tandur	960	960
297	J.Chokka Rao Devadula Lift Irrigation Scheme	Siddipet	Siddipet		Cheriyal		Chityal	1046	1046
298	J.Chokka Rao Devadula Lift Irrigation Scheme	Siddipet	Siddipet		Cheriyal		Dhanampally	493	493
299	J.Chokka Rao Devadula Lift Irrigation Scheme	Siddipet	Siddipet		Cheriyal		Akunur	5055	5055
300	J.Chokka Rao Devadula Lift Irrigation Scheme	Siddipet	Siddipet		Cheriyal		Nagpur	1316	1316

STATEMENT SHOWING THE DETAILS OF DISTRICT-WISE, MANDAL-WISE AYACUT & VILLAGE-WISE CONTEMPLATED AYACUT UNDER JCR-DLIS

Sl.No.	Name of the Irrigatin Project	District where located	District to which water planned to be supplied		Name of Mandals to be covered		Names of villages to be covered		Total area proposed to be covered (Acres)
			Districts	Area (Acres)	Mandals	Area (Acres)	Villages	Area (Acres)	
301	J.Chokka Rao Devadula Lift Irrigation Scheme	Siddipet	Siddipet		Cheriyal		Rajpet	570	570
302	J.Chokka Rao Devadula Lift Irrigation Scheme	Siddipet	Siddipet		Cheriyal		Kadaverugu	4361	4361
303	J.Chokka Rao Devadula Lift Irrigation Scheme	Siddipet	Siddipet		Cheriyal		Mutsyala	4270	4270
304	J.Chokka Rao Devadula Lift Irrigation Scheme	Siddipet	Siddipet		Cheriyal		Chunchunkonda	1675	1675
305	J.Chokka Rao Devadula Lift Irrigation Scheme	Siddipet	Siddipet		Maddur	22313	Salakpur	1098	1098
306	J.Chokka Rao Devadula Lift Irrigation Scheme	Siddipet	Siddipet		Maddur		Jalapally	885	885
307	J.Chokka Rao Devadula Lift Irrigation Scheme	Siddipet	Siddipet		Maddur		Lingapuram	783	783
308	J.Chokka Rao Devadula Lift Irrigation Scheme	Siddipet	Siddipet		Maddur		Arjunapatla	927	927
309	J.Chokka Rao Devadula Lift Irrigation Scheme	Siddipet	Siddipet		Maddur		Dhulmitta	986	986
310	J.Chokka Rao Devadula Lift Irrigation Scheme	Siddipet	Siddipet		Maddur		Kamlapally	454	454
311	J.Chokka Rao Devadula Lift Irrigation Scheme	Siddipet	Siddipet		Maddur		Maddur	1790	1790
312	J.Chokka Rao Devadula Lift Irrigation Scheme	Siddipet	Siddipet		Maddur		Gagillapur	1644	1644
313	J.Chokka Rao Devadula Lift Irrigation Scheme	Siddipet	Siddipet		Maddur		Narsaipally	778	778
314	J.Chokka Rao Devadula Lift Irrigation Scheme	Siddipet	Siddipet		Maddur		Laddanur	2046	2046
315	J.Chokka Rao Devadula Lift Irrigation Scheme	Siddipet	Siddipet		Maddur		Lakkapally	776	776
316	J.Chokka Rao Devadula Lift Irrigation Scheme	Siddipet	Siddipet		Maddur		Dharmaram	683	683
317	J.Chokka Rao Devadula Lift Irrigation Scheme	Siddipet	Siddipet		Maddur		Marmamula	787	787
318	J.Chokka Rao Devadula Lift Irrigation Scheme	Siddipet	Siddipet		Maddur		Vallampatla	1042	1042
319	J.Chokka Rao Devadula Lift Irrigation Scheme	Siddipet	Siddipet		Maddur		Kootigal	1700	1700
320	J.Chokka Rao Devadula Lift Irrigation Scheme	Siddipet	Siddipet		Maddur		Vangapally	1480	1480
321	J.Chokka Rao Devadula Lift Irrigation Scheme	Siddipet	Siddipet		Maddur		Rebarthi	1500	1500
322	J.Chokka Rao Devadula Lift Irrigation Scheme	Siddipet	Siddipet		Maddur		Bhairanpally	1170	1170
323	J.Chokka Rao Devadula Lift Irrigation Scheme	Siddipet	Siddipet		Maddur		Bekkal	1334	1334
324	J.Chokka Rao Devadula Lift Irrigation Scheme	Siddipet	Siddipet		Maddur		Kondapur	450	450
325	J.Chokka Rao Devadula Lift Irrigation Scheme	Siddipet	Siddipet		Kondapaka	13481	Vishwanathpally	441	441

STATEMENT SHOWING THE DETAILS OF DISTRICT-WISE, MANDAL-WISE AYACUT & VILLAGE-WISE CONTEMPLATED AYACUT UNDER JCR-DLIS

Sl.No.	Name of the Irrigatin Project	District where located	District to which water planned to be supplied		Name of Mandals to be covered		Names of villages to be covered		Total area proposed to be covered (Acres)
			Districts	Area (Acres)	Mandals	Area (Acres)	Villages	Area (Acres)	
326	J.Chokka Rao Devadula Lift Irrigation Scheme	Siddipet	Siddipet		Kondapaka		Vellikattu	355	355
327	J.Chokka Rao Devadula Lift Irrigation Scheme	Siddipet	Siddipet		Kondapaka		Thimmareddypally	883	883
328	J.Chokka Rao Devadula Lift Irrigation Scheme	Siddipet	Siddipet		Kondapaka		Kondapaka	675	675
329	J.Chokka Rao Devadula Lift Irrigation Scheme	Siddipet	Siddipet		Kondapaka		Nasaram	789	789
330	J.Chokka Rao Devadula Lift Irrigation Scheme	Siddipet	Siddipet		Kondapaka		Rajampally	545	545
331	J.Chokka Rao Devadula Lift Irrigation Scheme	Siddipet	Siddipet		Kondapaka		Dammakkapally	782	782
332	J.Chokka Rao Devadula Lift Irrigation Scheme	Siddipet	Siddipet		Kondapaka		Giraipally	902	902
333	J.Chokka Rao Devadula Lift Irrigation Scheme	Siddipet	Siddipet		Kondapaka		Sirsangandla	950	950
334	J.Chokka Rao Devadula Lift Irrigation Scheme	Siddipet	Siddipet		Kondapaka		Nagireddypally	688	688
335	J.Chokka Rao Devadula Lift Irrigation Scheme	Siddipet	Siddipet		Kondapaka		Domalampally	768	768
336	J.Chokka Rao Devadula Lift Irrigation Scheme	Siddipet	Siddipet		Kondapaka		Marpadaga	915	915
337	J.Chokka Rao Devadula Lift Irrigation Scheme	Siddipet	Siddipet		Kondapaka		Kamampally	782	782
338	J.Chokka Rao Devadula Lift Irrigation Scheme	Siddipet	Siddipet		Kondapaka		Rampally	845	845
339	J.Chokka Rao Devadula Lift Irrigation Scheme	Siddipet	Siddipet		Kondapaka		Duddela	996	996
340	J.Chokka Rao Devadula Lift Irrigation Scheme	Siddipet	Siddipet		Kondapaka		Dargah	705	705
341	J.Chokka Rao Devadula Lift Irrigation Scheme	Siddipet	Siddipet		Kondapaka		Bandaram	648	648
342	J.Chokka Rao Devadula Lift Irrigation Scheme	Siddipet	Siddipet		Kondapaka		Ankireddypally	812	812
343	J.Chokka Rao Devadula Lift Irrigation Scheme	Siddipet	Siddipet		Siddipet	2858	Mittapally	640	640
344	J.Chokka Rao Devadula Lift Irrigation Scheme	Siddipet	Siddipet		Siddipet		Ellupalli	742	742
345	J.Chokka Rao Devadula Lift Irrigation Scheme	Siddipet	Siddipet		Siddipet		Nacharapalli	786	786
346	J.Chokka Rao Devadula Lift Irrigation Scheme	Siddipet	Siddipet		Siddipet		Bakrichepal	690	690
347	J.Chokka Rao Devadula Lift Irrigation Scheme	Suryapet	Suryapet	13403	Thirumalagiri	13403	Mamidala	13	13
348	J.Chokka Rao Devadula Lift Irrigation Scheme	Suryapet	Suryapet		Thirumalagiri		Thirumalagiri	3579	3579
349	J.Chokka Rao Devadula Lift Irrigation Scheme	Suryapet	Suryapet		Thirumalagiri		Thatipamula	1378	1378
350	J.Chokka Rao Devadula Lift Irrigation Scheme	Suryapet	Suryapet		Thirumalagiri		Nandapuram	1335	1335

STATEMENT SHOWING THE DETAILS OF DISTRICT-WISE, MANDAL-WISE AYACUT & VILLAGE-WISE CONTEMPLATED AYACUT UNDER JCR-DLIS

Sl.No.	Name of the Irrigatin Project	District where located	District to which water planned to be supplied		Name of Mandals to be covered		Names of villages to be covered		Total area proposed to be covered (Acres)
			Districts	Area (Acres)	Mandals	Area (Acres)	Villages	Area (Acres)	
351	J.Chokka Rao Devadula Lift Irrigation Scheme	Suryapet	Suryapet		Thirumalagiri		Thonda	4012	4012
352	J.Chokka Rao Devadula Lift Irrigation Scheme	Suryapet	Suryapet		Thirumalagiri		Malipuram	1158	1158
353	J.Chokka Rao Devadula Lift Irrigation Scheme	Suryapet	Suryapet		Thirumalagiri		Eturu	376	376
354	J.Chokka Rao Devadula Lift Irrigation Scheme	Suryapet	Suryapet		Thirumalagiri		Mamidipalle	222	222
355	J.Chokka Rao Devadula Lift Irrigation Scheme	Suryapet	Suryapet		Thirumalagiri		Velchel	300	300
356	J.Chokka Rao Devadula Lift Irrigation Scheme	Suryapet	Suryapet		Thirumalagiri		Bandlapalle	590	590
357	J.Chokka Rao Devadula Lift Irrigation Scheme	Suryapet	Suryapet		Thirumalagiri		Velishala	440	440
358	J.Chokka Rao Devadula Lift Irrigation Scheme	Yadadri	Yadadri	16771	Aleru	15256	Tangutoor	2081	2081
359	J.Chokka Rao Devadula Lift Irrigation Scheme	Yadadri	Yadadri		Aleru		Sharajipeta	3736	3736
360	J.Chokka Rao Devadula Lift Irrigation Scheme	Yadadri	Yadadri		Aleru		Golankonda	3229	3229
361	J.Chokka Rao Devadula Lift Irrigation Scheme	Yadadri	Yadadri		Aleru		Aleru	2532	2532
362	J.Chokka Rao Devadula Lift Irrigation Scheme	Yadadri	Yadadri		Aleru		Kolluru	3086	3086
363	J.Chokka Rao Devadula Lift Irrigation Scheme	Yadadri	Yadadri		Aleru		Patelgudem	592	592
364	J.Chokka Rao Devadula Lift Irrigation Scheme	Yadadri	Yadadri		Mothukur	1515	Mothukur	1515	1515
	TOTAL			**553241**		**553241**		**553241**	**553241**
							Forest	2413	
							Deletion ayacut(P-IV)	2000	
							GRAND TOTAL	**557654**	

ANNEXURE-11

ANNEXURE - 11

SRSP Stgae I

DISTRIBUTARY WISE, MINOR WISE, ASSEMBLY CONSTITUTION WISE, MANDAL WISE, VILLAGE WISE AYACUT DETAILS

S No	Name of the		OT Location At km	Off take on	Length in km	Name of the Assembly	Name of the Mandal	Name of the village	Ayacut	
	Distributory	Minor/ Sub-minor							Ac	G
1	**DBM-40**		**249.400**							
2		D10	2.300	DBM-40	4.400	PARKAL	SANGAM	CHINTHALPALLY	403	23
3		R1	5.600	DBM-40	1.075	PARKAL		CHINTHALPALLY	203	13
4								PALLARIGUDA	47	35
5		R2	7.125	DBM-40	1.025	PARKAL		CHINTHALPALLY	146	38
6								MONDRAI	98	11
7								MUMMIDIVARAM	02	33
8		L1-R2	0.150	R2	3.000	PARKAL		MONDRAI	139	32
9								MUMMIDIVARAM	96	25
10		R3	12.800	DBM-40	6.400	NARSAMPET	NEKKONDA	DEEKSHAKUNTA	234	58
11						NARSAMPET	CHENNARAOPET	UPPARPALLY	20	0
12		L1-R3	0.475	R3	2.600	NARSAMPET	CHENNARAOPET	UPPARPALLY	259	34
13								KONAPUR	61	19
14		R3-L1-R3	0.850	L1-R3	0.500	NARSAMPET		UPPARPALLY	119	26
15		R1- R3	1.400	R3	1.400	PARKAL	SANGAM	NALLABELLY	204	26
16		R2- R3	2.100	R3	2.222			NALLABELLY	367	22
17		L4-R2- R3	2.220	R2-R3	0.550			NALLABELLY	300	32
18						NARSAMPET	NEKKONDA	MUDIGONDA	248	23
19		L2-R3	2.100	R3	1.200		CHENNARAOPET	UPPARPALLY	236	22
20		R3-R3	3.100	R3	0.450		NEKKONDA	MUDIGONDA	92	38
21		L1- R3-R3	0.200	R3-R3	0.050			MUDIGONDA	77	14
22		L2- R3-R3	0.450	R3-R3	0.050			MUDIGONDA	218	34
23		L3- R3	3.660	R3	0.900	NARSAMPET	NEKKONDA	DEEKSHAKUNTA	92	19
24							CHENNARAOPET	Upparapally	232	27
25		R4-R3	4.800	R3	0.720		NEKKONDA	MUDIGONDA	333	7
26								DEEKSHAKUNTA	127	31
27		L4-R3		R3	1.200			MUDIGONDA	26	0
28								DEEKSHAKUNTA	262	34
29		L1	13.367	DBM-40	17.650		NARSAMPET	MAHESHWARAM	43	18
30							CHENNARAOPET	LINGAPUR	108	17
31								GURIJALA	100	22
32								AKKALCHEDU	81	13
33								MAKDUMPUR	367	14
34							DUGGONDI	RANGAPUR	22	24
35								MADIRAMADANAPALLY	11	10
36								CHELAPARTHY	45	16
37								LAKNEPALLY	173	11
38								RAMAVARAM	240	29
39		L1A-L1	11.525	L1	1.200		NARSAMPET	MAHESHWARAM	87	17
40							DUGGONDI	MADIRA	19	13
41								RAMAVARAM	163	1
42		L1-L1	12.200	L1	2.750		NARSAMPET	MAHESHWARAM	536	14
43							DUGGONDI	LAKNEPALLY	60	27
44		L2-L1	13.125	L1	0.250		NARSAMPET	MAHESHWARAM	140	32
45		L3-L1	14.085	L1	0.780			MAHESHWARAM	325	20
46		L4-L1	14.775	L1	0.200			MAHESHWARAM	159	11
47							CHENNARAOPET	MAKDUMPUR	44	24
48		L5-L1	16.725	L1	0.350		NARSAMPET	MAHESHWARAM	87	4
49							CHENNARAOPET	MAKDUMPUR	130	34
50		R3-L1	2.350	L1	4.125		CHENNARAOPET	LINGAPUR	6	19
51								GURIJALA	474	31
52							DUGGONDI	RANGAPUR	63	28
53		R1-R3-L1	1.275	R3-L1	1.000		CHENNARAOPET	GURIJALA	225	36
54							DUGGONDI	RANGAPUR	7	37
55		R2-R3-L1	1.800	R3-L1	0.475		CHENNARAOPET	GURIJALA	190	17
56		R3A-L1	4.575	L1	2.700			GURIJALA	132	1
57							DUGGONDI	MADIRAMADANAPALLY	23	4
58							NARSAMPET	LAKNEPALLY	374	0
59		R5-L1	11.290	L1	0.750			LAKNEPALLY	134	5
60		L2	15.297	DBM-40	6.200		NEKKONDA	DEEKSHAKUNTA	85	0
61								CHENNARAOPET	190	39
62								MAKDUMPUR	25	29
63								AKKALCHEDU	36	36
64						NARSAMPET		KONAPUR	176	36
65								KONAPUR	113	26

66		L1-L2	0.100	L2	1.600			LINGAPUR	38	39
67								GURIJALA	28	39
68		L1-L1-L2	0.475	L1-L2	0.427			LINGAPUR	66	5
69		L2-L2	1.925	L2	1.550			KONAPUR	87	49
70							CHENNARAOPET	GURIJALA	99	21
71		R1-L2-L2	0.225	L2-L2	1.200			KONAPUR	34	32
72								GURIJALA	122	14
73		R1-R1-L2-L2	1.050	R1-L2-L2	0.826			GURIJALA	110	24
74		R1-L2	0.130	L2				KONAPUR	308	33
75		R2-L2	0.988	L2	0.584			KONAPUR	64	19
76		R3-L2	2.475	L2	1.350			KONAPUR	120	18
77		R4-L2	3.443	L2	0.970			KONAPUR	61	37
78								CHENNARAOPET	61	22
79		L3-L2	3.75	L2	0.850			GURIJALA	92	25
80								AKKALCHEDU	155	20
81		R1-L3-L2	0.500	L3-L2	1.250			AKKALCHEDU	100	9
82							CHENNARAOPET	CHENNARAOPET	19	2
83		R6-L2	4.925	L2	0.500			CHENNARAOPET	118	25
84		L4-L2	5.929	L2	0.800			AKKALACHEDU	59	2
85								MAKDUMPUR	31	5
86								CHENNARAOPET	43	9
87		R3A	17.550	DBM-40	0.775		NEKKONDA	DEEKSHAKUNTA	68	0
88							CHENNARAOPET	UPPARPALLY	299	14
89								KONAPUR	33	7
90		R4	19.575	DBM-40	2.300		NEKKONDA	DEEKSHAKUNTA	456	25
91								PANIKERA	17	20
92		R1-R4	0.075	R4	1.100	NARSAMPET		DEEKSHAKUNTA	364	21
93		R5	21.925	DBM-40	5.575					
94		1R-R5		R5				AMEENABAD	257	12
95		2R-R5		R5				AMEENABAD	80	0
96		2L-R5		R5				AMEENABAD	65	23
97		2LA-R5		R5				AMEENABAD	156	23
98		3R-R5	1.425	R5	0.500			AMEENABAD	77	17
99		3L-R5		R5			CHENNARAOPET	AMEENABAD	105	12
100		4R-R5	2.68	R5	0.600			AMEENABAD	323	0
101		4L-R5	2.79	R5	0.350			AMEENABAD	243	33
102		5R-R5	4.2	R5	1.300			AMEENABAD	297	0
103		5L-R5	3.85	R5	0.350			AMEENABAD	218	0
104		7R-R5		R5				AMEENABAD	112	30
105		6L-R5	4.95	R5	1.550			AMEENABAD	248	0
106		L3	22.503	DBM-40	5.475			JHELLY	123	1
107		1L-L3	0.315	L3	0.600			JHELLY	218	37
108		1R-L3	0.4	L3	4.000			JHELLY	317	26
109		2L-L3	2.865	L3	0.675			KHADERPET	102	27
110		3L-L3	1.95	L3	0.250			JHELLY	255	35
111								CHENNARAOPET	148	4
112								THIMMARAYNPHAD	5	10
113		4L-L3	4.15	L3	1.200			CHENNARAOPET	329	18
114		L4	25.000	DBM-40	3.525			AMEENABAD	206	25
115								JHELLY	33	0
116								THIMMARAYNPHAD	16	5
117								YELLAIAH GUDEM	68	7
118		1R-L4	0.66	L4	0.345			AMEENABAD	71	39
119		2L-L4	1.5	L4	1.700			THIMMARAYNPHAD	151	35
120		3R-L4	1.2	L4	1.200	NARSAMPET	CHENNARAOPET	THIMMARAYNPHAD	123	16
121		1L-L4	1.65	L4	1.650			YELLAIAH GUDEM	70	37
122								THIMMARAYNPHAD	427	13
123		1R-1L-L4		1L-L4				THIMMARAYNPHAD	127	10
124		2R-L4	1.2	L4	0.075			YELLAIAH GUDEM	124	36
125		3RA-L4	0.5	L4	0.600			THIMMARAYNPHAD	88	30
126								PAPAIAHPET	17	35
127								YELLAIAH GUDEM	11	11
128		R6	25.750	DBM-40	2.700			AMEENABAD	142	0
129		1L-R6	0.2	R6	1.425			AMEENABAD	957	57
130		3R-R6	5.9	R6	1.875			LINGAGIRI	310	9
131								SURIPALLY	156	23
132								AMEENABAD	115	1
133		R7	28.675	DBM-40	0.700			AMEENABAD	98	14
134								YELLAIAH GUDEM	15	25
135							GUDUR	GUNDENGA	19	35
136								YELLAIAH GUDEM	101	13

137		L5	28.675	DBM-40	5.800		CHENNARAOPET	PAPAIAHPET	603	8
138								YELLAIAH GUDEM	193	4
139								AMEENABAD	97	31
140		1R-L5	0.425	L5	0.425			YELLAIAH GUDEM	29	11
141							GUDUR	GUNDENGA	246	32
142								MADANAPUR	39	26
143		2L-L5	0.525	L5	0.750		CHENNARAOPET	YELLAIAH GUDEM	391	30
144		2R-L5	1.65	L5	0.250			YELLAIAH GUDEM	180	34
145		3L-L5	0.475	L5	0.500			PAPAIAHPET	121	36
146		3R-L5	0.325	L5	0.375			PAPAIAHPET	261	19
147		4L-L5	0.2	L5	0.200			PAPAIAHPET	264	12
148		R8	29.903	DBM-40	6.000		GUDUR	GUNDENGA	650	0
149		1R-R8	4.325	R8	0.525	NARSAMPET	NEKKONDA	NAGARAM	184	0
150		2R-R8	4.55	R8	0.913			NAGARAM	296	0
151		3R-R8	5.9	R8	1.700			NAGARAM	895	0
152		L6	32.000	DBM-40	5.125		GUDUR	PONUGODU	409	17
153							GUDUR	GUNDENGA	165	11
154		1R-L6	1.4	L6	1.000		CHENNARAOPET	PAPAIAHPET	36	0
155		3L-L6	2.05	L6	0.600			PAPAIAHPET	218	3
156		2L-L6	1.5	L6	0.575			PAPAIAHPET	97	30
157							Gudur	MADANAPUR	137	24
158		2R-L6	2.9	L6	2.925			PONUGODU	583	29
159		8R-L6						AYODHYAPUR	56	2
160		R9	32.150	DBM-40	0.725			GUNDENGA	169	0
161		L7A	33.125	DBM-40	5.475			GUNDENGA	88	13
162								GAJULAGATTU	78	22
163		L7	34.480	DBM-40	4.675	NARSAMPET	Gudur	GAJULAGATTU	172	0
164								AYODHYAPUR	110	0
165								NAIKPALLY	212	0
166		3L-L7	2.3	L7	5.475			BOLLEPALLY	103	36
167		4L-L7	4.4	L7	5.475			BOLLEPALLY	318	34
168		6L-L7		L7				NAIKPALLY	100	0
169		R10	36.350	DBM-40	2.875			RAJANPALLY	337	30
170		R11	38.665	DBM-40	2.800			RAJANPALLY	562	0
171		L8	40.475	DBM-40	2.875			THEEGALAVENI	359	0
172		L9	41.955	DBM-40	2.000			THEEGALAVENI	266	0
173		R12	42.175	DBM-40	1.350	Mahabubabad	KESAMUDRAM	ARPANPALLY	140	0
174		Main(T.E)		DBM-40		Narsampet	GUDUR	THEEGALAVENI	186	0
175	**DBM-46**	DBM-46	255.825	KMC	3.920	Parkal	GEESUGONDA	SHAYAMPET	182	0
176		--				Parkal	SANGAM	KUNTAPALLY	158	2
177		--						SANGAM	308	28
178	DBM-48		267.225	KMC						
179		Parvathagiri tank	7.35	DBM-48		WARDHANNAPET	PARVATAGIRI	PARVATAGIRI	1330	0
180	DBM-48	1L	4.350	DBM-48	9.525	NARSAMPET	NEKKONDA	CHANDRUGONDA	140	39
181	DBM-48	1R-1L	0.375	1L	3.875	WARDHANNAPET	PARVATHAGIRI	CHINTANEKKONDA	349	37
182	DBM-48							YENUGAL	236	19
183	DBM-48							CHINTANEKKONDA	149	12
184	DBM-48	2R-1R-1L	3.2	1R-1L	0.600			CHINTANEKKONDA		
185	DBM-48	1L-1R-1L	1.975	1R-1L	0.075			CHINTANEKKONDA	46	35
186	DBM-48	2R-1L	1.275	1L	2.200			CHINTANEKKONDA	135	7
187	DBM-48							YENUGAL	269	27
188	DBM-48	1R-2R-1L	0.875	2R-1L	0.150			YENUGAL	367	3
189	DBM-48	2L-2R-1L	0.875	2R-1L	0.300					
190	DBM-48	3L-2R-1L	1.975	2R-1L	0.100					
191	DBM-48	1L-1L	4.893	1L	0.300			YENUGAL	336	28
192	DBM-48	2L-1L	6.230	1L	0.425			YENUGAL		
193	DBM-48	3L-1L	6.552	1L	0.275	NARSAMPET	NEKKONDA	CHANDRUGONDA	102	4
194	DBM-48	4R-1L	6.552	1L	1.300	WARDHANNAPET	PARVATHAGIRI	CHOWTAPALLY	112	38
195	DBM-48							YENUGAL	422	39
196	DBM-48	1L-4R-1L	0.075	4R-1L	0.200	NARSAMPET	NEKKONDA	CHANDRUGONDA	222	31
197	DBM-48							CHINTANEKKONDA	363	23
197	DBM-48					WARDHANNAPET	PARVATHAGIRI	CHOWTAPALLY	21	6
198	DBM-48	2L-4R-1L	1.275	4R-1L	0.900			YENUGAL	118	0
198	DBM-48							CHANDRUGONDA	85	14
199	DBM-48	1L-4R-3R	1.275	4R-1L	0.725			CHINTANEKKONDA	65	11
200	DBM-48	5R-1L	7.765	1L	1.450			CHANDRUGONDA	201	15
201	DBM-48	6L-1L	7.900	1L	0.625			CHANDRUGONDA	85	25

202	DBM-48	1L-6L-1L	0.075	6L-1L	1.850	NARSAMPET	NEKKONDA	CHANDRUGONDA	412	3
203	DBM-48	7L-1L	8.550	1L	1.900			CHANDRUGONDA	320	33
204	DBM-48	8R-1L	9.435	1L	0.125			CHANDRUGONDA	241	27
205	DBM-48	9L-1L	9.435	1L	0.800			CHANDRUGONDA	276	34
206	DBM-48	2R	1.975	DBM-48	3.050	WARDHANNAPET	PARVATHAGIRI	CHOWTAPALLY	81	13
207	DBM-48							JAMALPOOR	207	33
208	DBM-48	1R-2R	0.350	2R	0.100			KONKAPAKA	116	4
209	DBM-48	2L-2R	0.450	2R	1.050			CHOWTAPALLY	242	21
210	DBM-48	3L-2R	1.720	2R	0.350			CHOWTAPALLY	120	23
211	DBM-48	4R	5.950	DBM-48	9.100			SOMARAM	103	36
212	DBM-48							KALLEDA	382	0
	DBM-48	1L-4R						CHINTHANEKKONDA	27	37
213			**0.325**	4R	1.350			PARVATAGIRI	163	17
214	DBM-48	1L-1L-4R	0.32	1L-4R	2.750			PARVATAGIRI	64	29
215	DBM-48	2R-4R	0.425	4R	1.925			CHOWTAPALLY	264	19
216	DBM-48	3R-4R	2.500	4R	1.700			SOMARAM	217	26
217	DBM-48							JAMALPOOR	18	12
218	DBM-48							CHOWTAPALLY	153	7
219	DBM-48	4R-4R	4.55	4R	2.385	WARDHANNAPET	PARVATHAGIRI	SOMARAM	274	38
220	DBM-48							PARVATAGIRI	147	39
221	DBM-48	1L-4R-4R	**0.075**	4R-4R	0.600			PARVATAGIRI	264	7
222	DBM-48	2R-4R-4R	0.775	4R-4R	0.525			SOMARAM	190	23
223	DBM-48	5R-4R	6.8	4R	1.800			PARVATAGIRI	332	12
224	DBM-48	6L	10.025	DBM-48	8.050	NARSAMPET	NEKKONDA	APPALRAOPET	113	0
225	DBM-48							GUNDREPALLI	393	15
226	DBM-48							PATHIPAKA	281	20
227	DBM-48							CHINTANEKKONDA	30	25
	DBM-48							NEKKONDA	22	9
228	DBM-48	1L-6L	0.325	6L	5.100			CHINTANEKKONDA	1823	19
229	DBM-48	1R-1L-6L		1L-6L	0.125			CHINTANEKKONDA	185	38
230	DBM-48	2R-1L-6L		1L-6L	0.375			CHINTANEKKONDA	182	33
231	DBM-48	3R-1L-6L		1L-6L				CHINTANEKKONDA	108	12
232	DBM-48	2R-6L	0.35	6L	0.835			CHINTANEKKONDA	239	0
233	DBM-48	4L-6L	**3.15**	6L	1.450			PATHIPAKA	343	17
234	DBM-48	5L-6L	4.578	6L	0.950			PATHIPAKA	70	33
235	DBM-48							GUNDREPALLI	7	26
236	DBM-48							NEKKONDA	173	26
237	DBM-48	6R-6L	4.725	6L	0.400			APPALRAOPET	129	26
238	DBM-48	7R-6L	5.975	6L	1.010			APPALRAOPET	299	0
239	DBM-48	8R-6L	6.425	6L	1.600			APPALRAOPET	214	34
240	DBM-48							GUNDREPALLI	55	33
241	DBM-48	9R-6L	7.200	6L	3.000		NEKKONDA	APPALRAOPET	650	12
242	DBM-48							GUNDREPALLI	137	2
243	DBM-48							PEDDAKORPOLE	92	0
244	DBM-48						CHENNARAOPET	SURIPALLY	99	11
245	DBM-48	1L-9R-6L		9R-6L				GUNDREPALLI	192	13
246	DBM-48	8L	11.625	DBM-48	4.750			APPALRAOPET	95	7
247	DBM-48							REDLAWADA	420	36
248	DBM-48							VENKATAPUR	126	14
249	DBM-48	8L-1R	0.500	8L	1.250	NARSAMPET		REDLAWADA	144	30
250	DBM-48	8L-2L	1.225	8L	0.225			APPALRAOPET	58	23
251	DBM-48						NEKKONDA	PATHIPAKA	19	25
252	DBM-48							REDLAWADA	124	16
253	DBM-48	8L-3R	1.875	8L	0.775			REDLAWADA	248	33
254	DBM-48	8L-4R	2.525	8L	0.575			REDLAWADA	177	27
255	DBM-48							VENKATAPUR	51	28
256	DBM-48	8L-5L	2.675	8L	0.475			APPALRAOPET	135	15
257	DBM-48							VENKATAPUR	43	30
258	DBM-48	8L-6R	4.1	8L	0.15			VENKATAPUR	239	4
259	DBM-48	9R	10.025	DBM-48	13.42	WARDHANNAPET	PARVATHAGIRI	BURGUMADLA	277	0
260	DBM-48					NARSAMPET	NEKKONDA	REDLAWADA	250	10
						WARDHANNAPET	PARVATHAGIRI	KALLEDA	339	31
							PARVATHAGIRI	PARVATHAGIRI	132	0
261	DBM-48					MAHABUBAD	NELLIKUDURU	METHARAJUPALLY	669	36
262	DBM-48	9R-1R	0.065	9R	2.875	WARDHANNAPET	PARVATHAGIRI	CHINTA NEKKONDA	37	5
263	DBM-48							PARVATHAGIRI	468	5
264	DBM-48	9R-1R-1L		9R-1R	0.05			PARVATHAGIRI	191	0
265	DBM-48		2.36	9R	4.5			PARVATHAGIRI	551	35

266	DBM-48	9R-2R	[illegible]	[illegible]	4.5			REDLAWADA	149	0
267								KALLEDA	244	35
268	DBM-48	9R-2R-1L		9R-2R	0.3			PARVATHAGIRI	109	30
269								REDLAWADA	88	0
270	DBM-48	9R-2R-2R			0.4	WARDHANNAPET	PARVATHAGIRI	PARVATHAGIRI	278	5
271	DBM-48	9R-2R-3L			0.175			PARVATHAGIRI	67	0
272								KALLEDA	100	6
273	DBM-48	9R-3R	8.5	9R	0.25			KALLEDA	201	0
274	DBM-48	9R-4R	11.873		0.1			BURGUMADLA	151	0
275	DBM-48							METHARAJUPALLY	21	0
275	DBM-48					NARSAMPET	NEKKONDA	GOTLAKONDA	238	17
276	DBM-48							REDLAWADA	282	20
277	DBM-48	10R	14.85	DBM-48	10.65	MAHABUBAD	NELLIKUDURU	METHARAJUPALLY	120	36
278								KALLEDA	41	9
279	DBM-48					WARDHANNAPET	PARVATHAGIRI	BURGUMADLA	347	3
280	DBM-48	10R-1R	1.725	10R	1.225	NARSAMPET	NEKKONDA	GOTLAKONDA	262	24
281	DBM-48	10R-1R-1R	0.25	10R-1R	0.75	WARDHANNAPET	PARVATHAGIRI	KALLEDA	140	31
282	DBM-48	10R-2R	3.75	10R	1.3	NARSAMPET	NEKKONDA	GOTLAKONDA	106	6
283	DBM-48	10R-2R-1R						GOTLAKONDA	105	38
284	DBM-48		0.9	10R-2R	1.1	WARDHANNAPET	PARVATHAGIRI	BURGUMADLA	261	29
285	DBM-48	10R-3R						BURGUMADLA	207	28
286	DBM-48		6.25	10R	0.95	MAHABUBAD	NELLIKUDURU	METHARAJUPALLY	1598	15
287	DBM-48	10R1						NAINALA	354	0
288	DBM-48							NELLIKUDURU	350	0
289	DBM-48							MADANATHURTHY	506	0
290	DBM-48						KESAMUDRAM	INGURTHY	789	0
291	DBM-48	10R1-1AL	0.05	10R1	2.825			INGURTHY	218	0
292	DBM-48					NARSAMPET	NEKKONDA	BOLLIKONDA	218	0
293	DBM-48	10R1-2L	3.8	10R1	1.075	MAHABUBABAD	KESAMUDRAM	INGURTHY	213	0
294	DBM-48	10R1-3L	9.8		2.7			INGURTHY	208	15
295	DBM-48						NELLIKUDURU	CHINNA NAGARAM	377	0
296	DBM-48							RAJULAKOTHAPALLY	445	13
297	DBM-48	10R1-3L-1L	0.425	10R1-3L	2.07		KESAMUDRAM	INGURTHY	677	6
298	DBM-48	10R1-4L	14.02	10R1	5.3		NELLIKUDURU	NAINALA	1281	22
299	DBM-48							RAVIRALA	570	24
300	DBM-48	10R1-4L-2L	2.19	10R1-4L	2.55			NAINALA	377	34
301	DBM-48							RAJULAKOTHAPALLY	294	8
302	DBM-48							RAVIRALA	129	0
303	DBM-48	10R1-4L-1L	0.175		0.85			NAINALA	213	0
304	DBM-48	10R1-5L	15.305	10R1	0.4			NAINALA	155	2
305	DBM-48	10R1-7L	16.35		1.025			NAINALA	235	8
306	DBM-48	10R1-8R	17.197	10R1	5.45			NELLIKUDURU	1120	0
307	DBM-48							KACHIKAL	294	0
308	DBM-48	10R1-8R-1L	0.512	10R1-8R	0.425			NELLIKUDURU	68	0
309	DBM-48	10R1-8R-1R	2.343		1.9			KACHIKAL	171	0
310	DBM-48							RAMANUJAGUDEM	289	0
311	DBM-48						NELLIKUDURU	YERRABELLIGUDEM	29	35
312	DBM-48	10R1-8R-1R-1R	1.26	10R1-8R-1R	0.775			YERRABELLIGUDEM	86	5
313	DBM-48	10R1-8R-2R	3.825	10R1-8R	0.84			KACHIKAL	456	0
314	DBM-48	10R1-9R	17.64	10R1	1.575			NELLIKUDURU	557	0
315	DBM-48	10R1-10L	18.25		2.75			NAINALA	672	0
316	DBM-48	10R1-11R	18.625		0.9			NELLIKUDURU	203	0
317	DBM-48	10R1-12R	19.125		0.925			NELLIKUDURU	278	0
318	DBM-48	10R1-13R			1.425			NELLIKUDURU	274	10
319	DBM-48								250	30
320	DBM-48	10R1-14L	20.19		0.2			NAINALA	197	0
321	DBM-48	10R1-15L	20.79		1.35			NAINALA	84	0
322	DBM-48							MADANATHURTHY	329	0
323	DBM-48	10R1-15L-1L	0.818	10R1-15L				NAINALA	106	0
324	DBM-48							MADANATHURTHY	640	30
325	DBM-48	10R1-16R	21.7	10R1	0.975	MAHABUBABAD	NELLIKODHURU	NELLIKUDURU	428	0
326	DBM-48	10R1-17R	22.2		0.325			NELLIKUDURU	93	20
327	DBM-48							MADANATHURTHY	114	0
328	DBM-48	11L	19.2	DBM-48	7.575			THOPANPALLY	253	19
329	DBM-48							VENKATAPUR	357	29
330	DBM-48							ALANKANIPET	62	5
331	DBM-48							APPALARAOPET	50	29

332	DBM-48							BOLLIKONDA	59	36
333	DBM-48							PEDDAKORPOLE	352	29
334	DBM-48	11L-1L	3.3	11L	0.55	NARSAMPET	NEKKONDA	VENKATAPUR	170	31
335	DBM-48							THOPANPALLY	46	13
336	DBM-48	11L-1AL	0.2		0.85			THOPANPALLY	104	21
337	DBM-48							BOLLIKONDA	28	34
338	DBM-48	11L-2R			1.6			ALANKANIPET	452	6
339	DBM-48	11L-3L	6.3		1.125			APPALARAOPET	241	10
340	DBM-48							PEDDAKORPOLE	56	37
341	DBM-48	11L-4L	7.575		0.69			PEDDAKORPOLE	486	20
342	DBM-50	DBM-50 MAIN	271.55	KMC	2.55	WARDHANNAPET	PARVATHAGIRI	KONKAPAKA	143	0
343								GOPANPALLY	253	27
344										
345	DBM-51	DBM-51 MAIN	274.5		10.65			WADLAKONDA	397	11
346	DBM-51							GOPANPALLY	117	27
347	DBM-51							ROLLAKAL	492	10
348	DBM-51						WARDHANNAPET	NALLABELLY	91	33
349	DBM-51	1R	2.575	DBM-51	0.625			NALLABELLY	193	26
350	DBM-51	1L-1R						NALLABELLY	106	0
351	DBM-51			1L			PARVATHAGIRI	WADLAKONDA	43	4
352	DBM-51	2L	4.52		0.3			WADLAKONDA	326	7
353	DBM-51	3R	4.7		0.5			WADLAKONDA	246	33
354	DBM-51	4R	4.9		0.2			WADLAKONDA	299	35
355	DBM-51/A		276.35	KMC	1.65	WARDHANNAPET	WARDHANNAPET	UPPARPALLI	63	9
356								NALLABELLI	245	32
357	DBM-53	DBM-53 MAIN	281.85	KMC	7.5			KATRIAL	137	17
358	DBM-53							NALLABELLY	1452	12
359	DBM-53						PARVATHAGIRI	ROLLAKAL	215	29
360	DBM-53	1R	1.5	DBM-53	2.875		WARDHANNAPET	ELLANDA	345	23
361	DBM-53							WARDHANNAPET	67	9
362	DBM-53							NALLABELLY	217	4

ANNEXURE-12

ANNEXURE - 12

STATEMENT OF SHOWING THE VILLAGE WISE AYACUT PARTICULARS OF SRSP STAGE-II K.C.CAMP, WARANGAL.

Sl. No.	Name of the Project / Distributor	District	Mandal	Village	Total ayacut contemplated	I.P. created	I.P. utilised (where water supply is given and crops are raised)	Gap ayacut	Reasons for non Utilisation	Remarks
1	DBM-54	Warangal	Wardhannapet	kothapalli	934	934			No F.Cs are excavated under this distributory.	Water released for feeding of tanks under Warangal Dist
		Warangal		labarthi	390	390				
		Warangal	Rayaparthi	mahaboobnagar	2978	2978				
		Warangal		periked	800	800				
		Warangal		kothur	2038	2038				
		Warangal	Parvathagiri	annaram	5013	5013				
		Warangal		ravoor	2366	2366				
		Warangal		kalleda	309	309				
		Warangal		TOTAL ::	14828	14828				
2	DBM-55	warangal	Rayaparthy	Rayaparthy	618	618			-	Water released for feeding of tanks under Warangal Dist
		warangal		TOTAL ::	618	618				
3	DBM-56	warangal		Rayaparthy	497	497			-	Water released for feeding of tanks under Warangal Dist
		warangal		TOTAL ::	497	497				

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Sl. No.	Name of the Project / Distributor	District	Mandal	Village	Total ayacut contemplated	I.P. created	I.P. utilised (where water supply is given and crops are raised)	Gap ayacut	Reasons for non Utilisation	Remarks
4	DBM-57	warangal		1. Sannur	1659	1483			HR to be tackled	Water released for feeding of tanks under Warangal Dist
		warangal		2. Mylaram	1777	-			HR to be tackled	
		warangal		3. Gattikal	433	-			HR to be tackled	
		warangal		4. Jagannathpally	818	331			HR to be tackled	
		warangal		5. Ookal	1792	1157			Work in progress	
		warangal		6. Ammapur	1000	1000			-	
		warangal		7. Gurthur	1401	1401			-	
		warangal		8. Khanapur	806	806			-	
		warangal		9. Kantaipalem	494	494			-	
		warangal		TOTAL ::	10180	6672				
5	DBM-59	warangal	Thorrur	Thorrur	175	nil			-	Water released for feeding of tanks under Warangal Dist
		warangal		Sannur	390	nil			-	
		warangal		Velikatte	1000	nil			-	
		warangal		Kommanapally Chinthalapally	3180	nil			-	
		warangal		Madipally Polepally	4251	nil			-	
		warangal		Matedu Gopalagiri	1012	nil			-	
		warangal		Fatepur						
		warangal		TOTAL ::	10008	0				

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Sl. No.	Name of the Project / Distributor	District	Mandal	Village	Total ayacut contemplated	I.P. created	I.P. utilised (where water supply is given and crops are raised)	Gap ayacut	Reasons for non Utilisation	Remarks
6	DBM-60 (Package-	warangal	Thurrur	1. Nanchari madur	86	0			FC.s are not started	Water released for feeding of tanks under Warangal Dist
		warangal		2.velikatta	2127	1800				
		warangal		3.Gopalgri	957	957				
		warangal		4.Cherlapalam	630	630				
		warangal		5.Venkatapur	839	839				
		warangal		6.Mated	507	507			FC.s are not started	
		warangal		7.Cinnavangra	1977	1600				
		warangal		8.Hariperala	1478	1100				
		warangal		9.Chikataya palem	892	892				
		warangal		10.Bonthupally	769	769				
		warangal	Narshimulapet	1.Ramavaram	799	799			FC.s are not started	
		warangal		2.Dhantala pally	1378	1200				
		warangal		3.Agapet	981	981				
		warangal		4.Kummri kunta	988	988				
		warangal		5.Gunnapally	1289	892				
		warangal		6.Narshimulapet	3890	1600			FC.s are not started	
		warangal		7.kummulavancha	1140	930				
		warangal		8.Dhatla	3050	1286				
		warangal		9.Kottapally	701	701				
		warangal		10.Mungimadu	1605	0				
		warangal		11.Akkirala	713	713				
		warangal		12.Jayapuram	922	0				

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Sl. No.	Name of the Project / Distributor	District	Mandal	Village	Total ayacut contemplated	I.P. created	I.P. utilised (where water supply is given and crops are raised)	Gap ayacut	Reasons for non Utilisation	Remarks
		warangal		13.Repani.	927	642				
		warangal		14.Pedda mupparam	2237	0				
		warangal		15.vemulapally	1399	0			FC.s are not started	
		warangal		16.vanthadapula	970	0				
		warangal		17.peddanagaram	2743	0				
		warangal		TOTAL::	35994	19826				
7	DBM-61	Warangal	Torrur	chinnavangara	4424				Due to hard rock in first reach	
		Warangal		chityala	2112					
		Warangal		aripirala	1323					
		Warangal		peddavangara	155					
		Warangal		bommakal	202					
		Warangal		karkal	1006					
		Warangal	Kodakandla	peddavangara	467					
		Warangal		TOTAL ::	9689	0				
8	DBM-63	Warangal	kodakandla	DPS	1268	-			-	Water released for feeding of tanks under Warangal Dist
		Warangal		Gantlakunta, pedavangara koripally	205	-			-	-
		Warangal		wadekothpally	726	-			-	-
		Warangal		Thorrur pocharam	1288	-			-	-
		Warangal		TOTAL ::	3487	0				

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Sl. No.	Name of the Project / Distributor	District	Mandal	Village	Total ayacut contemplated	I.P. created	I.P. utilised (where water supply is given and crops are raised)	Gap ayacut	Reasons for non Utilisation	Remarks
9	DBM-65	Warangal		Narsingapur	332	332				Water released for feeding of tanks under Warangal Dist
		Warangal		Rangapur	571	-			Work is stopped for want of revised rates	
		Warangal		TOTAL ::	571	0				
10	DBM-67	Warangal	Kodakandla	kodakandla	205				Tenders to be finalized at circle level	
		Warangal	TOTAL ::		205	0				
	DBM-69	WARANGAL	kodakandla	waddekothapalli	309					
		WARANGAL	Maripeda	ramapuram	130					
		WARANGAL		thanamcherla	1968					
		WARANGAL	Narsimhulapet	kummarikuntla	26					
		WARANGAL		peddamupparam	3184					
		WARANGAL		vemulapalli	1767					
		WARANGAL			7384					

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Superintending Engineer,
S R.S.P. Stage-II Circle,
K.C. Camp, Warangal.

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STATEMENT OF SHOWING THE VILLAGE WISE AYACUT PARTICULARS OF SRSP STAGE-II K.C.CAMP, WARANGAL.

Sl. No.	Name of the Project / Distributor	District	Mandal	Village	Total ayacut contemplated	I.P. created	I.P. utilised (where water supply is given and crops are raised)	Gap ayacut	Reasons for non Utilisation	Remarks
	DBM-60	Khammam	Tirumalayapalem	1.Subled	718	0			Not applicable	Water released for feeding of tanks under Khammam Dist
	(Package -54)	Khammam	"	2.Medidapalli	407	0				
		Khammam	"	3.Beerole	1582	0				
		Khammam	"	4. Jallepalli	1223	0				
		Khammam	"	5. Hydershahipet	913	0				
		Khammam	"	6.Tippareddygudem	690	0				
		Khammam	"	7.Pindiprole	1947	0				
		Khammam	"	8.Thettelapahad	1739	0				
		Khammam	"	9.Thallacheruvu	1140	0				
		Khammam	"	10.Edulacheruvu	1056	0				
		Khammam	"	11.Mahammadapura	62	0				
		Khammam	"	12.Patharlapadu	2130	0				
		Khammam	"	13.Kokkireni	2190	0				
		Khammam	"	14.Thirumalayapalei	1390	0				
		Khammam		Total:(A)	17187	0				
		Khammam	Mudigonda	1. Madapuram	923	0				
		Khammam	"	2. Yadavalli	668	0				
		Khammam	"	3. Katkur	849	0				
		Khammam		Total: (B)	2440	0				
		Khammam	Khamamm Rural	1. Kondapuram	1322	0				
		Khammam	"	2. Thallampadu	2412	0				
		Khammam	"	3. Gudurpahad	476	0				
		Khammam	"	4. Kachirajugudem	1649	0				
		Khammam	"	5. Mirenkodalpalem	1884	0				
		Khammam	"	6. Arekodu	1810	0				
		Khammam	"	7. Muthagudem	496	0				
		Khammam	"	8. Palapalli	23	0				
		Khammam	"	9. Palegudem	259	0				
		Khammam	"	10. Gollapadu	322	0				
		Khammam	"	11. Arempula	833	0				

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Sl. No.	Name of the Project / Distributor	District	Mandal	Village	Total ayacut contemplated	I.P. created	I.P. utilised (where water supply is given and crops are raised)	Gap ayacut	Reasons for non Utilisation	Remarks
		Khammam	-	12. Teldarpalli	566	0				
		Khammam	-	13. Barugudem	382	0				
		Khammam	-	14. Maddulapalli	490	0				
		Khammam		Total: (C)	12924	0				
		Khammam	Kusumanchi	1. Galgollapalli	2672	0				
		Khammam	-	2. Pocharam	1121	0				
		Khammam	-	3. Kusumanchi	5022	0				
		Khammam	-	4. Chegomma	2095	0				
		Khammam	-	5. Jeelacheruvu	2133	0				
		Khammam	-	6. Jujjularaopet	1284	0				
		Khammam	-	7. Gattusingaram	1708	0				
		Khammam	-	8. Mallepalli	438	0				
		Khammam	-	9. Nelapatla	2293	0				
		Khammam	-	10.Munigepallu	1406	0				
		Khammam	-	11.Palair	1321	0				
		Khammam	-	12.Chowtapalli	1037	0				
		Khammam	-	13.Perikasingaram	155	0				
		Khammam	-	14.Nayakangudem	763	0				
		Khammam		Total: (D)	23448	0				
		Khammam	Nelakondapally	1. Rajeswarapuram	1455	0				
		Khammam	-	2. Nelakondapally	1504	0				
		Khammam		Total: (E)	2959	0				
		Khammam								
		Khammam	Total Ayacut (A+B+C+D+E)		58958	Acres				

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S.P. Stage -II Circle,
K.C. Camp, Warangal.

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STATEMENT OF SHOWING THE VILLAGE WISE AYACUT PARTICULARS OF SRSP STAGE-II K.C.CAMP, WARANGAL.

Sl. No.	Name of the Project / Distributor	District	Mandal	Village	Total ayacut contemplated	I.P. created	I.P. utilised (where water supply is given and crops are raised)	Gap ayacut	Reasons for non Utilisation	Remarks
11	DBM-69	Nalgonda	Aatmakur	midtupalli	309					
		Nalgonda		epur	1465					
		Nalgonda			1774					
		Nalgonda	Nutankal	bikkumalla	694					Water released for feeding of tanks under Nalgonda Dist
		Nalgonda		chandupatla	1044					
		Nalgonda		chilapakunta	2018	2018				
		Nalgonda		chinnanemula	2068	2068				
		Nalgonda		dirshanapalli	641	641				
		Nalgonda		gorentla	3042	3042				
		Nalgonda		gundlasingaram	560	560				
		Nalgonda		lingampalli	1046	1046				
		Nalgonda		machannapalli	868	868				
		Nalgonda		muddirala	2631	2631				
		Nalgonda		mamidlamadava	854	854				
		Nalgonda		midiguda	121	121				
		Nalgonda		miryala	3058	3058				
		Nalgonda		mukuntapuram	1609	1609				
		Nalgonda		nutankal	3130	3130				
		Nalgonda		peddanemula	2041	2041				
		Nalgonda		polamalla	2196	2196				
		Nalgonda		tallasingaram	112	112				
		Nalgonda		venkipalli	1037	1037				
		Nalgonda		yedavalli	1137	1137				
		Nalgonda		yerrapahad	842	842				
		Nalgonda			30749	29011				

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Sl. No.	Name of the Project / Distributor	District	Mandal	Village	Total ayacut contemplated	I.P. created	I.P. utilised (where water supply is given and crops are raised)	Gap ayacut	Reasons for non Utilisation	Remarks
		Nalgonda	Tungaturti	Annaram	2898	2898				
		Nalgonda		Bandaramaram	1423	1423				
		Nalgonda		ganugabanda	840	840				
		Nalgonda		goddiparti	1503	1503				
		Nalgonda		gommadaveli	1831	1831				
		Nalgonda		karivirala	1424	1424				
		Nalgonda		kukudam	1820	1820				
		Nalgonda		kuntapalli	381	381				
		Nalgonda		manapuram	902	902				
		Nalgonda		pasnoor	712	712				
		Nalgonda		pastaala	416	416				
		Nalgonda		ramachandrapuram	248	248				
		Nalgonda		ravulapalli	2111	2111				
		Nalgonda		reddigudem	300	300				
		Nalgonda		sangam	880	880				
		Nalgonda		tungaturti	3048	3048				
		Nalgonda		venugupalli	178	178				
		Nalgonda		vempati	4207	4207				
		Nalgonda	Tirumalagiri	gottiparti	25122	25122				
		Nalgonda		jalalpur	167	167				
		Nalgonda		mamidala	1240	1240				
		Nalgonda		siddisamudram	655	655				
		Nalgonda		velishala	758	758				
		Nalgonda			107	107				
12	DBM-70	Nalgonda	Tirumalagiri	Mamidipalli	2927	2927				
		Nalgonda		Panigiri	150	-				
		Nalgonda	Tungaturthi	Pastala	1489	-			Preparation of Estimates for balance work. (Package No.1 in Circle office)	
		Nalgonda		Velugupalli	991					
		Nalgonda		Laxmapuram	1610					
					1020					

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Sl. No.	Name of the Project / Distributor	District	Mandal	Village	Total ayacut contemplated	I.P. created	I.P. utilised (where water supply is given and crops are raised)	Gap ayacut	Reasons for non Utilisation	Remarks
		Nalgonda		Keshavapur	240					
		Nalgonda	Jajireddygudem	kotaapall	972					
		Nalgonda		parsaipalli	701					
		Nalgonda		TOTAL ::	7173	0				
13	SRSP Stage-II DBM-71 of Kakatiya main Canal from Km.0.00 to 68.450	Nalgonda	Thirumlagiri	Etur	144677-00	422-20				Water released for feeding of tanks under Nalgonda Dist
		Nalgonda		Panigiri		297-08				
		Nalgonda				719-28				
		Nalgonda	Thungathurthy	Yelkipally		179-16				
		Nalgonda		Keshavapuram		1442-31				
		Nalgonda		Velugupally		1121-36				
		Nalgonda		Sangem		115-09				
		Nalgonda				2859-12				
		Nalgonda	Jajireddygudem	Vardhamankota		5864-32				
		Nalgonda		Aravapally		1610-03				
		Nalgonda		Kothapalli		691-12				
		Nalgonda		Parsaipalli		624-09				
		Nalgonda		Bollampalli		761-03				
		Nalgonda		Kasarlapahad		964-23				
		Nalgonda		Kommala		2567-35				
		Nalgonda		Kodur		2042-11				
		Nalgonda		Kunchamarthy		510-14				
		Nalgonda		Timmapur		1218-21				
		Nalgonda		Uyyalawada		528-20				
		Nalgonda		Jajireddygudem		1957-36				
		Nalgonda		Adivemula		1811-38				
		Nalgonda		Velpucherla		806-09				

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Sl. No.	Name of the Project / Distributor	District	Mandal	Village	Total ayacut contemplated	I.P. created	I.P. utilised (where water supply is given and crops are raised)	Gap ayacut	Reasons for non Utilisation	Remarks
		Nalgonda				21859-26				
		Nalgonda								
		Nalgonda	Nuthankal	Tallasingaram		1729-18				
		Nalgonda								
		Nalgonda	Atmakur (s)	Kandakatla		2454-23				
		Nalgonda		Nemmikal		3612-35				
		Nalgonda		Gattikal		731-30				
		Nalgonda		Patharlapahad		1846-38				
		Nalgonda		Istalapur		596-08				
		Nalgonda		Atmakur (s)		4506-04				
		Nalgonda		Mukuddevapalli		1211-38				
		Nalgonda		Yepur		2942-15				
		Nalgonda		Nasimpeta		522-10				
		Nalgonda		Thummalapenpahad		3181-34				
		Nalgonda		Kotapahad		1264-13				
		Nalgonda		Narayanappagudem		116-16				
		Nalgonda		Bopparam		1152-00				
		Nalgonda		Kothagudem		736-09				
		Nalgonda		Midthanpalli		59-03				
		Nalgonda		Settigudem		795-10				
		Nalgonda		Veakatapur		289-25				
		Nalgonda		Enubamula		1086-01				
		Nalgonda		Dacharam		729-30				
		Nalgonda		Gollagudem		330-25				
		Nalgonda				28166-07				
		Nalgonda								
		Nalgonda	Suryapet	Ramchandrapuram		731-00				
		Nalgonda		Solipet		976-19				
		Nalgonda		Erkaram		2661-30				

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S. No.	Name of the Project / Distributor	District	Mandal	Village	Total ayacut contemplated	I.P. created	I.P. utilised (where water supply is given and crops are raised)	Gap ayacut	Reasons for non Utilisation	Remarks
		Nalgonda		Ramavaram		919-32				
		Nalgonda		Balemula		4002-32				
		Nalgonda		Pinnayapalem		746-19				
		Nalgonda		Pillalamarri		1210-38				
		Nalgonda		Yendlapalli		966-23				
		Nalgonda		Venkataramapur		354-12				
		Nalgonda		Suryapet		237-26				
		Nalgonda		Ramannagudem		379-16				
		Nalgonda		Bechrag Dacharam		284-17				
		Nalgonda		Imampet		67-31				
		Nalgonda				13539-15				
		Nalgonda	Chevemula	Ilapuram		797-32				
		Nalgonda		Gayamvarigudem		806-20				
		Nalgonda		Chanduptla		2857-18				
		Nalgonda		Kudakuda		1553-29				
		Nalgonda		Chivemula		1483-37				
		Nalgonda		Vattikamampahad		4221-06				
		Nalgonda		BB Gudem		604-32				
		Nalgonda		Durajpalli		864-30				
		Nalgonda		Vallabhapuram		743-23				
		Nalgonda		Gumpula		875-19				
		Nalgonda		Thimmapur		1436-28				
		Nalgonda		Tirumalagiri		435-12				
		Nalgonda		Undrugonda		241-33				
		Nalgonda		Tuljaraopet		352-14				
		Nalgonda		Gunjaluru		1437-06				
		Nalgonda				18712-19				
		Nalgonda								
		Nalgonda	Penpahad	Dharmapuram		650-03				
		Nalgonda		Bhaktlapuram		351-39				
		Nalgonda		Mahamadapur		381-21				

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Sl. No.	Name of the Project / Distributor	District	Mandal	Village	Total ayacut contemplated	I.P. created	I.P. utilised (where water supply is given and crops are raised)	Gap ayacut	Reasons for non Utilisation	Remarks
		Nalgonda		Penpahad		1992-31				
		Nalgonda		Singireddypalli		1299-22				
		Nalgonda		Anantharam		420-29				
		Nalgonda		Gajulamalkapuram		76-22				
		Nalgonda		Lingala		427-22				
		Nalgonda		Potlapahad		487-00				
		Nalgonda		Chidella		0-0				
		Nalgonda		Dupahad		461-15				
		Nalgonda		Macharam		2308-07				
		Nalgonda				8857-11				
		Nalgonda	Mothe	Raypahad		1722-18				
		Nalgonda		Sarvaram		1338-36				
		Nalgonda		Kudali		552-10				
		Nalgonda		Urlagonda		2335-07				
		Nalgonda		Burkacherla		1764-16				
		Nalgonda		Sirikonda		5846-06				
		Nalgonda		Vibulapuram		1380-11				
		Nalgonda		Annavarigudem		896-16				
		Nalgonda		Nayakangudem		145-27				
		Nalgonda		Namavaram		3576-17				
		Nalgonda		Thummalapally		709-32				
		Nalgonda		Raghavapuram		1529-10				
		Nalgonda		Mothey		1473-20				
		Nalgonda		Hussainabad		2080-07				
		Nalgonda		Gopalapuram		112-35				
		Nalgonda		Mamillagudem		951-03				
		Nalgonda		Singarenipally		268-29				
		Nalgonda				26670-20				
		Nalgonda	Munugala	Repala		5124-14				
		Nalgonda		Kalakova		1548-29				
		Nalgonda		Madhavaram		1082-23				

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Sl. No.	Name of the Project / Distributor	District	Mandal	Village	Total ayacut contemplated	I.P. created	I.P. utilised (where water supply is given and crops are raised)	Gap ayacut	Reasons for non Utilisation	Remarks
		Nalgonda		Munugala		41-00				
		Nalgonda		Sayyadmujpharpet		495-14				
		Nalgonda		Tadvai		54-22				
		Nalgonda		Ganapavaram		0-0				
		Nalgonda		Kokkireni		0				
		Nalgonda		Nelamarri		113-26				
		Nalgonda				8460-08				
		Nalgonda	Nadigudem	Kariverala		2041-34				
		Nalgonda		Brundavanapuram		1308-32				
		Nalgonda		Nadigudem		140-31				
		Nalgonda		Ramchandrapuram		164-14				
		Nalgonda				3655-31				
		Nalgonda								
		Nalgonda	Gurdepalli	Veldanda		0				
		Nalgonda		Kutubshapur		0				
		Nalgonda				0-0				
		Nalgonda	GRAND TOTAL			135229-				
14	T.E. Distri. 0.0-6.45	Nalgonda	eturu	600					Thandus and small patches of sheet	
		Nalgonda	anantaram	600						
		Nalgonda	TOTAL	1200						

14/3

Superintending Engineer,
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ANNEXURE-13

THUPAKULAGUDEM BARRAGE

ANNEXURE - 13

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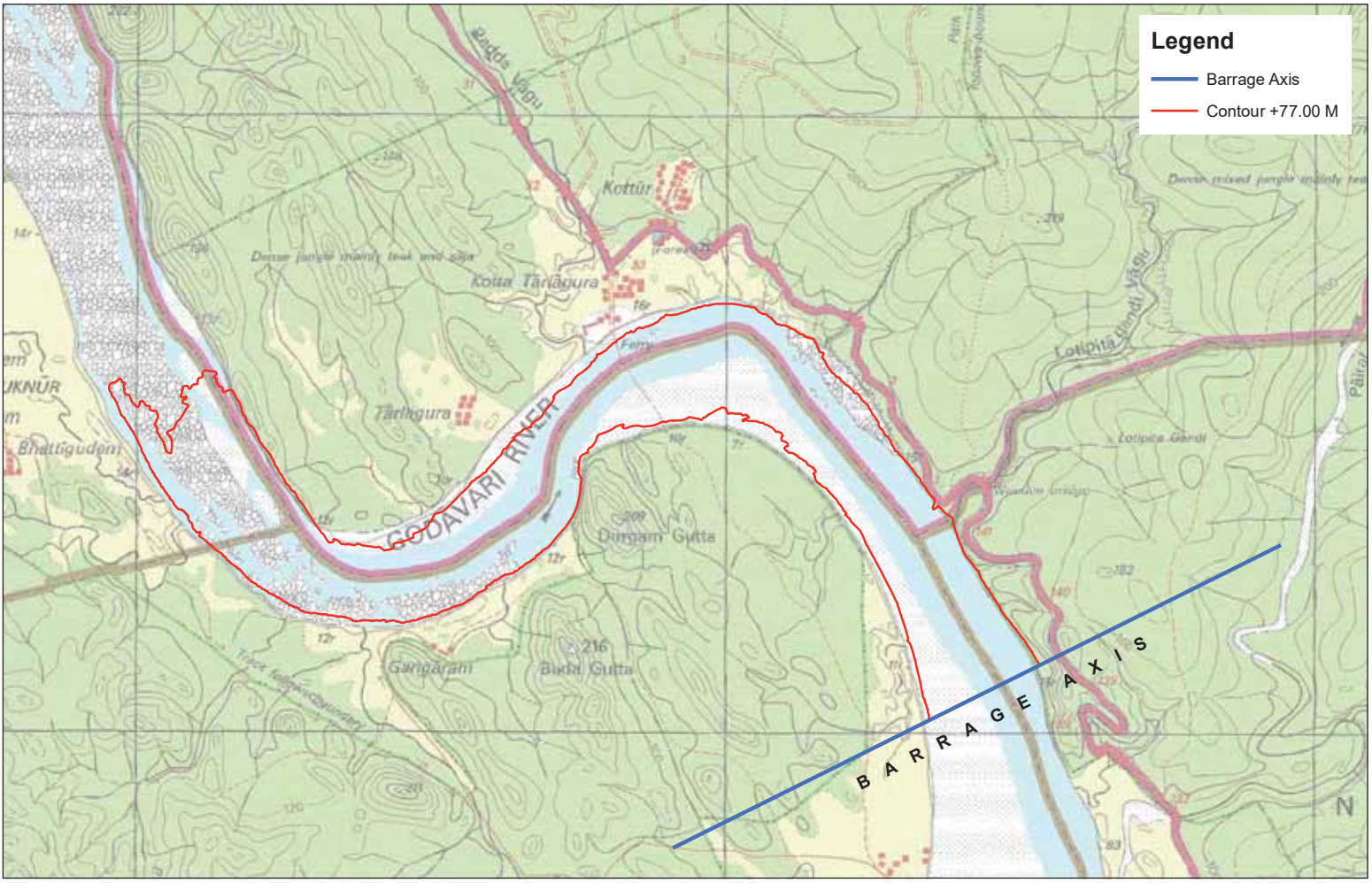


ANNEXURE-14

ANNEXURE – 14

Ambient Air Quality Monitoring results

Season	Dates	Monsoon season (July 2017- September 2017)				Dates	Post-monsoon season (October 2017- December 2017)				Dates	Pre-monsoon season (January 2018- March 2018)			
Location		**PM_{10}**	**$PM_{2.5}$**	**SO_2**	**NO_2**		**PM_{10}**	**$PM_{2.5}$**	**SO_2**	**NO_2**		**PM_{10}**	**$PM_{2.5}$**	**SO_2**	**NO_2**
NAAQ Standards		**100**	**60**	**80**	**80**		**100**	**60**	**80**	**80**		**100**	**60**	**80**	**80**
Near proposed barrage	04.07.2017	63	16	5.43	32.09	05.11.2017	65	18	5.02	31.48	02.02.2018	61	17	5.43	26.97
	07.07.2017	48	13	4.86	31.02	09.11.2017	53	14	5.14	32.12	06.02.2018	55	16	4.99	24.88
	11.07.2017	67	22	4.16	32.67	12.11.2017	66	20	4.28	32.06	09.02.2018	65	18	4.42	24.4
	14.07.2017	54	17	4.16	33.14	15.11.2017	59	19	4.58	32.96	13.02.2018	61	20	4.92	26.2
	18.07.2017	58	18	4.58	32.14	18.11.2017	62	20	4.76	32.28	16.02.2018	67	21	5.12	20.68
	22.07.2017	68	20	4.54	31.62	21.11.2017	67	21	4.72	32.64	20.02.2018	63	23	4.91	26.48
	26.07.2017	64	18	4.51	30.86	24.11.2017	63	20	4.62	31.16	23.02.2018	58	19	4.61	25.62
	30.07.2017	54	16	4.26	31.24	28.11.2017	56	17	4.46	32.04	27.02.2018	64	19	4.19	25.08
Kesamudram	03.07.2017	66	20	4.69	28.89	03.11.2017	69	22	4.72	29.26	01.02.2018	66	18	5.02	24.42
	06.07.2017	60	19	4.68	29.37	07.11.2017	63	20	4.78	30.46	05.02.2018	64	17	4.96	25.04
	10.07.2017	64	18	4.68	31.24	10.11.2017	67	23	5.16	31.84	08.02.2018	63	21	5.14	28.18
	13.07.2017	49	13	4.22	29.54	13.11.2017	46	12	4.86	30.24	12.02.2018	50	13	5.04	26.25
	17.07.2017	61	17	4.42	31.58	16.11.2017	64	16	5.02	30.86	15.02.2018	68	18	5.24	23.78
	20.07.2017	45	13	3.96	31.58	19.11.2017	49	12	4.02	32.08	19.02.2018	53	15	4.44	25.08
	24.07.2017	40	13	4.34	31.44	22.11.2017	46	11	5.02	31.78	22.02.2018	52	19	5.32	21.96
	28.07.2017	69	19	4.86	30.42	26.11.2017	67	21	5.24	30.86	26.02.2018	48	16	5.14	26.32
Mogulapally	03.07.2017	65	17	4.37	32.64	03.11.2017	67	20	4.46	30.18	01.02.2018	65	19	4.89	23.56
	06.07.2017	66	22	5.37	33.27	07.11.2017	68	23	5.64	32.08	05.02.2018	70	21	5.16	27.86
	10.07.2017	51	14	4.37	29.86	10.11.2017	55	16	4.66	30.22	08.02.2018	59	15	4.72	27.68
	13.07.2017	52	14	3.96	28.76	13.11.2017	54	15	4.24	29.16	12.02.2018	57	16	4.44	24.09
	17.07.2017	65	20	4.23	34.24	16.11.2017	68	19	4.46	33.32	15.02.2018	70	25	4.63	25.65
	20.07.2017	56	18	4.35	34.26	19.11.2017	60	19	4.64	34.82	19.02.2018	63	23	4.63	22.86
	24.07.2017	59	18	4.46	32.48	22.11.2017	62	17	4.88	32.68	22.02.2018	60	20	5.19	23.88
	28.07.2017	64	22	4.38	32.46	26.11.2017	65	18	4.58	33.1	26.02.2018	61	21	5.31	24.29

Season	Dates	Monsoon season (July 2017- September 2017)				Dates	Post-monsoon season (October 2017- December 2017)				Dates	Pre-monsoon season (January 2018- March 2018)			
Location		PM_{10}	$PM_{2.5}$	SO_2	NO_2		PM_{10}	$PM_{2.5}$	SO_2	NO_2		PM_{10}	$PM_{2.5}$	SO_2	NO_2
NAAQ Standards		**100**	**60**	**80**	**80**		**100**	**60**	**80**	**80**		**100**	**60**	**80**	**80**
Rampur	03.07.2017	62	15	5.02	31.12	03.11.2017	65	17	4.98	30.44	01.02.2018	62	16	5.16	26.46
	06.07.2017	58	16	4.92	30.76	07.11.2017	61	18	5.12	31.82	05.02.2018	60	19	5.06	27.06
	10.07.2017	60	15	4.92	32.78	10.11.2017	62	20	5.34	32.26	08.02.2018	61	18	5.26	27.36
	13.07.2017	55	16	4.56	30.98	13.11.2017	53	14	5.02	31.36	12.02.2018	56	17	5.18	25.89
	17.07.2017	47	14	4.68	32.64	16.11.2017	54	16	4.84	32.14	15.02.2018	60	14	4.98	25.48
	20.07.2017	48	15	4.28	30.74	19.11.2017	51	14	4.56	31.22	19.02.2018	56	17	4.87	26.46
	24.07.2017	63	21	5.02	30.26	22.11.2017	55	15	5.44	29.36	22.02.2018	59	21	4.98	22.76
	28.07.2017	50	15	5.02	29.76	26.11.2017	52	14	5.16	29.9	26.02.2018	57	20	5.2	23.41
Mallapura	04.07.2017	61	17	4.61	30.78	05.11.2017	59	15	4.72	29.68	02.02.2018	57	14	4.58	25.46
	07.07.2017	56	14	5.23	30.18	09.11.2017	59	16	5.44	30.68	06.02.2018	61	17	5.24	23.76
	11.07.2017	53	15	3.89	30.88	12.11.2017	57	14	3.96	29.56	09.02.2018	59	15	4.02	22.8
	14.07.2017	45	15	4.08	32.14	15.11.2017	52	16	4.36	31.54	13.02.2018	54	17	4.53	21.98
	18.07.2017	52	16	4.18	30.62	18.11.2017	59	18	4.28	30.76	16.02.2018	62	17	4.86	22.96
	22.07.2017	57	15	4.12	30.26	21.11.2017	60	18	4.34	30.98	20.02.2018	51	17	5.04	23.12
	26.07.2017	56	16	4.52	29.56	24.11.2017	58	17	4.76	30.54	23.02.2018	53	22	4.74	27.08
	30.07.2017	53	14	4.28	29.78	28.11.2017	50	14	4.58	29.97	27.02.2018	49	13	4.68	24.96
Odela	04.07.2017	57	19	4.85	31.66	05.11.2017	60	21	4.66	30.98	02.02.2018	63	22	4.28	26.18
	07.07.2017	59	16	4.9	29.63	09.11.2017	62	19	5.26	29.96	06.02.2018	64	20	5.06	21.16
	11.07.2017	61	17	4.34	31.64	12.11.2017	59	16	4.53	31.18	09.02.2018	55	14	4.37	22.02
	14.07.2017	62	19	5.02	30.27	15.11.2017	64	22	5.22	30.82	13.02.2018	66	23	5.37	23.64
	18.07.2017	50	13	4.88	32.46	18.11.2017	57	15	5.16	32.64	16.02.2018	56	13	5.44	24.12
	22.07.2017	60	21	4.58	31.98	21.11.2017	63	19	4.66	31.72	20.02.2018	62	21	4.7	21.78
	26.07.2017	49	15	4.64	28.76	24.11.2017	53	13	4.94	30.96	23.02.2018	61	23	4.4	26.48
	30.07.2017	44	12	4.86	30.6	28.11.2017	49	15	4.92	31.36	27.02.2018	53	14	4.82	24.06

ANNEXURE-15

ANNEXURE -15

HYDROLOGY AND GEOLOGY

Water quality analysis results (Ground water)

Sl. No.	Parameters	Unit	Std. IS10500:2012 (Second Revision)		GW-1	GW-2	GW-3	GW-4	GW-5	GW-6	GW-7	GW-8	GW-9	GW-10	GW-11	GW-12	GW-13	GW-14	GW-15	GW-16	GW-17
			AL	PL																	
1.	pH	-	6.5-8.5		6.93	6.56	7.34	6.52	7.25	6.77	7.21	7.34	6.91	6.87	6.72	6.74	6.63	6.66	6.68	7.02	6.94
2.	Conductivity	µS/cm	-		768	772	2840	1104	292	1733	580	98.9	441	447	735	180.5	579	1640	1700	533	1120
3.	Total Dissolved Solids	mg/L	500	2000	530	520	1888	706	180	992	370	64	268	280	475	138	370	1140	1158	370	710
4.	Total Hardness	mg/L	200	600	280	216	376	320	74	496	232	36	88	104	292	74	152	520	540	212	316
5.	Nitrate as NO_3	mg/L	45		BDL	1.10	3.21	15.13	2.92	4.28	BDL	BDL	BDl	3.42	BDL	13.78	BDL	4.85	6.96	BDL	1.85
6.	Chloride as Cl	mg/L	250	1000	11.65	33.02	422.52	60.22	20.39	246.71	83.53	7.77	54.39	60.22	42.73	18.45	34.96	140.84	145.69	75.76	46.62
7.	Sulphate as SO4	mg/L	200	400	1.30	31.66	241.42	36.48	6.28	13.39	BDL	BDL	1.30	1.42	21.93	BDL	20.27	102.45	152.96	22.29	18.73
8.	Sodium	mg/L			11.98	34.09	275.24	33.69	10.09	33.08	7.03	5.68	26.38	27.0	13.06	7.07	24.49	45.43	38.16	6.63	30.23
9.	Potassium	mg/L			0.43	8.10	3.26	0.83	1.38	3.12	2.95	1.02	0.64	0.65	1.89	0.76	10.09	1.99	2.55	2.09	4.67
10.	Calcium as Ca	mg/L	75	200	59.2	41.6	70.4	62.4	15.2	102.41	46.4	6.4	19.2	20.8	59.2	15.2	27.2	140	144	41.6	64
11.	Magnesium as Mg	mg/L	30	100	32.07	27.21	48.6	39.85	8.74	58.32	28.18	4.86	9.72	12.63	34.99	8.74	20.41	41.31	43.74	26.24	37.90
12.	Fluoride as F	mg/L	1	1.5	0.22	0.30	0.19	0.65	0.28	0.40	0.64	0.009	BDL	0.49	0.38	0.18	0.34	BDL	0.27	0.59	0.42
13.	Carbonate	mg/L	-		Not Detected																
14.	Bicarbonate	mg/L	-		292	200	340	232	48	180	184	32	56	68	184	36	148	340	340	172	308
15.	Iron as Fe	mg/L	0.3		0.18	0.05	0.45	0.19	0.09	0.03	0.22	0.46	0.12	0.09	0.03	BDL	0.02	0.12	BDL	0.24	0.12

Water quality analysis results (Surface water)

Sl. No.	Parameters	Unit	Water Quality Criteria					SW-1	SW-2	SW-3	SW-4
			A	B	C	D	E				
1.	pH	-	6.5-8.5					8.10	8.44	6.60	7.57
2.	Conductivity	µS/cm	-	-	-	1000	2250	544	542	1850	254
3.	Total Dissolved Solids	mg/L	500	-	1500	-	2100	340	340	1180	152
4.	Total Hardness	mg/L	-	-	-	-	-	136	164	520	72
5.	Dissolved Oxygen	mg/L	6	5	4	4	-	4.90	4.9	4.5	4.4
6.	BOD(3days@27^{o}C)	mg/L	2	3	3	-	-	2.6	ND	8.0	ND
7.	Nitrate as NO_3	mg/L	20	-	50	-	-	BDL	BDL	8.78	2.32
8.	Chloride as Cl	mg/L	250	-	600	-	600	27.19	23.31	213.69	14.56
9.	Sulphate as SO4	mg/L	400	-	400	-	1000	37.11	35.92	80.16	2.96
10.	Sodium	mg/L	-	-	-	-	-	32.79	33.48	118.55	8.0
11.	Potassium	mg/L	-	-	-	-	-	2.30	2.34	1.15	4.18
12.	Calcium as Ca	mg/L	-	-	-	-	-	27.2	33.6	96	13.6
13.	Magnesium as Mg	mg/L	-	-	-	-	-	16.52	19.44	68.04	9.23
14.	Fluoride as F	mg/L	1.5	1.5	1.5	-	-	0.08	0.65	BDL	0.01
15.	Carbonate	mg/L	-	-	-	-	-	24.0	32	ND	8.0
16.	Bicarbonate	mg/L	-	-	-	-	-	112	108	270	52
17.	Iron as Fe	mg/L	0.3	-	50	-	-	BDL	BDL	0.77	0.06

Note ND – Not Detected

FIELD PHOTOGRAPHS

PHOTOGRAPH SHOWING DEVADULA VILLAGE

PHOTOGRAPH SHOWING THE BARRAGE SITE ACROSS RIVER GODAVARI

PHOTOGRPAHS SHOWING THE WELLS INVENTORIED

DOLOMITE EXPOSED IN STREAM BED

SHALE EXPOSED ALONG THE RIVER BANK

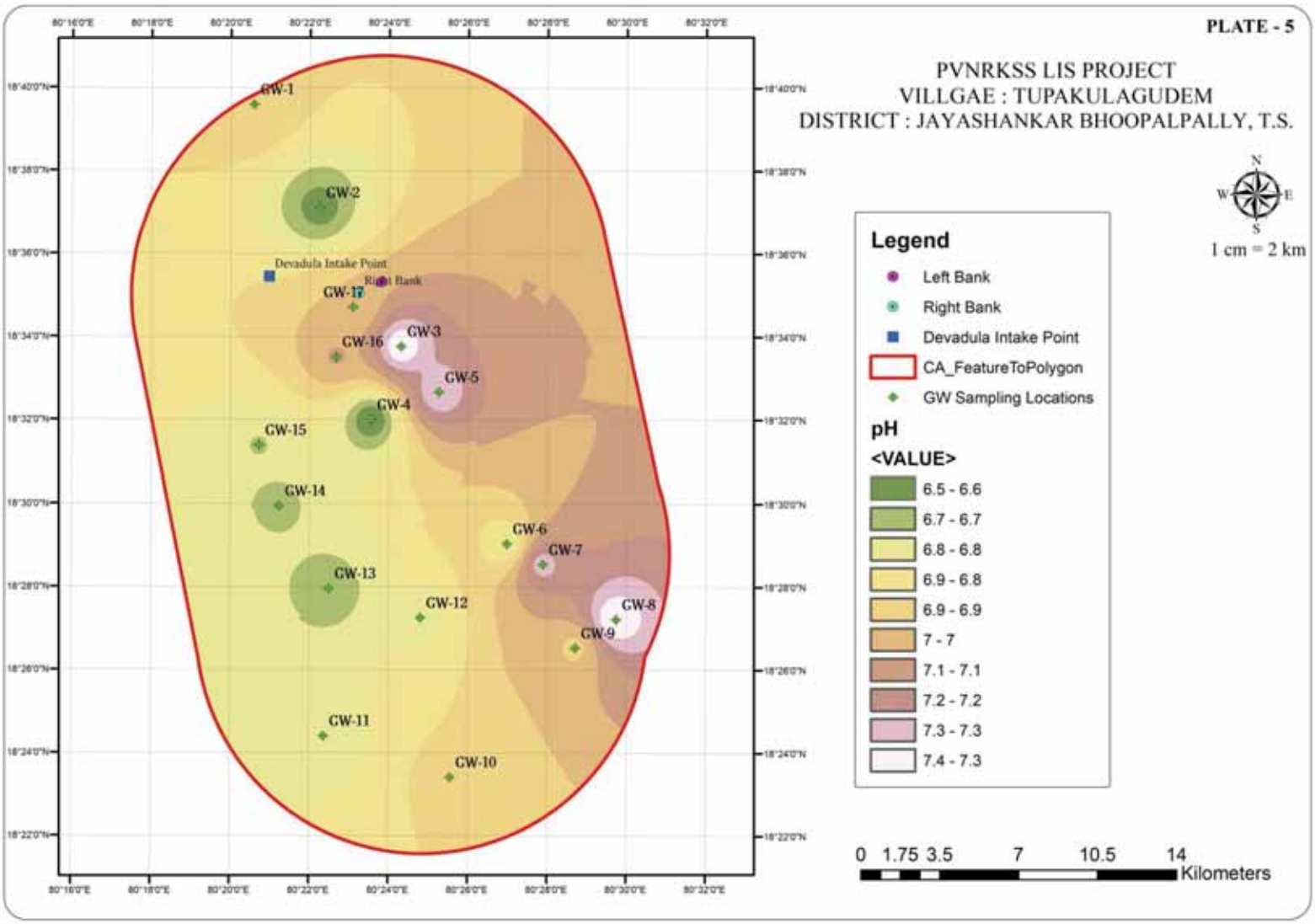


PLATE - 5
PVNRKSS LIS PROJECT
VILLGAE : TUPAKULAGUDEM
DISTRICT : JAYASHANKAR BHOOPALPALLY, T.S.
N
W
E
S
1 cm = 2 km
Legend
Left Bank
Right Bank
Devadula Intake Point
CA_FeatureToPolygon
GW Sampling Locations
pH
<VALUE>
6.5 - 6.6
6.7 - 6.7
6.8 - 6.8
6.9 - 6.8
6.9 - 6.9
7 - 7
7.1 - 7.1
7.2 - 7.2
7.3 - 7.3
7.4 - 7.3
0 1.75 3.5 7 10.5 14
Kilometers
GW-1
GW-2
Devadula Intake Point
Right Bank
GW-17
GW-3
GW-16
GW-5
GW-4
GW-15
GW-14
GW-6
GW-7
GW-13
GW-12
GW-8
GW-9
GW-11
GW-10

PLATE - 6

PVNRKSS LIS PROJECT
VILLGAE : TUPAKULAGUDEM
DISTRICT : JAYASHANKAR BHOOPALPALLY,T.S.

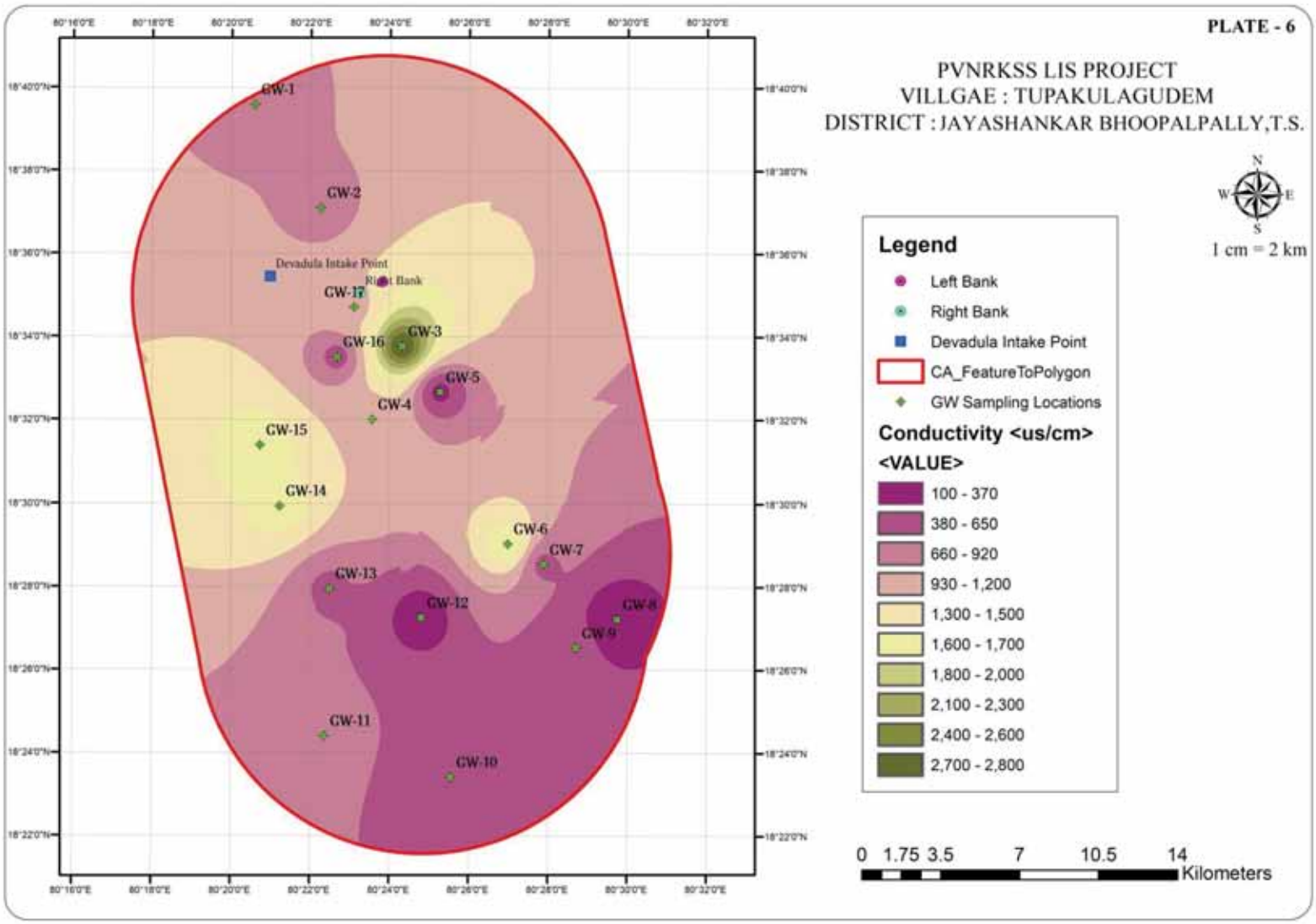
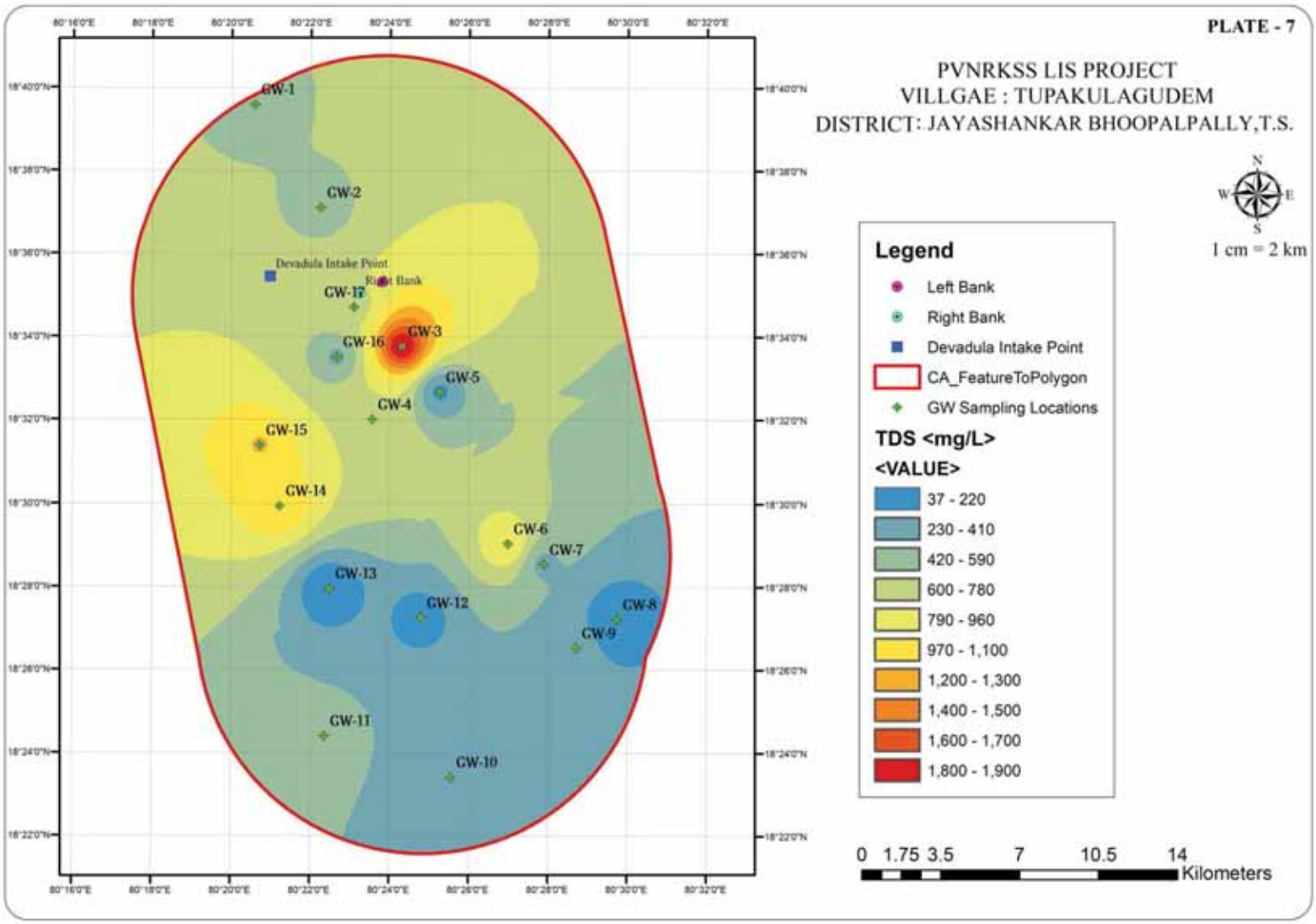


PLATE - 7

PVNRKSS LIS PROJECT
VILLGAE : TUPAKULAGUDEM
DISTRICT: JAYASHANKAR BHOOPALPALLY,T.S.



N
W E
S

1 cm = 2 km

Legend

- Left Bank
- Right Bank
- Devadula Intake Point
- CA_FeatureToPolygon
- GW Sampling Locations

TDS <mg/L>

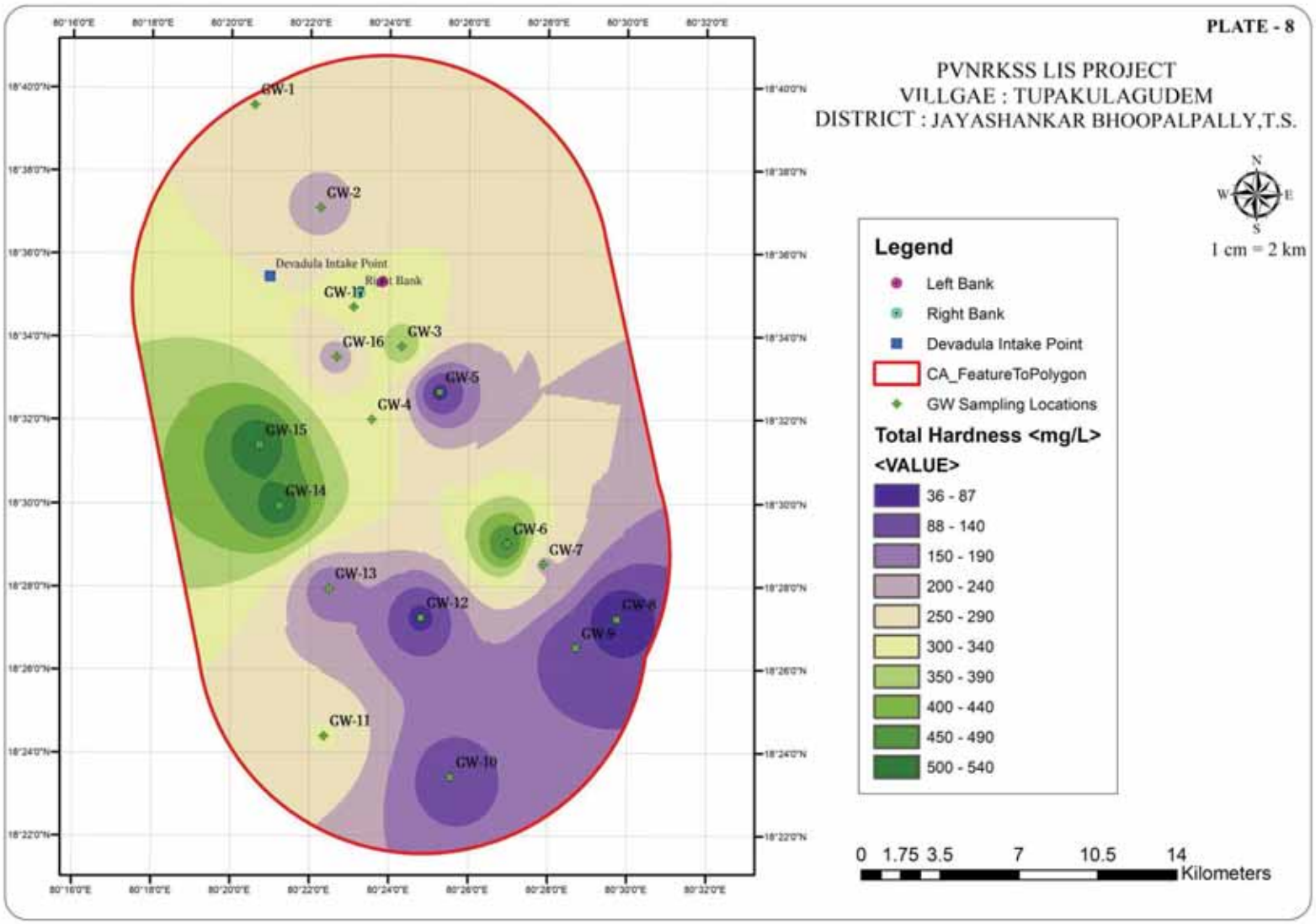
<VALUE>

- 37 - 220
- 230 - 410
- 420 - 590
- 600 - 780
- 790 - 960
- 970 - 1,100
- 1,200 - 1,300
- 1,400 - 1,500
- 1,600 - 1,700
- 1,800 - 1,900

0 1.75 3.5 7 10.5 14 Kilometers

PLATE - 8

PVNRKSS LIS PROJECT
VILLGAE : TUPAKULAGUDEM
DISTRICT : JAYASHANKAR BHOOPALPALLY,T.S.



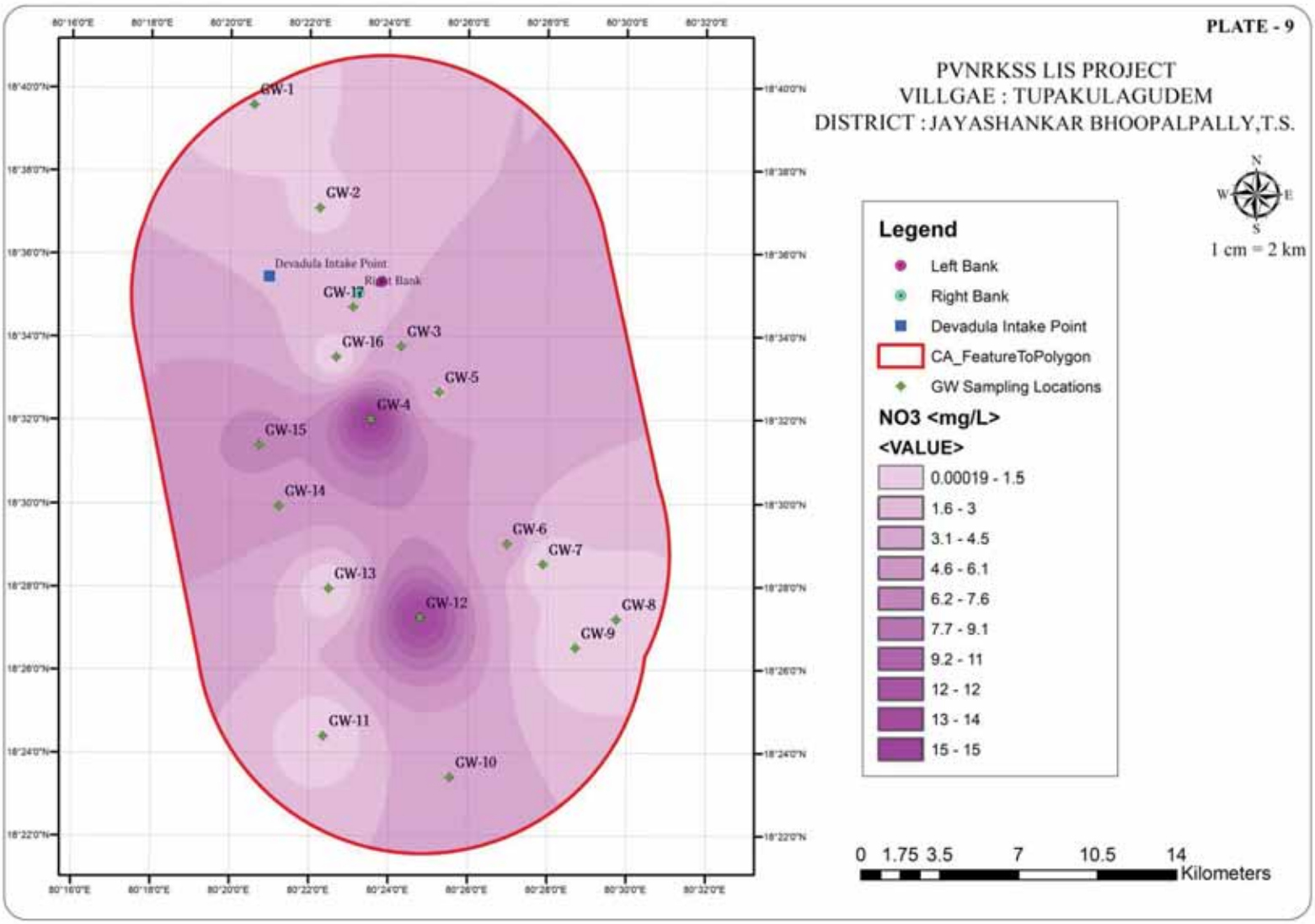


PLATE - 9
PVNRKSS LIS PROJECT
VILLGAE : TUPAKULAGUDEM
DISTRICT : JAYASHANKAR BHOOPALPALLY,T.S.
N
W
E
S
1 cm = 2 km
Legend
Left Bank
Right Bank
Devadula Intake Point
CA_FeatureToPolygon
GW Sampling Locations
NO3 <mg/L>
<VALUE>
0.00019 - 1.5
1.6 - 3
3.1 - 4.5
4.6 - 6.1
6.2 - 7.6
7.7 - 9.1
9.2 - 11
12 - 12
13 - 14
15 - 15
0 1.75 3.5 7 10.5 14
Kilometers
GW-1
GW-2
Devadula Intake Point
Right Bank
GW-17
GW-16
GW-3
GW-5
GW-4
GW-15
GW-14
GW-6
GW-7
GW-13
GW-12
GW-8
GW-9
GW-11
GW-10
80°16'0"E
80°18'0"E
80°20'0"E
80°22'0"E
80°24'0"E
80°26'0"E
80°28'0"E
80°30'0"E
80°32'0"E
18°40'0"N
18°38'0"N
18°36'0"N
18°34'0"N
18°32'0"N
18°30'0"N
18°28'0"N
18°26'0"N
18°24'0"N
18°22'0"N

PLATE - 10

PVNRKSS LIS PROJECT
VILLGAE : TUPAKULAGUDEM
DISTRICT : JAYASHANKAR BHOOPALPALLY,T.S.

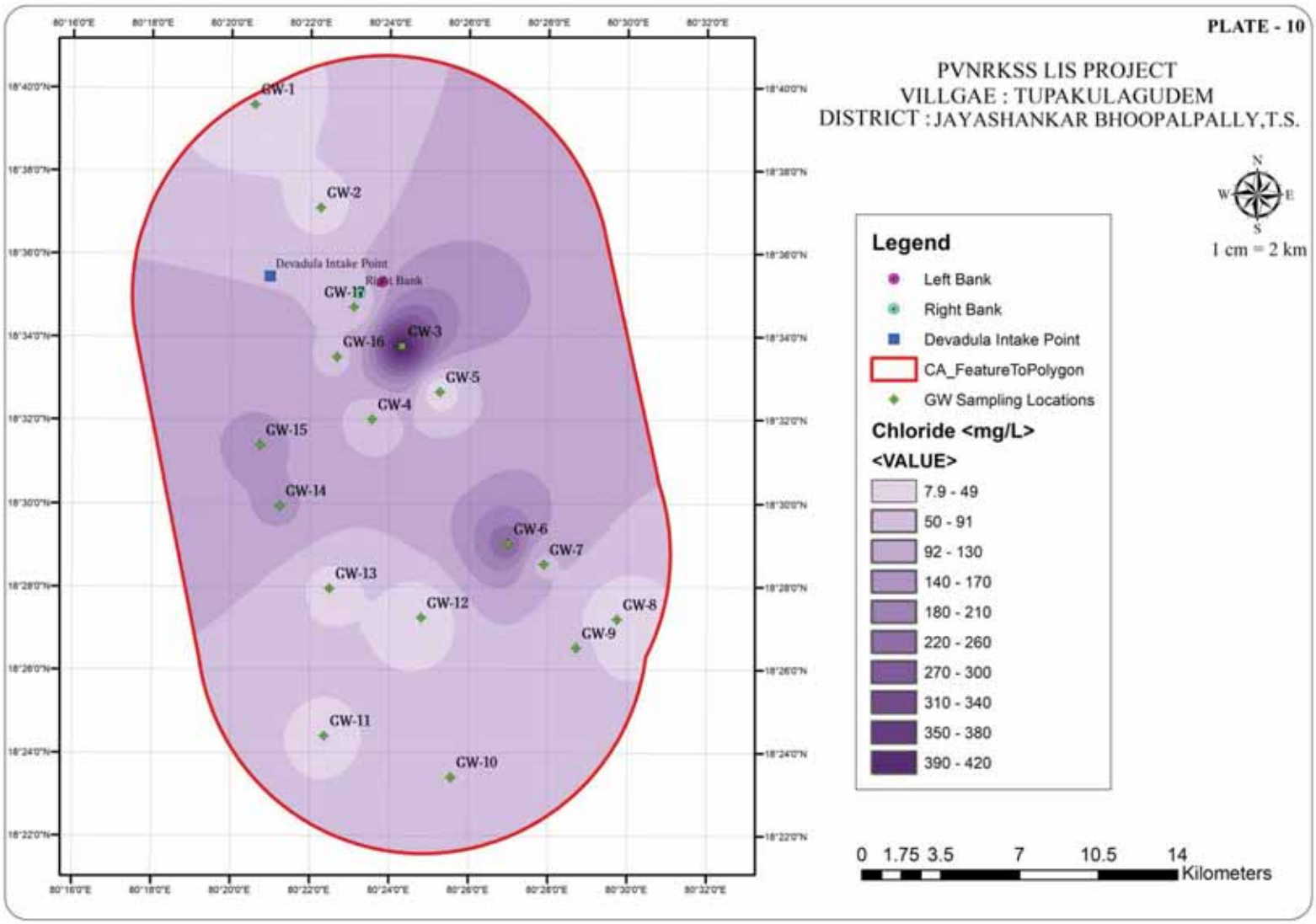
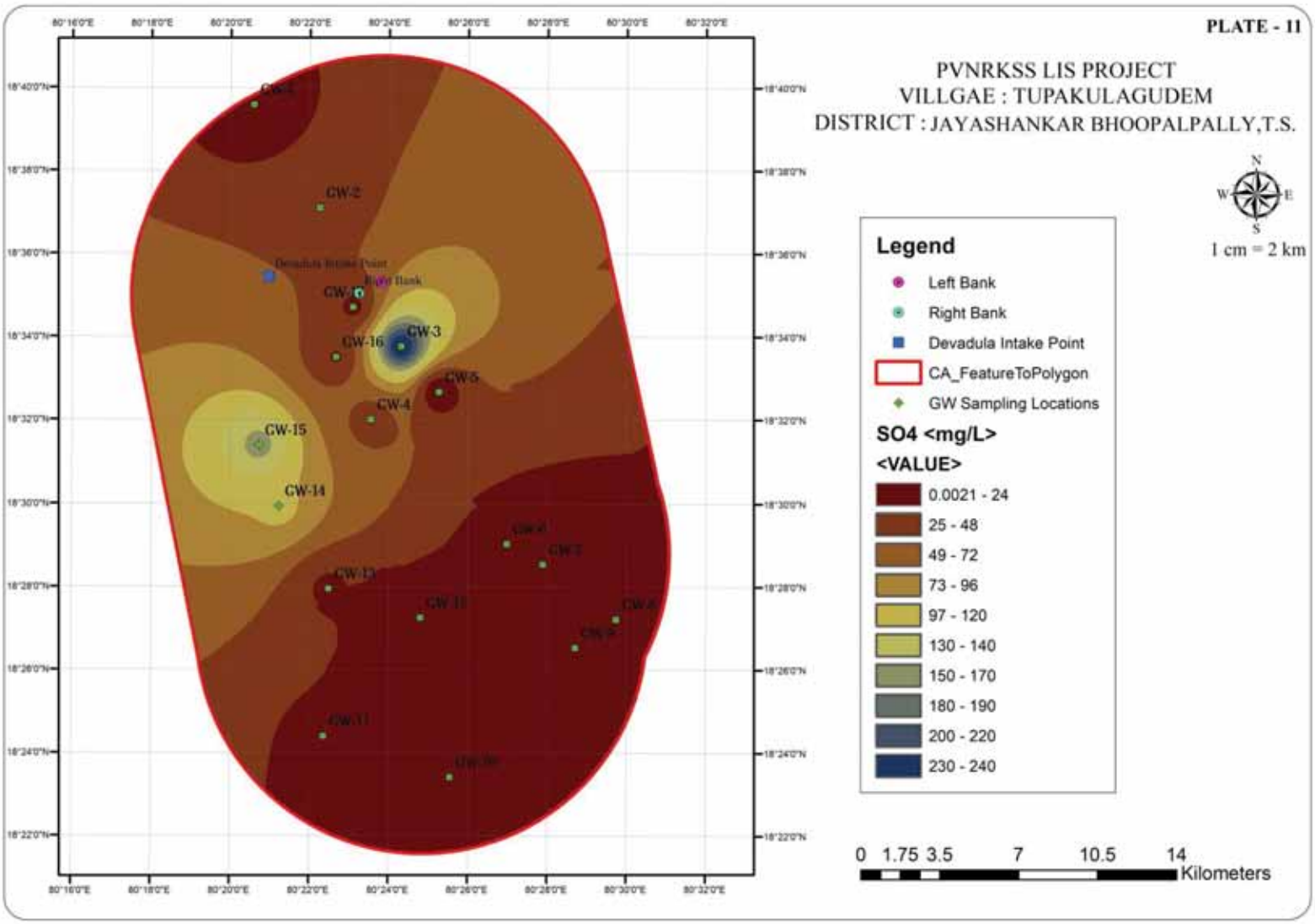


PLATE - 11

PVNRKSS LIS PROJECT
VILLGAE : TUPAKULAGUDEM
DISTRICT : JAYASHANKAR BHOOPALPALLY,T.S.



1 cm = 2 km

Legend

- Left Bank
- Right Bank
- Devadula Intake Point
- CA_FeatureToPolygon
- GW Sampling Locations

SO4 <mg/L>

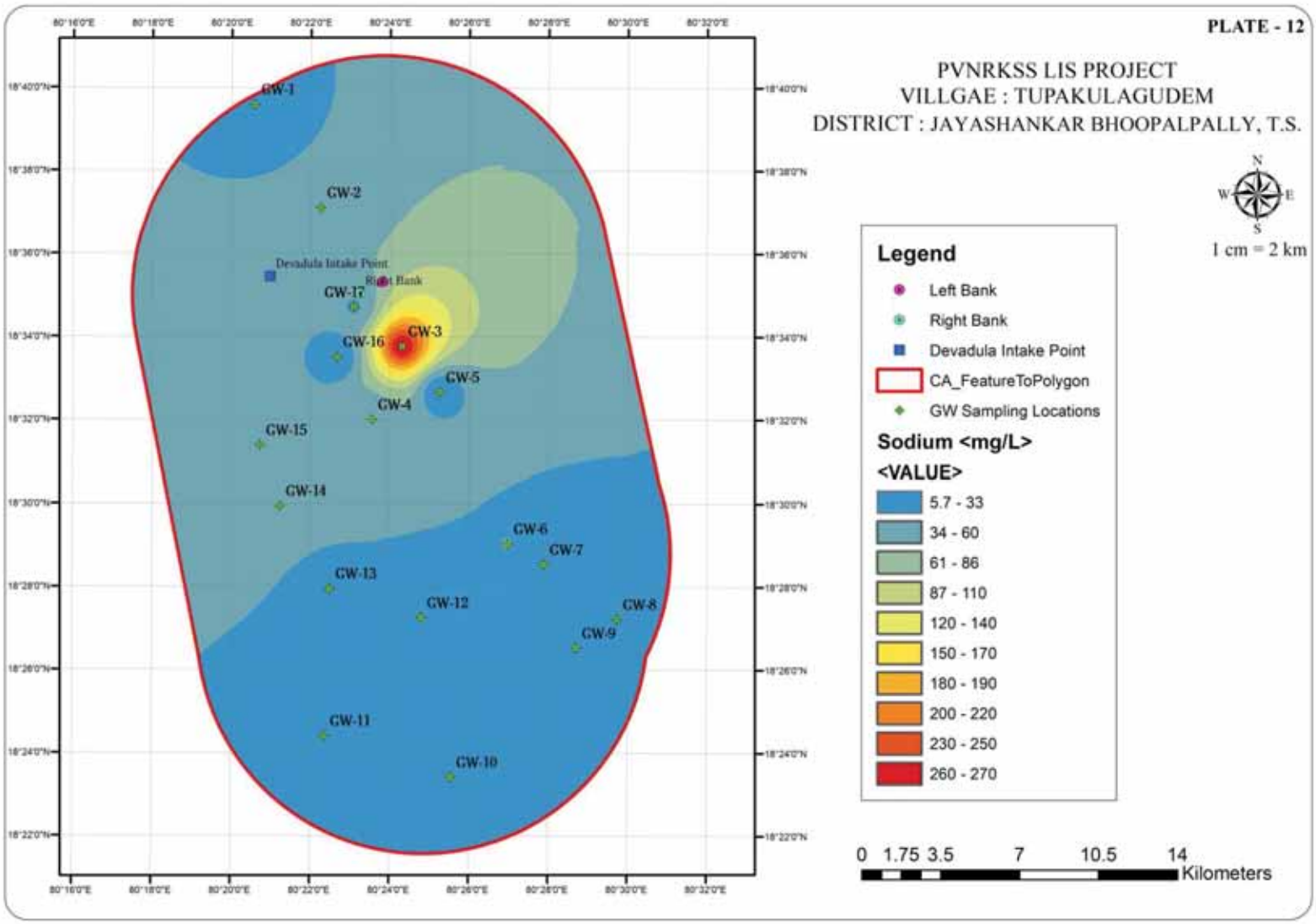
<VALUE>

- 0.0021 - 24
- 25 - 48
- 49 - 72
- 73 - 96
- 97 - 120
- 130 - 140
- 150 - 170
- 180 - 190
- 200 - 220
- 230 - 240

0 1.75 3.5 7 10.5 14 Kilometers

PLATE - 12

PVNRKSS LIS PROJECT
VILLGAE : TUPAKULAGUDEM
DISTRICT : JAYASHANKAR BHOOPALPALLY, T.S.



N
W
E
S

1 cm = 2 km

Legend

- Left Bank
- Right Bank
- Devadula Intake Point
- CA_FeatureToPolygon
- GW Sampling Locations

Sodium <mg/L>

<VALUE>

- 5.7 - 33
- 34 - 60
- 61 - 86
- 87 - 110
- 120 - 140
- 150 - 170
- 180 - 190
- 200 - 220
- 230 - 250
- 260 - 270

0 1.75 3.5 7 10.5 14 Kilometers

PLATE - 13

PVNRKSS LIS PROJECT
VILLGAE : TUPAKULAGUDEM
DISTRICT : JAYASHANKAR BHOOPALPALLY, T.S.

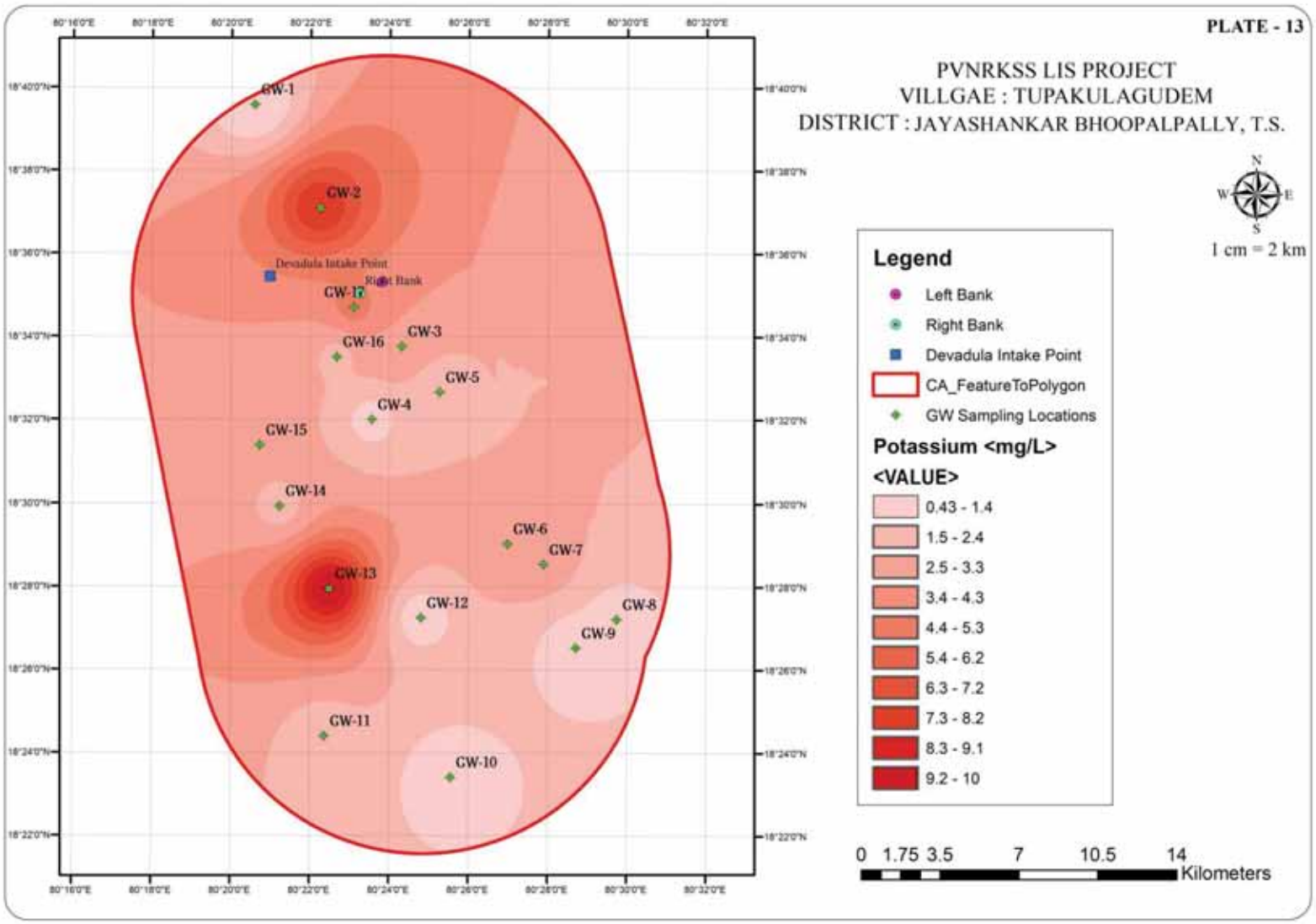
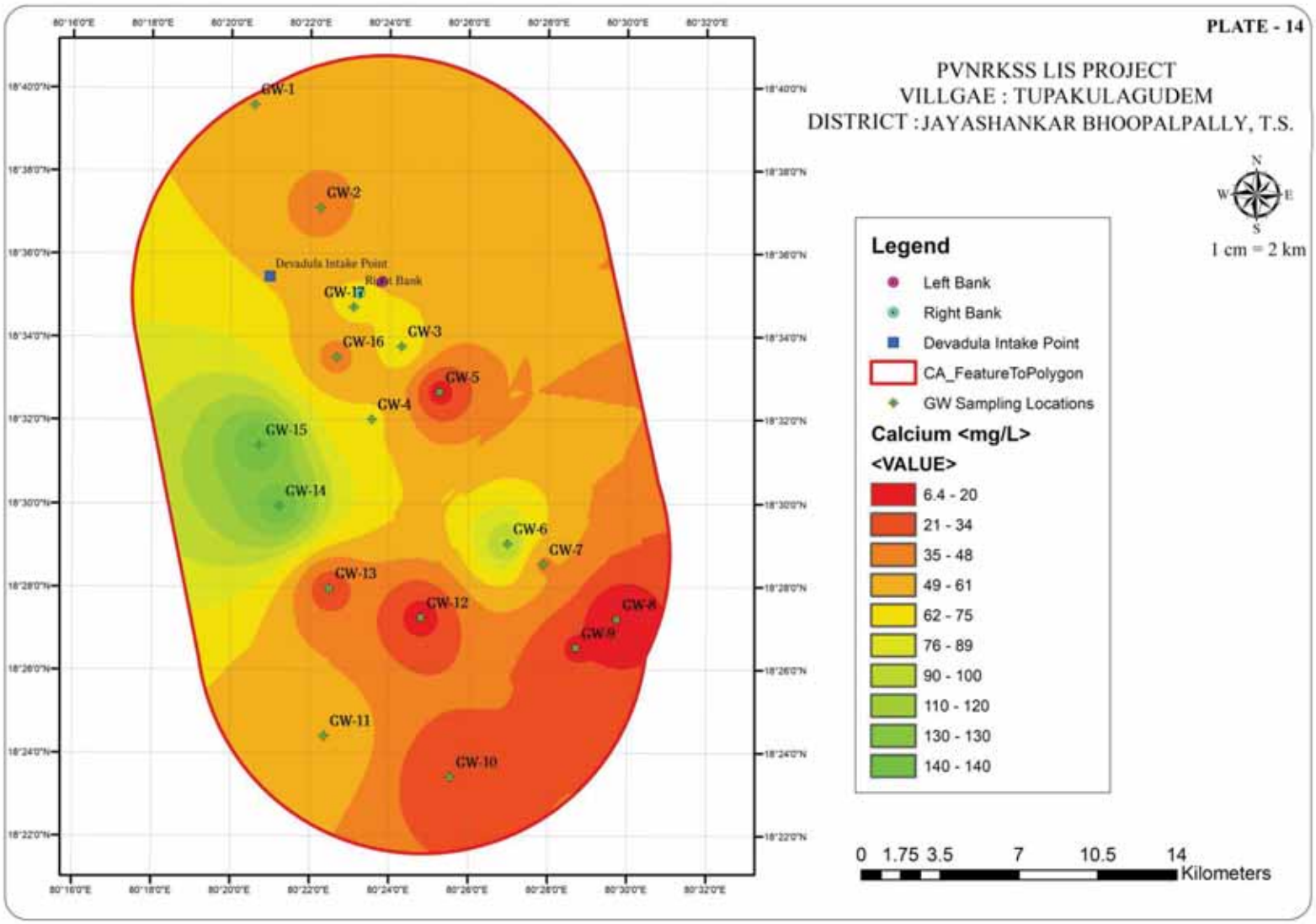


PLATE - 14

PVNRKSS LIS PROJECT
VILLGAE : TUPAKULAGUDEM
DISTRICT :JAYASHANKAR BHOOPALPALLY, T.S.



Legend

- Left Bank
- Right Bank
- Devadula Intake Point
- CA_FeatureToPolygon
- GW Sampling Locations

Calcium <mg/L>

<VALUE>

- 6.4 - 20
- 21 - 34
- 35 - 48
- 49 - 61
- 62 - 75
- 76 - 89
- 90 - 100
- 110 - 120
- 130 - 130
- 140 - 140

N
W E
S

1 cm = 2 km

0 1.75 3.5 7 10.5 14 Kilometers

PLATE - 15

PVNRKSS LIS PROJECT
VILLGAE : TUPAKULAGUDEM
DISTRICT : JAYASHANKAR BHOOPALPALLY, T.S.

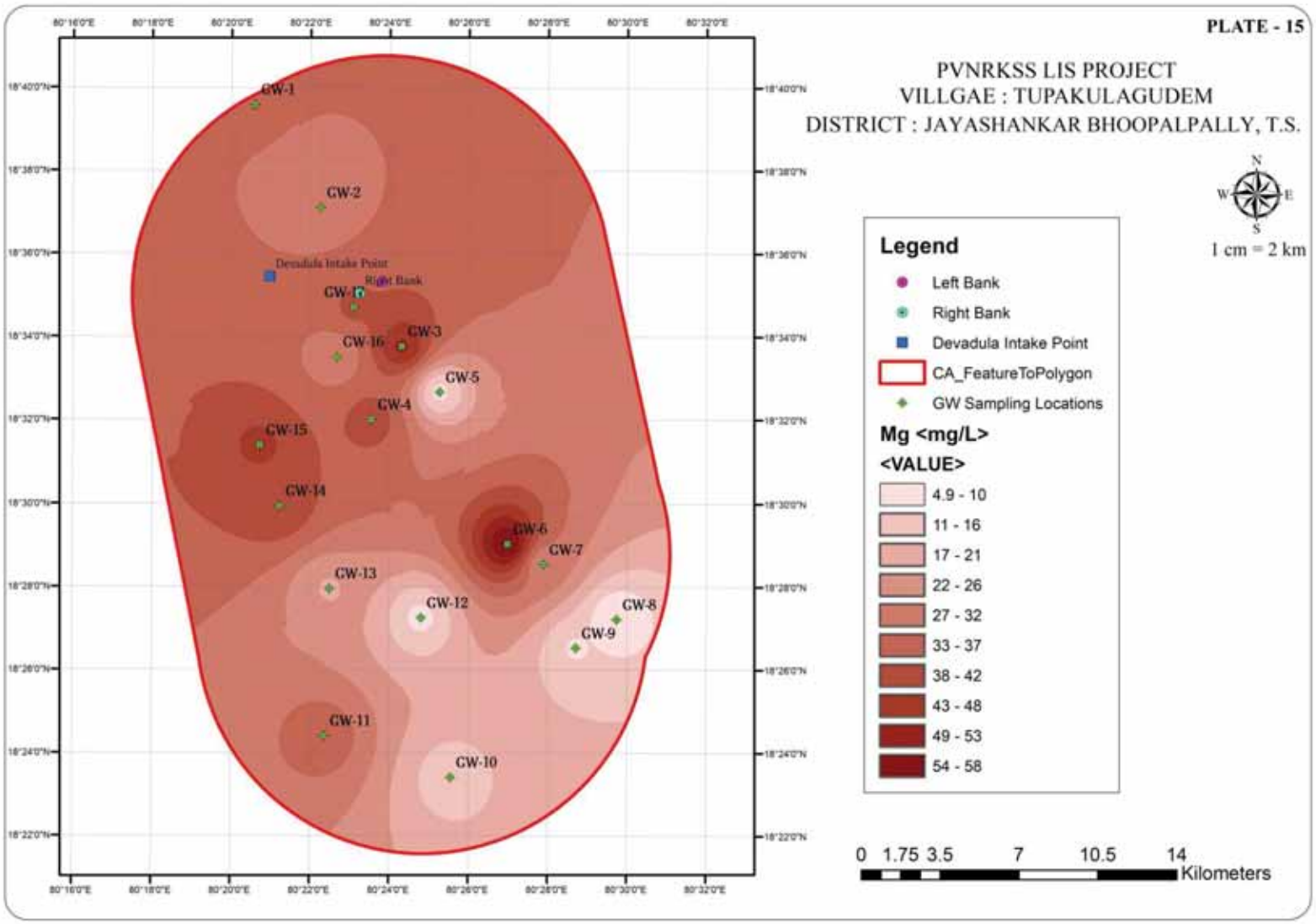


PLATE - 16

PVNRKSS LIS PROJECT
VILLGAE : TUPAKULAGUDEM
DISTRICT : JAYASHANKAR BHOOPALPALLY, T.S.

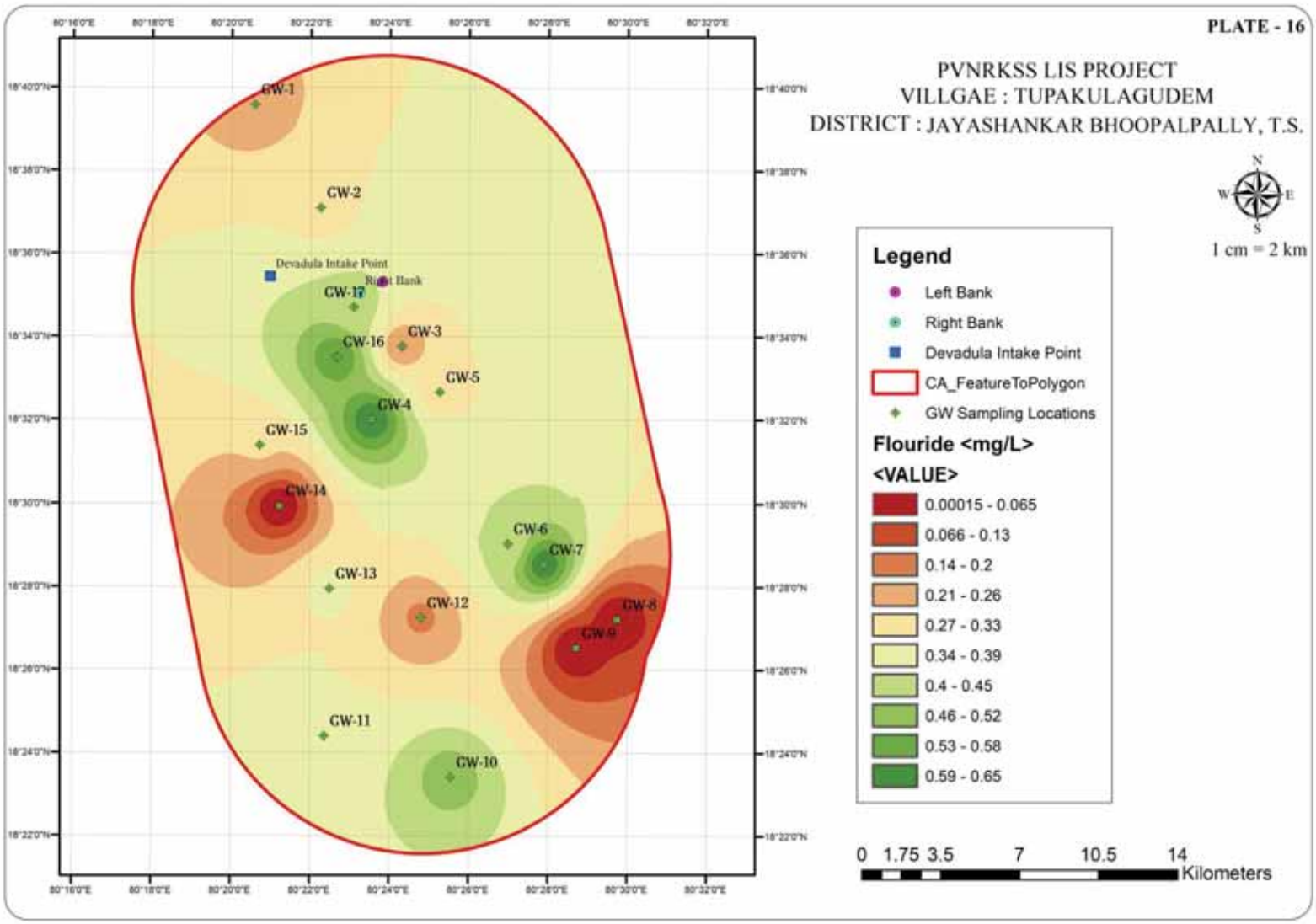


PLATE - 17

PVNRKSS LIS PROJECT
VILLGAE : TUPAKULAGUDEM
DISTRICT : JAYASHANKAR BHOOPALPALLY, T.S.

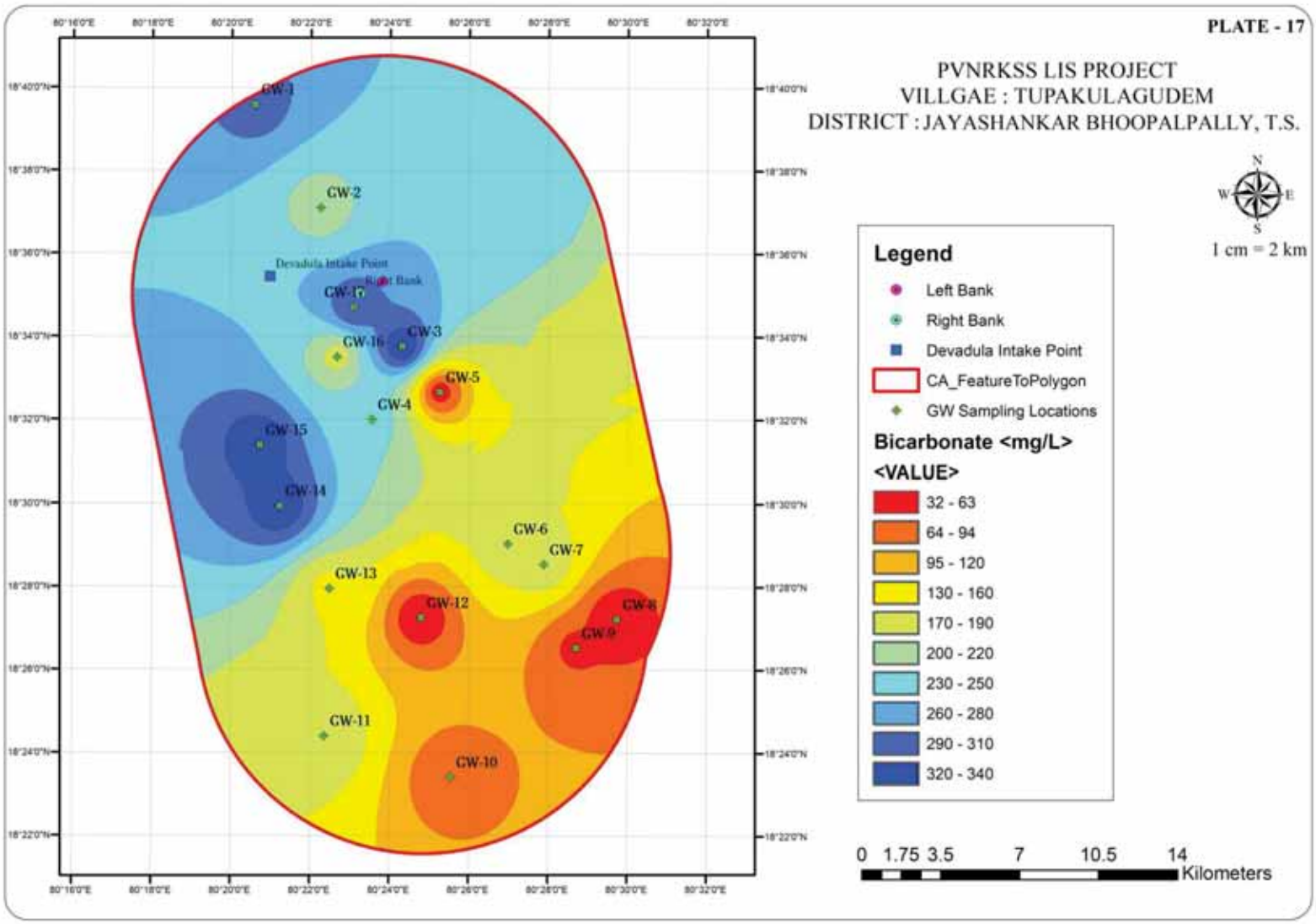


PLATE - 18

PVNRKSS LIS PROJECT
VILLGAE : TUPAKULAGUDEM
DISTRICT :JAYASHANKAR BHOOPALPALLY, T.S.

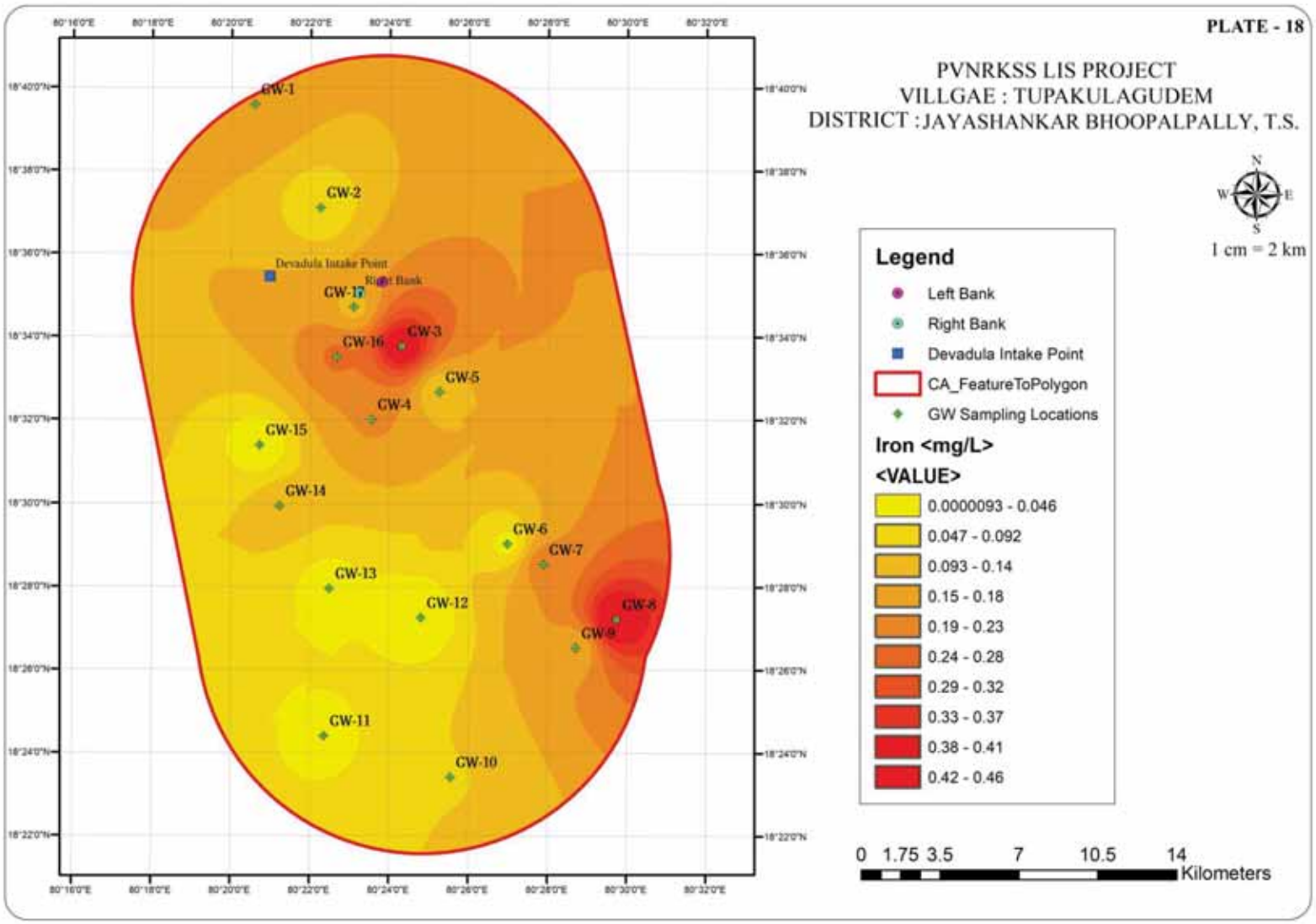


PLATE - 19

PVNRKSS LIS PROJECT
VILLGAE : TUPAKULAGUDEM
DISTRICT : JAYASHANKAR BHOOPALPALLY, T.S.

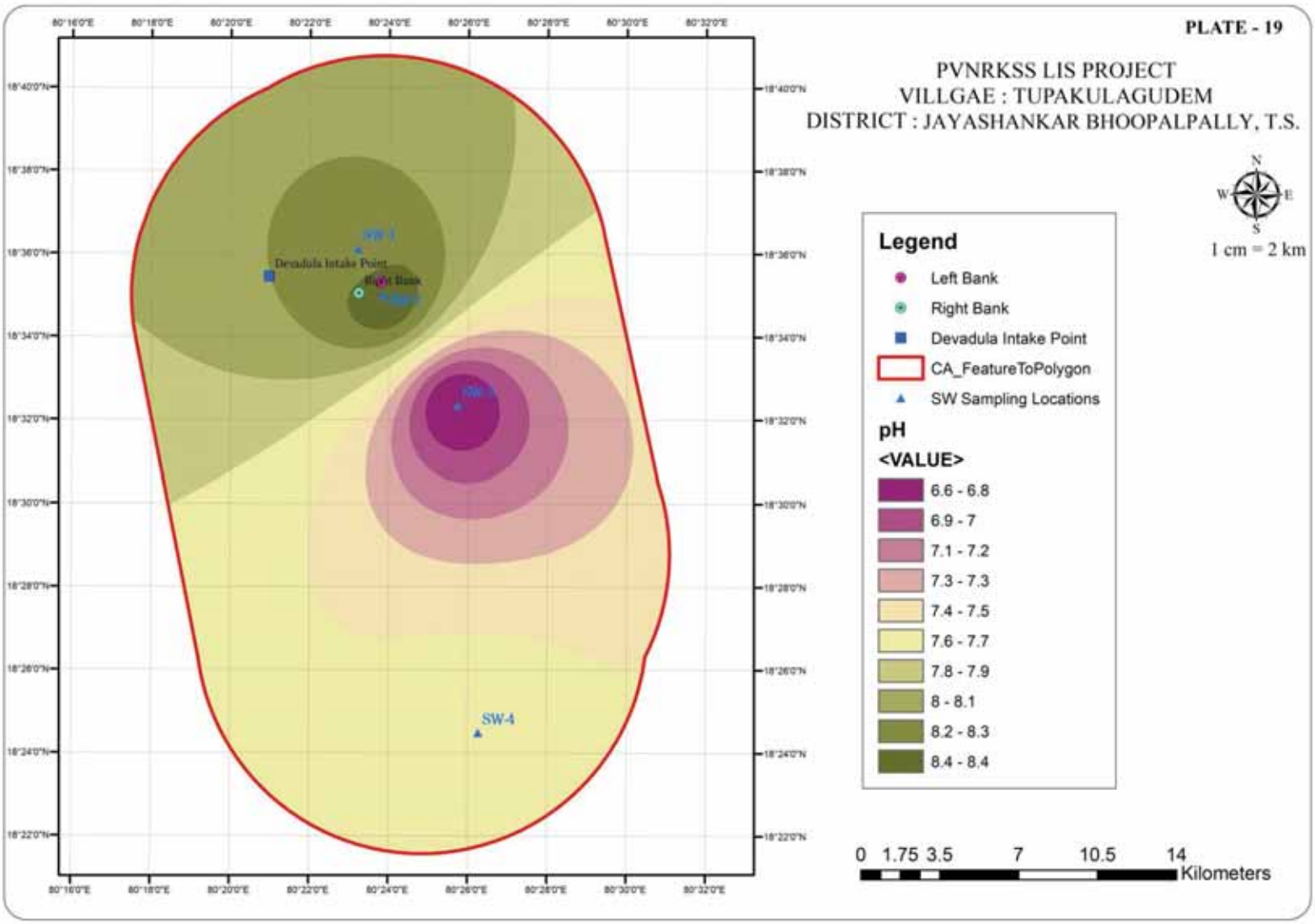


PLATE - 20

PVNRKSS LIS PROJECT
VILLGAE : TUPAKULAGUDEM
DISTRICT : JAYASHANKAR BHOOPALPALLY, T.S.

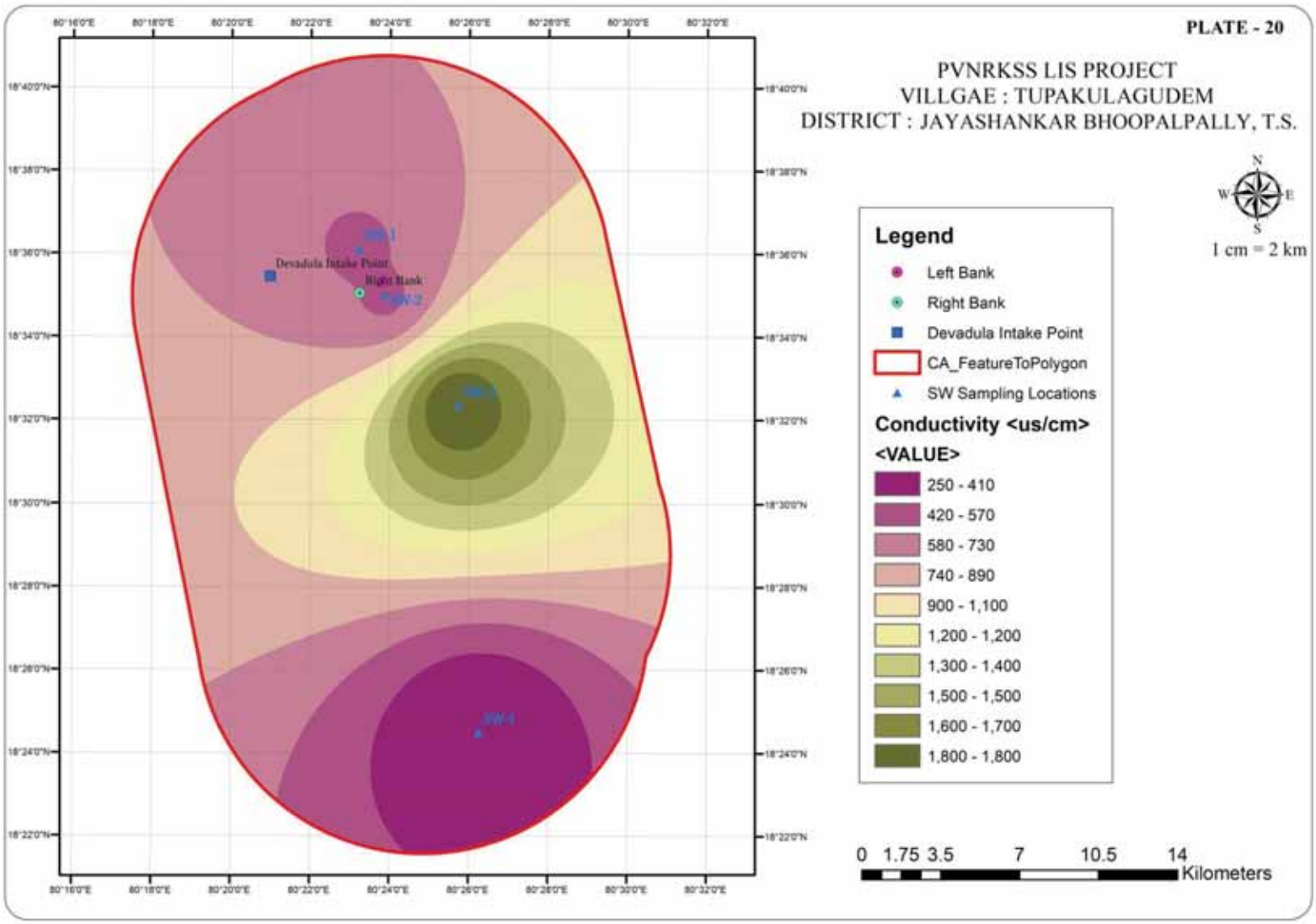
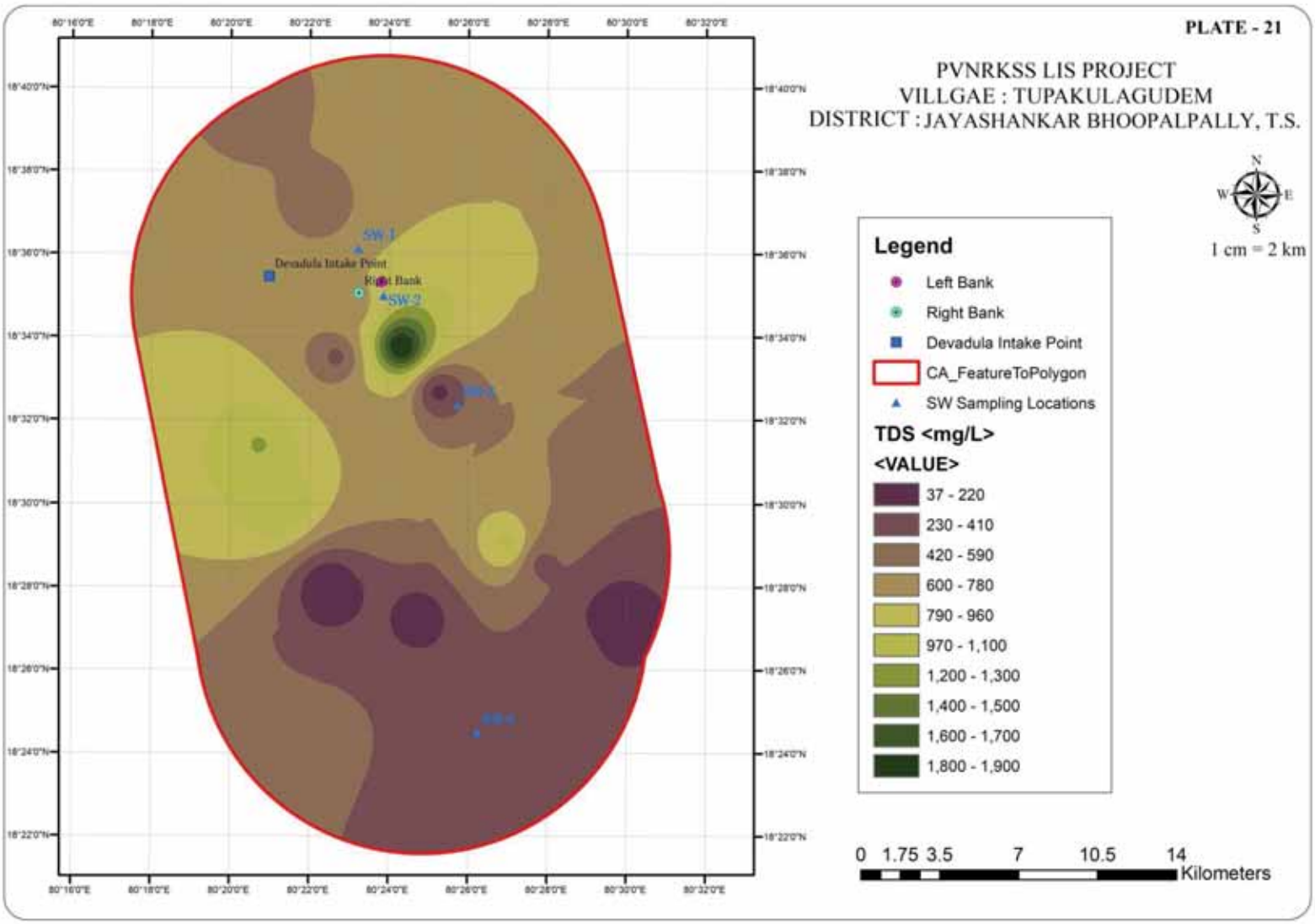


PLATE - 21

PVNRKSS LIS PROJECT
VILLGAE : TUPAKULAGUDEM
DISTRICT : JAYASHANKAR BHOOPALPALLY, T.S.



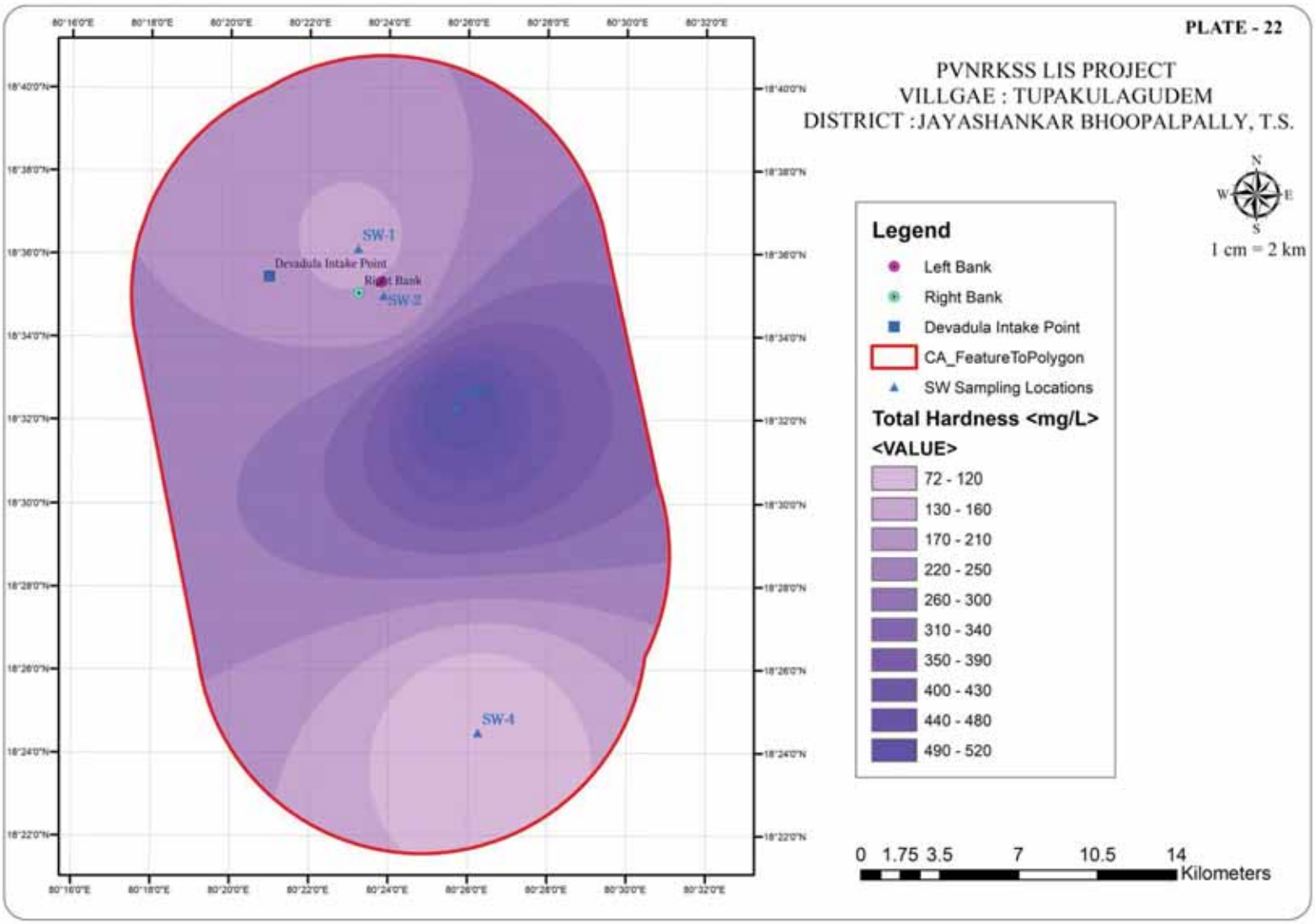
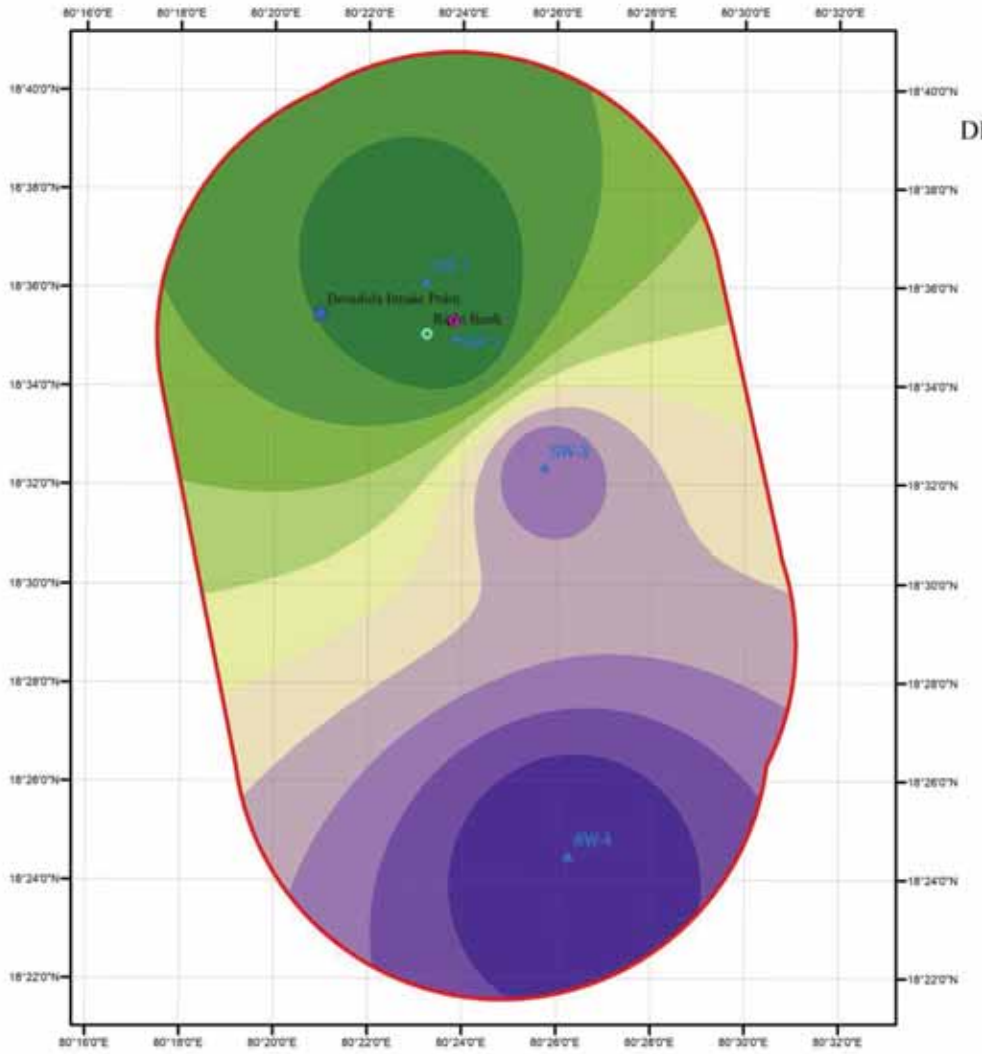
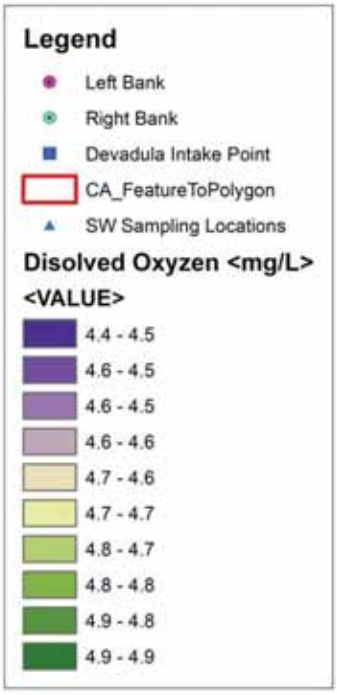


PLATE - 22
PVNRKSS LIS PROJECT
VILLGAE : TUPAKULAGUDEM
DISTRICT :JAYASHANKAR BHOOPALPALLY, T.S.
80°16'0"E
80°18'0"E
80°20'0"E
80°22'0"E
80°24'0"E
80°26'0"E
80°28'0"E
80°30'0"E
80°32'0"E
18°40'0"N
18°38'0"N
18°36'0"N
18°34'0"N
18°32'0"N
18°30'0"N
18°28'0"N
18°26'0"N
18°24'0"N
18°22'0"N
SW-1
Devadula Intake Point
Right Bank
SW-2
SW-3
SW-4
N
W
E
S
1 cm = 2 km
Legend
Left Bank
Right Bank
Devadula Intake Point
CA_FeatureToPolygon
SW Sampling Locations
Total Hardness <mg/L>
<VALUE>
72 - 120
130 - 160
170 - 210
220 - 250
260 - 300
310 - 340
350 - 390
400 - 430
440 - 480
490 - 520
0 1.75 3.5 7 10.5 14
Kilometers

PLATE - 23

PVNRKSS LIS PROJECT
VILLGAE : TUPAKULAGUDEM
DISTRICT : JAYASHANKAR BHOOPALPALLY, T.S.





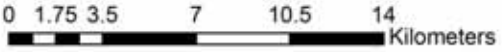
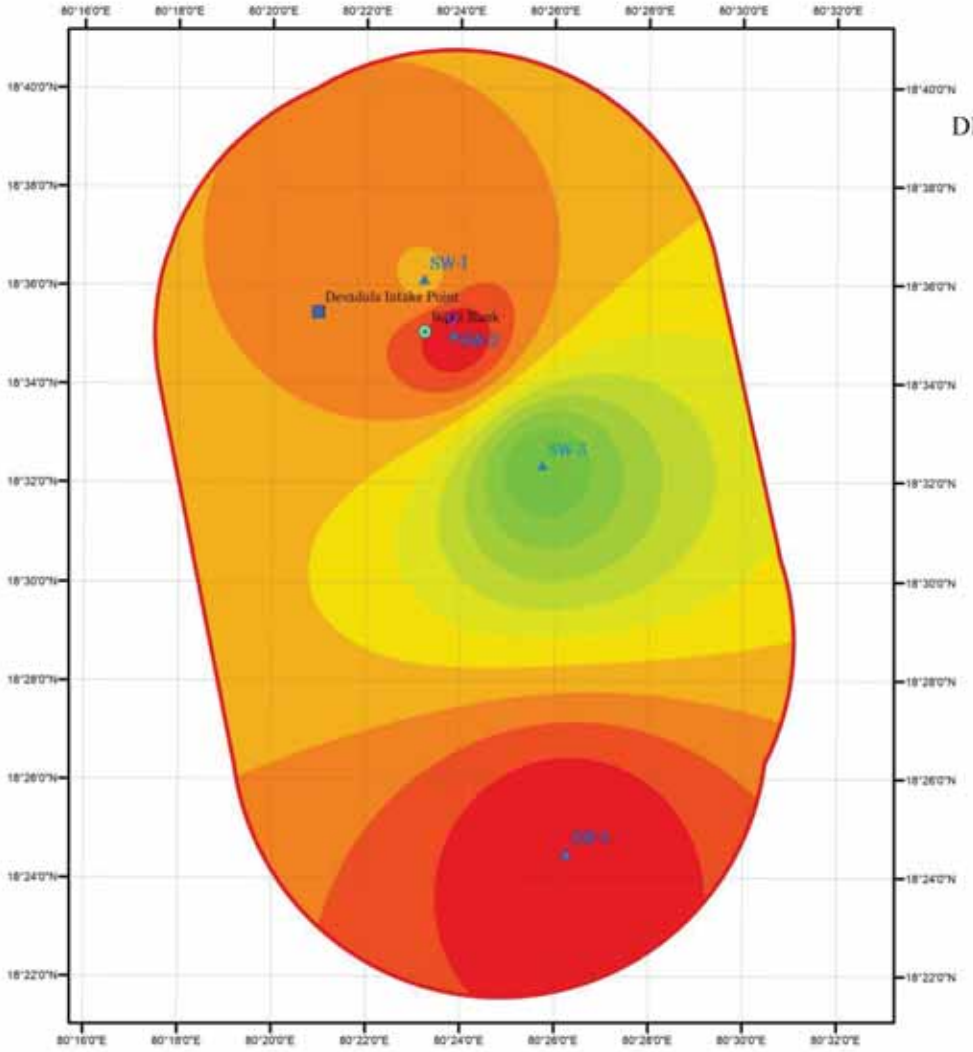


PLATE - 24

PVNRKSS LIS PROJECT
VILLGAE : TUPAKULAGUDEM
DISTRICT : JAYASHANKAR BHOOPALPALLY, T.S.



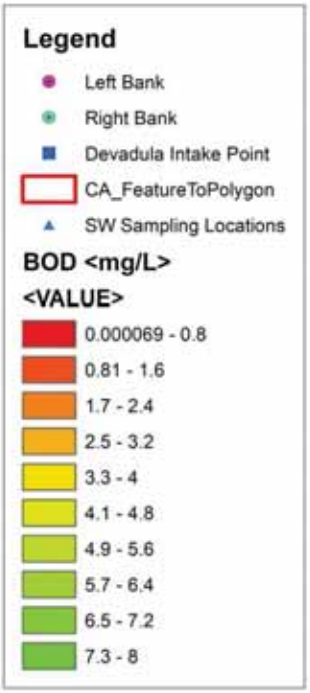
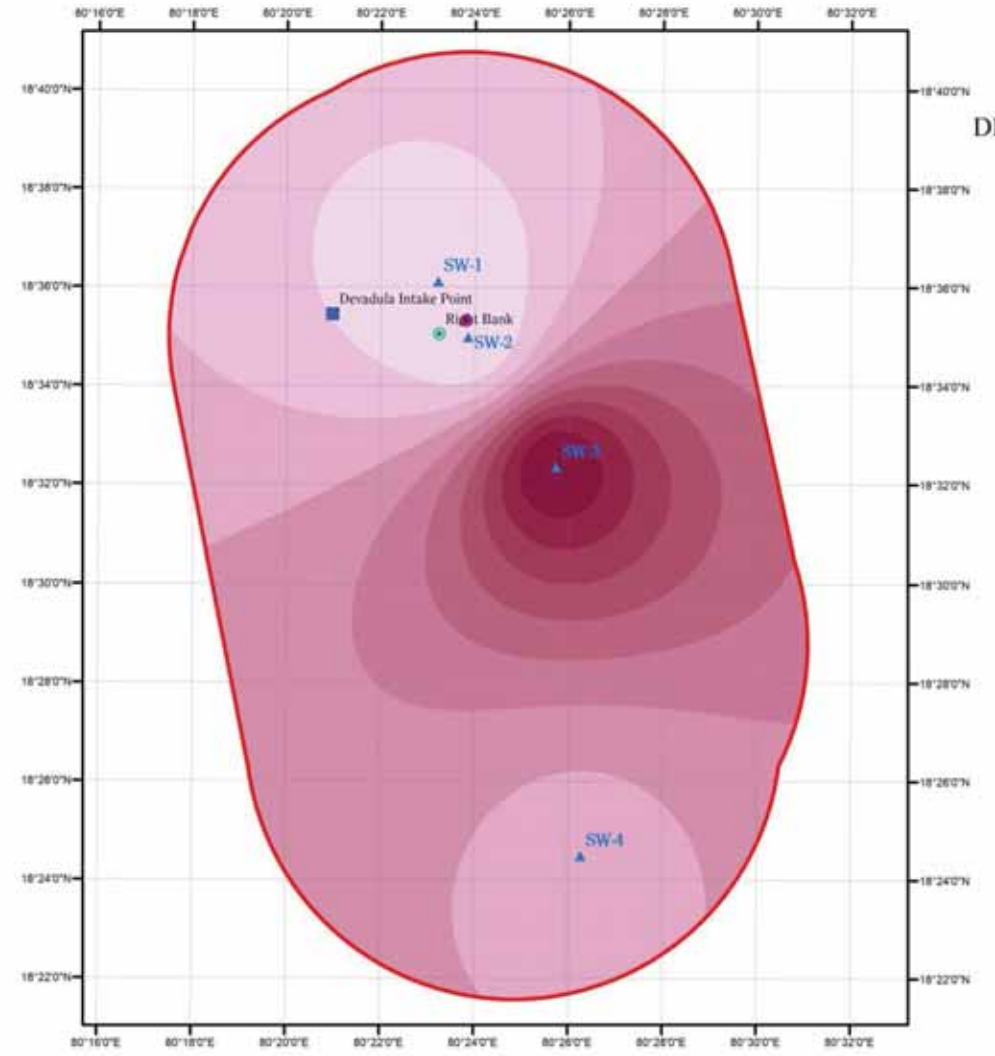


PLATE - 25

PVNRKSS LIS PROJECT
VILLGAE : TUPAKULAGUDEM
DISTRICT : JAYASHANKAR BHOOPALPALLY, T.S.



1 cm = 2 km

Legend

- Left Bank
- Right Bank
- Devadula Intake Point
- CA_FeatureToPolygon
- SW Sampling Locations

NO 3 <mg/L>

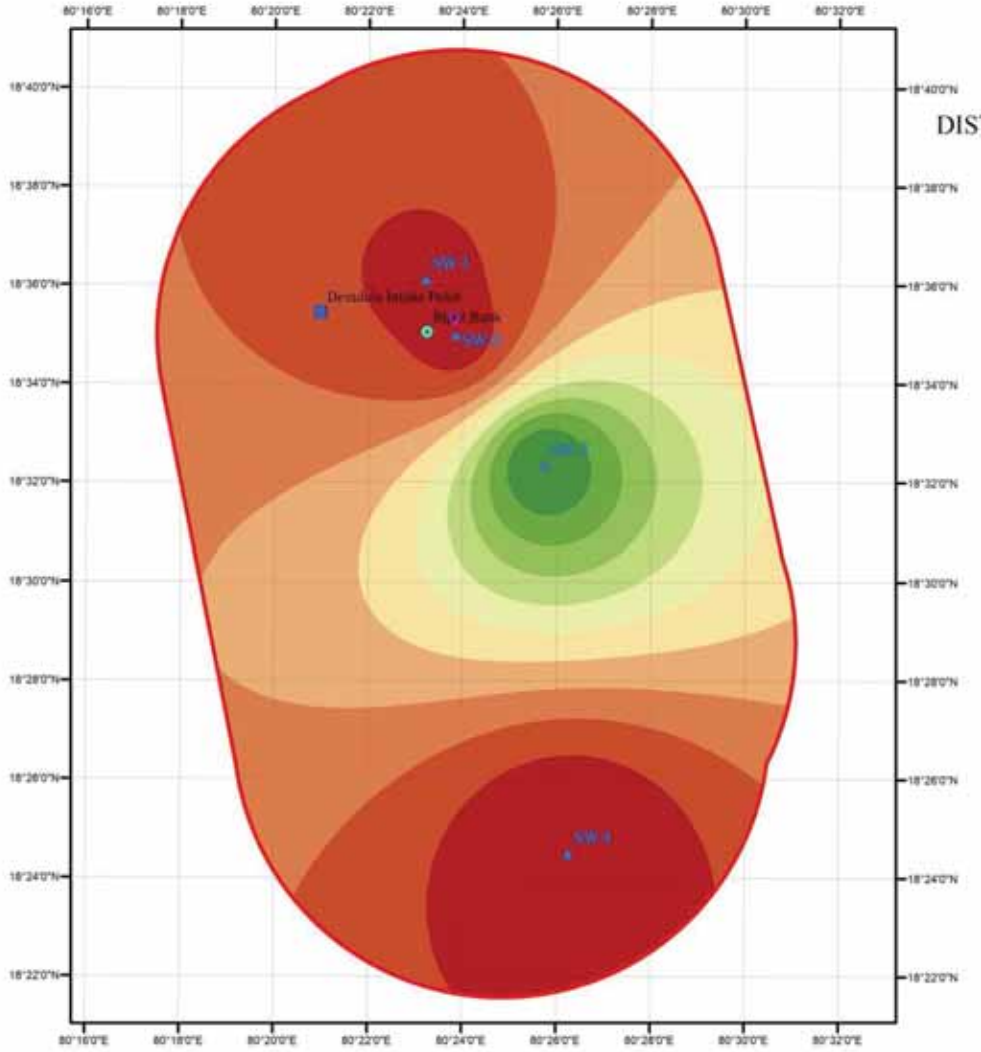
<VALUE>

- 0.0002 - 0.88
- 0.89 - 1.8
- 1.9 - 2.6
- 2.7 - 3.5
- 3.6 - 4.4
- 4.5 - 5.3
- 5.4 - 6.1
- 6.2 - 7
- 7.1 - 7.9
- 8 - 8.8

0 1.75 3.5 7 10.5 14 Kilometers

PLATE - 26

PVNRKSS LIS PROJECT
VILLGAE : TUPAKULAGUDEM
DISTRICT : JAYASHANKAR BHOOPALPALLY, T.S.



1 cm = 2 km

Legend

- Left Bank
- Right Bank
- Devadula Intake Point
- CA_FeatureToPolygon
- SW Sampling Locations

Chloride <mg/L>

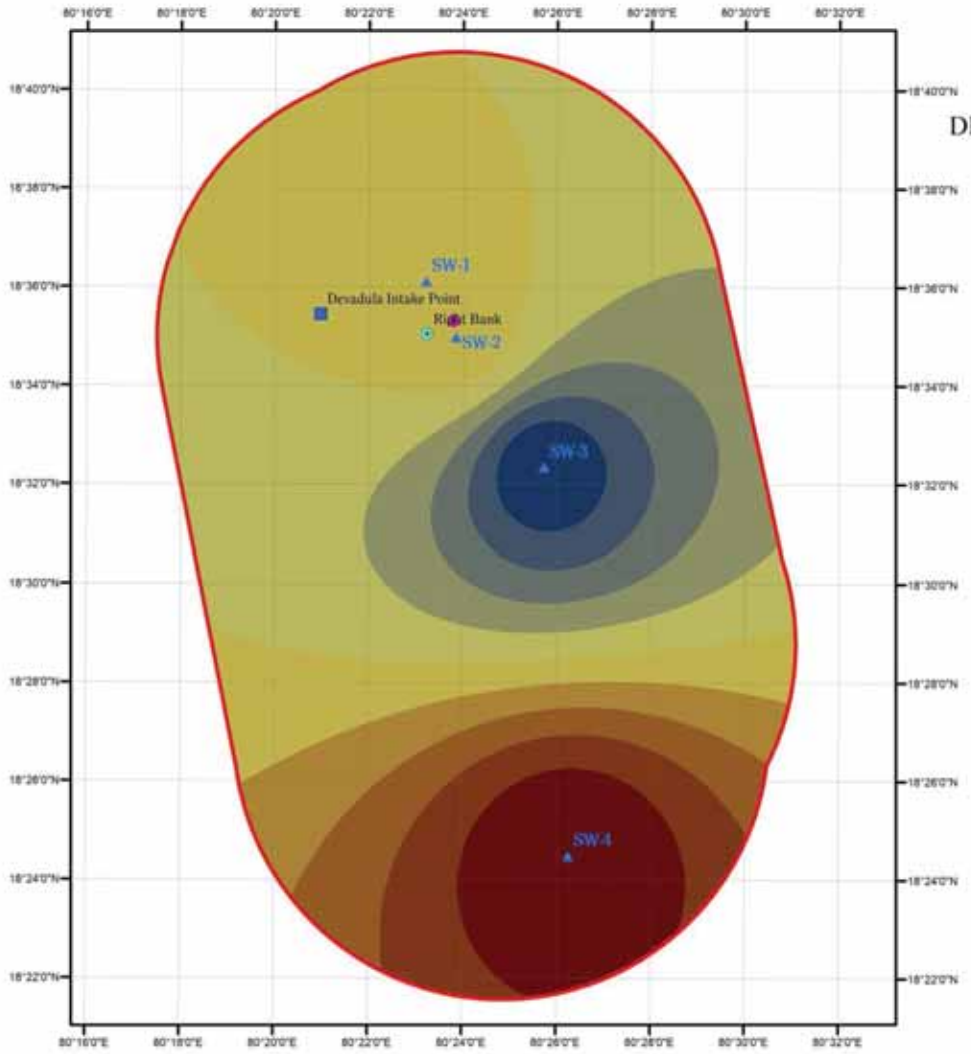
<VALUE>

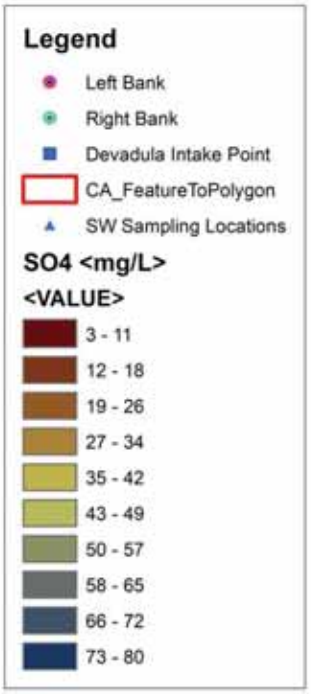
- 15 - 34
- 35 - 54
- 55 - 74
- 75 - 94
- 95 - 110
- 120 - 130
- 140 - 150
- 160 - 170
- 180 - 190
- 200 - 210

0 1.75 3.5 7 10.5 14 Kilometers

PLATE - 27

PVNRKSS LIS PROJECT
VILLGAE : TUPAKULAGUDEM
DISTRICT : JAYASHANKAR BHOOPALPALLY, T.S.





1 cm = 2 km

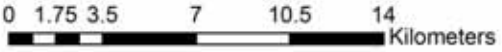
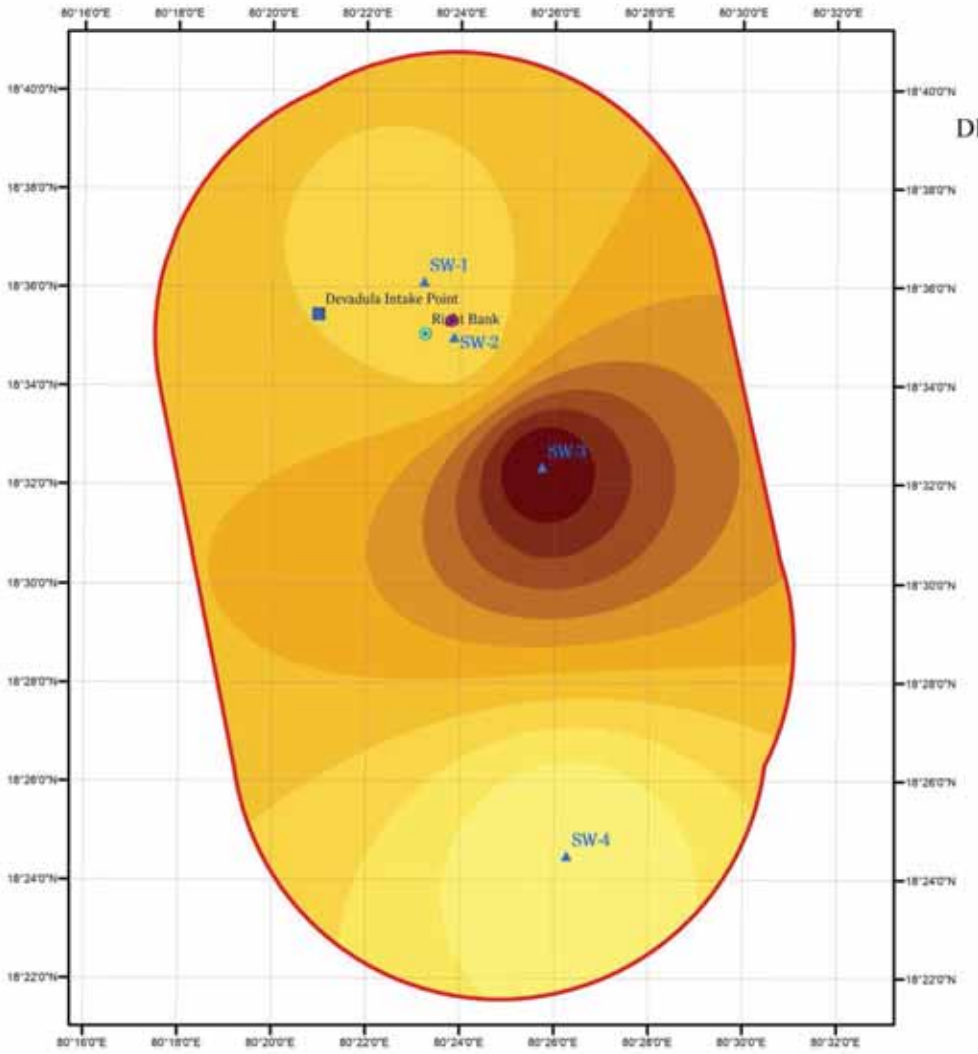


PLATE - 28

PVNRKSS LIS PROJECT
VILLGAE : TUPAKULAGUDEM
DISTRICT : JAYASHANKAR BHOOPALPALLY, T.S.



1 cm = 2 km

Legend

- Left Bank
- Right Bank
- Devadula Intake Point
- CA_FeatureToPolygon
- SW Sampling Locations

Sodium <mg/L>

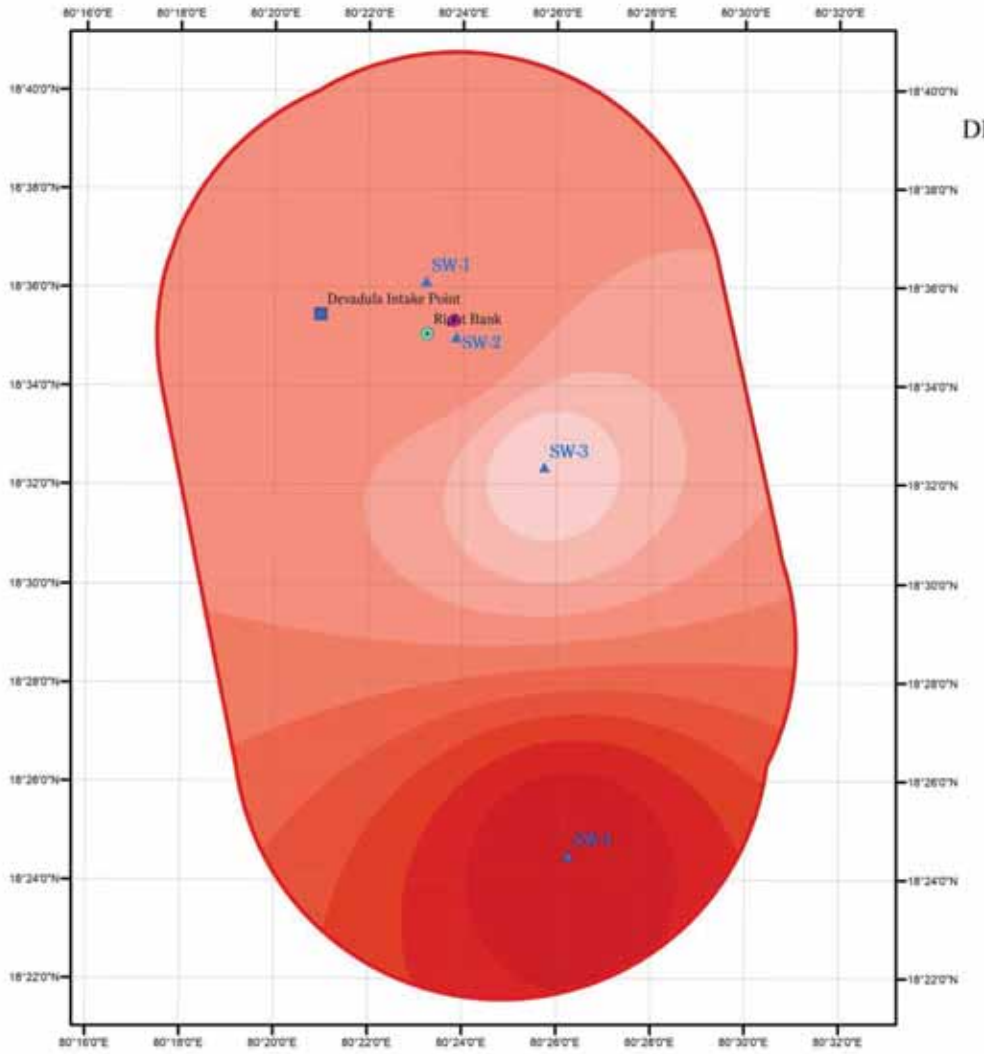
<VALUE>

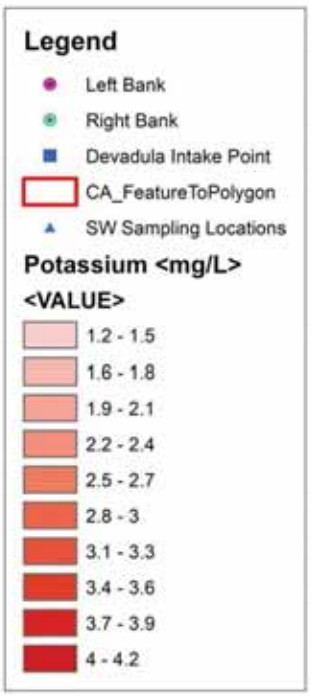
- 8 - 19
- 20 - 30
- 31 - 41
- 42 - 52
- 53 - 63
- 64 - 74
- 75 - 85
- 86 - 96
- 97 - 110
- 120 - 120

0 1.75 3.5 7 10.5 14 Kilometers

PLATE - 29

PVNRKSS LIS PROJECT
VILLGAE : TUPAKULAGUDEM
DISTRICT : JAYASHANKAR BHOOPALPALLY, T.S.





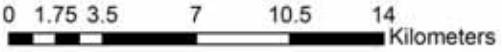
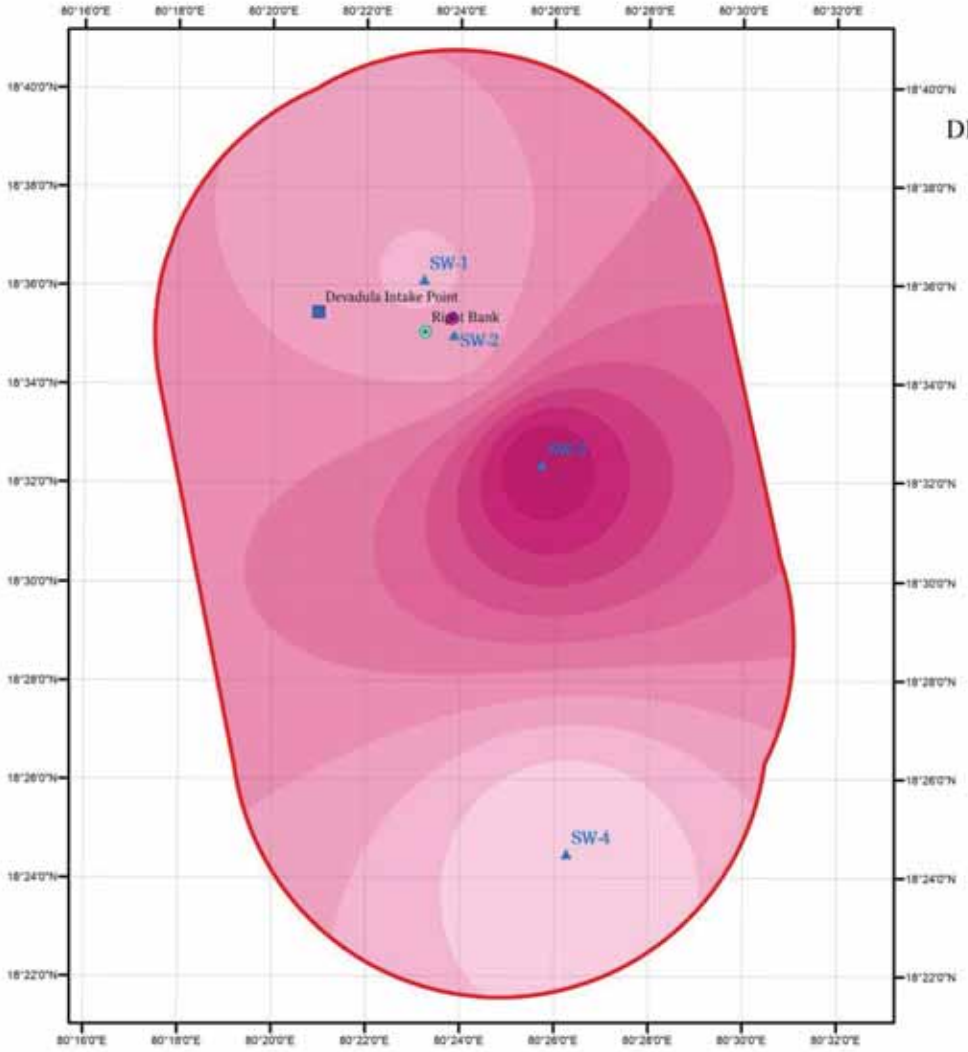


PLATE - 30

PVNRKSS LIS PROJECT
VILLGAE : TUPAKULAGUDEM
DISTRICT : JAYASHANKAR BHOOPALPALLY, T.S.



1 cm = 2 km

Legend

- Left Bank
- Right Bank
- Devadula Intake Point
- CA_FeatureToPolygon
- SW Sampling Locations

Calcium <mg/L>

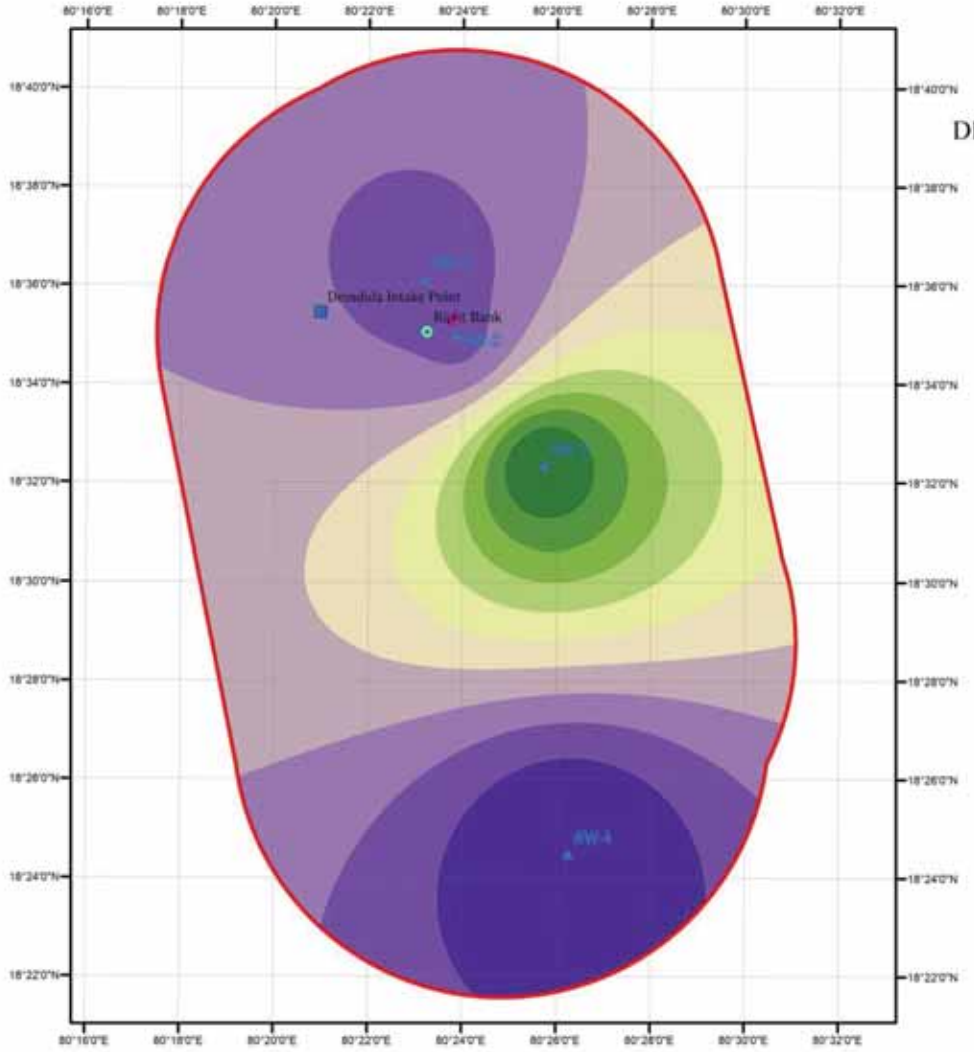
<VALUE>

- 14 - 22
- 23 - 30
- 31 - 38
- 39 - 47
- 48 - 55
- 56 - 63
- 64 - 71
- 72 - 80
- 81 - 88
- 89 - 96

0 1.75 3.5 7 10.5 14 Kilometers

PLATE - 31

PVNRKSS LIS PROJECT
VILLGAE : TUPAKULAGUDEM
DISTRICT : JAYASHANKAR BHOOPALPALLY, T.S.



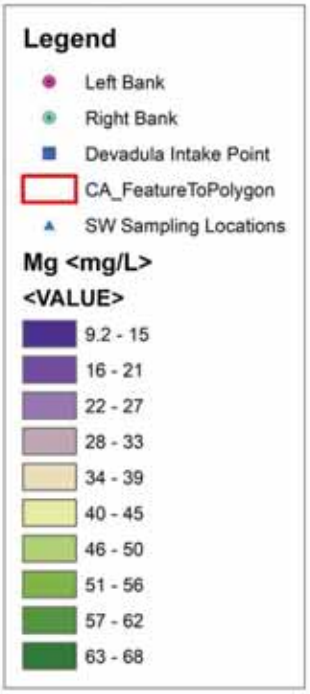
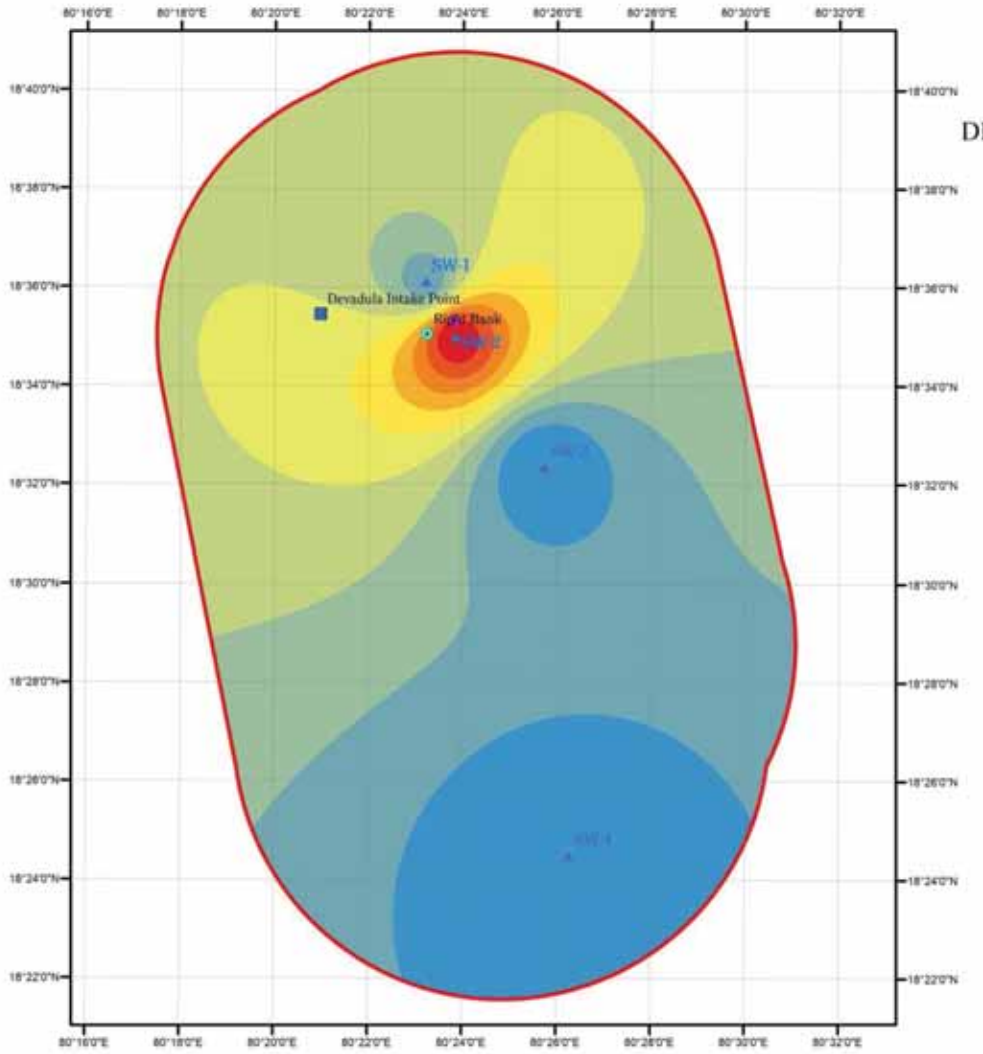
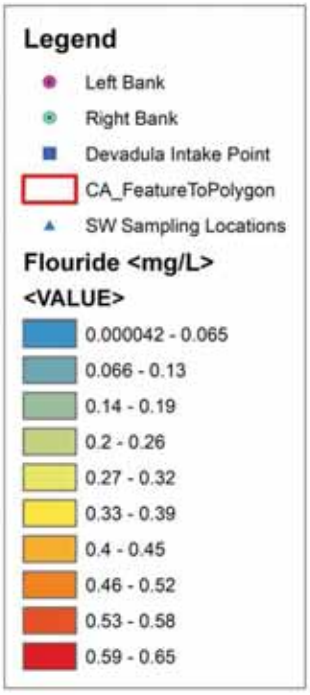


PLATE - 32

PVNRKSS LIS PROJECT
VILLGAE : TUPAKULAGUDEM
DISTRICT : JAYASHANKAR BHOOPALPALLY, T.S.





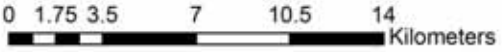
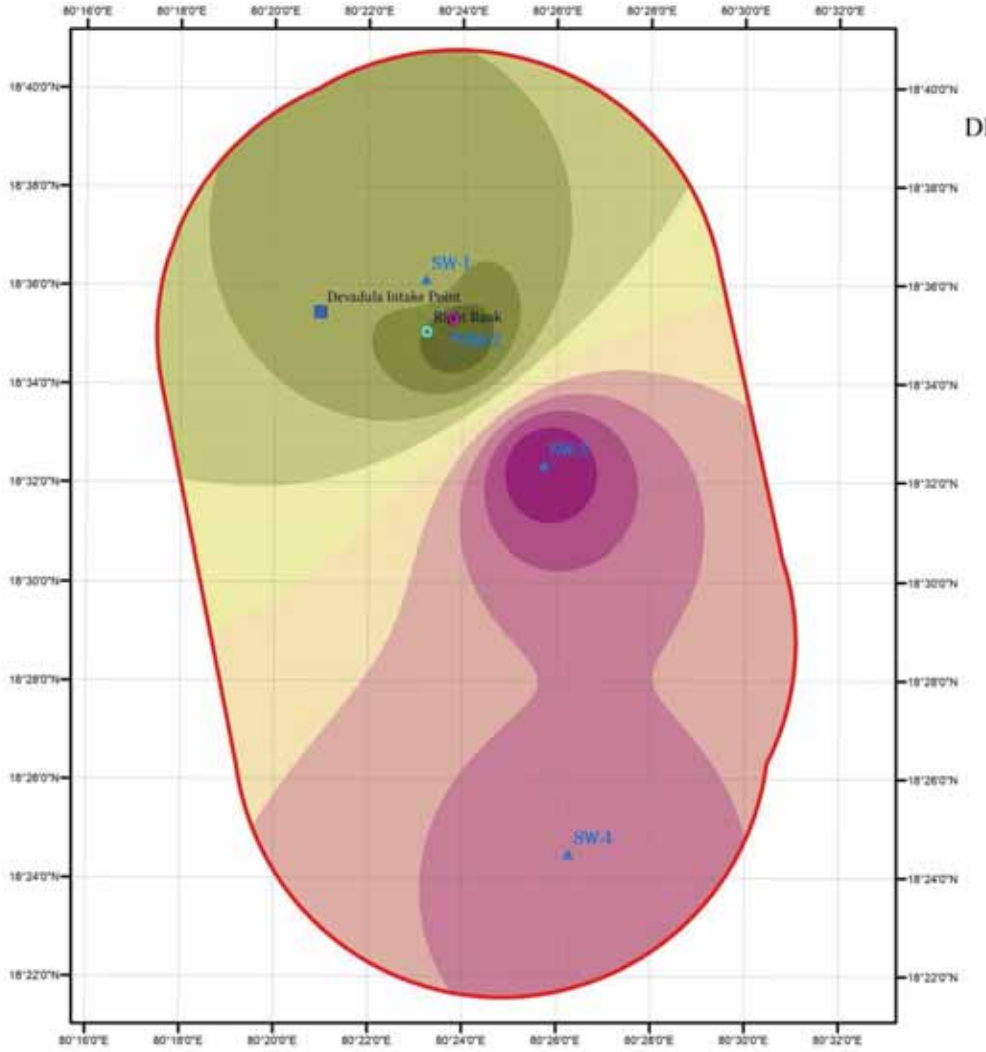


PLATE - 33

PVNRKSS LIS PROJECT
VILLGAE : TUPAKULAGUDEM
DISTRICT : JAYASHANKAR BHOOPALPALLY, T.S.



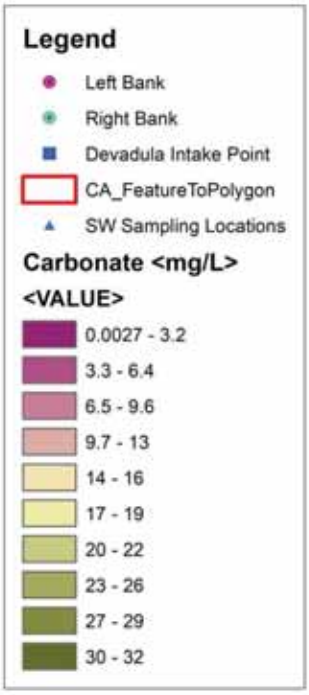
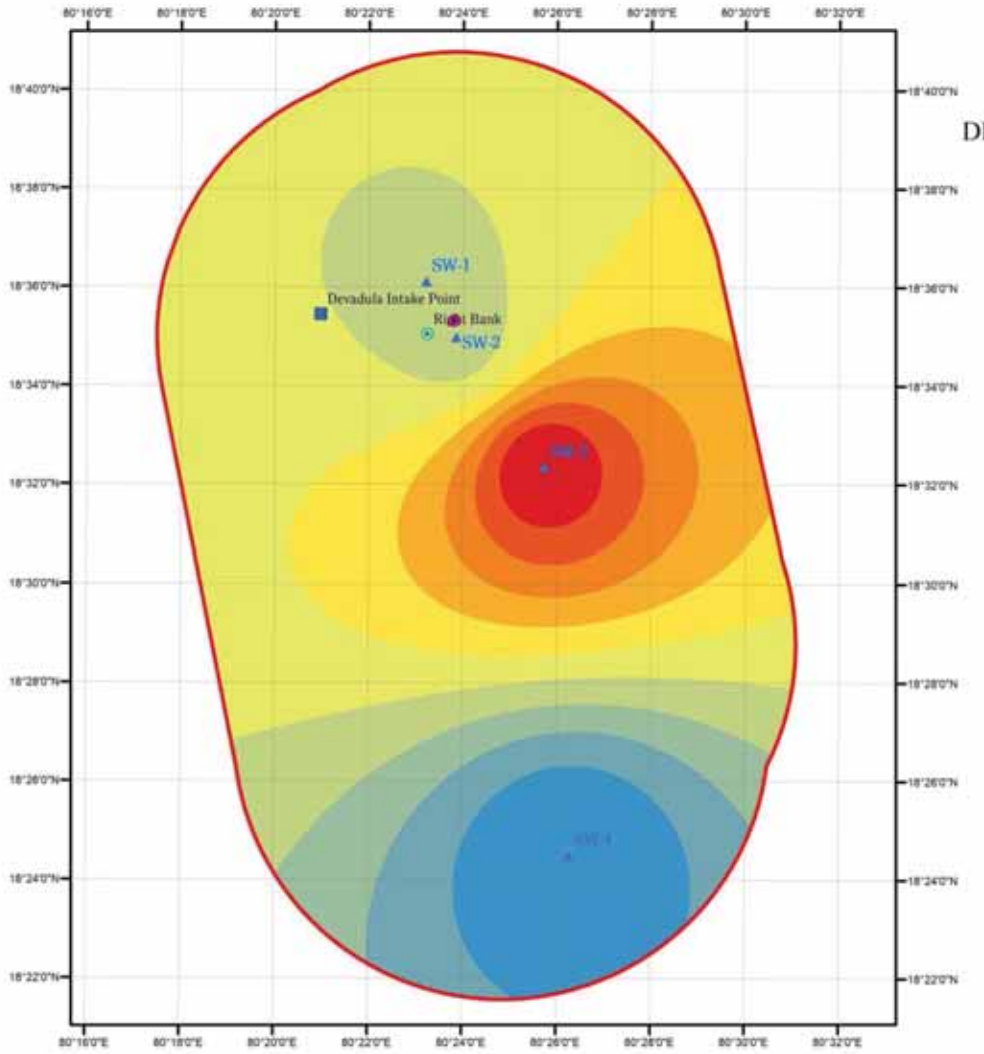


PLATE - 34

PVNRKSS LIS PROJECT
VILLGAE : TUPAKULAGUDEM
DISTRICT : JAYASHANKAR BHOOPALPALLY, T.S.



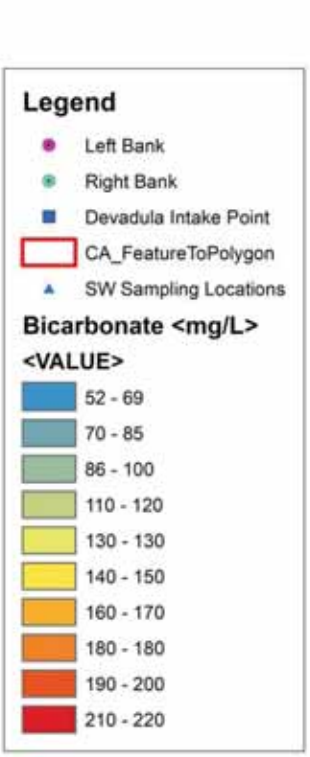
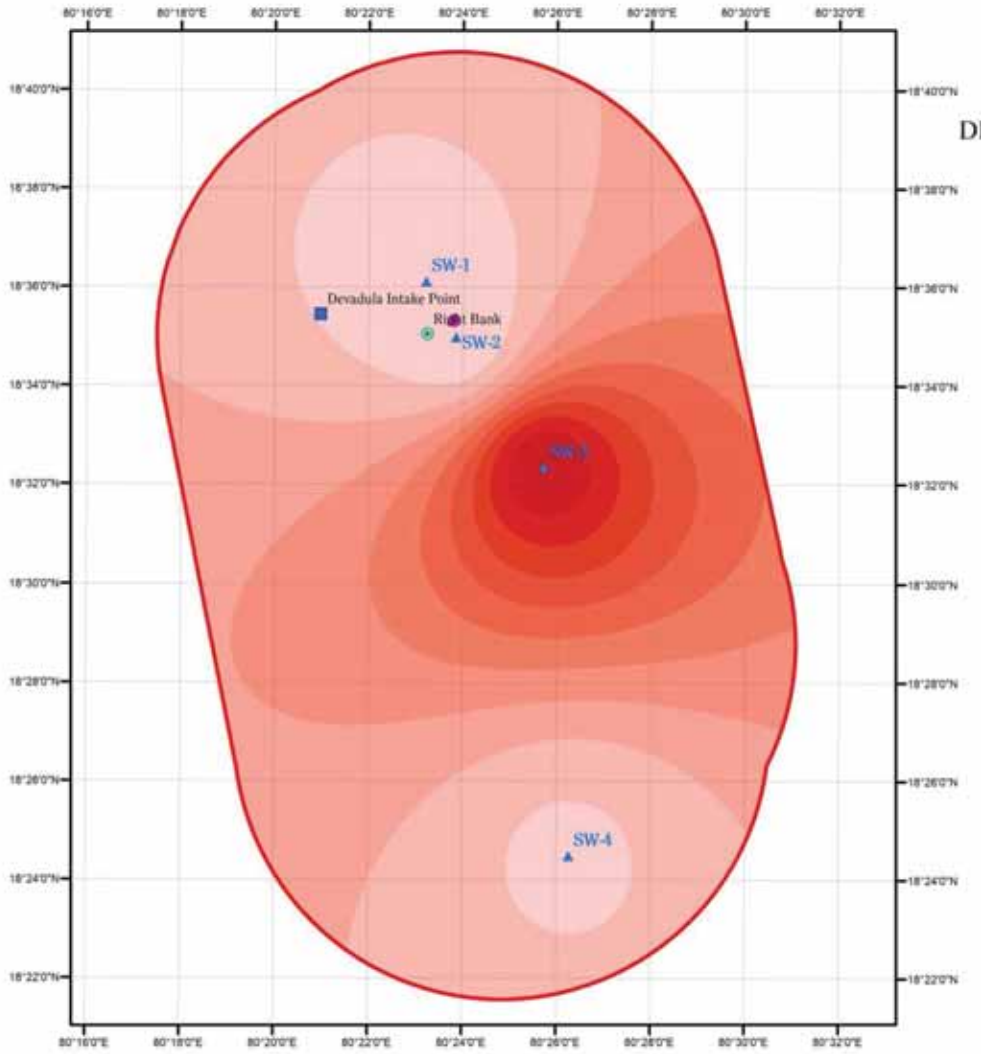
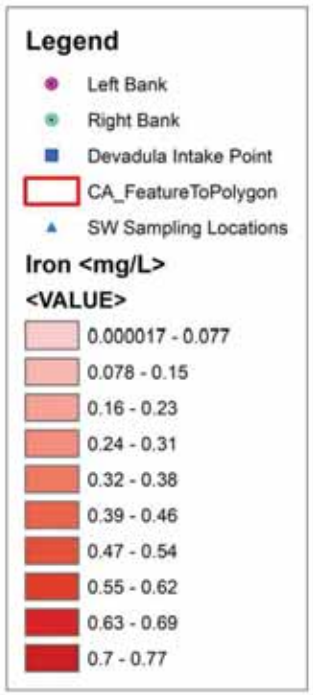


PLATE - 35

PVNRKSS LIS PROJECT
VILLGAE : TUPAKULAGUDEM
DISTRICT : JAYASHANKAR BHOOPALPALLY, T.S.





ANNEXURE-16

ANNEXURE 16

Surface water quality analysis results for Monsoon season (July 2017 - September 2017)

Sl. No.	Parameters	Unit	Water Quality Criteria					SW-1	SW-2	SW-3	SW-4	SW-5	SW-6	SW-7	SW-8	SW-9	SW-10
			A	B	C	D	E										
1.	pH	-	6.5-8.5					7.76	7.71	7.02	7.76	7.49	7.58	7.89	8.14	8.01	7.89
2.	Temperature	0^0C	-	-	-	-	-	26	26	26	26	26	26	26	26	26	26
3.	Conductivity	µS/cm	-	-	-	1000	2250	181.2	194.2	217.6	214	401	181.8	394	325	1021	531
4.	Suspended Solids	mg/L	-	-	-	-	-	116	80	440	34	666	54	66	22	9	ND
5.	Total Dissolved Solids	mg/L	500	-	1500	-	2100	169	179	170	193	344	121	336	203	684	337
6.	Total Hardness	mg/L	-	-	-	-	-	62	60	80	72	78	58	140	84	244	150
7.	Alkalinity	mg/L	-	-	-	-	-	72	70	48	87	194	80	182	148	196	150
8.	Dissolved Oxygen	mg/L	6	5	4	4	-	5.4	5.3	4	5.4	4.7	5.5	4.8	5.4	3.3	4.5
9.	BOD(3 Days@27^0C)	mg/L	2	3	3	-	-	ND	ND	10	ND	24	ND	8	ND	44	ND
10.	COD	mg/L	-	-	-	-	-	16	ND	44.8	ND	96	ND	35.2	ND	92	ND
11.	Nitrite (NO_2)	mg/L	-	-	-	-	-	ND	ND	ND	ND	0.34	0.31	0	ND	ND	ND
12.	Nitrate as NO_3	mg/L	20	-	50	-	-	5.81	6.17	3.53	6.43	4.71	3.69	6.43	3.93	0.81	1.67
13.	Phosphate Total	mg/L	-	-	-	-	-	0.62	0.46	0.07	ND	1.22	ND	ND	ND	1.26	0.98
14.	Chloride as Cl	mg/L	250	-	600	-	600	7.34	8.81	13.21	15.17	33.27	9.78	38.15	22.5	160.5	60.7
15.	Sulphate as SO4	mg/L	400	-	400	-	1000	31.94	37.54	40	27.3	43.91	8.83	14.86	3.99	67.02	45.61
16.	Sodium	mg/L	-	-	-	-	-	10.8	11.6	8	14	53.6	6.8	20	30	67.6	44
17.	Potassium	mg/L	-	-	-	-	-	4	4	4.8	4.8	9.2	4	4	6	11.6	4.4
18.	Calcium as Ca	mg/L	-	-	-	-	-	19.2	17.6	19.2	22	16.8	16	40	21.6	72	36
19.	Magnesium as Mg	mg/L	-	-	-	-	-	3.4	3.88	7.78	5.34	8.74	4.37	9.72	7.29	15.55	14.58
20.	Fluoride as F	mg/L	1.5	1.5	1.5	-	-	0.1	0.19	0.3	0.85	0.25	0.42	1.26	1.36	0.26	0.59

Sl. No.	Parameters	Unit	Water Quality Criteria					SW-1	SW-2	SW-3	SW-4	SW-5	SW-6	SW-7	SW-8	SW-9	SW-10
			A	B	C	D	E										
21.	Silica	mg/L	-	-	-	-	-	8.89	9.93	ND	6.62	9.82	4.47	5.94	8.55	6.03	5.76
22.	Oil & Grease	mg/L	-	-	-	-	-	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
23.	Phenolic Compounds	mg/L	-	-	-	-	-	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
24.	Residual Sodium Carbonate	mg/L	-	-	-	-	-	ND	ND	ND	ND	0.32	ND	ND	ND	ND	ND
25.	Carbonate	mg/L	-	-	-	-	-	4	6	6	4	16	6	8	36	8	12
26.	Bicarbonate	mg/L	-	-	-	-	-	68	64	42	83	178	74	174	112	180	138
27.	Lead as Pb	mg/L	0.1	-	0.1	-	-	0.006	0.005	0.032	ND	0.01	0.002	0.011	ND	ND	ND
28.	Arsenic as As	mg/L	0.05	0.2	0.2	-	-	0.007	ND	ND	ND	ND	ND	0.004	0.005	0.003	ND
29.	Mercury as Hg	mg/L	-	-	-	-	-	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
30.	Cadmium as Cd	mg/L	-	-	-	-	-	0.002	ND	ND	ND	ND	ND	ND	ND	ND	ND
31.	Chromium Hexavalent	mg/L	-	-	-	-	-	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
32.	Total Chromium	mg/L	-	-	-	-	-	0.02	0.008	0.058	0.004	0.02	0.002	0.017	ND	ND	ND
33.	Copper as Cu	mg/L	1.5	-	1.5	-	-	0.017	0.011	0.043	0.005	0.024	0.004	0.01	0.002	0.008	0.002
34.	Zinc as Zn	mg/L	15	-	15	-	-	0.115	0.169	0.196	0.049	0.062	0.009	0.227	0.008	0.008	0.005
35.	Iron as Fe	mg/L	0.3	-	50	-	-	3.76	5.69	6.28	2.87	0.15	0.6	ND	0.21	0.08	0.35
36.	E- Coli	MPN/100ml	-	-	-	-	-	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8
37.	Total Coliform	MPN/ 100ml	50	500	5000	-	-	10	14	84	39	31	58	33	70	12	10

Note: ND – Not Detected, BDL- Below Detectable Limit

Ground water quality analysis results for Monsoon season (July 2017 - September 2017)

Sl.No.	Parameters	Unit	Std IS 10500:2012 (Second Revision)		GW-1	GW-2	GW-3	GW-4	GW-5	GW-6	GW-7	GW-8	GW-9	GW-10	GW-11	GW-12	GW-13	GW-14	GW-15	GW-16	GW-17
			AL	PL																	
1.	pH	-	6.5-8.5		7.9	6.77	7.86	7.82	6.97	6.91	7.16	7.21	7.12	6.87	7.62	8.01	7.93	7.17	6.92	7.29	7.03
2.	Temperature	0^0C	-		26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26
3.	Conductivity	µS/cm	-		1810	1896	756	1240	6280	2480	1192	1711	2810	2910	769	1410	678	3350	2890	2250	2520
4.	Suspended Solids	mg/L	-		5	8	ND	ND	21	7	5	11	11	13	ND	ND	9	7	8	12	6
5.	Total Dissolved Solids	mg/L	500	2000	1164	1468	584	867	3738	2021	794	1441	2114	2524	477	1027	418	2752	1840	1517	1709
6.	Total Hardness	mg/L	200	600	572	656	288	504	880	740	380	524	920	1000	184	232	148	1080	550	420	610
7.	Alkalinity	mg/L	200	600	544	492	292	348	670	390	188	428	580	390	268	480	142	300	400	370	460
8.	Nitrite (NO_2)	mg/L	-		0.16	1.96	ND	0.05	0.54	1.26	0.05	0.03	0.71	0.43	0.08	ND	0.01	0.08	0.06	0.67	0.02
9.	Nitrate as NO_3	mg/L	45		3.33	6.14	6.14	12.15	4.02	2.54	8	3.05	3.2	7.07	1.99	28.98	0.75	2.45	7.86	15.7	0.16
10.	Phosphate Total	mg/L	-		0.16	0.2	0.18	ND	0.05	ND	ND	ND	ND	ND	ND	0.36	ND	0.29	ND	ND	0.056
11.	Chloride as Cl	mg/L	250	1000	248.5	262.2	37.17	133.1	1174.1	313.1	105.66	225	391.4	469.6	72.4	121.32	83.17	719.14	567.5	288.6	303.3
12.	Sulphate as SO4	mg/L	200	400	82.39	46.21	39.96	55.64	393.78	250	80.35	104.2	230.01	262.63	25.14	149.88	67.7	112.6	150.7	172.93	219.14
13.	Sodium	mg/L	-		150	70	26	8.4	880	136	56	120	180	180	60	180	64	210	364	240	210
14.	Potassium	mg/L	-		4.4	5.6	1.2	4	12.4	18	4.4	5.2	6	2.4	1.6	26.4	5.2	4	4.8	9.2	40
15.	Calcium as Ca	mg/L	75	200	126.4	136	80	124.8	220	188	110.4	128	152	220	48	57.6	32	228.0	128	108	128
16.	Magnesium as Mg	mg/L	30	100	62.2	76.78	21.38	46.7	80.19	65.61	25.27	49.57	131.22	109.35	15.52	21.38	16.52	123.9	55.89	36.45	70.47
17.	Fluoride as F	mg/L	1	1.5	0.58	0.28	0.66	1.76	0.22	1.41	0.94	0.3	1.34	1.07	1.24	0.92	1.18	1.4	1.27	1.32	1.27

Sl.No.	Parameters	Unit	Std IS 10500:2012 (Second Revision)		GW-1	GW-2	GW-3	GW-4	GW-5	GW-6	GW-7	GW-8	GW-9	GW-10	GW-11	GW-12	GW-13	GW-14	GW-15	GW-16	GW-17
			AL	PL																	
18.	Silica	mg/L	-		16.83	12.62	4.5	13.98	27.2	12.6	23.3	21.3	16.9	18.81	16.51	ND	5.7	28.72	18.28	15.28	13.83
19.	Oil & Grease	mg/L	-		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
20.	Phenolic Compounds	mg/L	0.001	0.002	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
21.	Residual Sodium Carbonate	mg/L	-		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
22.	Carbonate	mg/L	-		96	48	80	40	140	40	56	48	180	100	16	80	16	80	140	100	100
23.	Bicarbonate	mg/L	-		448	444	212	308	530	350	132	380	400	290	252	400	126	220	260	270	360
24.	Lead as Pb	mg/L	0.01		0.003	0.01	ND	0.002	0.01	0.003	0.017	0.003	0.007	0.008	0.007	ND	0.003	0.004	0.004	0.011	0.009
25.	Arsenic as As	mg/L	0.001	0.002	ND	ND	ND	ND	ND	ND	0.008	ND	ND	ND	ND	ND	0.003	0.003	ND	ND	0.003
26.	Mercury as Hg	mg/L	0.001		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
27.	Cadmium as Cd	mg/L	0.003		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
28.	Chromium Hexavalent	mg/L	-		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
29.	Total Chromium	mg/L	0.05		ND	ND	ND	ND	0.002	0.002	0.006	ND	ND	0.002	0.003	ND	ND	0.002	0.002	0.003	0.003
30.	Copper as Cu	mg/L	0.05	15	0.005	0.019	ND	0.002	0.094	0.018	0.031	0.005	0.01	0.006	0.004	ND	0.003	0.003	0.002	0.11	0.009
31.	Zinc as Zn	mg/L	5	15	0.343	1.124	ND	0.128	0.48	0.345	3.883	0.014	0.223	1.335	0.524	ND	0.246	0.177	0.006	1.052	0.442
32.	Iron as Fe	mg/L	0.3		0.66	2.43	0.44	ND	1.17	0.37	0.049	ND	0.26	0.1	0.03	ND	ND	0.41	0.21	0.25	0.45
33.	E- Coli	MPN/ 100ml	-		<1.8	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8
34.	Total Coliform	MPN/ 100ml	-		1.8	<1.8	<1.8	<1.8	<1.8	<1.8	1.8	2	<1.8	1.8	<1.8	<1.8	1.8	1.8	<1.8	1.8	1.8

Note: ND – Not Detected, BDL- Below Detectable Limit

Sl.No	Parameters	Unit	Std IS 10500:2012 (Second Revision)		GW-18	GW-19	GW-20	GW-21	GW-22	GW-23	GW-24	GW-25
			AL	PL								
1.	pH	-	6.5-8.5		7.34	7.15	7.34	7.19	6.75	7.25	6.88	7.07
2.	Temperature	0^0C	-		26	26	26	26	26	26	26	26
3.	Conductivity	µS/cm	-		1683	1943	3100	1252	1600	1431	1590	616
4.	Suspended Solids	mg/L	-		15	10	ND	ND	29	6	8	ND
5.	Total Dissolved Solids	mg/L	500	2000	1110	1473	1762	941	1244	858	1258	422
6.	Total Hardness	mg/L	200	600	484	542	520	452	364	268	428	198
7.	Alkalinity	mg/L	200	600	548	492	420	348	364	532	408	300
8.	Nitrite (NO_2)	mg/L	-		0.23	ND	0.09	0.06	0.7	ND	0.18	ND
9.	Nitrate as NO_3	mg/L	45		4.02	9.03	8.44	7.02	9.76	2.63	10.87	1.54
10.	Phosphate Total	mg/L	-		ND	ND	0.53	ND	ND	ND	ND	0.29
11.	Chloride as Cl	mg/L	250	1000	170.3	262.2	474.5	121.3	221.12	146.8	189.8	24.5
12.	Sulphate as SO4	mg/L	200	400	106.9	134.5	139.81	103.7	165.8	47.74	109.74	14.18
13.	Sodium	mg/L	-		110	160	260	56	150	160	92	22
14.	Potassium	mg/L	-		1.6	5.2	112	0.8	14	3.2	34	2
15.	Calcium as Ca	mg/L	75	200	113.6	138.8	96	136	81.6	70.4	94.4	52
16.	Magnesium as Mg	mg/L	30	100	48.6	51.03	68.04	27.21	38.88	22.4	46.65	16.52
17.	Fluoride as F	mg/L	1	1.5	1.61	1.48	0.57	0.37	0.82	1.96	0.9	0.85
18.	Silica	mg/L	-		6.18	14.84	21.37	4.45	12.1	14.91	13.15	42.74
19.	Oil & Grease	mg/L	-		ND	ND	ND	ND	ND	ND	ND	ND
20.	Phenolic Compounds	mg/L	0.001	0.002	ND	ND	ND	ND	ND	ND	ND	ND
21.	Residual Sodium Carbonate	mg/L	-		ND	ND	ND	ND	ND	ND	ND	ND
22.	Carbonate	mg/L	-		24	24	180	40	16	24	16	24
23.	Bicarbonate	mg/L	-		524	468	240	308	348	508	392	276
24.	Lead as Pb	mg/L	0.01		0.003	0.01	0.003	0.003	0.005	0.003	0.004	ND

25.	Arsenic as As	mg/L	0.001	0.002	ND	ND	ND	0.002	ND	0.002	ND	ND
26.	Mercury as Hg	mg/L	0.001		ND	ND	ND	ND	ND	ND	ND	ND
27.	Cadmium as Cd	mg/L	0.003		ND	ND	ND	ND	ND	ND	ND	ND
28.	Chromium Hexavalent	mg/L	-		ND	ND	ND	ND	ND	ND	ND	ND
29.	Total Chromium	mg/L	0.05		0.002	0.006	ND	0.002	0.002	0.002	0.004	ND
30.	Copper as Cu	mg/L	0.05	15	0.005	0.011	0.013	0.005	0.004	0.003	0.013	0.005
31.	Zinc as Zn	mg/L	5	15	0.412	1.313	0.31	0.139	0.268	0.02	0.297	0.014
32.	Iron as Fe	mg/L	0.3		ND	0.78	0.58	0.23	0.13	ND	ND	0.35
33.	E- Coli	MPN/ 100ml	-		<1.8	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8
34.	Total Coliform	MPN/ 100ml	-		1.8	<1.8	<1.8	2	<1.8	<1.8	1.8	2

Surface water quality analysis results for Post Monsoon season (October 2017 - December 2017)

Sl. No.	Parameters	Unit	Water Quality Criteria					SW-1	SW-2	SW-3	SW-4	SW-5	SW-6	SW-7	SW-8	SW-9	SW-10
			A	B	C	D	E										
1.	pH	-	6.5-8.5					7.8	7.9	7.74	6.91	7.62	7.74	6.90	7.9	7.9	7.54
2.	Temperature	0^0C	-	-	-	-	-	28	28	27	28	27	27	28	27	27	26
3.	Conductivity	µS/cm	-	-	-	1000	2250	264	259	634	1880	640	346	504	379	1543	851
4.	Suspended Solids	mg/L	-	-	-	-	-	24	20	32	6	26	30	156	18	32	40
5.	Total Dissolved Solids	mg/L	500	-	1500	-	2100	214	186	492	1388	510	272	426	218	944	564
6.	Total Hardness	mg/L	-	-	-	-	-	84	66	136	590	118	56	104	46	168	98
7.	Alkalinity	mg/L	-	-	-	-	-	106	100	204	342	192	126	170	158	316	226
8.	Dissolved Oxygen	mg/L	6	5	4	4	-	5.2	5.7	4.8	5.4	4.9	5.1	4.4	5.3	4.9	5.3
9.	BOD(3 Days@27^0C)	mg/L	2	3	3	-	-	2.2	2.4	25	2.2	15	2.4	18	2.9	32	2.6
10.	COD	mg/L	-	-	-	-	-	19.2	22.4	169.6	9.6	70.4	9.6	80	16	115.2	19.2
11.	Nitrite (NO_2)	mg/L	-	-	-	-	-	BDL	0.03	BDL	0.13	0.15	0.03	BDL	0.02	0.16	0.03
12.	Nitrate as NO_3	mg/L	20	-	50	-	-	BDL	0.99	BDL	27.4	5.99	1.67	BDL	0.89	0.82	0.60
13.	Phosphate Total	mg/L	-	-	-	-	-	BDL	BDL	BDL	BDL	0.65	BDL	0.47	BDL	2.13	BDL
14.	Chloride as Cl	mg/L	250	-	600	-	600	27.79	13.89	71.46	272.96	39.33	48.63	75.43	25.80	200.5	90.32
15.	Sulphate as SO4	mg/L	400	-	400	-	1000	19.56	18.97	66.04	153.32	63.55	38.06	44.11	1.54	120.83	79.21
16.	Sodium	mg/L	-	-	-	-	-	26	18	86	130	110	64	80	46	240	120
17.	Potassium	mg/L	-	-	-	-	-	2.0	2.8	3.2	6.4	11.6	5.2	9.2	6	16.4	6.8
18.	Calcium as Ca	mg/L	-	-	-	-	-	22.4	21.6	28.8	164	27.2	14.4	28.8	8.8	48.8	20
19.	Magnesium as Mg	mg/L	-	-	-	-	-	6.80	2.91	15.55	43.74	12.15	4.86	12.8	5.83	11.17	11.66
20.	Fluoride as F	mg/L	1.5	1.5	1.5	-	-	0.26	0.16	0.56	0.46	0.50	0.26	0.47	0.25	0.63	0.36
21.	Silica	mg/L	-	-	-	-	-	3.3	BDL	BDL	BDL	BDL	4.46	BDL	BDL	BDL	BDL

Sl. No.	Parameters	Unit	Water Quality Criteria					SW-1	SW-2	SW-3	SW-4	SW-5	SW-6	SW-7	SW-8	SW-9	SW-10
22.	Oil & Grease	mg/L	-	-	-	-	-	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
23.	Phenolic Compounds	mg/L	-	-	-	-	-	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
24.	Residual Sodium Carbonate	mg/L	-	-	-	-	-	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
25.	Carbonate	mg/L	-	-	-	-	-	24	12	16	BDL	24	BDL	BDL	28	88	BDL
26.	Bicarbonate	mg/L	-	-	-	-	-	84	88	188	342	168	126	170	130	228	226
27.	Lead as Pb	mg/L	0.1	-	0.1	-	-	BDL	BDL	BDL	0.006	0.006	0.003	0.006	BDL	BDL	BDL
28.	Arsenic as As	mg/L	0.05	0.2	0.2	-	-	BDL	BDL	BDL	0.004	BDL	0.003	0.003	0.004	0.003	0.004
29.	Mercury as Hg	mg/L	-	-	-	-	-	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
30.	Cadmium as Cd	mg/L	-	-	-	-	-	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
31.	Chromium Hexavalent	mg/L	-	-	-	-	-	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
32.	Total Chromium	mg/L	-	-	-	-	-	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
33.	Copper as Cu	mg/L	1.5	-	1.5	-	-	0.004	0.005	0.006	0.008	0.012	0.013	0.011	0.003	0.005	0.003
34.	Zinc as Zn	mg/L	15	-	15	-	-	0.005	0.005	0.009	0.015	0.018	0.027	0.019	0.005	0.013	0.014
35.	Iron as Fe	mg/L	0.3	-	50	-	-	0.55	0.37	0.38	0.09	0.49	0.13	7.98	0.12	0.39	0.11
36.	E- Coli	MPN/100ml	-	-	-	-	-	<1.8	2	17	<1.8	1.4	21	4	6	6	14
37.	Total Coliform	MPN/ 100ml	50	500	5000	-	-	14	21	120	4	84	110	79	120	38	94

Note: ND – Not Detected, BDL- Below Detectable Limit

Ground water quality analysis results for Post-Monsoon season (October 2017 - December 2017)

Sl.No	Parameters	Unit	Std IS 10500:2012 (Second Revision)		GW-1	GW-2	GW-3	GW-4	GW-5	GW-6	GW-7	GW-8	GW-9	GW-10	GW-11	GW-12	GW-13	GW-14	GW-15	GW-16	GW-17
			AL	PL																	
1.	pH	-	6.5-8.5		7.02	7.72	7.12	7.66	6.78	7.06	7.26	8.20	7.13	6.72	6.99	6.94	6.80	7.35	7.8	7.34	7.16
2.	Temperature	0^0C	-		27	27	28	28	27	27	27	28	27	27	27	28	27	27	27	28	27
3.	Conductivity	µS/cm	-		2100	1610	1120	1480	868	2340	1803	328	3150	1920	1854	1644	1446	860	1327	2530	2460
4.	Suspended Solids	mg/L	-		8	BDL	BDL	16	22	14	52	BDL	BDL	BDL	BDL	17	33	BDL	64	16	15
5.	Total Dissolved Solids	mg/L	500	2000	1580	872	866	1044	430	1684	1128	264	2680	1470	1144	1250	1024	504	882	1640	1708
6.	Total Hardness	mg/L	200	600	624	200	320	560	132	736	368	104	874	628	444	544	400	102	312	576	680
7.	Alkalinity	mg/L	200	600	580	504	310	400	110	360	440	138	628	444	416	380	392	302	380	380	140
8.	Nitrite (NO_2)	mg/L	-		0.07	BDL	BDL	BDL	0.40	0.78	0.29	BDL	0.05	BDL	BDL	0.06	BDL	0.02	0.15	0.14	0.12
9.	Nitrate as NO_3	mg/L	45		19.88	21.74	16.27	17.99	16.95	63.90	30.20	BDL	30.34	20.74	7.74	25.48	10.46	4.14	5.10	33.91	41.05
10.	Phosphate Total	mg/L	-		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.07	BDL	BDL	1.26	BDL	BDL
11.	Chloride as Cl	mg/L	250	1000	277.92	85.36	154.84	156.83	45.65	325.57	186.60	45.65	490.34	242.19	256.09	283.88	178.66	28.78	79.40	402.00	347.41
12.	Sulphate as SO4	mg/L	200	400	119.52	94.50	79.92	71.02	33.67	252.33	94.62	8.77	394.63	195.41	68.53	115.25	77.31	22.76	130.91	184.51	261.35
13.	Sodium	mg/L	-		150	176	110	30	30	180	180	38	392	150	164	150	110	70	80	288	180
14.	Potassium	mg/L	-		5.2	3.2	4	4.0	4.4	22	4	1.6	7.2	2.4	3.6	6	8.8	2.8	30	3.6	20
15.	Calcium as Ca	mg/L	75	200	139.2	30.4	84.8	160	30.4	230.4	84.8	28.88	185.6	139.2	92.8	131.2	112	31.2	81.6	140.8	184
16.	Magnesium as Mg	mg/L	30	100	67.06	30.13	26.24	38.88	13.60	38.88	37.01	7.77	99.63	68.04	51.51	52.48	29.16	5.83	26.24	54.43	53.46
17.	Fluoride as F	mg/L	1	1.5	0.72	0.61	0.53	1.1	0.52	0.56	0.65	0.44	0.22	0.46	0.64	0.41	0.32	0.84	0.41	0.41	0.70
18.	Silica	mg/L	-		BDL	BDL	4.89	10.87	2.36	BDL	BDL	BDL	21.39	2.71	BDL	BDL	BDL	BDL	BDL	BDL	BDL
19.	Oil & Grease	mg/L	-		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
20.	Phenolic Compounds	mg/L	0.001	0.002	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
21.	Residual Sodium Carbonate	mg/L	-		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
22.	Carbonate	mg/L	-		BDL	64	BDL	24	BDL	BDL	BDL	20	BDL	BDL	BDL	BDL	BDL	BDL	BDL	140	60
23.	Bicarbonate	mg/L	-		580	440	310	376	110	360	440	118	628	444	416	380	392	302	380	240	110
24.	Lead as Pb	mg/L	0.01		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.006	0.003	BDL

25.	Arsenic as As	mg/L	0.001	0.002	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
26.	Mercury as Hg	mg/L	0.001		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
27.	Cadmium as Cd	mg/L	0.003		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
28.	Chromium Hexavalent	mg/L	-		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
29.	Total Chromium	mg/L	0.05		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.007	BDL	BDL	0.003	
30.	Copper as Cu	mg/L	0.05	15	0.009	0.003	0.004	0.007	0.042	0.017	0.022	0.04	0.008	0.006	0.004	0.005	0.336	0.005	0.036	0.008	0.035	
31.	Zinc as Zn	mg/L	5	15	0.197	0.025	0.014	0.261	0.162	0.076	0.167	0.005	0.029	0.011	0.007	0.026	7.993	0.026	0.698	0.354	0.715	
32.	Iron as Fe	mg/L	0.3		1.36	0.36	0.26	0.22	0.61	0.37	0.98	0.13	0.30	0.04	0.06	0.41	0.55	0.12	0.76	0.63	0.66	
33.	E- Coli	MPN/ 100ml	-		<1.8	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8	
34.	Total Coliform	MPN/ 100ml	-		<1.8	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8	

Note: ND – Not Detected, BDL- Below Detectable Limit

Sl.No	Parameters	Unit	Std IS 10500:2012 (Second Revision)		GW-18	GW-19	GW-20	GW-21	GW-22	GW-23	GW-24	GW-25
			AL	PL								
1.	pH	-	6.5-8.5		7.64	7.01	6.94	7.03	6.83	6.92	6.77	6.89
2.	Temperature	0^0C	-		27	27	27	27	27	27	27	27
3.	Conductivity	µS/cm	-		1840	1580	1180	1760	1833	1253	1125	4140
4.	Suspended Solids	mg/L	-		BDL	BDL	14	44	BDL	6	BDL	BDL
5.	Total Dissolved Solids	mg/L	500	2000	1162	1236	910	1344	1204	1056	910	3240
6.	Total Hardness	mg/L	200	600	500	486	408	536	392	428	356	1190
7.	Alkalinity	mg/L	200	600	284	444	308	408	328	568	248	456
8.	Nitrite (NO_2)	mg/L	-		0.05	0.08	0.03	2.44	2.15	0.16	BDL	0.17
9.	Nitrate as NO_3	mg/L	45		48.55	43.26	24.84	15.74	43.19	6.74	34.23	83.89
10.	Phosphate Total	mg/L	-		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
11.	Chloride as Cl	mg/L	250	1000	214.40	144.91	170.72	208.44	206.46	133.00	154.84	630.30
12.	Sulphate as SO4	mg/L	200	400	120.83	101.38	71.26	208.22	104.46	42.57	116.20	394.63
13.	Sodium	mg/L	-		116	110	72	150	160	86	112	364
14.	Potassium	mg/L	-		17.6	6.0	1.6	0.4	19.6	4	15.6	8
15.	Calcium as Ca	mg/L	75	200	140	110.4	110.4	150.4	126.4	92.8	99.2	268
16.	Magnesium as Mg	mg/L	30	100	36.45	51.03	32.04	38.88	18.46	47.62	26.24	114.21
17.	Fluoride as F	mg/L	1	1.5	0.24	0.46	0.56	0.30	0.38	0.42	0.34	0.60
18.	Silica	mg/L	-		0.89	BDL	BDL	8.85	1.39	4.11	BDL	BDL
19.	Oil & Grease	mg/L	-		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
20.	Phenolic Compounds	mg/L	0.001	0.002	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
21.	Residual Sodium Carbonate	mg/L	-		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
22.	Carbonate	mg/L	-		72	BDL	BDL	BDL	16	BDL	24	BDL

23.	Bicarbonate	mg/L	-		212	444	308	408	312	568	224	456
24.	Lead as Pb	mg/L	0.01		0.004	0.005	BDL	0.004	0.003	0.004	BDL	0.005
25.	Arsenic as As	mg/L	0.001	0.002	BDL	BDL	BDL	BDL	BDL	0.003	BDL	BDL
26.	Mercury as Hg	mg/L	0.001		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
27.	Cadmium as Cd	mg/L	0.003		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
28.	Chromium Hexavalent	mg/L	-		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
29.	Total Chromium	mg/L	0.05		BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
30.	Copper as Cu	mg/L	0.05	15	0.014	0.006	0.010	0.013	0.017	0.017	0.004	0.011
31.	Zinc as Zn	mg/L	5	15	0.009	0.028	0.619	0.030	0.029	0.205	0.017	0.591
32.	Iron as Fe	mg/L	0.3		0.08	0.24	0.79	0.85	0.19	0.50	0.34	0.41
33.	E- Coli	MPN/ 100ml	-		<1.8	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8
34.	Total Coliform	MPN/ 100ml	-		<1.8	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8

Note: ND – Not Detected, BDL- Below Detectable Limit

Surface water quality analysis results for Pre Monsoon season (January 2018 - March 2018)

Sl. No.	Parameters	Unit	Water Quality Criteria					SW-1	SW-2	SW-3	SW-4	SW-5	SW-6	SW-7	SW-8	SW-9	SW-10
			A	B	C	D	E										
1.	pH	-	6.5-8.5					7.9	8.2	8.31	8.15	7.78	8.13	7.13	8.29	7.4	8.14
2.	Temperature	0^0C	-					-	-	-	-	27	27	27	27	27	27
3.	Conductivity	µS/cm	-	-	-	1000	2250	316	320	722	353	1049	331	756	362	2370	741
4.	Suspended Solids	mg/L	-	-	-	-	-	ND	ND	14	ND	64	18	9	14	12	8
5.	Total Dissolved Solids	mg/L	500	-	1500	-	2100	256	248	473	260	874	256	696	334	1494	572
6.	Total Hardness	mg/L	-	-	-	-	-	104	100	148	98	136	72	172	90	416	184
7.	Alkalinity	mg/L	-	-	-	-	-	134	128	212	132	324	128	204	160	280	192
8.	Dissolved Oxygen	mg/L	6	5	4	4	-	4.6	4.8	5.2	5.4	1.2	4.8	ND	4.4	4.5	4.8
9.	BOD(3 Days@27^{0}C)	mg/L	2	3	3	-	-	ND	2.5	8	2.4	9.4	10	92	ND	2.2	2.7
10.	COD	mg/L	-	-	-	-	-	6.4	12.8	32	9.6	320	35.2	480	ND	12.6	16
11.	Nitrite (NO_2)	mg/L	-	-	-	-	-	ND	ND	ND	ND	ND	ND	ND	ND	0.10	ND
12.	Nitrate as NO_3	mg/L	20	-	50	-	-	1.10	1.08	7.87	1.58	12.92	6.35	2.99	5.50	9.16	3.69
13.	Phosphate Total	mg/L	-	-	-	-	-	ND	ND	0.15	0.11	ND	ND	5.16	ND	1.04	0.15
14.	Chloride as Cl	mg/L	250	-	600	-	600	19.28	24.10	73.28	29.89	57.85	31.81	75.21	65.56	404.98	75.21
15.	Sulphate as SO4	mg/L	400	-	400	-	1000	16.0	15.05	27.27	15.05	224.35	12.92	195.89	6.87	170.04	80.04
16.	Sodium	mg/L	-	-	-	-	-	18	27.05	109.68	28.48	167.04	39.29	104.75	56	302.88	80
17.	Potassium	mg/L	-	-	-	-	-	3.26	3.19	5.14	3.26	21.45	5.18	14.78	5.30	15.33	4.40
18.	Calcium as Ca	mg/L	-	-	-	-	-	23.2	21.6	33.6	23.2	28.8	15.2	38.4	19.2	91.2	38.4
19.	Magnesium as Mg	mg/L	-	-	-	-	-	11.17	11.17	15.55	9.72	15.55	8.26	1.84	10.20	45.68	21.38
20.	Fluoride as F	mg/L	1.5	1.5	1.5	-	-	0.66	0.69	0.59	0.43	ND	0.63	ND	1.21	0.25	0.82
21.	Silica	mg/L	-	-	-	-	-	ND	ND	1.66	2.25	ND	ND	ND	ND	5.51	2.67

Sl. No.	Parameters	Unit	Water Quality Criteria					SW-1	SW-2	SW-3	SW-4	SW-5	SW-6	SW-7	SW-8	SW-9	SW-10
			A	B	C	D	E										
22.	Oil & Grease	mg/L	-	-	-	-	-	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
23.	Phenolic Compounds	mg/L	-	-	-	-	-	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
24.	Residual Sodium Carbonate	mg/L	-	-	-	-	-	ND	ND	ND	ND	0.39	ND	ND	ND	ND	ND
25.	Carbonate	mg/L	-	-	-	-	-	24	28	56	20	40	16	ND	24	64	32
26.	Bicarbonate	mg/L	-	-	-	-	-	110	100	156	112	284	112	204	136	216	160
27.	Lead as Pb	mg/L	0.1	-	0.1	-	-	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
28.	Arsenic as As	mg/L	0.05	0.2	0.2	-	-	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
29.	Mercury as Hg	mg/L	-	-	-	-	-	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
30.	Cadmium as Cd	mg/L	-	-	-	-	-	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
31.	Chromium Hexavalent	mg/L	-	-	-	-	-	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
32.	Total Chromium	mg/L	-	-	-	-	-	ND	ND	ND	ND	ND	ND	0.099	ND	ND	ND
33.	Copper as Cu	mg/L	1.5	-	1.5	-	-	ND	ND	ND	ND	ND	ND	0.086	ND	ND	ND
34.	Zinc as Zn	mg/L	15	-	15	-	-	ND	ND	ND	ND	ND	ND	0.027	ND	ND	ND
35.	Iron as Fe	mg/L	0.3	-	50	-	-	ND	0.02	0.12	0.10	ND	ND	ND	0.02	0.17	0.08
36.	E- Coli	MPN/100ml	-	-	-	-	-	<1.8	4	21	<1.8	21	27	550	11	26	17
37.	Total Coliform	MPN/ 100ml	50	500	5000	-	-	21	38	170	12	210	140	3900	170	140	120

Note: ND – Not Detected, BDL- Below Detectable Limit

Ground water quality analysis results for Pre-Monsoon season (January 2018 - March 2018)

Sl.No	Parameters	Unit	Std IS 10500:2012 (Second Revision)		GW-1	GW-2	GW-3	GW-4	GW-5	GW-6	GW-7	GW-8	GW-9	GW-10	GW-11	GW-12	GW-13	GW-14	GW-15	GW-16	GW-17
			AL	PL																	
1.	pH	-	6.5-8.5		7.75	8.34	7.76	7.27	6.92	7.41	7.34	7.36	7.58	7.83	8.26	7.95	7.34	7.75	7.56	7.65	7.44
2.	Temperature	0^0C	-		27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27
3.	Conductivity	µS/cm	-		1698	1520	716	3190	5950	2660	1572	1240	2960	2810	1275	1552	1393	1861	1344	2490	3150
4.	Suspended Solids	mg/L	-		10	10	ND	ND	8	12	6	ND	ND	6	ND	ND	18	ND	6	ND	12
5.	Total Dissolved Solids	mg/L	500	2000	1360	984	510	1780	4310	1562	1136	726	1860	1880	936	1038	1022	1426	1140	1542	1742
6.	Total Hardness	mg/L	200	600	576	196	262	900	880	716	412	216	720	620	400	196	440	548	384	576	690
7.	Alkalinity	mg/L	200	600	548	548	316	240	540	320	424	248	500	400	416	504	480	432	444	392	250
8.	Nitrite (NO_2)	mg/L	-		0.06	ND	ND	0.41	0.024	0.70	0.11	0.07	0.07	0.04	ND	0.03	ND	0.02	0.03	0.31	0.42
9.	Nitrate as NO_3	mg/L	45		31.58	45.91	5.36	39.59	47.89	50.22	45.82	47.55	49.4	49.01	28.39	35.29	1.19	7.88	32.79	36.60	50.57
10.	Phosphate Total	mg/L	-		ND	0.13	0.20	0.12	ND	ND	ND	ND	ND	0.12	0.22	0.57	ND	ND	1.55	ND	ND
11.	Chloride as Cl	mg/L	250	1000	181.27	79.06	26.99	366.41	1706.70	287.34	165.84	80.99	347.12	366.41	98.35	106.06	152.34	312.41	233.34	347.12	385.69
12.	Sulphate as SO4	mg/L	200	400	101.14	88.10	22.76	193.52	323.48	174.31	98.18	98.42	189.49	227.67	54.90	111.46	45.77	85.97	38.41	117.51	225.77
13.	Sodium	mg/L	-		252.56	232	34.93	30.06	1011.3	237.8	148	99.28	220	272	92	216	76	188	116.93	210	164
14.	Potassium	mg/L	-		4.23	2.25	1.76	6.20	7.80	10	5.14	20	5.46	7.41	3.43	43.89	8.06	1.77	60.23	7.47	72
15.	Calcium as Ca	mg/L	75	200	120	41.6	60.8	208	208	166.4	92.8	46.4	176	116	83.2	41.6	104	110.4	78.4	118.4	152
16.	Magnesium as Mg	mg/L	30	100	67.06	22.35	26.73	92.34	87.48	72.9	43.74	24.3	68.04	80.19	46.65	22.35	43.74	66.09	45.68	68.04	75.33
17.	Fluoride as F	mg/L	1	1.5	1.31	0.91	0.81	1.16	1.00	1.09	1.44	0.92	1.13	0.93	1.40	1.11	1.22	1.43	0.60	1.10	1.28

Sl.No	Parameters	Unit	Std IS 10500:2012 (Second Revision)		GW-1	GW-2	GW-3	GW-4	GW-5	GW-6	GW-7	GW-8	GW-9	GW-10	GW-11	GW-12	GW-13	GW-14	GW-15	GW-16	GW-17
			AL	PL																	
18.	Silica	mg/L	-		ND	9.12	5.90	8..96	ND	ND	ND	ND	ND	11.22	2.83	ND	ND	ND	ND	ND	ND
19.	Oil & Grease	mg/L	-		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
20.	Phenolic Compounds	mg/L	0.001	0.002	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
21.	Residual Sodium Carbonate	mg/L	-		ND	1.22	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.91	ND	ND	ND	ND	ND
22.	Carbonate	mg/L	-		40	136	96	ND	ND	ND	ND	ND	ND	96	112	72	ND	56	ND	16	ND
23.	Bicarbonate	mg/L	-		508	412	220	240	540	320	424	248	500	304	304	432	480	376	444	376	250
24.	Lead as Pb	mg/L	0.01		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.1092	ND	ND	ND	ND
25.	Arsenic as As	mg/L	0.001	0.002	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
26.	Mercury as Hg	mg/L	0.001		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
27.	Cadmium as Cd	mg/L	0.003		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
28.	Chromium Hexavalent	mg/L	-		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
29.	Total Chromium	mg/L	0.05		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
30.	Copper as Cu	mg/L	0.05	15	0.051	0.038	ND	ND	0.144	0.038	ND	ND	ND	0.053	0.054	ND	0.121	ND	ND	ND	ND
31.	Zinc as Zn	mg/L	5	15	0.088	0.029	ND	2.543	0.1877	0.179	0.1217	0.0895	0.049	0.0745	ND	ND	2.101	ND	0.661	0.657	0.321
32.	Iron as Fe	mg/L	0.3		0.06	0.14	0.81	0.22	ND	0.04	ND	ND	ND	ND	0.16	ND	0.06	0.08	ND	ND	0.02
33.	E- Coli	MPN/ 100ml	-		<1.8	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8
34.	Total Coliform	MPN/ 100ml	-		<1.2	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8	2	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8	1.8

Note: ND – Not Detected, BDL- Below Detectable Limit

Sl.No	Parameters	Unit	Std IS 10500:2012 (Second Revision)		GW-18	GW-19	GW-20	GW-21	GW-22	GW-23	GW-24	GW-25
			AL	PL								
1.	pH	-	6.5-8.5		8. 14	7.17	7.18	7.32	7.49	7.52	7.13	7.76
2.	Temperature	0^0C	-		27	27	27	27	27	27	27	27
3.	Conductivity	µS/cm	-		450	1568	1039	1608	1630	1475	1351	716
4.	Suspended Solids	mg/L	-		ND	ND	ND	8	ND	16	6	ND
5.	Total Dissolved Solids	mg/L	500	2000	370	1164	772	1226	1004	1174	1060	574
6.	Total Hardness	mg/L	200	600	146	478	354	536	376	566	416	262
7.	Alkalinity	mg/L	200	600	182	428	296	308	272	440	400	316
8.	Nitrite (NO_2)	mg/L	-		0.10	47.46	0.04	0.68	0.06	0.49	0.70	ND
9.	Nitrate as NO_3	mg/L	45		2.70	0.11	43.84	29.42	41.25	47.29	40.38	5.36
10.	Phosphate Total	mg/L	-		ND	ND	ND	0.16	0.12	0.11	ND	0.20
11.	Chloride as Cl	mg/L	250	1000	30.85	140.77	69.42	163.92	194.77	129.20	133.06	26.99
12.	Sulphate as SO4	mg/L	200	400	20.75	126.64	75.29	201.34	82.65	120.0	107.67	22.76
13.	Sodium	mg/L	-		35.83	88	40	120	136	56	96	34.93
14.	Potassium	mg/L	-		4.86	15.2	1.85	1.18	9.31	4.62	18	1.76
15.	Calcium as Ca	mg/L	75	200	29.6	115.2	89.6	110.4	78.4	126.4	94.4	60.8
16.	Magnesium as Mg	mg/L	30	100	17.49	46.17	31.59	63.18	43.74	60.75	43.74	26.73
17.	Fluoride as F	mg/L	1	1.5	0.91	1.36	1.33	0.60	1.33	1.39	1.30	0.81
18.	Silica	mg/L	-		ND	ND	ND	9.66	12.42	5.66	ND	5.90
19.	Oil & Grease	mg/L	-		ND	ND	ND	ND	ND	ND	ND	ND
20.	Phenolic Compounds	mg/L	0.001	0.002	ND	ND	ND	ND	ND	ND	ND	ND
21.	Residual Sodium Carbonate	mg/L	-		ND	ND	ND	ND	ND	ND	ND	ND
22.	Carbonate	mg/L	-		28	ND	ND	ND	ND	ND	ND	96

23.	Bicarbonate	mg/L	-		182	428	296	308	272	440	400	220
24.	Lead as Pb	mg/L	0.01		ND	ND	ND	ND	ND	ND	ND	ND
25.	Arsenic as As	mg/L	0.001	0.002	ND	ND	ND	ND	ND	ND	ND	ND
26.	Mercury as Hg	mg/L	0.001		ND	ND	ND	ND	ND	ND	ND	ND
27.	Cadmium as Cd	mg/L	0.003		ND	ND	ND	ND	ND	ND	ND	ND
28.	Chromium Hexavalent	mg/L	-		ND	ND	ND	ND	ND	ND	ND	ND
29.	Total Chromium	mg/L	0.05		ND	ND	ND	ND	ND	ND	ND	ND
30.	Copper as Cu	mg/L	0.05	15	ND	ND	ND	ND	ND	0.062	ND	ND
31.	Zinc as Zn	mg/L	5	15	0.004	ND	0.381	0.0119	ND	0.5307	0.112	ND
32.	Iron as Fe	mg/L	0.3		ND	0.04	0.02	0.15	ND	ND	ND	0.81
33.	E- Coli	MPN/ 100ml	-		<1.8	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8
34.	Total Coliform	MPN/ 100ml	-		<1.8	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8	<1.8

Note: ND – Not Detected, BDL- Below Detectable Limit

ANNEXURE-17

ANNEXURE -17

Results of soil quality analysis during Monsoon season (July 2017 - September 2017)

Locations	Unit	S-1	S-2	S-3	S-4	S-5	S-6	S-7	S-8	S-9	S-10	S-11	S-12	S-13	S-14	S-15
Texture	--	Sandy Loam	Sandy Loam	Loamy Sand	Loamy Sand	Loamy Sand	Loamy Sand	Sandy Loam	Sandy Loam	Loamy Sand	Sandy Loam	Loamy Sand	Loam	Loamy Sand	Loamy Sand	Sandy Loam
Porosity	%	46.06	50.37	42.75	47.7	43.46	37.69	35.1	42.68	40.63	46.4	57.79	54.68	37.94	39.62	43.47
Bulk Density	gm/cc	1.37	1.34	1.58	1.37	1.47	1.62	1.64	1.45	1.49	1.49	1.11	1.16	1.57	1.63	1.43
Water Holding Capacity	%	28.21	23.51	22.05	23.49	24.32	10.5	26.53	38.34	31.15	25.87	38.2	55.75	14.98	16.17	26.01
Moisture Content	%	3.84	3.4	4.47	4.3	6.93	6.99	2.09	2.53	6.86	8.02	17.95	14.68	5.56	4.29	4.41
pH	--	7.75	6.3	8.66	5.9	7.62	8.76	7.66	7.74	7.24	8.41	7.49	7.95	6.39	6.99	7.37
Electrical Conductivity	µs/cm	214	280	270	238	255	295	212	383	905	360	420	318	151	167	212
Magnesium	meq/L	4.9	4.8	3.2	1.9	1.2	2.1	2.4	3	2.8	5	5.7	9	3.5	1.3	1.3
Calcium	meq/L	20.9	18.1	21.8	4	10.4	7.9	15.1	15.1	19.5	35.1	37.6	38.9	32.6	3.1	12.9
Total Alkalinity	meq/L	1.4	0.6	1.2	0.8	1.2	2	1.4	1.8	1.6	1.8	1	1.4	1	1.6	0.18
Chlorides	meq/L	0.18	0.18	0.23	0.18	0.18	0.23	0.14	0.28	0.23	0.32	0.65	0.18	2.35	0.23	1.8
Sodium	mg/100g	5.98	10.97	151.69	1.79	6.98	3.39	4.59	6.78	59.27	81.76	15.96	57.88	5.38	2.59	15.87
Potassium	%	3.04	2.87	1.05	4.42	3.6	2.84	2.45	2.52	5.25	3.96	4.97	3.24	1.03	4.33	4.36
Organic carbon	%	0.24	0.36	0.48	0.24	0.48	0.12	0.36	0.24	0.84	0.48	0.72	0.6	0.36	0.24	0.36
Available Potassium	mg/100g	31.92	47.88	13.16	10	17.35	11.57	17.35	18.55	53.87	65.84	89.78	65.84	14.76	7.98	29.92
Available Phosphorus	kg/ha	98.24	754.91	67.21	1187.52	487.76	563.59	529.12	620.47	1337.47	423.99	965.18	486.03	458.46	991.03	167.18
SAR	--	0.07	0.13	1.86	0.05	0.12	0.06	0.06	0.09	0.77	0.18	0.14	0.51	0.05	0.07	0.97
Available Nitrogen	kg/ha	164.73	222.87	94.58	280.48	255.96	252.63	220.71	374.25	302.49	321.75	480.65	332.47	263.42	247.86	192.42

Locations	Unit	S-1	S-2	S-3	S-4	S-5	S-6	S-7	S-8	S-9	S-10	S-11	S-12	S-13	S-14	S-15
Nitrates	µg/g	Not Detected								12.15	Not Detected	19.57	4.83	Not Detected		
Nitrites	µg/g	4.87	1.35	0.64	2.32	3.82	1.49	3.12	2.06	1.9	3.02	2.42	7.45	0.67	3.24	8.9
Salinity	µs/cm	180	270	300	280	296	230	250	340	760	325	500	360	190	201	190
Zinc	mg/kg	26	26.7	71.4	13.8	13.7	12.9	25.7	11.1	37.3	30.4	25.8	18.8	8.4	6.6	8.2
Boron	mg/100gm	9.19	8.57	7.86	10.43	10.72	7.86	6.71	8.86	9.91	6.81	9.86	5.62	7.67	9.43	11.91
Lead	mg/kg	5.8	12.7	6.2	4.5	7.3	7.6	12.5	15.2	14.6	8.8	10.8	11	6.4	5.9	8.6
Iron	mg/kg	450	578	415	589	501.5	554	497	685	465	395	560	503	556	596	578
Nickel	mg/kg	23.3	22.7	51.4	8	14	12.6	11.4	10.1	7.8	30.1	28.1	24.6	2.5	3.6	10.9
Barium	mg/kg	58.2	187	286.2	33.4	73.5	45.6	44.3	84.4	65.3	105.1	193.9	221.1	25.4	16.6	36.8
Copper	mg/kg	25.2	12.5	20.6	4.9	9.3	11.4	5.4	6.9	9.1	13.2	15.2	114	2.6	2.4	4.8
Hexavalent Chromium	µg/g	Not Detected														
Permeability	Cm/hr	0.315	0.38	0.42	0.95	0.36	0.32	0.49	0.46	0.39	0.47	0.038	0.035	0.36	0.47	0.12
Cadmium	mg/kg	Not Detected														
Mercury	mg/kg															

Results of soil quality analysis during Post-monsoon season (October 2017 - December 2017)

Location	Unit	S-1	S-2	S-3	S-4	S-5	S-6	S-7	S-8	S-9	S-10	S-11	S-12	S-13	S-14	S-15
Texture	--	Sandy Loam	Sandy Loam	Loamy sand	Loamy sand	Sandy Loam	Sandy Loam	Sandy Loam	loamy sand	Sandy Loam	Sandy Loam	Loamy sand	Loam	Loamy sand	Loamy sand	Sandy loam
Porosity	%	56.64	46.97	41.04	43.16	42.14	36.43	48.43	36.63	42.6	47.7	43.24	47.05	38.6	55.05	39.35
Bulk Density	gm/cc	1.24	1.49	1.58	1.58	1.62	1.64	1.65	1.47	1.63	1.37	1.47	1.44	1.32	1.2	1.51
Water Holding Capacity	%	22.09	24.55	18.15	15.97	21.74	17.97	11.09	15.43	15.82	13.74	18.48	23.55	20.32	26.75	15.97
Moisture Content	%	14.28	5.38	2.5	1.96	11.12	7.52	5.13	5.4	8.55	1.37	3.91	3.29	2.21	8.37	3.08
pH	--	8.71	8.07	7.75	6.2	5.58	8.06	7.34	7.64	7.61	8.12	8.62	8.47	7.81	7.3	8.09

Location	Unit	S-1	S-2	S-3	S-4	S-5	S-6	S-7	S-8	S-9	S-10	S-11	S-12	S-13	S-14	S-15
Electrical Conductivity	µs/cm	101.6	89.9	182.2	200	32.6	74.2	144.3	95	27.4	100	246	109.5	121.8	135.8	90.8
Magnesium	meq/L	3.2	11	2.6	1.4	2.6	2	2.1	1.3	1.2	9.1	7.7	10.5	4	1.5	1.1
Calcium	meq/L	22.6	33.5	26.1	5.2	11.2	22.5	25.4	14.1	19.1	44.9	50.5	40.1	36.6	5.1	6.3
Total Alkalinity	meq/L	0.8	1.2	0.4	1.2	1	1.2	1.2	1.6	2	0.6	1.6	0.9	1.4	2	2.4
Chlorides	meq/L	0.28	0.28	0.32	0.37	0.23	0.47	0.56	0.28	0.32	0.37	0.28	0.42	0.28	0.42	0.37
Sodium	mg/100g	11.48	8.95	197.52	2.52	9.18	2.33	4.59	2.29	2.98	24.8	17.19	80.38	7.57	11.48	2.06
Potassium	%	22.02	5.53	150.29	30.48	21.8	8.74	34.96	17.75	14.22	10.46	6.18	17.71	9.1	14.03	19.78
Organic carbon	%	0.18	0.24	0.2	0.24	0.18	0.36	0.18	0.18	0.12	0.3	0.24	0.3	0.24	0.3	0.24
Available Potassium	mg/100g	33.91	13.56	139.66	13.16	19.35	9.37	61.85	17.75	13.96	29.52	16.95	71.82	17.15	7.38	7.98
Available Phosphorus	kg/ha	127.72	89.4	76.63	1481.63	638.63	447.04	194.14	176.26	81.74	102.18	112.39	587.54	715.27	247.79	56.19
SAR	--	1.39	0.82	22.71	0.6	1.52	0.17	0.53	0.35	0.4	2.07	1.44	6.94	0.73	2.74	0.46
Available Nitrogen	kg/ha	110.82	217.32	265.49	129.86	201.89	238.24	250.25	332.57	213.37	155.2	264.86	74.29	108.75	240.46	200.26
Nitrates	µg/g	20.7	16.65	207.45	20.25	20.25	47.47	35.32	57.37	33.8	20.02	15.07	21.37	16.65	37.12	38.7
Nitrites	µg/g	7.68	1.23	0.92	5.1	7.99	1.84	7.07	0.92	4.3	7.99	3.69	11.07	1.84	7.68	14.76
Salinity	µs/cm	92.6	96.1	196	180.6	30	86.2	130.2	89.6	40.2	130.1	210	90.6	136	160.1	50.5
Boron	mg/100gm	11.43	10.95	10.48	10.35	15.72	13.81	12.86	8.57	15.24	9.05	15.72	10.48	9.53	14.24	13.81
Hexavalent Chromium	µg/g	Not Detected														
Permeability	Cm/hr	0.58	0.38	0.47	0.69	Not Detected	0.37	0.46	0.48	0.37	0.48	0.3	0.16	0.35	0.42	0.3
Zinc	mg/kg	38.5	31.4	25.5	40.5	50.3	21.3	25.7	20.8	40.5	19.2	16.9	75	35.7	5.4	8
Lead	mg/kg	5.3	4.4	13.4	8.1	10.3	7.2	13.6	12.7	10	7.7	3.4	18.4	11.9	5.6	6.8
Iron	mg/kg	11343.2	12768.9	7657.9	13172.3	8174.4	7314.6	8594.8	7281.3	11345.9	8517.7	7622.7	12963.9	11051.3	2753.1	5038.8
Nickel	mg/kg	25.3	25.8	26.1	31.1	61.2	10.1	7.3	6.9	18.7	22.8	13.8	30.5	8.3	3.5	6.8

Location	Unit	S-1	S-2	S-3	S-4	S-5	S-6	S-7	S-8	S-9	S-10	S-11	S-12	S-13	S-14	S-15
Barium	mg/kg	61.4	137.65	274.6	38.2	61.8	44.5	43.1	41.6	61.3	162.1	78.8	167.7	86.6	19.5	28.8
Copper	mg/kg	29	23.3	14.4	31	35.2	7.8	6.8	6.6	5.7	14.4	11.9	19.1	4.8	3.1	4.9
Cadmium	mg/kg	BDL														
Mercury	mg/kg															

Results of soil quality analysis during Pre-monsoon season (January 2018 - March 2018)

Locations	Unit	S-1	S-2	S-3	S-4	S-5	S-6	S-7	S-8	S-9	S-10	S-11	S-12	S-13	S-14	S-15
Texture	--	Loam	Sandy loam	Sandy Loam	Sandy Loam	Loamy Sand	Sandy Loam	Sandy loam	Sandy Loam	Sandy Loam	Sandy Loam	Sandy Loam	Sandy Loam	Sandy Loam	Sandy Loam	Sandy loam
Porosity	%	43.02	22.48	49.81	26.63	25.92	41.49	36.97	54.51	38.83	39.51	32.55	46.79	49.24	27.31	38.14
Bulk Density	gm/cc	1.47	1.62	1.34	1.68	1.6	1.41	1.5	1.21	1.37	1.5	1.74	1.41	1.34	1.65	1.8
WHC	%	17.83	15.81	22.48	11.14	13.31	18.17	23.35	26.35	14.39	12.18	12.52	15.04	10.4	14.85	12.98
Moisture Content	%	5.66	2.73	1.88	1.63	1.66	1.67	6.87	1.26	2.61	6.94	3.56	1.63	1.79	1.21	1.32
pH	--	8.34	7.96	8.14	7.37	7.83	7.51	7.76	7.95	7.78	8.05	8.24	7.69	8.34	7.14	7.78
EC	µs/cm	53.9	136.1	65.3	112.9	160.4	216	65	97.6	173.2	106.4	77.2	132.2	99	83	173.2
Magnesium	meq/L	4.7	1.8	1.1	1.4	1.1	0.9	1.1	1.3	0.8	1.7	0.9	0.9	1.1	1.4	1
Calcium	meq/L	52.2	32.1	25.1	32.5	36.5	14.2	19	27.3	40.5	36.9	34.1	15.7	25.1	13.1	15.6
Total Alkalinity	meq/L	1	0.4	1.4	0.8	0.4	1	0.6	0.8	0.8	0.4	0.6	1.2	0.6	0.6	0.4
Chlorides	meq/L	0.37	0.47	0.37	0.28	0.23	0.42	0.37	0.42	0.37	0.32	0.28	0.28	0.42	0.51	0.37
Sodium	mg/100g	3.9	8.95	1.37	8.61	9.87	2.75	3.44	2.52	10.56	2.06	7.12	13.78	8.03	9.87	2.98
Potassium	%	2.88	10.64	42.04	19.21	9.5	60.1	13.87	13.16	8.37	7.76	8.89	41.63	18.29	21.73	16.07
Organic carbon	%	0.36	0.3	0.36	0.24	0.18	0.24	0.24	0.24	0.18	0.12	0.18	0.3	0.12	0.18	0.24
Available Potassium	mg/100g	6.78	17.55	75.81	34.91	17.15	95.77	13.56	17.55	16.36	12.19	14.16	62.85	25.93	20.35	13.36
Available Phosphorus	kg/ha	76.6	137.94	664.18	705.05	1673.22	518.57	237.57	1149.5	316.76	79.19	132.83	508.35	51.09	357.63	122.61

Locations	Unit	S-1	S-2	S-3	S-4	S-5	S-6	S-7	S-8	S-9	S-10	S-11	S-12	S-13	S-14	S-15
SAR	--	0.31	0.94	0.16	0.9	0.99	0.43	0.47	0.29	3.24	0.2	0.74	4.25	0.96	1.59	0.45
Available Nitrogen	kg/ha	325.98	211.11	269.22	240.71	142.53	130.28	159.55	136.19	137.54	139.61	145.35	142.53	38	155.2	209.04
Nitrates	µg/g	9	ND	8.1	13.27	85.05	126.67	7.87	4.5	ND	9	ND			4.05	22.5
Nitrites	µg/g	5.93	6.36	13.77	19.21	2.85	26.44	10.63	11.68	7.5	13.65	12.33	21	5.38	18.88	9.96
Salinity	µs/cm	60.3	95.6	75	131.3	140.1	230	55.9	110	193	123.6	63	145.2	86	90	203
Boron	mg/100gm	5.95	8.95	1.42	1.19	ND	ND	1.52	0.71	2.33	ND	ND	4.09	1	1.33	9
Hexavalent Chromium	µg/g	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Permeability	Cm/hr	0.19	0.41	0.46	0.47	0.41	0.46	0.55	0.33	0.27	0.61	0.49	0.25	0.7	0.33	0.36
Zinc	mg/kg	34.78	57.58	20.75	37.31	53.44	14.65	13.42	10.51	36.94	58.84	58.46	12.51	10.56	8.72	6.09
Lead	mg/kg	5.25	ND	12.39	5.5	1.35	11.87	7.88	12.67	9.7	3.14	ND	8.79	4.33	ND	ND
Iron	mg/kg	16198.83	18521.48	10563.97	13070.85	14538.32	13058.05	7728.37	6082.4	13537.69	25939.02	20141.25	7415.02	4475.59	6550.31	5369.2
Nickel	mg/kg	27.85	ND	33.34	27.1	19.29	4.71	1.59	4.31	11.84	29.12	24.57	ND	ND	ND	ND
Barium	mg/kg	107.12	465.79	515.12	172.43	374.37	ND	ND	ND	172.42	189.68	391.18	ND	126.99	ND	ND
Copper	mg/kg	45.13	48.64	16.82	27.39	20.68	10.05	11.8	10.63	14.79	22.42	27.92	3.47	ND	5.95	7.44
Cadmium	mg/kg	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Mercury	mg/kg	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

ANNEXURE-18

ANNEXURE -18

BIOLOGICAL ENVIRONMENT

A. NEAR THE PROPOSED BARRAGE

Table 1 List of tree species recorded near the proposed barrage

SL.NO	Scientific Name	Local Name	Family	IUCN Conservation status, 2018	RET Status	Uses
1	*Acacia chundra* (Rottler) Willd.	Sandra	Fabaceae	Not Assessed	Common	Timber and agroforestry
2	*Acacia leucocephala* (Lam.)Link	Tella tumma	Fabaceae	Not Assessed	Common	Fodder and agroforestry
3	*Acacia nilotica* (L.) Willd. ex Delile	Nalla tumma	Fabaceae	Least Concern	Common	Agri-equipments
4	*Albizia amara* (Roxb.) Boiv.	Narlinga	Fabaceae	Not Assessed	Common	Timber and agroforestry
5	*Albizia lebbeck* (L.) Benth.	Dirisena chettu	Fabaceae	Not Assessed	Common	Timber and avenue plantation
6	*Barringtonia acutangula* (L.) Gaertn.	Nir kanki	Lecythidaceae	Not Assessed	Common	Medicinal
7	*Borassus flabellifer* L.	Thati chettu	Arecaceae	Not Assessed	Common	Edible and thatching
8	*Boswellia serrata* Triana & Planch.	Andugum chettu	Burseraceae	Not Assessed	Common	Non timber forest produce
9	*Calophyllum inophyllum* L.	Punnagamu	Calophyllaceae	Least concern	Common	Timber
10	*Careya arborea* Roxb.	Budadhermi	Lecythidaceae	Not Assessed	Common	Edible and medicinal
11	*Cassia fistula* L.	Aragvadhamu	Fabaceae	Not Assessed	Common	Medicinal and Avenue plantation
12	*Cochlospermum religiosum* (L.) Alston	Adavi buruga	Bixaceae	Not Assessed	Common	Gum tragacanth (NTFP)
13	*Cordia dichotoma* G.Forst.	Banknakkeri	Boraginaceae	Not Assessed	Common	Timber and fuel wood
14	*Crateva adansonii* DC.	Voolemara	Capparaceae	Not Assessed	Common	Medicinal and edible
15	*Diospyros melanoxylon* Roxb.	Tuniki	Ebenaceae	Not Assessed	Common	Beedi making
16	*Ficus hispida* L.f.	Bomma-medi	Moraceae	Not Assessed	Common	Edible and medicinal
17	*Ficus racemosa* L.	Paidi	Moraceae	Not Assessed	Common	Edible and medicinal
18	*Gmelina arborea* Roxb.	Adavi gummadi	Verbenaceae	Not Assessed	Common	Agroforestry and plantation crop

SL.NO	Scientific Name	Local Name	Family	IUCN Conservation status, 2018	RET Status	Uses
19	*Grewia hirsuta* Vahl	Chitti jana	Malvaceae	Not Assessed	Common	Rope making
20	*Grewia tiliifolia* Vahl	Cahrachi	Tiliaceae	Not Assessed	Common	Rope making
21	*Hardwickia binata* Roxb.	Yepi	Fabaceae	Not Assessed	Common	Multipurpose tree
22	*Holoptelea integrifolia* Planch	Nemalinara	Ulmaceae	Not Assessed	Common	Timber and avenue plantation
23	*Lagerstroemia microcarpa* Wight	Chennangi	Lytharaceae	Not Assessed	Common	Timber and avenue plantation
24	*Leucaena leucocephala* (Lam.) de Wit	Subabul	Fabaceae	Not Assessed	Common	Fodder and agroforestry
25	*Mitragyna parvifolia* (Roxb.) Korth	Batta ganupu	Rubiaceae	Not Assessed	Common	Timber and medicinal
26	*Premna tomentosa* Willd.	Nagoru	Lamiaceae	Not Assessed	Common	Medicinal and fuel wood
27	*Pterocarpus indicus* Willd.	Agarugandhamu	Fabaceae	Vulnerable	Common	Timber and dye
28	*Pterospermum acerifolium* (L.) Willd.	Matsakanda	Sterculiaceae	Not Assessed	Common	Medicinal and timber
29	*Samanea saman* F.Muell.	Cimaivaka	Fabaceae	Not Assessed	Common	Timber and avenue plantation
30	*Strychnos potatorum* L.f.	Chillaginja	Loganiaceae	Not Assessed	Common	Timber and edible
31	*Tamarindus indicus* L.	Chinta	Fabaceae	Not Assessed	Common	Edible and timber
32	*Tectona grandis* L.f.	Teku	Verbenaceae	Not Assessed	Common	Timber
33	*Terminalia alata* Heyne ex Roth	Nalamaddi	Combertaceae	Not Assessed	Common	Timber
34	*Terminalia arjuna* (Roxb.) Wight & Arn.	Thella maddi	Combretaceae	Not Assessed	Common	Timber and
35	*Terminalia bellirica* (Gaertn.) Roxb.	Tanikaya	Combreteaceae	Not Assessed	Common	Edible and medicinal
36	*Terminalia tomentosa* Willd.	Nalla maddi	Combretaceae	Not Assessed	Common	Timber and avenue plantation
37	*Xylia xylocarpa* Roxb. Taub.	Konda tangedu	Fabaceae	Not Assessed	Common	Timber
38	*Ziziphus mauritiana* Lam.	Regu	Rhamnaceae	Not Assessed	Common	Edible and medicinal
39	*Ziziphus oenoplia* (L.) Mill.	Pariki	Rhamnaceae	Not Assessed	Common	Edible and medicinal

Note: Species identified by EHSCPL team

Table 2 Phyto-sociological parameters of tree species near the proposed barrage site

SL.NO	Scientific Name	D	Frq (%)	Do	BA (M^2/ha)	RD	RFr	RDo	IVI
1	*Acacia chundra* (Rottler) Willd.	0.75	25	0.010	0.08	0.85	1.82	0.95	3.62
2	*Acacia leucocephala* (Lam.)Link	2	50	0.024	0.20	2.27	3.64	2.40	8.31
3	*Acacia nilotica* (L.) Willd. ex Delile	14	25	0.138	1.13	15.91	1.82	13.82	31.55
4	*Albizia amara* (Roxb.) Boiv.	1	50	0.014	0.11	1.14	3.64	1.36	6.14
5	*Albizia lebbeck* (L.) Benth.	2.25	50	0.006	0.05	2.56	3.64	0.60	6.79
6	*Barringtonia acutangula* (L.) Gaertn.	0.5	25	0.014	0.11	0.57	1.82	1.36	3.75
7	*Borassus flabellifer* L.	1	50	0.006	0.05	1.14	3.64	0.65	5.42
8	*Boswellia serrata* Triana & Planch.	4.75	25	0.020	0.16	5.40	1.82	1.99	9.21
9	*Calophyllum inophyllum* L.	0.25	25	0.001	0.01	0.28	1.82	0.08	2.18
10	*Careya arborea* Roxb.	0.75	25	0.008	0.07	0.85	1.82	0.84	3.51
11	*Cassia fistula* L.	0.25	25	0.000	0.00	0.28	1.82	0.05	2.15
12	*Cochlospermum religiosum* (L.) Alston	0.25	25	0.011	0.09	0.28	1.82	1.07	3.18
13	*Cordia dichotoma* G.Forst.	0.25	25	0.001	0.01	0.28	1.82	0.09	2.19
14	*Crateva adansonii* DC.	0.75	25	0.003	0.02	0.85	1.82	0.26	2.93
15	*Diospyros melanoxylon* Roxb.	3.75	75	0.015	0.13	4.26	5.45	1.53	11.25
16	*Ficus hispida* L.f.	5.25	50	0.015	0.12	5.97	3.64	1.50	11.10
17	*Ficus racemosa* L.	8	75	0.080	0.65	9.09	5.45	7.99	22.54
18	*Gmelina arborea* Roxb.	0.25	25	0.002	0.02	0.28	1.82	0.19	2.29
19	*Grewia hirsuta* Vahl	1.5	25	0.003	0.03	1.70	1.82	0.32	3.84
20	*Grewia tiliifolia* Vahl	1.25	25	0.005	0.04	1.42	1.82	0.53	3.77
21	*Hardwickia binata* Roxb.	0.5	25	0.001	0.01	0.57	1.82	0.09	2.48
22	*Holoptelea integrifolia* Planch	1.5	75	0.007	0.06	1.70	5.45	0.70	7.86
23	*Lagerstroemia microcarpa* Wight	1.25	25	0.003	0.03	1.42	1.82	0.35	3.58
24	*Leucaena leucocephala* (Lam.) de Wit	0.25	25	0.000	0.00	0.28	1.82	0.02	2.13

SL.NO	Scientific Name	D	Frq (%)	Do	BA (M^2/ha)	RD	RFr	RDo	IVI
25	*Mitragyna parvifolia* (Roxb.) Korth	1.5	50	0.006	0.05	1.70	3.64	0.64	5.98
26	*Premna tomentosa* Willd.	1.75	25	0.005	0.04	1.99	1.82	0.52	4.32
27	*Pterocarpus indicus* Willd.	11.5	50	0.298	2.44	13.07	3.64	29.78	46.48
28	*Pterospermum acerifolium* (L.) Willd.	2	25	0.029	0.24	2.27	1.82	2.93	7.02
29	*Samanea saman* F.Muell.	0.25	25	0.002	0.01	0.28	1.82	0.18	2.28
30	*Strychnos potatorum* L.f.	0.25	25	0.001	0.01	0.28	1.82	0.07	2.18
31	*Tamarindus indicus* L.	4.5	25	0.164	1.34	5.11	1.82	16.44	23.37
32	*Tectona grandis* L.f.	5.5	50	0.013	0.11	6.25	3.64	1.33	11.21
33	*Terminalia alata* Heyne ex Roth	5.75	25	0.068	0.55	6.53	1.82	6.75	15.10
34	*Terminalia arjuna* (Roxb.) Wight & Arn.	0.25	25	0.000	0.00	0.28	1.82	0.02	2.12
35	*Terminalia bellirica* (Gaertn.) Roxb.	0.75	25	0.005	0.04	0.85	1.82	0.46	3.13
36	*Terminalia tomentosa* Willd.	0.25	25	0.002	0.01	0.28	1.82	0.18	2.28
37	*Xylia xylocarpa* Roxb. Taub.	0.25	25	0.013	0.11	0.28	1.82	1.29	3.39
38	*Ziziphus mauritiana* Lam.	0.75	50	0.002	0.02	0.85	3.64	0.24	4.72
39	*Ziziphus oenoplia* (L.) Mill.	0.5	50	0.004	0.04	0.57	3.64	0.44	4.64
Total					**8.18**	**100.00**	**100.00**	**100.00**	**300.00**

Note: Species identified by ESHCPL team; D= Density, Frq= frequency, Do=Dominance, BA= Basal area, RD= Relative density, RFr= Relative frequency, RDo= Relative Dominance, IVI= Important Value Index.

Table 3 Checklist of Herbs, Shrubs and Climbers near proposed barrage site.

Sl.No	Scientific Name	Common Name	Family	Occurrences			IUCN Conservation Status, 2018	RET status	Uses
				Monsoon	Post monsoon	Pre monsoon			
Herbs									
1	*Achyranthes aspera* L.	Uttareni	Amaranthaceae	✓	✓	✓	Not Assessed	Common	Medicinal
2	*Abelmoschus esculentus* (L.) Moench	Bendakaya	Malvaceae	-	✓	-	Not Assessed	Common	Medicinal
3	*Abutilon indicum* (Link) Sweet	Tuturabenda	Malvaceae	✓	-	-	Not Assessed	Common	Medicinal
4	*Acanthospermum hispidum* D.C.	Palleru	Asteraceae	✓	-	-	Not Assessed	Common	Medicinal
5	*Achyranthes bidentata* Blume	**	Amaranthaceae	✓	-	✓	Not Assessed	Common	Medicinal
6	*Aerva lanata* (L.) Juss. ex Schult.	Pindi kunda	Amaranthaceae	✓	-	✓	Not Assessed	Common	Medicinal
7	*Ageratum conyzoides* L.	Pokabanthi	Asteraceae	✓	-	✓	Not Assessed	Common	Medicinal
8	*Ageratum houstonianum* Mill.	**	Asteraceae	✓	-	✓	Not Assessed	Common	Medicinal
9	*Alternanthera sessilis* (L.) R.Br. ex DC.	Honganne soppu	Amaranthaceae	✓	✓	✓	Least concern	Common	Medicinal
10	*Alysicarpus monilifer* (L.) DC.	Amera	Fabaceae	-	-	✓	Not Assessed	Common	Medicinal
11	*Alysicarpus ovalifolius* (Schum.)Leonard	**	Fabaceae	✓	-	✓	Not Assessed	Common	Medicinal
12	*Alysicarpus vaginalis* (L.)DC.	Baramatal-chettu	Fabaceae	✓	-	✓	Not Assessed	Common	Medicinal
13	*Ammannia baccifera* (L.)	Agni vendrapaku	Lythraceae	✓	-	✓	Least concern	Common	Medicinal
14	*Anisomeles indica* (L.) Kuntze	Adabeera	Lamiaceae	-	-	-	Not Assessed	Common	Medicinal
15	*Argemone Mexicana* L.	Datturi	Papaveraceae	✓	✓	-	Not Assessed	Common	Medicinal
16	*Blainvillea acmella* (L.) Philipson	**	Asteraceae	✓	-	✓	Not Assessed	Common	Medicinal
17	*Boerhavia diffusa* L.	Ambati madu	Nyctaginaceae	✓	-	-	Not Assessed	Common	Medicinal

Sl.No	Scientific Name	Common Name	Family	Occurrences			IUCN Conservation Status, 2018	RET status	Uses
				Monsoon	Post monsoon	Pre monsoon			
18	*Boerhavia erecta* L.	Ataka maamidi	Nyctaginaceae	-	✓	-	Not Assessed	Common	Medicinal
19	*Borreria hispida* (L.) K.Schum.	Modina	Rubiaceae	✓	-	✓	Not Assessed	Common	Medicinal
20	*Brachiaria ramose* (L.) Stapf	Anda korra	Poaceae	✓	-	✓	Least Concern	Common	Medicinal
21	*Brachiaria reptans* (L.) C.A.Gardner & C.E.Hubb.	**	Poaceae	✓	✓	-	Not Assessed	Common	Medicinal
22	*Canthium parviflorum* Lam.	Baasu koora	Rubiaceae	✓	✓	-	Not Assessed	Common	Medicinal
23	*Cassia occidentalis* L.	Cashanda	Caesalpiniaceae	✓	✓	✓	Not Assessed	Common	Medicinal
24	*Cassia tora* L.	Pedda kasinda	Caesalpiniaceae	✓	-	✓	Not Assessed	Common	Medicinal
25	*Celosia argentea* L.	Gurugu aaku	Amaranthaceae	-	-	✓	Not Assessed	Common	Medicinal
26	*Chamaecrista pratensis* (R.Vig.)Du Puy	Nelaponna	Caesalpiniaceae	✓	-	✓	Least concern	Common	Medicinal
27	*Chloris barbata* Sw.	Uppu gaddi	Poaceae	✓	-	-	Not Assessed	Common	Medicinal
28	*Chorchorus trilocularis* L.	Bankitutturu	Tiliaceae	✓	-	-	Not Assessed	Common	Medicinal
29	*Chromolaena odorata* (L.) R.M.King & H.Rob.	Papataku	Asteraceae	-	✓	✓	Not Assessed	Common	Medicinal
30	*Chrozophora rottleri* (Geiseler) Spreng.	Erra miriyam	Euphorbiaceae	-	-	✓	Not Assessed	Common	Medicinal
31	*Cleome gynandra* L.	Thella vamita	Cleomaceae	✓	-	✓	Not Assessed	Common	Medicinal
32	*Cleome viscose* L.	Kukha-avalu	Cleomaceae	✓	-	-	Not Assessed	Common	Medicinal
33	*Coix barbata* Roxb.	Adavi guruginja	Poaceae	✓	-	✓	Not Assessed	Common	Medicinal
34	*Commelina benghalensis* L., nom. cons.	Nirukassuvu	Commelinaceae	✓	✓	-	Least Concern	Common	Medicinal
35	*Corchorus fascicularis* Lam.	**	Tiliaceae	✓	✓	✓	Not Assessed	Common	Medicinal
36	*Crotalaria juncea* L.	Gilaka	Fabaceae	-	-	✓	Not Assessed	Common	Medicinal

Sl.No	Scientific Name	Common Name	Family	Occurrences			IUCN Conservation Status, 2018	RET status	Uses
				Monsoon	Post monsoon	Pre monsoon			
37	*Cynodon dactylon* (L.) Pers.	Garike	Poaceae	✓	✓	✓	Not Assessed	Common	Medicinal
38	*Cyperus rotundus* L.	Thungamustha	Cyperaceae	✓	✓	✓	Least concern	Common	Medicinal
39	*Dactyloctenium aegyptium* (L.) Willd.	Muttengapillu	Poaceae	✓	-	✓	Not Assessed	Common	Medicinal
40	*Dichanthium annulatum* (Forssk.) Stapf	Kusa gaddi	Poaceae	✓	✓	✓	Not Assessed	Common	Medicinal
41	*Digera arvensis* Forsk.	Chenchalicettu	Amaranthaceae	✓	✓	-	Not Assessed	Common	Medicinal
42	*Dinebra retroflexa* (Vahl) Panz.	**	Poaceae	-	✓	✓	Not Assessed	Common	Medicinal
43	*Echinochloa colona* (L.) Link	**	Poaceae	-	✓	✓	Least concern	Common	Medicinal
44	*Eclipta alba* (L.) Hassk.	Gunta-kalagara	Asteraceae	✓	-	✓	Not Assessed	Common	Medicinal
45	*Eclipta prostrate* (L.) L.	Galagara chettu	Asteraceae	✓	-	✓	Least concern	Common	Medicinal
46	*Eleusine indica* (L.) Gaertn.	Kaaruchodi	Poaceae	-	-	✓	Least concern	Common	Medicinal
47	*Eragrostis tenella* (L.) P.Beauv. ex Roem. & Schult.	***	Poaceae	✓	-	-	Not Assessed	Common	Medicinal
48	*Euphorbia hirta* L.	Pachha bottu	Euphorbiaceae	✓	✓	✓	Not Assessed	Common	Medicinal
49	*Euphorbia pulcherrima* Willd. ex Klotzsch	Bomma jemudu,	Euphorbiaceae	✓	-	-	Not Assessed	Common	Medicinal
50	*Euphorbia thymifolia* L.	Bidurunabiyam	Euphorbiaceae	✓	-	✓	Not Assessed	Common	Medicinal
51	*Evolvulus nummularis* (L.) L.	Musakarni	Convolvulaceae	✓	-	✓	Not Assessed	Common	Medicinal
52	*Galium aparine* L.	***	Rubiaceae	✓	-	-	Not Assessed	Common	Medicinal
53	*Glinus lotoides* L.	Chadrasi koora	Aizoaceae	✓	✓	✓	Not Assessed	Common	Medicinal
54	*Heliotropium hirsutissimum* Grauer	**	Boraginaceae	✓	-	-	Not Assessed	Common	Medicinal
55	*Heteropogon contortus* (L.) P.Beauv. ex Roem. & Schult.	Kaseri gaddi	Poaceae	-	✓	-	Not Assessed	Common	Medicinal

Sl.No	Scientific Name	Common Name	Family	Occurrences			IUCN Conservation Status, 2018	RET status	Uses
				Monsoon	Post monsoon	Pre monsoon			
56	*Hypericum japonicum* Thunb.	***	Hypericaceae	✓	-	✓	Not Assessed	Common	Medicinal
57	*Indoneesiella echioides* (L.) Sreemadh.	Aaku pootha	Acanthaceae	✓	-	-	Not Assessed	Common	Medicinal
58	*Ipomoea obscura* (L.) Ker Gawler	Nallakokkita	Convolvulaceae	✓	-	-	Not Assessed	Common	Medicinal
59	*Ischaemum indicum* (Houtt.) Merr.	Tuturabenda	Poaceae	-	-	✓	Least concern	Common	Medicinal
60	*Ischaemum rugosum* Salisb.	**	Poaceae	-	-	✓	Not Assessed	Common	Medicinal
61	*Leucas martinicensis* (Jacq.) R.Br.	**	Lamiaceae	✓	✓	✓	Not Assessed	Common	Medicinal
62	*Leucas zeylanica* (L.) W.T.Aiton	Lamiaceae	Lamiaceae	✓	-	✓	Not Assessed	Common	Medicinal
63	*Lindernia crustacean* (L.) F. Muell.	**	Scrophulariaceae	✓	-	✓	Least concern	Common	Medicinal
64	*Lippia alba* (Mill.) N.E.Br. ex Britton & P.Wilson	**	Verbenaceae	-	-	✓	Not Assessed	Common	Medicinal
65	*Merremia emarginata* (Burm. fil.) Hall. fil.	Elika jimudu	Convolvulaceae	✓	✓	-	Not Assessed	Common	Medicinal
66	*Mollugo pentaphylla* L.	Chetarasi	Molluginaceae	✓	-	-	Not Assessed	Common	Medicinal
67	*Ocimum basilicum* L.	Kukkatulasi	Lamiaceae	✓	✓	✓	Not Assessed	Common	Medicinal
68	*Parthenium hysterophorus* L.	Congresspoolu	Asteraceae	✓	✓	✓	Not Assessed	Common	Medicinal
69	*Peristrophe bicalyculata* (Retz.) Nees	Chebeera	Acanthaceae	✓	-	✓	Not Assessed	Common	Medicinal
70	*Phyllanthus niruri* L.	Nela usirika	Euphorbiaceae	✓	✓	✓	Not Assessed	Common	Medicinal
71	*Phyllanthus nodiflora* (L.)	Bokkena	Phyllanthaceae	✓	-	✓	Not Assessed	Common	Medicinal
72	*Phyllanthus simplex* Retz.	Uchchi usirika	Euphorbiaceae	✓	-	-	Not Assessed	Common	Medicinal
73	*Physalis minima* L.	Budama	Solanaceae	✓	✓	✓	Least concern	Common	Medicinal
74	*Plumbago zeylanica* L.	Agnimaata	Plumbaginaceae	✓	✓	-	Not Assessed	Common	Medicinal
75	*Salvia plebeian* R.Br.	Kachoralu	Lamiaceae	✓	-	-	Not Assessed	Common	Medicinal

Sl.No	Scientific Name	Common Name	Family	Occurrences			IUCN Conservation Status, 2018	RET status	Uses
				Monsoon	Post monsoon	Pre monsoon			
76	*Scoparia dulcis* L.	Potti boli	Scrophulariaceae	✓	-	✓	Not Assessed	Common	Medicinal
77	*Sida acuta* Burm. fil.	Chitimuti	Malvaceae	✓	✓	-	Not Assessed	Common	Medicinal
78	*Solanum xanthocarpum* Schrader & Wendland	Nelamulaka	Solanaceae	-	✓	✓	Not Assessed	Common	Medicinal
79	*Sonchus asper* (L.) Hill	**	Asteraceae	✓	-	✓	Not Assessed	Common	Medicinal
80	*Sonchus oleraceus* L.	Ratrinta	Asteraceae	✓	-	-	Not Assessed	Common	Medicinal
81	*Sphaeranthus indicus* Gaertn.	Boda savamu	Asteraceae	-	-	✓	Least concern	Common	Medicinal
82	*Spilanthes acmella* (L.) Murray	**	Asteraceae	✓	-	✓	Not Assessed	Common	Medicinal
83	*Spilanthes calva* DC.	**	Asteraceae	✓	-	✓	Least concern	Common	Medicinal
84	*Tanacetum vulgare*	***	Asteraceae	✓	-	-	Not Assessed	Common	Medicinal
85	*Tephrosia purpurea* (L.) Pers.	Bonta vempali	Fabaceae	✓	✓	✓	Least concern	Common	Medicinal
86	*Tribulus terrestris* L.	Chirupalleru	Zygophyllaceae	✓	-	✓	Not Assessed	Common	Medicinal
87	*Tridax procumbens* L.	Gayapaaku	Asteraceae	✓	-	-	Not Assessed	Common	Medicinal
88	*Trigonella polycerata* auct. non L.	**	Fabaceae	✓	-	✓	Least concern	Common	Medicinal
89	*Triumfetta rhomboidea* Jacq.	Chiru sitrika	Tiliaceae	✓	✓	✓	Not Assessed	Common	Medicinal
90	*Urena lobata* L.	Nalla benda	Malvaceae	✓	✓	✓	Not Assessed	Common	Medicinal
91	*Vernonia cinerea* (L.) Less.	Garita kamm	Asteraceae	✓	-	✓	Not Assessed	Common	Medicinal
92	*Waltheria indica* L.	Nallabenda	Stirculiaceae	✓	✓	-	Not Assessed	Common	Medicinal
93	*Xanthium strumarium*	Maralu teege	Asteraceae	✓	✓	✓	Not Assessed	Common	Medicinal
Shrubs									
1	*Acacia seyal* Delile	Nalla tumma	Fabaceae	✓	✓	✓	Not Assessed	Common	Medicinal
2	*Cassia auriculata* L.	Merakatangedu	Caesalpiniaceae	✓	✓	✓	Not Assessed	Common	Medicinal
3	*Kirganelia reticulate* (Poir.) Baill.	Nallapurugudu	Euphorbiaceae	✓	✓	✓	Not Assessed	Common	Medicinal
4	*Prosopis juliflora* (Sw.) DC.	Bellari jali	Fabaceae	✓	✓	✓	Not Assessed	Common	Medicinal

Sl.No	Scientific Name	Common Name	Family	Occurrences			IUCN Conservation Status, 2018	RET status	Uses
				Monsoon	Post monsoon	Pre monsoon			
5	*Randia dumetorum* (Retz.) Poir.	Mande-kayalu	Rubiaceae	✓	✓	✓	Not Assessed	Common	Medicinal
6	*Vitex negundo* L.	Nallavavili	Verbenaceae	✓	✓	✓	Not Assessed	Common	Medicinal
7	*Woodfordia floribunda* Salisb.	Dhataki	Lythraceae	✓	✓	✓	Not Assessed	Common	Medicinal
8	*Ziziphus jujube* Miller	Regu chettu	Rhamnaceae	✓	✓	✓	Least concern	Common	Medicinal
9	*Calotropis procera* (Ait.) Ait. fil.	Erra jilledu	Apocynaceae	✓	✓	✓	Not Assessed	Common	Medicinal
10	*Ziziphus oenoplia* (L.) Mill.	Kanarese	Rhamnaceae	✓	✓	✓	Not Assessed	Common	Medicinal
Climbers									
1	*Coccinia grandis* (L.) Voigt	Kaki donda	Cucurbitaceae	✓	✓	✓	Not Assessed	Common	Medicinal
2	*Luffa cylindrical* Mill.	Gutti beera	Cucurbitaceae	✓	-	✓	Not Assessed	Common	**
3	*Alysicarpus longifolius* (Spreng.)Wight & Arn.	Baramatal-chettu	Fabaceae	-	-	-	Not Assessed	Common	Medicinal
4	*Atylosia scarabaeoides* (L.)Benth.	**	Fabaceae	-	✓	-	Not Assessed	Common	Medicinal
5	*Cardiospermum halicacabum* L.	Buddakakara	Sapinadaceae	✓	-	-	Not Assessed	Common	Medicinal
6	*Diplocyclos palmatus*	Lingadonda	Cucurbitaceae	✓	-	-	Not Assessed	Common	Medicinal
7	*Hemidesmus indicus* (L.) R. Br.	Suganda pala	Asclepiadaceae	✓	✓	✓	Not Assessed	Common	Medicinal
8	*Ipomoea obscura* (L.) Ker Gawler	**	Convolvulaceae	✓	✓	✓	Not Assessed	Common	Medicinal
9	*Pergularia daemia*	Chebira	Asclepiadaceae	✓	-	✓	Not Assessed	Common	Medicinal

Note: Species identified by ESHCPL team.

Table 4 List of avifaunal species recorded near proposed barrage site.

Sl. No.	Common Name	Scientific Name	Family	Occurrence			IUCN conservation status, 2018	Wildlife (Protection) Act, 1972
				Monsoon	Post Monsoon	Pre monsoon		
1	Asian openbill stork	*Anastomus oscitans* (Boddaert, 1783)	Ciconiidae	-	-	3	LC	IV
2	Asian palm swift	*Cypsiurus balasiensis* (J.E. Gray, 1829)	Apodidae	-	10	-	LC	-
3	Asian pied starling	*Gracupica contra* (Linnaeus, 1758)	Sturnidae	-	-	2	LC	IV
4	Barn swallow	*Hirundo rustica* Linnaeus, 1758	Hirundinidae	5	1	-	LC	-
5	Baya weaver	*Ploceus philippinus* (Linnaeus, 1766)	Ploceidae	-	-	8	LC	IV
6	Black drongo	*Dicrurus macrocercus* (Vieillot, 1817)	Dicruridae	-	1	10	LC	IV
7	Black headed cuckoo shrike	*Coracina melanoptera* (Rüppell, 1839)	Campephagidae	15	-	2	LC	IV
8	Black headed gull	*Larus ridibundus* (Linnaeus, 1766)	Laridae	-	-	1	LC	IV
9	Black headed munia	*Lonchura malacca* (Linnaeus, 1766)	Estrildidae	-	-	1	LC	IV
10	Black ibis	*Pseudibis papillosa* (Temminck, 1824)	Threskiornithidae	-	-	2	LC	IV
11	Black necked stork	*Ephippiorhynchus asiaticus* (Latham, 1790)	Ciconiidae	-	-	1	NT	IV
12	Black tailed godwit	*Limosa limosa* (Linnaeus, 1758)	Scolopacidae	1	-	2	NT	IV
13	Blue tailed bee-eater	*Merops philippinus* Linnaeus, 1766	Meropidae	18	-	7	LC	-
14	Blue-breasted flycatcher	*Cyornis herioti* Ramsay, 1886	Muscicapidae	-	39	-	NT	-
15	Booted eagle	*Hieraaetus pennatus* (Gmelin, 1788)	Accipitridae	-	1	-	LC	I
16	Cattle egret	*Bubulcus ibis* (Linnaeus, 1758)	Ardeidae	1	-	1	LC	IV
17	Collared Pratincole	*Glareola pratincola* (Linnaeus, 1766)	Glareolidae	1	-	-	LC	-
18	Common babbler	*Turdoides caudate* (Dumont, 1823)	Leiothrichidae	-	-	6	LC	IV
19	Common Buzzard	*Buteo buteo* (Linnaeus, 1758)	Accipitridae	1	3	-	NA	I
20	Common crane	*Grus grus* (Linnaeus, 1758)	Gruidae	-	-	1	LC	IV
21	Common crow	*Corvus splendens* Vieillot, 1817	Corvidae	-	-	7	LC	V
22	Common cuckoo	*Cuculus canorus* Linnaeus, 1758	Cuculidae	-	1	12	LC	IV

Sl. No.	Common Name	Scientific Name	Family	Occurrence			IUCN conservation status, 2018	Wildlife (Protection) Act, 1972
				Monsoon	Post Monsoon	Pre monsoon		
23	Common myna	*Acridotheres tristis* (Linnaeus, 1766)	Sturnidae	-	-	2	LC	IV
24	Common Sandpiper	*Actitis hypoleucos* (Linnaeus, 1758)	Scolopacidae	1	-	1	LC	IV
25	Common wood shrike	*Tephrodornis pondicerianus* (Gmelin, 1789)	Tephrodornithidae	-	-	1	LC	IV
26	Darter Oriental	*Anhinga melanogaster* (Pennant, 1769)	Anhingidae	-	-	1	NT	IV
27	Demoiselle crane	*Grus virgo* (Linnaeus, 1758)	Gruidae	-	-	5	LC	IV
28	Eurasian collared dove	*Streptopelia decaocto* (Frivaldszky, 1838)	Columbidae	-	-	4	LC	IV
29	Finn's weaver	*Ploceus megarhynchus* Hume, 1869	Ploceidae	-	-	1	VU	IV
30	Great crested grebe	*Podiceps cristatus* (Linnaeus, 1758)	Podicipedidae	-	-	2	LC	IV
31	Great egret	*Casmerodius albus* Linnaeus, 1758	Ardeidae	-	-	5	LC	IV
32	Great tit	*Parus major* Linnaeus, 1758	Paridae	-	-	1	LC	IV
33	Great White Pelican	*Pelecanus onocrotalus* Linnaeus, 1758	Pelecanidae	3	-	-	LC	IV
34	Greater Cormorant	*Phalacrocorax carbo* (Linnaeus, 1758)	Phalacrocoracidae	-	4	-	LC	IV
35	Greater coucal	*Centropus sinensis* (Stephens, 1815)	Cuculidae	-	3	-	LC	IV
36	Greater flamingo	*Phoenicopterus roseus* Pallas, 1811	Phoenicopteridae	-	-	5	LC	-
37	Grey Francolin	*Francolinus pondicerianus* (Gmelin, 1789)	Phasianidae	2	-	-	LC	IV
38	Green Barbet	*Megalaima zeylanica* (Gmelin, 1788)	Megalaimidae	1	-	-	LC	IV
39	House sparrow	*Passer domesticus* (Linnaeus, 1758)	Passeridae	-	2	27	LC	IV
40	House Swift	*Apus nipalensis* (Hodgson, 1837)	Apodidae	6	11	-	LC	-
41	Indian peafowl	*Pavo cristatus* Linnaeus, 1758	Phasianidae	1	-	4	LC	I
42	Indian roller	*Coracias benghalensis* (Linnaeus, 1758)	Coraciidae	1	-	-	LC	IV
43	Indian shag	*Phalacrocorax fuscicollis* Stephens, 1826	Phalacrocoracidae	-	-	2	LC	IV
44	Indian silverbill	*Lonchura malabarica* (Linnaeus, 1758)	Estrildidae	-	-	2	LC	IV
45	Indian skimmer	*Rynchops albicollis* (Swainson, 1838)	Laridae	-	-	3	VU	-
46	Intermediate egret	*Ardea intermedia* (Wagler, 1827)	Ardeidae	1	-	54	LC	IV

Sl. No.	Common Name	Scientific Name	Family	Occurrence			IUCN conservation status, 2018	Wildlife (Protection) Act, 1972
				Monsoon	Post Monsoon	Pre monsoon		
47	Jerdon's courser	*Rhinoptilus bitorquatus* (Blyth, 1848)	Glareolidae	1	-	1	CE	I
48	Jungle Babbler	*Turdoides striata* (Dumont, 1823)	Leiothrichidae	-	2	-	LC	-
49	Large egret	*Ardea alba* Linnaeus, 1758	Ardeidae	-	1	-	LC	-
50	Lesser coucal	*Centropus bengalensis* (Gmelin, 1788)	Cuculidae	1	-	-	LC	IV
51	Little bee-eater	*Merops pusillus* Statius Muller, 1776	Meropidae	-	13	-	LC	-
52	Little cormorant	*Microcarbo niger* (Vieillot, 1817)	Phalacrocoracidae	-	1	2	LC	IV
53	Little egret	*Egretta garzetta* (Linnaeus, 1766)	Ardeidae	1	-	-	LC	IV
54	Little green bee-eater	*Merops orientalis* Latham, 1801	Meropidae	-	4	8	LC	-
55	Little ringed plover	*Charadrius dubius* Scopoli, 1786	Charadriidae	2	-	2	LC	IV
56	Long tailed shrike	*Lanius schach* Linnaeus, 1758	Laniidae	-	-	6	LC	-
57	Loten's sunbird	*Cinnyris lotenius* (Linnaeus, 1766)	Nectariniidae	-	6	-	LC	-
58	Mountain imperial pigeon	*Ducula badia* (Raffles, 1822)	Columbidae	1	-	1	LC	IV
59	Oriental magpie robin	*Copsychus saularis* (Linnaeus, 1758)	Muscicapidae	4	-	1	LC	IV
60	Oriental turtle Dove	*Streptopelia orientalis* (Latham, 1790)	Columbidae	1	-	-	LC	IV
61	Palm warbler	*Setophaga palmarum* (Gmelin, 1789)	Parulidae	-	1	-	LC	-
62	Pied avocet	*Recurvirostra avosetta* Linnaeus, 1758	Recurvirostridae	-	-	1	LC	IV
63	Pied bush chat	*Saxicola caprata* (Linnaeus, 1766)	Muscicapidae	29	6	1	LC	IV
64	Pied flycatcher	*Hemipus picatus* (Sykes, 1832)	Tephrodornithidae	-	-	1	LC	IV
65	Plain prinia	*Prinia inornata* (Sykes, 1832)	Cisticolidae	-	-	2	LC	IV
66	Pond heron	*Ardeola grayii* (Sykes, 1832)	Ardeidae	-	-	10	LC	IV
67	Purple rumped sunbird	*Leptocoma zeylonica* (Linnaeus, 1766)	Nectariniidae	6	6	11	LC	IV
68	Purple wood pigeon	*Columba punicea* (Tickell in Blyth, 1842)	Columbidae	-	-	2	VU	IV
69	Red collared dove	*Streptopelia tranquebarica* (Hermann, 1804)	Columbidae	-	-	3	LC	IV
70	Red vented bulbul	*Pycnonotus cafer* (Linnaeus, 1766)	Pycnonotidae	-	-	1	LC	IV

Sl. No.	Common Name	Scientific Name	Family	Occurrence			IUCN conservation status, 2018	Wildlife (Protection) Act, 1972
				Monsoon	Post Monsoon	Pre monsoon		
71	Red wattled lapwing	*Vanellus indicus* (Boddaert, 1783)	Charadriidae	-	23	6	LC	IV
72	Red-vented bulbul	*Pycnonotus cafer* (Linnaeus, 1766)	Pycnonotidae	-	6	-	LC	-
73	Rock pigeon	*Columba livia* Gmelin, 1789	Columbidae	-	-	6	LC	IV
74	Rose ringed parakeet	*Psittacula krameri* (Scopoli, 1769)	Psittacidae	1	1	4	LC	IV
75	Scaly breasted munia	*Lonchura punctulata* (Linnaeus, 1758)	Estrildidae	-	-	1	LC	IV
76	Shikra	*Accipiter badius* Gmelin, 1788	Accipitridae	-	-	2	LC	I
77	Small minivet	*Pericrocotus cinnamomeus* (Linnaeus, 1766)	Campephagidae	-	5	2	LC	IV
78	Spotted dove	*Spilopelia chinensis* (Scopoli, 1768)	Columbidae	-	6	2	LC	IV
79	Spotted owlet	*Athene brama* (Temminck, 1821)	Strigidae	1	-	-	LC	IV
80	Tufted pochard	*Aythya fuligula* (Linnaeus, 1758)	Anatidae	-	-	25	LC	IV
81	Western reef egret	*Egretta gularis* (Bosc, 1792)	Ardeidae	-	-	4	LC	IV
82	White browed fantail	*Rhipidura aureola* Lesson, 1830	Rhipiduridae	-	-	1	LC	IV
83	White throated kingfisher	*Halcyon smyrnensis* (Linnaeus, 1758)	Alcedinidae	1	-	2	LC	IV
84	White wagtail	*Motacilla alba* Linnaeus, 1758	Motacillidae	-	-	15	LC	IV
85	White-breasted kingfisher	*Halcyon smyrnensis* (Linnaeus, 1758)	Alcedinidae	-	1	-	LC	IV
86	White-browed wagtail	*Motacilla maderaspatensis* Gmelin, 1789	Motacillidae	3	6	-	LC	IV
87	White-headed babbler	*Turdoides leucocephala* Cretzschmar, 1827	Leiothrichidae	-	1	-	LC	-
88	Yellow wagtail	*Motacilla flava* Linnaeus, 1758	Motacillidae	1	7	-	LC	IV

Note: Species identified by ESHCPL team; LC= least concern, VU= vulnerable, CE=critically Endangered, NT= near threatened, NA= not assessed

Table 5 List of butterfly species recorded near the proposed Barrage site.

Sl. No.	Common Name	Scientific Name	Family	Occurrence			IUCN conservation status, 2018	Wildlife (Protection) Act, 1972. Schedule
				Monsoon	Post Monsoon	Pre Monsoon		
1	Anar	*Virachola Isocrates* (Fabricius, 1793)	Lycaenidae	-	-	1	NA	-
2	Baronet	*Symphaedra nais* Forster, 1771	Nymphalidae	-	-	1	NA	-
3	Bath white	*Pontia daplidice* Linnaeus, 1758	Pieridae	1	-	-	LC	-
4	Blue mime	*Chilasa paradoxa* (Zincken, 1831)	Papilionidae	-	4	-	NA	-
5	Blue mormon	*Papilio polymnestor* Cramer, 1775	Papilionidae	1	-	-	NA	-
6	Blue tiger	*Tirumala limniace* Cramer, 1775	Nymphalidae	26	10	3	NA	-
7	Cabbage white	*Pieris rapae* (Linnaeus, 1758)	Pieridae	26	6	32	NA	-
8	Chestnut tiger	*Parantica sita* (Kollar, 1844)	Nymphalidae	1	-	-	NA	-
9	Chocolate albatross	*Appias lyncida* Cramer, 1777	Pieridae	2	-	1	NA	II
10	Chocolate tiger	*Parantica melaneus* (Cramer, 1775)	Nymphalidae	1	-	-	NA	-
11	Common bluebottle	*Graphium sarpedon* (Linnaeus, 1758)	Papilionidae	1	-	-	NA	-
12	Common branded skipper	*Hesperia comma* (Linnaeus, 1758)	Hesperiidae	-	-	5	NA	-
13	Common bush brown	*Mycalesis perseus* (Fabricius, 1775)	Nymphalidae	1	6	-	NA	-
14	Common clouded yellow	*Colias croceus* (Geoffroy, 1785)	Pieridae	-	-	13	NA	-
15	Common Copper butterfly	*Lycaena phlaeas (Linnaeus, 1761)*	Lycaenidae	-	6	-	NA	-
16	Common crow	*Euploea core* (Cramer, 1780)	Nymphalidae	18	7	3	LC	IV
17	Common emigrant	*Catopsilia Pomona* Fabricius, 1775	Pieridae	1	5	2	NA	-
18	Common evening brown	*Melanitis leda* (Linnaeus, 1758)	Nymphalidae	-	-	2	NA	-
19	Common gem	*Poritia hewitsoni* (Moore, 1865)	Lycaenidae	5	-	7	NA	II
20	Common grass yellow	*Eurema hecabe* (Linnaeus, 1758)	Pieridae	1	3	8	NA	-
21	Common gull	*Cepora nerissa* Fabricius, 1775	Pieridae	-	-	2	NA	II

Sl. No.	Common Name	Scientific Name	Family	Occurrence			IUCN conservation status, 2018	Wildlife (Protection) Act, 1972. Schedule
				Monsoon	Post Monsoon	Pre Monsoon		
22	Common imperial	*Cheritra freja* (Fabricius 1793)	Lycaenidae	-	5	-	NA	-
23	Common jezebel	*Delias eucharis* (Drury, 1773)	Pieridae	6	15	-	NA	-
25	Common leopaurd	*Phalanta phalantha* (Drury, [1773])	Nymphalidae	24	39	-	NA	-
26	Common mime	*Papilio clytia* Linnaeus, 1758	Papilionidae	-	7	4	NA	-
27	Common mormon	*Papilio polytes* Linnaeus, 1758	Papilionidae	5	-	6	NA	-
28	Common palmfly	*Elymnias hypermnestra* (Linnaeus, 1763)	Nymphalidae	3	-	-	NA	-
29	Common peacock	*Papilio polyctor* Boisduval, 1836	Papilionidae	2	-	-	NA	-
30	Common Pierrot	*Castalius rosimon* (Fabricius, 1775)	Lycaenidae	1	2	-	NA	I
31	Common rose	*Pachliopta aristolochiae* (Fabricius, 1775)	Papilionidae	-	3	-	NA	-
32	Common tit	*Hypolycaena erylus* (Godart, 1823)	Lycaenidae	1	-	-	NA	-
33	Common windmill	*Byasa polyeuctes* (Doubleday, 1842)	Papilionidae	2	1	5	NA	-
34	Common woodbrown	*Lethe sidonis* Hewitson, 1863	Nymphalidae	1	-	2	NA	-
35	Common yellow swallowtail	*Papilio machaon* Linnaeus, 1758	Papilionidae	-	-	2	NA	II
36	Common Grass Yellow	*Eurema hecabe* (Linnaeus, 1758)	Pieridae	2	-	-	NA	-
37	Crimson rose	*Pachliopta hector* (Linnaeus, 1758)	Papilionidae	1	-	2	NA	-
38	Dark clouded yellow	*Colias croceus* (Geoffroy, 1785)	Pieridae	1	-	-	NA	-
39	Dark evening brown	*Melanitis phedima* (Cramer, 1780)	Nymphalidae	1	-	-	NA	-
40	Dark grass blue	*Zizeeria karsandra* (Moore, 1865)	Lycaenidae	-	5	-	NA	-
41	Giant swallowtail	*Papilio cresphontes* Cramer, [1777]	Papilionidae	1	-	1	NA	-
42	Glassy blue bottle	*Graphium cloanthus* Cramer, 1775	Papilionidae	1	-	-	NA	-
43	Glassy tiger	*Parantica aglea* (Stoll, 1782)	Nymphalidae	7	-	-	NA	-

Sl. No.	Common Name	Scientific Name	Family	Occurrence			IUCN conservation status, 2018	Wildlife (Protection) Act, 1972. Schedule
				Monsoon	Post Monsoon	Pre Monsoon		
44	Grass jewel	*Chilades trochylus* (Freyer 1845)	Lycaenidae	1	5	-	NA	-
45	Great black vein	*Aporia agathon* (Gray, 1832)	Pieridae	1	-	-	NA	Ⅱ
46	Indian cupid	*Everes lacturnus* (Godart, [1824])	Lycaenidae	-	-	2	NA	-
47	Joker	*Byblia ilithyia* (Drury, 1773)	Nymphalidae	1	-	-	NA	-
48	Julia heliconian	*Dryas iulia* (Fabricius, 1775)	Nymphalidae	-	-	6	NA	-
49	Lime	*Papilio demoleus* Linnaeus, 1758	Papilionidae	25	-	27	NA	-
50	Lime blue	*Chilades laius* (Cramer 1782)	Lycaenidae	-	4	-	NA	-
51	Malabar blue	*Papilio Buddha* Westwood, 1872	Papilionidae	1	1	-	NA	Ⅱ
52	Mottled emigrant	*Catopsilia pyranthe* (Linnaeus, 1758)	Pieridae	-	-	2	NA	-
53	Painted lady	*Vanessa cardui* (Linnaeus, 1758)	Nymphalidae	3	-	13	NA	-
54	Pale grass blue	*Pseudozizeeria maha* (Kollar 1844)	Lycaenidae	1	5	-	NA	-
55	Plain tiger	*Danaus chrysippus* (Linnaeus, 1758)	Nymphalidae	38	-	12	NA	-
56	Red flash	*Rapala airbus* (Fabricius, 1787)	Nymphalidae	-	5	-	NA	-
57	Rose windmill	*Byasa latreillei* (Donovan, 1826)	Papilionidae	5	2	5	NA	-
58	Rounded Pierrot	*Tarucus extricates* Butler 1886	Lycaenidae	-	5	-	NA	-
59	Small grass yellow	*Eurema brigitta* (Cramer, 1780)	Pieridae	1	3	-	LC	-
60	Sorrel Sapphire	*Heliophorus sena* (Kollar 1844)	Lycaenidae	-	2	-	NA	-
61	Spicebush Swallowtail	*Papilio Troilus* Linnaeus, 1758	Papilionidae	-	-	20	NA	-
62	Striated satyr	*Aulocera saraswati* Kollar, 1844	Nymphalidae	1	-	1	NA	-
63	Striped blue crow	*Euploea mulciber* (Cramer, 1777)	Nymphalidae	1	-	-	NA	Ⅳ
64	Striped tiger	*Danaus genutia* (Cramer, [1779])	Nymphalidae	1	19	6	NA	-
65	Tailed jay	*Graphium Agamemnon* (Linnaeus, 1758)	Papilionidae	1	-	-	NA	-

Sl. No.	Common Name	Scientific Name	Family	Occurrence			IUCN conservation status, 2018	Wildlife (Protection) Act, 1972. Schedule
				Monsoon	Post Monsoon	Pre Monsoon		
66	Tawny coster	*Acraea terpsicore* (Linnaeus, 1758)	Nymphalidae	-	7	2	NA	-
67	Tiger brown	*Papilio glaucus* Linnaeus, 1758	Papilionidae	1	-	-	NA	-
68	White orange tip	*Ixias Marianne* (Cramer, 1779)	Pieridae	7	10	4	NA	-
69	Yellow orange tip	*Ixias pyrene* Linnaeus 1764	Pieridae	1	8	7	NA	-
70	Yellow pansy	*Junonia hierta* (Fabricius, 1798)	Nymphalidae	-	3	4	LC	-

Note: Species identified by ESHCPL team; NA= Not Assessed, LC= least Concern

B. COMMAND AREA

Table 6 List of tree species recorded in the command area

Sl. No.	Botanical name	Local name	Family	IUCN Conservation Status, 2018	RET Status	Uses
1	*Acacia chundra* (Rottler) Willd.	Khadiramu	Fabaceae	Not Assessed	Common	Medicinal
2	*Acacia nilotica* (L.) Willd. ex Delile	Babul	Fabaceae	Not Assessed	Common	Timber
3	*Alangium salvifolium* (L.f.) Wangerin	UdugaChettu	Alangiaceae	Not Assessed	Common	Medicinal
4	*Albizia amara* (Roxb.) Boiv.	ChigaraChettu	Fabaceae	Not Assessed	Common	Timber
5	*Albizia odoratissima* (L.f.) Benth.	Chinduga	Fabaceae	Not Assessed	Common	Timber
6	*Annona squamosa* L.	Seetapandu	Annonaceae	Not Assessed	Common	Edible
7	*Artocarpus heterophyllus* Lam.	Panas manu	Moraceae	Not Assessed	Common	Edible
8	*Azadirachta indica* A.Juss.	VepaChettu	Meliaceae	Not Assessed	Common	Medicinal
9	*Borassus flabellifer* L.	ThatiChettu	Arecaceae	Not Assessed	Common	Edible
10	*Buchanania lanzan* Spreng.	Charumamidi	Anacardiaceae	Not Assessed	Common	Edible
11	*Butea monosperma* (Lam.) Taub.	Moodugachettu	Fabaceae	Not Assessed	Common	NTFP
12	*Dalbergia paniculata* (Roxb.)Thoth.	Nagalapachari	Fabaceae	Not Assessed	Common	Timber
13	*Eucalyptus globules* Labill.	Neelagirichettu	Myrtaceae	Not Assessed	Common	Medicinal
14	*Ficus religioasa* Labill.	MarriChettu	Moraceae	Not Assessed	Common	Edible
15	*Gmelina arborea* Roxb. ex Sm.	Adavigummadi	Lamiaceae	Not Assessed	Common	Timber
16	*Mangifera indica* L.	Mamidichettu	Anacardiaceae	Not Assessed	Common	Edible
17	*Morinda pubensis* Sm.	Maddichekka	Rubiaceae	Not Assessed	Common	Medicinal
18	*Moringa oleifera* Lam.	Munagachettu	Moringaceae	Not Assessed	Common	Edible
19	*Pongamia pinnata* (L.)Pierre	Kanuga	Fabaceae	Not Assessed	Common	Bio fuel
20	*Premna tomentosa* Willd.	MalaiThekku	Lamiaceae	Not Assessed	Common	Medicinal
21	*Prosopis juliflora* (Sw.)DC.	Mullathumma	Fabaceae	Not Assessed	Common	Timber

Sl. No.	Botanical name	Local name	Family	IUCN Conservation Status, 2018	RET Status	Uses
22	*Psidium guajava* L.	Jamachettu	Myrtaceae	Not Assessed	Common	Medicinal
23	*Tectona grandis* L.f.	Tekumaanu	Verbinaceae	Not Assessed	Common	Timber
24	*Wrightia tinctoria*	Ankuduchettu	Apocynaceae	Not Assessed	Common	Medicinal
25	*Ziziphus mauritiana* Lam.	Gangaregu	Rhamnaceae	Not Assessed	Common	Edible
26	*Ziziphus oenoplia* (L.) Mill.	Paraki	Rhamnaceae	Not Assessed	Common	Edible

Note: Species identified by EHSCPL team, NTFP= Non Timber Forest Produce.

Table 7 Phyto-sociological features of Tree species recorded in the command area

Sl. No.	Scientific Name	n	D	Frq (%)	BA (m^2/ha)	Do	RD	RFr	RDo	IVI
1	*Borassus flabellifer* L.	9	1.50	66.67	0.240	0.159	6.08	8.89	15.94	30.91
2	*Azadirachta indica* A.Juss.	59	9.83	100.00	0.661	0.439	39.86	13.33	43.85	97.05
3	*Ziziphus oenoplia* (L.) Mill.	1	0.17	16.67	0.002	0.001	0.68	2.22	0.11	3.01
4	*Albizia odoratissima* (L.f.) Benth.	2	0.33	16.67	0.012	0.008	1.35	2.22	0.78	4.36
5	*Butea monosperma* (Lam.) Taub.	14	2.33	83.33	0.203	0.135	9.46	11.11	13.47	34.04
6	*Acacia chundra* (Rottler) Willd.	3	0.50	16.67	0.089	0.059	2.03	2.22	5.88	10.13
7	*Acacia nilotica* (L.) Willd. ex Delile	4	0.67	50.00	0.082	0.054	2.70	6.67	5.41	14.78
8	*Annona squamosa* L.	2	0.33	33.33	0.002	0.002	1.35	4.44	0.16	5.95
9	*Ficus religioasa* Labill.	1	0.17	16.67	0.010	0.007	0.68	2.22	0.66	3.56
10	*Albizia amara* (Roxb.) Boiv.	2	0.33	33.33	0.008	0.006	1.35	4.44	0.55	6.35
11	*Wrightia tinctoria*	1	0.17	16.67	0.002	0.001	0.68	2.22	0.11	3.01
12	*Alangium salvifolium* (L.f.) Wangerin	1	0.17	16.67	0.002	0.001	0.68	2.22	0.11	3.01
13	*Morinda pubensis* Sm.	1	0.17	16.67	0.002	0.001	0.68	2.22	0.11	3.01
14	*Ziziphus mauritiana* Lam.	1	0.17	16.67	0.002	0.001	0.68	2.22	0.11	3.01
15	*Psidium guajava* L.	3	0.50	33.33	0.005	0.004	2.03	4.44	0.36	6.83
16	*Buchanania lanzan* Spreng.	2	0.33	16.67	0.025	0.017	1.35	2.22	1.66	5.23
17	*Pongamia pinnata* (L.)Pierre	1	0.17	16.67	0.022	0.014	0.68	2.22	1.44	4.33
18	*Dalbergia paniculata* (Roxb.)Thoth.	1	0.17	16.67	0.015	0.010	0.68	2.22	0.99	3.89
19	*Tectona grandis* L.f.	20	3.33	33.33	0.042	0.028	13.51	4.44	2.76	20.72
20	*Gmelina arborea* Roxb. ex Sm.	2	0.33	16.67	0.008	0.006	1.35	2.22	0.55	4.13
21	*Moringa oleifera* Lam.	3	0.50	33.33	0.008	0.006	2.03	4.44	0.55	7.02
22	*Eucalyptus globules* Labill.	4	0.67	16.67	0.007	0.004	2.70	2.22	0.44	5.37
23	*Mangifera indica* L.	1	0.17	16.67	0.002	0.001	0.68	2.22	0.11	3.01
24	*Artocarpus heterophyllus* Lam.	1	0.17	16.67	0.002	0.001	0.68	2.22	0.11	3.01

Sl. No.	Scientific Name	n	D	Frq (%)	BA (m^2/ha)	Do	RD	RFr	RDo	IVI
25	*Prosopis juliflora* (Sw.)DC.	6	1.00	16.67	0.012	0.008	4.05	2.22	0.77	7.05
26	*Premna tomentosa* Willd.	3	0.50	16.67	0.045	0.030	2.03	2.22	2.98	7.23
	Total	**148**	-	-	**1.508**	**-**	**100.00**	**100.00**	**100.00**	**300.00**

Note: Species identified by ESHCPL team; n= Number, D= Density, Frq= frequency, Do=Dominance, BA= Basal area, RD= Relative density, RFr= Relative frequency, RDo= Relative Dominance, IVI= Important Value Index.

Table 8 List of shrubs, herbs and climbers recorded in the command area

Sl. No	Scientific Name	Common Name	Family	Occurrence			IUCN conservation status, 2018	RET Status	USES
				Monsoon	Post Monsoon	Pre Monsoon			
Herbs									
1	*Abelmoschus esculentus* (L.) Moench	Kastur benda	Malvaceae	✓	✓	-	Not Assessed	Common	Medicinal
2	*Abutilon hirtum* (Lam) Sweet	Bela benda	Malvaceae	✓	✓	✓	Not Assessed	Common	Medicinal
3	*Abutilon indicum* (Link) Sweet	Adavi benda	Malvaceae	✓	✓	✓	Not Assessed	Common	Medicinal
4	*Acalypha indica* L.	Kuppichettu	Euphorbiaceae	✓	✓	✓	Not Assessed	Common	Medicinal
5	*Acanthospermum hispidum* DC.	Palleru	Asteraceae	✓	✓	✓	Not Assessed	Common	Medicinal
6	*Achyranthes aspera* L.	Uttaraene	Amaranthaceae	✓	✓	✓	Not Assessed	Common	Medicinal
7	*Alternanthera bettzickiana* (Regel) G.Nicholson	Ponnaganti aaku	Amaranthaceae	✓	✓	✓	Not Assessed	Common	Medicinal
8	*Alternanthera paronychioides* A. St.-Hil.	Ponnaganti aaku	Amaranthaceae	✓	✓	✓	Not Assessed	Common	Medicinal
9	*Alysicarpus bupleurifolius* (L.)DC.	Nirmurrri	Fabaceae	✓	✓	-	Least Concern	Common	Medicinal
10	*Alysicarpus ovalifolius* (Schum.)Leonard	Baramatal chettu	Fabaceae	✓	-	✓	Not Assessed	Common	Medicinal
11	*Anagallis arvensis* L.	Nakamalli	Primulaceae	✓	✓	✓	Not Assessed	Common	Medicinal
12	*Argyreia cuneata* Willd. ex Ker-Gawl.	Samudrapela	Convolvulaceae	✓	-	✓	Not Assessed	Common	Medicinal
13	*Arundo donax* L.	Kaki veduru	Poaceae	✓	✓	✓	Least Concern	Common	Medicinal
14	*Asphodelus tenuifolius* Cav.	Seema vulli	Lilaceae	✓	-	✓	Not Assessed	Common	Medicinal
15	*Atylosia scarabaeoides* (L.) Benth.	Kattu thovarei	Fabaceae	✓	-	✓	Least Concern	Common	Medicinal
16	*Avena ludoviciana* Durieu	Yava	Poaceae	✓	-	✓	Not Assessed	Common	Medicinal
17	*Axonopus compressus* (Sw.) P.Beauv.	***	Poaceae	✓	-	✓	Not Assessed	Common	Medicinal
18	*Blainvillea acmella* (L.) Philipson	Kukundara	Asteraceae	✓	-	✓	Not Assessed	Common	Medicinal
19	*Brachiaria deflexa* (Schumach.)	Korralu	Poaceae	✓	-	✓	Not Assessed	Common	Medicinal

Sl. No	Scientific Name	Common Name	Family	Occurrence			IUCN conservation status, 2018	RET Status	USES
				Monsoon	Post Monsoon	Pre Monsoon			
	C.E.Hubb. ex Robyns								
20	*Brachiaria eruciformis* (Sm.) Griseb.	Korralu	Poaceae	✓	-	✓	Not Assessed	Common	Medicinal
21	*Brachiaria ramose* (L.) Stapf.	Korralu	Poaceae	✓	-	-	Least Concern	Common	Medicinal
22	*Brachiaria reptans* (L.) C.A.Gardner & C.E.Hubb.	Korralu	Poaceae	✓	-	✓	Least Concern	Common	Medicinal
23	*Cannabis sativa* L.	Bangiaaku	Cannabaceae	✓	-	✓	Not Assessed	Common	Medicinal
24	*Cardiospermum halicacabum* L.	Buddakakara	Sapindaceae	✓	-	✓	Not Assessed	Common	Medicinal
25	*Cassia occidentalis* (L.) Link	Thangedu	Fabaceae	✓	✓	✓	Not Assessed	Common	Medicinal
26	*Cassia tora* (L.) Roxb.	Tantepu chettu	Fabaceae	✓	-	✓	Not Assessed	Common	Medicinal
27	*Chenopodium album* L.	Pappukura aaku	Chenopodiaceae	✓	✓	✓	Not Assessed	Common	Medicinal
28	*Chloris barbata* Sw.	Uppu gaddi	Poaceae	✓	✓	✓	Not Assessed	Common	Medicinal
29	*Cleome monophylla* L.	Gorjuoi Saag	Capparidacae	✓	✓	✓	Not Assessed	Common	Medicinal
30	*Cleome viscose* L.	Kukkavaminta	Capparidacae	✓	✓	✓	Not Assessed	Common	Medicinal
31	*Coix barbata* Roxb.	Adavi guruginja	Poaceae	✓	-	✓	Not Assessed	Common	Medicinal
32	*Coix lacryma-jobi* L.	Adavi guruginja	Poaceae	✓	✓	✓	Not Assessed	Common	Medicinal
33	*Commelina bengalensis* L.	Neerukaassuvu	Commelinaceae	✓	✓	✓	Not Assessed	Common	Medicinal
34	*Commelina diffusa* Burm.f.	Nirukassuvu	Commelinaceae	✓	✓	✓	Least Concern	Common	Medicinal
35	*Corchorus trilocularis* L.	Bankitutturu	Tiliaceae	✓	✓	-	Not Assessed	Common	Medicinal
36	*Croton bonplandianum* Baill.	Kommulaka	Euphorbiaceae	✓	-	-	Not Assessed	Common	Medicinal
37	*Cynodon dactylon* (L.) Pers.	Garika	Poaceae	✓	✓	-	Not Assessed	Common	Medicinal
38	*Cyanotis cristata* (L.) D.Don	Mangisu	Commelinaceae	✓	-	✓	Not Assessed	Common	Medicinal
39	*Cyperus rotundus* L.	Tunga mustalu	Cyparaceae	✓	-	✓	Not Assessed	Common	Medicinal
40	*Cyperus tenuispica* Steud.	Konda Jatamaansi	Cyperaceae	✓	-	-	Least Concern	Common	Medicinal
41	*Dactyloctenium aegyptium* (L.) Willd.	Adityalu	Poaceae	✓	✓	✓	Not Assessed	Common	Medicinal

Sl. No	Scientific Name	Common Name	Family	Occurrence			IUCN conservation status, 2018	RET Status	USES
				Monsoon	Post Monsoon	Pre Monsoon			
42	*Datura metel* L.	Ummetta	Solanaceae	✓	✓	✓	Not Assessed	Common	Medicinal
43	*Dichanthium annulatum* (Forssk.) Stapf	Molava gaddi	Poaceae	✓	-	✓	Not Assessed	Common	Medicinal
44	*Digera arvensis* Forsk.	Chenchalicettu	Amaranthaceae	✓	✓	✓	Not Assessed	Common	Medicinal
45	*Digitaria sanguinalis* (L.) Scop.	***	Poaceae	✓	-	✓	Not Assessed	Common	Medicinal
46	*Dyschoriste depressa* Nees	Pedda-piohakada	Amaranthaceae	✓	✓	-	Not Assessed	Common	Medicinal
47	*Echinochloa crus-galli* (L.) P.Beauv.	Othagaddi	Poaceae	✓	-	✓	Not Assessed	Common	Medicinal
48	*Echinochloa colona* (L.) Link	Othagaddi	Poaceae	✓	✓	✓	Least Concern	Common	Medicinal
49	*Eleusine indica* (L.) Gaertn.	Ragi gaddi	poaceae	✓	-	✓	Not Assessed	Common	Medicinal
50	*Emilia sonchifolia* (L.) DC.	Elikivi chettu	Asteraceae	-	✓	✓	Not Assessed	Common	Medicinal
51	*Eragrostis unioloides* (Retz.) Nees ex Steud.	Udara gaddi	Poaceae	-	✓	✓	Not Assessed	Common	Medicinal
52	*Euphorbia geniculata* Ortega	Nanabalu	Euphorbiaceae	✓	-	✓	Not Assessed	Common	Medicinal
53	*Euphorbia hirta* L.	Raddivari	Euphorbiaceae	✓	-	✓	Not Assessed	Common	Medicinal
54	*Fimbristylis miliacea* (L.) Vahl	***	Cyperaceae	✓	✓	-	Not Assessed	Common	Medicinal
55	*Glinus lotoides* L.	Chadrasi koora	Molluginaceae	✓	✓	-	Not Assessed	Common	Medicinal
56	*Heliotropium indicum* L.	Naga Danti	Boraginaceae	-	✓	✓	Not Assessed	Common	Medicinal
57	*Hibiscus lobatus* (Murray) Kuntze	Atakanara	Malvaceae	✓	✓	-	Not Assessed	Common	Medicinal
58	*Hibiscus panduriformis* Burman fil.	Atakanara	Malvaceae	✓	✓	-	Not Assessed	Common	Medicinal
59	*Hibiscus vitifolius*	Atakanara	Malvaceae	✓	✓	-	Not Assessed	Common	Medicinal
60	*Leptochloa chinensis* (L.) Nees	Mandi gaddi	Poaceae	✓	-	✓	Not Assessed	Common	Medicinal
61	*Leucas martinicensis* (Jacq.) R.Br.	Tummi	Lamiaceae	-	✓	✓	Not Assessed	Common	Medicinal
62	*Lindernia crustacean* (L.) F. Muell.	Paapata janumu	Scrophulariaceae	-	✓	✓	Least Concern	Common	Medicinal
63	*Malachra capitata* (L.) L.	Dudipalatiga	Malvaceae	-	✓	✓	Not Assessed	Common	Medicinal

Sl. No	Scientific Name	Common Name	Family	Occurrence			IUCN conservation status, 2018	RET Status	USES
				Monsoon	Post Monsoon	Pre Monsoon			
64	*Malvastrum coromandelianum* (L.) Garcke.	Nela benda	Malvaceae	-	✓	✓	Not Assessed	Common	Medicinal
65	*Mitracarpus villosus* (Sw.) DC.	Nanabalu	Rubiaceae	✓	-	✓	Not Assessed	Common	Medicinal
66	*Mukia maderaspatana* (L.) M.Roem.	Budama dosa	Cucurbitaceae	✓	-	✓	Not Assessed	Common	Medicinal
67	*Ocimum canum* Sims	Kuppatulasi	Lamiaceae	✓	✓	-	Not Assessed	Common	Medicinal
68	*Oplismenus burmannii* (Retz.) P Beauv.	Kodijuttu gaddi	Poaceae	✓	✓	-	Not Assessed	Common	Medicinal
69	*Oxalis corniculata* L.	Ambotikura,	Oxalidaceae	-	✓	-	Not Assessed	Common	Medicinal
70	*Parthenium hysterophorus* L.	Congress chettu	Asteraceae	✓	-	✓	Not Assessed	Common	Medicinal
71	*Paspalum distichum* L.	***	Poaceae	✓	✓	-	Least Concern	Common	Medicinal
72	*Pedalium murex* L.	Enugapallaeru	Pedaliaceae	✓	✓	✓	Not Assessed	Common	Medicinal
73	*Phyllanthus niruri* L.	Nela usiraka	Phyllanthaceae	✓	✓	✓	Not Assessed	Common	Medicinal
74	*Polypogon monspeliensis* (L.) Desf.	***	Poaceae	✓	✓	-	Least Concern	Common	Medicinal
75	*Pouzolzia zeylanica* (L.) Benn. & R. Br.	Eddu-mutte dumpa	Urticaceae	-	-	✓	Not Assessed	Common	Medicinal
76	*Psoralea corylifolia* L.	Bavanchalu	Fabaceae	-	✓	-	Not Assessed	Common	Medicinal
77	*Saccharum spontaneum* L.	Kaki ceruku	Poaceae	✓	✓	-	Least Concern	Common	Medicinal
78	*Sacciolepis Indica* (L.) Chase	***	Poaceae	✓	✓	-	Not Assessed	Common	Medicinal
79	*Setaria glauca* (L.) P.Beauv.	Nakkakora	Poaceae	✓	✓	-	Not Assessed	Common	Medicinal
80	*Setaria viridis* (L.) P.Beauv.	Nakkakora	Poaceae	-	✓	-	Not Assessed	Common	Medicinal
81	*Sida acuta* Burm. f.	Muttavapulagamu	Malvaceae	✓	-	✓	Not Assessed	Common	Medicinal
82	*Sida cordifolia* L.	Chittamuttie	Malvaceae	✓	✓	✓	Not Assessed	Common	Medicinal
83	*Sida rhombifolia* L.	Chittamuttie	Malvaceae	✓	✓	✓	Not Assessed	Common	Medicinal
84	*Solanum Viarum* Dunal	Kamanchi	Solanaceae	✓	-	✓	Not Assessed	Common	Medicinal
85	*Sorghum halepense* (L.) Pers.	Gaddi janu	Poaceae	✓	✓	✓	Not Assessed	Common	Medicinal
86	*Stellaria media* (L.) Vill.	Donda kaya	Caryophyllaceae	✓	✓	✓	Not Assessed	Common	Medicinal

Sl. No	Scientific Name	Common Name	Family	Occurrence			IUCN conservation status, 2018	RET Status	USES
				Monsoon	Post Monsoon	Pre Monsoon			
87	*Synedrella nodiflora* (L.) Gaertn.	***	Asteraceae	✓	✓	✓	Not Assessed	Common	Medicinal
88	*Themeda triandra* Forssk.	***	Poaceae	✓	-	-	Not Assessed	Common	Medicinal
89	*Tribulus terrestris* L.	Palleru Urdu	Zygophyllaceae	✓	-	-	Not Assessed	Common	Medicinal
90	*Tridax procumbens* L.	Gaddi chemanthi	Asteraceae	✓	✓	✓	Not Assessed	Common	Medicinal
91	*Triumfetta rhomboidea* Jacq.	Bankathuthara	Tiliaceae	✓	-	-	Not Assessed	Common	Medicinal
92	*Urena lobata* L.	Nalla Benda	Malvaceae	✓	-	-	Not Assessed	Common	Medicinal
93	*Vicia sativa* L.	Ragulu gaddi	Fabaceae	✓	-	-	Not Assessed	Common	Medicinal
94	*Vicoa auriculata* Cass.	Tamgedu	Asteraceae	✓	-	✓	Not Assessed	Common	Medicinal
95	*Waltheria coromandelianum*	Duvvena Kayalu	Malvaceae	-	-	✓	Not Assessed	Common	Medicinal
96	*Waltheria indica* L.	Nallabenda	Malvaceae	✓	-	✓	Not Assessed	Common	Medicinal
97	*Xanthium strumarium* L.	Marulutige	Asteraceae	✓	✓	✓	Not Assessed	Common	Medicinal
Shrubs									
1	*Annona Squamosa* L.	Seetapandu	Annonaceae	✓	✓	✓	Not Assessed	Common	Medicinal
2	*Acacia chundra* (Rottler) Willd.	Chandra	Fabaceae	✓	✓	✓	Not Assessed	Common	Medicinal
3	*Calotropis procera* (Ait.) Ait. fil.	Jilledu	Asclepidaceae	✓	✓	✓	Not Assessed	Common	Medicinal
4	*Canthium parviflorum* Lam.	Balusu	Rubiaceae	✓	✓	✓	Not Assessed	Common	Medicinal
5	*Cassia auriculata* L.	Tagedu	Fabaceae	✓	✓	✓	Not Assessed	Common	Medicinal
6	*Cassia fistula* L.	Sema Tangedu	Fabaceae	✓	✓	✓	Not Assessed	Common	Medicinal
7	*Clerodendron infortunatum* L.	Basavanapadu	Verbenaceae	✓	✓	✓	Not Assessed	Common	Medicinal
8	*Kirganelia reticulate* (Poir.) Baill.	Nallapuli	Phyllanthaceae	✓	✓	✓	Not Assessed	Common	Medicinal
9	*Lantana camara* L.	Pulikampa	Verbenaceae	✓	✓	✓	Not Assessed	Common	Medicinal
10	*Murraya koenigii* (L.) Spreng.	Kavivepaku	Rutaceae	✓	✓	✓	Not Assessed	Common	Medicinal
11	*Musa paradisiaca* L.	Aritikayalu	Musaceae	✓	✓	✓	Not Assessed	Common	Medicinal
12	*Prosopis juliflora* (Sw.)DC.	Mulla Thumma	Fabaceae	✓	✓	✓	Not Assessed	Common	Medicinal

Sl. No	Scientific Name	Common Name	Family	Occurrence			IUCN conservation status, 2018	RET Status	USES
				Monsoon	Post Monsoon	Pre Monsoon			
13	*Vitex altissima* L.f.	Nalla-vavil	Lamiaceae	✓	✓	✓	Not Assessed	Common	Medicinal
Climbers									
1	*Clitoria ternatea* L.	Sanku pushpam	Fabaceae	✓	✓	✓	Least Concern	Common	Medicinal
2	*Cucumis maderaspatensis*	Donda kaya	Cucurbitaceae	✓	✓	✓	Not Assessed	Common	Medicinal
3	*Cyclea peltata* Hook. fil. & Thoms.	Chiruboddi	Menispermaceae	✓	-	✓	Not Assessed	Common	Medicinal
4	*Diplocyclos palmatus* Hook. f. & Thoms.	Linga donda	Cucurbitaceae	✓	✓	-	Least Concern	Common	Medicinal
5	*Hemidesmus indicus* (L.) R.Br.	Suganda pala	Asclepidaceae	-	✓	-	Not Assessed	Common	Medicinal
6	*Ipomea carnea* Jace.	Pandiri thooti	Convolvulaceae	✓	-	✓	Not Assessed	Common	Medicinal
7	*Ipomea obscura* (L.) Ker Gawler	Nallakokkita	Convolvulaceae	✓	-	✓	Not Assessed	Common	Medicinal
8	*Ipomoea pes-tigridis* L.	Chikunuvvu	Convolvulaceae	✓	-	✓	Not Assessed	Common	Medicinal
9	*Merremia emarginata* (Burm. fil.) Hall. fil.	Elika jimudu	Convolvulaceae	✓	-	-	Not Assessed	Common	Medicinal
10	*Passiflora foetida* L.	Tellajumiki	Passifloraceae	✓	✓	✓	Not Assessed	Common	Medicinal
11	*Pergularia daemia*	Juttu-paku	Asclepidaceae	-	✓	✓	Not Assessed	Common	Medicinal
12	*Rhynchosia minima* (L.)DC.	Gaddi-chikkudu	Fabaceae	✓	✓	✓	Not Assessed	Common	Medicinal

.Note: Species identified by EHSCPL team.

Table 9 List of Birds recorded in the command area

Sl. No.	Common Name	Scientific Name	Family	Occurrences			IUCN conservation status, 2018	Wildlife (Protection) Act, 1972
				Monsoon	Post Monsoon	Pre monsoon		
1	Asian openbill stork	*Anastomus oscitans* (Boddaert, 1783)	Ciconiidae	3	1	4	LC	IV
2	Asian pied starling	*Gracupica contra* (Linnaeus, 1758)	Sturnidae	2	-	2	LC	IV
3	Bay backed shrike	*Lanius vittatus* (Valenciennes, 1826)	Sturnidae	-	1	-	LC	-
4	Baya weaver	*Ploceus philippinus* (Linnaeus, 1766)	Ploceidae	8	-	5	LC	IV
5	Black drongo	*Dicrurus macrocercus* (Vieillot, 1817)	Dicruridae	10	-	8	LC	IV
6	Black headed cuckoo shrike	*Coracina melanoptera* (Rüppell, 1839)	Campephagidae	2	-	2	LC	IV
7	Black headed gull	*Larus ridibundus* (Linnaeus, 1766)	Laridae	1	-	2	LC	IV
8	Black headed munia	*Lonchura Malacca* (Linnaeus, 1766)	Estrildidae	1	-	1	LC	IV
9	Black ibis	*Pseudibis papillosa* (Temminck, 1824)	Threskiornithidae	2	-	2	LC	IV
10	Black necked stork	*Ephippiorhynchus asiaticus* (Latham, 1790)	Ciconiidae	1	5	1	NT	IV
11	Black tailed godwit	*Limosa limosa* (Linnaeus, 1758)	Scolopacidae	2	-	2	NT	IV
12	Black-winged stilt	*Himantopus himantopus* (Linnaeus, 1758)	Recurvirostridae	-	1	-	LC	IV
13	Blue tailed bee-eater	*Merops philippinus* (Linnaeus, 1766)	Meropidae	7	-	5	LC	-
14	Cattle egret	*Bubulcus ibis* (Linnaeus, 1758)	Ardeidae	1	1	1	LC	IV
15	Common babbler	*Turdoides caudate* (Dumont, 1823)	Leiothrichidae	6	-	4	LC	IV
16	Common crane	*Grus grus* (Linnaeus, 1758)	Gruidae	1	-	1	LC	IV
17	Common crow	*Corvus splendens* (Vieillot, 1817)	Corvidae	7	-	6	LC	V

Sl. No.	Common Name	Scientific Name	Family	Occurrences			IUCN conservation status, 2018	Wildlife (Protection) Act, 1972
				Monsoon	Post Monsoon	Pre monsoon		
18	Common cuckoo	*Cuculus canorus* (Linnaeus, 1758)	Cuculidae	12	-	10	LC	IV
19	Common myna	*Acridotheres tristis* (Linnaeus, 1766)	Sturnidae	2	2	2	LC	IV
20	Common Sandpiper	*Actitis hypoleucos* (Linnaeus, 1758)	Scolopacidae	1	-	1	LC	IV
21	Common wood shrike	*Tephrodornis pondicerianus* (Gmelin, 1789)	Tephrodornithidae	1	-	1	LC	IV
22	Darter Oriental	*Anhinga melanogaster* (Pennant, 1769)	Anhingidae	1	-	1	NT	IV
23	Demoiselle crane	*Grus virgo* (Linnaeus, 1758)	Gruidae	5	-	4	LC	IV
24	Eurasian collared dove	*Streptopelia decaocto* (Frivaldszky, 1838)	Columbidae	4	-	4	LC	IV
25	Finn's weaver	*Ploceus megarhynchus* (Hume, 1869)	Ploceidae	1	-	1	VU	IV
26	Forest wagtail	*Dendronanthus indicus* (Gmelin, 1789)	Motacillidae	-	2	-	LC	IV
27	Great cormorant	*Phalacrocorax carbo* (Linnaeus, 1758)	Phalacrocoracidae	-	1	-	LC	IV
28	Great crested grebe	*Podiceps cristatus* (Linnaeus, 1758)	Podicipedidae	2	-	2	LC	IV
29	Great egret	*Casmerodius albus* Linnaeus, 1758	Ardeidae	5	-	5	LC	IV
30	Great short toed Lark	*Calandrella brachydactyla* (Leisler, 1814)	*Alaudidae*	-	4	-	LC	IV
31	Great tit	*Parus major* (Linnaeus, 1758)	Paridae	1	-	1	LC	IV
32	Greater flamingo	*Phoenicopterus roseus* (Pallas, 1811)	Phoenicopteridae	5	-	5	LC	-
33	House sparrow	*Passer domesticus* (Linnaeus, 1758)	Passeridae	27	-	30	LC	IV
34	House Swift	*Apus nipalensis* (Hodgson, 1837)	Apodidae	-	18	-	LC	-

Sl. No.	Common Name	Scientific Name	Family	Occurrences			IUCN conservation status, 2018	Wildlife (Protection) Act, 1972
				Monsoon	Post Monsoon	Pre monsoon		
35	Indian chat	*Cercomela fusca* (Blyth, 1851)	*Muscicapidae*	-	3	-	LC	IV
36	Indian peafowl	*Pavo cristatus* (Linnaeus, 1758)	Phasianidae	4	-	4	LC	I
37	Indian Robin	*Saxicoloides fulicatus* (Linnaeus, 1766)	Muscicapidae	-	4	-	LC	-
38	Indian shag	*Phalacrocorax fuscicollis* (Stephens, 1826)	Phalacrocoracidae	2	-	2	LC	IV
39	Indian silverbill	*Lonchura malabarica* (Linnaeus, 1758)	Estrildidae	2	-	2	LC	IV
40	Indian skimmer	*Rynchops albicollis* (Swainson, 1838)	Laridae	3	-	3	LC	-
41	Intermediate egret	*Ardea intermedia* (Wagler, 1827)	Ardeidae	54	-	38	LC	IV
42	Jerdon's courser	*Rhinoptilus bitorquatus* (Blyth, 1848)	Glareolidae	1	-	1	CE	I
43	Large grey babbler	*Turdoides malcolmi* (Sykes, 1832)	Leiothrichidae	-	6	-	LC	IV
44	Little cormorant	*Microcarbo niger* (Vieillot, 1817)	Phalacrocoracidae	2	19	2	LC	IV
45	Little green bee-eater	*Merops orientalis* (Latham, 1801)	Meropidae	8	4	7	LC	-
46	Little ringed plover	*Charadrius dubius* (Scopoli, 1786)	Charadriidae	2	-	2	LC	IV
47	Long tailed shrike	*Lanius schach* (Linnaeus, 1758)	Laniidae	6	-	5	LC	-
48	Median egret	*Ardea intermedia* (Wagler, 1827)	Ardeidae	-	1	-	LC	-
49	Mountain imperial pigeon	*Ducula badia* (Raffles, 1822)	Columbidae	1	-	1	LC	IV
50	Oriental magpie-robin	*Copsychus saularis* (Linnaeus, 1758)	Muscicapidae	1	2	1	LC	IV
51	Palm warbler	*Setophaga palmarum* (Gmelin, 1789)	Parulidae	-	7	-	LC	-
52	Pied avocet	*Recurvirostra avosetta* (Linnaeus, 1758)	Recurvirostridae	1	-	2	LC	IV

Sl. No.	Common Name	Scientific Name	Family	Occurrences			IUCN conservation status, 2018	Wildlife (Protection) Act, 1972
				Monsoon	Post Monsoon	Pre monsoon		
53	Pied bushchat	*Saxicola caprata* (Linnaeus, 1766)	Muscicapidae	1	5	-	LC	IV
54	Pied flycatcher	*Hemipus picatus* (Sykes, 1832)	Tephrodornithidae	1	-	1	LC	IV
55	Plain prinia	*Prinia inornata* (Sykes, 1832)	Cisticolidae	2	-	2	LC	IV
56	Pond heron	*Ardeola grayii* (Sykes, 1832)	Ardeidae	10	-	8	LC	IV
57	Purple rumped sunbird	*Leptocoma zeylonica* (Linnaeus, 1766)	Nectariniidae	11	9	9	LC	IV
58	Purple sunbird	*Cinnyris asiaticus* (Latham, 1790)	Nectariniidae	-	5	-	LC	-
59	Purple wood pigeon	*Columba punicea* (Tickell in Blyth, 1842)	Columbidae	2	-	2	VU	IV
60	Red collared dove	*Streptopelia tranquebarica* (Hermann, 1804)	Columbidae	3	-	3	LC	IV
61	Red oriental dove	*Streptopelia orientalis* (Latham, 1790)	Columbidae	-	4	-	LC	IV
62	Red vented bulbul	*Pycnonotus cafer* (Linnaeus, 1766)	Pycnonotidae	1	-	1	LC	IV
63	Red wattled lapwing	*Vanellus indicus* (Boddaert, 1783)	Charadriidae	6	2	6	LC	IV
64	Red-vented bulbul	*Pycnonotus cafer* (Linnaeus, 1766)	Pycnonotidae	-	2	-	LC	IV
65	Rock pigeon	*Columba livia* (Gmelin, 1789)	Columbidae	6	-	8	LC	IV
66	Rose ringed parakeet	*Psittacula krameri* (Scopoli, 1769)	Psittacidae	4	-	4	LC	IV
67	Rufescent prinia	*Prinia rufescens* (Blyth, 1847)	Cisticolidae	-	8	-	LC	IV
68	Scaly breasted munia	*Lonchura punctulata* (Linnaeus, 1758)	Estrildidae	1	-	1	LC	IV
69	Shikra	*Accipiter badius* (Gmelin, 1788)	Accipitridae	2	-	2	LC	I
70	Small minivet	*Pericrocotus cinnamomeus* (Linnaeus, 1766)	Campephagidae	2	-	4	LC	IV
71	Spotted dove	*Spilopelia chinensis* (Scopoli, 1768)	Columbidae	2	-	2	LC	IV

Sl. No.	Common Name	Scientific Name	Family	Occurrences			IUCN conservation status, 2018	Wildlife (Protection) Act, 1972
				Monsoon	Post Monsoon	Pre monsoon		
72	Straw-necked ibis	*Threskiornis spinicollis* (Jameson, 1835)	Threskiornithidae	-	2	-	LC	-
73	Tufted pochard	*Aythya fuligula* (Linnaeus, 1758)	Anatidae	25	-	22	LC	IV
74	Western reef egret	*Egretta gularis* (Bosc, 1792)	Ardeidae	4	-	4	LC	IV
75	White browed fantail	*Rhipidura aureola* Lesson, 1830	Rhipiduridae	1	-	1	LC	IV
76	White throated kingfisher	*Halcyon smyrnensis* (Linnaeus, 1758)	Alcedinidae	2	1	2	LC	IV
77	White wagtail	*Motacilla alba* (Linnaeus, 1758)	Motacillidae	15	-	18	LC	IV
78	White-browed bulbul	*Pycnonotus luteolus* (Lesson, 1841)	Pycnonotidae	-	2	-	LC	IV
79	Yellow Wagtail	*Motacilla flava* (Linnaeus, 1758)	Motacillidae	-	2	-	LC	IV

Note: Species identified by ESHCPL team; LC= least concern, VU= vulnerable, CE=critically Endangered, NT= near threatened, NA= not assessed

Table 10 List of Butterflies recorded in the command area

Sl. No.	Common Name	Scientific Name	Family	Occurrences			IUCN conservation status, 2018	Wildlife (Protection) Act, 1972
				Monsoon	Post Monsoon	Pre Monsoon		
1	Anar	*Virachola Isocrates* (Fabricius, 1793)	Lycaenidae	1	-	1	NA	-
2	Baronet	*Symphaedra nais* (Forster, 1771)	Nymphalidae	1	-	2	NA	-
3	Blue tiger	*Tirumala limniace* (Cramer, 1775)	Nymphalidae	3	3	3	NA	-
4	Cabbage	*Pieris rapae* (Linnaeus, 1758)	Pieridae	32	5	24	NA	-
6	Chocolate albatross	*Appias lyncida* (Cramer, 1777)	Pieridae	1	-	1	NA	Ⅱ
7	Common branded skipper	*Hesperia comma* (Linnaeus, 1758)	Hesperiidae	5	-	5	NA	-
8	Common Bush brown	*Mycalesis perseus* (Fabricius, 1775)	Nymphalidae	-	12	-	NA	-
9	Common clouded yellow	*Colias croceus* (Geoffroy, 1785)	Pieridae	13	-	10	NA	-
10	Common crow	*Euploea core* (Cramer, 1780)	Nymphalidae	3	1	3	LC	Ⅳ
11	Common emigrant	*Catopsilia Pomona* (Fabricius, 1775)	Pieridae	2	-	2	NA	-
12	Common evening brown	*Melanitis leda* (Linnaeus, 1758)	Nymphalidae	2	-	1	NA	-
13	Common gem	*Poritia hewitsoni* (Moore, 1865)	Lycaenidae	7	-	6	NA	Ⅱ
14	Common grass yellow	*Eurema hecabe* (Linnaeus, 1758)	Pieridae	8	2	4	NA	-
15	Common gull	*Cepora nerissa* (Fabricius, 1775)	Pieridae	2	-	2	NA	Ⅱ
16	Common leopard	*Phalanta phalantha* (Drury, 1773)	Nymphalidae	-	2	-	NA	-
17	Common mime	*Papilio clytia* (Linnaeus, 1758)	Papilionidae	4	-	-	NA	-
18	Common mormon	*Papilio polytes* (Linnaeus, 1758)	Papilionidae	6	-	4	NA	-
19	Common rose	*Pachliopta aristolochiae* (Fabricius, 1775)	Papilionidae	-	3	5	NA	-
20	Common sailor	*Neptis hylas* (Linnaeus, 1758)	Nymphalidae	-	7	-	NA	-
21	Common wanderer	*Pareronia valeria* (Cramer, 1776)	Pieridae	-	3	-	NA	-
22	Common windmill	*Byasa polyeuctes* (Doubleday, 1842)	Papilionidae	5	-	5	NA	-
23	Common woodbrown	*Lethe sidonis* (Hewitson, 1863)	Nymphalidae	2	-	1	NA	-
24	Common yellow swallowtail	*Papilio machaon* (Linnaeus, 1758)	Papilionidae	2	-	2	NA	Ⅱ

Sl. No.	Common Name	Scientific Name	Family	Occurrences			IUCN conservation status, 2018	Wildlife (Protection) Act, 1972
				Monsoon	Post Monsoon	Pre Monsoon		
25	Crimson rose	*Pachliopta hector* (Linnaeus, 1758)	Papilionidae	2	-	1	NA	-
26	Giant swallowtail	*Papilio cresphontes* (Cramer, 1777)	Papilionidae	1	-	1	NA	-
27	Great eggfly	*Hypolimnas bolina* (Linnaeus, 1758)	Lycaenidae	-	3	-	NA	-
28	Hedge blue	*Acytolepis puspa* (Horsfield, 1828)	Lycaenidae	-	2	-	NA	-
29	Indian cupid	*Everes lacturnus* (Godart, 1824)	Lycaenidae	2	-	2	NA	-
30	Indian skipper	*Spialia galba* (Fabricius, 1793)	Hesperiidae	-	2	-	NA	-
31	Julia heliconian	*Dryas iulia* (Fabricius, 1775)	Nymphalidae	6	-	6	NA	-
32	Lemon pansy	*Junonia lemonias* (Linnaeus, 1758)	Nymphalidae	-	3	-	NA	-
33	Lime butterfly	*Papilio demoleus* (Linnaeus, 1758)	Papilionidae	27	-	15	NA	-
34	Lime blue	*Chilades laius* (Cramer 1782)	Lycaenidae	-	2	-	NA	-
35	Mottled emigrant	*Catopsilia pyranthe* (Linnaeus, 1758)	Pieridae	2	-	2	NA	-
36	Painted lady	*Vanessa cardui* (Linnaeus, 1758)	Nymphalidae	13	-	12	NA	-
37	Plain tiger	*Danaus chrysippus* (Linnaeus, 1758)	Nymphalidae	12	-	9	NA	-
38	Rose windmill	*Byasa latreillei* (Donovan, 1826)	Papilionidae	5	-	5	NA	-
39	Spicebush Swallowtail	*Papilio Troilus* (Linnaeus, 1758)	Papilionidae	20	-	17	NA	-
40	Striated satyr	*Aulocera saraswati* (Kollar, 1844)	Nymphalidae	1	-	1	NA	-
41	Striped tiger	*Danaus genutia* (Cramer, 1779)	Nymphalidae	6	2	5	NA	-
42	Tailed jay	*Graphium Agamemnon* (Linnaeus, 1758)	Papilionidae	-	2	-	NA	-
43	Tawny coster	*Acraea terpsicore* (Linnaeus, 1758)	Nymphalidae	2	2	2	NA	-
44	White orange tip	*Ixias Marianne* (Cramer, 1779)	Pieridae	4	1	3	NA	-
45	Woodbrown	*Pararge aegeria* (Linnaeus, 1758)	Nymphalidae	-	3	-	NA	-
46	Yellow orange tip	*Ixias pyrene* (Linnaeus 1764)	Pieridae	7	-	6	NA	-
47	Yellow pansy	*Junonia hierta* (Fabricius, 1798)	Nymphalidae	4	11	3	LC	-

Note: Species recorded by EHSCPL team, NA- Not Assessed.

ANNEXURE-19

ANNEXURE – 19

Table 1: Physico-chemical features of surface water sample of Godavari River

Sl. No.	Parameters	Values	Water Quality Criteria					PVNKSSIP Site	Project site	Project Site upstream zone	Project Site Downstream zone	Project Site PVNKSSIP	Project site Left bank	Project site Right bank Downstream	Project site Right bank Upstream
			A	B	C	D	E								
1	Date	-	-					13-08-2017	12-09-2017	07-10-2017	07-10-2017	08-10-2017	18-12-2017	18-12-2017	20-12-2017
2	Colour	-	10	300	300	-	-	Hazen	Hazen	Clear	Clear	Clear	Clear	Clear	Clear
3	Odour	-	-	-	-	-	-	Objectionable	odourless	odourless	odourless	odourless	odourless	odourless	odourless
4	Ambient Temp	°C	-	-	-	-	-	33.2		31.8	33.1	30.7	24.2	33.2	30.2
5	Water Temp	°C	-	-	-	-	-	31.8		30.1	32.6	29.5	23.7	31	27.8
6	Turbidity	NTU	-	-	-	-	-	36.8	4.98	25	33.8	32	1.26	2.57	1.02
7	pH		6.5 – 8.5					7.12	8	7.95	8.19	7.93	8.3	8.11	8.41
8	Dissolved Solids (DO)	mg/l	6	5	4	4	-	6.3	4.9	4.3	4.5	4.6	5.2	5.9	5.4
9	Free Carbon-do-oxide (CO_2)	mg/l	-	-	-	-	-	1.76	0.56	BDL	BDL	BDL	BDL	BDL	BDL
10	Free Ammonia (NH_3)	mg/l	-	-	-	1.2	-	0.43	BDL	0.32	0.3	0.26	BDL	BDL	BDL
11	Total Alkalinity ($caco_3$)	mg/l	-	-	-	-	-	59	88	76	58	72	106	124	114
12	Total Hardness ($Caco_3$)	mg/l	-	-	-	-	-	57	86	62	60	68	102	118	104
13	Phosphate (PO_4)	mg/l	-	-	-	-	-	0.35	0.23	0.18	0.17	0.1	BDL	0.13	BDL
14	Nitrate(NO_3)	mg/l	20	-	50	-	-	0.23	1.52	2.67	5.14	6.13	BDL	BDL	BDL
15	Silicate (Sio_2)	mg/l	-	-	-	-	-	4.87	1.52	8.65	10.83	6.6	BDL	BDL	BDL
16	Iron (Fe)	mg/l	0.3	-	50	-	-	2.16	0.74	1.87	1.75	1.82	BDL	BDL	BDL
17	Calcium (Ca)	mg/l	-	-	-	-	-	21.6	16	11.2	9.6	12.8	19.2	21.6	20
18	Potassium(K)	mg/l	-	-	-	-	-	2	2.8	3.2	5.2	3.2	2.4	3.2	2.4
19	Specific Conductivity	micro mhoms/cm	-	-	-	1000	2250	176.6	249	167.5	158.1	183.3	320	351	324

Table 2: Qualitative, Quantitative and Percentage Composition of Plankton Biomass of the Godavari River

Taxonomic Status		Locations															
		PVNKSSIP Site		PVNKSSIP Site		PVNKSSIP Site		PVNKSSIP Downstream		PVNKSSIP		PVNKSSIP Left Bank		PVNKSSIP Right Bank-Downstream		PVNKSSIP Right bank-Upstream	
		13.08.2017		13.08.2017		13.08.2017		07.10.2017		08.10.2017				18.12.2017		18.12.2017	
		Nos.1 - %		Nos.1 - %		Nos.1 - %		Nos.1 - %		Nos.1 - %		Nos.1 - %		Nos.1 - %		Nos.1 - %	
PHYTOPLANKTON		22	7.86	310	81.16	24	48	21	58.33	240	88.24	44	50.57	296	94.87	167	81.07
Division	Myxophyceae																
Family	CHRROCOCCACEAE																
Genus	*Anacystis* meneghini																
1. *Anacystis cyanea* (Kutzing) Drought & Dally		4	1.43	84	21.99	-	-	-	-	4	1.47	44	50.57	24	7.69	2	0.97
Family	OSCILLATORIACEAE																
Genus	Oscillateria Vaucher																
2. *Oscillatoria tenuis* Agardh		-	-	12	3.14	2	4	3	8.33	56	20.59	-	-	-	-	6	2.92
Genus	Spirulina Turpin																
3 . *Spirulina major* Kutzing		-	-	4	1.05	-	-	-	-	68	25	-	-	-	-	68	33.01
Division	Chlorophyta																
Class	Chlorophyceae																
Order	Volvocales																
Family	CHLAMYDOMONADACEAE																
Genus	*Chlorogonius* Ehrenberg																
4. *Chlorogonium elangatu* Dangeared		-	-	-	-	-	-	-	-	-	-	-	-	-	-	6	2.92
Family	VOLVOCACEAE																
Genus	*Platydorina* Kofoid																
5. *Platydirina caudata* Kofoid		2	0.71	4	1.05	-	-	-	-	-	-	-	-	-	-	-	-

Taxonomic Status		Locations															
		PVNKSSIP Site		PVNKSSIP Site		PVNKSSIP Site		PVNKSSIP Downstream		PVNKSSIP		PVNKSSIP Left Bank		PVNKSSIP Right Bank-Downstream		PVNKSSIP Right bank-Upstream	
		13.08.2017		13.08.2017		13.08.2017		07.10.2017		08.10.2017				18.12.2017		18.12.2017	
		Nos.1 - %		Nos.1 - %		Nos.1 - %		Nos.1 - %		Nos.1 - %		Nos.1 - %		Nos.1 - %		Nos.1 - %	
Family	CHARACIACEAE																
Genus	*Schroederia* Lemmermann																
6. *Schroederia setigera* (Schroeder) Lemmermann		-	-	-	-	-	-	-	-	-	-	-	-	-		4	1.94
Order	Chlorococcales																
Family	COELASTRACEAE																
Genus	*Coelastrum* Nageli																
7. *Coelastrum chodati* Ducell		-	-	190	49.74	-	-	-	-	4	1.47	-	-	-	-	3	1.46
Family	OOCYSTACEAE																
Genus	*Pachycladen* G.M.Smith																
8. *Pachycladen umbrinus* (Ehrenberg) Brebissen		-	-	-	-	-	-	5	5.55	-	-	-	-	-	-	-	-
Order	ZYGNEMATALES																
Family	DESMIDIACEAE																
Genus	*Penium* Brebssen																
9. *Penium margaritaceum* (Ehrenberg) Brebissen		-	-	-	-	-	-	2	5.55	-	-	-	-	-	-	-	-
Family	ZYGNEMATACEAE																
Genus	*Spirogyre* Link																
10. *Spiregyra Varians* (hassal) Kutzing		-	-	-	-	-	-	16	5.88	-	-	-	-	236	78.67	56	27.18
Order	Ulothrix																
Family	ULOTRICHASCEAE																

Taxonomic Status		Locations															
		PVNKSSIP Site		PVNKSSIP Site		PVNKSSIP Site		PVNKSSIP Downstream		PVNKSSIP		PVNKSSIP Left Bank		PVNKSSIP Right Bank-Downstream		PVNKSSIP Right bank-Upstream	
		13.08.2017		13.08.2017		13.08.2017		07.10.2017		08.10.2017				18.12.2017		18.12.2017	
		Nos.1 - %		Nos.1 - %		Nos.1 - %		Nos.1 - %		Nos.1 - %		Nos.1 - %		Nos.1 - %		Nos.1 - %	
Genus	*Radiofilum* Schmide																
11. *Radiofilum conjuctivum* Schmidle		2	0.71	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Genus	*Ulothrix* Kutzing																
12. Ulothrix zonata (Web et Mehr)		14	5.01	-	-	4	8	-	-	68	25	-	-	36	12	2	0.97
Order	Cladephorales																
Family	CLADOPHORACEAE																
Genus	*Cladophora* Kutzing																
13. *Cladophora glomerata* (L.) Kutzing		-	-	16	4.19	-	-	-	-	8	2.94	-	-	-	-	2	0.97
Division	Chrysophyta																
Class	Bacillariophyaceae																
Order	Bacillariales																
Suborder	Araphidineae																
Family	FRAGILARIACEAE																
Subfamily	Fragilaeioidaceae																
Genus	*Fragilaria* Lyngb																
14. *Fragilaria capucina* (Desmazieres)		-	-	-	-	-	-	-	-	16	5.88	-	-	-	-	8	3.88
Genus	*Synedra* Ehr.																
15. *Synedra ulna* (Nitzah) Ehr.		-	-	-	-	12	24	2	5.55	-	-	-	-	-	-	8	3.88
Genus	*Asterionella* hass.																
16. *Asterionella Formosa* Hass.		-	-	-	-	-	-	4	11.11	-	-	-	-	-	-	-	-

Taxonomic Status		Locations															
		PVNKSSIP Site		PVNKSSIP Site		PVNKSSIP Site		PVNKSSIP Downstream		PVNKSSIP		PVNKSSIP Left Bank		PVNKSSIP Right Bank-Downstream		PVNKSSIP Right bank-Upstream	
		13.08.2017		13.08.2017		13.08.2017		07.10.2017		08.10.2017				18.12.2017		18.12.2017	
		Nos.1 - %		Nos.1 - %		Nos.1 - %		Nos.1 - %		Nos.1 - %		Nos.1 - %		Nos.1 - %		Nos.1 - %	
Genus	*Opephora* Petit																
17. *Opephora martyi* Herib		-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	0.97
Suborder	Biraphidineae																
Family	NAVICULACEAE																
Subfamily	Naviculoideae																
Genus	*Navicula* Bery																
18. *Navicula radiosa* Kutz.		-	-	-	-	-	-	4	22.44	-	-	-	-	-	-	-	-
Family	EPITHEMIACEAE																
Subfamily	Epithemioideae																
Genus	*Denticula* Kutz.																
19. *Denticula thermalis* Kutz.		-	-	-	-	6	12	-	-	-	-	-	-	-	-	-	-
ZOOPLANKTON																	
		258	92.14	72	18.84	22	44	6	16.67	14	5.15	43	49.43	4	1.28	39	18.93
Order	TESTACOELODOSA																
Suborder	Amastigogenina																
Family	ARCELLIDAE																
Genus	*Arcella* Ehernberg																
20. *Arcella mitrata* Leidy		-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	3.88
Class	Monogononta																
Order	Ploima																

Taxonomic Status		Locations															
		PVNKSSIP Site		PVNKSSIP Site		PVNKSSIP Site		PVNKSSIP Downstream		PVNKSSIP		PVNKSSIP Left Bank		PVNKSSIP Right Bank-Downstream		PVNKSSIP Right bank-Upstream	
		13.08.2017		13.08.2017		13.08.2017		07.10.2017		08.10.2017				18.12.2017		18.12.2017	
		Nos.1 - %		Nos.1 - %		Nos.1 - %		Nos.1 - %		Nos.1 - %		Nos.1 - %		Nos.1 - %		Nos.1 - %	
Family	BRACHIONIDAE																
Subfamily	Brachioninae																
Genus	*Brachionus* Palla																
21. *Brachionus Calciforus* Pallas		200	71	38	9.95	2	4	-	-	6	2.21	2	2.2	-	-	14	6.8
Genus	*Keratella* Bery de St. Vincent																
22. *Keratella cochlearis*		4	14.28	3	0.78	-	-	-	-	-	-	-	-	-	-	-	-
23. *Keratella quadrata*		-	-	3	0.78	-	-	-	-	-	-	-	-	-	-	-	-
Order	Plosculariaceae																
Family	TESTUDINELLIDAE																
Genus	*Filinia* Bery de St.Vincent																
24. *Filinia longiseta* Ehrenberg		-	-	-	-	-	-	-	-	-	-	-	-	-	-	7	3.4
Subclass	Branchipoda																
superorder	Diplostraca Gerstaeker																
Order	Cladocera Calman																
Suborder	Eucladocera Eriksson																
Super Family	Bidoidea																
Family	HOLOPEDIDAE Sars																
Genus	*Diaphnosoma* Fischer																
25. *Diaphnosoma brachyurum* (Lieven)		-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	0.97
Suborder	Haplopoda Saras																

Taxonomic Status		Locations															
		PVNKSSIP Site		PVNKSSIP Site		PVNKSSIP Site		PVNKSSIP Downstream		PVNKSSIP		PVNKSSIP Left Bank		PVNKSSIP Right Bank-Downstream		PVNKSSIP Right bank-Upstream	
		13.08.2017		13.08.2017		13.08.2017		07.10.2017		08.10.2017				18.12.2017		18.12.2017	
		Nos.1 - %		Nos.1 - %		Nos.1 - %		Nos.1 - %		Nos.1 - %		Nos.1 - %		Nos.1 - %		Nos.1 - %	
Super Family	Chydoroidea																
Family	DAPHNIDAE																
Genus	*Daphnia* Sensu stricto																
26. *Daphnia magna* Straus		-	-	-	-	4	8	2	5.55	4	1.47	-	-	2	0.66	2	0.97
Order	Ostracoda																
Suborder	Podocepa																
Family	CYPRIDAE																
Subfamily	Cyprinae																
Genus	*Priocypris* Brady & Norman																
27. *Cypris subglobosa* Sowerby		2	0.71	16	4.19	4	8	2	5.55	4	1.47	4	4.6	-	-	-	-
Order	Copepoda																
Family	DIAPTOMIDAE																
Genus	*Diaptomus* Westwood																
28. cycleps		106	37.05	4	1.05	12	24	2	5.55	-	-	-	-	-	-	-	-
29. nauplius		144	51.42	8	2.09	-	-	-	-	-	-	37	42.53	2	0.66	2	0.97
MISCELLANEOUS																	
30. Insect appendages		-	-	-	-	4	8	7	19.44	14	5.14	-	-	12	3.85	-	-
31. Nematodes		-	-	-	-	-	-	-	-	4	1.44	-	-	-	-	-	-
32. Vegetative Parts		-	-	-	-	-	-	2	5.56	-	-	-	-	-	-	-	-

Table 3: Systematic List of the Littoral (Dry-river-bed) organisms collected from the Godavari River.

MOLLUSCS	
Phylum	Mollusca
Class	Gastropoda
Subclass	Prosobranchia
Order	Mesogastropoda
Family	VIVIPARIDAE
Super Family	Bellamyinae
Genus	*Bellamya* Jousseaume 1866
1. *Bellamya bengalensis* (Lamarck, 1883)	
2. *Bellamya crass* (Benson, 1836)	
3. *Bellamya dissimilis* (Mueller, 1774)	
Family	PILLIDAE
Genus	*Pila* (Botten) Roading, 1798
4. *Pila globosa* (Swainson, 1822)	
Family	BITHYNIDAE
Sub-family	Bithyniinae
Genus	*Gabbia* Tryen, 1865
5. *Gabbia stenothyroides* (Dohrn, 1857)	
Genus	*Digoniestoma* Annandale, 1920
6. *Digoniestoma pulchella* (Benson, 1836)	
Family	THIARDAE
Sub-family	Thiaroinae
Genus	*Thiara* Roeding, 1786
7. *Thiara* (Thiara) *scabra* (Muller, 1774)	
Sub-genus	*Melanoides* Olivier, 1807
8. *Thiara (Melanoides) tuberculata* (Muller, 1774)	
Sub-class	Pulmonata
Order	Bassomatophora
Family	LYMNAEIDAE
Genus	*Lymnaea* Lamarck, 1779
Sub-genus	Pseudosuccinea
9. *Lymnaea acuminata* Lamarck, 18822	
10. *Lymnaea luteola* Lamarck, 1822	
Family	PLANORBIDAE
Sub-family	Bulininae
Genus	*Indoplanorbis* Annandale &Prashad, 1921
11. *Indoplanorbis exustus,* (Deshayes, 1834)	

Sub-family	Planorbine
Genus	*Gyraulus* Charpentier, 1837
12. G*yraulus convexiusculus* (Hutton, 1849)	
Class	Bivalvia
Order	Unionida
Super-family	Unionaceae Fleming, 1828
Family	UNIONIDAE Fleming, 1828
Sub-family	Unioninae S.str.
Genus	*Lamellidens* Simpson, 1900
13. *Lamellidens corianus* (Lea, 1834)	
14. *Lamellidens marginalis* (Lamarck, 1819)	
Family	AMBLEMIDAE
Sub-family	Perreysiinae
Genus	*Parreysia* Conrad, 1853
15. *Parreysia (Parreysia) corrugata* (Mueller, 1774)	
16. *Parreysia (Parreysia) corrugata*-Sub-species. *P. Nagpoorensis* (Lea, 1860)	
Order	Veneroida
Family	CORBUCULIDAE
Genus	*Corbicula* Megerle von Muehlfeld, 1811
17. *Corbicula striatella* Deshayes, 1854	

Table 4: Systematic list of the fish species recorded from the Godavari River

(Project site & its Vicinity)

Ichthyological order	Scientific name	Vernacular name	Size attains (mm)	Size observed (mm)	IUCN Red-list 2017
Super-class	Gnathostomata				
Class	Actinopterygii				
Sub-class	Neopterygii				
Division	Teleostei				
Sub-division	Osteoglossomorpha				
Order	Osteoglossiformes				
Sub-order	Notopteroidei				
Family	NOTOPTERIDAE				
Genus	*Notoperus Lacepede 1800*				
	1. *Notopterus notopterus* (Pallas, 1769)	Mangali katti	210	153-177	LC
Order	Anguilliformes				
Sub-order	Anguilloidei				
Family	ANGUILLIDAE				
Genus	Anguilla Schrank, 1798				
	2. Anguilla bengalensis (Gray, 1831)	Malugu	2000		NT
	3. *Anguilla bicolour* McClelland, 1844	Malugu	1200	397	NT
Sub-division	Clupeomorpha				
Order	Clupeiformes				
Family	CLUPEIDAE				
Sub-family	Alosinae				
Genus	*Hilsa* Regan,1917				
	4. *Hilsa* (Tenualosa) ilisha (Hamilton)	Polasa			LC
	5. *Hilsa* (Hilsa) *kelee* (Cuvier)	Polasa			LC
Sub-division	Euteleostei				
Super-order	Ostariophysi				
Order	Cypriniformes				
Family	CYPRINIDAE				
Sub-family	Leuciscinae (Hypothalmichthyinae)				
Tribe	Chondrost-omini				
Genus	*Hypophthalmichthys Bleeker*, 1859				

Ichthyological order	Scientific name	Vernacular name	Size attains (mm)	Size observed (mm)	IUCN Red-list 2017
	6. *Hypothalichthys molitrix* Valenciennes, 1842	Vendi-chapa			LC
Sub-family	Danioninae (Rasborinae)				
Tribe	Oxygasterini				
Genus	*Salmophasis* Swainson, 1839				
	7. *Salmophasia acinaces* (Valenciennes, 1844)	Chela	150	125	LC
	8. *Salmophasia balookee* (Sykes, 1839)	Chela	150	115	LC
	9. *Salmophasia novacula* (Valenciennes, 1840) Chela	Chela	125	57	LC
Genus	*Aspidoparia* (Heckel, 1847)				
	10. Aspidoparia morar (Heckel, 1847)		50	37	LC
Genus	*Barilius* Hamilton, 1822				
	11. *Barilius barila* (Hamilton, 1822) Kodipe	Kodipe	100	25-61	LC
	12. *Barilius bendelisis* (Hamilton, 2007)		227	67-73	LC
Tribe	Danionini				
Genus	*Chela* Hamilton, 1822				
	13. *Chela cachius* (Hamilton, 1812)	Getchu			VU
	14. *Chela (Chela) laubuca* (Bleeker, 1959)	Getchu	60		VU
Genus	Esomus Swainson, 1839				
	15. *Esomus danrica* (Hamilton, 1822)	Asta-pakke		51	LC
Genus	*Devarion* Hamilton, 1822				
	16. *Devario aequipinnatus* (McClelland, 1839)	Nooltu	150	63-97	LC
	17. *Danio devario* (Hamilton, 1822)	Nootlu	100	67	LC
Genus	*Dania weber & Beaufort,* 1916				
	18. *Dania rerio* (Hamilton, 1822)	Chintaku-parega	60	39-41	LC
Genus	*Rasbora* Hamilton, 1859				
	19. *Rasbora* daniconius (Hamilton, 1822)	Katte-dodipe	150	67-83	LC
Genus	*Amblypharyngodon* Bleeker, 1859-60				
	20. *Amblypharyngodon mola* (Hamilton,	Kodipe	75	63	LC

Ichthyological order	Scientific name	Vernacular name	Size attains (mm)	Size observed (mm)	IUCN Red-list 2017
	1822)				
Sub-family	Cyprininae				
Tribe	Cyprinini				
Sub-tribe	Cyprini				
Genus	*Ctenopharyngodon* Steindachner, 1866				
	21. *Ctenopharyngodon idella* (valenciennes, 1844)	Gaddi-chepa		437-511	NE
Genus	*Cyprinus* Linnaeus, 1758				
	22. Cyprinus carpio Linnaeus, 1758	Bangaru-teega	1200	371	NE
Genus	*Thynnichthys* Bleeker				
	23. *Thynnichthys sandkhol* (Sykes, 1859)		460		VU
Sub-tribe	Tores				
Genus	*Tor* Gray 1834				
	24. *Tor Khudree* (Sykes, 1839)	Aku-chepa	460		EN
Genius	*Neolissochilus* Rainboth, 1985				
	25. *Neolissochilus hexagonolepis* (McClelland, 1839)				NT
Tribe	Systomini				
Sub-tribe	*Osteobramae*				
Genus	*Osteobrama* Heckel, 1843				
	26. *Osteobrama cunma* (Day, 1888)	Kagitum-paraka	150		LC
	27. *Osteobrama peninsularis* (Silas, 1952)	Khira			DD
	28. *Osteobrama vigorsii* (Sykes, 1839)	Khira			LC
Genus	*Rohtee* Sykes, 1839				
	29. *Rohtee ogilbii* Sykes, 1839	Aku-chepa			LC
Sub-tribe	Systomi				
	Puntius Hamilton, 1822				
	30. *Puntius amphibious* (Valenciennes, 1842)	Parka-chapa	150	54	DD
	31. *Puntius chola* (Hamilton, 1822)	Pakki	125	53-66	DD
	32. *Puntius sophore* (Hamilton, 1822)	Budda-pakke	125	87	LC
Genus	*Pethia* (Hamilton, 1822)				
	33. *Pethia ticto* (Hamilton, 1822)	Budda-parke	100	43-57	LC

Ichthyological order	Scientific name	Vernacular name	Size attains (mm)	Size observed (mm)	IUCN Red-list 2017
Genus	*Systomus* Hamilton				
	34. *Systomus sarana* (Hamilton, 1822)	Gende-paraka	375	183	LC
Genus	*Hypselobarbus* Bleeker, 1859				
	35. *Hypselobarbus kolus* (Sykes, 1839) Nilusu	Nilusu	341	259-273	LC
	36. *Hypselobarbus pulchellus* (Day, 1870)	Parka	741	259-273	LC
Tribe	Semiplotini				
Genus	*Osteochilichthys* Hora, 1942				
	37. *Osteochilichthys godavariensis*				DD
Tribe	Labeonini				
Sub-tribe	Labeones				
Genus	*Cirrhinus* (Oken, 1817)				
	38. *Cirrhinus cirrhosus*	Aruza			LC
	39. *Cirrhinus macrops* Steindachner,				LC
	40. *Cirrhinus mrigala* (Hamilton, 1822)	Yerra mosu	990		LC
	41. *Cirrhinus reba* (Hamilton, 1822)	Chittrai	220	211	LC
Genus	Gibelion Valenciennes, 1844				
	42. *Gibelion catla* (Hamilton, 1822)	Botcha	1820		LC
Genus	*Labeo* Cuvier, 1816				LC
	43. *Labeo bata* (Hamilton, 1822)	Mosu			LC
	44. *Labeo boga* (Hamilton, 1822)	Mosu			LC
	45. *Labeo boggut* (Sykes, 1839)	Nusi-gadu			LC
	46. *Labeo calbasu* (Hamilton 1822)	Kaki-paraka			LC
	47. *Labeo dero* (Hamilton, 1822)				LC
	48. *Labeo dyocheilus* (McClelland, 1822)	Paraka			LC
	49. *Labeo fimbriatus* (Bloch, 1795)				LC
	50. *Labeo gonius* (Hamilton 1795)	Paraka			LC
	51. *Labeo pabgusia* (Hamilton, 1822)	Done chepa			NT
	52. *Labeo porcellus* (Heckel, 1844)	Moyya			LC
	53. *Labeo potail* (Sykes, 1839)	Baman-chapa			EN
	54. *Labeo rohita* (Hamilton, 1822)	Seelavathi			LC
Genus	*Schismatorhynchus* Bleeker, 1855				
	55. *Schismatorhnychus nukta Skyes,*	Mukkidi-chepa			LC

Ichthyological order	Scientific name	Vernacular name	Size attains (mm)	Size observed (mm)	IUCN Red-list 2017
	1855				
Sub-family	Garrinae				
Genus	*Garra* Hamilton, 1822				
	56. *Garra stenorhynchus* (Jerdon, 1849)	Banda pakiri			LC
	57. *Garra mullya* (Sykes, 1839)	Banda pakiri			LC
Family	BALITORIDAE				
Sub-family	Nemacheilinae				
Genus	*Oreonectus* Gunther, 1868				
	58. *Oreonectes (Oreonectes) evazardi (Day)*				LC
Order	Siluriformes				
Family	BAGRIDAE				
Sub-family	Ritinae				
Genus	Rita bleaker, 1853				
	59. *Rita bakaluae*	Bondu			
	60. *Rita pavimentata* (valenciennes,)	Bondu	260	237	LC
Sub-family	Bagrinae				
Genus	Mystus Scopoli, 1777				
	61. *Mystus cavasius* (Hamilton, 1822)	Muti-jella	450	113-119	LC
	62. Mystus vittatus (Bloch, 1794)	Erra-jella			LC
Genus	*Hemibagrus* Scopoli, 1777				
	63. *Hemibagrus maydelli* (Rossel, 1964)	Ponduga			LC
Genus	Sperata Wu, 1939				
	64. *sperata aor* (Hamilton, 1822)	Mukul- jella	1500	559-603	LC
	65. *Sperata Seenghala* (Sykes, 1839)	Mukul- jella	1800	521	LC
Family	SILURIDAE				
Genus	Ompok lacepede, 180.				
	66. *Ompak bimaculatus* (Bloch, 1794)	Bugga-dumma	450	235	NT
Genus	Wallago Bleeeker, 1851				
	67. *Wallago attu* (Bloch & Schneider, 1801)	Valuga	2400	349	NT
Family	SCHEILBEIDAE				
Sub-Family	Scheilbeinae				

Ichthyological order	Scientific name	Vernacular name	Size attains (mm)	Size observed (mm)	IUCN Red-list 2017
Genus	Proeutropiichthys Hora, 1937				
	68. *Proeutropiichthyus taakre* (Sykes,1839)	Siriari-jella	420	130-385	LC
Genus	Pachypterus Kulkarni, 1952				
	69. *Pachypterus khavalchor* (kulkarni, 1952)	Kocha-muthi-jella	150	101-103	DD
Genus	Silonia swainson, 1839				
	70.*Silonia childreni* (Sykes, 1839)	wan-jow	680	233-379	EN
Family	SISORIDAE				
Genus	Bagarius bleeker, 1853				
	71. *Bagarius yarrelli* (sykes, 1875)	Guddi chapa	1800		EN
Genus	Glyptothorax Blyth, 1860				
	72. *Glyptothorax lonah* (Sykes, 1839)				EN
Family	CLARIDAE				
Genus	Clarias Scopoli, 1777				
	73. *Clarias batrachus* Linnaeus	Marpu	450		LC
	74. *Clarias gariepinus* (Burchell, 1822)	African marpu	1770	567	LC
Family	HETEROPNEUSTEDAE				
Genus	Heteropneustes Muller, 1840				
	75. *Heteropneustes fossilis* (Bloch,)	Ingilayee	170	93	EN
Family	ARIDAE				
Genus	Arius Valenciennes, 1840				
	76. *Arius caelatus* Valenciennes				LC
Series	Atherinomorpha				
Order	Beloniformes				
Sub-order	Belonoidei				
Family	Belonidae				
Genus	Xenontodon Regan, 1911				
	77. *Xenontodon cancila* (Hamilton, 1822)	Vodla mukka	150	53	LC
Family	HEMIRAMPHIDAE				
Genus	Hypormaphus gill, 1859				
	78. *Hyporhamphus limbatus* (Valenciennes, 1846)	Konga mukku		153-157	LC

Ichthyological order	Scientific name	Vernacular name	Size attains (mm)	Size observed (mm)	IUCN Red-list 2017
Order	Cyprinodontiformes				
Family	APLOCHEILIDAE				
Sub-family	Aplocheilinae				
Genus	Aplocheilus McClelland, 1839				
	79. *Aplocheilus lineatus* (Valenciennes, 1846)	Minnow Chapa	104	93	LC
Family	POECILIDAE				
Sub-family	Poecilinae				
Genus	Gambusia poey, 1854				
	80. *Gambusia affinis* (baird & Girard, 1853)	Gambusia	51-71	31-47	LC
Genus	Poecilia Bloch & Schneider, 1801				
	81. *Poecilia reticulata* Peters, 1859	Guppi	30-60	23-47	NE
Order	Synbranchiformes				
Sub-order	Mastacembeloidei				
Family	MASTACEMBELIDAE				
Sub-family	Mastacembelinae				
Genus	Mastacembelus Scopoli, 1800				
	82.*Mastacembelus armatus* (Lacepede, 1800)	Konte-mukku	900	567	LC
Order	Perciformes				
Sub-order	Percoidei				
Genus	Chanda Hamilton, 1822				
	83. *Chanda nama* Hamilton, 1822	Akurati	100	62	LC
Genus	Parambassis Bleeker, 1874				
	84. *Parambassis ranga* (Hamilton, 1822)	Sarawa	80	57-61	LC
Sub-order	Labroidei				
Family	CICHLIDAE				
Genus	Etroplus Cuvier, 1830				
	85. *Etroplus suratensis* (Bloch, 1790)	Duvenna- chapa	400		LC
Genus	Oreochromis Gunther, 1889				
	86. *Oreochromis mossambica* (peters, 1852)	Doobotcha	390	243-261	NT

Ichthyological order	Scientific name	Vernacular name	Size attains (mm)	Size observed (mm)	IUCN Red-list 2017
Family	GOBIIDAE				
Sub-family	Gobiinae				
Genus	Parachaeturi Chthys Bleeker, 1874				
	87. *Parachaeturichthys polynema* (Bleeker, 1874)				LC
Genus	Oxyurichthys (Bleeker, 1857)				
	88. *Oxyurichthys microlepis* (Bleeker,)				LC
	89. *Oxyurichthys formosanus* Nichols,				LC
	90. *Oxyurichthys Tentaculosis* (Valenciennes,)				LC
Genus	Chiramenu Rae, 1971				
	91. *Chiramenu fluviatalis* Rao				LC
Genus	Silhouetta smith, 1959				
	92. *Silhouetta indicus* Rao, V.V.				LC
Genus	Gobiopsis Steindachner, 1860				
	93. *Gobiopsis macrostomus* steindachner,				LC
Genus	Clossogobius Gill, 1859				
	94. *Glossogobius biocellatus* Valenciennes,				LC
	95. *Glossogobius giuris* (Hamilton, 1822)	Isika-dondu	230	179-189	LC
Genus	Bathygobius Bleeker, 1878				
	96. *Bathygobius fuscus* (Ruppell,)				LC
	97. *Bathygobius osteicola* (Chaudhuri,)				LC
Sub- family	Gobionellinae				
Genus	Stigmatogobius Bleeker, 1874				
	98. *Stigmatogobius Minima* (Hora,)				LC
	99. *Stigmatogobius sadanundio* (Hamilton, 1822)		90		NE
Sub-order	Anabantoidei				
Family	Anabantidae				
Genus	*Anabas* Cuvier, 1816				
	100. *Anabas oligolepis* Bleeker,	Goraka chapa			DD

Ichthyological order	Scientific name	Vernacular name	Size attains (mm)	Size observed (mm)	IUCN Red-list 2017
	101. *Anabas testudineus* (Bloch, 1792)	Goraka chapa	250		DD
Sub-order	Channoidei				
Family	CHANNIDAE				
Genus	*Channa* Scopoli				
	102. *Channa marulius* (Hamilton, 1822)	Poo-meenu	1883	567	LC
	103. *Channa orientalis* (Bloch,Scheneider, 1801)	Guruja	330		NE
	104. *Channa punctatus* (Bloch, 1793)	Burudamatta			LC
	105. *Channa striatus* (Bloch, 1793)	Korra-meenu			LC

NOTE:

- CR = CRITICALLY ENDANGERED: Taxon is critically Endangered when it is facing an extremely high risk of Extinction in the wild in the near future.
- EN = ENDANGERED: A Taxon is Endangered when it is not Critically Endangered when it is not Critically Endangered or Endangered, but is facing a very high risk of Extinction in the Near Future.
- VU = VULNERABLE: A Taxon is Vulnerable when it is Not Critically Endangered, but, is facing high risk of Extinction in the wild in the Medium-term Future.
- LR = LOWER RISK: A Taxon is in low risk when it has been Evaluated and does not qualify for any of the Threatened Categories.

Plate - 1

Gibelion catla (Hamilton)

Cirrhinus mrigala (Hamilton)

Labeo rohita (Hamilton)

Systomus sarana (Hamilton)

Plate - 2

Labeo bata (Hamilton)

Labeo calbasu
(Hamilton)

Labeo fimbriatus (Bloch)

Labeo rohita (Hamilton)

Plate - 3

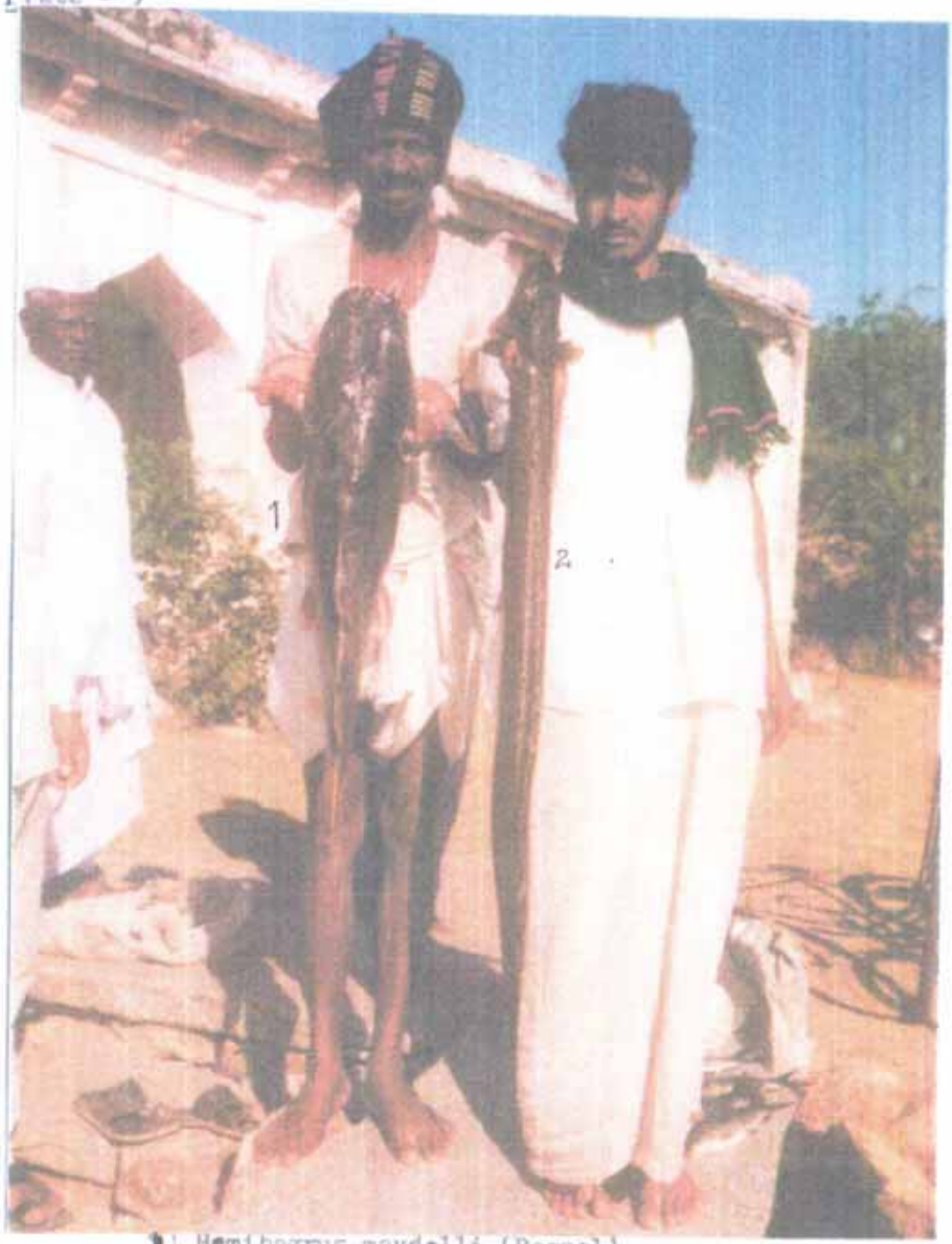
Hypseloborbus pulchellus (Day)

Hypselobarbus kolus (Sykes)

Cirrhinus reba (Hamilton)

Cybrinus carpio linnaeus

Hemibagrus maydelli (Rossel)



1) Hemibagrus maydelli (Rossel)

2) Anguilla bengalensis (Gray)

Plate - 4

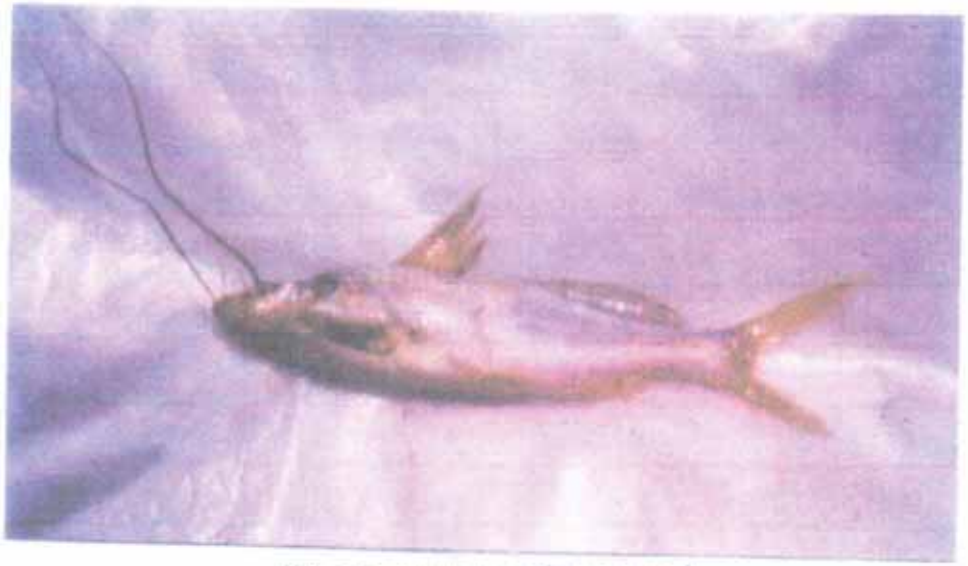
Plate - 5

Channa marulius (Hamilton)

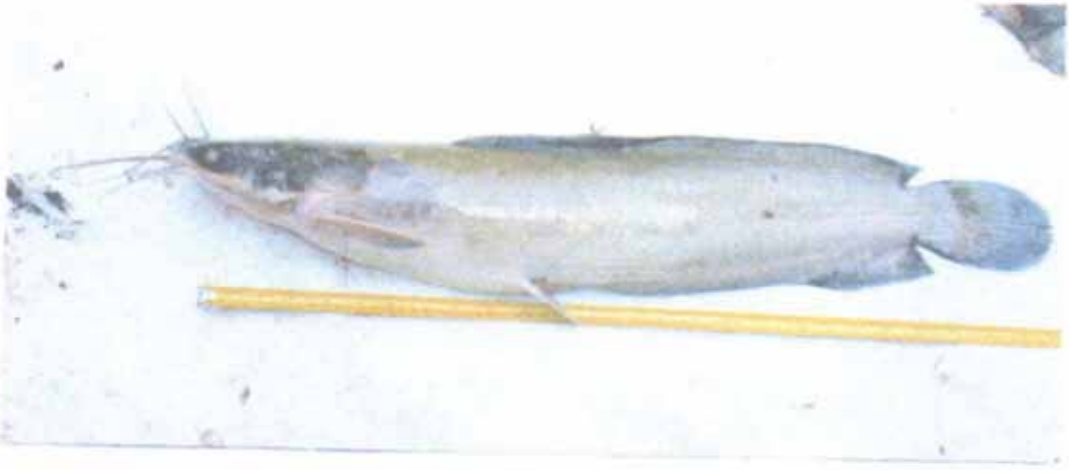
Channa striatus (Bloch)

Ompok bimaculatus (Bloch)

Plate - 6



Mystus cavasius (Hamilton)



Clarias batrachus Linnaeus

Glossogobius giuris (Hamilton)

Plate - 7

Gambusia affinis (Baird & Girard)

Poecilia reticulata (Peters)

Poecilia (Lebistes) reticulatus

Mastacembelus armatus (Lacepede)

Chanda nama (Hamilton)

Parambassis ranga (Hamilton)

Table - 8

i) Notopterus notopterus ii) Macrobrachium malcolmsoni

Macrobrachium malcolmsoni

ANNEXURE-20

ANNEXURE -20

QUESTIONNAIRE

Name of the respondent	
Address and phone number	
Name of the village / Taluk/District	
Which part of the construction work proposed in this land	1. Head works / 2. submergence area 3.dumping yard
Type of land	1. Agricultural land/2. residential property/ 3. Barren land /4. Government land / 5. land of institution

1. Personnel details of respondent:

2. Household Information:

Sl. No.	Name of the person	Age	M/F	Relation with HoF	Education	Occupation	Yearly Income
1							
2							
3							
4							
5							
6							
7							

3. Whether any of the family members is physically handicapped?
   Yes ☐ No. ☐

4. Religion…… 4(A) Caste: ……
   4(B).which caste category- SC /ST/ OBC/ Upper caste (tick mark)

5. Are you aware of the PVNRKSSP Lift Irrigation Scheme?
   Yes ☐ No. ☐
6. Is there any need of irrigation facilities to this region?

   Yes ☐ No. ☐

If Yes, Why?

If No, Why?

7. Land details

A.What is the total extent of land owned by you in this area?	
B. Extent of land acquired?	
C.In there any building in this acquired land	Yes/No
D. If yes, type of the building (take a photo and attach)	
E.Is there any other structures in the land ?	Yes/ No
F. if yes what?(list)	

8. Are you willing to give your land for construction of main canal?

   Yes ☐ No. ☐

   If Yes, What is the type of compensation expected?

If No, why?

9. Will this project impact your livelihood ? yes / No

9(A).If Yes, in what way?

9(.B) Do you have any alternate choice of livelihood?

9 (C) To compensate the impact of the project (if any) in your livelihood what are your choices/ suggestions?

10. List out the schools/colleges / Hospitals/ temples and other common institutions in the area?

11. Additional information (if any) and Remarks

Name and signature of surveyor	Date of survey

ANNEXURE-21

PROCEEDINGS OF THE ENVIRONMENTAL PUBLIC HEARING FOR THE PROPOSAL TO STABALISE THE EXISTING COMMAND AREAS OF J. CHOKKARAO DEVADULA LIFT IRRIGATION SCHEME (2,51,310 HA) AND SRIRAM SAGAR PROJECT STAGE – I AND II (3,04,000 HA) AND PROVDING DRINKING WATER SUPPLY TO THE ENROUTE VILLAGES BY P.V. NARASIMHARAO KANTHANAPALLY SUJALA SRAVANTHI PROJECT IN JAYASHANKAR BHUPALPALLY DISTRICT CONDUCTED ON 27.09.2018 AT 10.30 AM IN THE PREMISES OF ZILLA PARISHAD HIGH SCHOOL, ETURNAGARAM MANDAL, JAYASHANKAR BHUPALPALLY DISTRICT.

The following panel members present:

Sl.No	Name of the Panel Member	Designation
1.	Sri Dr. V. Venkateswarlu, IAS Collector and Magistrate Jayashankar Bhupalpally District	Chairman of the Public Hearing
2.	Sri G. Hanumantha Reddy, Environmental Engineer Telangana State Pollution Control Board, Regional Office, Warangal.	Member of the Public Hearing

The following representatives of the project authority were present:

Sl.No	Name & Designation
1.	Sri B. Nagendra Rao, Engineer-in-Chief and Chief Engineer (A/c), Kanthanpally Project, Irrigation & CAD Department, K.C Colony, Chintagattu, Warangal.
2.	Sri A. Venkateshwar Rao, Superintending Engineer, Irrigation & CAD Department, SRSP Stage-II Circle, K.C Colony, Chintagattu, Warangal.
3.	Sri V. Jagadeesh, Executive Engineer, Kanthanapally Project Division, Irrigation & CAD Department, Akkulavari Ghanpuram Village, Eturnagaram Mandal, Jayashankar Bhupalpally District.

Environmental Engineer, TSPCB, Regional Office, Warangal: At the outset, the Environmental Engineer, TSPCB, RO, Warangal, while welcoming the District Collector of Jayashankar Bhupalpally District, public representatives, farmers and public, explained about the EIA Notification, vide Notification No. S.O. 1533 dt: 14.09.2006 issued by the Ministry of Environment, Forests and Climate Change, Government of India. The Environmental Public Hearing is made mandatory for certain category of projects to obtain prior Environmental Clearance. He stated that, P.V. Narasimharao Kanthanapally Sujala Sravanthi Project is proposed for stabilization of existing command areas of J. Chokkarao Devadula Lift Irrigation Scheme and Sriram Sagar Project Stage-I and II and also providing Drinking Water Supply to the enroute villages by proposing the Project in Jayashankar Bhupalpally District which is categorised as Irrigation Project as per EIA Notification, 2006.

The P.V. Narasimharao Kanthanapally Sujala Sravanthi Project obtained ToR (Terms of Reference) from the Ministry of Environment, Forests and Climate Change, Government

of India, New Delhi vide order dt: 03.04.2017 and submitted the Draft EIA Report to the Pollution Control Board and requested to conduct Public Hearing.

Accordingly, a press notification was published in Telugu and English Daily News Papers on 27.08.2018 i.e., Andhra Jyothi Daily News Paper and The Hindu English Daily News Papers.

The said Notification has invited from the public and others for their suggestions, concerns, comments and objections, if any on the proposed project. He added that, the copies of Draft Environmental Impact Assessment / Environmental Management Plan (EIA/EMP) and the Executive Summary in Telugu and English were made available to the people as mentioned in the press notification.

He further informed that, the hearing is intended only to record the views, opinions, objections and suggestions of the participants and same will be conducted in transparent manner and the proceedings will be video recorded. The minutes of the hearing along with the representations will be forwarded to the Ministry of Environment, Forests and Climate Change, Government of India, New Delhi for further course of action. He informed that, no representations were received by the TSPCB, Regional Office, Warangal.

He then requested the Hon'ble District Collector, Jayashankar Bhupalpally District to Chair the meeting to conduct the Public Hearing.

The Collector and District Magistrate, Jayashankar Bhupalpally District: Instructed the project authorities, Irrigation & CAD Dept., and Environmental Consultants (M/s Environmental Health and Safety Consultants Pvt. Ltd, Bangalore) to explain the environmental aspects of the proposed P.V. Narasimharao Kanthanapally Sujala Sravanthi Project so that people would be able to offer their views on the proposed project.

Ms. Navya, representative of M/s Environmental Health and Safety Consultants Pvt. Ltd, Bangalore has explained the environmental impacts and on their study and the details are as follows;

- The P.V. Narasimharao Kanthanapally Sujala Sravanthi Project involves construction of 1,132 m long barrage near Thupakulagudem village across River Godavari located 3 Km downstream of existing lift point of J. Chokka Rao Devadula Lift Irrigation Scheme (JCRDLIS).
- The proposed project stabilizes and provides irrigation facilities to existing 5,55,310 ha of existing command area belonging to J. Chokka Rao Devadula LIS (2,51,310 ha) and Sri Ram Sagar Project (SRSP) - Stage I & II (3,04,000 ha).
- 50 TMC of water will be utilized for stabilizing the existing command area and for drinking water purpose for enroute villages.

- The command area is already benefitted by the existing irrigation facilities for the Kharif and bi-seasonal crops and the proposed scheme stabilises existing irrigation facilities in Rabi season.
- The construction of proposed barrage across Godavari River does not involve any diversion of forest land.
- The proposed project involves submergence of 658.96 ha of river bed area at an FRL of 77 m and do not involve any submergence of villages.
- The proposed project requires 94.27 ha of private land for implementation.
- She informed that, the EIA studies had been conducted by the organization.
- The study was carried out as per the provisions of the EIA Notification, 2006 and its amendments and they have covered three seasons i.e. July, 2017 to March, 2018.
- They conducted environmental baseline study on air, water, noise, soil, land use, ecology and biodiversity, socio-economics, hydrology, geology, impact assessment study and environmental management study in the existing command area and 10 Km radius around proposed barrage. The ambient air quality monitoring had been conducted for the parameters PM_{10}, $PM_{2.5}$, SO_2 and NO_2. Also, conducted water quality sampling and analysis in the project area.
- The environmental baseline data for ambient air quality was observed to be within the NAAQ standards-2009 and ambient noise levels in the project area were observed to be within the CPCB standards.
- Ground Water Quality analysis conforms to IS 10500: 2012 Drinking Water Quality Standards.
- Environmental Impact Assessment was carried out using Global Environmental Flow Calculator model, Noise model, Universal Soil Loss Equation, Air Quality model and quantified the impacts by using Leopold Matrix Method for construction and operation phase of the project.
- In construction phase, water sprinkling measures will be proposed for dust control, reuse of muck through muck disposal plan, solid waste management and sewage treatment at the labour camps through Septic tank and Soak pits.
- DG sets will be provided with acoustic enclosures and silencers to vehicles to avoid noise nuisance.
- In Environmental Management Plan, Muck Disposal Plan, Sanitation and Solid Waste Management Plan, Catchment Area Treatment Plan, Biodiversity Management Plan, Fisheries Conservation and Management Plan, Green Belt Development Plan, Environmental Monitoring Programme, Public Health Delivery Plan, during construction and operation phase, etc will be implemented.

The Collector and District Magistrate, Jayashankar Bhupalpally District: has requested the public representatives, farmers and public to express their views:

1. **Sri B. Mallaiah, Superintending Engineer (Retd.), Hanumakonda** has expressed the following;

- He welcomed the project and suggested to increase the water sprinkling frequency to reduce fugitive dust emissions.
- While construction of embankment, water sprinkling shall be carried out to reduce the dust emissions.
- Speed Limit restrictions to be maintained in the construction area and over taking of vehicle should be avoided in the interest of villagers safety and traffic management.
- He suggested implementing the CAT Plan, CAD Plan, Plantation, Sanitation arrangements for the labourers.
- He suggested that this project is very much necessary as SRSP project storage capacity has been reducing and hence couldn't supply the water to the complete ayacut as planned earlier. Hence, by implementing this project, judicious use of water allocated for the state shall be ensured in the command area.

2. **Sri Ponnala Ramaiah, Chief Engineer (Retd.), Warangal** has expressed the following;

- He welcomed the project in view of non-submergence of villages and no forest land involved in the project.
- All the mitigation measures and environmental management plan stated in the EIA/EMP report shall be implemented in right spirit.

3. **Sri K. Prakashchary, Executive Engineer (Retd.) and Researcher on Irrigation, Warangal** has expressed the following;

- He welcomed the project in view of good project design which does not involve any submergence of villages, no rehabilitation and resettlement and no forest land requirement for the project.
- He also stated that due to the gated arrangements for the barrage, there are no chances of siltation.
- He stated that, SRSP project storage capacity has reduced due to siltation and hence this project is technically feasible to cater the existing command area irrigation needs.
- The Godavari basin has variation in rainfall pattern and hence this project is necessary and beneficial to cater the irrigation and drinking water needs.

4. **Sri B. Yalla Reddy, Chief Engineer (Retd.), Hanumakonda** has expressed the following;

- He welcomed the project in view of no forest land involved in the project.
- All the mitigation measures and environmental management plan stated in the EIA/EMP report shall be implemented in right spirit.

5. **Sri Dhavaleshwara Rao, Executive Engineer (Retd.), Warangal** has expressed the following;

- He welcomed the project and he suggested looking into the issues of Fish Migration, increase in Carbon dioxide, sedimentation and soil erosion.
- He suggested mitigation of water logging issues in the upstream area.
- He stated that this project is harmless to environment and with the implementation of this project, flora and fauna will be benefited by large due to water availability.

6. **Sri G. Dhamodar Reddy, Superintending Engineer (Retd.), Warangal** has expressed the following;

- He welcomed the project and he stated that this project does not pose any impacts and further it enhances the positive benefits to the region in terms of water availability.

7. **Sri Nagaraju, Thupakulagudem (V)** has expressed the following;

- Other villages might have benefitted from the project but not their village. Earlier officers promised us with jobs and double bed room houses but nothing happened till now.
- He stated that some of them had received compensation whereas few people had not received any compensation and requested to settle the compensation issues at the earliest.

8. **Sri S. Chandramouli, Chief Engineer (Retd.), Warangal** has expressed the following;

- He stated that, this project has larger positive benefits to the environment and to the farmers.
- He stated that, Godavari river water shall be utilised for the benefit of local people.
- He stated that, by stabilizing the command area of the project, socio-economic conditions of the farmers and the region will be improved.
- He urged that, water retention in the soil will improve the fertility status of the soil.
- Unlike factories and industries, this project has no negative impact on environment, local people, flora and fauna.

9. **Sri G. Devdas, Hanumakonda** has expressed the following;

- He welcomed the project and informed that there are no negative impacts from the project.
- He suggested installing the sewage treatment facilities during construction phase in the labour camps and strict implementation of mitigation measures and EMP as stated in the EIA/EMP Report.
- He suggested focusing on periodical water sprinkling to be undertaken to avoid fugitive dust emissions due to movement of vehicles carrying construction materials.

10. Sri D. Sambaiah, Chief Engineer (Retd.), Warangal has expressed the following;

- He welcomed the project and stated that this project will help in improving the agricultural yield.
- He also stated that, this project will have substantial positive benefits on environment, flora and fauna, fisheries, etc.
- He requested the Collector to support the project for early implementation.

11. Sri Ratnam, Ex-Sarpanch, Thupakulagudem(V) has expressed the following;

- He stated that, many more people of Thupakuladem village shall present in this type of meetings.
- He stated that, the assurance given by the Government during land acquisition shall be fulfilled at the earliest.
- He also sought clarification from the project authorities on whether any other project is being planned in this region in the acquired land.

The Collector and District Magistrate, Jayashankar Bhupalpally District: has directed the Chief Engineer to clarify the issues raised during the meeting.

Chief Engineer, Kanthanapally project: clarified that;

- During monsoon season, barrage gates will be kept open and during lean season sluice gates will be kept open for movement of fishes and hence fish migration will not be obstructed. Environmental flows will be maintained to ensure downstream aquatic flora and fauna are protected.
- Fish culture / aquaculture are part of the project plan to ensure fisheries conservation and management.
- Plantation will be undertaken around the barrage to improve the environment around the site.
- The private land required for the dumping yard will be provided with protection measures to ensure no pollution.
- Except the present project no other project is proposed in the region and hence farmers need not worry on this aspect.
- All the environmental mitigation and management measures will be implemented to make the project environment friendly.

Collector and District Magistrate, Jayashankar Bhupalpally District thanked all the people for attending the Environmental Public Hearing and expressing their views and concluded the public hearing on positive note.

Environmental Engineer
T.S Pollution Control Board
Regional Office, Warangal

22/09/18
Collector & District Magistrate
Jayashankar Bhupalpally District

జె.చొక్కారావు ఎత్తిపోతల పధకం (2,51,310 హెక్టార్లు) మరియు శ్రీ రామ సాగర్ స్టేజ్ 1 & 2 (3,04,000 హెక్టార్లు) స్థిరీకరణకు, జయశంకర్ భూపాలపల్లి జిల్లాలోని గ్రామాలకు త్రాగు నీటి సౌకర్యాలు కల్పించటానికై ప్రతిపాదించబడిన పి.వి.నరసింహారావు కంతనపల్లి సుజల స్రవంతి ప్రాజెక్టు ఏర్పాటునకు సంబంధించి ఏటూరునాగారం గ్రామం లోని జిల్లా పరిషత్తు ఉన్నత పాఠశాల, జయశంకర్ భూపాలపల్లి జిల్లా తేది: 27-09-2018 సమయం 10:30 ని||లకు నిర్వహించబడిన పర్యావరణ ప్రజాభిప్రాయ సేకరణ కార్యక్రమము యొక్క వివరాల నివేదిక.

ఈ కార్యక్రమమునకు ఈ క్రింది పేర్కొనబడిన కార్యనిర్వహణ సభ్యులు, కాలుష్య నియంత్రణ మండలి అధికారులు మరియు ప్రాజెక్టు ప్రతినిధులు పాల్గొనియున్నారు.

క్రమ సంఖ్య	ప్యానెల్ సభ్యుల పేర్లు	
1)	శ్రీ డా. వి. వెంకటేశ్వర్లు, ఐఏఎస్ కలెక్టర్ & జిల్లా మ్యాజిస్ట్రేట్, జయశంకర్ భూపాలపల్లి జిల్లా.	అధ్యక్షులు
2)	శ్రీ జి.హనుమంతరెడ్డి, పర్యావరణ ఇంజనీర్, తెలంగాణ రాష్ట్ర కాలుష్య నియంత్రణ మండలి, ప్రాంతీయ కార్యాలయం, వరంగల్.	సభ్యులు

ప్రాజెక్టు యొక్క ప్రతినిధులు:

క్రమ సంఖ్య	పేరు & వృత్తి
1)	శ్రీ బి.నాగేంద్ర రావు, ఛీఫ్ ఇంజనీరు, పి.వి.నరసింహారావు కంతనపల్లి సుజల స్రవంతి ప్రాజెక్టు, నీటి పారుదల మరియు ఆయకట్టు అభివృద్ధి శాఖ, కె.సి. కాలనీ,చింతగట్టు, వరంగల్లు.
2)	శ్రీ ఎ. వెంకటేశ్వర్లు, సూపరింటెండింగ్ ఇంజనీరు, శ్రీ రామ సాగర్ స్టేజ్ 1 & 2 నీటి పారుదల మరియు ఆయకట్టు అభివృద్ధి శాఖ, కె.సి. కాలనీ,చింతగట్టు, వరంగల్లు.
3)	శ్రీ వి.జగదీష్, ఎగ్జిక్యూటివ్ ఇంజనీర్, పి.వి.నరసింహారావు కంతనపల్లి సుజల స్రవంతి ప్రాజెక్టు, నీటి పారుదల మరియు ఆయకట్టు అభివృద్ధి శాఖ, ఆకులవారి ఘన్పూర్ గ్రామం, ఏటూరునాగారం మండలం, జయశంకర్ భూపాలపల్లి జిల్లా, తెలంగాణ ప్రభుత్వం.

శ్రీయుత జి.హనుమంతరెడ్డి పర్యావరణ ఇంజనీర్, తెలంగాణ రాష్ట్ర కాలుష్య నియంత్రణ మండలి, ప్రాంతీయ కార్యాలయం, వరంగల్ వారు ప్రజాభిప్రాయసేకరణకై **ఏటూరునాగారం గ్రామం లోని జిల్లా పరిషత్తు ఉన్నత పాఠశాల**, జయశంకర్ భూపాలపల్లి జిల్లా కు విచ్చేసిన జిల్లా ప్రజా ప్రతినిధులకు మరియు ప్రజా సమూహమునకు స్వాగతము తెలిపి పర్యావరణ ప్రజాభిప్రాయ సేకరణ కార్యక్రమము యొక్క ప్రాముఖ్యతను వివరించుచూ, భారత ప్రభుత్వం, పర్యావరణము మరియు అటవీ శాఖ & వాతావరణ మార్పు, న్యూఢిల్లీ వారి ఉత్తర్వులు ఎస్.ఒ.నెం.1533, తేది: 14-09-2006 ననుసరించి, అందులో పొందుపరిచిన పలు అంశాలను విపులీకరించారు, ఏమనగా, పర్యావరణ ప్రజాభిప్రాయ సేకరణ కార్యక్రమము కొన్ని తరహా ప్రాజెక్ట్ లకు పర్యావరణ అనుమతుల కొరకు తప్పనిసరిగా నిర్వహించవలసినదిగా వివరించారు. EIA నోటిఫికేషన్ ప్రకారం, పి.వి.నరసింహారావు కంతనపల్లి సుజల స్రవంతి ప్రాజెక్టు, జయశంకర్ భూపాలపల్లి జిల్లా లో నీటి పారుదల సౌకర్యాలను కలిపించుటకు

ఈ ప్రాజెక్టును ప్రతిపాదించటమైనది మరియు ఈ ప్రాజెక్ట్ నీటి పారుదల ప్రాజెక్ట్ విభాగం క్రిందకు వస్తున్నది అని వివరించారు. భారత ప్రభుత్వం, పర్యావరణము మరియు అటవీ శాఖ & వాతావరణ మార్పు, న్యూఢిల్లీ వారు పొందుపరచిన నిబంధనల ప్రకారం (TOR), పి.వి.నరసింహారావు కంతనపల్లి సుజల స్రవంతి ప్రాజెక్టు వారు పర్యావరణ పర్యవేక్షణ ప్రణాళిక నివేదికను సమర్పించి, పర్యావరణ ప్రజాభిప్రాయ సేకరణ **కార్యక్రమమును నిర్వహించవలసిందిగా** తెలంగాణ రాష్ట్ర కాలుష్య నియంత్రణ మండలి, ప్రాంతీయ కార్యాలయ అధికారిని కోరారు.

ఇందుకు గాను, తెలుగు దినపత్రిక అయిన "ఆంధ్రజ్యోతి" మరియు ఆంగ్ల దినపత్రిక అయిన "ది హిందూ" లలో తేది 27-08-2018 నాడు తెలుగు మరియు ఆంగ్ల మాధ్యమాలలో ప్రకటన జారీ చేయడమైనది.

ఈ ప్రకటన ద్వారా ప్రతిపాదిత ప్రాజెక్ట్ పై ప్రజల నుండి వారికి గల సలహాలు, సూచనలు, అభిప్రాయాలు మరియు అభ్యంతరాలను **తెలియజేయవలసినదిగా** కోరడమైనది. ప్రజలు ఈ ప్రాజెక్ట్ వివరాలను తెలుసుకొనటుకు గాను ప్రాజెక్టుకు సంబంధించిన పర్యావరణ పర్యవేక్షణ ప్రణాళిక నివేదికలను (తెలుగు మరియు ఆంగ్ల మాధ్యమాలలో) పొందుపరిచిన చిరునామాలను ఈ ప్రకటనలో పొందుపరచడమైనది.

పర్యావరణ ప్రజాభిప్రాయ సేకరణ కార్యక్రమము విధిగా జరగవలసిన కార్యక్రమము గనుక ప్రజలు తగు సలహాలు, సూచనలను, అభిప్రాయాలను మరియు అభ్యంతరాలను సభా ముఖంగా తెలియజేసిన యెడల వాటినన్నింటిని ఒక నివేదిక మరియు వీడియో రూపంలో పారదర్శకంగా సంబంధిత అధికార యంత్రాంగమునకు తదుపరి చర్యల నిమిత్తము పంపించడం జరుగుతుందన్నారు. అలాగే ఇప్పుడు అయినను ప్రజలు ఏమైనా వినతి పత్రాలు సమర్పించదలచినచో స్వీకరించబడుతుందన్నారు. అనంతరము శ్రీయుత పర్యావరణ ఇంజనీరు, తెలంగాణ రాష్ట్ర కాలుష్య నియంత్రణ మండలి, ప్రాంతీయ కార్యాలయం, వరంగల్ వారు శ్రీయుత జిల్లా కలెక్టర్, జయశంకర్ భూపాలపల్లి జిల్లా వారిని నేటి పర్యావరణ ప్రజాభిప్రాయ సేకరణ కార్యక్రమమునకు అధ్యక్షత వహించి కార్యక్రమమును జరుపవలసిందిగా కోరారు.

అనంతరం శ్రీయుత జిల్లా కలెక్టర్, ప్రజాభిప్రాయసేకరణకై విచ్చేసిన జిల్లా ప్రజా ప్రతినిధులకు మరియు ప్రజా సమూహమునకు స్వాగతము తెలిపి పి.వి.నరసింహారావు కంతనపల్లి సుజల స్రవంతి ప్రాజెక్టు కు సంబంధించిన పర్యావరణ ప్రభావ అంచనా నివేదికను తయారుచేసిన ఎం /ఎస్. ఎన్విరాన్మెంటల్ హెల్త్ & సేఫ్టీ కన్సల్టెంట్ ప్రైవేట్ లిమిటెడ్ వారిని నివేదికను ప్రజలకు వివరించాలని కోరారు.

శ్రీమతి నవ్య, ఎన్విరాన్మెంటల్ హెల్త్ అండ్ సేఫ్టీ కన్సల్టెంట్స్ ప్రైవేట్ లిమిటెడ్ వారు పర్యావరణంపై అధ్యయనం చేసి వాటి యొక్క ప్రభావాలను ఈ క్రింది విధంగా వివరించారు.

- పి.వి.నరసింహారావు కంతనపల్లి సుజల స్రవంతి ప్రాజెక్టు ప్రస్తుతం ఉన్న జె.చొక్కారావు ఎత్తిపోతల పధకానికి 3 కి.మీ దిగువ భాగమున గల తుపాకులగూడెం గ్రామం దగ్గర గోదావరి నది పై 1,132 మీటర్ల పొడవున ఆనకట్ట నిర్మాణం జరుగును.
- జె.చొక్కారావు ఎత్తిపోతల పధకం (2,51,310 హె) మరియు శ్రీ రామ సాగర్ స్టేజ్ 1 & 2(3,04,000 హె) స్థిరీకరణకు, జయశంకర్ భూపాలపల్లి జిల్లాలోని గ్రామాలకు త్రాగు నీటి సౌకర్యాలు కల్పించటానికై పి.వి.నరసింహారావు కంతనపల్లి సుజల స్రవంతి ప్రాజెక్టు ప్రతిపాదించబడింది అని తెలిపారు.
- మొత్తం 50 టియంసి ల నీరు ప్రాంత స్థిరీకరణకు మరియు ప్రాజెక్టు దారిలో గల గ్రామాలకు త్రాగు నీటి సౌకర్యాలు కల్పించాటానికై ప్రతిపాదించబడిందని తెలిపారు.

- ప్రతిపాదిత ప్రాజెక్టు 77 మీటర్ల పొడవు నదీ తీరం దగ్గర గల 658.96 హెక్టార్ల భూమిని కలపడం జరుగుతుంది మరియు గ్రామాల మునిగిపోవడం లేదు.
- గోదావరి నది మీద ప్రతిపాదిత ఆయకట్టు నిర్మాణ సమయంలో అటవీ ప్రాంతం ఎటువంటి మళ్లింపునకు గురి చేయబడదని తెలిపారు. ప్రతిపాదిత ప్రాజెక్ట్ అమలు కోసం 94.27 హెక్టార్లు ప్రైవేట్ భూమి అవసరం.
- ఈ ప్రాజెక్టు ప్రాంతంలో ఈ EIA అధ్యయనం చేసినాము అని అన్నారు.
- EIA నోటిఫికేషన్ 2016 అనుగుణంగా ఈ అధ్యయనం చేసాము మరియు మూడు కాలాలలో ఈ అధ్యయనం చేశాము {జులై 2017లో నుండి మార్చి 2018లో}.
- పది కిలోమీటర్ల వ్యాసార్ధంలో గాలి, నీరు, ధ్వని మరియు భూమి వాడకంపై ప్రభావ అంచనా మరియు పర్యావరణ పర్యవేక్షణ ప్రణాళికపై పైన పేర్కొన్న అంశాల ఆధారిత అధ్యయనాలు చేపట్టారు. NOX, SO2, SPM (PM10, PM2.5) లను AAQ స్టేషన్ లను ఏర్పరిచి పర్యవేక్షణ చేసాము ప్రాజెక్టు ప్రాంతంలో నీటిని పర్యవేక్షించారు అని అన్నారు.
- గాలి నీరు మరియు ధ్వని యొక్క బేస్లైన్ సమాచారం CPCB నిర్ణయించిన ప్రమాణాల లోనే ఉన్నాయి.
- ప్రాజెక్ట్ నిర్మాణ దశలో మరియు ఆపరేషన్ దశలో కలిగే భూమి నీరు ధ్వని జలం మరియు గాలి సమస్యలను అధ్యయనం చేయుటకు వివిధ నమూనాలను అనుసరించి పర్యావరణ ప్రభావ అంచనా అధ్యయనం చేపట్టాము.
- భూగర్భ జల నాణ్యత పరీక్షల ఫలితాలు ISO 10500:2012 త్రాగునీటి నీటి నాణ్యత ప్రమాణాలకు అణుగుణంగా మరియు ఉపరితల నీటి నాణ్యత పరీక్షల ఫలితాలు సిపిసిబి వాటర్ క్వాలిటీ క్లాస్-C ప్రమాణాలకు అణుగుణంగా ఉన్నాయి.
- ప్రాజెక్టు నిర్మాణ దశలో ఒకటి నుండి రెండు సంవత్సరాల వరకు భూమి త్రవ్వకాలు జరుగుతాయి దీనివల్ల దుమ్ము సమస్యలు తలెత్తకుండా నీటిని చల్లించమని ప్రతిపాదించారు. భూమి పై పొరను వేరుచేయటం, ఘన వ్యర్థాల నిర్వహణ మరియు STP ఏర్పాటు చేయటం ప్రతిపాదించారు.
- డీజిల్ జనరేటర్లు మరియు వాహనాల ద్వారా ధ్వని కాలుష్యం జరగకుండా సైలెన్సర్లు అమర్చాలని సూచించారు.
- ఎన్విరాన్మెంటల్ మేనేజ్మెంట్ ప్లాన్, కాచ్మెంట్ ఏరియా ట్రీట్మెంట్ ప్లాన్, బయోడైవర్సిటీ మేనేజ్మెంట్ ప్లాన్, ఫిషరీస్ డెవలప్మెంట్ ప్లాన్, ఎన్విరాన్మెంటల్ మానిటరింగ్ ప్రోగ్రాం ఈ ప్రాజెక్టు నిర్మాణదశ నుండీ అమలు చేయబడుతాయి అని వివరించారు.

శ్రీయుత కలెక్టర్ & జిల్లా మ్యాజిస్ట్రేట్, జయశంకర్ భూపాలపల్లి జిల్లా గారు మాట్లాడుతూ ఈ ప్రతిపాదక ప్రాజెక్ట్ పై ప్రజల నుండి వారికి గల సలహాలు, సూచనలు, అభిప్రాయాలు, మరియు అభ్యంతరాలను తెలుపవలసినదిగా కోరారు.

1.శ్రీ బి మల్లయ్య, రిటైర్డ్ సూపరింటెండెంట్ ఇంజనీర్, హనుమకొండ మాట్లాడుతూ ఈ క్రింద విధముగా పేర్కొన్నారు:

- ఈయన ఈ ప్రాజెక్టును స్వాగతిస్తూ ప్రాజెక్టు నిర్మాణ సమయంలో దుమ్ము ధూళి కణాలు లేకుండా తరచుగా నీటిని మట్టి పై చల్లాలని చెప్పడం జరిగింది. భూమి కోతకు గురికాకుండా నివారణ చర్యలు చేపట్టాలని కోరారు.
- ప్రాజెక్టు నిర్మాణ ప్రదేశంలో వాహనాల వేగం పై నియంత్రణ విధించాలని మరియు ఓవర్ టేకింగ్ నిషేధించాలని తద్వారా గ్రామస్తులకు వాహనాల ద్వారా ఎలాంటి ఇబ్బందులు కలగవని పేర్కొన్నారు.

- క్వారీ ప్రాంతంలో చెట్ల పెంపకం చేపట్టాలని కాలువకు రెండు పక్కల మొక్కల పెంపకం జరపాలని కోరారు. ప్రాజెక్ట్ వద్ద పనిచేసే కార్మికులకు పారిశుధ్యం మరియు రక్షిత మంచినీటి సదుపాయం కల్పించాలని కోరారు. గ్రామస్తులు యొక్క ఆరోగ్య పరిస్థితులను ప్రతి ఆర్నెల్లకు ఒకసారి పరీక్షించాలని విన్నవించారు.
- శ్రీరాంసాగర్ ప్రాజెక్టు యొక్క నిల్వ సామర్థ్యం రోజురోజుకు పూడిక వల్ల తగ్గుతుంది కాబట్టి ప్రస్తుత ప్రాజెక్టు ద్వారా శ్రీరాంసాగర్ కింద నీరు అందని ఆయకట్టుకు నీటిని అందించవచ్చని మరియు రాష్ట్రానికి కేటాయించిన పూర్తిస్థాయి నీటి వాటాలను వాడుకోవచ్చని చెప్పారు.

2.శ్రీ పొన్నాల రామయ్య, రిటైర్డ్ చీఫ్ ఇంజనీర్, వరంగల్ వారు మాట్లాడుతూ ఈ క్రింద విధముగా పేర్కొన్నారు:

- ప్రస్తుత ప్రాజెక్ట్ నిర్మాణంలో ఎలాంటి ముంపు గ్రామాలు లేవని మరియు అటవీ భూమి సేకరించబడి లేదని అందుకు తను ఈ ప్రాజెక్టుని స్వాగతిస్తున్నానని తెలిపారు.
- పర్యావరణ ప్రభావ అంచనా నివేదిక అనుగుణంగా పర్యావరణ పర్యవేక్షణ మరియు కాలుష్య నివారణ చర్యలు చేపట్టవలసిందిగా కోరుతూ ముగించారు.

3.శ్రీ కె. ప్రకాశాచారి, రిటైర్డ్ ఎగ్జిక్యూటివ్ ఇంజనీర్, వరంగల్ వారు మాట్లాడుతూ ఈ క్రింద విధముగా పేర్కొన్నారు:

- ఈ ప్రాజెక్టు నిర్మాణంలో ఎలాంటి ముంపు గ్రామాలు లేకపోవడం మరియు అటవీ భూమి లేకపోవడం తనకు ఎంతో ఆనందంగా ఉందని అందుకే ప్రాజెక్టు నిర్మాణాన్ని స్వాగతిస్తున్నానని తెలిపారు.
- ప్రస్తుతం నిర్మాణంలో ఉన్న ప్రాజెక్టు బ్యారేజ్ కావడం వలన దీనికి పూడిక రావడానికి ఆస్కారం లేదు అని పేర్కొన్నారు.
- పూడిక వలన ఎస్ ఆర్ ఎస్ పి యొక్క నిల్వ సామర్థ్యం తగ్గి పోతుంది కనుక ఈ ప్రాజెక్టు వలన ఎస్.ఆర్.ఎస్.పి యొక్క మిగతా ఆయకట్టుకు నీటిని అందించవచ్చని తెలిపారు.
- నీరు అనేది రోజు రోజుకి తగ్గిపోతున్న వనరు కావున మనం దానిని కాపాడుకోవడానికి ఇలాంటి ప్రాజెక్టులను నిర్మించాలి. మన తెలంగాణలో నెలకొన్న వర్షాభావ పరిస్థితులు మరియు నిలకడలేని వర్షపాతం దృష్ట్యా ఇలాంటి ప్రాజెక్టులు మన యొక్క త్రాగునీరు మరియు సాగునీరు అవసరాలకు చాలా అవసరం అంటూ ముగించారు.

4.శ్రీ బి ఎల్లారెడ్డి, రిటైర్డ్ చీఫ్ ఇంజనీర్, హన్మకొండ వారు మాట్లాడుతూ ఈ క్రింద విధముగా పేర్కొన్నారు:

- ఎలాంటి అటవీ భూమిని సేకరించకుండా ఈ ప్రాజెక్టు నిర్మాణం సాగుతున్నందున తనకెంతో సంతోషంగా ఉందని కావున ప్రాజెక్టును స్వాగతిస్తున్నానని తెలిపారు.
- పర్యావరణ ప్రభావ అంచనా నివేదిక అనుగుణంగా పర్యావరణ పర్యవేక్షణ మరియు కాలుష్య నివారణ చర్యలు చేపట్టవలసిందిగా కోరుతూ ముగించారు.

5.శ్రీ బండారు ధవళేశ్వరావు, రిటైర్డ్ కార్యనిర్వాహక ఇంజనీర్, వరంగల్ వారు మాట్లాడుతూ ఈ క్రింద విధముగా పేర్కొన్నారు:

- తాను ఈ ప్రాజెక్టును స్వాగతిస్తున్నానని ఈ ప్రాజెక్టు వల్ల చేపల వలస,కార్బన్ డయాక్సైడ్ వృద్ధి,మట్టి కోత మరియు పూడిక అవకాశం ఉంది కాబట్టి అందుకు అనుగుణంగా నివారణ చర్యలు చేపట్టాలని సూచిస్తూ ముగించారు.

6.శ్రీ జి. దామోదర్ రెడ్డి, రిటైర్డ్ సూపరిండెంట్ ఇంజనీర్,వరంగల్ వారు మాట్లాడుతూ ఈ క్రింద విధముగా పేర్కొన్నారు:

- ఈయన ప్రాజెక్టును స్వాగతించారు మరియు ఈ ప్రాజెక్టు వల్ల పర్యావరణానికి ఎలాంటి నష్టం లేకపోగా అదనపు ప్రయోజనాలున్నాయని తెలిపారు. ఈ ప్రాజెక్టు నిర్మాణం వల్ల ఈ ప్రాంతపు నీటి లభ్యత పెరుగుతుందని తెలుపుతూ ముగించారు.

7.శ్రీ నాగరాజు, రైతు, తుపాకుల గూడెం వారు మాట్లాడుతూ ఈ క్రింద విధముగా పేర్కొన్నారు:

- ఈ ప్రాజెక్టు వల్ల వేరే గ్రామాలు లబ్ధి పొందుతాయి కావచ్చు కానీ మా గ్రామానికి మాత్రం ఎటువంటి లబ్ధి లేదు.
- ఇంతకుముందు అధికారులు మాకు ఉద్యోగాలిస్తామని మరియు డబుల్ బెడ్ రూమ్ ఇళ్లు ఇస్తామని వాగ్దానం చేశారు కానీ ఇంతవరకు అది కార్య రూపం దాల్చలేదన్నారు.
- కొంతమందికి మాత్రమే పరిహారం ఇవ్వడం జరిగింది కొంతమందికి ఇంకా అందలేదని వారికి పరిహారం ఇప్పించాల్సిందిగా కోరుతూ ముగించారు.

8. శ్రీ ఎస్. చంద్రమౌళి, రిటైర్డ్ చీఫ్ ఇంజనీర్ వారు మాట్లాడుతూ ఈ క్రింద విధముగా పేర్కొన్నారు:

- మనం గత కొన్నేళ్లుగా గోదావరి జిల్లాలను సముద్రంలోకి వృధాగా వదలడం జరిగింది కానీ ఈ ప్రాజెక్టు వల్ల మనకు కేటాయించిన ప్రతి నీటి చుక్కను పూర్తిస్థాయిలో వినియోగించడం జరుగుతుంది తద్వారా ఈ ప్రాంతంలో జలకళ సంతరించుకుంటుందన్నారు.
- ప్రస్తుత ప్రాజెక్టు వల్ల ఈ ప్రాంత పర్యావరణానికి ఇలాంటి ఇబ్బంది లేదు. ఈ ప్రాజెక్టు వల్ల ఈ ప్రాంత రైతులు సామాజికంగా ఆర్థికంగా వృద్ధిలోకి వస్తారు. ఈ ప్రాజెక్టు వల్ల మట్టిలో తేమ శాతం పెరిగి భూమి సారవంతమవుతుంది తద్వారా వ్యవసాయ అభివృద్ధి జరుగుతుంది. పరిశ్రమల లాగా కాకుండా ఈ ప్రాజెక్టు వల్ల పర్యావరణానికి, స్థానికులకు,సమస్త జీవ జాతికి ఎటువంటి హాని కలగడం జరగదంటూ ముగించారు.

9.శ్రీ జి. దేవదాస్, హనుమకొండ వారు మాట్లాడుతూ ఈ క్రింద విధముగా పేర్కొన్నారు:

- ఈ ప్రాజెక్టు వల్ల పర్యావరణానికి ఎటువంటి ప్రభావాలు కలగవని అందువల్ల తాను ఈ ప్రాజెక్టుని స్వాగతిస్తున్నానని తెలిపారు.
- ప్రాజెక్టు నిర్మాణ స్థలం లో పనిచేసే కార్మికులకు మురుగునీటి వ్యవస్థను ఏర్పాటు చేయాలని మరియు కాలుష్య నియంత్రణ చర్యలను పర్యావరణ ప్రభావ అంచనా నివేదిక లో చెప్పినట్టుగా తీసుకోవాలని సూచించడం జరిగింది.
- వాహనాల రాకపోకల వల్ల లే చే దుమ్ము ధూళి నియంత్రించడానికి తరచుగా దారిలో నీటిని చల్లుతూ ఉండాలని సూచిస్తూ ముగించారు.

10.శ్రీ డి. సాంబయ్య, చీఫ్ ఇంజనీర్ రిటైర్డ్ వరంగల్ వారు మాట్లాడుతూ ఈ క్రింద విధముగా పేర్కొన్నారు:

- ఆయన ఈ ప్రాజెక్టును స్వాగతిస్తూ ఈ ప్రాజెక్టు వల్ల వ్యవసాయ ఉత్పాదకత గణనీయంగా పెరుగుతుందని అభిప్రాయపడ్డారు. ఈ ప్రాజెక్టు వల్ల గణనీయమైన అభివృద్ధి తప్ప పర్యావరణానికి గాని పశుపక్షాదులకు గాని మరియు జలచరాలకు గాని ఎటువంటి హాని కలగదని చెప్పారు. ఈ ప్రాజెక్టును సాధ్యమైనంత త్వరగా నిర్మాణం చేపట్టాలని కలెక్టర్ గారికి విన్నవిస్తూ ముగించారు.

11.శ్రీ రత్నం, మాజీ సర్పంచ్. తుపాకుల గూడెం వారు మాట్లాడుతూ ఈ క్రింద విధముగా పేర్కొన్నారు:

- ప్రాజెక్టు నిర్మాణం గురించి పర్యావరణ ప్రజాభిప్రాయ సేకరణ జరగడం చాలా ఆనందదాయకమైన విషయం కానీ నిజానికి ఈ సమావేశంలో తుపాకులగూడెం ప్రజలు ఎక్కువగా రాలేదు. మా గ్రామ ప్రజలు లేకుండా ఈ సమావేశం జరగడం ఏ విధంగానూ ఆమోదయోగ్యం కాదు. మా గ్రామ ప్రజలతో ఎన్నో చర్చల తర్వాత ఈ ప్రాజెక్టు నిర్మాణానికి ఒప్పుకోవడం జరిగిందని తెలిపారు.
- ఈ ప్రాజెక్టు నిర్మాణానికి గాను మేము 18 డిమాండ్లను విధించడం జరిగింది కానీ అందులో భూసేకరణ సంబంధించిన డిమాండ్ మాత్రమే పూర్తి చేయడం జరిగింది. మిగిలినవి ఎప్పుడు పూర్తి చేస్తారో తెలియాల్సి ఉందన్నారు.
- మా గ్రామంలో మొత్తం 176 ఎకరాల భూమి సేకరించడం జరిగింది కానీ బ్యారేజ్ నిర్మాణానికి 25 నుంచి 30 ఎకరాల స్థలం సరిపోతుంది మరి మిగతా స్థలం ఎందుకు సేకరించబడింది అందుకు తగిన సహేతుకమైన కారణాలు తెలియాల్సి ఉందన్నారు. ఇక్కడ విద్యుదుత్పత్తి సంబంధించి వేరే ఏదైనా ప్రాజెక్టు కడతారేమోనని అనుమానాలు కలుగుతున్నాయన్నారు. వీటన్నింటి గురించి సంబంధిత అధికారులు వివరణ ఇవ్వాలని కోరుతూ ముగించారు.

శ్రీ జిల్లా కలెక్టర్, జయశంకర్ భూపాలపల్లి జిల్లా గారు మాట్లాడుతూ వక్తలు లేవనెత్తిన అంశాలపై వివరణ ఇవ్వవలసిందిగా ప్రాజెక్టు చీఫ్ ఇంజనీరు గారిని కోరడం జరిగింది.

శ్రీ బి.నాగేంద్ర రావు, చీఫ్ ఇంజనీరు పి.వి.నరసింహారావు కంతనపల్లి సుజల స్రవంతి ప్రాజెక్టు గారు వక్తలు లేవనెత్తిన అంశాలపై ఈ క్రింది విధంగా వివరణ ఇచ్చారు.

- వర్షాకాలంలో వరదల సమయంలో మాత్రమే బ్యారేజీ గేట్లు ఎత్తడం జరుగుతుందని మిగతా సమయాల్లో చేపల కదలికలకు అనువుగా స్లుయిస్ గేట్లు ఎత్తి ఉంచడం జరుగుతుంది మరియు కాలువలో దిగువన గల జలచరాలు జీవించేందుకు తగినంత నీరు ఎల్లప్పుడు ఉంచబడుతుంది. మత్స్య సంపదను వృద్ధి చేయడానికి మరియు పరిరక్షించడానికి చేపల పెంపకాన్ని కూడా ప్రాజెక్ట్లో భాగంగా చేయబడింది. బ్యారేజీ పొడవునా పర్యావరణ అభివృద్ధి కోసం చెట్లను పెంచడం జరుగుతుందని తెలిపారు.
- ప్రాజెక్టులో భాగంగా సేకరించిన భూమిలో కొంత భాగాన్ని ప్రాజెక్టుకు కేటాయించి మిగతా భాగాన్ని అక్కడ కార్మికుల సదుపాయాల కోసం, ప్రాజెక్టు నిర్మాణం కార్యాలయం కోసం మరియు ప్రాజెక్ట్ నిర్మాణానికి సంబంధించిన సామాగ్రి లేదా వస్తువులను ఉంచడానికి ఉద్దేశించబడింది. అంతే తప్ప వేరే ఏ ప్రాజెక్ట్ నిర్మాణం కోసం కాదని తెలిపారు.
- ఇక్కడ కేవలం బ్యారేజి మాత్రమే నిర్మించబడుతుంది ఇతర ప్రాజెక్టులు ఏవీ కూడా ఇక్కడ చేపట్టడం లేదు. దీనిపై రైతులు ఎటువంటి ఆందోళన చెందవలసిన అవసరం లేదన్నారు. పర్యావరణ పరిరక్షణ కోసం మరియు కాలుష్య నియంత్రణ కోసం ఉద్దేశించబడిన అన్ని చర్యలు కూడా తీసుకోవడం జరుగుతుందంటూ వివరించి ముగించారు.

అనంతరం కలెక్టర్ & జిల్లా మ్యాజిస్ట్రేట్, జయశంకర్ భూపాలపల్లి జిల్లా వారు మాట్లాడుతూ ఈ ప్రజాభిప్రాయ సేకరణ కోసం సభకు హాజరైనవారందరికీ ధన్యవాదములు తెలుపుతూ సభను ముగించారు.

పర్యావరణ ఇంజనీరు,
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కలెక్టర్ & జిల్లా మ్యాజిస్ట్రేట్
జయశంకర్ భూపాలపల్లి జిల్లా.

Consultants

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