

Ref No. EOGEPL/CBM-RG (E)/E&F/2017/183

Date: 29<sup>th</sup> November, 2017

To,  
**The Director**  
**Ministry of Environment and Forests**  
**Eastern Regional Office**  
**A/3 Chandrasekharpur**  
**Bhubaneswar-751 023**  
**Orissa**

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**Sub: Submission Half-yearly Compliance Report of the Environmental Clearance (Phase-II and Phase-II A) by Essar Oil Limited (E&P Division) reg.**

**Ref: Environmental Clearance of Phase-II granted by MoEF vide letter no. J-11011/351/2009- IA II (I) dated 23.09.2011; letter no.J-11011/351/2009-IA II(I) dated 18<sup>th</sup> June, 2012**

Dear Sir

We are enclosing herewith the half-yearly compliance report in respect of the stipulated prior environmental clearance terms and conditions for the Phase-II and II A CBM project activities for the period of April, 2016- September, 2017.

Thanking you.

Yours faithfully  
For Essar Oil and Gas Exploration and production Limited



Authorized Signatory

**C. D. Narayanswamy**  
*Chief Operating Officer*  
Essar Oil and Gas Exploration and Production Limited  
Raniganj East CBM Project-Durgapur

**Encl: Phase-II and II A Compliance Report**

**Copy to:**

1. Member Secretary (Industry), MoEF, CGO Complex, Paryavan Bhavan, New Delhi-110003
2. The Environmental Engineer, Durgapur Regional Office, WBPCB, Durgapur-713216

**Essar Oil and Gas Exploration and Production Limited**  
**RG (East)-CBM-2001/1 (Phase-II) Half Yearly Environment Clearance Compliance Report**  
**(April'17- September'17)**  
**Ref: Environment Clearance no. F. No. J-11011/351/2009- IA II (I) dated 23.09.2011**

Sr. No.	EC Conditions	Compliance Status
<b>A. Specific Conditions</b>		
i.	As proposed, Only 58 pilot-cum-production wells shall be drilled upto a depth of 1000 m. No additional wells shall be drilled without prior permission from this Ministry.	Number of pilot-cum-production wells has been drilled as per the permission. Amendment in Environmental Clearance has been granted by MoEF for drilling 4 additional supporting wells at each pilot cum production site to augment the production.
ii	As proposed, no drilling of well and any construction work shall be carried out in forest land. No forest land shall be used for installation of Group Gathering Stations (GGSs) and pipeline laying in the proposed location	All the facilities including well sites & Gas Gathering Stations are located outside the forest area.
iii	Recommendations of the State Forest Department shall be obtained regarding likely impact of the proposed plant on the surrounding protected forests viz. Durgapur PF & Ukhra PF and implemented.	The Conservator of Forests (South East Circle), Forest Department, West Bengal made site inspection on 19th Dec'12 to assess the probable impacts & suggest suitable recommendations. The Addl. PCCF, West Bengal with his recommendations forwarded to the Addl. PCCF, MoEF (Eastern Regional Office). (A copy of the letter is already submitted along with compliance report after that).
iv	Compensation for the land acquisition to the land oustees, if any, and also for standing crop shall be paid as per the National Resettlement and Rehabilitation Policy (NRRP) 2007 or State Government norms. It may be ensured that compensation provided shall not be less than the norms of the NRRP, 2007.	The acquisition is directly being done with the concerned land owners and compensation is paid above the prevailing market rates. There is no involvement of Rehabilitation and Resettlement.
v	Prior permission from the Ministry of Defence shall be obtained regarding impact of proposed plant on Panagarh air base, if any.	The Gas Gathering Station 1 & 2 was constructed as per the condition of the NOC of MoD.

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vi	The surface facilities shall be installed as per the applicable codes and standards, international practices and applicable local regulations.	Surface facilities have been designed as per OISD, DGMS and international standards viz. API.
vii	Ambient air quality shall be monitored near the closest human settlements as per the National Ambient Air Quality Emission Standards (NAAQES) issued by the Ministry vide G.S.R. No. 826(E) dated 16th November, 2009 for PM <sub>10</sub> , PM <sub>2.5</sub> , S02, NOx, CO, CH4, VOCs, HC, Non-methane HC etc. Efforts shall be made to improve the ambient air quality of the area.	Ambient Air Quality Monitoring has been carried out near to the closest human settlements as per the Ambient Air Quality Emission Standards (NAAQES) issued by the Ministry vide G.S.R No. 826(E) dated 16th November, 2009 for PM10, PM2.5, SO <sub>2</sub> , NO <sub>x</sub> , CO, CH <sub>4</sub> , VOCs, HC, Non-methane HC.  The monitoring results have been attached in <b>Annexure I</b> .
viii	The company shall monitor data on methane and non-methane hydrocarbon at the drilling site, GGS, CGS and at the SV station from where the gas is supplied to the customers.	Methane hydrocarbons are monitored as part of Ambient Air Quality Monitoring Plan at Major facilities (GGS) and villages. The monitoring results are provided in <b>Annexure I</b> .
ix	Mercury shall also be analyzed in air, water and drill cuttings twice during drilling period.	The drilling operation was temporarily suspended since April 2017 till date.
x	The flare system shall be designed as per good oil field practices and Oil Industry Safety Directorate (OISD) guidelines. The company shall take necessary measures to prevent fire hazards and soil remediation as needed. At the place of ground flaring, the flare pit shall be lined with refractory bricks and efficient burning system. In case of overhead flare stacks, the stack height shall be provided as per the regulatory requirements and emissions from stacks shall meet the MOEF/CPCB guidelines.	Elevated flare system has been designed as per OISD guidelines. Measures delineated in the EIA/EMP have been taken to prevent fire hazards. The overhead flaring has been installed with height of 30 m. The following measures have been implemented to prevent fire hazard. <ul style="list-style-type: none"> <li>• Installation of electrical equipment as per approved hazardous zone classification as communicated to DGMS</li> <li>• Provided dry chemical fire extinguishers</li> <li>• Online methane gas analyzers (CH<sub>4</sub>)</li> <li>• Use of flame proof type lighting fixtures, push buttons and switches in the drill site facilities</li> </ul>

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xi	The company shall make the arrangement for control of noise from the drilling activity and DG sets by providing necessary mitigation measures such as proper acoustic enclosures to DG sets and meet the norms notified by the MoEF. Height of all the stacks/vents shall be as per the CPCB guidelines.	CPCB approved models of Silent DG sets have been installed with acoustic enclosures. Noise monitoring has been carried out in the activity area and surrounding habitat. The results are attached in <b>Annexure II</b> .
xii	The company shall comply with the guidelines for disposal of solid waste, drill cutting and drilling fluids for onshore drilling operation notified vide GSR. 546(E) dated 30'August, 2005.	The drilling operation was temporarily suspended since April 2017 till date.
xiii	Total fresh water requirement from local approved water suppliers shall not exceed 75 m3/day/well and prior permission shall be obtained from the concerned Authority and a copy submitted to the Ministry's Regional Office at Bhubaneswar. No ground water shall be used without permission of CGWA.	The drilling operation was temporarily suspended since April 2017 till date.  However, The RO treat water is supply the water demand HF, Work over operation and other utilities. No ground water is withdrawal for water consumption.
xiv	The produced water during drilling operations shall be collected in HDPE lined waste pit to prevent ground water contamination. Effluent shall be properly treated and treated effluent shall conform to CPCB standards. As proposed, produced water may also be used in operational coal mines of Eastern Coal Fields for dust suppression, slurry activities and post-mining restoration efforts etc. Domestic effluent shall be disposed through septic tank followed by soak pit. No effluent shall be discharged outside the premises and 'zero' discharge shall be adopted	Produced water is collected & stored in HDPE lined pits & the water is treated by Reverse Osmosis Treatment System. Currently RO treatment plants of total capacity 5100 m3/day have been installed. The treated water is used for our own operations (Work over & site preparation activities). Excess treated water will be discharged to nearby streams only after meeting discharge standards.  Domestic effluent is treated septic tank followed by soak pits.  There is no discharge of effluent for the facilities.
xv	Water produced during drilling shall be reused in drilling of other core/test wells.	Produced water has been collected & stored in HDPE lined pits and water if not meeting the standards will be passed through suitable treatment system. Water meeting the standards set by CPCB will be reused in the construction activities & Work over of adjoining wells. Excess water is discharged only after meeting the

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		discharge standards.
xvi	Reverse Osmosis plant shall be installed for further treatment of the wastewater in case the TDS is > 2000 mg/l and treated wastewater shall be reused or discharge on the land after meeting the norms.	Currently, Reverse Osmosis plants with total capacity of 5100m3/day are installed to treat the produced water generated from production wells. The produced water quality of different wells are attached in <b>Annexure III</b> . The analysis reports of water treated through Reverse Osmosis plant are attached in <b>Annexure IV</b> . The treated water is reused in HF, Work over and other construction activities. Excess water is discharged to nearby streams only after meeting the discharges standards. Analysis reports of Surface water are attached in <b>Annexure IV A</b> .
xvii	Ground water quality monitoring shall be done to assess if produced water storage or disposal has any effect.	The ground water monitoring has been carried out by collecting samples from Tube wells (use for drinking water) of surrounding habitats in the project area and the analysis results are attached in <b>Annexure V</b> .
xviii	Drilling wastewater including drill cuttings wash water shall be collected in disposal pit lined with HDPE lining and evaporated or treated and shall comply with the notified standards for on-shore disposal. The treated waste water should be reused in other wells during drilling operations. The membership of common TSDF shall be obtained for the disposal of drill cuttings and hazardous waste. Otherwise secured land fill shall be created at the site as per the design of the secured shall be approved by the CPCB and obtain the authorization of the WBPCB. Copy of authorization or membership of TSDF shall be submitted to Ministry's Regional Office at Bhubaneswar.	The drilling operation was temporarily suspended from April 2017 to till date.
xix	Only water based drilling mud shall be used. The drilling mud shall be recycled. Hazardous waste shall be disposed of as per Hazardous Waste (Management, Handling and Transboundary Movement) Rules, 2008. The recyclable waste (oily sludge) and spent oil shall be disposed of to	The drilling operation was temporarily suspended from April 2017 to till date. Oil contaminated waste & waste filters have been sent to TSDF facility, Haldia. WBPCB approve storage time extension used filter upto 180 days. Used oil has been

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	the authorized recyclers/re-processors.	sent to authorize recycler. The copies of Form 10 & 13 (old) for Used oil and Hazardous waste are attached as <b>Annexure-VI</b> .
xx	The Company shall carry out long term subsidence study by collecting base line data before initiating drilling operation till the project lasts. The data so collected shall be submitted six monthly to the Ministry and its Regional Office at Bhubaneswar.	Subsidence monitoring was performed at all Monitoring Stations established by The National Institute of Technology (NIT), Durgapur in March'2017. The latest Subsidence Study report is attached as <b>Annexure VII</b> .
xxi	The Company shall take necessary measures to prevent fire hazards, containing oil spill and soil remediation as needed. At place of ground flaring, the overhead flaring stack with knockout drums shall be installed to minimize gaseous emissions during operation.	The necessary measures have been taken to prevent fire hazards and for soil remediation as follows. <ul style="list-style-type: none"> <li>• Installation of electrical equipment as per approved hazardous zone classification as communicated to DGMS</li> <li>• Dry chemical fire extinguishers</li> <li>• Portable methane gas analyzers (CH4)</li> <li>• Use of flame proof type lighting fixtures, push buttons and switches in the drill site facilities</li> <li>• Impervious surface, secondary containment and spill kit are provided whenever there is possibility of soil contamination</li> </ul>
xxii	The project authorities shall install SCADA system with dedicated optical fiber based telecommunication link for safe operation of pipeline and Leak Detection System. Additional sectionalizing valves in the residential area and sensitive installations shall be provided to prevent the amount of gas going to the atmosphere in the event of pipeline failure. Intelligent pigging facility shall be provided for the entire pipeline system for internal corrosion monitoring. Coating and impressed current cathodic protection system shall be provided to prevent external corrosion.	Installation of SCADA system with dedicated optical fiber based telecommunication link for safe operation of pipeline and Leak Detection System is under process. Cathodic Ray Protection system has been installed along the length of pipeline to prevent the corrosion. The design and laying of surface facilities have been confirmed to the standards of OISD 141.
xxiii	All the surface facilities including GGS, CGS and	All the surface facilities including GGS, CGS and SV

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	SV station shall be as per applicable codes and standards, international practices and applicable local regulations.	stations have been laid as per OISD & API standards.
xxiv	The design, material of construction, assembly, inspection, testing and safety recommendations of operation and maintenance of pipeline and transporting the natural gas/oil shall be governed by ASME/ANSI B 31.8/B31.4 and OISD standard 141. Pipeline wall thickness and minimum depth of burial at river crossing and casings at rails, major road crossings should be in conformity with ANSI/ASME requirements.	All surface facilities have been installed as per the ASME/ANSI B 31.8 standards. Pipelines design and laying is also confirms to the ANSI/ASME standards.
xxv	Annual safety audit should be carried out for the initial three years by an independent agency and report submitted to this Ministry for ensuring the strict compliance of safety regulations on operations and maintenance.	Safety audits are conducted by third party to maintain the safety standards.
xxvi	The project authorities shall patrol and inspect the pipeline regularly for detection of faults as per OISD guidelines and continuous monitoring of pipeline operation by adopting non-destructive method (s) of testing as envisaged in the EMP. Pearson survey and continuous potential survey should be carried out at regular intervals to ensure the adequacy of cathodic protection system.	Regular patrolling and inspection of laid pipeline has been carried out for detection of faults as per OISD guidelines. Pipeline operations shall be continuously monitored by adopting non-destructive methods of testing as envisaged in the EIA/EMP. Pearson survey and continuous potential survey shall be carried out at regular intervals to ensure the adequacy of cathodic protection system.
xxvii	The company shall develop a contingency plan for H2S release including all necessary recommendations from evacuation to resumption of normal operations. The workers shall be provided with personal H2S detectors in locations of high risk of exposure along with self containing breathing apparatus.	H2S is not present as per the analysis of gas tapped from the test wells. However all the necessary safety measures shall be delineated in emergency response plan. Gas detectors are kept at the drilling and production sites to check any presence of gases which are beyond threshold values. All workers have been provided with standard PPEs according to job requirement.
xxviii	Adequate well protection system shall be	Adequate well control measures along with BOP have

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	provided like BoP or diverter systems as required based on the geological formation of the blocks.	been adopted to ensure necessary level of safety.
xxix	Blow Out Preventor (BOP) system shall be installed to prevent well blowouts during drilling operations. BOP measures during drilling shall focus on maintaining well bore hydrostatic pressure by proper pre-well planning and drilling fluid logging etc.	CBM well hydrostatic pressures are normally less than 2psi. However considering the hydrostatic pressures and sensitivity of well, Blow Out Preventers or diverter systems have been provided at the well head during drilling along with other well control measures such as proper pre-well planning and drilling fluid logging to maintain the hydrostatic pressure.
xxx	The top soil removed shall be stacked separately for reuse during restoration process	The top soil being spread in the designated Green Belt area of the major facility.
xxxi	Emergency Response Plan shall be based on the guidelines prepared by OISO, DGMS and Govt. of India. Recommendations mentioned in the Risk Assessment & Consequence Analysis and Disaster Management Plan shall be strictly followed.	Emergency Response plan has been prepared as per the OISD & DGMS guidelines. Recommendations mentioned in risk assessment and consequence analysis are being duly implemented.
xxxii	Project proponent shall comply with the environment protection measures and safeguards recommended in the EIA/EMP/risk analysis report/disaster management plan.	Environmental protection measures and safeguards recommended in EMP/risk analysis report/disaster management plan have been implemented.
xxxiii	The company shall take measures after completion of drilling process by well plugging and secured enclosures, decommissioning of rig upon abandonment of the well and drilling site shall be restored in original condition. In the event that no economic quantity of hydrocarbon is found a full abandonment plan shall be implemented for the drilling site in accordance with the applicable Indian Petroleum Regulations.	Wells will be abandoned and restored to natural position if found unsuitable for hydrocarbon extraction. Wells will be fully abandoned in compliance with Indian Petroleum Regulations in the event of no economic quality of hydrocarbon is found.
xxxiv	Occupational health surveillance of the workers shall be carried out as per the prevailing Acts and Rules.	All employees have undergone Pre-employment Medical Examination. Periodical Occupational Health Surveillance will be conducted and records maintained.

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xxxv	In case the commercial viability of the project is established, the Company shall prepare a detailed plan for development of gas fields and obtain fresh environmental clearance from the Ministry.	MoEF granted amendment in phase II EC for drilling 4 nos. of additional supporting wells at each well site to meet the production capacity over and above 5 lakh m3 per day.
xxxvi	All the commitments made to the public during the Public Hearing / Public Consultation meeting held on 26th March, 2010 shall be satisfactorily implemented.	Commitments made during the Public Hearing are under implementation.
xxxvii	Company shall adopt Corporate Environment Policy as per the Ministry's O.M. No. J-11 013/41/2006-1A.II(1) dated 26th April, 2011 and implemented.	Corporate Environmental Policy is in place and being implemented. (A copy of the Policy is attached with previous compliance report)
xxxviii	Provision shall be made for the housing of construction labour within the site with all necessary infrastructure and facilities such as fuel for cooking, mobile toilets, mobile STP, Safe drinking water, medical health care, creche etc. The housing may be in the form of temporary structures to be removed after the completion of the project	We do not intend to bring labor from outside; hence construction of colony is not envisaged. We have been hiring local labour for all construction work. Nonetheless, we are providing all the necessary infrastructure and facilities like porta cabins, mobile toilets, soak pit & septic tank, safe drinking water, medical health care, creche, etc.
<b>General Condition</b>		
i	The project authorities must strictly adhere to the stipulations made by the State Pollution Control Board (SPCB), State Government and any other statutory authority.	We comply with the stipulations made by the State Pollution Control Board (SPCB), State Government and statutory bodies.
ii	No further expansion or modification in the project shall be carried out without prior approval of the Ministry of Environment & Forests. In case of deviations or alterations in the project proposal from those submitted to this Ministry for clearance, a fresh reference shall be made to the Ministry to assess the adequacy of conditions imposed and to add additional environmental	For any further expansion and modification in project configuration, we would approach MoEF for the prior Environmental Clearance.

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	protection measures required, if any	
iii	The project authorities must strictly comply with the rules and regulations under Manufacture, Storage and Import of Hazardous Chemicals Rules, 2000 as amended subsequently. Prior approvals from Chief Inspectorate of Factories, Chief Controller of Explosives, Fire Safety Inspectorate etc. must be obtained, wherever applicable.	We comply with the rules and regulations under Manufacture, Storage and Import of Hazardous Chemicals Rules, 2000 as amended subsequently. Prior approvals will be obtained from appropriate authority.
iv	The project authorities must strictly comply with the rules and regulation with regarding to handling and disposal of Hazardous Wastes (Management, Handling and Transboundary Movement) Rules, 2008 wherever applicable. Authorization from the State Pollution Control Board must be obtained for collections/treatment/ storage/disposal of hazardous wastes	We comply with the rules and regulations with regard to handling and disposal of Hazardous Wastes (Management, Handling and Transboundary Movement) Rules, 2008. Authorization from the West Bengal Pollution Control Board has been obtained with regard to storage, treatment and disposal of hazardous waste.
v	The overall noise levels in and around the plant area shall be kept well within the standards by providing noise control measures including acoustic hoods, silencers, enclosures etc. on all sources of noise generation. The ambient noise levels shall conform to the standards prescribed under EPA Rules, 1989 viz. 75 dBA (daytime) and 70 dBA (nighttime).	Acoustic hoods, silencers, enclosures will be provided to high noise generating equipment. Noise levels will be restricted to the standards prescribed under EPA Rules, 1989. Regular noise monitoring has been carried out.
vi	A separate Environmental Management Cell equipped with full fledged laboratory facilities must be set up to carry out the environmental management and monitoring functions.	A dedicated environment management is currently in operation and functioning for implementation of environment management plan at large. The sampling and analysis of environmental parameters is been carried out by Scientific Research laboratory (MoEF recognized).
vii	As proposed, Rs. 7.80 Crores earmarked for environment protection and pollution control measures shall be used to implement the conditions stipulated by the Ministry of	The environment expenditure for the environment activities has been attached as <b>Annexure VIII</b> .

<b>Sr. No.</b>	<b>EC Conditions</b>	<b>Compliance Status</b>
	Environment and Forests as well as the State Government along with the implementation schedule for all the conditions stipulated herein. The funds so provided shall not be diverted for any other purposes.	
viii	The Regional Office of this Ministry/Central Pollution Control Board/State Pollution Control Board will monitor the stipulated conditions. A six monthly compliance report and the monitored data along with statistical interpretation shall be submitted to them regularly.	Support has been and will be extended to the Regional office of this Ministry/Central Pollution Control Board/State Pollution Control Board for monitoring the stipulated conditions. Six monthly compliance reports of environmental clearances are regularly submitted to Regional office of MoEF.
ix	A copy of clearance letter shall be sent by the proponent to concerned Panchayat, ZilaParishad / 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 web site of the company by the proponent	A copy of Environmental Clearance (EC) has been circulated to the local administration and was uploaded on the Company's website.
x	The project proponent shall upload the status of compliance of the stipulated environment 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 the MOEF, the respective Zonal Office of CPCB and the WBPCB. The criteria pollutant levels namely; SPM, RSPM, S02, NOx, HC (Methane & Non-methane), VOCs (ambient levels as well as stack emissions) or critical sectoral parameters, indicated for the projects shall be monitored and displayed at a convenient location near the main gate of the company in the public domain.	Compliance reports have been uploaded on company's website & sent to Regional Office of the MOEF, the respective Zonal Office of CPCB and the WBPCB. The Ambient air quality monitoring has been carried out as per revised NAAQM criteria. The criteria pollutant levels namely; SPM, RSPM, S02, NOx, HC (Methane & Non-methane), VOCs has been monitored periodically and displayed at the main entrance of the Gas Gathering Station.
xi	The project proponent shall also submit six monthly reports on the status of the compliance of the stipulated environmental conditions including results of monitored data (both in hard	We are submitting the six monthly compliance reports on the status of the compliance of the stipulated environmental conditions including results of monitored data (both in hard copies as well as by e-mail) to the

<b>Sr. No.</b>	<b>EC Conditions</b>	<b>Compliance Status</b>
	copies as well as by e-mail) to the Regional Office of MOEF, the respective Zonal Office of CPCB and the WBPCB. The Regional Office of this Ministry /CPCB / WBPCB shall monitor the stipulated conditions	Regional Office of MOEF, the respective Zonal Office of CPCB and the WBPCB.
xii	The environmental 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 conditions and shall also be sent to the respective Regional Offices of the MOEF by e-mail.	The environmental statement for each financial year ending 31st March in Form-V as is being regularly submitted to West Bengal Pollution Control Board and the same will be uploaded on the company's website along with the status of compliance report.
xiii	The Project Proponent shall inform the public that. The project has been accorded environmental clearance by the Ministry and copies of the clearance letter are available with the WBPCB 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> . This shall be advertised within seven days from the date of issue of the clearance letter, at least in two local newspapers that are widely circulated in the region of which one shall be in the vernacular language of the locality concerned and a copy of the same shall be forwarded to the Regional office	The advertisement was published in The Telegraph Calcutta and Anand Bazaar Pathrika on 30th September, 2011. A copy of the same has been submitted in the compliance report during the period Apr'11-Sep'11.
xiv	Project authorities shall inform the Regional Office as well as the Ministry, the date of financial closure and final approval of the project by the concerned authorities and the date of commencing the land development work	Financial closure has been prepared in the year of 2010. The development work was commenced on 7th Dec, 2011 after obtaining consent to establish from WBPCB.

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4(I)	As proposed, supporting wells (4 nos.) on each pilot-cum-production wells (58 nos.) shall be drilled upto a depth of 1000m. No additional wells/support well shall be drilled without prior permission of this Ministry.	4 supporting wells will be drilled at each pilot-cum-production wells (58x4=232 wells). No additional wells will be drilled without prior approval from MoEF.
4(ii)	Unit shall monitor ground water table within one Km radius of each well during pre-monsoon (i.e. May) and winter season (November). Trend analysis shall be carried out and report shall be submitted to the Ministry's regional office at Bhubaneswar	Monitoring of ground water table has been carried out in the month of June'2016 (pre-monsoon). The ground water table data and the analysis of ground water report is attached as <b>Annexure- IX</b> .
4(iii)	Permission from CGWA for dewatering shall be obtained and submitted to the Ministry's Regional Office at Bhubaneswar.	Dewatering is an inherent process of CBM extraction & carried at much deeper depths (>500m) which does not disturb the usable drinking water aquifers located at the shallow depths.  "No Objections Certificate" regarding the same has been obtained from State Water Investigation Directorate (SWID), Water Resources Investigation & Development Department, Govt. of West Bengal. (A copy of the letter is attached with previous compliance report). In west Bengal SWID is the approved local authority of CGWA for given permission for water withdrawal
4(iv)	Smokeless flare shall be installed	Smokeless flares will be installed for complete combustion of CBM. Flaring will be carried out only during process upsets.
4(v)	All measures shall be taken to control noise pollution during drilling process. Acoustic enclosure/barrier shall be installed	Only silent DG sets meeting the specifications of CPCB are used. Acoustic enclosures have been provided to major noise generating equipment (Diesel Generators Sets). Earplugs have been provided to the working personnel at the site.
4(vi)	Any produced water shall be treated and recycled/reused within the project area. Any	Produced water is treated by Reverse Osmosis System. Treated water is being used for HF, Workover

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	excess water shall be discharged after treatment and meeting the standards prescribed by the CPCB/SPCB. Regular water quality monitoring shall be carried out and monitoring report shall be submitted to the respective Regional Office of the MoEF.	& construction activities of other wells. Excess water will be discharged to the streams only after meeting the discharge standards. Treated Water quality monitoring reports are attached as <b>Annexure-IV</b> and discharged water quality monitoring reports are attached as <b>Annexure IV A</b> .
4(vii)	Approach road shall be constructed prior to the drilling	Approach roads are being constructed wherever the access is not available.
4(viii)	Land subsidence shall be monitored regularly and monitoring report shall be submitted to CPCB, SPCB and respective Ministry's regional office	The subsidence monitoring was performed at all Monitoring Stations established by National Institute of Technology (NIT), Durgapur. The Latest Subsidence study report is attached as <b>Annexure VII</b> .
5	All the specific conditions and general conditions specified in the environmental clearance accorded vide Ministry's letter no.J-11011/351/2009-IA II (I) dated 23rd September, 2011 shall be implemented	All the specific and general conditions of the Phase-II Environmental Clearance are being implemented.
6	Consent to Establish & Operate for the revised proposal shall be obtained from the W.B. Pollution Control Board	Regular CTE & CTO will be obtained from Pollution Control Board and will be submitted to MoEF.
7	No further expansion or modifications in the plant shall be carried out without prior approval of the Ministry of Environment and Forests. In case of deviations or alterations in the project proposal from those submitted to this Ministry for clearance, a fresh reference shall be made to the Ministry to assess the adequacy of conditions imposed and to add additional environmental protection measures if required, if any.	No further expansion or modification will be done in the project configuration without prior approval from the MoEF.

**Ambient Air Quality of Surrounding Villages of CBM Raniganj Project by Essar Oil and Gas Exploration and Production Limited**  
**Compliance Period: Apr'17 to Sep'17**

**ANNEXURE I**

S. NO.	Parameter	Unit	NAAQS Limit	GGS 1 (GOPALPUR)					
				Apr'17	May'18	Jun'19	Jul'17	Aug'17	Sep'17
1	Particulate Matter (PM2.5)	µg/m <sup>3</sup>	60 (24 hrs)	32.66	24.51	23.54	28.22	34.46	33.36
2	Particulate Matter 10 (PM10)	µg/m <sup>3</sup>	100 (24 hrs)	68.85	55.92	54.21	59.75	57.18	78.61
3	Nitrogen Dioxide (NO <sub>2</sub> )	µg/m <sup>3</sup>	80 (24 hrs)	27.37	29.91	34.82	33.04	33.04	36.38
4	Sulphur Dioxide (SO <sub>2</sub> )	µg/m <sup>3</sup>	80 (24 hrs)	5.31	6.18	5.27	5.94	4.83	6.18
5	Carbon Monoxide (CO)	mg/m <sup>3</sup>	2 (8 hrs)	0.468	0.472	0.432	0.386	0.392	0.374
6	THC as Methane	mg/m <sup>3</sup>	-	1.84	1.72	1.48	1.79	1.56	2.31
7	Mercury	µg/m <sup>3</sup>	-	< 0.002			< 0.002		
8	Hydrocarbon as Non Methane	mg/m <sup>3</sup>	-	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003
9	VOCs	µg/m <sup>3</sup>	-	2.43			3.23		
10	Benzo(a)Pyrene	ng/m <sup>3</sup>	1	0.64			0.68		
11	Ammonia (NH <sub>3</sub> )	µg/m <sup>3</sup>	400	21.34			19.39		
12	Ozone (O <sub>3</sub> )	µg/m <sup>3</sup>	100	32.31			40.16		
13	Lead (Pb)	µg/m <sup>3</sup>	1	0.09			0.12		
14	Nickel (Ni)	ng/m <sup>3</sup>	20	9.38			12.61		
15	Arsenic	ng/m <sup>3</sup>	6	1.31			1.55		
16	Benzene	µg/m <sup>3</sup>	5	1.51			20.20		

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**ANNEXURE I**

S. NO.	Parameter	Unit	NAAQS Limit	JATGORIA					
				Apr'17	May'18	Jun'19	Jul'17	Aug'17	Sep'17
1	Particulate Matter (PM2.5)	µg/m <sup>3</sup>	60 (24 hrs)	50.28	37.87	27.45	26.47	30.41	34.56
2	Particulate Matter 10 (PM10)	µg/m <sup>3</sup>	100 (24 hrs)	101.53	74.08	59.46	51.39	52.85	62.16
3	Nitrogen Dioxide (NO <sub>2</sub> )	µg/m <sup>3</sup>	80 (24 hrs)	30.03	29.81	31.69	36.03	34.62	33.51
4	Sulphur Dioxide (SO <sub>2</sub> )	µg/m <sup>3</sup>	80 (24 hrs)	5.29	5.88	5.80	6.84	5.63	5.37
5	Carbon Monoxide (CO)	mg/m <sup>3</sup>	2 (8 hrs)	0.346	0.386	0.440	0.418	0.344	0.342
6	THC as Methane	mg/m <sup>3</sup>	-	1.92	1.99	1.68	1.61	1.78	2.08
7	Mercury	µg/m <sup>3</sup>	-	< 0.002			< 0.002		
8	Hydrocarbon as Non Methane	mg/m <sup>3</sup>	-	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003
9	VOCs	µg/m <sup>3</sup>	-	2.95			3.17		
10	Benzo(a)Pyrene	ng/m <sup>3</sup>	1	0.84			0.42		
11	Ammonia (NH <sub>3</sub> )	µg/m <sup>3</sup>	400	18.86			17.28		
12	Ozone (O <sub>3</sub> )	µg/m <sup>3</sup>	100	31.42			34.16		
13	Lead (Pb)	µg/m <sup>3</sup>	1	0.12			0.11		
14	Nickel (Ni)	ng/m <sup>3</sup>	20	11.25			11.29		
15	Arsenic	ng/m <sup>3</sup>	6	1.31			1.48		
16	Benzene	µg/m <sup>3</sup>	5	2.04			1.88		

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**ANNEXURE I**

S. NO.	Parameter	Unit	NAAQS Limit	MCS (MALANDIGHI)					
				Apr'17	May'18	Jun'19	Jul'17	Aug'17	Sep'17
1	Particulate Matter (PM2.5)	µg/m <sup>3</sup>	60 (24 hrs)	36.73	23.17	24.44	31.22	36.85	24.47
2	Particulate Matter 10 (PM10)	µg/m <sup>3</sup>	100 (24 hrs)	80.29	43.52	50.68	57.43	58.54	53.83
3	Nitrogen Dioxide (NO <sub>2</sub> )	µg/m <sup>3</sup>	80 (24 hrs)	32.32	33.04	35.33	36.74	34.40	36.31
4	Sulphur Dioxide (SO <sub>2</sub> )	µg/m <sup>3</sup>	80 (24 hrs)	5.38	5.81	5.56	6.65	5.27	6.72
5	Carbon Monoxide (CO)	mg/m <sup>3</sup>	2 (8 hrs)	0.464	0.482	0.398	0.382	0.342	0.362
6	THC as Methane	mg/m <sup>3</sup>	-	1.71	1.48	1.52	1.66	1.84	1.54
7	Mercury	µg/m <sup>3</sup>	-	< 0.002			< 0.002		
8	Hydrocarbon as Non Methane	mg/m <sup>3</sup>	-	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003
9	VOCs	µg/m <sup>3</sup>	-	2.82			3.13		
10	Benzo(a)Pyrene	ng/m <sup>3</sup>	1	0.88			0.78		
11	Ammonia (NH <sub>3</sub> )	µg/m <sup>3</sup>	400	18.12			20.48		
12	Ozone (O <sub>3</sub> )	µg/m <sup>3</sup>	100	42.26			35.77		
13	Lead (Pb)	µg/m <sup>3</sup>	1	0.09			0.13		
14	Nickel (Ni)	ng/m <sup>3</sup>	20	10.57			10.53		
15	Arsenic	ng/m <sup>3</sup>	6	1.16			1.45		
16	Benzene	µg/m <sup>3</sup>	5	1.95			1.88		

S. NO.	Parameter	Unit	NAAQS Limit	KULDIHA					
				Apr'17	May'18	Jun'19	Jul'17	Aug'17	Sep'17
1	Particulate Matter (PM2.5)	µg/m <sup>3</sup>	60 (24 hrs)	44.24	30.63	40.65	36.84	24.05	34.68
2	Particulate Matter 10 (PM10)	µg/m <sup>3</sup>	100 (24 hrs)	89.39	57.61	84.79	66.45	43.26	61.03
3	Nitrogen Dioxide (NO <sub>2</sub> )	µg/m <sup>3</sup>	80 (24 hrs)	30.37	32.66	34.94	36.91	33.76	33.73
4	Sulphur Dioxide (SO <sub>2</sub> )	µg/m <sup>3</sup>	80 (24 hrs)	5.63	5.75	6.03	6.71	5.94	5.51
5	Carbon Monoxide (CO)	mg/m <sup>3</sup>	2 (8 hrs)	0.302	0.328	0.438	0.384	0.342	0.392
6	THC as Methane	mg/m <sup>3</sup>	-	1.41	1.57	1.52	2.13	1.48	1.97
7	Mercury	µg/m <sup>3</sup>	-	< 0.002			< 0.002		
8	Hydrocarbon as Non Methane	mg/m <sup>3</sup>	-	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003
9	VOCs	µg/m <sup>3</sup>	-	3.14			4.17		
10	Benzo(a)Pyrene	ng/m <sup>3</sup>	1	0.83			0.85		
11	Ammonia (NH <sub>3</sub> )	µg/m <sup>3</sup>	400	20.45			22.07		
12	Ozone (O <sub>3</sub> )	µg/m <sup>3</sup>	100	42.11			49.54		
13	Lead (Pb)	µg/m <sup>3</sup>	1	0.11			0.17		
14	Nickel (Ni)	ng/m <sup>3</sup>	20	10.75			14.71		
15	Arsenic	ng/m <sup>3</sup>	6	1.2			1.68		
16	Benzene	µg/m <sup>3</sup>	5	1.93			2.47		

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**ANNEXURE I**

S. NO.	Parameter	Unit	NAAQS Limit	GOPALPUR					
				Apr'17	May'18	Jun'19	Jul'17	Aug'17	Sep'17
1	Particulate Matter (PM2.5)	µg/m <sup>3</sup>	60 (24 hrs)	33.82	39.98	29.71	26.45	26.12	25.95
2	Particulate Matter 10 (PM10)	µg/m <sup>3</sup>	100 (24 hrs)	66.34	74.40	57.42	49.94	48.30	59.56
3	Nitrogen Dioxide (NO <sub>2</sub> )	µg/m <sup>3</sup>	80 (24 hrs)	29.96	31.17	32.63	32.81	34.65	36.59
4	Sulphur Dioxide (SO <sub>2</sub> )	µg/m <sup>3</sup>	80 (24 hrs)	6.41	5.78	4.81	5.71	5.58	5.89
5	Carbon Monoxide (CO)	mg/m <sup>3</sup>	2 (8 hrs)	0.386	0.368	0.478	0.394	0.374	0.342
6	THC as Methane	mg/m <sup>3</sup>	-	1.57	1.91	1.48	1.57	1.51	1.92
7	Mercury	µg/m <sup>3</sup>	-	< 0.002			< 0.002		
8	Hydrocarbon as Non Methane	mg/m <sup>3</sup>	-	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003
9	VOCs	µg/m <sup>3</sup>	-	2.76			2.93		
10	Benzo(a)Pyrene	ng/m <sup>3</sup>	1	0.68			0.69		
11	Ammonia (NH <sub>3</sub> )	µg/m <sup>3</sup>	400	23.16			17.66		
12	Ozone (O <sub>3</sub> )	µg/m <sup>3</sup>	100	40.64			31.42		
13	Lead (Pb)	µg/m <sup>3</sup>	1	0.09			0.09		
14	Nickel (Ni)	ng/m <sup>3</sup>	20	9.47			9.14		
15	Arsenic	ng/m <sup>3</sup>	6	1.24			1.36		
16	Benzene	µg/m <sup>3</sup>	5	1.43			1.74		

S. NO.	Parameter	Unit	NAAQS Limit	GGS 2 ( AKANDARA)					
				Apr'17	May'18	Jun'19	Jul'17	Aug'17	Sep'17
1	Particulate Matter (PM2.5)	µg/m3	60 (24 hrs)	50.11	23.93	32.24	30.08	24.30	24.07
2	Particulate Matter 10 (PM10)	µg/m3	100 (24 hrs)	116.90	46.76	69.16	62.64	49.17	53.63
3	Nitrogen Dioxide (NO2)	µg/m3	80 (24 hrs)	27.76	31.99	34.18	31.24	34.44	31.09
4	Sulphur Dioxide (SO2)	µg/m3	80 (24 hrs)	5.53	6.18	5.30	6.24	5.66	5.36
5	Carbon Monoxide (CO)	mg/m3	2 (8 hrs)	0.502	0.524	0.438	0.364	0.347	0.368
6	THC as Methane	mg/m3	-	1.98	1.55	1.48	1.91	1.68	1.57
7	Mercury	µg/m3	-	< 0.002			< 0.002		
8	Hydrocarbon as Non Methane	mg/m3	-	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003
9	VOCs	µg/m3	-	4.17			3.41		
10	Benzo(a)Pyrene	ng/m <sup>3</sup>	1	0.95			0.76		
11	Ammonia (NH <sub>3</sub> )	µg/m <sup>3</sup>	400	22.18			20.55		
12	Ozone (O <sub>3</sub> )	µg/m <sup>3</sup>	100	31.11			43.24		
13	Lead (Pb)	µg/m <sup>3</sup>	1	0.12			0.16		
14	Nickel (Ni)	ng/m <sup>3</sup>	20	10.69			13.84		
15	Arsenic	ng/m <sup>3</sup>	6	1.26			1.58		
16	Benzene	µg/m <sup>3</sup>	5	2.98			2.06		

S. NO.	Parameter	Unit	NAAQS Limit	SARENGA					
				Apr'17	May'18	Jun'19	Jul'17	Aug'17	Sep'17
1	Particulate Matter (PM2.5)	µg/m <sup>3</sup>	60 (24 hrs)	35.64	38.23	22.89	34.22	29.06	24.55
2	Particulate Matter 10 (PM10)	µg/m <sup>3</sup>	100 (24 hrs)	70.77	69.49	47.30	59.19	52.87	54.05
3	Nitrogen Dioxide (NO <sub>2</sub> )	µg/m <sup>3</sup>	80 (24 hrs)	32.14	32.80	33.13	34.98	35.78	32.82
4	Sulphur Dioxide (SO <sub>2</sub> )	µg/m <sup>3</sup>	80 (24 hrs)	5.14	6.03	4.97	5.49	5.56	5.24
5	Carbon Monoxide (CO)	mg/m <sup>3</sup>	2 (8 hrs)	0.394	0.408	0.457	0.394	0.368	0.302
6	THC as Methane	mg/m <sup>3</sup>	-	1.49	1.66	1.71	1.98	1.62	1.71
7	Mercury	µg/m <sup>3</sup>	-	< 0.002			< 0.002		
8	Hydrocarbon as Non Methane	mg/m <sup>3</sup>	-	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003
9	VOCs	µg/m <sup>3</sup>	-	2.86			3.58		
10	Benzo(a)Pyrene	ng/m <sup>3</sup>	1	0.62			0.74		
11	Ammonia (NH <sub>3</sub> )	µg/m <sup>3</sup>	400	21.16			20.88		
12	Ozone (O <sub>3</sub> )	µg/m <sup>3</sup>	100	47.36			46.73		
13	Lead (Pb)	µg/m <sup>3</sup>	1	0.1			0.13		
14	Nickel (Ni)	ng/m <sup>3</sup>	20	9.28			13.51		
15	Arsenic	ng/m <sup>3</sup>	6	1.26			1.53		
16	Benzene	µg/m <sup>3</sup>	5	1.73			2.07		

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**ANNEXURE I**

S. NO.	Parameter	Unit	NAAQS Limit	DHABANI					
				Apr'17	May'18	Jun'19	Jul'17	Aug'17	Sep'17
1	Particulate Matter (PM2.5)	µg/m3	60 (24 hrs)	37.94	30.13	26.36	28.22	28.54	23.26
2	Particulate Matter 10 (PM10)	µg/m3	100 (24 hrs)	69.13	60.52	58.33	53.42	58.94	45.30
3	Nitrogen Dioxide (NO2)	µg/m3	80 (24 hrs)	28.95	33.93	32.29	32.92	27.89	36.08
4	Sulphur Dioxide (SO2)	µg/m3	80 (24 hrs)	5.70	6.26	5.06	5.79	5.78	6.91
5	Carbon Monoxide (CO)	mg/m3	2 (8 hrs)	0.438	0.465	0.412	0.368	0.328	0.314
6	THC as Methane	mg/m3	-	1.67	1.61	1.72	1.63	1.72	1.55
7	Mercury	µg/m3	-	< 0.002			< 0.002		
8	Hydrocarbon as Non Methane	mg/m3	-	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003
9	VOCs	µg/m3	-	2.75			3.05		
10	Benzo(a)Pyrene	ng/m <sup>3</sup>	1	0.81			0.67		
11	Ammonia (NH <sub>3</sub> )	µg/m <sup>3</sup>	400	20.16			18.78		
12	Ozone (O <sub>3</sub> )	µg/m <sup>3</sup>	100	31.21			35.27		
13	Lead (Pb)	µg/m <sup>3</sup>	1	0.12			0.14		
14	Nickel (Ni)	ng/m <sup>3</sup>	20	9.44			12.47		
15	Arsenic	ng/m <sup>3</sup>	6	1.36			1.41		
16	Benzene	µg/m <sup>3</sup>	5	1.83			1.68		

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**ANNEXURE I**

S. NO.	Parameter	Unit	NAAQS Limit	NACHAN					
				Apr'17	May'18	Jun'19	Jul'17	Aug'17	Sep'17
1	Particulate Matter (PM2.5)	µg/m3	60 (24 hrs)	40.80	26.72	25.22	20.39	24.10	31.33
2	Particulate Matter 10 (PM10)	µg/m3	100 (24 hrs)	76.12	56.84	54.49	47.37	49.39	56.25
3	Nitrogen Dioxide (NO2)	µg/m3	80 (24 hrs)	28.10	33.70	32.20	32.79	34.28	38.20
4	Sulphur Dioxide (SO2)	µg/m3	80 (24 hrs)	5.53	6.06	5.45	6.94	5.48	6.38
5	Carbon Monoxide (CO)	mg/m3	2 (8 hrs)	0.474	0.484	0.462	0.402	0.368	0.347
6	THC as Methane	mg/m3	-	1.73	1.68	1.57	1.5	1.65	1.89
7	Mercury	µg/m3	-	< 0.002			< 0.002		
8	Hydrocarbon as Non Methane	mg/m3	-	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003
9	VOCs	µg/m3	-	3.02			3.09		
10	Benzo(a)Pyrene	ng/m <sup>3</sup>	1	0.74			0.46		
11	Ammonia (NH <sub>3</sub> )	µg/m <sup>3</sup>	400	13.89			15.23		
12	Ozone (O <sub>3</sub> )	µg/m <sup>3</sup>	100	33.16			33.12		
13	Lead (Pb)	µg/m <sup>3</sup>	1	0.11			0.10		
14	Nickel (Ni)	ng/m <sup>3</sup>	20	10.29			10.36		
15	Arsenic	ng/m <sup>3</sup>	6	1.45			1.39		
16	Benzene	µg/m <sup>3</sup>	5	1.69			1.71		

S. NO.	Parameter	Unit	NAAQS Limit	GHATAKDANGA					
				Apr'17	May'18	Jun'19	Jul'17	Aug'17	Sep'17
1	Particulate Matter (PM2.5)	µg/m <sup>3</sup>	60 (24 hrs)	53.97	26.19	23.56	29.65	35.49	21.23
2	Particulate Matter 10 (PM10)	µg/m <sup>3</sup>	100 (24 hrs)	128.05	52.61	51.93	55.73	61.68	43.10
3	Nitrogen Dioxide (NO <sub>2</sub> )	µg/m <sup>3</sup>	80 (24 hrs)	28.17	30.67	34.90	35.89	33.44	34.62
4	Sulphur Dioxide (SO <sub>2</sub> )	µg/m <sup>3</sup>	80 (24 hrs)	5.05	5.77	5.58	6.75	4.80	6.46
5	Carbon Monoxide (CO)	mg/m <sup>3</sup>	2 (8 hrs)	0.322	0.364	0.368	0.344	0.302	0.328
6	THC as Methane	mg/m <sup>3</sup>	-	1.89	1.67	1.34	1.84	1.97	1.43
7	Mercury	µg/m <sup>3</sup>	-	< 0.002			< 0.002		
8	Hydrocarbon as Non Methane	mg/m <sup>3</sup>	-	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003
9	VOCs	µg/m <sup>3</sup>	-	4.09			3.48		
10	Benzo(a)Pyrene	ng/m <sup>3</sup>	1	0.97			0.71		
11	Ammonia (NH <sub>3</sub> )	µg/m <sup>3</sup>	400	17.06			19.74		
12	Ozone (O <sub>3</sub> )	µg/m <sup>3</sup>	100	38.14			40.81		
13	Lead (Pb)	µg/m <sup>3</sup>	1	0.15			0.15		
14	Nickel (Ni)	ng/m <sup>3</sup>	20	12.89			12.23		
15	Arsenic	ng/m <sup>3</sup>	6	1.17			1.49		
16	Benzene	µg/m <sup>3</sup>	5	2.67			1.95		

S. NO.	Parameter	Unit	NAAQS Limit	KANTABERIA					
				Apr'17	May'18	Jun'19	Jul'17	Aug'17	Sep'17
1	Particulate Matter (PM2.5)	µg/m <sup>3</sup>	60 (24 hrs)	35.62	37.85	33.67	25.38	34.50	21.21
2	Particulate Matter 10 (PM10)	µg/m <sup>3</sup>	100 (24 hrs)	75.53	72.33	63.29	41.19	55.59	56.41
3	Nitrogen Dioxide (NO <sub>2</sub> )	µg/m <sup>3</sup>	80 (24 hrs)	32.03	30.02	32.30	32.32	38.85	36.49
4	Sulphur Dioxide (SO <sub>2</sub> )	µg/m <sup>3</sup>	80 (24 hrs)	6.17	6.35	5.64	6.11	5.89	5.70
5	Carbon Monoxide (CO)	mg/m <sup>3</sup>	2 (8 hrs)	0.462	0.482	0.408	0.382	0.362	0.368
6	THC as Methane	mg/m <sup>3</sup>	-	1.29	1.84	1.64	1.33	1.6	1.86
7	Mercury	µg/m <sup>3</sup>	-	< 0.002			< 0.002		
8	Hydrocarbon as Non Methane	mg/m <sup>3</sup>	-	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003
9	VOCs	µg/m <sup>3</sup>	-	2.88			2.78		
10	Benzo(a)Pyrene	ng/m <sup>3</sup>	1	0.75			0.38		
11	Ammonia (NH <sub>3</sub> )	µg/m <sup>3</sup>	400	17.36			14.71		
12	Ozone (O <sub>3</sub> )	µg/m <sup>3</sup>	100	32.16			30.11		
13	Lead (Pb)	µg/m <sup>3</sup>	1	0.1			0.08		
14	Nickel (Ni)	ng/m <sup>3</sup>	20	9.82			9.02		
15	Arsenic	ng/m <sup>3</sup>	6	1.3			1.27		
16	Benzene	µg/m <sup>3</sup>	5	1.77			1.54		

S. NO.	Parameter	Unit	NAAQS Limit	PRATAPPUR					
				Apr'17	May'18	Jun'19	Jul'17	Aug'17	Sep'17
1	Particulate Matter (PM2.5)	µg/m <sup>3</sup>	60 (24 hrs)	31.36	43.98	23.40	26.84	23.77	20.95
2	Particulate Matter 10 (PM10)	µg/m <sup>3</sup>	100 (24 hrs)	66.60	95.80	48.37	64.45	48.48	49.59
3	Nitrogen Dioxide (NO <sub>2</sub> )	µg/m <sup>3</sup>	80 (24 hrs)	32.07	33.05	33.87	36.03	34.04	35.11
4	Sulphur Dioxide (SO <sub>2</sub> )	µg/m <sup>3</sup>	80 (24 hrs)	6.55	6.40	4.97	6.84	6.33	5.96
5	Carbon Monoxide (CO)	mg/m <sup>3</sup>	2 (8 hrs)	0.408	0.422	0.438	0.398	0.314	0.344
6	THC as Methane	mg/m <sup>3</sup>	-	1.34	1.77	1.38	2.04	1.61	1.66
7	Mercury	µg/m <sup>3</sup>	-	< 0.002			< 0.002		
8	Hydrocarbon as Non Methane	mg/m <sup>3</sup>	-	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003
9	VOCs	µg/m <sup>3</sup>	-	2.53			3.72		
10	Benzo(a)Pyrene	ng/m <sup>3</sup>	1	0.62			0.81		
11	Ammonia (NH <sub>3</sub> )	µg/m <sup>3</sup>	400	15.36			21.09		
12	Ozone (O <sub>3</sub> )	µg/m <sup>3</sup>	100	32.31			45.64		
13	Lead (Pb)	µg/m <sup>3</sup>	1	0.08			0.16		
14	Nickel (Ni)	ng/m <sup>3</sup>	20	9.25			14.34		
15	Arsenic	ng/m <sup>3</sup>	6	1.42			1.62		
16	Benzene	µg/m <sup>3</sup>	5	1.66			2.33		

S. NO.	Parameter	Unit	NAAQS Limit	PARULIA					
				Apr'17	May'18	Jun'19	Jul'17	Aug'17	Sep'17
1	Particulate Matter (PM2.5)	µg/m <sup>3</sup>	60 (24 hrs)	33.84	39.46	20.19	31.12	39.06	31.25
2	Particulate Matter 10 (PM10)	µg/m <sup>3</sup>	100 (24 hrs)	69.50	82.49	46.26	58.98	67.99	58.18
3	Nitrogen Dioxide (NO <sub>2</sub> )	µg/m <sup>3</sup>	80 (24 hrs)	30.66	31.86	34.16	31.96	33.67	35.84
4	Sulphur Dioxide (SO <sub>2</sub> )	µg/m <sup>3</sup>	80 (24 hrs)	5.80	6.66	5.18	5.63	5.59	5.92
5	Carbon Monoxide (CO)	mg/m <sup>3</sup>	2 (8 hrs)	0.462	0.432	0.468	0.416	0.374	0.374
6	THC as Methane	mg/m <sup>3</sup>	-	1.47	1.85	1.56	1.81	2.06	1.74
7	Mercury	µg/m <sup>3</sup>	-	< 0.002			< 0.002		
8	Hydrocarbon as Non Methane	mg/m <sup>3</sup>	-	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003
9	VOCs	µg/m <sup>3</sup>	-	2.77			3.65		
10	Benzo(a)Pyrene	ng/m <sup>3</sup>	1	0.57			0.72		
11	Ammonia (NH <sub>3</sub> )	µg/m <sup>3</sup>	400	21.2			18.62		
12	Ozone (O <sub>3</sub> )	µg/m <sup>3</sup>	100	37.15			42.33		
13	Lead (Pb)	µg/m <sup>3</sup>	1	0.08			0.12		
14	Nickel (Ni)	ng/m <sup>3</sup>	20	8.85			12.17		
15	Arsenic	ng/m <sup>3</sup>	6	1.3			1.51		
16	Benzene	µg/m <sup>3</sup>	5	1.72			2.12		

**Noise Monitoring Report of CBM Raniganj Project, Essar Oil and Gas Exploration and Production Limited**  
**Compliance Period Apr'17 -Sep'17**

ANNEXURE II

Noise in Surrounding Villages (Leq dB (A))							
Permissible Limit as per CPCB	Location	Dhabani	Kantabaria Crossing	Saraswatigunj	Kuldiha	Nachan	Pratappur
	Sampling Date	08.06.17 to 09.06.17	10.06.17 to 11.06.17	13.06.17 to 14.06.17	15.06.17 to 16.06.17	16.06.17 to 17.06.17	17.06.17 to 18.06.17
75	Day time	64.15	88.50	67.70	50.30	69.45	69.05
70	Night Time	68.25	75.70	65.85	44.20	70.05	62.20

Noise in Surrounding Villages (Leq dB (A))				
Permissible Limit as per CPCB	Location	Jatgoria	Saranga	Parulia
	Sampling Date	19.06.17 to 20.06.17	20.07.17 to 21.07.17	21.07.17 to 22.07.17
75	Day time	70.30	45.88	54.08
70	Night Time	58.30	44.36	49.15

Noise in Operational Areas (Leq dB (A))					
Permissible Limit as per CPCB	Location	GGS-1 at Khatgoria	GGS-2 at Akandara	MCS at Malandighi	Warehous at Gopalpur
	Sampling Date	09.06.17 to 10.06.17	12.06.17 to 13.06.17	14.06.17 to 15.06.17	19.07.17 to 20.07.17
75	Day time	66.95	67.20	71.80	62.71
70	Night Time	66.40	66.30	49.80	50.25

**Produced Water Analysis Report of CBM Raniganj Project of Essar Oil and Gas Exploration and Production Limited**  
**(Compliance Period: Apr'17 - Sep'17)**

**ANNEXURE III**

S. No.	Parameter	Unit	CPCB Standard	EDI-040 D-3	EDI-038 D-2	EDE-018 V-1	EDD-003 D-6	EDD-011 D-2	EDD-404 D-1	EDD-401 V-1	EDD-429 D-2	ED-411 D-1
	Date			07.04.2017	07.04.2017	07.04.2017	07.04.2017	07.04.2017	07.04.2017	07.04.2017	07.04.2017	07.04.2017
1	pH		5.5 to 9.0	8.11	8.16	8.62	8.81	8.32	8.45	8.51	8.37	8.05
2	Total Suspended Solids	mg/l	100	41	17	3	<2	8	<2	<2	4	16
3	Total Dissolved Solids	mg/l	---	1532	3078	1618	1928	1276	1386	1092	794	2026
4	Turbidity	NTU	---	70.3	42.6	6.3	5.2	24.2	2.8	3.2	11.3	4.3
5	Acidity as CaCO <sub>3</sub>	mg/l	---	2.8	2.8	Nil	Nil	Nil	Nil	Nil	Nil	3.2
6	Total Alkalinity as Calcium Carbonate	mg/l	---	180.50	441.6	280.6	304	190.2	218.4	165.3	134.2	411.4
7	Chloride	mg/l	---	428.5	730.1	440	630.2	317.1	379.2	280.5	239	612
8	Total Hardness	mg/l	---	64.00	124	76	88	56	60	44	40	92
9	Sulphate	mg/l	---	15.3	27.6	14.2	11.7	10.3	9.6	<2.5	<2.5	14.2
10	Calcium	mg/l		14.4	32.1	16	17.6	16	14.4	12.8	11.2	27.3
11	Magnesium	mg/l	---	6.8	10.7	8.7	10.7	3.9	5.8	2.9	2.9	5.8
12	Dissolved Oxygen	mg/l	---	5.9	6.1	6.4	4.1	2.8	4.6	5.1	2.5	3.3
13	Biological Oxygen Demand, 3 Days at 27°C	mg/l	30	3	<2	<2	2	7	2	<2	<2	6
14	Chemical Oxygen Demand	mg/l	250	14.0	<8	<8	9	28	8	<8	<8	19
15	Oil & Grease(Hexane Extract)	mg/l	10	<5.0	<5.0	<5	<5.0	6	6	<5.0	<5.0	<5.0
16	Phenolic Compounds (as C <sub>6</sub> H <sub>5</sub> OH)	mg/l	1	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
17	Sulphide	mg/l	2	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
18	Fluoride	mg/l	2	2.8	1.35	1.15	0.83	1.3	0.98	3.2	4.1	2.1
19	Ammoniacal Nitrogen	mg/l	---	5.20	2.3	1.9	1.9	4.7	3.3	5.7	2.8	4.3
20	Iron	mg/l	---	21.40	11.2	2.8	0.96	3.8	0.48	0.72	1.85	9.62
21	Total Chromium	mg/l	2	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
22	Zinc	mg/l	---	0.158	0.086	0.097	0.049	0.025	<0.01	0.025	0.039	<0.01
23	Copper	mg/l	---	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
24	Nickel	mg/l		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
25	Total Arsenic	mg/l		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
26	Lead	mg/l		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
27	Mercury	mg/l	0.01	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001

**Produced Water Analysis Report of CBM Raniganj Project of Essar Oil and Gas Exploration and Production Limited**  
**(Compliance Period: Apr'17 - Sep'17)**

**ANNEXURE III**

S. No.	Parameter	Unit	CPCB Standard	EDI-040 D-3	EDI-038 D-2	EDE-018 V-1	EDD-003 D-6	EDD-011 D-2	EDD-404 D-1	EDD-401 V-1	EDD-429 D-2	ED-411 D-1
28	Boron	mg/l		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
29	SAR		---	15.3	16.8	5.4	19.2	11.8	12.7	12.4	11.4	23
30	Phosphorus	mg/l	---	0.43	0.29	0.18	0.14	0.28	0.19	0.079	0.18	0.11
31	Aluminium	mg/l	---	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
32	Lithium	mg/l		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
33	Manganese	mg/l		0.081	<0.05	<0.05	<0.05	0.073	<0.05	<0.05	0.093	<0.05
34	Molybdenum	mg/l	---	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
35	Palladium	mg/l	---	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
36	Selenium	mg/l		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
37	Vanadium	mg/l	---	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
38	Cadmium	mg/l		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
39	Cobalt	mg/l		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
40	Bicarbonate	mg/l	---	220.2	538.8	332.3	312.3	232	266.4	201.7	163.7	501.9
41	Electrical Conductivity	µmhos/cm	---	2311	4792	2426	3017	2025	2148	1732	1280	3112
42	Sodium	mg/l	---	280.1	430	245.1	414	202.5	225.3	188	165	508
43	Potassium	mg/l	---	10.5	14.3	8.6	9.3	6.4	7.3	14.1	8.9	10.2

**Produced Water Analysis Report of CBM Raniganj Project of Essar Oil and Gas Exploration and Production Limited**  
**(Compliance Period: Apr'17 - Sep'17)**

**ANNEXURE III**

S. No.	Parameter	Unit	CPCB Standard	EDP-406 D-3	EDH-65 D-3	EDN-162 D-6	EDN-179 V-1	EDN-184 V-1	EDN-184 D-5	EDI-70 D-2	EDD-26 D-2	EDD-26 D-4	EDI-32 V-1
	Date			07.04.2017	07.04.2017	07.04.2017	07.04.2017	07.04.2017	07.04.2017	10.04.2017	10.04.2017	10.04.2017	10.04.2017
1	pH		5.5 to 9.0	8.92	8.24	6.52	8.71	7.78	7.31	7.85	7.98	8.69	8.22
2	Total Suspended Solids	mg/l	100	<2	7	97	14	12	23	38	11	2	<2
3	Total Dissolved Solids	mg/l	---	786	2846	2924	2164	1984	2496	6248	2342	1038	3234
4	Turbidity	NTU	---	5.8	14.7	180	48.5	37.2	61.3	81.2	23.5	6.9	<1
5	Acidity as CaCO <sub>3</sub>	mg/l	---	Nil	Nil	20.8	Nil	11.8	15.3	9.3	6.8	Nil	1.1
6	Total Alkalinity as Calcium Carbonate	mg/l	---	157.8	382	407.2	247	211.5	379.5	626	282.5	170.3	426.5
7	Chloride	mg/l	---	303.1	812	926	770	668.1	745.3	1420	812	336.5	928
8	Total Hardness	mg/l	---	40	112	120	84	76	100	188	88	72	172
9	Sulphate	mg/l	---	6.9	18.7	16.3	17.4	12.2	21.5	22.4	14.7	11.3	14.7
10	Calcium	mg/l		9.6	27.3	30.5	24	16	28.9	46.5	20.8	17.6	43.3
11	Magnesium	mg/l	---	3.9	10.7	10.7	5.8	8.7	6.8	17.5	8.7	6.8	15.6
12	Dissolved Oxygen	mg/l	---	5.8	5.5	4.3	5.1	5.3	3.9	5.9	6	6.2	6.2
13	Biological Oxygen Demand, 3 Days at 27°C	mg/l	30	<2	<2	4	2			2	<2	<2	<2
14	Chemical Oxygen Demand	mg/l	250	<8	<8	14	11	8	14	8	<8	<8	<8
15	Oil & Grease(Hexane Extract)	mg/l	10	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
16	Phenolic Compounds (as C <sub>6</sub> H <sub>5</sub> OH)	mg/l	1	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
17	Sulphide	mg/l	2	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
18	Fluoride	mg/l	2	3.7	5.7	6.8	3.8	6.2	4.9	2.85	1.8	1.16	3.8
19	Ammoniacal Nitrogen	mg/l	---	1.7	2.8	3.9	5.5	3.1	7.2	4.3	2.1	2.7	2.9
20	Iron	mg/l	---	1.8	2.45	32.4	9.65	7.8	11.6	49.6	12.2	4.2	0.18
21	Total Chromium	mg/l	2	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
22	Zinc	mg/l	---	<0.01	0.019	0.156	0.109	0.075	0.117	0.109	<0.01	<0.01	<0.01
23	Copper	mg/l	---	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
24	Nickel	mg/l		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
25	Total Arsenic	mg/l		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
26	Lead	mg/l		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
27	Mercury	mg/l	0.01	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001

**Produced Water Analysis Report of CBM Raniganj Project of Essar Oil and Gas Exploration and Production Limited**  
**(Compliance Period: Apr'17 - Sep'17)**

**ANNEXURE III**

S. No.	Parameter	Unit	CPCB Standard	EDP-406 D-3	EDH-65 D-3	EDN-162 D-6	EDN-179 V-1	EDN-184 V-1	EDN-184 D-5	EDI-70 D-2	EDD-26 D-2	EDD-26 D-4	EDI-32 V-1
28	Boron	mg/l		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
29	SAR		---	14.5	21.9	26.8	25.7	21.3	22	31.1	26.4	9	20.5
30	Phosphorus	mg/l	---	0.12	0.21	0.49	0.33	0.23	0.45	0.33	0.19	0.14	0.29
31	Aluminium	mg/l	---	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
32	Lithium	mg/l		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
33	Manganese	mg/l		<0.05	<0.05	0.108	0.081	0.065	0.092	0.143	0.088	<0.05	<0.05
34	Molybdenum	mg/l	---	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
35	Palladium	mg/l	---	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
36	Selenium	mg/l		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
37	Vanadium	mg/l	---	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
38	Cadmium	mg/l		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
39	Cobalt	mg/l		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
40	Bicarbonate	mg/l	---	95.2	466	496.5	285	258	463	763.7	344.7	207.8	520.3
41	Electrical Conductivity	µmhos/cm	---	1224	4516	469	3382	3070	3892	9588	3682	1662	4897
42	Sodium	mg/l	---	212.2	533.6	676.5	543	428	506	980.3	570	174	618
43	Potassium	mg/l	---	9.2	7.4	11.6	10	12.6	14.5	16.5	9.8	6.5	8.6

**Produced Water Analysis Report of CBM Raniganj Project of Essar Oil and Gas Exploration and Production Limited**  
**(Compliance Period: Apr'17 - Sep'17)**

**ANNEXURE III**

S. No.	Parameter	Unit	CPCB Standard	EDI-032 D-2	EDI-032 D-3	EDI-032 D-4	EDI-30 D-1	EDI-30 D-2	EDI-30 D-3	EDN-170 D1	EDN-099 D2	EDI-042 D1	EDI-068 D2
	Date			10.04.2017	10.04.2017	10.04.2017	10.04.2017	10.04.2017	10.04.2017	12.05.2017	12.05.2017	12.05.2017	12.05.2017
1	pH		5.5 to 9.0	7.97	8.28	8.11	8.45	7.58	8.36	7.38	7.32	7.7	7.76
2	Total Suspended Solids	mg/l	100	<2	<2	12	84	96	8	6	5.5	3.2	7.5
3	Total Dissolved Solids	mg/l	---	4326	4168	4126	452	4786	3648	16388	13192	18276	10216
4	Turbidity	NTU	---	<1	<1	31.7	140	162	12.5	43.6	52	23.5	19.4
5	Acidity as CaCO <sub>3</sub>	mg/l	---	2.1	1.1	2.4	Nil	11.3	Nil	12.1	13.2	8.4	12.4
6	Total Alkalinity as Calcium Carbonate	mg/l	---	712	640.3	511	603.4	711.5	522.1	584.10	287.1	300.8	1212.6
7	Chloride	mg/l	---	1012	1142	1186	1091	1207.5	943	8628.2	7638	12400	6459
8	Total Hardness	mg/l	---	152	164	148	156	144	140	1080.00	620	412	76
9	Sulphate	mg/l	---	15.3	11.4	18.6	21.3	24.5	11.6	<2.5	<2.5	<2.5	<2.5
10	Calcium	mg/l		33.7	36.9	30.5	36.9	33.7	35.3	312.6	168.3	80.2	11.2
11	Magnesium	mg/l	---	16.5	17.5	17.5	15.6	14.6	12.6	73.0	48.6	51.5	11.7
12	Dissolved Oxygen	mg/l	---	5.9	6.1	5.2	3.9	3.1	3.3	5.7	5.1	4.9	5.4
13	Biological Oxygen Demand, 3 Days at 27°C	mg/l	30	<2	<2	2	3	4	4	<2	<2	2.5	<2
14	Chemical Oxygen Demand	mg/l	250	<8	<8	9	14	16	15	<8	<8	14	11
15	Oil & Grease(Hexane Extract)	mg/l	10	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5	<5.0
16	Phenolic Compounds (as C <sub>6</sub> H <sub>5</sub> OH)	mg/l	1	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.002	<0.002	<0.002	<0.002
17	Sulphide	mg/l	2	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
18	Fluoride	mg/l	2	4.2	4.7	4.6	3.9	3.7	2.4	3.85	2.72	2.46	2.8
19	Ammoniacal Nitrogen	mg/l	---	3.7	3.3	1.9	3.2	2.1	3.6	1.90	2.1	2.5	2.1
20	Iron	mg/l	---	0.12	0.14	7.6	8.3	18.5	1.33	18.96	19.67	5.99	13.41
21	Total Chromium	mg/l	2	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
22	Zinc	mg/l	---	<0.01	<0.01	0.019	0.076	0.053	0.043	0.018	<0.01	<0.01	0.042
23	Copper	mg/l	---	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
24	Nickel	mg/l		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
25	Total Arsenic	mg/l		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
26	Lead	mg/l		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
27	Mercury	mg/l	0.01	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001

**Produced Water Analysis Report of CBM Raniganj Project of Essar Oil and Gas Exploration and Production Limited**  
**(Compliance Period: Apr'17 - Sep'17)**

**ANNEXURE III**

S. No.	Parameter	Unit	CPCB Standard	EDI-032 D-2	EDI-032 D-3	EDI-032 D-4	EDI-30 D-1	EDI-30 D-2	EDI-30 D-3	EDN-170 D1	EDN-099 D2	EDI-042 D1	EDI-068 D2
28	Boron	mg/l		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
29	SAR		---	24.8	26.2	28.9	25.9	29.8	26.2	75	89.39	136.66	201.69
30	Phosphorus	mg/l	---	0.33	0.17	0.21	0.17	0.24	0.17	0.14	0.18	0.21	0.29
31	Aluminium	mg/l	---	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
32	Lithium	mg/l		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
33	Manganese	mg/l		<0.05	<0.05	0.114	0.163	0.083	0.076	<0.05	<0.05	<0.05	0.086
34	Molybdenum	mg/l	---	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
35	Palladium	mg/l	---	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
36	Selenium	mg/l		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
37	Vanadium	mg/l	---	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
38	Cadmium	mg/l		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
39	Cobalt	mg/l		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
40	Bicarbonate	mg/l	---	868.6	780.8	623.4	736.1	868	637	712.6	350.2	3669	1479.4
41	Electrical Conductivity	µmhos/cm	---	6724	6496	6348	6518	7285	5704	21800	16440	24800	11830
42	Sodium	mg/l	---	702	770.4	810	742	822	712	5669.8	5019.3	6380	4044
43	Potassium	mg/l	---	15.7	10.8	7.6	12.4	16.4	12.3	16.3	7.5	5.3	9.4

**Produced Water Analysis Report of CBM Raniganj Project of Essar Oil and Gas Exploration and Production Limited**  
**(Compliance Period: Apr'17 - Sep'17)**

**ANNEXURE III**

S. No.	Parameter	Unit	CPCB Standard	EDI-037 D6	EDH-035 V1	EDD-022 D3	EDD-008 V1	EDD-403 D1	EDC-409 D1	EDC-072 D8	EDC-411 V	EDG-075 D6	EDC-413 D3
	Date			12.05.2017	12.05.2017	12.05.2017	12.05.2017	12.05.2017	12.05.2017	12.05.2017	12.05.2017	12.05.2017	12.05.2017
1	pH		5.5 to 9.0	7.6	7.92	8.15	8.25	8.42	8.05	7.92	7.67	8.2	7.56
2	Total Suspended Solids	mg/l	100	4.2	6.8	3	<2	<2	2	<2	7.5	<2	5.4
3	Total Dissolved Solids	mg/l	---	14514	6344	2010	2584	1108	2579.3	3440	3250	1964	3236
4	Turbidity	NTU	---	22.7	38.9	6.2	<1	3.5	10.7	2.4	76.5	<1	87.5
5	Acidity as CaCO <sub>3</sub>	mg/l	---	13.5	7.8	3.2	Nil	Nil	2.8	7.8	10.9	1.8	14.8
6	Total Alkalinity as Calcium Carbonate	mg/l	---	714.4	1344.2	1410	1729.6	780.2	1616.8	1842.4	1983.4	1052.8	1052.8
7	Chloride	mg/l	---	8439.6	3819	155.4	291.4	111.7	344.8	626.5	519.7	349.7	1107.3
8	Total Hardness	mg/l	---	212	220	28	20	24	40	40	100	28	120
9	Sulphate	mg/l	---	<2.5	17.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	13
10	Calcium	mg/l		51.3	24	3.2	4.8	3.2	8	9.6	24	4.8	40.1
11	Magnesium	mg/l	---	20.4	38.9	4.8	1.9	3.9	4.8	3.9	9.7	3.9	4.8
12	Dissolved Oxygen	mg/l	---	5.2	5.9	5.3	4.9	5.1	5.4	5.3	4.9	5.8	4.6
13	Biological Oxygen Demand, 3 Days at 27°C	mg/l	30	<2	2.5	<2	<2	<2	<2	<2	2.9	<2	3
14	Chemical Oxygen Demand	mg/l	250	<8	14	<8	<8	11	<8	<8	17	<8	14
15	Oil & Grease(Hexane Extract)	mg/l	10	<5	<5	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
16	Phenolic Compounds (as C <sub>6</sub> H <sub>5</sub> OH)	mg/l	1	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
17	Sulphide	mg/l	2	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
18	Fluoride	mg/l	2	3.92	1.76	1.3	1.95	1.82	2.36	2.57	2.42	1.87	2.16
19	Ammoniacal Nitrogen	mg/l	---	3.8	2.7	2.4	3.2	1.8	1.8	2.1	1.5	3.5	2.8
20	Iron	mg/l	---	10.33	14.64	2.16	0.25	1.11	1.68	0.68	14.67	0.52	14.41
21	Total Chromium	mg/l	2	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
22	Zinc	mg/l	---	0.067	0.102	0.087	<0.01	0.066	0.069	<0.01	0.104	0.072	0.108
23	Copper	mg/l	---	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
24	Nickel	mg/l		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
25	Total Arsenic	mg/l		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
26	Lead	mg/l		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
27	Mercury	mg/l	0.01	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001

**Produced Water Analysis Report of CBM Raniganj Project of Essar Oil and Gas Exploration and Production Limited**  
**(Compliance Period: Apr'17 - Sep'17)**

**ANNEXURE III**

S. No.	Parameter	Unit	CPCB Standard	EDI-037 D6	EDH-035 V1	EDD-022 D3	EDD-008 V1	EDD-403 D1	EDC-409 D1	EDC-072 D8	EDC-411 V	EDG-075 D6	EDC-413 D3
28	Boron	mg/l		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
29	SAR		---	153.67	63.02	8.37	18.4	6.51	15.23	28.19	14.93	18.41	29.28
30	Phosphorus	mg/l	---	0.42	0.21	0.094	0.16	0.22	0.27	0.17	0.21	0.19	0.27
31	Aluminium	mg/l	---	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
32	Lithium	mg/l		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
33	Manganese	mg/l		<0.05	<0.05	<0.05	<0.05	0.083	<0.05	<0.05	0.124	<0.05	0.084
34	Molybdenum	mg/l	---	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
35	Palladium	mg/l	---	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
36	Selenium	mg/l		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
37	Vanadium	mg/l	---	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
38	Cadmium	mg/l		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
39	Cobalt	mg/l		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
40	Bicarbonate	mg/l	---	871.1	1639.9	1720.2	2110.1	951.8	1971.5	2247.7	2419.7	1284.4	1350.9
41	Electrical Conductivity	µmhos/cm	---	18570	10400	3370	4330	1877	4160	5660	5310	3330	5650
42	Sodium	mg/l	---	5146	2150	102	189.4	73.4	221.5	408.5	343.4	224	737.5
43	Potassium	mg/l	---	6	5.3	6	8	11.4	3.2	4.6	4.5	11.9	14.2

**Produced Water Analysis Report of CBM Raniganj Project of Essar Oil and Gas Exploration and Production Limited**  
**(Compliance Period: Apr'17 - Sep'17)**

**ANNEXURE III**

S. No.	Parameter	Unit	CPCB Standard	EDN-98 D-3	EDN-99 D-3	EDI-40 V-1	EDI-39 D-1	EDI-37 D-2	EDE-024 D-1	EDE-001 D-1	EDI-123 V-1	EDH-44 D-4	EDH-58 D-2
	Date			09.06.2017	09.06.2017	09.06.2017	09.06.2017	09.06.2017	09.06.2017	09.06.2017	09.06.2017	09.06.2017	09.06.2017
1	pH		5.5 to 9.0	7.81	8.39	7.58	7.32	7.51	8.15	8.67	8.05	7.64	8.38
2	Total Suspended Solids	mg/l	100	19	14	3	21	9	11	2	11	9	3
3	Total Dissolved Solids	mg/l	---	11662	5842	4638	4866	13650	5864	2864	20734	4436	4612
4	Turbidity	NTU	---	72.5	61.4	10.6	69.2	21.3	30.4	9.7	51.2	43.5	11.2
5	Acidity as CaCO <sub>3</sub>	mg/l	---	19.3	Nil	11.6	21.4	15.4	7.7	Nil	4.9	15.4	Nil
6	Total Alkalinity as Calcium Carbonate	mg/l	---	1089.00	1524.6	772.2	1287	722.7	425.7	1950.3	5049	196	1072
7	Chloride	mg/l	---	6412.2	2310.2	2498.9	2593.2	7826.6	3206.1	612.9	10042.6	1603	1933.1
8	Total Hardness	mg/l	---	428.00	64	220	96	380	252	44	664	92	80
9	Sulphate	mg/l	---	<2.5	<2.5	<2.5	<2.5	9.6	<2.5	<2.5	8.8	<2.5	<2.5
10	Calcium	mg/l		85	8	53	20.8	75.3	86.6	16	227.6	20.8	19.2
11	Magnesium	mg/l	---	52.5	10.7	21.4	10.7	46.6	8.7	1	23.3	9.7	7.8
12	Dissolved Oxygen	mg/l	---	3.4	2.9	3.9	2	2.7	2.1	5.4	5.6	5.1	2.7
13	Biological Oxygen Demand, 3 Days at 27°C	mg/l	30	4	8	4	8	5	6	2	<2	2	3
14	Chemical Oxygen Demand	mg/l	250	14.0	28	12	27	19	20	10	8	13	13
15	Oil & Grease(Hexane Extract)	mg/l	10	<5.0	<5.0	<5	<5.0	<5	<5	<5.0	<5.0	<5.0	<5.0
16	Phenolic Compounds (as C <sub>6</sub> H <sub>5</sub> OH)	mg/l	1	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
17	Sulphide	mg/l	2	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
18	Fluoride	mg/l	2	3.22	1.86	2.45	1.9	2.4	1.55	0.85	3.5	1.45	2.45
19	Ammoniacal Nitrogen	mg/l	---	6.80	4.2	3.9	4.3	7.2	3.2	2.4	5.9	4.1	3.15
20	Iron	mg/l	---	13.77	12.79	1.87	13.36	2.76	6.38	1.49	14.99	13.75	4.52
21	Total Chromium	mg/l	2	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
22	Zinc	mg/l	---	0.044	0.143	0.019	0.069	0.042	0.011	0.017	0.053	0.041	<0.01
23	Copper	mg/l	---	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
24	Nickel	mg/l		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
25	Total Arsenic	mg/l		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
26	Lead	mg/l		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
27	Mercury	mg/l	0.01	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001

**Produced Water Analysis Report of CBM Raniganj Project of Essar Oil and Gas Exploration and Production Limited**  
**(Compliance Period: Apr'17 - Sep'17)**

**ANNEXURE III**

S. No.	Parameter	Unit	CPCB Standard	EDN-98 D-3	EDN-99 D-3	EDI-40 V-1	EDI-39 D-1	EDI-37 D-2	EDE-024 D-1	EDE-001 D-1	EDI-123 V-1	EDH-44 D-4	EDH-58 D-2
28	Boron	mg/l		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
29	SAR		---	88.6	81	52.2	81	117.1	61.9	39.5	112.1	53.2	64.5
30	Phosphorus	mg/l	---	0.41	0.36	0.29	0.33	0.41	0.38	0.21	0.44	0.3	0.24
31	Aluminium	mg/l	---	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
32	Lithium	mg/l		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
33	Manganese	mg/l		0.211	0.134	0.062	0.214	0.092	<0.05	<0.05	0.082	0.095	<0.05
34	Molybdenum	mg/l	---	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
35	Palladium	mg/l	---	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
36	Selenium	mg/l		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
37	Vanadium	mg/l	---	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
38	Cadmium	mg/l		<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
39	Cobalt	mg/l		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
40	Bicarbonate	mg/l	---	1328.6	7127.2	5658.4	1570	880.8	519.4	1860.1	6159.1	239.1	1307.8
41	Electrical Conductivity	µmhos/cm	---	18508	9738	7730	8117	22751	9746	4619	33894	7272	7460
42	Sodium	mg/l	---	4214.0	1470	1780	1827	5249	2248.5	602.5	6649	1172	1326
43	Potassium	mg/l	---	14.5	10.2	11.9	16.5	11.4	6.9	9.3	18.2	15.7	8.9

**Produced Water Analysis Report of CBM Raniganj Project of Essar Oil and Gas Exploration and Production Limited**  
**(Compliance Period: Apr'17 - Sep'17)**

**ANNEXURE III**

S. No.	Parameter	Unit	CPCB Standard	EDH-29 D-6	EDH-29 D-1	EDH-29 D-3	EDD-004 D-4	EDD-003 D-4	EDG-74 V-1	EDD-53 D-2	EDD-54 V-1	EDD-49 D-4	EDD-405 D-4
	Date			09.06.2017	09.06.2017	09.06.2017	09.06.2017	09.06.2017	10.07.2017	10.07.2017	10.07.2017	10.07.2017	10.07.2017
1	pH		5.5 to 9.0	8.17	8.28	8.14	8.65	8.93	8.72	8.81	8.64	8.86	9.21
2	Total Suspended Solids	mg/l	100	5	<2	12	6	<2	<2	4	7	11	8
3	Total Dissolved Solids	mg/l	---	7048	4554	5298	1948	2466	1786	2758	2642	6382	2462
4	Turbidity	NTU	---	13.7	2.1	39.3	14.5	3.3	5.5	11.3	20.4	23.5	20.9
5	Acidity as CaCO <sub>3</sub>	mg/l	---	7.7	Nil	4.9	Nil	Nil	Nil	Nil	Nil	Nil	Nil
6	Total Alkalinity as Calcium Carbonate	mg/l	---	1463.5	1148.5	1470.3	580.1	672	1405.80	2148.3	1415.7	1989.9	1980
7	Chloride	mg/l	---	3866.2	2404.6	2498.9	660.1	565.8	335.5	650.7	1075	3960.5	348.9
8	Total Hardness	mg/l	---	144	68	116	40	24	66.60	31.4	62.7	43.1	43.1
9	Sulphate	mg/l	---	7.5	<2.5	<2.5	<2.5	<2.5	7.8	9.2	8.5	12.5	8.8
10	Calcium	mg/l		40.1	9.6	40.1	9.6	6.4	7.8	7.8	6.3	11	9.4
11	Magnesium	mg/l	---	10.7	10.7	3.9	3.9	1.9	11.4	2.8	11.4	3.8	4.8
12	Dissolved Oxygen	mg/l	---	4.3	6.3	2.6	2.5	6	5.3	4.9	5.1	5.6	4.9
13	Biological Oxygen Demand, 3 Days at 27°C	mg/l	30	3	<2	5	8	<2	<2	<2	<2	<2	<2
14	Chemical Oxygen Demand	mg/l	250	11	<8	21	27	<8	<8	<8	<8	<8	<8
15	Oil & Grease(Hexane Extract)	mg/l	10	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5	<5.0	<5
16	Phenolic Compounds (as C <sub>6</sub> H <sub>5</sub> OH)	mg/l	1	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
17	Sulphide	mg/l	2	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
18	Fluoride	mg/l	2	1.8	2.6	2.6	0.91	1	1.2	1.9	1.65	2.8	2.25
19	Ammoniacal Nitrogen	mg/l	---	4.85	3.49	4.2	2.9	3.4	3.30	4.28	2.92	2.62	2.15
20	Iron	mg/l	---	6.81	0.64	12.05	3.99	0.65	1.20	3.64	7.23	4.43	3.99
21	Total Chromium	mg/l	2	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
22	Zinc	mg/l	---	0.018	0.021	0.023	0.017	0.011	0.021	0.026	0.024	0.039	0.017
23	Copper	mg/l	---	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
24	Nickel	mg/l		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
25	Total Arsenic	mg/l		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
26	Lead	mg/l		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
27	Mercury	mg/l	0.01	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001

**Produced Water Analysis Report of CBM Raniganj Project of Essar Oil and Gas Exploration and Production Limited**  
**(Compliance Period: Apr'17 - Sep'17)**

**ANNEXURE III**

S. No.	Parameter	Unit	CPCB Standard	EDH-29 D-6	EDH-29 D-1	EDH-29 D-3	EDD-004 D-4	EDD-003 D-4	EDG-74 V-1	EDD-53 D-2	EDD-54 V-1	EDD-49 D-4	EDD-405 D-4
28	Boron	mg/l		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
29	SAR		---	38.8	75.3	65.9	27.7	32.7	8.69	19.2	34.2	71.6	8
30	Phosphorus	mg/l	---	0.19	0.15	0.26	0.19	0.11	0.29	0.43	0.32	0.49	0.35
31	Aluminium	mg/l	---	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
32	Lithium	mg/l		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
33	Manganese	mg/l		<0.05	<0.05	0.071	0.059	<0.05	<0.05	0.082	0.107	0.057	0.059
34	Molybdenum	mg/l	---	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
35	Palladium	mg/l	---	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
36	Selenium	mg/l		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
37	Vanadium	mg/l	---	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
38	Cadmium	mg/l		<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
39	Cobalt	mg/l		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
40	Bicarbonate	mg/l	---	1784.9	1400.6	1793.7	567.6	640.5	1702.2	2620.9	1727.2	2127.6	2326
41	Electrical Conductivity	µmhos/cm	---	11543	7466	8849	3044	4042	2876	4297	3844	9578	4106
42	Sodium	mg/l	---	1070	1428	1632	402	368	163.0	248	620	1079.5	122
43	Potassium	mg/l	---	19.2	14.7	12.2	9.1	7.3	4.0	6	10	14	<1

**Produced Water Analysis Report of CBM Raniganj Project of Essar Oil and Gas Exploration and Production Limited**  
**(Compliance Period: Apr'17 - Sep'17)**

**ANNEXURE III**

S. No.	Parameter	Unit	CPCB Standard	EDD-10 V-1	EDD-12 V-1	EDD-04 D-3	EDE-019 V-1	EDI-36 D-1	EDI-40 D-1	EDI-68 D-5	EDI-71 D-3	EDN-171 D-1	EDN-184 D-2
	Date			10.07.2017	10.07.2017	10.07.2017	10.07.2017	10.07.2017	10.07.2017	10.07.2017	10.07.2017	14.07.2017	14.07.2017
1	pH		5.5 to 9.0	9.07	9.18	8.71	9.25	8.78	8.38	8.17	7.84	8.38	8.32
2	Total Suspended Solids	mg/l	100	<2	<2	17	8	38	18	22	58	24	<2
3	Total Dissolved Solids	mg/l	---	2164	1636	2714	2436	14280	3842	4964	16328	2514	1434
4	Turbidity	NTU	---	3.2	3.9	40.7	13.4	95.5	34	38.5	125.5	57.6	3.7
5	Acidity as CaCO <sub>3</sub>	mg/l	---	Nil	Nil	Nil	Nil	Nil	Nil	4.6	8.8	Nil	Nil
6	Total Alkalinity as Calcium Carbonate	mg/l	---	1534.5	950.4	702.9	1683	900.9	841.5	1277.1	673.2	310.4	368.6
7	Chloride	mg/l	---	688.4	132	1537	264	7732.4	2348	3017.5	10419.8	1367.3	660.1
8	Total Hardness	mg/l	---	27.4	23.5	86.2	27.4	303.8	321.4	156.8	548.8	2744	105.8
9	Sulphate	mg/l	---	6.9	9.5	11.5	10.3	46.3	12.5	10.5	15.7	9.2	<2.5
10	Calcium	mg/l		6.3	4.7	20.4	6.3	82.5	66	50.3	113.9	92.7	10.5
11	Magnesium	mg/l	---	2.8	2.8	8.6	2.8	23.8	38.1	7.6	64.3	26.7	9.5
12	Dissolved Oxygen	mg/l	---	5.4	5.3	4.5	5.1	3.8	4.6	4.1	3.1	4.5	5.8
13	Biological Oxygen Demand, 3 Days at 27°C	mg/l	30	<2	<2	2	<2	3	<2	2	5	3	<2
14	Chemical Oxygen Demand	mg/l	250	<8	<8	9	<8	14	9	10	24	10	<8
15	Oil & Grease(Hexane Extract)	mg/l	10	<5	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
16	Phenolic Compounds (as C <sub>6</sub> H <sub>5</sub> OH)	mg/l	1	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
17	Sulphide	mg/l	2	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
18	Fluoride	mg/l	2	1.4	2.8	2.4	1.95	3.4	2.9	2.65	3.3	1.8	0.65
19	Ammoniacal Nitrogen	mg/l	---	1.98	4.35	2.65	3.24	6.2	3.92	4.45	5.36	3.35	1.52
20	Iron	mg/l	---	0.1	0.1	11.22	2.2	18	22.6	20.5	27	0.74	13.72
21	Total Chromium	mg/l	2	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
22	Zinc	mg/l	---	0.023	0.018	0.042	0.039	0.082	0.053	0.061	0.089	0.071	<0.01
23	Copper	mg/l	---	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
24	Nickel	mg/l		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
25	Total Arsenic	mg/l		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
26	Lead	mg/l		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
27	Mercury	mg/l	0.01	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001

**Produced Water Analysis Report of CBM Raniganj Project of Essar Oil and Gas Exploration and Production Limited**  
**(Compliance Period: Apr'17 - Sep'17)**

**ANNEXURE III**

S. No.	Parameter	Unit	CPCB Standard	EDD-10 V-1	EDD-12 V-1	EDD-04 D-3	EDE-019 V-1	EDI-36 D-1	EDI-40 D-1	EDI-68 D-5	EDI-71 D-3	EDN-171 D-1	EDN-184 D-2
28	Boron	mg/l		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
29	SAR		---	22.4	5	25.1	7.3	98.1	23.8	42.1	63.4	1.9	7.7
30	Phosphorus	mg/l	---	0.26	0.21	0.47	0.38	0.51	0.34	0.29	0.54	0.42	0.14
31	Aluminium	mg/l	---	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
32	Lithium	mg/l		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
33	Manganese	mg/l		<0.05	<0.05	0.173	0.059	0.183	<0.05	<0.05	0.153	<0.05	<0.05
34	Molybdenum	mg/l	---	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
35	Palladium	mg/l	---	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
36	Selenium	mg/l		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
37	Vanadium	mg/l	---	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
38	Cadmium	mg/l		<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
39	Cobalt	mg/l		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
40	Bicarbonate	mg/l	---	1632.5	1048.2	826.5	1826.3	1099	1026.6	1558.1	821.3	378.7	449.7
41	Electrical Conductivity	µmhos/cm	---	3548	2357	4242	3548	18780	5780	6429	23248	3842.1	2142
42	Sodium	mg/l	---	270.5	56	535	88	3935.5	980.3	1214	3422	728	182
43	Potassium	mg/l	---	2	<1	9	7	18	7	11	14	8	<1

**Produced Water Analysis Report of CBM Raniganj Project of Essar Oil and Gas Exploration and Production Limited**  
**(Compliance Period: Apr'17 - Sep'17)**

**ANNEXURE III**

S. No.	Parameter	Unit	CPCB Standard	EDI-42 D-2	EDI-40 V-1	EDI-70 D-1	EDI-38 D-1	EDI-39 V-1	EDI-68 D-3	EDI-34 D-1	EDH-44 V-1	EDD-003 D-1	EDD-17 D-4
	Date			10.08.2017	10.08.2017	10.08.2017	10.08.2017	10.08.2017	10.08.2017	10.08.2017	10.08.2017	10.08.2017	10.08.2017
1	pH		5.5 to 9.0	8.19	6.21	8.04	8.83	8.76	9.21	8.34	8.29	9.15	9.45
2	Total Suspended Solids	mg/l	100	48	37	29	12	10	13	24	47	<2	18
3	Total Dissolved Solids	mg/l	---	8632	4278	11722	5752	4466	6892	5742	4246	2276	3184
4	Turbidity	NTU	---	171.5	154	83.5	29.3	19.4	27	55.5	111	<1	41.4
5	Acidity as CaCO <sub>3</sub>	mg/l	---	4.9	32	5.8	Nil	Nil	Nil	Nil	Nil	Nil	Nil
6	Total Alkalinity as Calcium Carbonate	mg/l	---	824.50	632.4	461.7	1251.3	746.9	1804.2	1028.2	1503.5	1843	1901.2
7	Chloride	mg/l	---	5563.5	2781.8	8581	3064.7	2593.2	3583.3	233.5	2178.3	216.9	650.7
8	Total Hardness	mg/l	---	232.80	120.3	613	147.4	205.6	147.4	275.5	116.4	19.4	38.8
9	Sulphate	mg/l	---	8.8	10.2	7.5	6.5	7.3	5.8	7.4	<2.5	<2.5	4.5
10	Calcium	mg/l		77.7	31.1	205.3	42	46.6	38.9	85.5	29.5	4.7	7.8
11	Magnesium	mg/l	---	9.4	10.4	24.5	10.4	21.7	12.2	15.1	10.4	1.9	4.7
12	Dissolved Oxygen	mg/l	---	5.1	4.8	3.5	5.9	5.3	4.9	4.7	5.8	5.1	6.2
13	Biological Oxygen Demand, 3 Days at 27°C	mg/l	30	2	<2	5	<2	<2	2	2	<2	<2	<2
14	Chemical Oxygen Demand	mg/l	250	10.0	8	24	<8	<8	10	9	<8	<8	<8
15	Oil & Grease(Hexane Extract)	mg/l	10	<5.0	<5.0	<5	<5.0	<5	<5	<5.0	<5.0	<5.0	<5.0
16	Phenolic Compounds (as C <sub>6</sub> H <sub>5</sub> OH)	mg/l	1	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
17	Sulphide	mg/l	2	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
18	Fluoride	mg/l	2	3.8	2.9	2.1	2.45	3.25	2.85	2.35	3.65	2.2	2.85
19	Ammoniacal Nitrogen	mg/l	---	4.21	6.42	3.96	5.2	7.28	6.42	4.3	5.7	3.8	4.6
20	Iron	mg/l	---	27.90	36.4	18.4	16.8	14.7	10.7	15.8	35	0.28	8.1
21	Total Chromium	mg/l	2	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
22	Zinc	mg/l	---	0.014	0.037	0.021	0.042	0.033	0.028	0.011	0.039	<0.01	0.044
23	Copper	mg/l	---	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
24	Nickel	mg/l		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
25	Total Arsenic	mg/l		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
26	Lead	mg/l		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
27	Mercury	mg/l	0.01	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001

**Produced Water Analysis Report of CBM Raniganj Project of Essar Oil and Gas Exploration and Production Limited**  
**(Compliance Period: Apr'17 - Sep'17)**

**ANNEXURE III**

S. No.	Parameter	Unit	CPCB Standard	EDI-42 D-2	EDI-40 V-1	EDI-70 D-1	EDI-38 D-1	EDI-39 V-1	EDI-68 D-3	EDI-34 D-1	EDH-44 V-1	EDD-003 D-1	EDD-17 D-4
28	Boron	mg/l		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
29	SAR		---	56.3	32.5	45.2	29.6	15.8	78.9	18.2	19.9	41.2	33.8
30	Phosphorus	mg/l	---	0.24	0.19	0.15	0.27	0.18	0.22	0.33	0.21	0.37	0.18
31	Aluminium	mg/l	---	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
32	Lithium	mg/l		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
33	Manganese	mg/l		0.082	0.073	0.058	<0.05	<0.05	<0.05	0.068	0.078	<0.05	0.082
34	Molybdenum	mg/l	---	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
35	Palladium	mg/l	---	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
36	Selenium	mg/l		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
37	Vanadium	mg/l	---	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
38	Cadmium	mg/l		<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
39	Cobalt	mg/l		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
40	Bicarbonate	mg/l	---	1005.9	771.5	563.3	1085.8	669.2	1293	1254	1834.3	1342	1415.2
41	Electrical Conductivity	µmhos/cm	---	10583	6102	14622	8201	5982	8846	8431	5522	3348	4582
42	Sodium	mg/l	---	1978.0	822	2576	1632	1136	2204	1512	1074	912	1054
43	Potassium	mg/l	---	7.3	5.9	10.2	8.2	6.8	5.4	5.2	6.5	4.2	8.8

**Produced Water Analysis Report of CBM Raniganj Project of Essar Oil and Gas Exploration and Production Limited**  
**(Compliance Period: Apr'17 - Sep'17)**

**ANNEXURE III**

S. No.	Parameter	Unit	CPCB Standard	EDD-17 D-5	EDD-15 D-3	EDD-13 V-1	EDI-42 D-4	EDI-40 D-2	EDI-39 D-1	EDI-34 D-2	EDI-36 V-1	EDH-64 D-1	EDH-33 V-1
	Date			10.08.2017	10.08.2017	10.08.2017	04.09.2017	04.09.2017	04.09.2017	04.09.2017	04.09.2017	04.09.2017	04.09.2017
1	pH		5.5 to 9.0	9.51	9.22	9.83	8.42	8.15	8.47	8.16	7.93	8.75	8.31
2	Total Suspended Solids	mg/l	100	<2	<2	<2	24	49	17	149	41	7	11
3	Total Dissolved Solids	mg/l	---	3622	3248	2488	6482	6588	5182	7696	9062	3692	5498
4	Turbidity	NTU	---	2.5	2	<1	60.5	97.5	48.8	679	95.5	18	26.2
5	Acidity as CaCO <sub>3</sub>	mg/l	---	Nil	Nil	Nil	Nil	3.8	Nil	4.1	11.8	Nil	Nil
6	Total Alkalinity as Calcium Carbonate	mg/l	---	2124.3	2172.8	1474.4	336.00	787.2	1257.6	873.6	710.4	2217.6	1833.6
7	Chloride	mg/l	---	669.5	367.7	273.5	5516.4	4054.8	2596.2	4092	4978	877	2027.4
8	Total Hardness	mg/l	---	27.2	19.4	23.3	333.20	176.4	188.2	160.7	313.6	54.9	94.1
9	Sulphate	mg/l	---	7.1	5.5	8.3	6.8	7.6	6.2	5.9	8.3	5.2	<2.5
10	Calcium	mg/l		6.2	6.2	7.8	110	47.1	50.3	34.6	102.1	12.6	22
11	Magnesium	mg/l	---	2.8	<1	<1	14.3	14.3	15.2	18.1	14.3	5.7	9.5
12	Dissolved Oxygen	mg/l	---	5.9	5.5	6.3	5.3	5	5.1	5.1	5	5.9	4.8
13	Biological Oxygen Demand, 3 Days at 27°C	mg/l	30	<2	<2	<2	<2	<2	<2	<2	2	<2	
14	Chemical Oxygen Demand	mg/l	250	<8	<8	<8	<8	<8	<8	8	8	<8	<8
15	Oil & Grease(Hexane Extract)	mg/l	10	<5.0	<5.0	<5.0	<5.0	<5.0	<5	<5.0	<5	<5	<5.0
16	Phenolic Compounds (as C <sub>6</sub> H <sub>5</sub> OH)	mg/l	1	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
17	Sulphide	mg/l	2	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
18	Fluoride	mg/l	2	3.15	1.9	4.25	1.98	2.4	1.36	3.11	3.65	2.92	1.96
19	Ammoniacal Nitrogen	mg/l	---	5.95	6.2	3.9	5.21	4.96	4.22	6.24	6.81	5.17	3.28
20	Iron	mg/l	---	0.33	0.26	0.2	12.10	24.4	23.6	61.5	25.9	3.73	2.84
21	Total Chromium	mg/l	2	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
22	Zinc	mg/l	---	0.017	<0.01	<0.01	0.021	0.033	0.026	0.017	0.025	0.022	0.027
23	Copper	mg/l	---	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
24	Nickel	mg/l		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
25	Total Arsenic	mg/l		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
26	Lead	mg/l		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
27	Mercury	mg/l	0.01	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001

**Produced Water Analysis Report of CBM Raniganj Project of Essar Oil and Gas Exploration and Production Limited**  
**(Compliance Period: Apr'17 - Sep'17)**

**ANNEXURE III**

S. No.	Parameter	Unit	CPCB Standard	EDD-17 D-5	EDD-15 D-3	EDD-13 V-1	EDI-42 D-4	EDI-40 D-2	EDI-39 D-1	EDI-34 D-2	EDI-36 V-1	EDH-64 D-1	EDH-33 V-1
28	Boron	mg/l		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
29	SAR		---	44.3	96.7	68.9	50.7	78.8	62.8	92	68.3	97.9	94.6
30	Phosphorus	mg/l	---	0.29	0.24	0.15	0.29	0.32	0.17	0.28	0.34	0.21	0.25
31	Aluminium	mg/l	---	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
32	Lithium	mg/l		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
33	Manganese	mg/l		<0.05	<0.05	<0.05	<0.05	0.072	0.061	0.850	<0.05	<0.05	<0.05
34	Molybdenum	mg/l	---	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
35	Palladium	mg/l	---	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
36	Selenium	mg/l		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
37	Vanadium	mg/l	---	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
38	Cadmium	mg/l		<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
39	Cobalt	mg/l		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
40	Bicarbonate	mg/l	---	1573.8	1464	634.4	410.0	960.4	1534.3	1065.8	866.7	1952	2237
41	Electrical Conductivity	µmhos/cm	---	4926	4481	3622	8249	8536	6847	9782	10190	5199	6391
42	Sodium	mg/l	---	1148	982	768	2130.0	2408	1980	2680	2782	1670	2108
43	Potassium	mg/l	---	9.2	7.8	6.1	9.7	10.8	8.2	8.1	10.6	7.3	7.8

**Produced Water Analysis Report of CBM Raniganj Project of Essar Oil and Gas Exploration and Production Limited**  
**(Compliance Period: Apr'17 - Sep'17)**

**ANNEXURE III**

S. No.	Parameter	Unit	CPCB Standard	EDH-58 D-2	EDH-31 D-1	EDD-50 D-1	EDD-50 D-4	EDD-005 D-1	EDD-12 D-1	EDE-09 D-1	EDD-49 V-1
Date				04.09.2017	04.09.2017	04.09.2017	04.09.2017	04.09.2017	04.09.2017	04.09.2017	04.09.2017
1	pH		5.5 to 9.0	9.11	8.6	8.55	9.1	9.18	8.95	8.85	9.22
2	Total Suspended Solids	mg/l	100	7	23	41	5	<2	3	4	<2
3	Total Dissolved Solids	mg/l	---	5106	5540	4208	2582	2896	2964	2822	2592
4	Turbidity	NTU	---	16.5	53.5	107	12.5	1.2	6.6	10	1
5	Acidity as CaCO <sub>3</sub>	mg/l	---	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
6	Total Alkalinity as Calcium Carbonate	mg/l	---	1555.2	1286.4	1267.2	1324.8	2035.2	1708.8	1536	1651.2
7	Chloride	mg/l	---	1895.4	2357.4	1612.5	414.9	386.6	490.3	245.2	358.3
8	Total Hardness	mg/l	---	78.4	160.7	121.5	43.1	35.3	43.1	39.2	39.2
9	Sulphate	mg/l	---	5.3	4.5	5.8	<2.5	<2.5	<2.5	<2.5	<2.5
10	Calcium	mg/l		23.6	33	26.7	7.9	7.9	9.4	7.9	7.9
11	Magnesium	mg/l	---	4.8	19	13.3	5.7	3.8	4.8	4.8	4.8
12	Dissolved Oxygen	mg/l	---	4.9	5.1	5.2	6.1	5.9	6.3	6.5	6.1
13	Biological Oxygen Demand, 3 Days at 27°C	mg/l	30	<2	<2	<2	<2	<2	<2	<2	<2
14	Chemical Oxygen Demand	mg/l	250	<8	<8	8	<8	<8	<8	<8	<8
15	Oil & Grease(Hexane Extract)	mg/l	10	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
16	Phenolic Compounds (as C <sub>6</sub> H <sub>5</sub> OH)	mg/l	1	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
17	Sulphide	mg/l	2	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
18	Fluoride	mg/l	2	1.52	2.5	2.45	1.1	0.62	0.92	0.75	0.95
19	Ammoniacal Nitrogen	mg/l	---	2.4	3.65	2.79	1.86	1.7	1.08	0.95	1.15
20	Iron	mg/l	---	2.97	7.84	51.5	2.81	0.31	0.89	1.61	0.51
21	Total Chromium	mg/l	2	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
22	Zinc	mg/l	---	0.036	0.041	0.015	<0.01	<0.01	0.012	<0.01	0.017
23	Copper	mg/l	---	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
24	Nickel	mg/l		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
25	Total Arsenic	mg/l		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
26	Lead	mg/l		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
27	Mercury	mg/l	0.01	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001

**Produced Water Analysis Report of CBM Raniganj Project of Essar Oil and Gas Exploration and Production Limited**  
**(Compliance Period: Apr'17 - Sep'17)**

**ANNEXURE III**

S. No.	Parameter	Unit	CPCB Standard	EDH-58 D-2	EDH-31 D-1	EDD-50 D-1	EDD-50 D-4	EDD-005 D-1	EDD-12 D-1	EDE-09 D-1	EDD-49 V-1
28	Boron	mg/l		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
29	SAR		---	94.4	71.7	61.9	60.8	84.1	72.4	110.2	81
30	Phosphorus	mg/l	---	0.17	0.19	0.21	0.11	0.09	0.15	0.12	0.18
31	Aluminium	mg/l	---	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
32	Lithium	mg/l		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
33	Manganese	mg/l		<0.05	0.065	0.081	<0.05	<0.05	<0.05	<0.05	<0.05
34	Molybdenum	mg/l	---	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
35	Palladium	mg/l	---	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
36	Selenium	mg/l		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
37	Vanadium	mg/l	---	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
38	Cadmium	mg/l		<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
39	Cobalt	mg/l		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
40	Bicarbonate	mg/l	---	1220	1098	1545.7	878.4	1342	1426	1260.4	1340.2
41	Electrical Conductivity	µmhos/cm	---	6168	6682	5163	3492	3244	3844	2908	3492
42	Sodium	mg/l	---	1922	2088	1568	918	1152	1092	1582	1164
43	Potassium	mg/l	---	8.1	6.9	5.2	4.1	5.6	6.8	7.2	7.9

Surface water quality analysis of surrounding areas of CBM Raniganj Project by Essar Oil and Gas Exploration and Production Limited **ANNEXURE IV A**  
 Compliance Period: Apr'17 to Sep'17

S. No.	Parameter	Unit	O & G Discharge Standards	GGS-1 (R.O Discharge)	Kunur Nala Upstream Near GGS-1	EDD-50 (R.O-Discharge)	Kunur Nala Downstream Between EDH-58 & 63	Kunur Nala Downstream Near Kuldiha Bridge	Kunur Nala Downstream Near Kuldiha Bridge
			Date	08.04.2017	08.04.2017	08.04.2017	08.04.2017	08.04.2017	11.05.2017
1	pH at 27°C		5.5-9.0	8.57	8.62	8.71	8.75	8.55	8.42
2	Colour in hazen			<5	<5	<5	<5	<5	<5
3	Total Suspended Solids	mg/l	100	3	13	<2	7	3	<2
4	Total Dissolved Solids	mg/l	2100	1254	132	1142	1962	526	830
5	Turbidity	NTU		10.3	27.4	6.5	18.7	9.1	<1.0
6	Acidity as CaCO <sub>3</sub>	mg/l		Nil	Nil	Nil	Nil	Nil	Nil
7	Total Alkalinity as CaCO <sub>3</sub>	mg/l		192	28.4	153.5	307.5	102.1	306.9
8	Chloride as Chlorine	mg/l	600	510	38	438.5	458	214	198
9	Total Hardness	mg/l		68	32	56	88	40	104
10	Sulphate	mg/l	1000	10.5	<2.5	8.8	15.3	5.5	34.25
11	Calcium	mg/l		16	8	12.8	17.6	11.2	32.1
12	Magnesium	mg/l		6.8	2.9	5.8	10.7	2.9	5.8
13	Dissolved Oxygen	mg/l		5.4	5.9	5.1	4.9	5.5	5
14	Biochemical Oxygen Demand	mg/l	30	<2	<2	<2	<2	<2	<2
15	Chemical Oxygen Demand	mg/l	100	<8	<8	<8	8	<8	<8
16	Oil & Grease	mg/l	10	<5	<5	<5	<5	<5	<5
17	Phenolic Compounds (as C <sub>6</sub> H <sub>5</sub> OH)	mg/l	1.2	<0.001	<0.001	<0.001	<0.001	<0.001	<0.002
18	Sulphides (as S <sub>2</sub> )	mg/l	2	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
19	Fluoride	mg/l	1.5	2.16	2.75	3.3	1.96	1.05	3.1
20	Residual free chlorine	mg/l		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
21	Iron	mg/l	3	1.25	3.45	0.96	2.75	1.21	0.32
22	Sodium	mg/l		348	18	288	328.1	140	130.7
23	Total Chromium	mg/l	1	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05

Surface water quality analysis of surrounding areas of CBM Raniganj Project by Essar Oil and Gas Exploration and Production Limited **ANNEXURE IV A**  
 Compliance Period: Apr'17 to Sep'17

S. No.	Parameter	Unit	O & G Discharge Standards	GGS-1 (R.O Discharge)	Kunur Nala Upstream Near GGS-1	EDD-50 (R.O-Discharge)	Kunur Nala Downstream Between EDH-58 & 63	Kunur Nala Downstream Near Kuldiha Bridge	Kunur Nala Downstream Near Kuldiha Bridge
			Date	08.04.2017	08.04.2017	08.04.2017	08.04.2017	08.04.2017	11.05.2017
24	Zinc	mg/l	2	<0.01	<0.01	<0.01	0.049	0.028	0.034
25	Copper	mg/l	0.2	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
26	Nickel	mg/l	3	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
27	Arsenic	mg/l	0.2	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
28	Lead	mg/l	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
29	Mercury	mg/l	0.01	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
30	Boron	mg/l		<1	<1	<1	<1	<1	<1
31	Phosphate	mg/l		0.36	0.48	0.29	0.33	0.14	0.34
32	Potassium	mg/l		8.2	1.7	9.1	11.2	15.3	4.4
33	Aluminium	mg/l		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
34	EC at 25° C	µmhos/cm		1862	202	1682	2918	830	1385
35	Cadmium	mg/l		<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
36	Cobalt	mg/l		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
37	Vanadium	mg/l		<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
38	Palladium	mg/l		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
39	Selenium	mg/l		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
40	Manganese	mg/l		<0.05	0.059	0.101	<0.05	<0.05	<0.05
41	Molybdenum	mg/l		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
42	Lithium	mg/l		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
43	Beryllium	mg/l		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
44	Cyanide	mg/l		<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
45	Bicarbonate (as HCO <sub>3</sub> )	mg/l		212	31.3	175.3	368.2	118.5	374.4
46	Free Ammonia as Nitrogen	mg/l	5	0.1	47	0.16	0.17	0.11	0.14
47	Total coliform bacteria	MPN/100ml		41	33	63	94	84	84

Surface water quality analysis of surrounding areas of CBM Raniganj Project by Essar Oil and Gas Exploration and Production Limited **ANNEXURE IV A**  
 Compliance Period:Apr'17 to Sep'17

S. No.	Parameter	Unit	O & G Discharge Standards	GGS-1 (R.O Discharge)	Kunur Nala Unstream	Kunur Nala Downstream Near Kuldihha Bridge	EDD-50 (R.O Discharge)	Kunur Nala Upstream Near GGS-1	GGS-1(R.O Discharge)
			Date	11.05.2017	12.05.2017	08.06.2017	08.06.2017	08.06.2017	08.06.2017
1	pH at 27°C		5.5-9.0	8.38	8.39	8.51	8.78	8.83	8.47
2	Colour in hazen			<5	<5	<5	<5	<5	<5
3	Total Suspended Solids	mg/l	100	<2	2	4	<2	3	2
4	Total Dissolved Solids	mg/l	2100	988	104	862	926	392	1526
5	Turbidity	NTU		2.8	4.5	11.7	<1	7.6	6.2
6	Acidity as CaCO <sub>3</sub>	mg/l		Nil	Nil	Nil	Nil	Nil	Nil
7	Total Alkalinity as CaCO <sub>3</sub>	mg/l		613.8	89.1	425.7	663.3	168.3	1386
8	Chloride as Chlorine	mg/l	600	122.6	84.9	330	235.7	192.4	282.8
9	Total Hardness	mg/l		24	56	124	20	60.6	20
10	Sulphate	mg/l	1000	18.75	<2.5	<2.5	<2.5	4.8	<2.5
11	Calcium	mg/l		4.8	12.8	32.1	11.2	12.8	6.4
12	Magnesium	mg/l		2.9	5.8	10.7	4.9	6.8	1
13	Dissolved Oxygen	mg/l		5.1	5	2.2	2.9	1.7	2.3
14	Biochemical Oxygen Demand	mg/l	30	<2	2.9	7	8	10	9
15	Chemical Oxygen Demand	mg/l	100	10	14	31	32	41	37
16	Oil & Grease	mg/l	10	<5	<5	<5	<5	<5	<5
17	Phenolic Compounds (as C <sub>6</sub> H <sub>5</sub> OH)	mg/l	1.2	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
18	Sulphides (as S <sub>2</sub> )	mg/l	2	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
19	Fluoride	mg/l	1.5	1.97	2.85	1.65	1.15	0.54	1.65
20	Residual free chlorine	mg/l		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
21	Iron	mg/l	3	0.35	0.56	1.33	0.11	1.17	0.93
22	Sodium	mg/l		80.5	58.5	225	254	136	312.8
23	Total Chromium	mg/l	1	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05

Surface water quality analysis of surrounding areas of CBM Raniganj Project by Essar Oil and Gas Exploration and Production Limited **ANNEXURE IV A**  
 Compliance Period:Apr'17 to Sep'17

S. No.	Parameter	Unit	O & G Discharge Standards	GGS-1 (R.O Discharge)	Kunur Nala Unstream	Kunur Nala Downstream Near Kuldihha Bridge	EDD-50 (R.O Discharge)	Kunur Nala Upstream Near GGS-1	GGS-1(R.O Discharge)
			Date	11.05.2017	12.05.2017	08.06.2017	08.06.2017	08.06.2017	08.06.2017
24	Zinc	mg/l	2	0.087	<0.01	0.028	0.014	<0.01	<0.01
25	Copper	mg/l	0.2	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
26	Nickel	mg/l	3	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
27	Arsenic	mg/l	0.2	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
28	Lead	mg/l	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
29	Mercury	mg/l	0.01	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
30	Boron	mg/l		<1	<1	<1	<1	<1	<1
31	Phosphate	mg/l		0.46	0.15	0.26	0.1	0.13	0.11
32	Potassium	mg/l		5.6	2.4	8.5	6.5	4.3	8.2
33	Aluminium	mg/l		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
34	EC at 25° C	µmhos/cm		1688	180	1480	1596	653	2358
35	Cadmium	mg/l		<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
36	Cobalt	mg/l		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
37	Vanadium	mg/l		<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
38	Palladium	mg/l		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
39	Selenium	mg/l		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
40	Manganese	mg/l		0.062	<0.05	0.061	<0.05	<0.05	<0.05
41	Molybednum	mg/l		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
42	Lithium	mg/l		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
43	Beryllium	mg/l		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
44	Cyanide	mg/l		<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
45	Bicarbonate (as HCO <sub>3</sub> )	mg/l		748.8	108.7	418.5	585.6	151.8	1460.4
46	Free Ammonia as Nitrogen	mg/l	5	0.15	0.12	0.82	0.52	0.63	0.41
47	Total coliform bacteria	MPN/100ml		84	58	63	49	22	49

Surface water quality analysis of surrounding areas of CBM Raniganj Project by Essar Oil and Gas Exploration and Production Limited ANNEXURE IV A  
Compliance Period:Apr'17 to Sep'17

S. No.	Parameter	Unit	O & G Discharge Standards	EDD-50 (R.O-Discharge)	Kunur Nala Downstream Between EDH-58 & 63	Kunur Nala Downstream Near Akandara	Kunur Nala Downstream Near Kuldihha Bridge	GGS-1(R.O Discharge)	Kunur Nala Upstream Near GGS-1
		Date	11.07.2017	11.07.2017	11.07.2017	11.07.2017	11.08.2017	11.08.2017	11.08.2017
1	pH at 27°C		5.5-9.0	9.43	7.82	8.71	8.41	9.44	8.92
2	Colour in hazen			<5	5	<5	<5	<5	5
3	Total Suspended Solids	mg/l	100	<2	62	28	19	<2	18
4	Total Dissolved Solids	mg/l	2100	958	164	242	232	896	172
5	Turbidity	NTU		3.8	106.3	62.6	45.9	<1	46.8
6	Acidity as CaCO <sub>3</sub>	mg/l		Nil	9.8	Nil	Nil	Nil	Nil
7	Total Alkalinity as CaCO <sub>3</sub>	mg/l		465.3	99	158.4	108.9	688.7	164.9
8	Chloride as Chlorine	mg/l	600	164.1	24.5	43.4	41.2	96.2	19.8
9	Total Hardness	mg/l		21.6	50.9	78.4	78.4	73.7	34.9
10	Sulphate	mg/l	1000	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5
11	Calcium	mg/l		7	17.3	17.3	20.4	12.4	7.8
12	Magnesium	mg/l		<1.0	1.9	8.6	6.7	10.4	3.8
13	Dissolved Oxygen	mg/l		3.1	4.6	3.8	3.8	4.8	5.4
14	Biochemical Oxygen Demand	mg/l	30	<2	<2	<2	<2	2	<2
15	Chemical Oxygen Demand	mg/l	100	<8	<8	<8	<8	10	<8
16	Oil & Grease	mg/l	10	<5	<5	<5	<5	<5	<5
17	Phenolic Compounds (as C <sub>6</sub> H <sub>5</sub> OH)	mg/l	1.2	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
18	Sulphides (as S <sub>2</sub> )	mg/l	2	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
19	Fluoride	mg/l	1.5	0.82	0.82	0.37	0.89	2.75	2.36
20	Residual free chlorine	mg/l		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
21	Iron	mg/l	3	0.81	31.81	12.64	7.49	0.32	2.97
22	Sodium	mg/l		301	18.5	14.3	34.5	226	32
23	Total Chromium	mg/l	1	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05

Surface water quality analysis of surrounding areas of CBM Raniganj Project by Essar Oil and Gas Exploration and Production Limited **ANNEXURE IV A**  
 Compliance Period:Apr'17 to Sep'17

S. No.	Parameter	Unit	O & G Discharge Standards	EDD-50 (R.O-Discharge)	Kunur Nala Downstream Between EDH-58 & 63	Kunur Nala Downstream Near Akandara	Kunur Nala Downstream Near Kuldigha Bridge	GGS-1(R.O Discharge)	Kunur Nala Upstream Near GGS-1
			Date	11.07.2017	11.07.2017	11.07.2017	11.07.2017	11.08.2017	11.08.2017
24	Zinc	mg/l	2	<0.01	<0.01	<0.01	<0.01	<0.01	0.036
25	Copper	mg/l	0.2	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
26	Nickel	mg/l	3	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
27	Arsenic	mg/l	0.2	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
28	Lead	mg/l	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
29	Mercury	mg/l	0.01	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
30	Boron	mg/l		<1	<1	<1	<1	<1	<1
31	Phosphate	mg/l		0.17	0.15	0.11	0.12	0.19	0.26
32	Potassium	mg/l		4	2	2	3	7.3	2.9
33	Aluminium	mg/l		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
34	EC at 25° C	µmhos/cm		1520	278	392	379	1412	269
35	Cadmium	mg/l		<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
36	Cobalt	mg/l		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
37	Vanadium	mg/l		<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
38	Palladium	mg/l		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
39	Selenium	mg/l		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
40	Manganese	mg/l		<0.05	0.143	0.162	0.092	<0.05	0.063
41	Molybdenum	mg/l		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
42	Lithium	mg/l		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
43	Beryllium	mg/l		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
44	Cyanide	mg/l		<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
45	Bicarbonate (as HCO <sub>3</sub> )	mg/l		317.2	120.8	186.3	132.9	378.2	122
46	Free Ammonia as Nitrogen	mg/l	5	2.1	0.33	0.92	0.63	0.68	0.37
47	Total coliform bacteria	MPN/100ml		51	36	48	63	63	58

Surface water quality analysis of surrounding areas of CBM Raniganj Project by Essar Oil and Gas Exploration and Production Limited ANNEXURE IV A  
Compliance Period:Apr'17 to Sep'17

S. No.	Parameter	Unit	O & G Discharge Standards	EDD-50 (R.O Discharge)	Kunur Nala Downstream Between EDH-58 & 63	Kunur Nala Downstream at Kuldiha Bridge	GGS-1 (R.O Discharge)	Kunur Nala Upstream Near GGS-1	Kunur Nala Downstream Between EDH-58 & 63
			Date	11.08.2017	11.08.2017	11.08.2017	05.09.2017	05.09.2017	05.09.2017
1	pH at 27°C		5.5-9.0	9.1	9.25	9.22	9.21	8.65	9.14
2	Colour in hazen			<5	<5	5	<5	5	<5
3	Total Suspended Solids	mg/l	100	<2	4	38	<2	14	19
4	Total Dissolved Solids	mg/l	2100	934	762	452	714	196	204
5	Turbidity	NTU		2.3	11.7	87.8	<1	33.5	47.5
6	Acidity as CaCO <sub>3</sub>	mg/l		Nil	Nil	Nil	Nil	Nil	Nil
7	Total Alkalinity as CaCO <sub>3</sub>	mg/l		543.2	572.3	213.4	576	107.2	118
8	Chloride as Chlorine	mg/l	600	154.7	100	60.4	84.9	11.3	32.1
9	Total Hardness	mg/l		15.5	77.6	89.2	35.3	90.2	86.2
10	Sulphate	mg/l	1000	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5
11	Calcium	mg/l		3.1	20.2	20.2	7.9	28.3	26.7
12	Magnesium	mg/l		1.9	7	9.4	3.8	4.8	4.8
13	Dissolved Oxygen	mg/l		3.7	6	6.2	4.8	4.3	5.3
14	Biochemical Oxygen Demand	mg/l	30	3	<2	<2	<2	2	<2
15	Chemical Oxygen Demand	mg/l	100	12	<8	<8	9	10	<8
16	Oil & Grease	mg/l	10	<5	<5	<5	<5	<5	<5
17	Phenolic Compounds (as C <sub>6</sub> H <sub>5</sub> OH)	mg/l	1.2	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
18	Sulphides (as S <sub>2</sub> )	mg/l	2	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
19	Fluoride	mg/l	1.5	1.75	1.78	2.86	0.68	0.33	0.72
20	Residual free chlorine	mg/l		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
21	Iron	mg/l	3	0.11	1.28	3.23	1.24	1.66	0.1
22	Sodium	mg/l		208	182	73	242	26	21
23	Total Chromium	mg/l	1	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05

Surface water quality analysis of surrounding areas of CBM Raniganj Project by Essar Oil and Gas Exploration and Production Limited ANNEXURE IV A  
Compliance Period:Apr'17 to Sep'17

S. No.	Parameter	Unit	O & G Discharge Standards	EDD-50 (R.O Discharge)	Kunur Nala Downstream Between EDH-58 & 63	Kunur Nala Downstream at Kuldiha Bridge	GGS-1 (R.O Discharge)	Kunur Nala Upstream Near GGS-1	Kunur Nala Downstream Between EDH-58 & 63
		Date	11.08.2017	11.08.2017	11.08.2017	05.09.2017	05.09.2017	05.09.2017	05.09.2017
24	Zinc	mg/l	2	<0.01	0.027	0.048	<0.01	<0.01	<0.01
25	Copper	mg/l	0.2	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
26	Nickel	mg/l	3	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
27	Arsenic	mg/l	0.2	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
28	Lead	mg/l	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
29	Mercury	mg/l	0.01	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
30	Boron	mg/l		<1	<1	<1	<1	<1	<1
31	Phosphate	mg/l		0.2	0.22	0.13	0.29	0.21	0.25
32	Potassium	mg/l		11.6	9.2	5.1	7.3	6.1	8.4
33	Aluminium	mg/l		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
34	EC at 25° C	µmhos/cm		1670	1482	545	1024	340	375
35	Cadmium	mg/l		<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
36	Cobalt	mg/l		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
37	Vanadium	mg/l		<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
38	Palladium	mg/l		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
39	Selenium	mg/l		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
40	Manganese	mg/l		<0.05	<0.05	0.072	<0.05	0.063	<0.05
41	Molybdenum	mg/l		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
42	Lithium	mg/l		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
43	Beryllium	mg/l		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
44	Cyanide	mg/l		<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
45	Bicarbonate (as HCO <sub>3</sub> )	mg/l		390.4	353.8	122	434.2	89.4	154.5
46	Free Ammonia as Nitrogen	mg/l	5	0.46	0.51	0.49	1.6	0.7	1.1
47	Total coliform bacteria	MPN/100ml		43	22	40	58	41	17

Surface water quality analysis of surrounding areas of CBM Raniganj Project by Essar Oil and Gas Exploration and Production Limited **ANNEXURE IV A**  
 Compliance Period:Apr'17 to Sep'17

S. No.	Parameter	Unit	O & G Discharge Standards	EDD-50 (R.O-Discharge)	Kunur Nala Downstream Near Kuldiha Bridge
			Date	05.09.2017	05.09.2017
1	pH at 27°C		5.5-9.0	9.81	9.05
2	Colour in hazen			<5	<5
3	Total Suspended Solids	mg/l	100	<2	24
4	Total Dissolved Solids	mg/l	2100	832	172
5	Turbidity	NTU		1.5	62.1
6	Acidity as CaCO <sub>3</sub>	mg/l		Nil	Nil
7	Total Alkalinity as CaCO <sub>3</sub>	mg/l		556.8	115.2
8	Chloride as Chlorine	mg/l	600	160.3	35.8
9	Total Hardness	mg/l		27.4	109.8
10	Sulphate	mg/l	1000	6.3	6.9
11	Calcium	mg/l		6.3	29.8
12	Magnesium	mg/l		2.9	8.6
13	Dissolved Oxygen	mg/l		4.8	4.9
14	Biochemical Oxygen Demand	mg/l	30	2	<2
15	Chemical Oxygen Demand	mg/l	100	8	8
16	Oil & Grease	mg/l	10	<5	<5
17	Phenolic Compounds (as C <sub>6</sub> H <sub>5</sub> OH)	mg/l	1.2	<0.002	<0.002
18	Sulphides (as S <sub>2</sub> )	mg/l	2	<0.5	<0.5
19	Fluoride	mg/l	1.5	0.58	1.45
20	Residual free chlorine	mg/l		<0.1	<0.1
21	Iron	mg/l	3	0.1	2.95
22	Sodium	mg/l		182	18
23	Total Chromium	mg/l	1	<0.05	<0.05

Surface water quality analysis of surrounding areas of CBM Raniganj Project by Essar Oil and Gas Exploration and Production Limited **ANNEXURE IV A**  
 Compliance Period:Apr'17 to Sep'17

S. No.	Parameter	Unit	O & G Discharge Standards	EDD-50 (R.O-Discharge)	Kunur Nala Downstream Near Kuldiha Bridge
			Date	05.09.2017	05.09.2017
24	Zinc	mg/l	2	0.011	0.013
25	Copper	mg/l	0.2	<0.05	<0.05
26	Nickel	mg/l	3	<0.05	<0.05
27	Arsenic	mg/l	0.2	<0.01	<0.01
28	Lead	mg/l	0.1	<0.1	<0.1
29	Mercury	mg/l	0.01	<0.001	<0.001
30	Boron	mg/l		<1	<1
31	Phosphate	mg/l		0.1	0.26
32	Potassium	mg/l		2.2	8.2
33	Aluminium	mg/l		<0.01	<0.01
34	EC at 25° C	µmhos/cm		1282	280
35	Cadmium	mg/l		<0.02	<0.02
36	Cobalt	mg/l		<0.1	<0.1
37	Vanadium	mg/l		<0.2	<0.2
38	Palladium	mg/l		<0.5	<0.5
39	Selenium	mg/l		<0.01	<0.01
40	Manganese	mg/l		<0.05	<0.05
41	Molybdenum	mg/l		<0.5	<0.5
42	Lithium	mg/l		<0.5	<0.5
43	Beryllium	mg/l		<0.5	<0.5
44	Cyanide	mg/l		<0.02	<0.02
45	Bicarbonate (as HCO <sub>3</sub> )	mg/l		305	76.3
46	Free Ammonia as Nitrogen	mg/l	5	1.1	0.81
47	Total coliform bacteria	MPN/100ml		47	94

**Analysis of R.O. Water of CBM Raniganj Project by Essar Oil and gas Exploration and Production Limited**  
**Compliance Period: Apr'17 to Sep'17**

**ANNEXURE IV**

S. No.	Parameter	Unit	General Discharge Standards	O & G Discharge Standards	Date	08.04.2017	08.04.2017	08.04.2017	08.04.2017	08.04.2017	08.04.2017	08.04.2017	08.04.2017
					GGS-1 (R.O-Inlet)	GGS-1 (R.O-Outlet)	GGS-1 (R.O-Reject)	EDD-50 (R.O-Inlet)	EDD-50 (R.O-outlet)	EDD-50 (R.O-Reject)	EDH-44 (R.O Inlet)	EDH-44 (R.O Outlet)	
1	pH		5.5 to 9.0	5.5-9.0	8.53	8.15	7.75	8.31	8.7	8.85	8.53	8.45	
2	Total Suspended Solids	mg/l	100	100	<2	<2	4	6	<2	5	4	3	
3	Total Dissolved Solids	mg/l	---	2100	1422	218	7848	2078	792	2428	2784	1418	
4	Turbidity	NTU	---	---	8.4	3.1	12.3	17.1	1.8	12.2	10.9	8.6	
5	Acidity as CaCO <sub>3</sub>	mg/l	---	---	Nil	3.5	14.5	Nil	Nil	Nil	Nil	Nil	
6	Total Alkalinity as Calcium Carbonate	mg/l	---	---	242.3	58.5	770.5	356.1	139.5	410	470.5	198.2	
7	Chloride	mg/l	---	600	658	86	1826	414	248.5	526	937.5	843	
8	Total Hardness	mg/l	---	---	64	32	368	92	44	108	132	80	
9	Sulphate	mg/l	---	1000	9.8	<2.5	25.7	14.5	7.5	18.7	24.7	16.5	
10	Calcium	mg/l			14.4	9.6	115.4	28.9	11.2	24	33.7	25.7	
11	Magnesium	mg/l	---	---	6.8	1.9	19.4	4.9	3.9	11.7	11.7	3.9	
12	Biological Oxygen Demand, 3 Days at 27°C	mg/l	30	30	<2	<2	7	<2	<2	<2	<2	<2	
13	Chemical Oxygen Demand	mg/l	250	100	<8	<8	28	<8	<8	<8	<8	<8	
14	Oil & Grease (Hexane Extract)	mg/l	10	10	<5	<5	<5	<5	<5	<5	<5	<5	
15	Phenolic Compounds (as C <sub>6</sub> H <sub>5</sub> OH)	mg/l	1	1.2	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	
16	Sulphide (as H <sub>2</sub> S)	mg/l	2	2	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	
17	Fluoride	mg/l	2	1.5	1.89	1.65	2.5	3.75	1.3	2.9	0.86	0.95	
18	Ammoniacal Nitrogen	mg/l	---	---	2.4	1.8	2.9	2.4	1.7	1.9	2.7	2.1	
19	Iron	mg/l	---	---	1.15	0.85	1.75	1.72	0.48	1.53	0.86	0.39	
20	Total Chromium	mg/l	2	1	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	
21	Zinc	mg/l	---	---	<0.01	<0.01	0.028	<0.01	<0.01	<0.01	0.019	0.017	
22	Copper	mg/l	---	---	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	

**Analysis of R.O. Water of CBM Raniganj Project by Essar Oil and gas Exploration and Production Limited**  
**Compliance Period: Apr'17 to Sep'17**

**ANNEXURE IV**

S. No.	Parameter	Unit	General Discharge Standards	O & G Discharge Standards	Date	08.04.2017	08.04.2017	08.04.2017	08.04.2017	08.04.2017	08.04.2017	08.04.2017	08.04.2017
					GGS-1 (R.O-Inlet)	GGS-1 (R.O-Outlet)	GGS-1 (R.O-Reject)	EDD-50 (R.O-Inlet)	EDD-50 (R.O-outlet)	EDD-50 (R.O-Reject)	EDH-44 (R.O Inlet)	EDH-44 (R.O Outlet)	EDH-44 (R.O Outlet)
23	Nickel	mg/l			<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
24	Total Arsenic	mg/l			<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
25	Lead	mg/l			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
26	Mercury	mg/l	0.01	0.01	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
27	Boron	mg/l			<1	<1	<1	<1	<1	<1	<1	<1	<1
28	SAR		---	---	24.4	4.6	27.6	12.8	11.5	7.8	23.7	13.1	
29	Phosphorus	mg/l	---	---	0.11	0.15	0.24	0.14	0.1	0.19	0.088	0.072	
30	Aluminium	mg/l	---	---	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
31	Lithium	mg/l			<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
32	Manganese	mg/l			<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
33	Molybdenum	mg/l	---	---	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
34	Palladium	mg/l	---	---	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
35	Selenium	mg/l			<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
36	Vanadium	mg/l	---	---	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
37	Cadmium	mg/l			<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
38	Cobalt	mg/l			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
39	Bicarbonate	mg/l	---	---	285.6	71.4	940	434.4	170.2	500.2	574	241.8	
40	Conductivity	µmhos/cm	---	---	2256	354	10970	3248	1298	3916	4416	2178	
41	Sodium	mg/l	---	---	448	59	1220	282	174	356	625	270	

**Analysis of R.O. Water of CBM Raniganj Project by Essar Oil and gas Exploration and Production Limited**  
**Compliance Period: Apr'17 to Sep'17**

**ANNEXURE IV**

					Date	08.04.2017	10.04.2017	10.04.2017	10.04.2017	11.05.2017	11.05.2017	11.05.2017	11.05.2017
S. No.	Parameter	Unit	General Discharge Standards	O & G Discharge Standards	EDH-44 (R.O Reject)	EDN-99 (R.O Inlet)	EDN-99 (R.O Outlet)	EDN-99 (R.O Reject)	R.O Treated at EDD-050	R.O Raw Water at EDD-050	R.O Reject Water at EDD-050	R.O Permit Water at EDN-099	
1	pH		5.5 to 9.0	5.5-9.0	7.93	8.17	8.07	7.71	8.46	8.4	8.66	7.88	
2	Total Suspended Solids	mg/l	100	100	3	<2	<2	<2	<2	2	<2	<2	
3	Total Dissolved Solids	mg/l	---	2100	3612	4512	1124	8478	952	2988	3562	1550	
4	Turbidity	NTU	---	---	11.3	7.8	<1	1.3	<1	2.5	2	<1	
5	Acidity as CaCO <sub>3</sub>	mg/l	---	---	11.5	3.2	4.8	9.6	Nil	Nil	Nil	9.4	
6	Total Alkalinity as Calcium Carbonate	mg/l	---	---	580.3	658	186	823	445.5	1514.7	1732.5	89.1	
7	Chloride	mg/l	---	600	1132	1173	484	1482	165.01	589.4	589.4	702.5	
8	Total Hardness	mg/l	---	---	140	144	68	408	16	48	52	40	
9	Sulphate	mg/l	---	1000	28.3	19.8	12.3	28.1	<2.5	22.25	<2.5	20	
10	Calcium	mg/l			30.5	32.1	16	131.5	4.8	9.6	11.2	11.2	
11	Magnesium	mg/l	---	---	15.6	15.6	6.8	19.4	0.97	5.8	5.8	2.9	
12	Biological Oxygen Demand, 3 Days at 27°C	mg/l	30	30	<2	<2	<2	<2	<2	<2	<2	4.2	
13	Chemical Oxygen Demand	mg/l	250	100	<8	<8	<8	<8	<8	10	<8	16	
14	Oil & Grease (Hexane Extract)	mg/l	10	10	<5	<5	<5	<5	<5	<5	<5	<5	
15	Phenolic Compounds (as C <sub>6</sub> H <sub>5</sub> OH)	mg/l	1	1.2	<0.001	<0.001	<0.001	<0.001	<0.002	<0.002	<0.002	<0.002	
16	Sulphide (as H <sub>2</sub> S)	mg/l	2	2	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	
17	Fluoride	mg/l	2	1.5	1.1	1.45	0.75	0.62	1.85	2.1	3.56	1.26	
18	Ammoniacal Nitrogen	mg/l	---	---	3.2	3.2	2.8	2.5	2.1	3.2	1.8	1.4	
19	Iron	mg/l	---	---	0.97	0.81	0.12	0.16	0.173	1.28	0.519	0.11	
20	Total Chromium	mg/l	2	1	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	
21	Zinc	mg/l	---	---	0.024	<0.01	<0.01	0.015	0.061	0.087	0.056	<0.01	
22	Copper	mg/l	---	---	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	

**Analysis of R.O. Water of CBM Raniganj Project by Essar Oil and gas Exploration and Production Limited**  
**Compliance Period: Apr'17 to Sep'17**

**ANNEXURE IV**

S. No.	Parameter	Unit	General Discharge Standards	O & G Discharge Standards	Date	08.04.2017	10.04.2017	10.04.2017	10.04.2017	11.05.2017	11.05.2017	11.05.2017	11.05.2017
					EDH-44 (R.O Reject)	EDN-99 (R.O Inlet)	EDN-99 (R.O Outlet)	EDN-99 (R.O Reject)	R.O Treated at EDD-050	R.O Raw Water at EDD-050	R.O Reject Water at EDD-050	R.O Permit Water at EDN-099	
23	Nickel	mg/l			<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
24	Total Arsenic	mg/l			<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
25	Lead	mg/l			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
26	Mercury	mg/l	0.01	0.01	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
27	Boron	mg/l			<1	<1	<1	<1	<1	<1	<1	<1	<1
28	SAR		---	---	17.1	26.8	16.9	21	11.75	23.84	23.35	31.62	
29	Phosphorus	mg/l	---	---	0.11	0.18	0.25	0.14	0.23	0.32	0.17	0.11	
30	Aluminium	mg/l	---	---	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
31	Lithium	mg/l			<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
32	Manganese	mg/l			0.128	<0.05	<0.05	0.128	<0.05	0.069	<0.05	<0.05	<0.05
33	Molybdenum	mg/l	---	---	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
34	Palladium	mg/l	---	---	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
35	Selenium	mg/l			<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
36	Vanadium	mg/l	---	---	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
37	Cadmium	mg/l			<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
38	Cobalt	mg/l			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
39	Bicarbonate	mg/l	---	---	708	802.8	226.9	1004.6	543.5	1847.9	2113.6	108.7	
40	Conductivity	μmhos/cm	---	---	5619	7243	1796	12470	1584	4820	5840	2630	
41	Sodium	mg/l	---	---	465	740	322	976	108	380	387.3	460	

**Analysis of R.O. Water of CBM Raniganj Project by Essar Oil and gas Exploration and Production Limited**

Compliance Period: Apr'17 to Sep'17

**ANNEXURE IV**

					Date	11.05.2017	11.05.2017	11.05.2017	11.05.2017	11.05.2017	08.06.2017	08.06.2017	08.06.2017
S. No.	Parameter	Unit	General Discharge Standards	O & G Discharge Standards	R.O Raw Water at EDN-099	R.O Reject Water at EDN-099	R.O Product at GGS-1	R.O Reject at GGS-1	GGS-1 (R.O Inlet)	EDN-99 (R.O Inlet)	EDN-99 (R.O Outlet)	EDN-99 (R.O Outlet)	
1	pH		5.5 to 9.0	5.5-9.0	7.76	7.58	8.15	7.79	8.52	8.09	7.73	7.56	
2	Total Suspended Solids	mg/l	100	100	<2	2.5	<2	3	4	6	<2	<2	
3	Total Dissolved Solids	mg/l	---	2100	9384	11760	270	5636	2244	8012	572	1012	
4	Turbidity	NTU	---	---	2.0	2	<1	5	2.8	14.2	1.8	<1	
5	Acidity as CaCO <sub>3</sub>	mg/l	---	---	8.7	15.2	3.9	8.4	Nil	9.3	17.7	25.4	
6	Total Alkalinity as Calcium Carbonate	mg/l	---	---	435.6	574.2	158.4	3694.2	1494.9	623.7	89.1	89.1	
7	Chloride	mg/l	---	600	5044.9	6317.9	42	825.1	306.5	3866.2	222.5	565.8	
8	Total Hardness	mg/l	---	---	344	520	12	76	28	376	20	52	
9	Sulphate	mg/l	---	1000	19.25	<2.5	19	<2.5	<2.5	8	5	6.5	
10	Calcium	mg/l			43.3	160.32	3.2	3.2	6.4	73.7	4.8	9.6	
11	Magnesium	mg/l	---	---	57.3	29.2	0.97	16.5	2.9	46.6	1.9	6.8	
12	Biological Oxygen Demand, 3 Days at 27°C	mg/l	30	30	<2	<2	<2	4.5	3.9	3	<2	<2	
13	Chemical Oxygen Demand	mg/l	250	100	10	12	<8	20	17	14	<8	10	
14	Oil & Grease (Hexane Extract)	mg/l	10	10	<5	<5	<5	<5	<5	<5	<5	<5	
15	Phenolic Compounds (as C <sub>6</sub> H <sub>5</sub> OH)	mg/l	1	1.2	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	
16	Sulphide (as H <sub>2</sub> S)	mg/l	2	2	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	
17	Fluoride	mg/l	2	1.5	2.85	1.79	0.85	1.42	2.97	1.83	0.97	0.81	
18	Ammoniacal Nitrogen	mg/l	---	---	2.9	4.8	1.24	2.8	3.2	6.8	2.2	2.7	
19	Iron	mg/l	---	---	0.42	1.52	0.54	2.27	0.55	2.87	0.37	<0.1	
20	Total Chromium	mg/l	2	1	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	
21	Zinc	mg/l	---	---	0.35	0.107	<0.01	0.092	0.037	0.024	<0.01	<0.01	
22	Copper	mg/l	---	---	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	

**Analysis of R.O. Water of CBM Raniganj Project by Essar Oil and gas Exploration and Production Limited**  
**Compliance Period: Apr'17 to Sep'17**

**ANNEXURE IV**

S. No.	Parameter	Unit	General Discharge Standards	O & G Discharge Standards	Date	11.05.2017	11.05.2017	11.05.2017	11.05.2017	11.05.2017	08.06.2017	08.06.2017	08.06.2017
					R.O Raw Water at EDN-099	R.O Reject Water at EDN-099	R.O Product at GGS-1	R.O Reject at GGS-1	GGS-1 (R.O Inlet)	EDN-99 (R.O Inlet)	EDN-99 (R.O Outlet)	EDN-99 (R.O Outlet)	
23	Nickel	mg/l			<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	
24	Total Arsenic	mg/l			<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	
25	Lead	mg/l			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	
26	Mercury	mg/l	0.01	0.01	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	
27	Boron	mg/l			<1	<1	<1	<1	<1	<1	<1	<1	
28	SAR		---	---	77.69	79.14	3.46	50.21	16.63	50.3	13.6	22.2	
29	Phosphorus	mg/l	---	---	0.21	0.53	0.18	0.44	0.38	0.23	0.14	0.19	
30	Aluminium	mg/l	---	---	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	
31	Lithium	mg/l			<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	
32	Manganese	mg/l			0.087	0.089	<0.05	0.092	0.077	<0.05	0.069	<0.05	
33	Molybdenum	mg/l	---	---	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	
34	Palladium	mg/l	---	---	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	
35	Selenium	mg/l			<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	
36	Vanadium	mg/l	---	---	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	
37	Cadmium	mg/l			<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	
38	Cobalt	mg/l			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	
39	Bicarbonate	mg/l	---	---	531.4	700.5	193.2	4506.9	1823.7	760.9	108.7	108.7	
40	Conductivity	µmhos/cm	---	---	15630	18960	471	9240	3870	11780	922	1630	
41	Sodium	mg/l	---	---	3314.6	4151.2	27.6	1006.6	202.4	2241	140	368.5	

**Analysis of R.O. Water of CBM Raniganj Project by Essar Oil and gas Exploration and Production Limited**  
**Compliance Period: Apr'17 to Sep'17**

**ANNEXURE IV**

					Date	08.06.2017	08.06.2017	08.06.2017	08.06.2017	08.06.2017	08.06.2017	08.06.2017	11.07.2017
S. No.	Parameter	Unit	General Discharge Standards	O & G Discharge Standards	EDN-99 (R.O Reject)	EDD-50 (R.O-Inlet)	EDD-50 (R.O-outlet)	EDD-50 (R.O Reject)	GGS-1 (R.O-Inlet)	GGS-1 (R.O-Outlet)	GGS-1 (R.O Reject)	GGS-1 (R.O Inlet)	
1	pH		5.5 to 9.0	5.5-9.0	7.24	8.07	8.64	9.11	8.37	7.38	8.71	9.1	
2	Total Suspended Solids	mg/l	100	100	<2	<2	<2	<2	<2	<2	<2	2	
3	Total Dissolved Solids	mg/l	---	2100	23212	2916	884	3402	1920	334	7296	1562	
4	Turbidity	NTU	---	---	<1	1.4	<1	2.1	3.2	<1	1.8	6.8	
5	Acidity as CaCO <sub>3</sub>	mg/l	---	---	57.4	11.6	Nil	Nil	Nil	19.3	Nil	Nil	
6	Total Alkalinity as Calcium Carbonate	mg/l	---	---	1663.2	1920.6	563.3	2217.6	1801.8	267.3	2494.4	1197.9	
7	Chloride	mg/l	---	600	12447.2	518.6	282.8	848.7	330	41.5	1367.3	221.6	
8	Total Hardness	mg/l	---	---	860	48	8	52	24	8	96	35.3	
9	Sulphate	mg/l	---	1000	12.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	6.9	
10	Calcium	mg/l			166.7	11.2	1.6	8	8	1.6	22.4	6.3	
11	Magnesium	mg/l	---	---	108	4.9	1	7.8	1	1	9.7	4.8	
12	Biological Oxygen Demand, 3 Days at 27°C	mg/l	30	30	4	<2	2	3	6	4	<2	3	
13	Chemical Oxygen Demand	mg/l	250	100	18	<8	12	15	18	12	9	14	
14	Oil & Grease (Hexane Extract)	mg/l	10	10	<5	<5	<5	<5	<5	<5	<5	<5	
15	Phenolic Compounds (as C <sub>6</sub> H <sub>5</sub> OH)	mg/l	1	1.2	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	
16	Sulphide (as H <sub>2</sub> S)	mg/l	2	2	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	
17	Fluoride	mg/l	2	1.5	3.65	1.4	0.62	0.81	0.98	0.48	2.8	1.7	
18	Ammoniacal Nitrogen	mg/l	---	---	4.7	1.9	1.1	2.6	1.9	1.5	4.8	2.1	
19	Iron	mg/l	---	---	0.11	0.53	0.11	0.36	0.93	<0.1	0.95	1.37	
20	Total Chromium	mg/l	2	1	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	
21	Zinc	mg/l	---	---	0.017	<0.01	<0.01	0.021	0.033	<0.01	0.018	0.037	
22	Copper	mg/l	---	---	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	

**Analysis of R.O. Water of CBM Raniganj Project by Essar Oil and gas Exploration and Production Limited**  
**Compliance Period: Apr'17 to Sep'17**

**ANNEXURE IV**

S. No.	Parameter	Unit	General Discharge Standards	O & G Discharge Standards	Date	08.06.2017	08.06.2017	08.06.2017	08.06.2017	08.06.2017	08.06.2017	08.06.2017	11.07.2017
					EDN-99 (R.O Reject)	EDD-50 (R.O-Inlet)	EDD-50 (R.O-outlet)	EDD-50 (R.O Reject)	GGS-1 (R.O-Inlet)	GGS-1 (R.O-Outlet)	GGS-1 (R.O Reject)	GGS-1 (R.O Inlet)	
23	Nickel	mg/l			<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
24	Total Arsenic	mg/l			<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
25	Lead	mg/l			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
26	Mercury	mg/l	0.01	0.01	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
27	Boron	mg/l			<1	<1	<1	<1	<1	<1	<1	<1	<1
28	SAR		---	---	120.8	21.1	27.6	34.1	24.6	3.9	70.9	22.3	
29	Phosphorus	mg/l	---	---	0.33	0.28	0.15	0.23	0.14	0.11	0.29	0.37	
30	Aluminium	mg/l	---	---	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
31	Lithium	mg/l			<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
32	Manganese	mg/l			<0.05	<0.05	<0.05	<0.05	0.054	<0.05	<0.05	<0.05	<0.05
33	Molybdenum	mg/l	---	---	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
34	Palladium	mg/l	---	---	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
35	Selenium	mg/l			<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
36	Vanadium	mg/l	---	---	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
37	Cadmium	mg/l			<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
38	Cobalt	mg/l			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
39	Bicarbonate	mg/l	---	---	2029.1	2342.4	585.6	2117.9	2198.2	326.1	2793.8	1220	
40	Conductivity	μmhos/cm	---	---	38388	4861	1473	5416	3194	576	12160	2518	
41	Sodium	mg/l	---	---	8148	336	179	557.7	210	25.5	1598	306	

**Analysis of R.O. Water of CBM Raniganj Project by Essar Oil and gas Exploration and Production Limited**

Compliance Period: Apr'17 to Sep'17

**ANNEXURE IV**

S. No.	Parameter	Unit	General Discharge Standards	O & G Discharge Standards	Date	11.07.2017	11.07.2017	11.07.2017	11.07.2017	11.07.2017	11.07.2017	11.07.2017	11.07.2017
					GGS-1 (R.O-Outlet)	GGS-1 (R.O-Reject)	EDD-50 (R.O-Inlet)	EDD-50 (R.O-outlet)	EDD-50 (R.O-Reject)	EDN-99(R.O Inlet)	EDN-99(R.O Outlet)	EDN-99(R.O Reject)	
1	pH		5.5 to 9.0	5.5-9.0	8.62	8.39	8.68	9.59	9.24	8.45	8.58	7.82	
2	Total Suspended Solids	mg/l	100	100	<2	<2	3	<2	15	<2	<2	<2	
3	Total Dissolved Solids	mg/l	---	2100	342	7014	2344	872	2716	4182	402	4872	
4	Turbidity	NTU	---	---	<1	4.8	8.3	<1	51.8	1.3	0.6	0.9	
5	Acidity as CaCO <sub>3</sub>	mg/l	---	---	Nil	Nil	Nil	Nil	Nil	Nil	Nil	10.3	
6	Total Alkalinity as Calcium Carbonate	mg/l	---	---	207.9	2841	1524.6	514.8	1663.2	504.9	27.7	702.9	
7	Chloride	mg/l	---	600	86.8	1603.1	429.1	173.5	612.9	2819	162.2	2771.9	
8	Total Hardness	mg/l	---	---	19.6	101.9	43.1	15.7	47	172.5	23.5	443	
9	Sulphate	mg/l	---	1000	<2.5	11.6	10.2	<2.5	7.8	14.3	<2.5	11.2	
10	Calcium	mg/l			4.7	26.7	12.6	3.9	12.6	47.1	6.3	94.3	
11	Magnesium	mg/l	---	---	1.9	8.6	2.8	1.4	3.8	13.3	1.9	50.5	
12	Biological Oxygen Demand, 3 Days at 27°C	mg/l	30	30	<2	4	4	<2	11	2	<2	4	
13	Chemical Oxygen Demand	mg/l	250	100	<8	18	12	<8	36	11	<8	13	
14	Oil & Grease (Hexane Extract)	mg/l	10	10	<5	<5	<5	<5	<5	<5	<5	<5	
15	Phenolic Compounds (as C <sub>6</sub> H <sub>5</sub> OH)	mg/l	1	1.2	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	
16	Sulphide (as H <sub>2</sub> S)	mg/l	2	2	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	
17	Fluoride	mg/l	2	1.5	0.55	2.4	1.45	0.85	1.75	1.85	0.64	2.35	
18	Ammoniacal Nitrogen	mg/l	---	---	1.4	3.95	2.52	1.95	3.85	4.25	1.35	3.95	
19	Iron	mg/l	---	---	<0.1	0.84	1.43	0.1	0.32	0.25	<0.1	0.11	
20	Total Chromium	mg/l	2	1	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	
21	Zinc	mg/l	---	---	<0.01	0.066	0.021	<0.01	0.034	0.019	<0.01	0.024	
22	Copper	mg/l	---	---	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	

**Analysis of R.O. Water of CBM Raniganj Project by Essar Oil and gas Exploration and Production Limited**  
**Compliance Period: Apr'17 to Sep'17**

**ANNEXURE IV**

S. No.	Parameter	Unit	General Discharge Standards	O & G Discharge Standards	Date	11.07.2017	11.07.2017	11.07.2017	11.07.2017	11.07.2017	11.07.2017	11.07.2017	11.07.2017
					GGS-1 (R.O-Outlet)	GGS-1 (R.O-Reject)	EDD-50 (R.O-Inlet)	EDD-50 (R.O-outlet)	EDD-50 (R.O-Reject)	EDN-99(R.O Inlet)	EDN-99(R.O Outlet)	EDN-99(R.O Reject)	
23	Nickel	mg/l			<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
24	Total Arsenic	mg/l			<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
25	Lead	mg/l			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
26	Mercury	mg/l	0.01	0.01	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
27	Boron	mg/l			<1	<1	<1	<1	<1	<1	<1	<1	<1
28	SAR		---	---	5.1	92.4	33.3	23.4	46.2	36.5	3.6	25.7	
29	Phosphorus	mg/l	---	---	0.24	0.49	0.24	0.19	0.37	0.11	0.16	0.45	
30	Aluminium	mg/l	---	---	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
31	Lithium	mg/l			<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
32	Manganese	mg/l			<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
33	Molybdenum	mg/l	---	---	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
34	Palladium	mg/l	---	---	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
35	Selenium	mg/l			<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
36	Vanadium	mg/l	---	---	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
37	Cadmium	mg/l			<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
38	Cobalt	mg/l			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
39	Bicarbonate	mg/l	---	---	356	3466	1852	378.2	1708	614.9	33.8	857.5	
40	Conductivity	μmhos/cm	---	---	580	10470	3722	1426	4245	6814	645	7342	
41	Sodium	mg/l	---	---	52	2147	502	212	728.4	1104	40	1245	

**Analysis of R.O. Water of CBM Raniganj Project by Essar Oil and gas Exploration and Production Limited**  
**Compliance Period: Apr'17 to Sep'17**

**ANNEXURE IV**

S. No.	Parameter	Unit	General Discharge Standards	O & G Discharge Standards	Date	11.08.2017	11.08.2017	11.08.2017	11.08.2017	11.08.2017	11.08.2017	11.08.2017	11.08.2017
					GGS-1(R.O-Inlet)	GGS-1(R.O-Outlet)	GGS-1(R.O-Reject)	EDD-50(R.O-Inlet)	EDD-50(R.O-outlet)	EDD-50(R.O- Reject)	EDN-99(R.O Inlet)	EDN-99(R.O Outlet)	
1	pH		5.5 to 9.0	5.5-9.0	9.31	9.17	8.71	9.18	9.56	9.65	8.42	9.48	
2	Total Suspended Solids	mg/l	100	100	5	<2	<2	<2	<2	14	<2	<2	
3	Total Dissolved Solids	mg/l	---	2100	2258	494	7982	2578	966	2892	4758	682	
4	Turbidity	NTU	---	---	9.8	1.2	3.2	3.9	<1	39.2	<1	2.1	
5	Acidity as CaCO <sub>3</sub>	mg/l	---	---	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	
6	Total Alkalinity as Calcium Carbonate	mg/l	---	---	1503.5	349.2	785.7	1406.5	591.7	1639.3	582	97	
7	Chloride	mg/l	---	600	198	45.3	1131.6	556.4	173.5	528.1	3064.7	277.2	
8	Total Hardness	mg/l	---	---	15.5	89.2	15.5	38.8	23.3	46.6	287.1	23.3	
9	Sulphate	mg/l	---	1000	9.3	<2.5	10.5	6.8	<2.5	4.7	6.9	<2.5	
10	Calcium	mg/l			4.7	21.8	4.7	9.3	6.2	10.9	96.4	6.2	
11	Magnesium	mg/l	---	---	<1	8.5	<1	3.8	1.9	4.7	11.3	1.9	
12	Biological Oxygen Demand, 3 Days at 27°C	mg/l	30	30	2	<2	4	2	<2	<2	<2	<2	
13	Chemical Oxygen Demand	mg/l	250	100	11	<8	18	9	<8	8	8	<8	
14	Oil & Grease (Hexane Extract)	mg/l	10	10	<5	<5	<5	<5	<5	<5	<5	<5	
15	Phenolic Compounds (as C <sub>6</sub> H <sub>5</sub> OH)	mg/l	1	1.2	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	
16	Sulphide (as H <sub>2</sub> S)	mg/l	2	2	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	
17	Fluoride	mg/l	2	1.5	2.55	3.1	3.35	2.7	2.15	3.25	2.55	1.2	
18	Ammoniacal Nitrogen	mg/l	---	---	3.86	4.92	6.45	4.11	3.82	4.65	4.31	3.85	
19	Iron	mg/l	---	---	0.11	0.5	0.26	0.66	1.22	0.77	0.19	<0.1	
20	Total Chromium	mg/l	2	1	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	
21	Zinc	mg/l	---	---	0.031	<0.01	0.018	0.019	0.011	0.042	<0.01	0.012	
22	Copper	mg/l	---	---	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	

**Analysis of R.O. Water of CBM Raniganj Project by Essar Oil and gas Exploration and Production Limited**  
**Compliance Period: Apr'17 to Sep'17**

**ANNEXURE IV**

S. No.	Parameter	Unit	General Discharge Standards	O & G Discharge Standards	Date	11.08.2017	11.08.2017	11.08.2017	11.08.2017	11.08.2017	11.08.2017	11.08.2017	11.08.2017
					GGS-1(R.O-Inlet)	GGS-1(R.O-Outlet)	GGS-1(R.O-Reject)	EDD-50(R.O-Inlet)	EDD-50(R.O-outlet)	EDD-50(R.O- Reject)	EDN-99(R.O Inlet)	EDN-99(R.O Outlet)	EDN-99(R.O Outlet)
23	Nickel	mg/l			<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
24	Total Arsenic	mg/l			<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
25	Lead	mg/l			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
26	Mercury	mg/l	0.01	0.01	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
27	Boron	mg/l			<1	<1	<1	<1	<1	<1	<1	<1	<1
28	SAR		---	---	82.2	9.5	113.8	78.5	27.4	84.8	49.1	9.3	
29	Phosphorus	mg/l	---	---	0.13	0.24	0.37	0.23	0.14	0.27	0.18	0.11	
30	Aluminium	mg/l	---	---	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
31	Lithium	mg/l			<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
32	Manganese	mg/l			<0.05	<0.05	<0.05	<0.05	0.056	<0.05	<0.05	<0.05	<0.05
33	Molybdenum	mg/l	---	---	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
34	Palladium	mg/l	---	---	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
35	Selenium	mg/l			<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
36	Vanadium	mg/l	---	---	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
37	Cadmium	mg/l			<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
38	Cobalt	mg/l			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
39	Bicarbonate	mg/l	---	---	1159	195.2	744.2	1037	378.2	1207.8	610	85.4	
40	Conductivity	μmhos/cm	---	---	3318	884	11242	3648	1670	4022	6581	1108	
41	Sodium	mg/l	---	---	749	208	1030	1128	306	1214	1912	103	

**Analysis of R.O. Water of CBM Raniganj Project by Essar Oil and gas Exploration and Production Limited**  
**Compliance Period: Apr'17 to Sep'17**

**ANNEXURE IV**

S. No.	Parameter	Unit	General Discharge Standards	O & G Discharge Standards	Date	11.08.2017	05.09.2017	05.09.2017	05.09.2017	05.09.2017	05.09.2017	05.09.2017	05.09.2017	
					EDN-99(R.O Reject)	GGS-1(R.O-Inlet)	GGS-1(R.O-Outlet)	GGS-1(R.O-Reject)	EDD-50(R.O-Inlet)	EDD-50(R.O-outlet)	EDD-50(R.O-Reject)	EDN-99(R.O Inlet)	EDN-99(R.O Inlet)	
1	pH		5.5 to 9.0	5.5-9.0	8.88	9.11	8.82	8.88	9.07	9.27	9.82	8.45		
2	Total Suspended Solids	mg/l	100	100	<2	<2	<2	<2	12	<2	3	10		
3	Total Dissolved Solids	mg/l	---	2100	5022	2246	558	8882	2738	868	2876	3648		
4	Turbidity	NTU	---	---	<1	4	<1	3.8	27.7	<1	9.4	22		
5	Acidity as CaCO <sub>3</sub>	mg/l	---	---	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil		
6	Total Alkalinity as Calcium Carbonate	mg/l	---	---	455.9	1632	403.2	5721.6	1440	499.2	1593.6	480		
7	Chloride	mg/l	---	600	3489	207.5	43.4	1367.3	612.9	226.3	471.5	2076.1		
8	Total Hardness	mg/l	---	---	329.8	39.2	15.7	86.2	164.6	19.6	47	227.4		
9	Sulphate	mg/l	---	1000	10.2	<2.5	<2.5	6.5	5.5	<2.5	6.9	6.8		
10	Calcium	mg/l			74.6	9.4	4.7	26.7	47.1	4.7	9.4	70.7		
11	Magnesium	mg/l	---	---	34.9	7.7	1.9	9.6	11.4	1.9	5.7	12.4		
12	Biological Oxygen Demand, 3 Days at 27°C	mg/l	30	30	<2	<2	<2	<2	<2	<2	<2	<2		
13	Chemical Oxygen Demand	mg/l	250	100	8	<8	<8	8	8	<8	9	<8		
14	Oil & Grease (Hexane Extract)	mg/l	10	10	<5	<5	<5	<5	<5	<5	<5	<5		
15	Phenolic Compounds (as C <sub>6</sub> H <sub>5</sub> OH)	mg/l	1	1.2	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002		
16	Sulphide (as H <sub>2</sub> S)	mg/l	2	2	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5		
17	Fluoride	mg/l	2	1.5	3.1	0.96	0.62	1.4	1.9	0.7	2.25	2.4		
18	Ammoniacal Nitrogen	mg/l	---	---	4.65	1.92	1.3	2.85	3.4	2.55	4.12	2.68		
19	Iron	mg/l	---	---	0.52	0.21	0.1	0.41	1.98	0.94	0.98	1.75		
20	Total Chromium	mg/l	2	1	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05		
21	Zinc	mg/l	---	---	0.024	<0.01	<0.01	0.027	0.013	0.011	0.017	0.015		
22	Copper	mg/l	---	---	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05		

**Analysis of R.O. Water of CBM Raniganj Project by Essar Oil and gas Exploration and Production Limited**  
**Compliance Period: Apr'17 to Sep'17**

**ANNEXURE IV**

S. No.	Parameter	Unit	General Discharge Standards	O & G Discharge Standards	Date	11.08.2017	05.09.2017	05.09.2017	05.09.2017	05.09.2017	05.09.2017	05.09.2017	05.09.2017
					EDN-99(R.O Reject)	GGS-1(R.O-Inlet)	GGS-1(R.O-Outlet)	GGS-1(R.O-Reject)	EDD-50(R.O-Inlet)	EDD-50(R.O-outlet)	EDD-50(R.O-Reject)	EDN-99(R.O Inlet)	
23	Nickel	mg/l			<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
24	Total Arsenic	mg/l			<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
25	Lead	mg/l			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
26	Mercury	mg/l	0.01	0.01	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
27	Boron	mg/l			<1	<1	<1	<1	<1	<1	<1	<1	<1
28	SAR		---	---	27	65	26.2	182.8	35.2	30.8	71.2	30.4	
29	Phosphorus	mg/l	---	---	0.23	0.18	0.1	0.29	0.21	0.15	0.24	0.18	
30	Aluminium	mg/l	---	---	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
31	Lithium	mg/l			<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
32	Manganese	mg/l			<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
33	Molybdenum	mg/l	---	---	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
34	Palladium	mg/l	---	---	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
35	Selenium	mg/l			<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
36	Vanadium	mg/l	---	---	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
37	Cadmium	mg/l			<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
38	Cobalt	mg/l			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
39	Bicarbonate	mg/l	---	---	329.4	1452	292.8	4514	1024	290.5	1287.4	341	
40	Conductivity	μmhos/cm	---	---	7342	2864	645	10200	3648	1170	3686	4682	
41	Sodium	mg/l	---	---	1128	934	238	3898	1014	312	1122	1055	

**Analysis of R.O. Water of CBM Raniganj Project by Essar Oil and gas Exploration and Production Limited**  
**Compliance Period: Apr'17 to Sep'17**

**ANNEXURE IV**

S. No.	Parameter	Unit	General Discharge Standards	O & G Discharge Standards	05.09.2017	05.09.2017
					EDN-99(R.O Outlet)	EDN-99(R.O Reject)
1	pH		5.5 to 9.0	5.5-9.0	8.61	8.25
2	Total Suspended Solids	mg/l	100	100	<2	<2
3	Total Dissolved Solids	mg/l	---	2100	652	7012
4	Turbidity	NTU	---	---	<1	<1
5	Acidity as CaCO <sub>3</sub>	mg/l	---	---	Nil	Nil
6	Total Alkalinity as Calcium Carbonate	mg/l	---	---	230.4	825.6
7	Chloride	mg/l	---	600	245.2	3799.3
8	Total Hardness	mg/l	---	---	86.2	31.4
9	Sulphate	mg/l	---	1000	4.5	7.5
10	Calcium	mg/l			26.7	7.9
11	Magnesium	mg/l	---	---	4.8	2.9
12	Biological Oxygen Demand, 3 Days at 27°C	mg/l	30	30	<2	<2
13	Chemical Oxygen Demand	mg/l	250	100	<8	8
14	Oil & Grease (Hexane Extract)	mg/l	10	10	<5	<5
15	Phenolic Compounds (as C <sub>6</sub> H <sub>5</sub> OH)	mg/l	1	1.2	<0.002	<0.002
16	Sulphide (as H <sub>2</sub> S)	mg/l	2	2	<0.5	<0.5
17	Fluoride	mg/l	2	1.5	1.25	2.85
18	Ammoniacal Nitrogen	mg/l	---	---	1.98	3.75
19	Iron	mg/l	---	---	0.12	<0.1
20	Total Chromium	mg/l	2	1	<0.05	<0.05
21	Zinc	mg/l	---	---	<0.01	0.019
22	Copper	mg/l	---	---	<0.05	<0.05

**Analysis of R.O. Water of CBM Raniganj Project by Essar Oil and gas Exploration and Production Limited**  
**Compliance Period: Apr'17 to Sep'17**

**ANNEXURE IV**

S. No.	Parameter	Unit	General Discharge Standards	O & G Discharge Standards	Date	05.09.2017	05.09.2017
					EDN-99(R.O Outlet)	EDN-99(R.O Reject)	
23	Nickel	mg/l			<0.05	<0.05	
24	Total Arsenic	mg/l			<0.01	<0.01	
25	Lead	mg/l			<0.1	<0.1	
26	Mercury	mg/l	0.01	0.01	<0.001	<0.001	
27	Boron	mg/l			<1	<1	
28	SAR		---	---	8.4	208.8	
29	Phosphorus	mg/l	---	---	0.11	0.24	
30	Aluminium	mg/l	---	---	<0.01	<0.01	
31	Lithium	mg/l			<0.5	<0.5	
32	Manganese	mg/l			<0.05	<0.05	
33	Molybdenum	mg/l	---	---	<0.5	<0.5	
34	Palladium	mg/l	---	---	<0.5	<0.5	
35	Selenium	mg/l			<0.01	<0.01	
36	Vanadium	mg/l	---	---	<0.2	<0.2	
37	Cadmium	mg/l			<0.02	<0.02	
38	Cobalt	mg/l			<0.1	<0.1	
39	Bicarbonate	mg/l	---	---	224.5	1007.2	
40	Conductivity	µmhos/cm	---	---	835	10826	
41	Sodium	mg/l	---	---	180	2696	



# SCIENTIFIC RESEARCH LABORATORY

(Analytical &amp; Environmental Engineering Laboratory)

Laboratory Recognised By West Bengal Pollution Control Board

An ISO 14001 : 2004, ISO 9001 : 2008 &amp; OHSAS 18001 : 2007 Certified

90, Lake East (4th Road) Santoshpur, Jadavpur, Kolkata - 700 075

Tele Fax : (033) 2416 2267, Tel. : (033) 2416 1311, E-mail : jyotimoysrl@gmail.com

Website : www.scientificlab.org

## DETAILS OF GROUND WATER LEVEL MEASUREMENT

[Format No. SRL/FM/48]

Name & Address of the Customer	: M/s. Essar Oil Ltd. Village +P.O. – Gopalpur , Gopalpur Sarengan Road, Near Rajendra Nath Polytechnic College , P.S. – Kanksha, Durgapur – 713 212, District – Burdwan, West Bengal, INDIA
Sample Identification No.	: GWLM-01-2017 to GWLM-07-2017
Instrument Used	: PIEZOMETER
Environmental Condition	: Dry
Sampling Date	: 10.06.2017

## REPORT OF GROUND WATER LEVEL MEASUREMENT

[Report No. SRL / EOL / GWLM-01-2017 to GWLM-07-2017 Dated: 20.06.2017]

SL No.	Location Details	Land Mark	Latitude	Longitude	Measurement Result (In Meters)			
					Parapet Height	Diameter of Well	DTW from Parapet top	DTW bgl
1.	GWLM-01-2017 : Nachon Village	House of Arup Ghatak	23°36'42.4"N	87°19'58.9"E	0.68	1	2.63	1.95
2.	GWLM-02-2017 : Kalikapur Village	Behind Durga Mandir	23°37.464"N	87°20.151"E	0.8	1.85	3.7	2.9
3.	GWLM-03-2017 : Dhabani (Bauripara)	Bauripara	23°35'519"N	87°22.085"E	0.95	1.8	3.52	2.57
4.	GWLM-04-2017 : Dhabani (Rana)	Rana Bari	23°35'31.2"N	87°22'00.9"E	0.7	0.68	3.0	2.3
5.	GWLM-05-2017 : Labnapara	Near High School	23°35'05.36N	87°22'15.8"E	1.2	1.5	11.92	10.72
6.	GWLM-06-2017 : Akandara	Adhibasi Para(Choto)	23°34'461"N	87°23'013"E	0.65	1.85	6.05	5.4
7.	GWLM-07-2017 : Saraswatiganj	House of Sibhu Saha	23°35'226"N	87°24'784"E	0.6	1.75	3.05	2.45

For Scientific Research Laboratory

*Shivender Das*

(Senior Chemist)



- The test report shall not be reproduced, except in full, without written approval of the company.
- Results relate only to the parameters tested.
- No Repeat Analysis will be entertained after 15 days from the date of sampling.



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90, Lake East (4th Road) Santoshpur, Jadavpur, Kolkata - 700 075

Tele Fax : (033) 2416 2267, Tel. : (033) 2416 1311, E-mail : jyotirmoysrl@gmail.com

Website : www.scientificlab.org

## DETAILS OF GROUND WATER LEVEL MEASUREMENT

[Format No. SRL/FM/48]

Name & Address of the Customer

: M/s. Essar Oil Ltd.  
Village +P.O. - Gopalpur , Gopalpur Sarengan Road,  
Near Rajendra Nath Polytechnic College , P.S. - Kanksha,  
Durgapur - 713 212, District - Burdwan, West Bengal, INDIA

Sample Identification No.

: GWLM-08-2017 to GWLM-14-2017

Instrument Used

: PIEZOMETER

Environmental Condition

: Dry

Sampling Date

: 10.06.2017

## REPORT OF GROUND WATER LEVEL MEASUREMENT

[Report No. SRL / EOL / GWLM-08-2017 to GWLM-14-2017 Dated: 20.06.2017]

SL No.	Location Details	Land Mark	Latitude	Longitude	Measurement Result (In Meters)			
					Parapet Height	Diameter of Well	DTW from Parapet top	DTW bgl
1.	GWLM-08-2017 : Ghatak Danga	New Atchala	23°34'147"N	87°24'308"E	1	2.4	6.98	5.98
2.	GWLM-09-2017 : Saranga (Kesabpur)	House of Damal Lohar	23°31'665"N	87°24'400"E	0	0.6	3.53	.3.53
3.	GWLM-10-2017 : Gopalpur (Chatal Danga)	Near EDN 178	23°30'639"N	87°23'408"E	0.5	1.53	4.9	4.4
4.	GWLM-11-2017 : Jatgoria	Near Mosjid	23°36'973"N	87°23'432"E	0.6	1.8	3.08	2.48
5.	GWLM-12-2017 : Kantaberia	Near Mandir	23°36'829"N	87°22'242"E	0.6	1.3	3.8	3.2
6.	GWLM-13-2017 : Bargoria	Near EDT-006	23°37'580"N	87°21'397"E	0.7	2.5	4.58	3.88
7.	GWLM-14-2017 : Khatgoria	Near Rabindra Sanga	23°37'52.5"N	87°21'08.3"E	0.8	0.8	3.99	3.19

For Scientific Research Laboratory

*Shivendra Das*

(Senior Chemist)



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- No Repeat Analysis will be entertained after 15 days from the date of sampling.

S. No.	Parameter	Unit	S:10500 -1991		Gopalpur Village	Saranga Village	Saraswati Ganj Village	Ghatak Danga Village	Akandara Village	Labnapara Village	Dhabani Village
			Desirable limit	Permissible limit							
			Date :		10.06.2017	10.06.2017	10.06.2017	10.06.2017	10.06.2017	10.06.2017	10.06.2017
1	pH at 27°C		6.5 to 8.5	No Relaxation	8.19	7.41	7.15	7.24	7.28	6.62	6.53
2	Colour in Hazen unit		5	15	<5	<5	<5	<5	<5	<5	<5
3	Odour		Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable
4	Total Suspended Solids	mg/l	---	---	<2	<2	<2	10	<2	<2	2
5	Total Dissolved Solids	mg/l	500	2000	172	184	198	52	82	64	48
6	Turbidity	NTU	1	5	3.3	<1	4.1	24.2	<1	<1	7.2
7	Nitrate	mg/l	45	No Relaxation	3.26	3.86	4.41	<0.5	0.73	1.96	1.5
8	Total Alkalinity (as CaCO <sub>3</sub> )	mg/l	200	600	21.5	27	32.5	8.6	12.8	11.9	5.8
9	Chloride	mg/l	250	1000	52.8	20.7	66	11.3	11.3	15.1	9.4
10	Total Hardness (as CaCO <sub>3</sub> )	mg/l	200	600	68	124	92	16	44	40	28
11	Sulphate	mg/l	200	400	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5
12	Calcium	mg/l	75	200	11.2	30.5	24	4.8	9.6	9.6	8
13	Magnesium	mg/l	30	100	9.7	11.7	7.8	1	4.9	3.9	1.9
14	Anionic Detergents (as MBAS)	mg/l	0.2	1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
15	Mineral Oil	mg/l	0.5	No Relaxation	<1	<1	<1	<1	<1	<1	<1
16	Phenolic Compounds (as C <sub>6</sub> H <sub>5</sub> OH)	mg/l	0.001	0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
17	Fluoride	mg/l	1	1.5	0.53	0.41	0.33	0.18	0.26	0.21	0.15
18	Residual Free Chlorine	mg/l	0.2	1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
19	Iron	mg/l	0.3	No Relaxation	0.43	<0.1	0.59	4.17	<0.1	<0.1	1.2
20	Sodium	mg/l	---	---	34	13.8	21.4	6.8	7.2	7.9	5.8
21	Total Chromium	mg/l	0.05	No Relaxation	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
22	Zinc	mg/l	5	15	0.023	0.014	0.02	<0.01	<0.01	<0.01	0.019
23	Copper	mg/l	0.05	1.5	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
24	Nickel	mg/l	0.02	No Relaxation	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
25	Arsenic	mg/l	0.01	0.05	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
26	Lead	mg/l	0.01	No Relaxation	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
27	Mercury	mg/l	0.001	No Relaxation	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
28	Boron	mg/l	0.5	1	<1	<1	<1	<1	<1	<1	<1
29	Phosphorus	mg/l	---	---	0.058	0.062	0.074	<0.05	<0.05	<0.05	<0.05
30	Potassium	mg/l	---	---	2	1.2	1.5	<1	<1	<1	<1
31	Aluminium	mg/l	0.03	0.2	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
32	Manganese	mg/l	0.1	0.3	<0.05	<0.05	0.059	0.104	<0.05	<0.05	0.077
33	Selenium	mg/l	0.01	No Relaxation	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
34	Cadmium	mg/l	0.003	No Relaxation	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
35	Cyanide	mg/l	0.05	No Relaxation	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
36	Electrical Conductivity at 25°C	us/cm	---	---	268	298	307	89	128	96	82
37	Hexavalent Chromium	mg/l	---	---	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
38	Total Coliform	MPN/100ml	---	---	<1.1	<1.1	2.2	2.2	<1.1	<1.1	<1.1

S. No.	Parameter	Unit	S:10500 -1991		Kantaberia Village	Jatgoria Village	Bargoria Village	Kalikapur Village	Nachan Village
			Desirable limit	Permissible limit					
			Date :		10.06.2017	10.06.2017	10.06.2017	10.06.2017	10.06.2017
1	pH at 27°C		6.5 to 8.5	No Relaxation	6.81	6.76	6.82	7.45	7.69
2	Colour in Hazen unit		5	15	<5	<5	<5	<5	<5
3	Odour		Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable
4	Total Suspended Solids	mg/l	---	---	<2	12	<2	<2	6
5	Total Dissolved Solids	mg/l	500	2000	96	118	42	514	380
6	Turbidity	NTU	1	5	<1	31.7	2.8	1.5	14.7
7	Nitrate	mg/l	45	No Relaxation	4.24	<0.5	3.86	<0.5	1.94
8	Total Alkalinity (as CaCO <sub>3</sub> )	mg/l	200	600	14.5	11.6	6	38.6	56.2
9	Chloride	mg/l	250	1000	16.9	13.2	7.5	81.1	15.1
10	Total Hardness (as CaCO <sub>3</sub> )	mg/l	200	600	52	40	20	220	280
11	Sulphate	mg/l	200	400	<2.5	<2.5	<2.5	<2.5	<2.5
12	Calcium	mg/l	75	200	11.2	9.6	4.8	64.1	99.4
13	Magnesium	mg/l	30	100	5.8	3.9	1.9	14.6	7.4
14	Anionic Detergents (as MBAS)	mg/l	0.2	1	<0.1	<0.1	<0.1	<0.1	<0.1
15	Mineral Oil	mg/l	0.5	No Relaxation	<1	<1	<1	<1	<1
16	Phenolic Compounds (as C <sub>6</sub> H <sub>5</sub> OH)	mg/l	0.001	0.002	<0.002	<0.002	<0.002	<0.002	<0.002
17	Fluoride	mg/l	1	1.5	0.21	0.2	0.19	0.21	0.27
18	Residual Free Chlorine	mg/l	0.2	1	<0.1	<0.1	<0.1	<0.1	<0.1
19	Iron	mg/l	0.3	No Relaxation	<0.1	7.73	0.48	0.26	4.72
20	Sodium	mg/l	---	---	6.9	8.1	4	49	11.7
21	Total Chromium	mg/l	0.05	No Relaxation	<0.05	<0.05	<0.05	<0.05	<0.05
22	Zinc	mg/l	5	15	<0.01	0.041	<0.01	<0.01	0.037
23	Copper	mg/l	0.05	1.5	<0.05	<0.05	<0.05	<0.05	<0.05
24	Nickel	mg/l	0.02	No Relaxation	<0.05	<0.05	<0.05	<0.05	<0.05
25	Arsenic	mg/l	0.01	0.05	<0.01	<0.01	<0.01	<0.01	<0.01
26	Lead	mg/l	0.01	No Relaxation	<0.1	<0.1	<0.1	<0.1	<0.1
27	Mercury	mg/l	0.001	No Relaxation	<0.001	<0.001	<0.001	<0.001	<0.001
28	Boron	mg/l	0.5	1	<1	<1	<1	<1	<1
29	Phosphorus	mg/l	---	---	<0.05	0.052	<0.05	0.081	0.073
30	Potassium	mg/l	---	---	<1	<1	<1	4	2
31	Aluminium	mg/l	0.03	0.2	<0.01	<0.01	<0.01	<0.01	<0.01
32	Manganese	mg/l	0.1	0.3	<0.05	0.145	<0.05	<0.05	0.063
33	Selenium	mg/l	0.01	No Relaxation	<0.01	<0.01	<0.01	<0.01	<0.01
34	Cadmium	mg/l	0.003	No Relaxation	<0.02	<0.02	<0.02	<0.02	<0.02
35	Cyanide	mg/l	0.05	No Relaxation	<0.02	<0.02	<0.02	<0.02	<0.02
36	Electrical Conductivity at 25° C	us/cm	---	---	148	183	85	765	622
37	Hexavalent Chromium	mg/l	---	---	<0.01	<0.01	<0.01	<0.01	<0.01
38	Total Coliform	MPN/100ml	---	---	<1.1	3.6	<1.1	<1.1	2.2

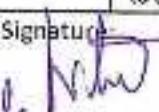
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## FORM 10

## WEST BENGAL WASTE MANAGEMENT LIMITED

J.L.No. 103, Mouza Purba Srikrishnapur, P.O. &amp; P.S. Sutahata, Haldia 721635, Dist. Purba Medinipur, West Bengal

## MANIFEST FOR HAZARDOUS AND OTHER WASTE

1	Sender's name and mailing address (including Phone No. and e-mail) :	ESSAR OIL AND GAS EXPLORATION AND PRODUCTION LIMITED GOPALPUR, (NEAR RAJENDRA NATH COLLEGE, OPP-OLD GANJA GHAT)-DURGAPUR-713212 Ph. No- 0343-6608000		
2	Sender's authorization No. :	110/25(HW)2449/2008		
3	Manifest Document No. :	2928		
4	Transporter's name and address (including Phone No. and e-mail) :	West Bengal Waste Management Limited J.L No. 103, Mouza Purba Srikrishnapur, P.O. & P.S. Sutahata, Haldia 721635 Dist. Purba Medinipur, West Bengal, Ph. No.- 03224-278238 / 39 E-mail : wbwml_haldia@ramky.com		
5	Type of vehicle :	(Truck/Tanker/Special Vehicle)		
6	Transporter's registration No. :	1-MD(E)/X/06		
7	Vehicle registration No. :	WB 29-8073		
8	Receiver's name and mailing address (including Phone No. and e-mail) :	West Bengal Waste Management Limited J.L No. 103, Mouza Purba Srikrishnapur, P.O. & P.S. Sutahata, Haldia 721635 Dist. Purba Medinipur, West Bengal, Ph. No.- 03224-278238 / 39 E-mail : wbwml_haldia@ramky.com		
9	Receiver's authorization No. :			
10	Waste description :	oil contaminated materials, Filter, RO pipe		
11	Total quantity No. of Containers :	2.070 ....kg or MT 01 Ltr ....Nos.		
12	Physical form :	(Solid/Semi-Solid/Sludge/Oily/Tarry/Slurry/Liquid)		
13	Special handling instructions and additional information :	use gloves, safety helmet, goggles, full PPE.		
14	Sender's Certificate 	I hereby declare that the contents of the consignment are fully and accurately described above by proper shipping categorized, packed, marked, and named and are labeled, and are in all respects in proper conditions for transport by road according to applicable national government regulations.		
	Name and stamp:	Signature:	Day	Month
	DURGAPUR CBM PROJECTS JUNE 2012		29	08
			20	12
15	Transporter acknowledgement of receipt of wastes :			
	Name and stamp:	Signature:	Day	Month
			29	08
			20	12
16	Receiver's certification for receipt of hazardous and other waste:			
	Name and stamp:	Signature:	Day	Month
			29	08
			20	12

1. White Colour forwarded to WBPCB by HzW Sender.

3. Pink Colour retained by HzW Receiver.

5. Green Colour forwarded to WBPCB after disposal by HzW Receiver.

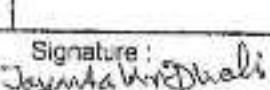
7. Grey Colour returned to SPCB of the HzW Sender (In case the Sender is in another State) by HzW Receiver.

2. Yellow Colour retained by HzW Sender.

4. Orange Colour retained by Transporter.

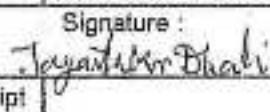
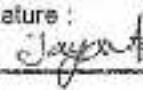
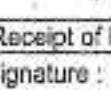
6. Blue Colour returned to Sender after disposal by HzW Receiver.

**FORM 13**  
 [See Rule 21 (1)]  
**HAZARDOUS WASTE MANIFEST**

1. Occupier's Name & Mailing Address (including Phone No.)	ESSar oil Limited (E&P division) ware house , Near son-son what, Bopalpur , Durgapur 172								
2. Occupier's Registration No.	199125 (H.W) - 2004/2006 2449/2008								
3. Manifest Document No.									
4. Transporter's Name & Address (including Phone No.)	Self arranged, N.K. COMPANY, J. R. Industrial Estate, Haran Molla Road, Vill-Banagram, P.O - Rasapunja, P.S - Bishnupur, Dist - South 24 PGS (WB) P.H - 033 - 24980674								
5. Type of Vehicle	(Truck / Tanker / Special Vehicle)								
6. Transporter's Registration No.	WB-19D-1674								
7. Vehicle Registration No.									
8. Designated Facility Name & Site Address :	<b>N. K. COMPANY</b> J. R. INDUSTRIAL ESTATE Vill:-Banagram, Haran Molla Rd., P.O.-Rasapunja, P.S.-Bishnupur,								
9. Facility's Registration No.	104/257(H.W) - 2004/2006 31-16/12/15								
10. Facility's Phone No.	033 - 24980674								
11. Waste Description	Waste oil								
12. Total Quantity	3150 Ltr..... m3 or MT								
13. Consistency	(Solid / Semi-Solid / Sludge / Oily / Tarry / Skurry)								
14. Transport description of wastes									
15. Containers	<table border="1"> <thead> <tr> <th>Number</th> <th>Type</th> </tr> </thead> <tbody> <tr> <td>15</td> <td>Drum</td> </tr> <tr> <td></td> <td></td> </tr> </tbody> </table>			Number	Type	15	Drum		
Number	Type								
15	Drum								
16. Total Quantity	3150 Ltr..... m3 or MT								
17. Unit Wt. / Vol.	3150 Ltr..... m3 or MT								
18. Waste Category Number	5-2								
19. Special Handling Instruction & Additional information									
20. OCCUPIER'S DECLARATION	 I hereby declare that the contents of the consignment are fully and accurately described above by proper shipping name and are categorised, packed, marked, and labeled, and are in all respects in proper condition for transport by road according to applicable national Government Regulations.								
21. Transporter Acknowledgment of Receipt of Wastes	Typed Name & Stamp : Signature : Month Day Year  04 18 2017								
22. Discrepancy Note Space									
23. Facility Owner or Operator's Certification	Receipt of Hazardous Waste Month Day Year Typed Name & Stamp : Signature : Month Day Year  N. K. COMPANY J. R. INDUSTRIAL ESTATE 12/06/07								

1. White Colour forwarded to Generator  
 2. Yellow Colour retained by Generator  
 3. Pink Colour retained by Generator  
 4. Orange Colour retained by transporter  
 5. Green Colour forwarded to Disposal  
 6. Blue Colour returned to Generator after disposal

**FORM 13**  
 [See Rule 21 (1)]  
**HAZARDOUS WASTE MANIFEST**

1. Occupier's Name & Mailing Address (including Phone No.)	ESSAR OIL LIMITED (E&P DIVISION) WAREHOUSE, GOPALPUR, NEAR SAMSON GHAT, DURGAPUR								
2. Occupier's Registration No.	178/LS (HW) 2449/2009								
3. Manifest Document No.									
4. Transporter's Name & Address (including Phone No.)	Self arranged, N.K. Company. J.R. Industrial Estate, Vill:- Banagram Haran Molla Road, P.O.-Rasapunja, P.S.-Bishnupur 24 Prgs. (S)								
5. Type of Vehicle	(Truck / Tanker / Special Vehicle)								
6. Transporter's Registration No.									
7. Vehicle Registration No.	WB-19D-1674								
8. Designated Facility Name & Site Address :	<b>N. K. COMPANY</b> J. R. INDUSTRIAL ESTATE Vill:-Banagram, Haran Molla Rd., P.O.-Rasapunja, P.S.-Bishnupur,								
9. Facility's Registration No.	194/23 (HN) 2004/2006 DT. 16/12/15								
10. Facility's Phone No.	033-24980674								
11. Waste Description	Waste Oil								
12. Total Quantity	315.0 LTRS m3 or MT								
13. Consistency	(Solid / Semi-Solid / Sludge / Oily / Tarry / Slurry)								
14. Transport description of Wastes									
15. Containers	<table border="1"> <thead> <tr> <th>Number</th> <th>Type</th> </tr> </thead> <tbody> <tr> <td>15</td> <td>Drum</td> </tr> <tr> <td></td> <td></td> </tr> </tbody> </table>			Number	Type	15	Drum		
Number	Type								
15	Drum								
16. Total Quantity	315.0 LTRS m3 or MT								
17. Unit Wt. / Vol.	3150 LTRS m3 or MT								
18. Waste Category Number	5.2								
19. Special Handling Instruction & Additional Information									
20. OCCUPIER'S CERTIFICATE	I hereby declare that the contents of the consignment are fully and accurately described above by proper shipping name and are categorised, packed, marked, and labeled, and are in all respects in proper condition for transport by road according to applicable national Government Regulations.								
Typed Name & Stamp	Signature :  Month Day Year 04 21 2017								
21. Transporter Acknowledgment of Receipt of Wastes									
Typed Name & Stamp	Signature :  Month Day Year 04 21 2017								
22. Discrepancy Note Space									
23. Facility Owner or Operator's Certification of Receipt of Hazardous Waste	Signature :  Month Day Year 04 21 2017								

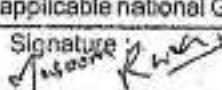
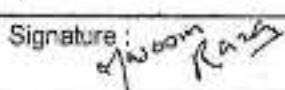
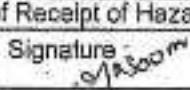
1. White Colour forwarded to Generator  
 2. Yellow Colour retained by Generator  
 3. Pink Colour retained by Generator  
 4. Orange Colour retained by transporter  
 5. Green Colour forwarded to Generator after disposal  
 6. Blue Colour returned to Generator after disposal

**FORM 13**  
 [See Rule 21 (1)]  
**HAZARDOUS WASTE MANIFEST**

1. Occupier's Name & Mailing Address (including Phone No.)	EOKF PL (E&P DIVISION) WARP HOUSE, KOPALTUP, NEAR SAMSAI WHT, DURGAPUR			
2. Occupier's Registration No.	178/2 S (JWD) 2448/2008			
3. Manifest Document No.				
4. Transporter's Name & Address (including Phone No.)	SALF AGRICULTURE, N.K. COMPANY B.P. INDUSTRIAL ESTATE, VILL-BANAKRAN Harrow village road, P.O - ROGAJPOTRA, P.S. RASHPUR, 24 Parg (S)			
5. Type of Vehicle	(Truck / Tanker / Special Vehicle)			
6. Transporter's Registration No.	WB 41F - 2781			
7. Vehicle Registration No.				
8. Designated Facility Name & Site Address :				
9. Facility's Registration No.	1941251HMD 20042006 DT-16-12-15			
10. Facility's Phone No.	033 - 24980674			
11. Waste Description	waste oil			
12. Total Quantity	2400 Ltr.... m3 or MT			
13. Consistency	(Solid / Semi-Solid / Sludge / Oily / Tarry / Slurry)			
14. Transport description of Wastes				
15. Containers	Number	Type		
	40	Drum		
16. Total Quantity	2400 Ltr.... m3 or MT			
17. Unit Wt. / Vol.	2400 Ltr.... m3 or MT			
18. Waste Category Number				
19. Special Handling Instruction & Additional information				
20. OCCUPIER'S CERTIFICATE	I hereby declare that the contents of the consignment are fully and accurately described above by proper shipping name and are categorised, packed, marked, and labeled, and are in all respects in proper condition for transport by road according to applicable national Government Regulations.			
Typed Name & Stamp : 	Signature	Month	Day	Year
	Jayanta Kr Mukherjee	05	10	2017
21. Transporter Acknowledgment for Receipt of Wastes				
Typed Name & Stamp :	Signature	Month	Day	Year
	Jayanta Kr Mukherjee	05	10	2017
22. Discrepancy Note Space				
23. Facility Owner or Operator Certification of Receipt of Hazardous Waste				
Typed Name & Stamp :	Signature	Month	Day	Year
		05	10	2017

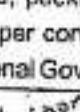
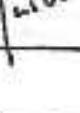
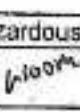
1. White Colour forwarded to WBPCB by Generator      2. Yellow Colour retained by Generator  
 3. Pink Colour retained by facilitor      4. Orange Colour retained by transportor  
 5. Green Colour forwarded to WBPCB after disposal      6. Blue Colour returned to Generator after disposal

**FORM 13**  
 [See Rule 21 (1)]  
**HAZARDOUS WASTE MANIFEST**

1. Occupier's Name & Mailing Address (including Phone No.)	EOGEPL (E&P DIVISION) WARE HOUSE, Gopalpur, NEAR SAMSANGHAT DURGAPUR.		
2. Occupier's Registration No.	178/25 (HW) - 2449/2008		
3. Manifest Document No.			
4. Transporter's Name & Address (including Phone No.)	Self arranged - N.K. COMPANY J. R. INDUSTRIAL, ESTATE, NILL - BANAGRAM HARAN MOLLA ROAD, P.O - RASAPUNJA, P.S - BHINNUPUR 24 PGS (S)		
5. Type of Vehicle	(Truck / Tanker / Special Vehicle) TRUCK		
6. Transporter's Registration No.	WB - 03 - D - 1489		
7. Vehicle Registration No.	N. K. COMPANY		
8. Designated Facility Name & Site Address :	J. R. INDUSTRIAL ESTATE VILL:-Banagram, Haran Molla Rd., P.O.-Rasapunja, P.S.-Bhinnupur, 24 PGS (S)		
9. Facility's Registration No.	194/25 (HW) - 2004 / 2008 Dt :- 16/12/2015		
10. Facility's Phone No.	033 - 24980674		
11. Waste Description	WASTE OIL		
12. Total Quantity	4,830 LTRS... m3 or MT		
13. Consistency	(Solid / Semi-Solid / Sludge / oily / Tarry / Slurry)		
14. Transport description of Wastes			
15. Containers	Number	Type	
	23	Drums	
16. Total Quantity	4,830 LTRS... m3 or MT		
17. Unit Wt / Vol.	4,830 LTRS... m3 or MT		
18. Waste Category Number	5-2		
19. Special Handling Instruction & Additional Information			
20. OCCUPIER'S CERTIFICATE	I hereby declare that the contents of the consignment are fully and accurately described above by proper shipping name and are categorised, packed, marked, and labeled, and are in all respects in proper condition for transport by road according to applicable national Government Regulations.		
21. Transporter Acknowledgement of Wastes	Typed Name & Stamp : 	Signature : 	Month Day Year 05 26 2017
22. Discrepancy Note Stamp : 	Typed Name & Stamp : 	Signature : 	Month Day Year 05 26 2017
23. Facility Owner or Operator's Certificate of Receipt of Hazardous Waste	Typed Name & Stamp : 	Signature : 	Month Day Year 05 26 2017

1. White Colour forwarded to WTPC after disposal  
 2. Yellow Colour retained by Generator  
 3. Pink Colour retained by Generator  
 4. Orange Colour retained by transporter  
 5. Green Colour forwarded to WTPC after disposal  
 6. Blue Colour returned to Generator after disposal

**FORM 13**  
 [See Rule 21 (1)]  
**HAZARDOUS WASTE MANIFEST**

1. Occupier's Name & Mailing Address (including Phone No.)	EOGEPL (E&P DIVISION) WARE-HOUSE, GOPALPUR, NEAR SAMSAN GHAT DURGAPUR					
2. Occupier's Registration No.	178/25 (HW)-2449/2008					
3. Manifest Document No.						
4. Transporter's Name & Address (including Phone No.)	Self Arranged: N K Company J. R. Industrial Estate, Vill-Banagram Harau Molla Road, P. O.-Rasapunja P. S.-Bishnupur, 24 Prgs(S)					
5. Type of Vehicle	(Truck / Tanker / Special Vehicle) TRUCK					
6. Transporter's Registration No.						
7. Vehicle Registration No.	WB 19 H-3512					
8. Designated Facility Name & Site Address :	N. K. COMPANY J. R. INDUSTRIAL ESTATE Vill-Banagram, Harau Molla Rd., P.O.-Rasapunja, P.S.-Bishnupur, 24 Prgs(S)					
9. Facility's Registration No.	124/25 (HW) 2004/2006 dt: 16/12/2015					
10. Facility's Phone No.	033-24980674					
11. Waste Description	WASTE OIL					
12. Total Quantity	1470 LTRS. m3 or MT					
13. Consistency	(Solid / Semi-Solid / Sludge / Oily / Tarry / Slurry)					
14. Transport description of Wastes						
15. Containers	<table border="1" style="width: 100px;"> <thead> <tr> <th>Number</th> <th>Type</th> </tr> </thead> <tbody> <tr> <td>07</td> <td>DRUM</td> </tr> </tbody> </table>		Number	Type	07	DRUM
Number	Type					
07	DRUM					
16. Total Quantily	1470 LTRS. m3 or MT					
17. Unit Wt. / Vol.	1470 LTRS. m3 or MT					
18. Waste Category Number	S-2					
19. Special Handling Instruction & Additional information						
20. OCCUPIER'S CERTIFICATE	I hereby declare that the contents of the consignment are fully and accurately described above by proper shipping name and are categorised, packed, marked, and labeled, and are in all respects in proper condition for transport by road according to applicable national Government Regulations.					
Typed Name & Stamp	Signature :  Month Day Year 07 10 2017					
21. Transporter Acknowledgement of Receipt of Wastes						
Typed Name & Stamp	Signature :  Month Day Year 07 10 2017					
22. Discrepancy Note Space						
23. Facility Owner or Occupier's Certificate of Receipt of Hazardous Waste						
Typed Name & Stamp	Signature :  Month Day Year 07 10 2017					

1. White Colour forwarded to WPCB by Generator  
 2. Yellow Colour retained by Generator  
 3. Pink Colour retained by Generator  
 4. Orange Colour retained by transporter  
 5. Green Colour forwarded to WPCB after disposal  
 6. Blue Colour returned to Generator after disposal

**SECOND PHASE  
REPORT  
ON**

**Subsidence Monitoring at ESSAR Raniganj CBM Block at Durgapur  
[RG (E) –CBM-2001/1 Block]**

**FOR  
ESSAR OIL LTD. (E&P DIVISION)**

*PREPARED BY*



**DEPARTMENT OF EARTH AND ENVIRONMENTAL STUDIES  
NATIONAL INSTITUTE OF TECHNOLOGY  
DURGAPUR- 713209**

**Dr. Kalyan Adhikari  
Dept. of EES  
Principal Investigator**

**Dr. Supriya Pal  
Dept. of CE  
Investigator**

**SEPTEMBER 2017**

# **Subsidence Monitoring at ESSAR Raniganj CBM Block at Durgapur [RG (E) –CBM-2001/1 Block]**

## **1. Introduction**

Essar Oil Limited (EOL) was awarded block RG (East)-CBM-2001/1 covering an area of approx. 500 sq km under the CBM-I Round, contract signed on 26<sup>th</sup> July 2002. EOL holds 100% participating interest in the block. The Petroleum Exploration License (PEL) was issued by the Government of West Bengal on 29<sup>th</sup> March 2005.

The Ministry of Environment & Forests (MoEF) granted Environment Clearance for drilling 650 development cum production wells, laying 8 Gas Gathering Stations, 1 Main Compressor Station and pipeline vide F.No.J-11011/491/2011-IA II(I) dated 26<sup>th</sup> February, 2013.

It was further suggested by MoEF to get the land subsidence study carried out by an institute of repute. In view of above, it was requested by ESSAR to Department of Earth and Environmental Studies, National Institute of Technology (NIT) Durgapur for carrying out land subsidence study on prefixed control stations (vertical concrete pillars) at RG (E) –CBM-2001/1 block. Project work order was awarded to the Department of Earth and Environmental Studies, NIT Durgapur for a period of two years with half yearly frequency subsidence monitoring to all established monitoring stations. Accordingly, a visit was made by the Investigators for reconnaissance study of the site in the month of June 2016. During the study, it was observed that few controlling stations are in damaged conditions. However, first and second phase monitoring work was executed in the mid of June, 2016 and mid of January 2017. A brief report was prepared based on the data obtained from the site.

This report mainly consists of the following

- A brief description of the Essar CBM Block, RG (East)-CBM-2001/1
- Details of locations of monitoring stations over the surface of the CBM block, RG (East)-CBM-2001/1
- Methodology adopted for subsidence study through open traverse.
- Plot of ground elevation of the control stations.

## **2. Project Location**

Block: RG (East)-CBM-2001/1 covers an area of 500 sq.km. (Approximately) and is located in the eastern-most part of the Raniganj Coalfield. It falls largely in Bardhaman district (90%), West Bengal. The block is bounded by Latitude 23°21'45" and 23°41'12" N and Longitude: 87°14'40" and

## **Subsidence Monitoring at ESSAR Raniganj CBM Block**

### **at Durgapur [RG (E) –CBM-2001/1 Block]**

87°28'46" E. It lies in the Survey of India Topographical Sheet Nos. 73 M/2, M/3, M/6 & M/7 (1:50,000).

#### **3. Development of subsidence**

Coal seam gas production often involves the extraction of groundwater to facilitate depressurisation of the target coal seam. The disposal or reuse of this collected water is an area of great public interest, as depressurisation results in compaction of the ground and leads to settlement of the ground surface (surface subsidence). The reduction in pressure results in compaction of the geological units in which depressurisation occurs. In addition, the liberation of gas from coal seams results in compaction of the coal. Subsidence at the ground surface is some component of the total compaction occurring within (potentially) multiple geological units. It is dependent on the magnitude and direction of compression (which is dictated by pressure changes from groundwater withdrawal and desorption of gas from coal seams), the depth and depth-interval over which compression occurs, and the geotechnical properties of the geological units throughout the depth profile.

#### **4. Impacts of subsidence**

Land subsidence may affect a variety of assets, including infrastructure (such as buildings, roads, railways, pipelines, dams, water channels, levees and electrical infrastructure) and environmental assets (such as aquifers, groundwater dependent ecosystems, streams, lakes, springs, and other surface water resources). Impacts of subsidence on infrastructure could include structural damage to buildings, buried pipes and sewers, and reduction in stability of buildings and electrical transmission lines and towers/poles. The serviceability of roads and railways may be affected by distortion of the road surface and rail foundation. Depressions in the ground surface due to subsidence may increase exposure to flooding, overflowing levees or storm surges in areas near the coast. Impacts of subsidence on environmental assets could include the formation of ground fissures and partial or complete loss of surface water drainage to deeper strata, stream bed and bank erosion, development of subsidence troughs and ponding of water, disruption to hillside groundwater springs and sensitive wetlands or swamps, and potential shearing of groundwater supply wells.

#### **5. Subsidence monitoring techniques**

Subsidence monitoring is conducted to gain an understanding of the threat subsidence poses to assets and the environment. It can provide early warnings of subsidence approaching levels that pose a risk to the environment or assets such as infrastructure; however, in many cases it is difficult to define triggers or thresholds for action, since subsidence is a slow, displacement-controlled process.

## **Subsidence Monitoring at ESSAR Raniganj CBM Block at Durgapur [RG (E) –CBM-2001/1 Block]**

A monitoring program must commence prior to coal seam gas extraction if it is to provide appropriate baseline conditions. The first phase is to establish the existing ground profile and identify existing ground movements (if occurring). As coal seam gas extraction commences, monitoring may be undertaken over the project area at prefixed time intervals.

Monitoring may be carried out with a range of instrumentation. A variety of monitoring techniques are discussed below, and indications of the accuracy, methods of use and suitability for subsidence monitoring, are provided.

Following the section on instrumentation, a detailed framework for monitoring subsidence using specific methods is provided.

### **5.1 Description of subsidence monitoring techniques**

**Table 1:** The techniques which can be used for monitoring and measuring surface subsidence

<b>Method</b>	<b>Use</b>	<b>Advantage</b>	<b>Disadvantage</b>
Visual Observation	Any newly formed tension cracks or fracturing in rocks and soil at the surface can indicate ground curvature or horizontal strain resulting from subsidence.	To see any new fractures in rock outcrops, to rock falls, to changes in water levels in ponds or creeks and to any signs of gas emissions at the surface.	Observing the effects of subsidence does not provide knowledge of the actual magnitude of vertical displacement and other possible causes of the observed effect may be responsible.
Conventional Levelling	Determining the elevations of points on the Earth's surface relative to some starting point or height datum.	For subsidence induced by coal seam gas production, especially in areas with readily available benchmarks, conventional levelling may provide a simple approach to accurately monitoring subsidence. Conventional levelling results may be combined with Global Positioning Systems (GPS) levelling to provide a clearer picture of the magnitude and extent of subsidence.	Over long distances, conventional levelling can produce accurate results but can be time consuming. Accuracy for standard conventional levelling is 8 mm times the square root of the distance in kilometres. This gives accuracies of about 25 mm over 10 km distance from the benchmark and 80 mm over 100 km distance (ICSM 2012). In some areas it may be difficult to achieve these accuracies, such as in heavily forested, hard to access or very steep terrain. Standard accuracy requires a good line of sight between

## Subsidence Monitoring at ESSAR Raniganj CBM Block at Durgapur [RG (E) –CBM-2001/1 Block]

<b>Method</b>	<b>Use</b>	<b>Advantage</b>	<b>Disadvantage</b>
Campaign and permanent Global Positioning System (GPS)	Can be used to monitor all type of subsidence	GPS does not require line of site between observing stations and can be used day or night and in low visibility conditions.	GPS receiving stations require a relatively clear view of sky to receive transmitted satellite signals. The data acquired can be highly deviated from the accurate result due to satellite orbital error, tropospheric error, and ionospheric error and errors due to multipath and receivers noise
DInSAR technique using high wavelength waves or L-band (~1/4 m)	to measure ground deformation problems, such as subsidence, over large areas.	This method is suitable for areas of high vegetation and agriculture land. Less sensitive to the noise disturbances.	Resolution of ground is less thus the monitoring of ground movement is not too accurate
DInSAR technique using low wavelength waves or C-band (~5-6 cm)	to measure ground deformation problems, such as subsidence, over large areas.	The resolution of the area is high and thus monitoring the movement is very accurate	Cannot be used in the areas where there is high vegetation cover.
Light Detection and Ranging (LiDAR) or Airborne Laser Survey (ALS)	Used to monitor all type of subsidence	1. High-density maps of deformation >1 sample per square metre. 2. LiDAR surveys can be scheduled and flown any time (within weather limitations). 3. Can make measurements in all terrain and vegetation conditions.	1. Accuracy is only 5 - 10 cm in the vertical component. 2. Specialized processing of data is required to obtain the highest accuracy results, which may not be available from commercial operators. 3. Surveys can only be flown in good weather.
Borehole extensometer s	to measure ground settlement.	Permits direct measurement of the amount of settlement that occurs as a result of	The information provided by this type of monitoring is restricted to the response at the

## Subsidence Monitoring at ESSAR Raniganj CBM Block at Durgapur [RG (E) –CBM-2001/1 Block]

<b>Method</b>	<b>Use</b>	<b>Advantage</b>	<b>Disadvantage</b>
		subsidence due to coal seam gas production.	selected location.
Tiltmeters	Measure changes in the slope of the ground on two orthogonal axes. Tilt is specified in terms of degrees or radians or vertical displacement over horizontal distance (for example, in units of mm/m).	1. Highly precise measurements. 1 nanoradian tilt of a line between Sydney and Perth is equivalent to a height change of ~4 mm. 2. The highly precise measurements of tilt allow for variations in subterranean gas/fluid reservoirs to be estimated, providing potentially useful information on the CSG activity being undertaken.	1. Tiltmeters do not measure surface subsidence directly; rather, the tilts must be integrated to derive surface movement. 2. Tiltmeters do drift with time. Thus, while the instantaneous precision can be as small as 1 nanoradian, some calibration of the instruments is required in order to maintain accuracy at this level. 3. Tiltmeters are relatively expensive. A network of ~40 tiltmeters to monitor a 500 x 500 m region would cost around \$36,000/month
Time domain reflectometry		Respond best to localised shear	TDR only measures ground movement that deforms the TDR cable. If the TDR cable settles uniformly, no movement will be detected by the TDR monitoring device

### 6. Methodology adopted to monitor ground subsidence in the present study

#### 6.1 Instruments used

The following instruments have been used during the monitoring of subsidence at different monitoring stations.

**Table2:** Instrument used for subsidence monitoring

Name of the Instrument	Least count	Accuracy
TOTAL STATION (SOKKIA CX-105)	1 mm	1 sec
AUTO LEVEL (LEICA NA700)	1 mm	1mm

## **Subsidence Monitoring at ESSAR Raniganj CBM Block at Durgapur [RG (E) –CBM-2001/1 Block]**

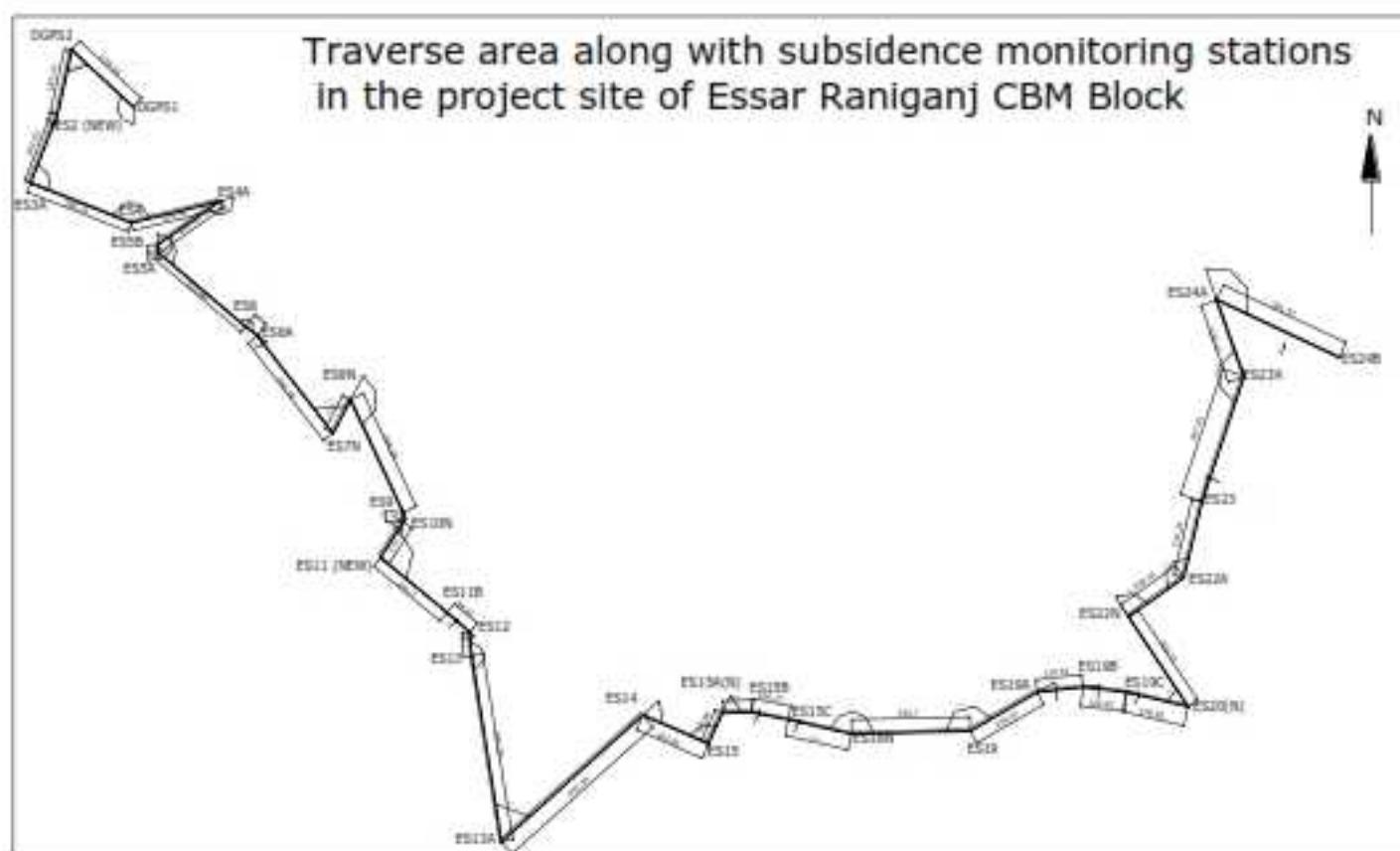
### **6.2 Traverse survey**

Traverse survey conducted from one pair of DGPS Control Pillar to another DGPS control pillar by using digital total station.

All computation complies with the following:

- ✓ Traverse adjustment by Bowditch Method
- ✓ Least square adjustment
- ✓ Use of latest programme & software

The figure below shows the traverse area along with monitoring stations in the project site



**Fig 1:** Map showing traverse area along with monitoring stations in the project site

### **6.3 Levelling works**

After completion of open traverse, precise levelling work was carried out at all the control stations (pillar). Auto Level instrument with 1 mm accuracy was used for levelling purposes. Equal fore sight and back sight distance was maintained as far as possible. The coordinate of DGPS1 and the bearing of baseline DGPS1-DGPS2 were used as initial survey data.

## **Subsidence Monitoring at ESSAR Raniganj CBM Block at Durgapur [RG (E) –CBM-2001/1 Block]**

### **6.4 Establishing Control Stations and Subsidence Monitoring Stations**

The phase-wise subsidence monitoring studies were conducted by measuring the ground elevation of all pre-established permanent control station near the well locations at the project site. The coordinates (X,Y, Z) of the stations were also checked. These control stations were found established by embedding and casting concrete pillars in the ground to a depth of at least 0.5 m. At some well locations, existing concrete cemented foundation blocks were selected and control points were marked on the block using the appropriate markers. Table 3 exhibits the identification marks and corresponding Station ID.

**Table 3:** Control station details

<b>Station No.</b>	<b>Location details</b>
DGPS1	BENCH MARK. BARREN LAND NEAR GGS-I
DGPS2	CULVERT OPPOSITE TO SCHOOL
ES2 (NEW)	CONCRETE PILLAR NEAR GGS-I ENTRANCE OLD SECURITY ROOM
ES3A	CONCRETE SMALL PILLAR NEAR SECURITY ROOM AT EDD009
ES4	CONCRETE SMALL PILLAR NEAR SECURITY ROOM AT EDD011
ES4A	CONCRETE SMALL PILLAR NEAR SECURITY ROOM AT EDD006
ES5B	CONCRETE PILLAR NEAR WATER TANK AT EDD011
ES5A	PAINT MARK ON EXISTING FOUNDATION NEAR DG SET AT EDD011
ES6	ANCHOR PILLAR NEAR WATER POND AT EDD010
ES6A	CONCRETE PILLAR NEAR BOUNDARY AT EDD010
ES7A	CONCRETE PILLAR NEAR BOUNDARY & GATE AT EDD003
ES8N	PAINT MARK ON EXISTING FOUNDATION OF EARTH PROTECTOR PIPE NEAR ROAD SIDE TOWARDS EDD003
ES9	CONCRETE SMALL PILLAR NEAR BOUNDARY AT ROAD SIDE NEAR NEAM TREE
ES10N	NAIL ON ROAD SIDE NEAR TEMPLE & BEDI
ES11 (NEW)	SURVEY PEG WITH NAIL AT ROAD SIDE NEAR TRANSFORMER
ES11B	KM MILESTONE PILLAR ROADSIDE LEADING TO KANTABERIA
ES12	BROKEN CONCRETE PILLAR AT ROAD SIDE NEAR ENTRY EDD004 (R/S)
ES13	EDD004
ES13A	EDD026
ES14	EDD012
ES15	ROAD SIDE CULVERT
ES15A( NEW)	KM MILESTONE PILLAR ROADSIDE KANTABERIA CHOWK
ES15B	ROAD SIDE RIGHT HAND CULVERT AFTER KANTABERIA CHOWK
ES15C	ROAD SIDE KM MILE STONE AFTER KANTABERIA CHOWK
ES18N	NEAR BOUNDARY WALL OF PLAYGROUND AFTER KANTABERIA CHOWK
ES19	EDD008
ES19A	PAINT MARK ON FOUNDATION OF PIPE LINE SIGN BOARD RIGHT SIDE ROAD AFTER EDD008
ES19B	PAINT MARK ON FOUNDATION OF EARTH PROTECTOR RIGHT SIDE ROAD AFTER EDD008
ES19C	PAINT MARK ON KM MILE STONE RIGHT SIDE ROAD AFTER EDD008

## Subsidence Monitoring at ESSAR Raniganj CBM Block at Durgapur [RG (E) –CBM-2001/1 Block]

ES20	EDD005
ES22N	IN FRONT OF EDD013 ON HIGH MOUND GROUND NEAR TEMPORARY SHED
ES22A	LEFT SIDE CULVERT NEAR WATER SETLING POND AFTER EDD013
ES23	EDD002
ES23A	CONCRETE PILLAR LEFT SIDE OF ROAD AFTER EDD002, BARREN LAND
ES24A	EDD018
ES24B	EDD025

### 7. Results

The R.L. (Elevation Z) as observed during the second phase (II) at the established control stations surrounding the well locations (DGPS1 to ES24) are given in Table 4 and Fig. 2. The photographs of subsidence monitoring study conducted at RG (East) CBM block are given in Annexure-1.

**Table 4:** Total Latitude, longitude and ground elevation at the control stations during January 2017

MEASUREMENTS/ SURVEY OF GROUND LEVELS & POSITION (X,Y & Z) AT THE CONTROL STATIONS IN THE PROXIMITY OF WELL LOCATIONS AND HABITANTS AT CBM BLOCK (ESSAR OIL LIMITED) (DATE OF OBSERVATION: JANUARY-2017)

DATE OF OBSERVATION: JANUARY-2017												
SL. NO	TRAVERSE POINT			OBSERVED ANGLE			DIST IN MTR.	TOTAL LATITUD E (Y)	TOTAL DEPART URE (X)	ELEVATIO N (M)	STATIO N ID	STATION LOCATION
	BACK STN.	INST STN.	FORE STN.	DE G	MI N	SE C						
								2613150.514	536100.280	-75.422	DGPS1	BRANCH MARK, BARREN LAND NEAR OGS-I
	DGPS1	DGPS2					235.92	2613500.157	530012.645	-76.265	DGPS2	CULVERT OPPOSITE TO SCHOOL
1	DGPS1	DGPS2	ES2 (NEW)	60	32	19	183.21	2613130.511	535975.094	-76.422	ES2 (NEW)	CONCRETE PILLAR NEAR OGS-I ENTRANCE OLD SECURITY ROOM
2	DGPS2	ES2 (NEW)	ES3A	189	9	21	204.93	2612940.432	535898.405	-75.780	ES3A	CONCRETE SMALL PILLAR NEAR SECURITY ROOM AT EDD009
3	ES2 (NEW)	ES3A	ES4	88	2	29	300.18	2612830.781	536184.313	-75.793	ES4	CONCRETE SMALL PILLAR NEAR SECURITY ROOM AT EDD011
4	ES3A	ES4	ES4A	145	37	33	239.51	2612880.846	536436.756	-77.174	ES4A	CONCRETE SMALL PILLAR NEAR SECURITY ROOM AT EDD009
5	ES4	ES4A	ES5B	338	2	11	214.72	2612780.882	536259.471	-75.388	ES5B	CONCRETE PILLAR NEAR WATER TANK AT EDD011
6	ES4A	ES5B	ES5A	132	38	1	21.11	2612748.628	536268.225	-75.388	ES5A	PAINT MARK ON EXISTING FOUNDATION NEAR DO SET AT EDD011

# Subsidence Monitoring at ESSAR Raniganj CBM Block at Durgapur [RG (E) –CBM-2001/1 Block]

DATE OF OBSERVATION: JANUARY-2017												
SL N	TRaverse Point			Observed Angle			DIST IN	Total Latitud	Total Depart	Elevation (m)	Station ID	Station Location
7	ES5B	ES5A	ES6	133	40	13	323.87	2612542.743	536508.304	75.579	ES6	ANCHOR PILLAR NEAR WATER POND AT EDD009
8	ES5A	ES6	ES6A	177	30	29	41.05	2612517.969	536541.633	75.607	ES6A	CONCRETE PILLAR NEAR BOUNDARY AT EDD010
9	ES6	ES6A	ES7N	194	20	1	344.43	2612248.586	536756.106	75.783	ES7A	CONCRETE PILLAR NEAR BOUNDARY & GATE AT EDD009
10	ES8N	ES8T	ES8N	98	50	49	108.28	2612341.126	536808.353	76.781	ES8N	PAINT MARK ON EXISTING FOUNDATION OF EARTH PROTECTOR PIPE NEAR ROAD SIDE TOWARDS EDD005
11	ES7N	ES8N	ES9	308	54	1	340.33	2612028.830	536956.398	76.726	ES9	CONCRETE SMALL PILLAR NEAR BOUNDARY AT ROAD SIDE NEAR NEAM TREE
12	ES8N	ES9	ES10N	208	22	24	26.37	2612002.384	536954.405	76.814	ES10N	NAIL ON ROAD SIDE NEAR TEMPLE & HEDDE
13	ES9	ES10N	ES11 (NEW)	208	37	18	117.17	2611980.426	536888.317	74.248	ES11 (NEW)	SURVEY PEG WITH NAIL AT ROAD SIDE NEAR TRANSFORMER (OLD PEG REMOVED, FIXED NEW SURVEY PEG)
14	ES10N	ES11 (NEW)	ES11B	98	11	36	241.75	2611752.047	537078.335	75.209	ES11B	KM MILESTONE PILLAR ROADSIDE LEADING TO KANTABERIA
15	ES11 (NEW)	ES11B	ES12	180	26	27	84.39	2611647.993	537144.173	74.885	ES12	BROKEN CONCRETE PILLAR AT ROAD SIDE NEAR ENTRY EDD004 (R.BI)
16	ES11B	ES12	ES13	225	16	9	66.06	2611632.197	537144.826	73.931	ES13	EDD004
17	ES12	ES13	ES13A	125	37	36	321.27	2611122.773	537231.878	74.851	ES13A	EDD026
18	ES13	ES13A	ES14	58	2	56	832.29	2611488.831	537634.232	76.875	ES14	EDD012
19	ES13A	ES14	ES13	244	17	49	210.79	2611386.176	537820.824	76.815	ES15	ROAD SIDE CULVERT
20	ES14	ES13	ES15A(N)	82	1	11	303.57	2611473.825	537800.502	76.121	ES15A(N) (EW)	KM MILESTONE PILLAR ROADSIDE KANTABERIA CHOWK
21	ES15	ES15A(N)	ES15B	243	3	11	82.41	2613476.684	537942.684	76.912	ES15B	ROAD SIDE RIGHT-HAND CULVERT AFTER KANTABERIA CHOWK
22	ES15A(N)	ES15B	ES15C	195	8	26	186.74	2613455.820	538047.556	76.895	ES15C	ROAD SIDE KM MILE STONE AFTER

# Subsidence Monitoring at ESSAR Raniganj CBM Block at Durgapur [RG (E) –CBM-2001/1 Block]

DATE OF OBSERVATION: JANUARY-2017												
SL N	TRAVERSE POINT			OBSERVED ANGLE			DIST IN	TOTAL LATITUD	TOTAL DEPART	ELEVATION (M)	STATION ID	STATION LOCATION
											KANTABERIA CHOWK	
23	ES19B	ES19C	ES19N	181	11	29	103.35	2611400.359	518228.426	81.309	ES19N	NEAR INBOUNDARY WALL OF PLAYGROUND D-AFTER KANTABERIA CHOWK
24	ES19C	ES19N	ES19W	166	17	32	336.74	2611423.871	538563.243	82.304	ES19	EDD008
25	ES19N	ES19B	ES19A	131	41	22	218.11	2611531.851	538732.871	80.438	ES19A	PAINT MARK ON FOUNDATION OF PIPE LINE SIGN BOARD RIGHT SIDE ROAD AFTER EDD008
26	ES19B	ES19A	ES19B	203	11	18	130.49	2611546.105	538882.583	78.409	ES19B	PAINT MARK ON FOUNDATION OF EARTH PROTECTOR RIGHT SIDE ROAD AFTER EDD008
27	ES19A	ES19B	ES19C	193	2	31	124.97	2611531.859	510006.705	81.309	ES19C	PAINT MARK ON KM MILE STONE RIGHT SIDE ROAD AFTER EDD008
28	ES19B	ES19C	ES20(N)	186	8	17	179.83	2611402.028	538181.216	80.259	ES20	EDD008
29	ES19C	ES20(N)	ES22N	42	89	21	301.09	2611748.713	530012.118	78.863	ES22N	IN FRONT OF EDD003 ON HIGH MOUNDED GROUND NEAR TEMPORARY SHED
30	ES20(N)	ES22N	ES22A	206	30	21	190.35	2611848.818	520168.780	78.657	ES22A	LEFT SIDE CULVERT NEAR WATER SETLING POND AFTER EDD003
31	ES22N	ES22A	ES23	138	23	26	216.21	2612058.839	519226.301	74.837	ES23	EDD002
32	ES22A	ES23	ES23A	185	12	83	367.03	2612405.850	531038.777	72.621	ES23A	CONCRETE PILLAR LEFT SIDE OF ROAD AFTER EDD002, BARREN LAND
33	ES23	ES23A	ES24A	149	54	32	228.12	2612617.264	538262.460	80.746	ES24A	EDD018
34	ES23A	ES24A	ES24B	314	43	16	381.39	2612488.189	530609.216	73.814	ES24B	EDD025

## Subsidence Monitoring at ESSAR Raniganj CBM Block at Durgapur [RG (E) –CBM-2001/1 Block]

**Table 5:** Total ground elevation at the control stations during June 2016

Sl. No.	Station ID	Elevation (M)
1	<b>DGPS1</b>	75.422
2	<b>DGPS2</b>	76.268
3	<b>ES2 (NEW)</b>	76.425
4	<b>ES3A</b>	75.383
5	<b>ES4</b>	75.796
6	<b>ES4A</b>	77.17
7	<b>ES5B</b>	75.384
8	<b>ES5A</b>	75.354
9	<b>ES6</b>	75.582
10	<b>ES6A</b>	75.605
11	<b>ES7A</b>	75.785
12	<b>ES8N</b>	76.783
13	<b>ES9</b>	75.726
14	<b>ES10N</b>	75.617
15	<b>ES11 (NEW)</b>	74.442
16	<b>ES11B</b>	75.211
17	<b>ES12</b>	74.683
18	<b>ES13</b>	73.935
19	<b>ES13A</b>	74.954
20	<b>ES14</b>	76.673
21	<b>ES15</b>	78.816
22	<b>ES15A(NEW)</b>	79.125
23	<b>ES15B</b>	79.912
24	<b>ES15C</b>	80.096
25	<b>ES18N</b>	80.811
26	<b>ES19</b>	82.502
27	<b>ES19A</b>	80.438
28	<b>ES19B</b>	79.408
29	<b>ES19C</b>	80.398
30	<b>ES20</b>	80.258
31	<b>ES22N</b>	79.688
32	<b>ES22A</b>	76.655
33	<b>ES23</b>	74.835
34	<b>ES23A</b>	72.023
35	<b>ES24A</b>	68.742
36	<b>ES24B</b>	73.811

## Subsidence Monitoring at ESSAR Raniganj CBM Block at Durgapur [RG (E) –CBM-2001/1 Block]

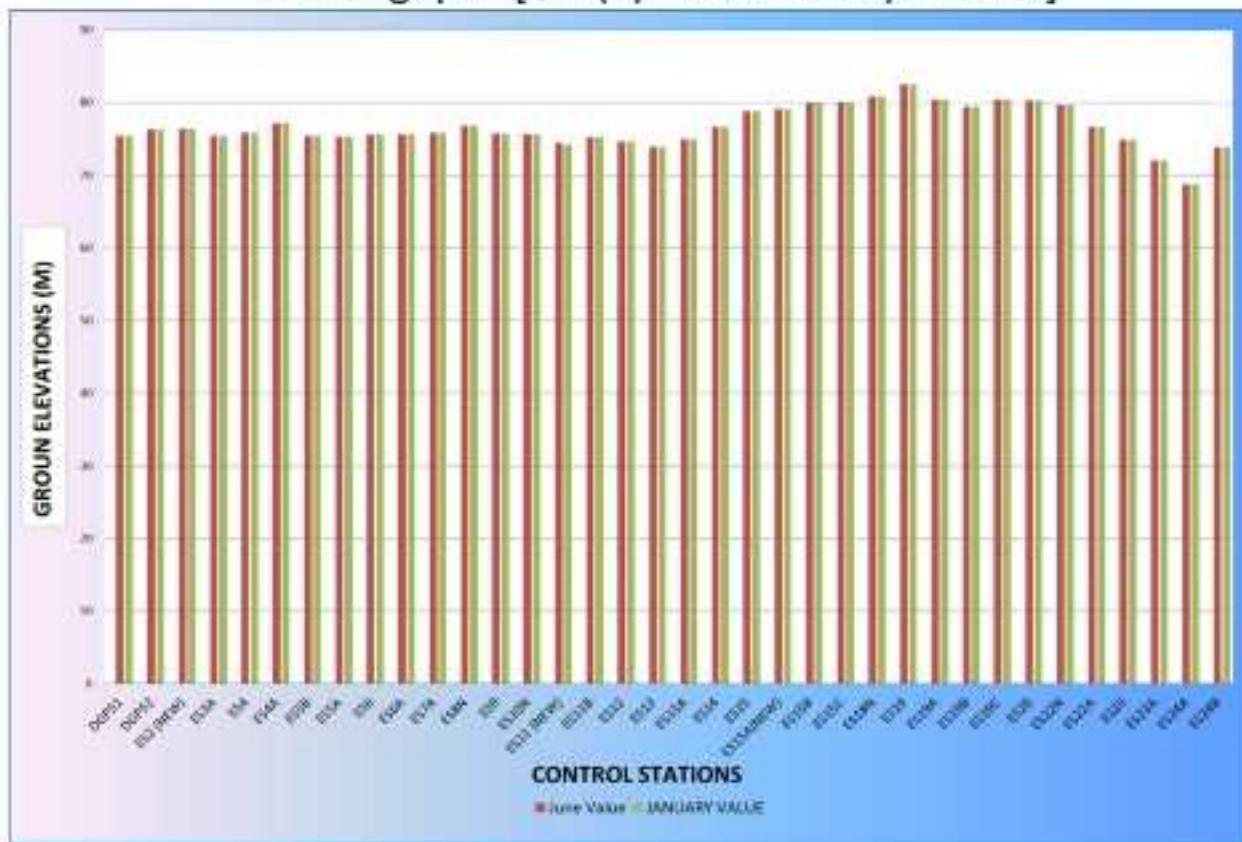


Fig.2: Ground elevations at control stations as observed during June 2016 vs. January 2017

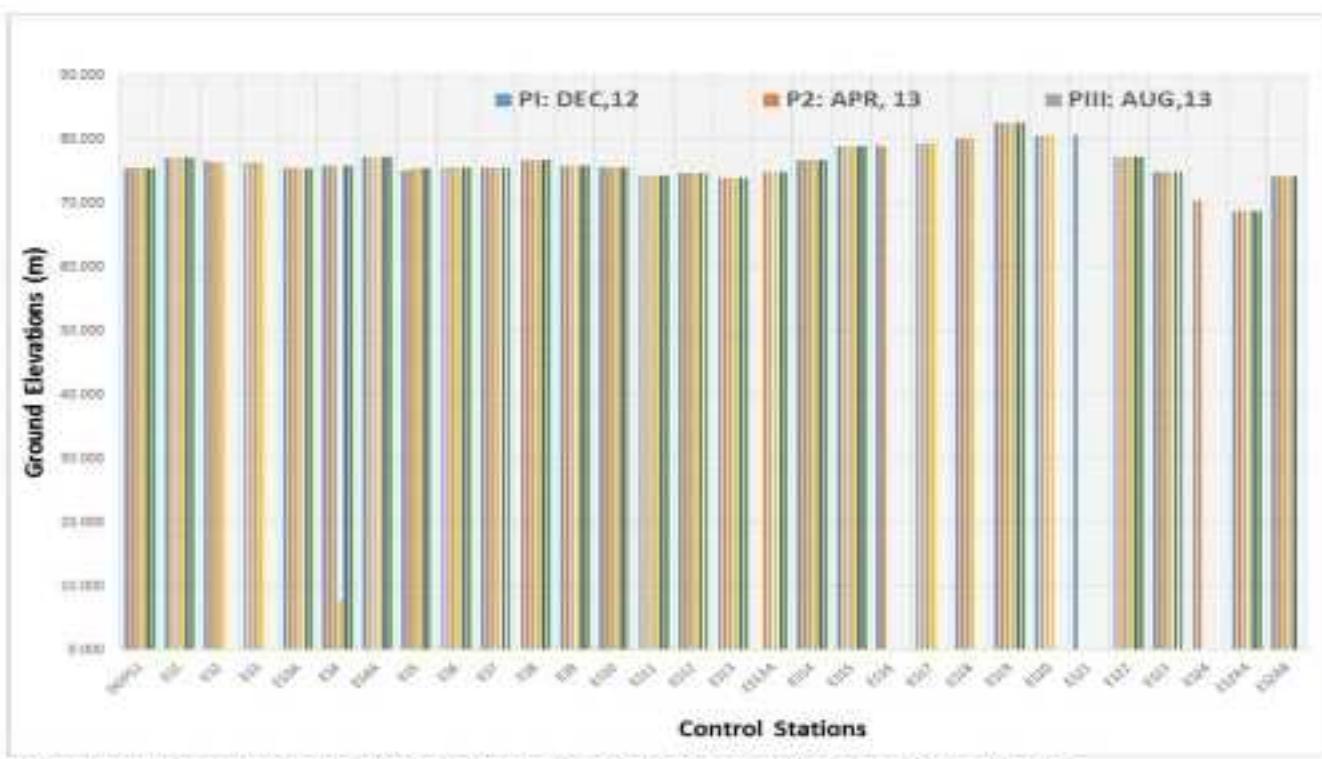


Fig.3.:Ground elevation at ESSAR Raniganj CBM Block during Dec,12 to May,15.

Source:- As per report of Department of Mining Engineering, Indian School of Mines, Dhanbad supplied by Essar Oil Limited (EOL).

## **Subsidence Monitoring at ESSAR Raniganj CBM Block at Durgapur [RG (E) –CBM-2001/1 Block]**

### **8. Conclusions and recommendations**

The R.Ls. (Elevation) of all the survey control points were measured during the present phases of subsidence survey with the precise auto level and also to be periodically monitored to examine the ground subsidence in the area due to compaction and collapse of overlying litho units as a result of continuous withdrawal of CBM gases. During the subsidence monitoring for nearing two and half years (December 2012 – May 2015) at CBM block conducted by Department of Mining Engineering, Indian School of Mines, Dhanbad and the studies (June 2016- January 2017) performed by National Institute of Technology Durgapur, no active subsidence were observed at the stations close to the CBM Gas well, plants side as well as at places of habitats.

The established control stations should be preserved carefully without causing any ground disturbance at the surroundings. However, during the study at the site, it was observed that few control stations were either disturbed or removed/broken. Therefore, suitable precautionary measures should be taken to preserve the survey stations from any external disturbances. A very careful preservation of control stations are required because subsidence study is a long term study and comparison of time series elevation data of each control station will depict the occurrence of subsidence, if any. Proper fencing arrangements surrounding the control stations along with sign boards displaying names of subsidence monitoring stations with their elevations are recommended to be provided at control stations. The already disturbed control stations are to be repaired prior to third phase of the monitoring study.

**Subsidence Monitoring at ESSAR Raniganj CBM Block  
at Durgapur [RG (E) –CBM-2001/1 Block]**

**ANNEXURE - 1**

**Subsidence Monitoring at ESSAR Raniganj CBM Block  
at Durgapur [RG (E) –CBM-2001/1 Block]**



**Plate 1:** Subsidence monitoring station at ES 12

## **Subsidence Monitoring at ESSAR Raniganj CBM Block at Durgapur [RG (E) –CBM-2001/1 Block]**



**Plate 2:** Subsidence monitoring station being established at ES 6A

**Subsidence Monitoring at ESSAR Raniganj CBM Block  
at Durgapur [RG (E) –CBM-2001/1 Block]**



**Plate3:** Subsidence monitoring station being established at ES 13

**Annexure VIII**

Environmental Expenditure of CBM Raniganj Project by Essar Oil and Gas Exploration and Production Limited  
 Compliance Period: Apr'17 to Sep'17

Expenditure towards Environmental Protection Measures at Raniganj CBM Project April,2017 - Septembe, 2017)		(Period
SI No	Particular	Expenses (in Rs)
1	Installation of Reverse Osmosis Treatment System for Produced Water Treatment and METP unit for liquid waste treatment at Drill Site (Capital & Recurring)	5,83,00,000.00
2	Environmental Monitoring Activities (Recurring)	7,96,077.00
3	HDPE liners for drill cuttings storage & disposal (Capital)	22,93,815.00
4	Non Hazardous Waste Disposal (Recurring)	5,88,266.00
5	Hazardous Waste Disposal (Recurring)	2,06,563.00
6	CSR Activities (Recurring)	20,85,036.00
7	Third Party HSE Audit	2,00,000.00
<b>TOTAL</b>		<b>6,44,69,757.00</b>