




We hope you will find the above in order.

Thanking You  
Your faithfully

For GMR Chhattisgarh Energy Limited



Ravi Shanker S.

(Chief Operating Officer)



- CC to :
1. The Additional Principal Chief Conservator of Forests  
Ministry of Environment, Forest & climate change  
Regional Office (West Central Zone)  
Ground Floor, Est Wing  
"New Secretary Building"  
Civil Line, Nagpur - 440001
  2. The Zonal Officer  
Zonal Office CPCB (MoEF Govt. of India)  
Sahkar Bhavan, North TT Nagar  
Infront of Rang Mahal  
Bhopal - 462016, Madhya Pradesh
  3. The Member Secretary  
Chhattisgarh Environment Conservation Board  
Raipur- 492001, Chhattisgarh
  4. The Regional Officer  
Regional Office  
Chhattisgarh Environment Conservation Board  
Kabir Nagar, Raipur- 492001, Chhattisgarh

**GMR CHHATTISGARH ENERGY LTD.**  
**Village – Raikheda, Gayatra and Chicholi, Block – Tilda, Distt – Raipur,**  
**Chhattisgarh**

Half yearly EC compliance Status of 1370 (2*685) MW Thermal Power Plant		
Environmental Clearance Letter No. and dated		J-13012/62/2008-IA.II (T), MoEF GOI 9 <sup>th</sup> May 2011 (amendments dated 13/06/13, 18/11/14, 04/02/15, 09/12/2015 )
Date		26/11/2016
SN	Condition	Compliance Status
<b>A - Specific Condition</b>		
i	Vision document specifying prospective plan for the site shall be formulated and submitted to the Ministry within six months	Latest vision document specifying prospective plan for site has been submitted vide our letter no. GMR/CTPP/MOEF/2014-15/121 dated 28/11/2014.
ii	In case source of fuel supply now proposed to be run on imported coal from South Africa for running the power plant is proposed to be changed to domestic coal at a later stage, the project proponent shall apply for such a change in environmental clearance along with necessary documents as required under EIA notification, 2006 (and its amendments). In such a case the necessity for holding public hearing again or otherwise will be determined by the Ministry in consultation with the Expert Appraisal Committee (Thermal Power).	Application with request for necessary change in fuel supply source has been made & amended EC has also been issued to us in accordance with the above change.
iii	Provision for installation of FGD shall be provided for future use.	Complied, Space provision for FGD has been made.
iv	Stack of 275 m height shall be installed and provided with continuous online monitoring equipments for SO <sub>x</sub> , NO <sub>x</sub> and PM <sub>2.5</sub> & PM <sub>10</sub> . Exit velocity of flue gases shall not be less than 22 m/sec. Mercury emissions from stack may also	Stack Height of 275m with continuous emission monitoring system (CEMS) has been installed with exit velocity of 25m/sec. Mercury emissions from stack shall be monitored on periodic

**GMR CHHATTISGARH ENERGY LTD.**  
**Village – Raikheda, Gayatra and Chicholi, Block – Tilda, Distt – Raipur,**  
**Chhattisgarh**

	monitored on periodic basis.	basis during the operation.
v	High Efficiency Electrostatic Precipitators (ESPs) shall be installed followed by installation of Bag Filter and it shall be ensured that particulate emission does not exceed 50 mg/Nm <sup>3</sup> .	High efficiency ESP is installed i.e. 99.95% ensuring emission level < 50 mg/Nm <sup>3</sup> . An amendment has been obtained from MoEF on this condition for installation of ESP alone. Letter to MOEF bearing No. J-13012/62/2008-IA.II (T) GOI, MOEF dated 13/06/2013 may please be referred in this regard. Copy of letter has already been submitted to your good office vide our letter no. GMR/CTPP/MOEF/2014-15/121 dated 28/11/2014.
vi	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.	Dust extraction system has been installed in coal crusher, AHP & coal bunker. Dust suppression system through dry fog method has been installed in coal conveyor transfer point & water spray system in coal yard.
vii	Sulphur and ash contents in the coal to be used in the project shall not exceed 0.5 % and 34 % respectively at any given time. In case of variation of coal quality at any point of time fresh reference shall be made to MOEF for suitable amendments to environmental clearance condition wherever necessary.	The stipulated conditions for sulphur & ash contents has been changed from 0.5 % and 34% to 0.7 % and 34% respectively as per the letter issued by MOEF vide no. No. J-13012/62/2008-IA.II (T) GOI, MOEF dated 13/06/2013. The same is being complied.
viii	Transport of coal to the plant site shall be strictly by rail. The project proponent shall therefore immediately take up the matter with the Railways. Status of implementation shall be submitted to the Regional Office of the Ministry from time to time.	"Railway Transport Clearance" approval from Railway Authorities granted for the transportation of coal. Already submitted to your good office vide our letter No. GMR/CTPP/MOEF/2012-13/269

**GMR CHHATTISGARH ENERGY LTD.**  
**Village – Raikheda, Gayatra and Chicholi, Block – Tilda, Distt – Raipur,**  
**Chhattisgarh**

		<p>dated 13/06/2012.</p> <p>The MOEF &amp; CC has issued permission for a period of three year to transport coal by road vide letter No. J-13012/62/2008-IA.II (T) dated 18/11/2014. Copy of letter has already been submitted to your good office vide our letter no. GMR/CTPP/MOEF/2014-15/121 dated 28/11/2014. However as per the present status, railway track is complete &amp; coal transportation is started by rail.</p>
ix	Existing de-generated water bodies (if any) within 5.0 Km of the site shall be regenerated at the project proponent's expenses in consultation with the state govt.	There is no existing de-generated water body within 5.0 Km of the site.
x	The proponent shall sponsor a detailed study regarding water availability in Mahanadi River for all competing sources such as drinking, agriculture, industrial, minimum flow of water in the river during the lean season etc through institutions like IIT, Delhi/IIT, Roorkee. The draft terms of reference shall be submitted within three months which shall be finalized by the Expert Appraisal Committee. The preliminary report on the above study shall be submitted within one year.	Complied. Draft TOR has been submitted vide our letter no. GMR/CTPP/2015-16 /88, dated 08/07/2015.
xi	The project proponent shall undertake proactive water harvesting measures and water storage for a larger period not less than 30 days storage shall be developed. The rain water harvesting system shall be put in place before commissioning of the plant. Central Groundwater Authority/ Board shall be consulted for finalization of appropriate	CGWA has been consulted for finalization of rainwater harvesting technology/design. CGWA has approved our proposed rain water harvesting design vide letter no. 21-4(118)/NCCR/CGWA/2011-1840 dated 14.12.2011. Copy of approval

**GMR CHHATTISGARH ENERGY LTD.**  
**Village – Raikheda, Gayatra and Chicholi, Block – Tilda, Distt – Raipur,**  
**Chhattisgarh**

	rainwater harvesting technology/design within a period of three months from the date of this clearance and details shall be furnished. The design of rain water harvesting shall comprise of rain water collection from the built up and open area in the plant premises. Action plan and road map for implementation shall be submitted to the Ministry within six months.	letter is already submitted to your good office vide our letter No. GMR/CTPP/MOEF/2012-13/269 dated 13/06/2012. Construction of rain water harvesting ponds completed.
xii	Hydrogeology in and around the project area shall be reviewed annually from an institute/ organization of repute to assess impact of surface water and ground regime (especially around ash dyke). In case and deterioration is observed specific mitigation measures shall be undertaken and reports/ data of water quality monitored regularly and maintained shall be submitted to the Regional Office of the Ministry.	The hydrogeology study report is attached herewith as Annexure-I.
xiii	No ground water shall be extracted for use in operation of the power plant even in lean season.	Shall be complied.
xiv	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.	Complied.
xv	Water requirement shall be optimized to around 32 MCM and shall accordingly adopt higher COC of at least not less than 5.0.	Being complied.
xvi	Minimum required environmental flow suggested by the Competent Authority of the State Govt. shall be maintained in the Channel/ Rivers (as applicable) even in lean season.	Being complied.
xvii	Regular monitoring of ground water level shall be carried out by establishing a network of existing wells and constructing new piezometers. Monitoring around the ash pond area shall be	Six nos. piezometers constructed around periphery of the plant and ash pond. Photograph of piezometers have been submitted to your good office

**GMR CHHATTISGARH ENERGY LTD.**  
**Village – Raikheda, Gayatra and Chicholi, Block – Tilda, Distt – Raipur,**  
**Chhattisgarh**

	carried out particularly for heavy metals (Hg, Cr, As, Pb) and records maintained and submitted to the Regional Office of this Ministry. The data so obtained should be compared with the baseline data so as to ensure that the ground water quality is not adversely affected due to the project	vide our letter No. GMR/CTPP/MOEF/2012-13/269 dated 13/06/2012. Seasonal monitoring of ground water level and quality is being done and monitored data being submitted to the MOEF/CPCB/CECB regularly.
xviii	Monitoring surface water quality in the region 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 be undertaken.	Seasonal monitoring of Surface water is being done. The monitored data being submitted to MOEF/CPCB/CECB regularly.
xix	Additional soil for levelling of the proposed site shall be generated within the sites (to the extent possible) so that natural drainage system of the area is protected and improved.	Complied.
xx	The project proponent shall undertake measures and ensure that no fugitive fly ash emissions take place at any point of time.	Being complied.
xxi	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.	Generated fly ash is being supplied to nearest cement industry and brick manufacturer. Being complied as per Notification.
xxii	Fly ash shall be collected in dry form and storage facility (silos) shall be provided. Unutilized fly ash shall be disposed off in the ash pond in the form of slurry form. Mercury and other heavy metals (As,Hg, Cr, Pb etc.) will be monitored in the	Being complied.

**GMR CHHATTISGARH ENERGY LTD.**  
**Village – Raikheda, Gayatra and Chicholi, Block – Tilda, Distt – Raipur,**  
**Chhattisgarh**

	bottom ash as also in the effluents emanating from the existing ash pond. No ash shall be disposed off in low lying area.	
xxiii	Ash pond shall be lined with HDPE/LDPE lining or any other suitable impermeable media such that no leachate takes place at any point of time. Adequate safety measures shall also be implemented to protect the ash dyke from getting breached.	Complied.
xxiv	For disposal of Bottom Ash in abandoned mines (if proposed to be undertaken) shall be done after obtaining due permission from DGMS and after ensuring that the bottom and sides of the mined out areas are adequately lined with clay before Bottom Ash is filled up. The project proponent shall inform the State Pollution Control Board well in advance before undertaking the activity.	Shall be complied as & when required.
xxv	Green Belt consisting of 3 tiers of plantations of native species around plant and at least 75 m width shall be raised. Tree density shall not less than 2500 per ha with survival rate not less than 80 %.	Complied.  The plantations have been done in 234 acre. Survival rate of plantation is >90%.
xxvi	At least three nearest village shall be adopted and basic amenities like development of roads, drinking water supply, primary health centre, primary school etc shall be developed in co-ordination with the district administration.	GMR Varalakshmi Foundation (CSR arm of GMR group) initiated community services in three project affected villages namely Raikheda, Chicholi & Gaitera in June, 2009 and expanded its reach to two new villages namely Sontara and Gaurkheda in June, 2012. One peripheral village "Murra" has been taken up from July, 2013. The outreach is expanded to other near by villages namely Khamariya, Konari, Tulsi, Tarashiv, Bartori, Chatod and Samoda in year 2015. Half Yearly report of CSR activities is enclosed in <b>Annexure- II</b> .



**GMR CHHATTISGARH ENERGY LTD.**  
**Village – Raikheda, Gayatra and Chicholi, Block – Tilda, Distt – Raipur,**  
**Chhattisgarh**

		The Thematic area of work in villages is improving quality of education, access of health care and sanitation, empowerment and livelihood and community development.
xxvii	The project proponent shall also adequately contribute in the development of the neighbouring villages. Special package with implementation schedule for providing potable drinking water supply in the nearby villages and schools shall be undertaken in a time bound manner.	Currently GMRVF is working in Four directly project affected villages and Nine indirectly affected and Railway siding villages namely Sontara, Gaurkheda, Khamariya, Konari Murra, Tulsi, Tarashiv, Bartori, Chatod located on western and northern boundary of the proposed plant. The development work in these villages is implemented in planned and time bound manner.
xxviii	A time bound implementation of the CSR shall be formulated within six months and submitted to the Ministry. While identifying CSR activities it shall be ensured that need based assessment for the nearby villages within study area shall be conducted to study economic measures with action plan which can help in upliftment of poor section of society. Income generating projects consistent with the traditional skills of the people shall be undertaken. Development of fodder farm, fruit bearing orchards, vocational training etc. can form a part of such programme. Company shall provide separate budget for community development activities and income generating programmes. Vocational training programme for possible self-employment and jobs shall be imparted to identify villagers free of cost.	CSR Plan for the villages is made as per local need and CSR activities are identified by Social work professionals employed exclusively for CSR through GMR Varalakshmi Foundation in consultation with communities and their representatives. Poorest of the poor families are identified basing village Panchayats statistics and special interventions have been planned for their upliftment. Separate budget has been allocated for community development activities, income generation activities. Vocational training is being provided to youth for self-employment free of cost.
xxix	An amount of Rs 33.16 Crores shall be earmarked as one time capital cost for CSR programme as committed by the project proponent. Subsequently a recurring expenditure of Rs 6.63 Crores per annum shall be earmarked as recurring expenditure for CSR activities. Details of the activities to be undertaken shall be submitted within six month along with road map for implementation.	Time bound implementation of CSR activities with budget of Rs.33.16 has already been planned and same is being implemented in nearby project villages. Expenditure status is Attached as <b>Annexure – III</b> .

**GMR CHHATTISGARH ENERGY LTD.**  
**Village – Raikheda, Gayatra and Chicholi, Block – Tilda, Distt – Raipur,**  
**Chhattisgarh**

xxx	It shall be ensured that in-built monitoring mechanism for the schemes identified is in place and annual social audit shall be got done from the nearest government institute of repute in the region. The project proponent shall also submit the status of implementation of the scheme from time to time	The social audit for year 2015-16 is Completed. The Social audit work conducted by the nearest government institute of repute in coordination with independent agency. Copy of Social Audit Report is attached as <b>Annexure – IV.</b>
<b>B - General Conditions</b>		
i	The treated effluents conforming to the prescribed standards only shall be re-circulated and reused within the plant. Arrangements shall be made that effluents and storm water do not get mixed.	Complied.
ii	A sewage treatment plant shall be provided (as applicable) and the treated sewage shall be used for raising greenbelt/plantation.	Complied.
iii	Adequate safety measures shall be provided in the plant area to check/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.	Being complied. The drawing of the fire detection, protection & fighting system has been submitted vide our previous compliance letter No. GMR/CTPP/MOEF/2014-15/40, dated 25/06/2014.
iv	Storage facilities for auxiliary liquid fuel such as LDO and/ HFO/LSHS shall be made in the plant area in consultation with Department of Explosives, 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.	Complied.  A copy of approval for storage facilities for auxiliary liquid fuel such as LDO and/ HFO/LSHS obtained from Department of Explosives, Nagpur has been submitted.  Disaster Management Plan also is in place.
v	First Aid and sanitation arrangements shall be made for the drivers and other contract workers during construction phase.	Now our construction phase is over, however it was being complied with during construction.

**GMR CHHATTISGARH ENERGY LTD.**  
**Village – Raikheda, Gayatra and Chicholi, Block – Tilda, Distt – Raipur,**  
**Chhattisgarh**

vi	Noise levels emanating for turbines shall be so controlled such that the noise in the work zone shall be limited to 85 dBA from the source. For people working in the high noise area, requisite personal protective equipment like ear plugs/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 non-noisy/less noisy areas.	Engineering control for noise such as acoustic enclosure, silencer has been installed in the turbine. Moreover also ear plug, muff etc. is provided to workers in high noise area.  Noise label monitoring report is being submitted to your good office regularly.
vii	Regular monitoring of ambient air ground level concentration of SO <sub>2</sub> , NO <sub>x</sub> , PM <sub>2.5</sub> & PM <sub>10</sub> 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 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.	Being complied.
viii	Provision shall be made for the housing of construction labor (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 completion of the project.	Complied. Now construction work is completed.
ix	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 Quality concerned within seven days from the date of this clearance letter, informing that the project has been	Complied; copy of newspapers submitted to your good office vide our letter no. GMR/CTPP/MOEF/2011-12/212 dated 10/11/2011.

**GMR CHHATTISGARH ENERGY LTD.**  
**Village – Raikheda, Gayatra and Chicholi, Block – Tilda, Distt – Raipur,**  
**Chhattisgarh**

	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 <a href="http://envfor.nic.in">http://envfor.nic.in</a>	
x	A copy of the clearance letter shall be sent by the proponent to concerned Panchayat, Zilla Parishad/ Municipal Corporation, urban local Body and the Local NGO, if any, from whom suggestions/representations. If any, receive while processing the proposal. The clearance letter shall also be put on the website of the Company by the proponent.	Complied, copies of letters submitted to your good office vide our letter no. GMR/CTPP/MOEF/2011-12/212 dated 10/11/2011.
xi	An Environmental Cell comprising of at least one expert in environmental science / engineering, occupational health and social scientist, shall be created at the project site itself and shall be headed by an officer of appropriate superiority and qualification it shall be ensured that the Head the Cell shall directly report to the head of the organization and he shall be held responsible for implementation of environmental regulations and social impact improvement/mitigation measures.	Complied with.
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 SPCB. The criteria pollutant levels namely SPM, RSPM (PM2.5 & PM10), SO2, NOX (ambient levels as well as stack emissions) shall display at a convenient location near the main gate of the company in the public domain.	Being complied.  The previous compliance status report can be viewed at following web-link  <a href="http://www.gmrgroup.in/Energy/GMR_Chhattisgarh_Power_Project.html">http://www.gmrgroup.in/Energy/GMR_Chhattisgarh_Power_Project.html</a>  Display board has also been installed at main gate.

**GMR CHHATTISGARH ENERGY LTD.**  
**Village – Raikheda, Gayatra and Chicholi, Block – Tilda, Distt – Raipur,**  
**Chhattisgarh**

xiii	The environment statement for each financial year ending 31 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 to the respective Regional Offices at the Ministry.	Being complied.  The Environmental Statement report can be viewed at following web-link  <a href="http://www.gmrgroup.in/Energy/GMR Chhattisgarh Power Project.html">http://www.gmrgroup.in/Energy/GMR Chhattisgarh Power Project.html</a>
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 environment of the environmental clearance conditions on their website and update the same periodically and simultaneously send the same by e-mail to the Regional Office, Ministry of Environment and Forests.	Being complied.  The previous compliance status report can be viewed at following web-link  <a href="http://www.gmrgroup.in/Energy/GMR Chhattisgarh Power Project.html">http://www.gmrgroup.in/Energy/GMR Chhattisgarh Power Project.html</a>
xv	Regional Office of the Ministry of Environment, forest and climate change 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 upload the compliance status in their website and update the same from time to time at least six monthly basis Criteria pollutants levels including NOX (from stack & ambient air) shall be displayed at the main gate of the power plant.	Complied.

**GMR CHHATTISGARH ENERGY LTD.**  
**Village – Raikheda, Gayatra and Chicholi, Block – Tilda, Distt – Raipur,**  
**Chhattisgarh**

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 protection measures shall not be diverted for other purposes and year-wise expenditure should be reported to the Ministry.	Complied.
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 by the concerned authorities and the date of start of land development work a commissioning of plant.	Financial Closure granted on 10 <sup>th</sup> Dec'10. The Project development started after receiving Consent to establish dated 13 <sup>th</sup> Jun'11.
xviii	Full cooperation shall be extended to the Scientists/Officers from the Ministry Regional Office of the Ministry at Bangalore / CPCB/ SPCB who would be monitoring the compliance of environmental status.	Agreed and complied.
<b>Compliance status of EC amendment dated 16/06/2013 with respect to ash pond coordinate change and removal of bag filter in place of ESP along with bag filter</b>		
xxxi	The GCV of the imported coal from south Africa shall not be less than 4911Kcal/kg and the ash and sulphur contents shall not exceed the limits stated under: Ash contents : 33.7% Sulphur Contents : 0.7%	MOEF has changed the norm of Fly ash content in coal. Being complied as per latest norms.
xxxii	A long term study of radioactive and heavy metals contents on coal to be used shall be carried out through a reputed institute. 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.	Will be complied.
xxxiii	Continuous monitoring for heavy metals in and around the ash pond area shall be carried out through reputed institutes like IIT, Kanpur and records/data maintained.	Will be complied.

**GMR CHHATTISGARH ENERGY LTD.**  
**Village – Raikheda, Gayatra and Chicholi, Block – Tilda, Distt – Raipur,**  
**Chhattisgarh**

Compliance Status of environmental clearance letter No. J-13012/62/2018-IA.II (T), MoEF GOI, dated 18/11/14 with respect to road transportation of coal.		
Sr. No. 2	Condition	Compliance Status
i	The coal transportation by road shall be through mechanically covered trucks to the extent feasible, else, shall be through tarpaulin covered trucks.	After completion of our railway line, coal is now being transported in rail.
ii	Avenue plantation of 2/3 row all along the road shall be carried out by the project proponent at its own expenses in consultation with the State Government Authority.	Avenue plantation all along the road has already been done and there is no scope for further plantation. Photo of plantation along with road has already been submitted with previous compliance report dated 28/05/2016.
iii	Periodic maintenance of the road shall be done by the project proponent at its own expenses and shall facilitate the traffic control on the road in consultation with State Government Authorities.	Not applicable as the coal is now being transported by rail.
iv	The PP shall advertise in the newspaper and place on the website, the amendment issued by the Ministry for public information.	Complied. Copy of newspaper has already been submitted to your good office vide our letter no. GMR/CTPP/MOEF/2014-15/121 dated 28/11/2014.
Sr. No. 3	Other condition	
xxxiv	Harnessing solar power within the premises of the plant particularly at available rooftops shall be undertaken and status of the implementation shall be submitted periodically to the regional Office of the Ministry.	Already a study for the same has been done & its project report has been submitted for approval of management.
xxxv	Greenbelt shall also be developed around the ash pond over and above the Green belt around the plant boundary.	Already complied.
xxxvi	The project proponent shall formulate a well-laid corporate environment policy, identify and designate responsible officers at all levels of its hierarchy for ensuring adherence to the policy	Already complied.

**GMR CHHATTISGARH ENERGY LTD.**  
**Village – Raikheda, Gayatra and Chicholi, Block – Tilda, Distt – Raipur,**  
**Chhattisgarh**

	and compliance with the condition stipulated in this clearance letter and other applicable environmental laws and regulations.	
<b>Compliance status of the EC amendment letter dated 04/02/2015 with respect to usage of 50% e-auction domestic coal issued</b>		
i	Sulphure and ash content in the coal to be used in the project shall not exceed 0.7% and 34% respectively for at any given time. In case of variation of coal quality at any point of time, fresh reference shall be made to the Ministry for suitable amendment to environmental clearance condition wherever necessary.	Being complied.
ii	The PP shall advertise in the local newspapers and place on the on the website, the proposed amendment for public information.	Complied.
<b>Compliance Status of environmental clearance letter No. J-13012/62/2018-IA.II (T), MoEF GOI, dated 09/12/15 with respect to usage of 100% domestic coal.</b>		
Sr. No. 2	Condition	Compliance Status
i	Sulphure and ash content of coal shall not exceed 0.7 % and 34 % respectively. In case of variation quality at any point of time, fresh reference shall be made to the ministry for consideration.	Being complied.
ii	The PP shall advertise in the local leading newspaper and place on the website, the proposed amendment of EC (after receiving from ministry) for change in source of coal for public information.	Complied. Copy of newspaper has already been submitted with previous compliance report dated 28/05/2016.



**Hydrogeology Report in & around GMR Power plant area,  
Raikhera, near Tilda, district Raipur, Chhattisgarh**

**EXECUTIVE SUMMARY**

M/s GMR Chhattisgarh Energy Ltd, (GMR) Raikheda is situated in Tilda block of Raipur district of Chhattisgarh state. The plant area is 850 acres. GMR established and commissioned a coal based thermal power plant comprising 2 x 660 MW (1370 MW) electricity. Construction of the power plant started in 2011-12 and it became operational in 2015.

GMR obtained Environmental Clearance for the power project from the Ministry of Environment & Forests, Government of India vide letter No J-13012/62/2008-IA.II (T) dated 9<sup>th</sup> May 2011. Point No. xii of specific conditions of EC stipulates "Hydrogeology of the in and around the project area shall be reviewed annually from an institute/ organization of repute to assess impact of surface water and ground regime (especially around ash dyke). In case and deterioration is observed specific mitigation measures shall be undertaken and reports/ data of water quality monitored regularly and maintained shall be submitted to the Regional Office of the Ministry".

The objective of this report is to review the present ground water regime and resources and to assess the impact of rainwater harvesting and artificial recharge to groundwater, if any. Field studies were carried out in core area comprising existing plant at Raikhera and its surroundings

The power plant of GMR is located at north latitude 21°27'07" & east longitude of 81°51'54" and covered by Survey of India Toposheet number 64 G/11 on 1: 50,000 scale. Raipur is located at about 35 km SW of Raikheda. Raikheda is well connected to main city & towns by a network of National & State Highways. The plant site is at a distance of approximately 14 km from Tilda, the nearest town and Railway station (situated on Nagpur - Howrah Broad Gauge of South Eastern Central Railway). The nearest airport is at Mana-Raipur about 50 km from the site. Century Cement Plant is located inside the buffer zone at Baikunth.

The present study area falls between Shivnath and Kharun rivers, of Mahanadi river basin. A gently grazing lowly elevated ground apparently separates the Shivnath watershed in the west from that of the Kharun in the east.

GMR also obtained permission from CGWA for withdrawal of 900m<sup>3</sup>/day groundwater vide letter no 21-4(118)/NCCR/CGWA/2011-1840 dated 14<sup>th</sup> December, 2011. This water was

used during the project construction. The withdrawal of groundwater was regulated through pumps fitted with water meters. The monthly reading of pumps used for groundwater withdrawal was maintained and regularly provided to CGWB. Groundwater draft from plant area was maintained below 900m<sup>3</sup>/day during the entire construction phase. The rainwater is harvested in four water harvesting ponds of >41000m<sup>3</sup> capacity.

Water is required mainly for making DM water for steam generation in boiler, condenser cooling system, auxiliary cooling system, ash handling, plant domestic and sanitary and plantation. Water is also required for washing and servicing utilities for equipment. Water requirement for the operation of the existing power plant is 32 MCM and is 100% met through river Mahanadi. Water harvested by reuse and recycled water (867m<sup>3</sup>/hr) is used for the purpose of dust suppression, plant cleaning & plantation obtaining zero discharge norm.

The investigated area is characterized geomorphologically by peniplain of carbonate and argillaceous rocks. Geologically the entire study area is mainly occupied by Chandi limestone of Raipur Group of Mesoproterozoic age. Chhattisgarh Supergroup comprises of unmetamorphosed, structurally undisturbed marine sedimentary rocks.

The Chandi limestones are considered one of the best aquifer in this region. The drill time discharge for these limestones varies from seepage to as high as 20 lps excluding massive area the average discharge remain between 2 and 7 lps for a moderate drawdown of 10-25 m. This aquifer is being tapped for irrigation purpose in the area and having good ground water development. In the core zone of plant area 9 bore wells were drilled having drill time discharge upto 3 lps in the cavernous and fractured zone. The transmissivity and storativity calculated for Raikhera is 49m<sup>2</sup>/day and 2.5\*10<sup>-4</sup> respectively. The ground water occurrence in these limestone are mainly restricted in weathered part and cavernous and fractured zone in unconfined to semi-confined condition. Total 20 dug wells and BW were monitored in these limestone where the ground water level varies from 2.2 to 14.77 m bgl in pre monsoon (i.e. May 2015).

15 bore wells drilled in the campus including 6 piezometers are all restricted down to 17.6m. The casing lengths are restricted to 12m. The drill time discharge is restricted to 3 lps only. The water bearing zones are either cavernous or fractured limestone. 1 to 3 zones are

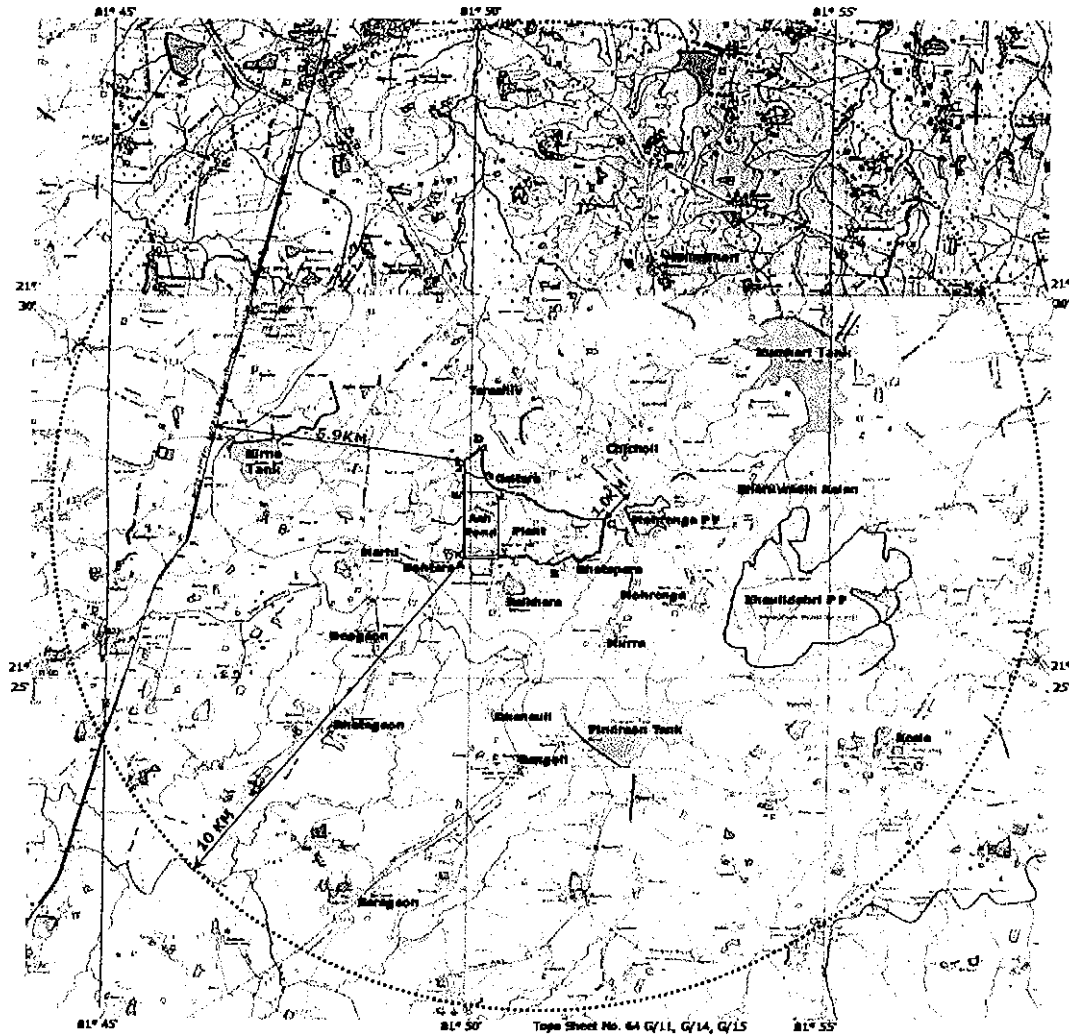
encountered in these limestones. Ground water development in the area is moderate to good. The Tilda block has been categorized as safe in the latest GW Resource estimation, made jointly by State and Central agency. A raising trend in both pre and post monsoon level in GMR plant area is observed since the inception of plant. Quality of ground water is being continuously monitored to maintain clean and safe water resources surroundings GMR power plant area. Ground water samples are collected from existing bore wells in the premises and adjoining villages. The ground water of the buffer area and in vicinity of plant are fresh and potable with all chemical constituents well within the permissible limits and fit for domestic, agriculture and industrial uses. As there is no toxic substance being discharged, hence there is no adverse effect on the water regime

In the core zone no major change in topography and drainage can be visualized. The land use is modified taking utmost care to protect all water bodies. Ten water bodies marked in the area all can be seen in the google image after establishing the plant. However, more water bodies were created by construction of four new rain water harvesting ponds in addition to ash ponds and raw water pond in the plant area. The radius of influence of withdrawal in summer is found to be not more than 400-500 m in calcareous rock formation of the area. The impact on ground water regime of the area will be limited in extent. However to have a detailed and comprehensive study of the impact of abstraction, if any at present and in future Groundwater monitoring by establishing 6no piezometers has been initiated targeting the core area and its surrounding watershed. Periodical monitoring of all the above established piezometer clearly indicates rise in water level during the last three year. Ground water contour (GWC) map superimposed on the Google image map reflects formation of groundwater plateau surrounding plant area clearly indicating recharge, however the extent of which is limited.

The committed construction of 16 no of recharge well within recharge trench in the residential colony area will be taken up along with the construction of residential quarters for roof top rain water harvesting. At present artificial recharge of groundwater of the area is well evident in the form of rising trends of piezometers installed in the plant area and by formation of groundwater plateau beneath the plant area due to the measures taken by the GMR for artificial recharge of groundwater of the area.



# HYDROGEOLOGY REPORT IN GMR POWER PLANT AREA, RAIKHERA & ITS SURROUNDINGS





## 1.0 INTRODUCTION

For the Production of 1370 (2\*685) MW thermal power, GMR Chhattisgarh Energy Ltd has been setup in 2011 at Village: Raikheda, block: Tilda, District-Raipur, (Chhattisgarh). GMR obtained permission from CGWA for withdrawal of 900 m<sup>3</sup>/day groundwater vide letter no 21-4(118)/NCCR/CGWA/2011-1840 dated 14<sup>th</sup> December, 2011. This water is required during the construction stage of the power plant.

The plant area is 850 acres. Water requirement during the operation stage is 32 MCM, which will be taken from Mahanadi river, about 35 km away from the plant site. Water is transported by means of pipelines. Water is required mainly for cooling tower, ash pond, sprinkling on haulage roads and for suppression of dust and plantation. Water is also required for washing and servicing utilities for equipment.

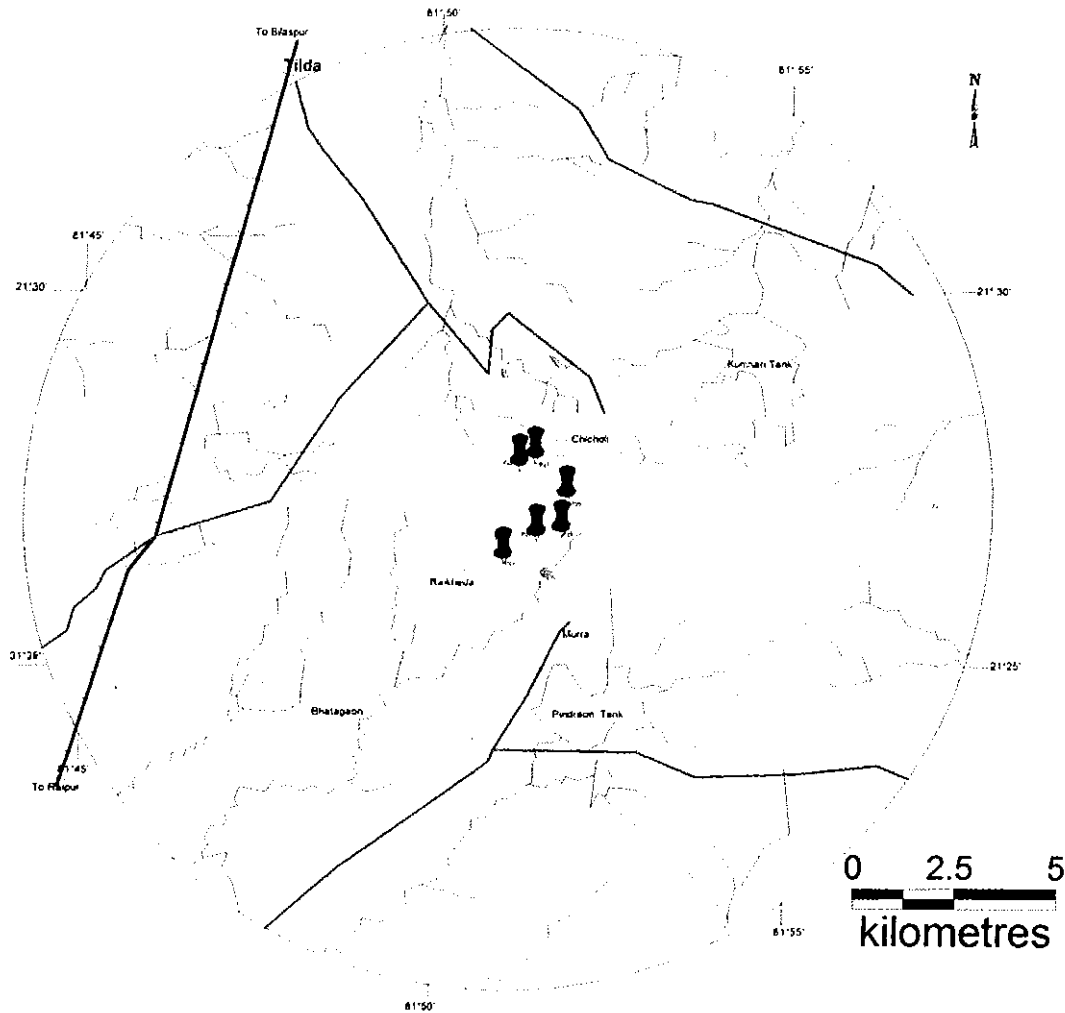
The objective of this Hydrogeological Report is to review the present ground water regime and resources and to assess the impact of rainwater harvesting and artificial recharge to groundwater, if any. Field studies were carried out in core area comprising existing plant as well as in the buffer zone falling within 10 km radius from Raikheda. Dug wells and hand pumps/ bore wells were inventoried at different locations and observation wells network was established for carrying out periodic monitoring of water levels. Water samples were collected from different types of ground water abstraction structures occurring in varied geological and hydrogeological environs and also from surface water bodies. Local and Regional Geology, topography, drainage pattern, land use and cropping pattern were studied in the field. Data was also collected from State and Central Govt. offices to correlate with field information and for precise assessment of ground water resources of the area.

### 1.1 LOCATION

The GMR Chhattisgarh Energy Ltd had established 1370MW power plant at village Raikheda, which started production in the year 2015. The plant area is located in Tilda block of Raipur district of Chhattisgarh covering an area of 850 acre, under the village areas of Raikheda and is located at north latitude 21°27'07" & east longitude of 81°51'54" and covered by Survey of India toposheet number 64 G/11 on 1: 50,000 scale. The location map is given in **Fig 1.1**.

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**Fig 1.1: The location Map of the GMR power plant and 10km radius buffer zone. Note the drainage, road and groundwater level and quality sampling sites.**

The plant is connected by Tilda and Raipur by all-weather roads. Village Raikheda is at about 35 km, NE of Raipur. It is well connected to important cities & towns by a network of National & State Highways. The plant site is at a distance of approximately 14 km from Tilda, the nearest town and Railway station (situated on Nagpur - Howrah Broad Gauge of South Eastern Central Railway). The nearest airport is at Mana-Raipur about 50 km from the site. The plant site at Raikheda is well connected with communication facilities like telephone, fax, STD.



The study area in the Tilda block of Raipur district of Chhattisgarh is bound on the north by Simga, on the east by Arang block of the Raipur district and on the west by Berla block of Durg district as shown in Fig 1.2.

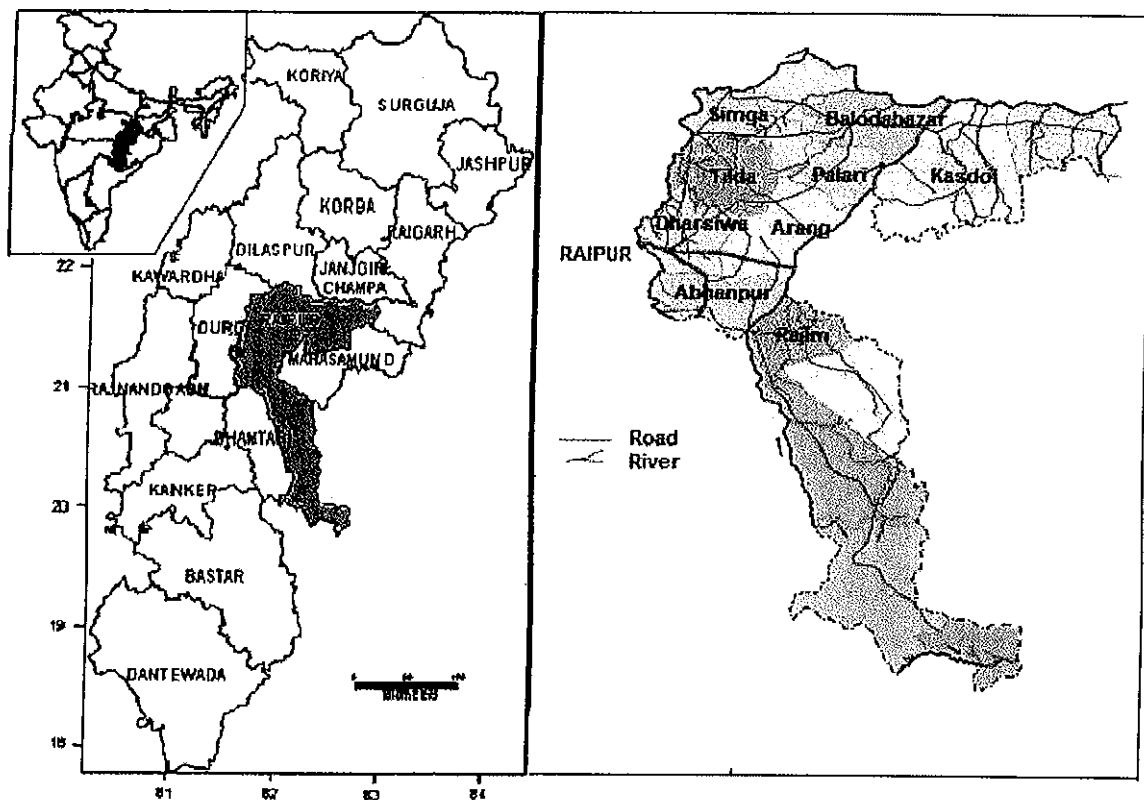


Fig 1.2: Administrative Boundary of Study Area

The buffer zone covering 10 km radius area demarcated for the present study falls entirely in Tilda block of Raipur district lies between N 21°20' 35" – 21° 32' 28" latitude and E 81°44'13" – 81° 56'30" longitude.

## 1.2 DEMOGRAPHIC SET UP OF PROJECT AREA

The study area encircling 10 kms of radius of the project site covers 57 numbers of villages as per Census 2001. The total population of the present study area is around 77548. Out of which 38718 are males & 38830 are females. Schedule Caste population is 12786 and Scheduled Tribe constitutes 2759. In the present study area, out of total male population, nearly 65% males are literate while the literacy rate for female is around 45%.



### **1.3. LAND USE:**

Out of the total area taken for the study, nearly 1100 ha is covered by forested area, 6050 ha is covered by irrigated area, 16150 ha is covered by non-irrigated area. Culturable waste land area comes around 1900 ha while 7750 ha area is covered by area not available for cultivation.

### **1.4 AGRICULTURE**

Agriculture is the main occupation of local population and maximum area is utilized for this. The villages don't have sufficient irrigation facilities and most of the crop cultivation is by rain fed farming. Agriculture season begins in the month of June with onset of SW monsoon. Paddy is the predominant crop and maize and jowar are other dry crops grown. October & November are the harvesting months for paddy. Wheat, sugarcane, pulses and vegetables are the second crop grown in the area, wherever the irrigation facilities are available. Vegetables are also extensively grown in the vicinity of the cities, townships and flourishing villages. Main staple food of the area is rice and wheat.

### **1.5 IRRIGATION**

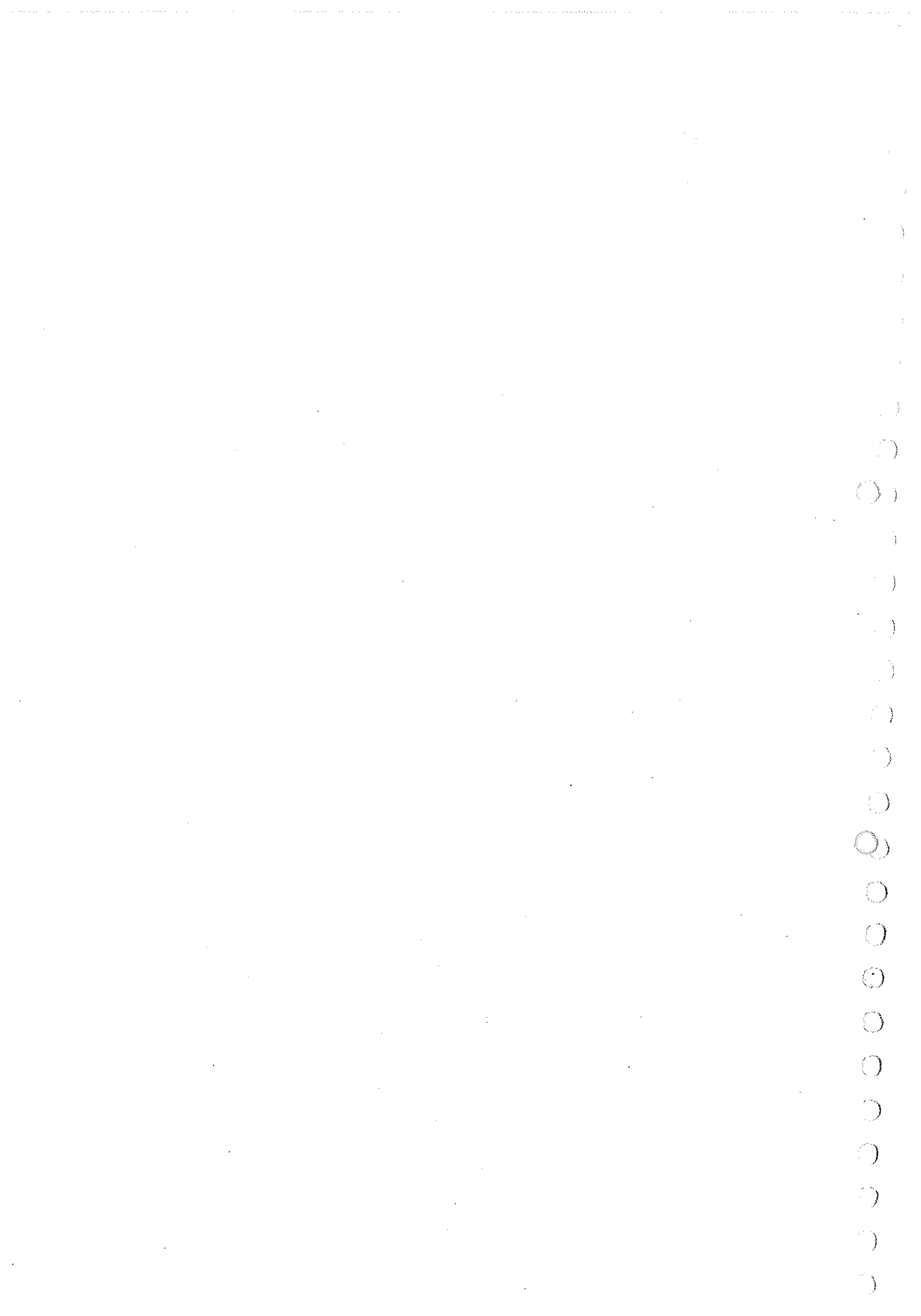
The irrigated area in buffer zone is 2900 hectares i.e, which constitutes only 9.20% of the total study area. Electric supply from the Chhattisgarh State Electricity Board is available for both domestic and agricultural purposes but supply through rural feeder is very erratic. Ground water irrigation by dug wells and bore wells. Most of the irrigated area comes under paddy crop in khariff season. The cash crop such as sugarcane and vegetables are being grown by the farmers through ground water irrigation from bore wells/dugwells and rivers. Un-irrigated area forms about 91 per cent of the total crop area as the area receives good quantity of rainfall (~1200 mm) mostly evenly distributed during monsoon, paddy is cultivated utilizing rainwater effectively. Jowar, maize and vegetables are also sown. Within the vicinity of urban area, the vegetables are grown as cash crops.

### **1.6 INDUSTRIES**

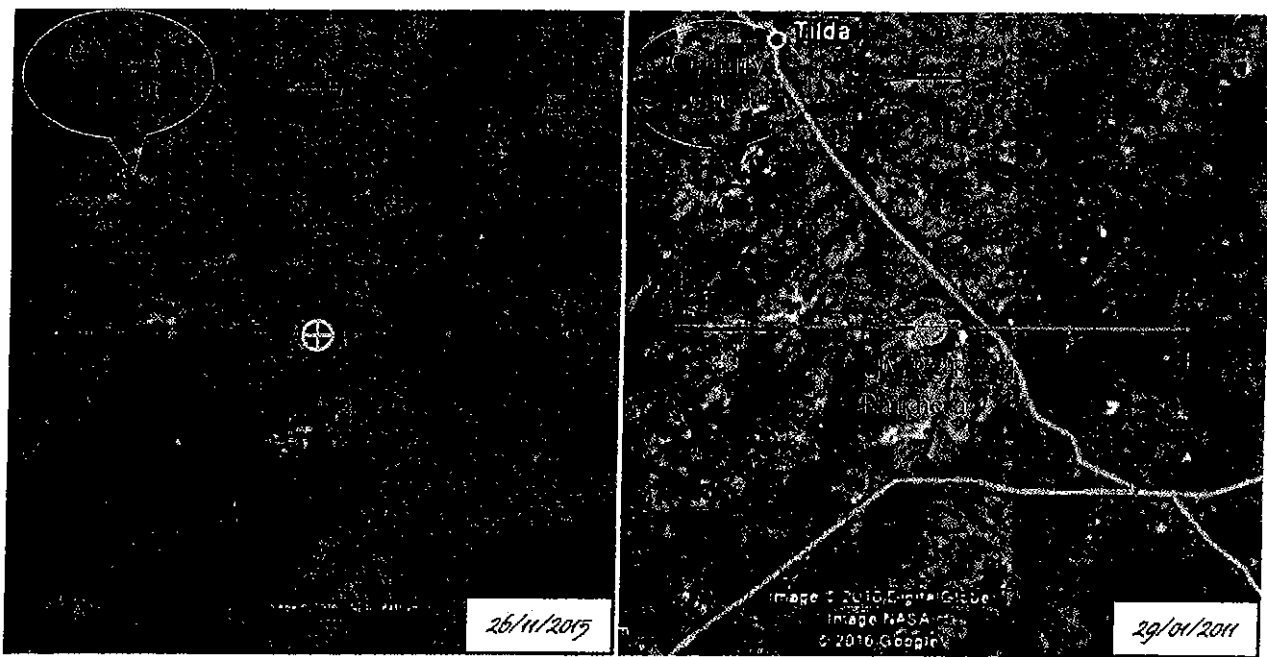
Century Cement Plant is located at Baikunth, which is within 10 km area of the GMR power project.

### **1.7 PHYSIOGRAPHY**

The present plant core zone area and study area falls on the plain/rolling terrain and the site elevation is uniform at around 300 m above Mean Sea Level (MSL). The slopes of the area



are gentle in gradient. There are no natural watercourses within plant areas. The plant area is situated on a local high having slop in all direction. The rainwater from the entire area flows north and west and reaches Shivnath river through a natural nallahs flowing in North and West direction. The nallahs remains dry in all seasons except in rainy season. The Shivnath river is flowing at a distance of 16 kms from western boundary of the plant. This canal is earthen canal with earthen embankments on two sides. The Pathariya village is the nearest human settlement, which lies in the North-West at a distance of 1.5 kms from the northern tips. The entire area within the leasehold area is mineralized with an average soil cover of 2 m thick. At places outcrops of limestone is also observed.



**Fig:1.3 Comparison of Google image of 10 km radius buffer zone after and before establishment of GMR power plant at Raikhera, Raipur**





