एनटीपीसी
NTPC

रामगुण्डम
RAMAGUNDAM

Ref.No:09/EMG/E-10/2019/R1

Date: 02.11.2019

To

Dr. M.R.G. REDDY, IFS
Addl. Principal Chief Conservator of Forests (C), Regional Office (SEZ)
Ministry of Environment Forests & Climate Change,
1st and 2nd Floors, Handloom Export Promotional Council,
4 Cathedral Garden Road,
Nungambakkam, Chennai – 560 034.

Respected Sir,

Sub: Six monthly compliance report of EC accorded to NTPC TeSTPP -reg

Please find enclosed herewith submitting the six monthly compliance reports for Environmental Clearance (EC) accorded by MOEF&CC to NTPC Telangana Super Thermal Power Project (TeSTPP), pertaining to the period April-2019 to September-2019.

Thanking you

Yours sincerely
For NTPC Ltd

(Ch.Shankar)
Sr. Manager (EMG/AU)

E/a

The Environmental Engineer,
Telangana State Pollution Control Board,
Regional Office – Ramagundam,
Jyothinagar, Peddapalli (Dist), Telangana, India - 505215

Received 02/11/19.
Office of the
Environmental Engineer
Telangana State Pollution Control Board
Regional Office, Ramagundam,
H. No. Special C-3, NTPC, TTS,
Near Zilla Parishad High School
JYOTHINAGAR - 505 215,
Dist. Peddapalli (T.S.).

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सीएच.शंकर CH. SHANKAR
वरीष्ठ प्रबंधक Sr. Manager (EMG AU)
एनटीपीसी लिमिटेड NTPC Limited, Ramagundam
ज्योतिनगर JYOTHINAGAR - 505 215

E/a

The Environmental Engineer,
Telangana State Pollution Control Board,
Regional Office – Ramagundam,
Jyothinagar, Peddapalli (Dist), Telangana, India - 505215

Telangana Super Thermal Power Plant

Stage-I (2X800MW)

ENVIRONMENTAL CLEARANCE

Half-Yearly Compliance Status

April 2019 to September 2019

Status as on 30.09.2019

Telangana Super Thermal Power Plant
Stage-I (2X800MW)

HALF-YEARLY COMPLIANCE STATUS OF ENVIRONMENTAL CLEARANCE CONDITIONS

Vide Letter No. J- 13012/112/2010-IA. II (T) Dated 20th January 2016

Sr.No.	EC Conditions	Status AS ON 30.09.2019
A	**SPECIFIC CONDITIONS**	
(i)	As the Satellite Imagery submitted was not clear, a clear satellite imagery shall be submitted to the Ministry and its R.O. Further, latest authenticated. Satellite imagery shall be submitted on an annual basis to the Ministry and its R.O to monitor the alterations of the area.	The consultancy contract for the stipulated condition was awarded to Telangana State Remote Sensing Application Centre (TRAC), Govt. of Telangana. 2016-17 report submitted to Regional Office (South Eastern Zone at Chennai) & Central Office of MOEF&CC on 16th March 2018. 2017-18 report is attached.
(ii)	The PP shall ensure compliance to the Ministry's Notification. Dated 02.01.2014 regarding use of coal with ash content not exceeding thirty-four per cent, on quarterly average basis. This is to be ensured by incorporating a condition in the MoU/FSA with CIL etc. Also, if required, coal washery shall be installed.	The said stipulation will be complied during operation phase of the project.
(iii)	The Sulphur and ash content of coal shall not exceed 0.5% and 34% respectively. In case of variation of quality at any point of time, fresh reference shall be made to the Ministry and suitable amendments to the environmental clearance will have to be sought.	The said stipulation will be complied during operation phase of the project.
(iv)	FGD shall be installed as the emissions are found to be almost reaching threshold limit of 80 unit (for the worst-case scenario) and also considering the cushion w.r.t NAAQS.	NTPC has already initiated an action plan for installing FGD system in the layout for all units for controlling SO_x concentration in flue gas in compliance to latest MOEF&CC emission norms for TPP dated 07.12.2015. FGD Package was awarded to GE in Jan-2018. Civil foundation works of various buildings viz., ball mill building, lime stone building, gypsum de-watering building completed. Super-structure work, Absorber tower, tank erection are in progress.
(v)	NTPC shall endeavor to enter into MoUs with NHAI, Associations of Cement Industries and Municipal Authorities for ensuring ash utilization in roads construction and cement manufacturing.	Ash Utilization Plan has been prepared and shall be implemented in compliance to fly ash gazette notification dated 03.11.2009 and its amendment dated 25.01.2016 during the operation phase of the project. Already NTPC received Expression of Interest (EOI) for lifting ash from various cement & brick manufacturing industries. NTPC is also

Sr.No.	EC Conditions	Status AS ON 30.09.2019
		continuously making efforts to sign MoU with other cluster of industries for ensuring maximum ash utilization. Matter has also been taken up with NHAI for entering into MOUs for use of ash in road construction works.
(vi)	The PP shall examine possibility of relocating the ash pond. In case, the relocation of ash pond is not possible, precautionary measures by providing maximum green belt between ash pond and reservoir etc. shall be undertaken.	The location of ash pond was selected after making detailed techno feasible examination of all available options. However, maximum possible thick greenbelt will be developed and bund will be constructed between ash pond and reservoir area.
(vii)	Study shall be conducted regarding the impact on agricultural fields in terms of heavy metal in food chain and ground water/soil for a period of one year and the report submitted to the Ministry.	A scientific study for assessment of impact on vegetation within 10 km radius of the Telangana STPP due to fly ash generated will be carried out through a reputed Government Organization / Agricultural University and its status report will be submitted as per the stipulation. However, a study is in progress for the present scenario.
(viii)	The Ash water Re-circulation System (AWRS) shall be immediately installed for the existing TPP. Till that time, the ash pond effluent shall not be discharged into agricultural fields etc.	AWRS (Ash Water Recirculation System) is already in place for Ramagundam. However, to ensure 100 % recirculation, AWRS is being augmented by awarding an additional AWRS package. AWRS works like construction of pump house building, installation of pumps, laying of pipe line and other allied structures and activities are expected to be completed by January 2020.
(ix)	The PP shall enhance the green belt of the existing TPP in compliance to the earlier EC conditions etc.	• Already extensive greenbelt has been developed in the existing Ramagundam STPP, Township area and around the proposed Telangana main plant site. • Further, plantation will also continue at all available spaces in and around the project area, after construction is complete. • Plantation of Approx. 46,000 nos. of additional sapling was done in two phases. • To support State Govt's Plantation Program namely "Telangana ku Haritha Haram" following Financial aid was given to District Forest Department; ✓ FY 2016-17: Rs. 57 lakhs ✓ FY 2017-18: Rs 77.5 lakhs • In FY 2019-20 more than 71,000 nos. of

Sr.No.	EC Conditions	Status AS ON 30.09.2019
		trees have been planted at different locations under Ramagundam Municipal Corporation and Sultanabad Municipality.
(x)	Long term monitoring of temperature shall be undertaken on-site and off-site of the TPP, as data of decrease in temperature needs to be Verified. Further, requisite corrective action shall be taken based on the findings of the monitoring.	Long term monitoring of temperature profile will be undertaken both on-site and off-site of the TPP and accordingly the necessary corrective action will be taken.
(xi)	As the data for the health studies was more than five years old, a fresh Occupational health and epidemic health disorders survey of the study area (10 km radius) shall be conducted and the report submitted to the Ministry and its R.O within one year.	M/s Pollucon Laboratories Pvt. Ltd, Surat, conducted the Occupational Health and Epidemic Health Disorders Survey of the study area (10 Km radius) and submitted the Final report was submitted to the Regional Office (South Eastern Zone), MOEF&CC at Chennai on 25th November 2018.
(xii)	As Committed, a minimum amount of Rs. 20 Crores shall be earmarked as capital cost for CSR activities and the recurring cost per annum shall be as per the CSR Policy of GOI till the operation of the plant commences.	Budget has been increased from Rs.20Cr to Rs25.89Cr, for Community Development works under Telangana Phase-1 project as per stipulation out of which, as on date 1.Rs.9.78Cr of works are in various stages of implantation. Out of which Rs.4.72Cr has been spent. 2.Rs.7.89Cr is allocated for construction of 2nd floor along with furniture and equipments in Govt. Area Hospital-Godavarikhani and is under process for execution. Estimation under progress for works, for remaining amount.
(xiii)	Vision document specifying prospective plan for the site shall be formulated and submitted to the Regional office of the Ministry within six months.	NTPC vide letter dated 06.04.2016 has already submitted a project vision document to the Regional Office (South Eastern Zone), MOEF&CC at Chennai.
(xiv)	Harnessing solar power within the premises of the plant particularly at available roof tops shall be carried out and status of implementation including actual generation of solar power shall be submitted along with half yearly monitoring report.	A Solar plant PV based 10 MW capacity is already operating within the premises, also solar power is being harnessed from roof tops. Besides this, scheme for harnessing solar power from roof tops within the premise of the upcoming plant has been awarded to M/s. Tata Projects Limited.

Sr.No.	EC Conditions	Status AS ON 30.09.2019
(xv)	A long term study of radio activity and heavy metals contents of coal to be used shall be carried out through a reputed institute and results thereof analyzed every two year and reported along with monitoring reports. Thereafter mechanism for an in-built continuous monitoring for radio activity and heavy metals in coal and fly ash (including bottom ash) shall be put in place.	• Heavy Metals and radio activity of tapering linkage coal (WCL) has been carried out from Environment Protection Training & Research Institute (EPTRI), Hyderabad and Department of Atomic Energy, Board of Radiation & Isotope Technology, Navi Mumbai respectively. • Further long-term study on heavy metal and radioactivity contents will be carried out once the project starts receiving the coal during operation phase. • However, Expert Appraisal Committee (EAC) of MOEF&CC in its recent meeting held on 23.08.2019 has recommended for amendment to the stipulated EC condition and directed to carry out monitoring of Radio activity and heavy metals contents in coal and fly ash (including bottom ash) through a reputed institute on periodic basis i.e. once in a year.
(xvi)	Online continuous emission monitoring system for stack emission and ambient air shall be installed.	Online Continuous Emission Monitoring System (CEMS) for stack emission shall be installed for proposed units. Already online Continuous Emissions Monitoring System (AAQMS) at 3 locations installed and are functional.
(xvii)	High Efficiency Electrostatic Precipitators (ESPs) shall be installed to ensure that particulate emission does not exceed 50 mg/Nm^3 or as would be notified by the Ministry, whichever is lesser. Adequate dust extraction system such as cyclones/ bag filters and water spray system in dusty areas such as in coal handling and ash handling Points, transfer areas and other vulnerable dusty areas shall be provided along with an environment friendly sludge disposal system.	The High Efficiency Electrostatic Precipitators (ESP) has been designed and installed for achieving guaranteed efficiency of 99.99 % in order to comply with the stipulation. Besides, dust extraction systems and suitable water spray systems are included in the design of the plant to suppress/avoid dust emissions from the coal and ash handling areas. However, NTPC will also make all its efforts in order to comply with the latest emission notification by MOEF&CC for TPP dated 07.12.2015
(xviii)	Adequate dust extraction system such as cyclones/hag filters and water spray system in dusty areas such as in coal handling and ash handling points, transfer areas and other	Adequate no. of dust suppression and dust extraction systems are under construction in coal handling area including coal stockyard area ash handling area and other vulnerable

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	vulnerable dusty area shall be provided	dusty area for control of fugitive dust emissions. Water sprinklers will also be installed at dust prone sites in order to attenuate fugitive dust emission. Dry fog dust suppression system is being provided at all transfer points.
(xix)	COC of at least 5.0 shall be adopted.	Closed cycle cooling system has been designed with Cycle of Concentration (COC) of 5.0 for optimization of water requirement.
(xx)	Monitoring of surface water quantity and quality shall also be regularly conducted and records maintained. The monitored data shall be submitted to the Ministry regularly. Further, monitoring points shall be located between the plant and drainage in the direction of flow of ground water and records maintained. Monitoring for heavy metals in ground water shall also be undertaken and results/findings submitted along with half yearly monitoring report.	Monitoring of Surface and Ground water quality will be carried out regularly as per stipulations and Half-Yearly reports will be submitted to Regional Office (South Eastern Zone), MOEF&CC at Chennai during the operation phase of the project.
(xxi)	A well designed rain water harvesting system shall be put in place within six months, which shall comprise of rain collection from the built up and Open area in the plant premises and detailed record kept of the quantity of water harvested every year and its use.	Rainwater harvesting system will be put in place and records shall be maintained. All the main plant & offsite buildings, switchyard control rooms are having provisions of rain water harvesting and is incorporated in the contract.
(xxii)	No water bodies including natural drainage system in the area shall be disturbed due to activities associated with the setting up/ operation of the power plant.	No water body including natural drainage system of the area has been disturbed / shall be disturbed due to activities associated with the setting up / operation of the power plant.
(xxiii)	Wastewater generated from the plant shall be treated before discharge to comply limits prescribed by the SPCB/CPCB.	An effluent management scheme will be implemented during the operation phase of the project with the objective to treat the wastewater as per the prescribed statutory standards of TSPCB/CPCB before its final discharge. The water system of Telangana STPP, Stage-I has been designed with Zero Liquid Discharge (ZLD) Concept by maximum recycle power of waste water after treatment for various plant activities. Accordingly, NTPC has already revised its water requirement in order to comply with the latest emission notification by MOEF&CC for TPP dated 07.12.2015.
(xxiv)	Online continuous effluent monitoring system shall also be installed.	Online continuous effluent monitoring system will be installed during operation phase of the project.
(xxv)	Additional soil for leveling of the proposed site shall be generated within the sites (to the extent	All additional soil leveling of the project site will be done from within the sites only with

Sr.No.	EC Conditions	Status AS ON 30.09.2019
	possible) so that natural drainage system of the area is protected and improved.	all necessary precautions to protect natural drainage system of the area.
(xxvi)	Fly ash shall be collected in dry form and storage facility (silos) shall be provided. Mercury and other heavy metals (AS, Hg, Cr, Pb etc.) shall be monitored in the bottom ash. No ash shall be disposed off in low lying area.	An ash management & disposal scheme will be implemented consisting of dry ash extraction system (DAES) for dry collection of fly ash with storage facility (silos), supply of ash to entrepreneurs for utilization and promoting ash utilization to maximum extent and safe disposal of unused ash in the ash pond area. Monitoring for mercury & heavy metals in the bottom ash and water emanating from ash pond will be done during the operation phase of the project.
(xxvii)	Fugitive emission of fly ash (dry or wet) shall be controlled such that no agricultural or non-agricultural land is affected. Damage to any land shall be mitigated and suitable compensation provided in consultation with the local Panchayat.	Fugitive emission of fly ash & dust will be controlled with the aid of suitable pollution control devices such as dust extraction system and dust suppression system, bag filters, etc. Extensive plantation will be undertaken in all available spaces including coal handling, ash pond area etc
(xxviii)	Green Belt consisting of three tiers of plantations of native species all around plant and at least 50 m width shall be raised. Wherever 50 m width is not feasible a 20 m width shall be raised and adequate justification shall be submitted to the Ministry. Tree density shall not be less than 2500 per ha with survival rate not less than 80 %	Already greenbelt has been developed in existing Ramagundam STPP, Township area and around the proposed Telangana main plant site. Further, plantation will also continue at all available spaces in and around the project area, after construction is complete.
(xxix)	CSR schemes identified based on need based assessment shall be implemented in consultation with the village Panchayat and the District administration starting from the development of project itself. As part of CSR prior identification of local employable youth and eventual employment in the project after imparting relevant training shall be also undertaken. Company shall provide separate budget for community development activities and income generating programmes.	Various CSR schemes have been implemented and will be continued based on need-based survey in consultation with the village Panchayat and the District Administration. Separate budget has been earmarked for implementing CSR-CD activities for the project and shall be utilized in accordance with the said stipulations. NTPC is already providing solar lights & toilets in villages, distributed scholarships to school children & organized medical camps for local population and provided vocational training for local youth. Development of infrastructure facilities, viz., improvement in roads, bus shelters, public facilities, solar street lamps, sanitation, toilets, medical, Schools, sports facilities etc. are already being implemented.

Sr.No.	EC Conditions	Status AS ON 30.09.2019
(xxx)	For proper and periodic monitoring of CSR activities, a CSR committee or a social Audit committee or a suitable credible external agency shall be appointed. CSR activities shall also be evaluated by an independent external agency. This evaluation shall be both concurrent and final.	Social committee will be engaged at an appropriate time after a substantial amount is incurred on this account. Work order for social audit of CSR activities under CD-Budget is already placed to Department of Business Management, Shathavahana University, Karimnagar and audit conducted in October 2018. Audit Report submitted on 08.05.2019 along with Six Monthly Compliance report.
(xxxi)	An Environmental cell comprising of at least one expert in environmental science/ engineering, ecology, occupation health and social science, shall be created preferably at the project site itself and shall be headed by an officer of appropriate superiority and qualification. It shall be ensured that the Head of the Cell shall directly report to the Head of the Plant who would be accountable for implementation of environmental regulations and social impact improvement/mitigation measures.	An Environment Management Group (EMG) is already functional. The EMG will be responsible for implementing and monitoring the stipulations. EMG shall have sufficient trained manpower and equipment for environmental monitoring and other environmental related activities to ensure compliance with statutory requirements. It will interact regularly with the State Pollution Control Board.
B	**GENERAL CONDITIONS**	
(i)	The treated effluents conforming to the prescribed standards only shall be recalculated and reused within the plant. Arrangements shall be made that effluents and storm water do not get mixed.	The concept of Zero Liquid Discharge (ZLD) shall be adopted through reuse of plant effluents. An independent plant effluent drainage system will be constructed to ensure that plant effluents do not mix with storm water drainage.
(ii)	A sewage treatment plant shall be provided (as applicable) and the treated sewage shall be used for raising greenbelt/ plantation.	All domestic sewage emanating from plant and township will be treated in a sewage treatment plant. The treated sewage conforming to prescribed standards shall be utilized for plantation & raising greenbelt to the extent possible.
(iii)	Adequate safety measure shall be provided in the plant area to chcek/minimize spontaneous fires in coal yard, especially during summer season. Copy of these measures with full details along with location plant layout shall be submitted to the Ministry as well as to the Regional office of the Ministry.	Hydrant system for covering the entire power station including all the auxiliaries and buildings in the plant area shall be implemented. The system will be complete with piping, hydrants, valves, instrumentation, hoses, nozzles, hose boxes/stations etc. Copy of these measures with full details will be submitted to R.O, MOEF&CC (South-Eastern Zone) at Chennai, after detailed Engineering Completion.
(iv)	Storage facilities for auxiliary liquid fuel such as LDO/HFO/ LSHS shall be made in the plant area in consultation with Department of Explosives,	Storage facilities for auxiliary liquid fuel LDO/LSHS are designed conforming to the safety standards and where risk is minimal.

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	Nagpur. Sulphur content in the liquid fuel will not exceed 0.5% Disaster Management Plan shall be prepared to meet any eventuality in case of an accident taking place due to storage of oil.	A detailed Disaster Management Plan & Risk assessment including fire and explosion issues will be prepared and finalized in consultation with Department of Explosives, Nagpur and regular mock drills shall be conducted as per plan in order to address any eventuality in case of an accident.
(v)	First Aid and sanitation arrangement shall be made for the drivers and other contract workers during construction phase.	All arrangements related to first aid, health & safety and sanitation for workers during construction phase of the project have been kept under the scope of EPC contractor. However, NTPC will ensure effective compliance of the said stipulations. Various measures implemented during construction phase through contractor are: • Adequate infrastructure facilities, such as sanitation, fuel, restroom, medical facilities, safety, and suitable water supply are being provided to the labor colonies housing the work force during construction phase of the project. • Safety equipment such as earplugs and earmuffs, helmets, face shields, safety goggles etc. is being provided to workers engaged in high risk areas. • A first aid center is established to provide immediate medical aid to the workers and their family members. A 24 Hr ambulance is in service at site to transport injured workers to nearby hospitals.
(vi)	Noise levels emanating from turbines shall be so controlled such that the noise in the work zone shall be limited to 85 dB (A) from source. For people working in the high noise area, requisite personal protective equipment like earplugs/ear muffs etc. shall be provided. Workers engaged in noisy areas such as turbine area, air compressors etc shall be periodically examined to maintain audiometric record and for treatment for any hearing loss including shifting to none noisy/less noisy areas.	Design specification for the equipment has been made to comply with the stipulation. Personal protective equipment has been arranged through contractors during construction phase. Periodic examination of workers during operation phase shall be done as stipulated. The workers of generator hall and other high noise area will be provided with appropriate ear protection devices.
(vii)	Regular monitoring of ambient air ground level concentration of SO_2, NOX, $PM_{2.5}$ & PM_{10} and Hg shall be carried out in the impact zone and records maintained. If at any stage these levels are found to exceed the prescribed limits, Necessary control measures shall be provided immediately. The location of the monitoring stations and frequency	Regular Monitoring of Ambient air quality is being carried out through Continuous Ambient Air Quality Monitoring System and internal as well as through third party monitoring and reports are being submitted to Telangana SPCB and R.O, MOEF&CC (South-Eastern Zone) at Chennai.

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	of monitoring shall be decided in consultation with SPCB. Periodic reports shall be submitted to the Regional office of this Ministry. The data shall also be put on the website of the company.	The data shall also be put up on the website of the company during the operation phase of the project.
(viii)	Utilization of 100% Fly Ash generated shall be made from 4th year of operation. Status of implementation shall be reported to the Regional office of the Ministry from time to time.	Ash Utilization plan will be formulated and implemented in compliance to fly ash gazette notification by MOEF&CC dated 03.11.2011 and its subsequent amendments dated 26.01.2016 and status of ash utilization plan implementation shall be intimated to the RO, MOEF&CC (South-Eastern Zone), at Chennai.
(ix)	Provision shall be made for the housing of construction labour (as applicable) within the site with all necessary infrastructure and facilities such as fuel for cooking, mobile toilets, mobile STP, safe drinking water, medical health care, crèche etc. The housing may be in the form of temporary structures to be removed after the completion of the project.	A labour colony with necessary infrastructure facilities such as housing, sanitation, mobile toilet, fuel, medical facilities, safety, drinking water supply etc. has been provided for construction labour through EPC contractor. Also NTPC will ensure effective compliance of the said stipulations.
(x)	The project proponent shall advertise in at least two local newspapers widely circulated in the region around the project one of which shall be in the vernacular language of the locality concerned within seven days from the date of this clearance letter, informing that the project has been accorded environmental clearance and copies of clearance letter 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://envfor.nic.in.	The information of Environmental Clearance was published in Two newspapers widely circulated in the region on 23.01.2016 namely: 1. THE HINDU (English) & 2. EENADU (Telugu)
(xi)	A copy of the clearance letter shall be sent by the proponent to concerned Panchayat, Zila Parisad / Municipal Corporation, urban local Body and the Local NGO, if any from whom suggestions / representations, if any, were received while processing the proposal. The clearance letter shall also be put on the website of the Company by the proponent.	Copy of Environmental Clearance Letter has been submitted to Municipal Corporation, office of Zila Parisad and other concerned local authorities on 23.01.2016. The Environmental Clearance was also uploaded on the NTPC website on 25.01.2016.
(xii)	The proponent shall upload the status of compliance of the stipulated environmental clearance conditions, including results of monitored data on their website and shall update the same periodically. It shall simultaneously be sent to the Regional Office of MOEF, the respective Zonal Office of CPCB and the SPCBB. The criteria pollutant levels namely; SPM, RSPM ($MP_{2.5}$ & PM_{10}), SO_2, NO_X (ambient levels as well as stack emissions) shall be displayed at a convenient location near the main gate of the company in the	The latest HYC status report of the stipulated Environmental Clearance (EC) conditions is regularly being submitted to the Regional Office (South-Eastern Zone) of MOEF&CC at Chennai and at the same time being uploaded on MOEF&CC Web site. It is also being uploaded on the NTPC website of the company as per the stipulation. LED screen near the project entrance gate has been erected and it displays ambient air quality in terms of PM_{10}, $PM_{2.5}$, SO_2 and NOx.

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	public domain.	
(xiii)	The environment statement for each financial year ending 31st March in Form-v as is mandated to be submitted by the project proponent to the concerned State Pollution Control Board as prescribed under the Environment (Protection) Rules, 1986, as amended subsequently, shall also be put on the website of the company along with the status of compliance of environmental clearance conditions and shall also be sent the respective Regional Offices of the Ministry by e-mail.	The Environment Statement for each financial year ending 31st March in prescribed Form-V will be submitted to the Telangana State Pollution Control Board (Telangana SPCB) once the plant becomes operational by the project proponent.
(xiv)	The project proponent shall submit six monthly reports on the status of the implementation of the stipulated environmental safeguards to the Ministry of Environment and Forests, its Regional Office, Central Pollution Control Board and State Pollution Control Board. The project proponent shall upload the status of compliance of the environmental clearance conditions of their website and update the same periodically and simultaneously send the same by e-mail to the Regional Office, Ministry of Environment and Forests.	The said stipulation is being regularly complied. Half yearly compliance report for the period October 2018 to March 2019 was submitted on 08th May, 2019.
(xv)	Regional Office of the Ministry of Environment & Forests will monitor the implementation of the stipulated conditions. A complete set of documents including Environmental Impact Assessment Report and Environment Management Plan along with the additional information submitted from time to time shall be forwarded to the Regional Office for their use during monitoring. Project proponent will up-load the compliance status in their website and up-date the same from time to time at least six monthly basis. Criteria pollutants levels including NO_X (from stack & ambient air) shall be displayed at the main gate of the power plant.	Being complied.
(xvi)	Separate funds shall be allocated for implementation of environmental protection measures along with item-wise break-up. These cost shall be included as part of the project cost. The funds earmarked for the environment protections measures shall not be diverted for other purposes and year-wise expenditure should be reported to the Ministry.	Separate funds have been already allocated for Environment Protection measures. Financial Provision stipulated towards environment protection measure will not be diverted for any other purpose.
(xvii)	The project authorities shall inform the Regional Office as well as the Ministry regarding the date of financial closure and final approval of the project	Financial approval of the project is on 29.01.2016 and start of Land development work is on 09.05.2017.

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	by the concerned authorities and the dates of start of land development work and commissioning of plant.	
(xviii)	Full cooperation shall be extended to the Scientists / Officers from the Ministry / Regional Office of the Ministry /CPCB / SPCB who would be monitoring the compliance of environmental status.	Full cooperation shall be extended to the Scientists / officers from the Ministry / Regional Office of the MOEF&CC (South-Eastern Zone), at Chennai / CPCB / Telangana SPCB during monitoring of the project.
7	The ministry reserves the right to revoke the clearance if conditions stipulated are not implemented to the satisfaction. The Ministry may also impose additional environmental conditions or modify the existing ones, if necessary.	Noted.
8	The environmental clearance accorded shall be valid for a period of 7 years from the date of issue of this letter to start operations by the power plant.	Noted.
9	Concealing factual data or submission of false / fabricated data and failure to comply with any of the conditions mentioned above may result in withdrawal of this clearance and attract action under the provisions of Environmental (Protection) Act, 1986.	Noted.
10	In case of any deviation or alteration in the project proposed including coal transportation system from those submitted to this Ministry for clearance, a fresh reference should be made to the Ministry to assess the adequacy of the conditions (s) imposed and to add additional environmental protection measures required, if any.	Noted.
11	The above stipulations would be enforced among others under the water (Prevention and Control of Pollution) Act, 1974, the Air (Prevention and Control of Pollution) Act, 1981, the Environmental (Protection) Act, 1986 and rules there under, Hazardous Wastes (Management, Handling & Transboundary Movement) Rules, 2008 and its amendments, the Public Liability Insurance Act, 1991 and its amendments.	Noted.
12	Any appeal against this environmental clearance shall lie with the National Green Tribunal, if preferred, within 30 days as prescribed under Section 16 of the National Green Tribunal Act, 2010.	Noted.

Telangana State Remote Sensing Application Centre (TRAC),
Govt. of Telangana.
2017-18 Report.

Report

On

LANDUSE / LAND COVER CHANGE DETECTION ANALYSIS USING HIGH RESOLUTION SATELLITE IMAGERY

for

Telangana STPP, Stage-I (2x800MW)

Ramagundam, Peddapalli District, Telangana

(Sponsored by: NTPC Ltd. Ramagundam STPP, Telangana)

August, 2019

Prepared by

TELANGANA STATE REMOTE SENSING APPLICATIONS CENTRE (TRAC)

PLANNING DEPARTMENT, GOVERNMENT OF TELANGANA

NORTH BLOCK, GANANKA BHAVAN, KHAIRATABAD

HYDERABAD - 500 004

PREFACE

Efficient management of natural resources is possible to a maximum extent by having proper information about Land use/land cover. Also, knowledge about land use and land cover is important for planning in order to overcome the problems of uncontrolled development, deteriorating environmental quality, loss of agricultural lands, destruction of wetlands, biodiversity loss due to loss of natural forests and to understand the effects of climate changes. Land use data is needed in the analysis of environmental processes and problems that must be understood if living conditions and standards are to be improved to a greater extent. One of the main requirements for better use of land is information on existing land use patterns and changes in land use through time.

Realizing the potential of remote sensing technology in generating spatial information on natural resources in near-real time, which has become a pre-requisite in all the scientific planning activities, National Thermal Power Cooperation (NTPC)-Ramagundam, Peddapalli District, Telangana has entrusted mapping of land use/land cover on 1:25,000 scale using multi-temporal IRS-R2 LISS-IV data on annual basis from 2016-17 to 2020-21 to Telangana State Remote Sensing Applications Centre (TRAC).

The current report provides an account of the background of the project, methodology adapted and highlights of the classification results achieved during the second mapping cycle of 2017-18.

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1. Background

Ministry of Environment and Forests Climate Change (MoEF&CC) has accorded Environmental Clearance (EC) vide letter dated 20.01.2016 for setting up of Telangana, Stage - I (2X800 MW) project near Ramagundam, Peddapalli District of Telangana State. The clearance is with a condition that Land Use / Land Cover (LU/LC) status must be generated using the latest authenticated satellite imagery and should be submitted on annual basis to the Ministry and its Regional Office (R.O.) to monitor and estimate the spatial distribution and temporal variation of LU/LC. Remote Sensing and GIS tools provide fast, economic and fairly accurate information of Land Use patterns. The realistic information provided by Remote Sensing techniques is quite useful for planners and decision makers to monitor the annual changes in both spatial distribution and extent.

The consultancy was awarded to Telangana State Remote Sensing Applications Centre (TRAC) for study of annual mapping of LU/LC of NTPC-Ramagundam, Peddapalli District, Telangana over a period of five years. The multi-temporal LU/LC spatial data generated would be used for change detection analysis, so as to monitor the changes that have occurred when compared with previous years. This analysis depicts the spatial distribution and temporal changes in the study area which would enable the Ministry to monitor the nature and extent of vegetation.

2. Objective

To generate LU/LC map of NTPC, Ramagundam covering an area of 38311 acres and its environmental features on 1:10,000 scale, using Remote Sensing and GIS techniques. Specific objectives include:

- To generate spatial database on land use / land cover consecutively for five years;
- To generate land use / land cover change database along with change matrix with respect to 2016-17; and
- To identify nature and extent of major change in vegetation pattern.

3. Study Area

The study area of NTPC Ramagundam Plant including proposed Telangana STPP, Stage-I, covers major portion of Ramagundam and Mallialpalli Villages, which are located in Ramagundam Mandal, Peddapalli District. The study area extends between 18° 41' 40" to 18°49' 15" of North Latitude and 79° 31' 17" to 79° 23' 20" of East Longitude. The study area of 38311 acres, with a buffer of 7 km radius from centre of plant encompasses Main Plant, Ash-pond, Township, NTPC-Solar Power Plant and their environmental features are shown in (Figure -1).

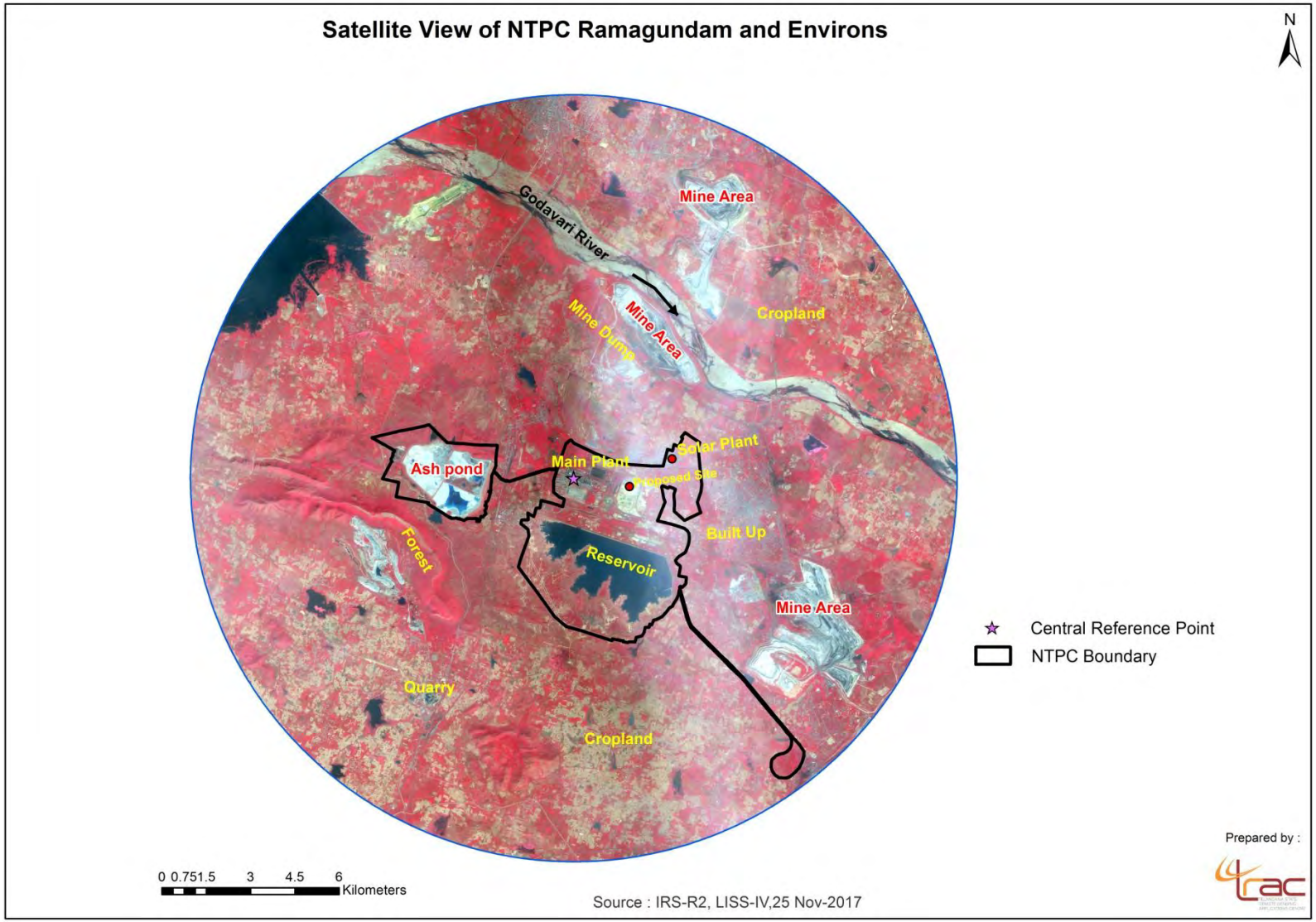


Figure - 1 Study area

4. Methodology

The work commences with base map preparation, using Survey of India (SoI) Toposheets on 1:50,000 scale. The base map contains Road (SH), Rail, Canal, River, Stream, Tanks, Forest boundary and other administrative boundaries.

High resolution satellite Imagery of IRS-Resourcesat-2, LISS-IV sensor with a spatial resolution of 5.8 m is used for generation of LU/LC features at 1:10,000 scale. Satellite image is enhanced to improve the basic visual interpretation characteristics. The Visual Interpretation technique is employed to delineate the extent of LU/LC classes. The entire study area is demarcated into various Land Use Land Cover categories based on 3rd level classification. The classes of LU/LC thus mapped are Cropland, Core Urban, Villages, Industry, Mines, Mixed built up, Water bodies and various categories of vegetation, Forest etc, in side plant area and its environmental features.

Ground truth/field verification is an important component in mapping and its validation exercise. To ascertain the accuracy of the pre-interpretation, field visit for ground truth data collection is carried out by TRAC team. During field work, all the identified doubtful areas in pre-field interpreted map were observed for clarity and correction. Post field corrections and incorporations considering ground truth were carried at TRAC to arrive at final map of Land use and Land cover having all classes which are mapable and existing on the ground.

5. Classification System for Land Use / Land Cover Mapping

The scheme for classification to be followed is based on standard National Remote Sensing Centre (NRSC) classification of LULC mapping. The classification considered is having three level hierarchical systems, wherein level-III is with 17 classes; level-II is with 12 classes and level-I having 5 classes. The classes used in this were primarily having land cover categories for level-I and mix of land use and land cover for level-II and III. The details of the classification schema are shown in Table -1.

Table - 1 Land Use / Land Cover Classification

S. No	Level - I	S. No 2	Level - II	S. No 3	Level - III
1	Built-up land	1.1	Urban	1.1.1	Core-Urban
				1.1.2	Mixed Built Up
				1.1.3	Vegetated Area
				1.1.4	NTPC -Vegetated Area
		1.2	Rural	1.2.1	Village
				1.2.2	Hamlets & Dispersed Household
		1.3	Industrial	1.3.1	Industrial area
				1.3.2	Ash pond
		1.4	Mining	1.4.1	Mining-Active
				1.4.2	Un vegetated mine dump
				1.4.3	Dense Vegetated mine dump
				1.4.4	Sparse Vegetated mine dump
2	Agricultural land	2.1	Crop land		
		2.2	Crop inside Forest		
		2.3	Agriculture Plantation		
3	Forest	3.1	Tree Clad Area		
		3.2	Scrub Forest		
4	Waste lands	4.1	Scrub land	4.1.1	Dense Scrub
				4.1.2	Open scrub
		4.2	Barren rocky/Stony waste		
5	Water bodies	5.1	River/ Stream/Drain		
		5.2	Reservoir/Tank	5.2.1	Dry tank with weed

6. Land Use / Land Cover classes and its definitions

Land classification refers to systemic grouping of different land types based on similar characteristics. Land cover classification considers biophysical characteristics, while land use classification considers the functional use of land connected with socio-economic activities.

6.1. Built-Up Land

Built-up areas are the area of human habitation that has a cover of buildings, transport and communication, utilities in association with water, vegetation and vacant lands. It consists of four level-2 classes namely Urban, Rural, Industrial and Mining.

6.1.1. Built-up - Urban

Urban areas are non-linear built up areas covered by impervious structures adjacent to or connected by streets. This usually occurs in combination with, vegetated areas that are connected to buildings that show regular pattern, such as vegetated areas, gardens, industrial and other areas. It comprises of three Level-III classes as discussed below:

6.1.1.1. Core-urban

The core-urban class is assigned when the urban structures and transport network occupies more than 80% of the surface area. Most of the land is covered by buildings, roads and artificially surfaced area and cover almost all the ground with an area of **3496.95** acres in the study area.

6.1.1.2. Mixed built up

Most of the land is covered by the structures like buildings, roads and artificially surfaced areas associated with vegetated areas and bare soil, which occupy discontinuous but significant surfaces. The discrimination between core urban and mixed built up is set from the presence of vegetation visible in the satellite image illustrating built up areas with green areas between them, associated with residential, institutional and recreational areas, and also avenue plantation along roads within the township of NTPC (Figure -2), covering an area of **1005.27** acres.

6.1.1.3. Vegetated area

These are the areas within urban agglomeration situated within or in contact with urban areas. An area is included in this class if vegetation cover of trees, shrubs and herbs covers at least 5% of the total surface area. This includes green spaces situated within or contact with built-up and are occupying more than 2.25 ha. Vegetated area of **1539.38** acres is observed especially at Ramagundam, Godavarikhani, towards East of Jyothisagar reservoir and near coal mine at Northern side of the study area.

6.1.1.4. NTPC -Vegetated area

The class is defined similar to the vegetated area. These are the areas identified on satellite imagery where NTPC has taken up plantation in and around the plant as part of protecting environment in the area. These areas are separately delineated as these are seen in large stretches within the plant boundary (Figure -2) and the area increased from **1747.39** acres in 2016-17 to **2099.91** acres in 2017-18. Apart from these plantations there are also large numbers of trees in the town ship of NTPC all along the roads (avenue plantations) and open spaces which actually form part of mixed built class.

Figure - 2 (i) NTPC vegetated area near Jyothisagar reservoir

Figure - 2 (ii) NTPC vegetated area near Jyothisagar reservoir with main plant in background

6.1.2. Built up - Rural

They are the built-up areas, smaller in size, used for settlement of size comparatively less than urban settlements of which more than 80% of the people are involved in primary activity of agriculture. This category includes two level-III classes namely village and Hamlet & Dispersed Household.

6.1.2.1. Village

Villages are the built-up areas, with an area of **718.15** acres, smaller in size, mainly associated with agriculture and allied sectors and non-commercial activities and they generally lack of supporting facilities that are unique to urban areas.

6.1.2.2. Hamlets & dispersed household

Settlements fragmented into several units physically separated from main settlement are called Hamlets. Dispersed or isolated settlement pattern in the form of hamlets are found in association with rural areas in an area of **36.97** acres.

6.1.3. Built-up Industrial

Non-linear impervious surfaces are included in this class which is related to trade, manufacturing, distribution and commerce and are not occurring in continuity with urban cover.

6.1.3.1. Industrial area

These are artificially surfaced areas (with concrete, asphalt, tar macadam, or stabilized, e.g. beaten earth) without vegetation, which also contains buildings and/or vegetation. These are the areas where the human activity is observed in the form of manufacturing along with other supporting establishments of maintenance. **1526.55** acres of industrial area including, NTPC main plant and a solar power plant (Figure -3) is also observed during field visit in study area.

Figure -3 NTPC Solar power plant

6.1.3.2. Ash pond

Ash pond (Figure - 4) of **1389.04** acres is a portion of Thermal Power Station areas used as temporary storage area of ash. . Ash excavation from ash pond by trucks is observed during the field visit.

Figure - 4 (i) Ash Pond

Figure - 4 (ii) Ash Pond

6.1.4. Built-up Mining

These areas encompass area under surface operations subjected to removal of different earth material by manual and mechanized operations.

6.1.4.1. Mining-active

These are the areas where presently large scale surface operations of removal of economically important ores are presently going on. These areas are majorly observed on satellite image at coal mine site and one at forest towards West of Reservoir site with an area of **1359.07** acres. It is observed that part of the mining activity is carried within the notified forest boundary.

6.1.4.2. Un-vegetated mine dump

These mine dumps are those areas where waste debris is accumulated after extraction of required minerals. Generally these lands are confined to the surroundings of the mining area and are devoid of vegetation. These are observed in **459.52** acres near coal mine at North Eastern side of the study area.

6.1.4.3. Dense vegetated mine dump

The mine dump areas are where, waste debris is accumulated and are artificially developed or reclaimed with dense vegetation. Vegetation is encouraged on such bare dump surfaces to stabilize and arrest the erosion due to high surface run off during rains. **751.29** acres of dense vegetated mine dump areas are observed near the Godavari river.

6.1.4.4. Sparse vegetated mine dump

The mine dump areas where waste debris is accumulated, are artificially developed or reclaimed presently noticed with sparse vegetation in an area of **140.02** acres. There is a scope for further plantations/vegetative reclamation in these areas.

6.2. Agricultural Land

These are the lands primarily used for agriculture for production of food, fiber, and other commercial and horticultural crops which include irrigated and un-irrigated, fallow, plantations etc. Under this two level-II classes are included namely cropland, and agriculture plantation.

6.2.1. Crop land

These are the areas with standing crop as on the date of satellite overpass. Cropped areas appear in bright red to red in colour with varying shape and size in a contiguous to non-contiguous pattern. Cropland comprising of **7909.03** acres exist in the Southern and Northern of study area.

6.2.2. Agriculture plantation

These are the areas under agricultural tree crops planted adopting agricultural management techniques. These also include the areas of land use systems and practices wherein cultivation of herbs, shrubs, and vegetable crops are deliberately integrated with agricultural crops mostly in irrigated conditions for ecological and economic reasons. An area of **49.95** acres of agriculture plantation is noticed.

6.3. Forest

The term forest is used to refer to land with a tree canopy cover of more than 10 percent and area of more than 0.5 ha. Forest is determined both by presence of trees and the absence of other predominant land uses within notified forest boundaries. The total forest area in the study area is **5451.43** acres. Scrub forest and tree clad areas are also observed within the plant area and study area respectively.

6.3.1. Scrub Forest

These are the forest areas where the crown density is less than 10% of the canopy cover, generally seen at the fringes of dense forest cover and settlements, where there is biotic and abiotic interference. Most of these are located on hill/mountain slopes within notified forest areas, at times closer to habitations. Scrub forest areas of **332** acres are noticed to North of ash pond area in the study area.

6.3.2. Tree clad area

Areas with tree cover lying outside the notified forest area with woody perennial plants with a single, well-defined stem carrying defined crown and being at least 3 m tall. The areas are dense vegetated areas generally with forest species at the periphery of forest boundaries. These are observed in **325.52** acres on satellite imagery at some places near forest on Northern side of ash pond.

6.4. Waste Lands

Wasteland is described as degraded land which can be brought under vegetative cover with reasonable effort and which is currently underutilized and land which is deteriorating for lack of appropriate water and soil management or on account of natural causes. Under this two level-II classes are included namely scrub land and barren rocky/stony waste.

6.4.1. Scrub land

This is a land, which is generally prone to deterioration due to erosion. Such lands generally occupy topographically high locations, excluding hilly/mountainous terrain. Scrublands are associated with moderate slopes in plains and foot hills and are generally surrounded by agricultural lands. Dense scrub and open scrub are the two level-III classes included in this class.

6.4.1.1. Dense scrub

These areas possess shallow skeletal soils, at times chemically degraded, extremes of slopes, severely eroded and lands subjected to excessive aridity with scrubs dominating the landscape. The majority dense scrub area of **742.64** acres is noticed towards South and West of main plant.

6.4.1.2. Open scrub

This category has a similar description as mentioned in the earlier class excepting that they possess sparse vegetation or devoid of scrub and have a thin soil cover. Open scrub (Figure - 5) areas are noticed to towards the South of reservoir, west of main plant with a total area of **3658.05** acres.

Figure -5 Open scrub areas near Jyothisagar reservoir

6.4.2. Barren rocky/Stony waste

This class contains areas that are dominated by a continuous rock surface or covered by a coarse rock fragments. Rock surface is continuous, with some areas may be covered by shallow layer of soil or there could be isolated pockets of soil or a mixture of both. The area of barren rocky/stony waste is **241.84** acres in study area.

6.5. Water body

This category comprises areas with surface water, either impounded in the form of ponds, lakes and reservoirs or flowing as streams, rivers, canals etc. Two level-II and one level-III classes are included in this category.

6.5.1. River/ stream/drain

River/ Stream/Drain are natural course of water flowing on the land surface along a definite channel/slope regularly or intermittently towards a sea or in most cases or a lake or an inland basin. The area covered by these features in the study area is **1123.71** acres.

6.5.2. Reservoir/tank

Reservoir is an artificial lake created by construction of a dam across the river specifically for hydel power generation, irrigation, and water supply for domestic/industrial needs, flood control. Tanks are small lakes of impounded water ways constructed on land surface for irrigation.

Jyothisagar reservoir (Figure -6) which is source of water for both main plant and township is located to the South of study area comprising of **3078.43** acres. Vegetated areas are observed in and around reservoir.

Figure - 6 (i) Jyothisagar reservoir

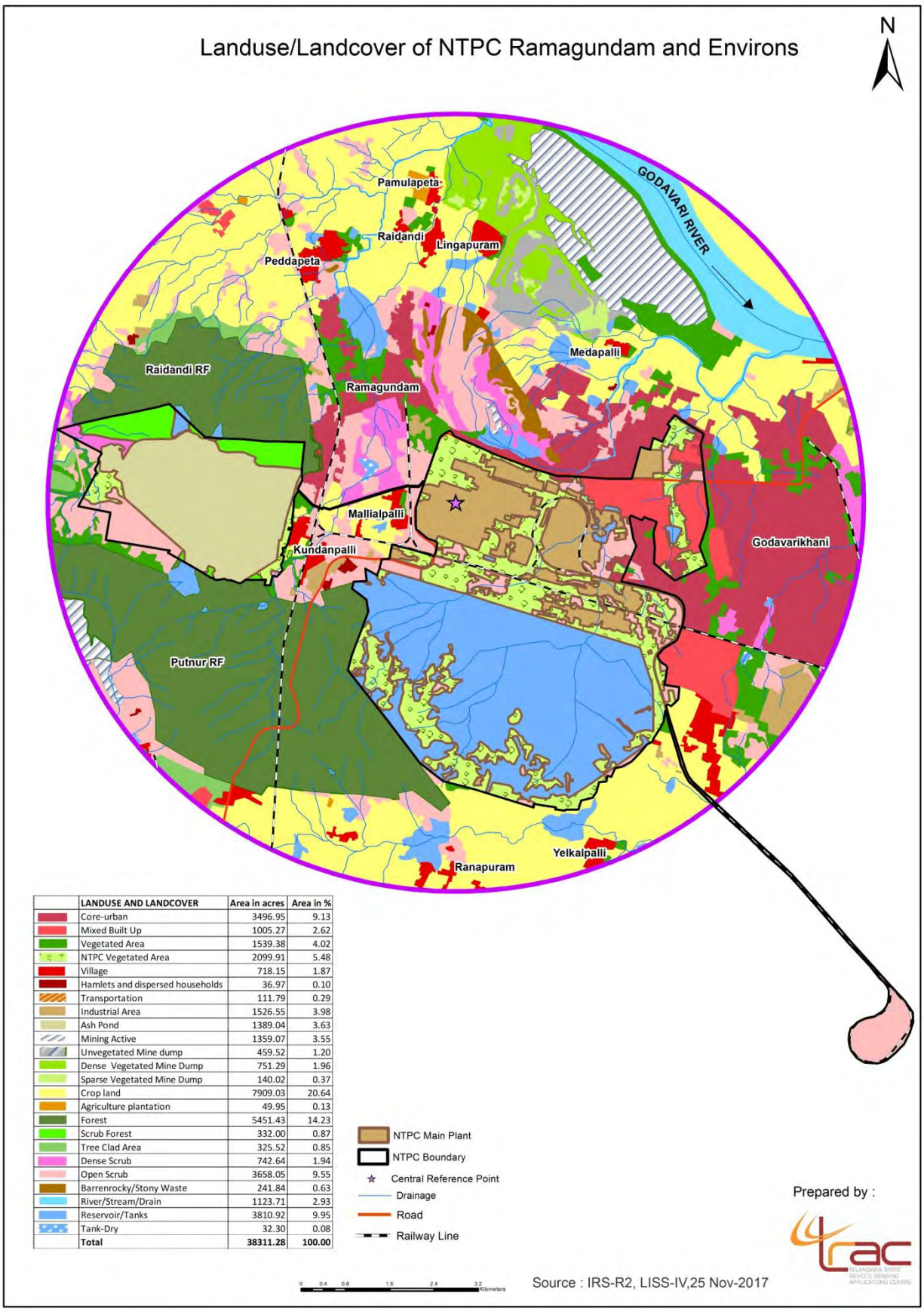
Figure - 6 (ii) NTPC vegetated area observed near Jyothisagar reservoir

6.5.2.1. Dry tank

Dry tanks are those, which do not have water spread throughout the year. Few small dry water bodies are noticed in the study area with an area of **32.30** acres. The dry tank within plant boundary is defunct in nature and no more exists, as entire catchment area of the tank completely drains into Jyothisagar reservoir built by NTPC. The proposed Telangana, Stage - I (2X800 MW) project site is shown in the Figure -7 with Ground Control Points (GCP) overlaid on the satellite image.

The Land Use / Land Cover of NTPC and its environmental features is shown in the Figure - 8. The summary of statistics of each Land Use / Land Cover classes in study area are shown in the Table-2. Table-3 is showing the summary of statistics of land use / land cover classes within NTPC.

Figure - 7 GCP point overlaid on satellite image near proposed Telangana, Stage - I (2X800 MW) project site



	LANDUSE AND LANDCOVER	Area in acres	Area in %
	Core-urban	3496.95	9.13
	Mixed Built Up	1005.27	2.62
	Vegetated Area	1539.38	4.02
	NTPC Vegetated Area	2099.91	5.48
	Village	718.15	1.87
	Hamlets and dispersed households	36.97	0.10
	Transportation	111.79	0.29
	Industrial Area	1526.55	3.98
	Ash Pond	1389.04	3.63
	Mining Active	1359.07	3.55
	Unvegetated Mine dump	459.52	1.20
	Dense Vegetated Mine Dump	751.29	1.96
	Sparse Vegetated Mine Dump	140.02	0.37
	Crop land	7909.03	20.64
	Agriculture plantation	49.95	0.13
	Forest	5451.43	14.23
	Scrub Forest	332.00	0.87
	Tree Clad Area	325.52	0.85
	Dense Scrub	742.64	1.94
	Open Scrub	3658.05	9.55
	Barrenrocky/Stony Waste	241.84	0.63
	River/Stream/Drain	1123.71	2.93
	Reservoir/Tanks	3810.92	9.95
	Tank-Dry	32.30	0.08
	Total	**38311.28**	**100.00**

Figure - 8 Map showing Land Use / Land Cover of NTPC and its Environs

Table- 2 Summary of statistics of Land Use / Land Cover classes in study area

S. No	Land Use / Land Cover (Level- II)	S. No	Land Use / Land Cover (Level- III)	Area in acres, 2016-17	% area to total geographical area	Area in acres, 2017-18	% area to total geographical area
1	Urban	1	Core-urban	3625.74	9.46	3496.95	9.13
		2	Mixed built up	887.86	2.32	1005.27	2.62
		3	Vegetated area	1145.2	2.99	1539.36	4.02
		4	NTPC vegetated area	1747.39	4.56	2099.91	5.48
		5	Transportation	85.04	0.22	111.79	0.29
2	Rural	6	Village	751.96	1.96	718.15	1.87
		7	Hamlets and dispersed households	45.25	0.12	36.97	0.10
3	Industrial	8	Industrial area	1160.89	3.03	1526.55	3.98
		9	Ash pond	1391.32	3.63	1389.04	3.63
4	Mining	10	Mining active	1363.3	3.56	1359.07	3.55
		11	Un-vegetated mine dump	548.06	1.43	459.52	1.20
		12	Dense vegetated mine dump	704.72	1.84	751.29	1.96
		13	Sparse vegetated mine dump	93.5	0.24	140.02	0.37
5	Agricultural land	14	Crop land	8062.31	21.04	7909.03	20.64
		15	Agriculture plantation	49.96	0.13	49.95	0.13
6	Forest	16	Forest	5438.58	14.2	5451.43	14.23
		17	Scrub forest	332.05	0.87	332.00	0.87
		18	Tree clad area	327.25	0.85	325.52	0.85
7	Waste land	19	Dense scrub	766.47	2	742.64	1.94
		20	Open scrub	4132.32	10.79	3658.05	9.55
		21	Barren rocky/Stony waste	250.48	0.65	241.84	0.63
8	Water body	22	River/Stream/Drain	1113.57	2.91	1123.71	2.93
		23	Reservoir/Tanks	4166.14	10.87	3810.92	9.55
		24	Tank-Dry	121.92	0.32	32.30	0.08
			Total	**38311.28**	**100.00**	**38311.28**	**100.00**

Table- 3 Summary of statistics of Land Use / Land Cover classes within NTPC

S. No	NTPC Main Plant	Area in acres, 2016-17	Area in %	Area in acres, 2017-18	Area in %
1	Main plant	834.00	9	1195.32	12
2	Township	547.00	6	530.96	6
3	Ash pond	1391.00	14	1389.04	14
4	Transportation	85.00	1	94.46	1
5	NTPC Vegetated Area	1747.00	18	2099.91	22
6	Scrub Forest	332.00	3	332.00	3
7	Scrub land-Dense	59.00	1	54.94	1
8	Scrub land-Open	1126.00	12	826.94	9
9	Reservoir/Tank	3481.00	36	3078.43	32
	Grand Total	**9602.00**	**100**	**9602.00**	**100**

Table - 4 Change Matrix of Land Use / Land Cover classes within NTPC

2017-18 / 2016-17	Ash Pond	Main plant	NTPC Vegetated Area	Reservoir/ Tanks	Scrub Forest	Scrub land-Dense	Scrub land-Open	Township	Transpo-rtation	Total
Ash Pond	1385.88		5.12							1391.00
Main Plant		769.99	61.75	2.26						834.00
NTPC Vegetated Area		225.22	1508.89				5.91	2.42	4.56	1747.00
Reservoir/Tanks		63.24	333.82	3076.17	0		7.77			3481.00
Scrub Forest					332					332.00
Scrub land-Dense	2.25	1.72	35.62			5.81	12.75		0.85	59.00
Scrub land-Open	0.91	125.22	149.1			49.13	799.63		2.01	1126.00
Township		9.93	5.61				0.88	528.54	2.04	547.00
Transportation									85	85.00
Total	1389.04	1195.32	2099.91	3078.43	332	54.94	826.94	530.96	94.46	**9602.00**

References

Manual, National Land Use land Cover Mapping using Multi-temporal Satellite Data, NRC-LULC-50 K, NRSA, May-2006.