Executive Summary

Block No: AA-ONHP-2017/4

Prepared For:

Vedanta Limited

(Division: Cairn Oil & Gas)

Prepared By:

AECOM India Private Limited

Executive Summary

Introduction

Vedanta Ltd. (Division: Cairn Oil & Gas), formerly known as Cairn India Ltd., has been allocated the hydro-carbon Block AA-ONHP-2017/4 by Government of India under the Revenue Sharing Contract (RSC) for exploration and exploitation of hydrocarbons. Revenue Sharing Contract (RSC) was signed between the Government of India (GoI) and Vedanta Ltd on 1st October 2018. The proposed Block encloses an area of 839 sq. km. in Jorhat District of Assam and Wokha and Mokokchung districts of Nagaland.

Vedanta Limited (Division: Cairn Oil & Gas) proposes to carry out exploration and appraisal wells drilling and early production of oil and associated natural gas in the Block. In case of discovery (ies), the exploratory and appraisal well(s) would be tested for extended duration by flowing hydrocarbons to ascertain the reservoir parameters and assess the quality and commercial viability. The exploratory and appraisal wells would be drilled to explore the reservoirs in the range of 1750m to 5000m.

The proposed exploratory and appraisal drilling activities fall under category 1(b) of the EIA Notification, 2006 and its subsequent amendment and require Environmental Clearance (EC) from the Ministry of Environment and Forests and Climate Change (MoEF&CC). The Terms of Reference for the Project have been approved by MoEF&CC vide letter File No. IA-J-11011/93/2019-IA-II(I) dated 18th April 2019.

AECOM India Private Limited, a NABET-QCI accredited firm has been entrusted to conduct the Environmental Impact Assessment (EIA) for the proposed Block AA-ONHP-2017/4. The EIA study comprised of initial scoping, site visits, environmental monitoring and surveys, conduct of Public Hearing (PH) and the preparation of draft and final EIA-EMP reports.

Block location and Accessibility

AA-ONHP-2017/4 block is located in Jorhat District of Assam and Wokha and Mokokchung districts of Nagaland, with an area covering of 839 sq. km. Vedanta Limited (Division: Cairn Oil & Gas) proposes to drill 29 exploratory and appraisal wells and all exploratory operations will be restricted within the block area situated within the Jorhat district of Assam and, not extending to the Wokha and Mokokchung districts of Nagaland.

The major connectivity of the block is NH 715 (Assam Trunk Road and the By-Pass Road), SH 31 (Gar Ali Road or Jorhat to Mariani Road), SH 32 (Na Ali Road), SH 33 (KB Road), these connects the major cities within the block viz. Jorhat City with Cinnamora, Mariani and Titabor. Motorable access roads are there within the block to connect the internal areas where the proposed well sites are located. North-East Frontier Railway and Jorhat Airport establishes accessibility within the block area.

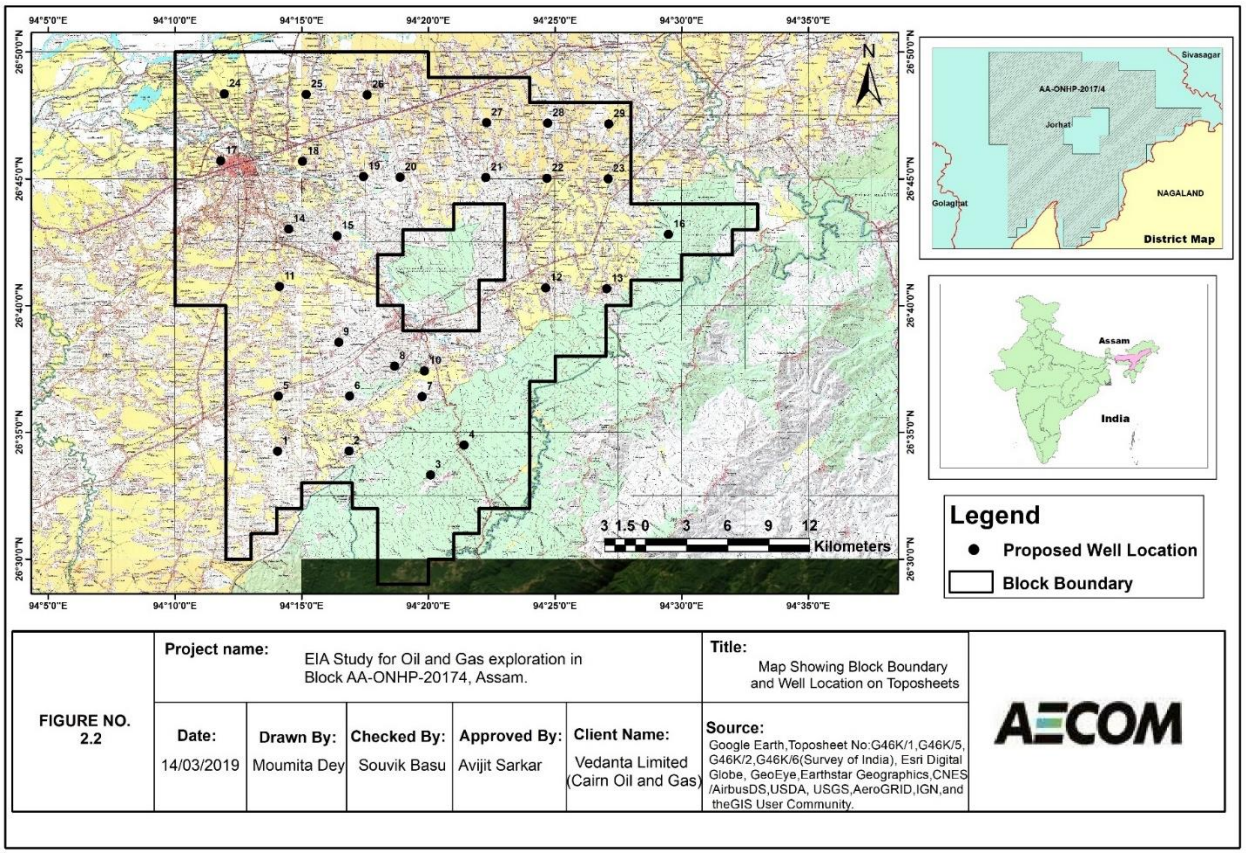
Land Requirement

During the site selection process, all legal requirements would be considered and surface location of the exploratory well would be finalized. Once surface drilling location is finalized, short term lease of the land would be taken from concerned owners. If well location falls in agricultural lands, tea gardens or other private lands, land and crop compensation would be provided to the land owner, and in case of govt. land, land allotment from Govt. to be applied. Initially temporary short-term lease would be taken for 3 - 5 years for exploration purpose and in case of commercially viable discovery of hydrocarbon resources; the land

lease would be converted into long term lease up to life of the project. The estimated land required per drill site is approximately 9ha. Total 15918 ha, reserved forest area is located within the AA-ONHP-2017/4 block however none of the proposed well location is located within forest land.

Description of the project

The Proposed project includes drilling of 29 nos. of onshore exploratory and appraisal wells and setting up of Early Production Units (EPUs)/ Quick Production Units (QPUs) for produced well fluid processing and production of up to 12000 BOPD crude oil and up to 2.4 MMSCFD associated natural gas.. Block Location on SOI Toposheet is presented below.



Drill Site Preparation

Drill Site Selection

An initial assessment of the exploratory well site would be carried out through analysis of satellite imageries. Field surveys would be carried out to earmark the drill site location maintaining maximum possible distance from any settlement and sensitive receptors. Ease of accessibility to the site would also be considered.

Site Preparation

Detailed site surveys would be carried, and the boundary of the drill site to be earmarked. Site levelling, and excavation works would be carried out for site preparation. Individual sites would be duly fenced. New approach roads to drill sites would be constructed or existing village roads would be strengthened to provide access for the drilling equipment and machinery. If the earmarked site has vegetation cover, clearance of vegetation is the first activity that would be undertaken during drill site construction.

Following this, the preparation and construction of drill site would involve top soil scraping and storage for future use, elevating the drill platform by excavated material from the drill site and authorized quarry area. Reinforced Cement Concrete (RCC) platforms would be used as foundation for drill pad and all other heavy equipment systems or machinery. Cast in-situ bored under-reamed piles of specified lengths would be used as foundation for main rig structure.

Additionally, there will be other ancillary facilities of a Drilling mud system, Effluent Treatment Plant (ETP), Cuttings disposal, Drill Cementing equipment along with utilities to supply power (DG sets), water and fuel (HSD) and provision of proper garland drains for storm water with sufficient gradient.

Rig Mobilization

After completion of the construction activities and with the provision of the basic facilities, drill rig would be transported to the site. The drill equipment is designed as Standard Land Rig or a Mobile Land Rig type, which facilitates quick mobilization and de-mobilization.

Drilling Operation

A rig would be installed at the potential site of drilling after thorough inspection for its working capability and quality standards. Well spudding shall be the start of drilling activity. Wells would be drilled in sections, with the diameter of each section decreasing with increasing depth. Before commencing the actual drilling, large diameter pipe (Conductor) would be lowered into a hole and cemented/grouted. Top-hole section would be drilled to a desired depth based on well design. After drilling top-hole section, it would be cased with a pipe called “Casing”. Once each section of the well is completed, the drill string is lifted, and protective steel pipe or casing lowered into the well and cemented into place. The lengths and diameters of each section of the well would be determined prior to the starting of the drilling activities and are dependent on the geological conditions through which the well is to be drilled. This process of drilling and casing the hole section continues until the final well depth (target) is achieved.

Drill cuttings generated from the drilling activity, would be collected and separated using a solid control system and temporarily stored on-site in HDPE lined pits. Drilling and wash wastewater generated would also be stored at an onsite HDPE lined pit. The water would be adequately treated in a mobile ETP to ensure conformance to the S No. 72 A (ii) Schedule I - Standards for Emission or Discharge of Environmental Pollutants from Oil Drilling and Gas Extraction Industry of CPCB.

Hydraulic Fracturing Activity

Hydraulic fracking may be conducted in wells with low permeability formation and the wells with low pressure. Fracking fluid would typically be 99% water and sand (or other granulated material) and approximately 1% gelled chemicals that would be pumped at a high rate (in excess of 20 bpm) and high pressure (up to 5000 psi) to fracture the formation and improve the well deliverability. Sites for the wells with more than 2 fracs per well (multi-stage fracturing) would have provision of additional space for water storage for better continuity of operations.

Well Testing & Flaring

During the exploration and appraisal drilling, where a hydrocarbon formation is found, initial well tests (generally about one month of duration) would be carried out to establish flow rates, formation pressure and other parameters. However, depending on the need, based on nature of the reservoirs, the exploratory and appraisal wells would be tested for longer/extended durations to ascertain the reservoir parameters.

Associated Facilities

Each drill site would be provided with facilities such as drilling rig foundation and cellar pit, waste and water storage pits, chemical storage area including fuel storages, drill cutting disposal pit, flare pit and mobile STPs. The drill cutting and spent mud disposal pits would be provided with a HDPE lining for temporary storage. Adequate drainage and wastewater conveyance system also would be installed.

Liquid Mud Plant (LMP)

The Liquid Mud Plant (LMP) shall be located at suitable locations of the fields to prepare synthetic/ water-based mud for the drilling operations. Water Base Mud (WBM) will be used as drilling fluid for initial, shallower sections where massive shale not encountered. The deeper and difficult to drill geological formations will be drilled using Synthetic Base Mud (SBM) as drilling fluid.

Appraisal

When, exploratory drilling is successful, more wells (termed as Appraisal wells) would be drilled to determine the size and the extent of the field. The technical procedures and activities in appraisal drilling would be the same as those employed for exploration wells Deviated or directional drilling at an angle from a site adjacent to the original discovery well may be used to appraise other parts of the reservoir.

Quick Production Unit (QPU)

In case of commercially viable discovery, QPUs would be installed for the processing of produced well fluid processing and early production of up to 12000 BOPD crude oil and up to 2.4 MMSCFD associated natural gas. A QPU would be a packaged/ modular mobile unit and would mainly consists of a three-phase separator & production heater or heater-treater, oil storage tanks, oil tanker loading system, produced water (PW) separation and disposal system, power generation (GEG or DG), utility systems such as fuel gas, flare & Inst. Air packages, firefighting equipment, etc. Each QPU capacity would be ~2,000 BFPD (Barrels of Fluid per Day).

Accommodation and Camp Site

Temporary camp site (porta cabin) for the drilling of exploratory (including) appraisal wells are envisaged, which would be dismantled after drilling of the wells. At any point of time, it is anticipated that about 50 personnel per shift would be housed in the campsite during the well drilling campaign.

Well decommissioning

After completion of the drilling activity, partial de-mobilization of the drilling rig and associated infrastructure would be initiated. As discussed earlier, well testing may be carried out immediately after the drilling has completed. The complete de-mobilization of the facilities at site would be undertaken after well-testing has completed successfully. in case of commercially viable discovery (s) of hydrocarbons in the Block and having established the size of the hydrocarbon field (s), proposes to immediately bring the field (s) into production using one or more of the appraisal wells for the production of crude oil by setting up of QPU (Quick Production Unit). All other equipment, materials, fuel and wastes would be removed from the drilling site and reused for other drilling activities or disposed as per the applicable regulatory requirements.

If hydrocarbon is not found, a full abandonment plan would be implemented. All concrete or steel installations would be removed to at least 1m below ground level, to ensure that there would be no protruding surface structures. All waste at the site would be removed and the pits would be closed. The

drill sites and associated sites (for camps and liquid mud plant) would be restored to its original conditions or as required by the landowner.

Utilities and Resource Requirement

Water – Total of 102 m^3 per day fresh water would be required per well. From the total water, 22 m^3/day water would be used for mud preparations, 50 m^3/day would be required for drilling activities and 30 m^3/day freshwater would be used for domestic purposes including drinking, washings and domestic use. The water requirement for all the project activities would be sourced locally through approved/authorized sources of surface water and/or ground water (e.g. PHD bore wells, privately owned bore wells, irrigation Department/water resources Dept. Of State Govt.). In case, required water would not be sourced locally available approved sources, ground water will be extracted after obtaining permission from CGWA/State Govt.

During early production, for each typical EPU/QPU unit water requirement for process, domestic consumption, green-belt and miscellaneous use would be15-18 m^3/day.

Power – For a drilling operations site, the power would be provided through diesel generator (DG) sets (Camp site - 2x350 KVA (including one as standby), Drilling site - 3x1000 KVA (including one as standby) or 2X1850 KVA (1 Working + 1 Standby) depending on the rig capacity / availability during E&A drilling phase as per rig requirement and Radio Room -2*x100 KVA (including one as standby).

Labour– It is anticipated that, at any given time, there would be about 80 - 100 personnel working on site including technical staff, drilling crew, security staff etc.

Project Cost

The cost of the project has been estimated to be about INR 728 Crores.

Pollution Sources

Air emissions: Point source air emissions would be generated from DG sets. Fugitive emissions would occur from vehicles involved in the drilling operations, re-suspension and from wind-blown dust from storage and staging areas within the drill site.
During early production stage emissions would be generated from GEG/DG sets and flaring

Noise & Vibrations: Noise and vibration would be generated due to operation of drilling rig, DG sets and vehicles.

Liquid wastes: During the drilling phase, approximately 30-40 m^3 per day of waste water would be generated from the drilling activity and 16-25 m^3 per day of domestic waste water would be generated from each drill site. During early production stage produced water would be generated which would be properly treated.

Drill cuttings & spent mud: Produced water (Waste Water) for Early Production is approximately 500-1500 tons/well of drill cuttings from WBM, 250-500 tons/well of drill cuttings from SBM and 250-500 tons/well of spent mud would be generated per site.

Existing Baseline Environment of the Project Area

Baseline information about the Block was collated by review of other published literature, site surveys, stakeholder interactions and primary monitoring carried out during the period of March-May 2019 by Mitra S. K. Private Limited (NABL Accredited Laboratory).

Geology

Upper Assam Basin is a proven petroliferous basin which represents the passive continental margin that evolved simultaneously with other east coast basins of India concomitant with rifting, followed by drifting of the Indian Plate from eastern Gondwanaland and its subsequent subduction underneath the Burmese and Eurasian plates. Gondwana sediments of Early Permian and Early Cretaceous Age are locally confined between the Tertiary succession and granitic metamorphic basement. In general, the district of Jorhat is covered by alluvium deposited by the river Brahmaputra and its tributaries. The older alluvium mainly of the Pleistocene period (less than 1 million years) consists of reddish to brownish sandy clay with coarser particles of sand and newer alluvium consists of sand, silt and clay along the plains of the Brahmaputra River. There is only a thin strip along the eastern boundaries of the district, where rocks belonging to Tipam groups of sedimentary rocks of Tertiary period consists mainly of coarse to gritty, ferruginous sandstones and shales is observed.

Jorhat District is underlain by unconsolidated alluvial sediments of the Quaternary age, which is classified into older and younger alluvium. The Older alluvium occupies the upland areas with sediments of oxidized and relatively compact nature, while the Younger alluvium occurs along the low-lying tracts of the area along the river courses. The southern part of the district, adjacent to the Naga hill range is covered by surficial blanket of clay, belonging to Younger alluvium which is derived from the adjacent hills and are composed of the rocks of Tertiary age.

Topography

The plain terrains of the Jorhat district slopes from east to west with the gradient varying at the rate of 1: 1000 meters. The elevation of the flood plain area ranges from 80 to 90 m above MSL while, the central upland area is 95 to 110 m above MSL. The altitude of the hills in the southern and eastern parts of the district is up to 312 m above MSL, with a general trend of NE-SW and at places is N-S. The major portion of the block lies in the plains, with elevation below 200m above MSL. The southern and a minor portion on the eastern side of the project area, has an altitudinal variation of 201 to 400 m above MSL.

Drainage

The study area is included within the catchment of the River Brahmaputra, nearest bank of the river being situated outside but close to the block boundary on the extreme north-western vertex of the block. The Bhogdai River (also known as Desoi River) originates from Long Samtang of Mukokchung (Naga Hills) and then flows E-W from the foothills of Assam-Nagaland border and traverses diagonally from South-East to North-West of the project area in the plains of Assam, and joins River Brahmaputra, forming a sub-parallel type of drainage system. The river being highly meandering in nature and sudden changes in courses cause the flood havocs.

Hydrogeology

Jorhat District is underlain by unconsolidated alluvial sediments of the Quaternary age, which is classified into older alluvium (upland tract) and younger alluvium (low-lying tract). Ground water occurs under water table under semi-confined conditions in the near surface and in the deeper horizon under semi-confined to confined conditions. Depth to water level in the water table zone varies from 3.79 to 8.32 m bgl in the pre-monsoon period and 0.50 to 4.26 m bgl during post-monsoon period. In the vicinity of Brahmaputra

River, five to six aquifer systems and in southern parts the system fades due to mixing of finer particles of sand and clay. Throughout the district, varied thickness of clay beds overlying and underlying the aquifer system exists with local variation in the existence of very limited thickness of sand beds mixed with clay performing as conduits of ground water is also observed.

Groundwater Quality

Total 9 nos. of ground water samples have been collected and analysed for parameters as per IS: 10500:2012 standards. The colour of the samples was found <1 hazen unit and with agreeable odour. The pH of water samples ranged from 6.35 to 7.8. Turbidity of all the samples varied from <0.1 to 207 NTU. The TDS in the water samples varied from 54 mg/l – 260 mg/l . The total alkalinity of the samples varied from 26 to 240 mg/l which falls within their corresponding permissible limit of 600 mg/l. Total hardness of the samples varied from 19 to 198 mg/l and was within the permissible limit of 600 mg/l. The concentrations of heavy metals such as Aluminium, Manganese, Nickel, Copper, Zinc, Arsenic were below their corresponding permissible limit. Cadmium, Mercury, Lead and other parameters like Residual Chlorine, Cyanide, Hexavalent Chromium, Phenol, Total Phosphorus, Free Ammonia, Cyanide, polychlorinated bi-phenyls, PAHs were found to be below detection limit. Presence of iron has been detected ranging from 5.8 to 39 mg/l, more than the permissible value 0.3 mg/l. E-coli and Fecal coliform were found to be absent and no pesticides were detected.

Surface Water

Total 9 nos. of samples were collected to analyse the surface water quality, by comparing with the CPCB Water Use Criteria and justifing their use in compliance with the same. The pH of the water ranged from 5.6 to 7.35 and the dissolved oxygen content was reported to be ranging between 5.9 to 6.4 mg/l. The BOD and COD was found to range between 2.2 to 4.2 mg/l and 7.7 to 31 mg/l respectively. Total coliform content was reported to be varying from 14 – 220 MPN/100 ml and fecal coliform was detected across all sampling locations except at SW7. TDS and total hardness concentration ranged from 46 to 192 mg/l and 15 to 123 mg/l. Concentration of metals (PB, Hg, Cd, Cr^{+6}), phenol, arsenic was found to be below detection limit. From the parameters reported it was observed that water samples were suitable for "B" class of water, i.e. Outdoor bathing. The analysed parameter concentration also revealed that all the samples simultaneously complied to the CPCB Class D i.e. Propagation of Wild life and Fisheries.

Climate and Meteorology

As per CGWB Report for Jorhat District and the Indian Meteorological Department (IMD), Climatological Normals (1971-2000) of North Lakhimpur (which is the nearest weather station, located 46 km to the North-West from the proposed well location), the monthly maximum and minimum temperature is experienced in August (36°C) and January (5.4°C). The mean relative humidity for day time and night time was recorded as 52.3% and 29% respectively. The maximum relative humidity is observed during the monsoon months (June to September). It was observed that the rainfall in the area ranged between 1581.2- 2129.2 mm as per the five-year district rainfall data of IMD (2014-2018).

Ambient Air Quality

Ambient air quality was monitored at 9 nos. of locations (for a period of 3 months - March to May'19). PM_{10} concentration in the study area varied from 51.55 µg/m^3 to 72.90 µg/m^3. The highest (81.60 µg/m^3) and lowest (38.70 µg/m^3) concentration was observed for the monitoring location at Dholi Village (AAQ9). The $PM_{2.5}$ concentration varied from 26.95 µg/m3 to 40.10 µg/m3 with the maximum and minimum concentration of 56.50 µg/m3 and 17.90 µg/m3 was observed for AAQ9 (Dholi Village). NOx, SO_2, and NH_3, values were in the range of 20.45 µg/m3 to 30.85 µg/m3, 0 µg/m3 to 7.30 µg/m3, 0 µg/m3 to 15.42 µg/m3 respectively. The concentration of the measured parameters are observed to be within the National

Ambient Air Quality Standards (NAAQS). Other parameters such as Pb, CO, Benzene, VOC, HC (as non-methane), Ni, As and [Ba(p)] were observed to be below their detectable limits.

Ambient Noise Levels

Noise levels were monitored at 9 locations within the study area. The monitoring locations for noise levels were selected on the basis of locations of sensitive receptors such as health centre, educational centres, market place etc. The equivalent noise level is observed to range between 53.85 - 62.85 dB(A) at day time and between 41.81-47.66 dB(A) at night time. The equivalent day time noise values exceeded Ambient Air Quality Standards in respect of Noise for day time residential areas, except for NQ9. The equivalent night time noise values in all the locations were complying to the night time standard of 45 dB(A) for residential areas.

Soil Quality

Soil samples were collected from 9 nos. of locations. The pH was reported to range in between 4.16 to 6.1 which indicated the soil characteristics to vary from slightly acidic to extremely acidic. The texture of the soil was observed to vary from sandy loam to loam except for SQ2 and SQ3 where clayey loam and clay was reported respectively. The soil in general indicated low permeability characteristics with average permeability of 2.6 cm/min. the lowest permeability was observed at SQ3 (0.19 cm/min, clay soil). The EC values in the study area ranged between 23 and 116 µs/cm. The reported Available Nitrogen, Phosphorus and Potassium concentration was reported to range between 784.7 – 2800 kg/ha, 375.5 to 1062.5 kg/ha and 654.9 to 1612.5 kg/ha respectively; when compared with the rating chart, nutrient status of the soil is observed to be high. Metal contamination was not observed.

Ecology

Ecology and Biodiversity Survey was conducted in the study area. Total 13 transects, 27 quadrats, 6 PBZ locations and 6 primary productivity sampling locations were selected within the block based on topography, land use, habitat and vegetation pattern. For assessment of floral species, quadrats of size 10m x 10m for trees, 5m x 5m for shrubs and 1m x 1m for herbs were plotted and qualitative and quantitative analysis of the same was carried out. Faunal species were assessed by transect method by traversing a known distance and noting observed faunal species along the length. The different habitats observed were forest, scrubland, wetlands, agricultural fields, tea estates. The floral diversity was high, 51 trees, 20 shrubs, 63 herbs, 4 climbers and 4 aquatic plant. Simpson's and Shannon's index indicate medium to high biodiversity – with respect to the flora. Shannon's index value varied from 0.63-2.85, whereas Simpson's index value varied from 0.459 - 0.944.

Socio- Economic Conditions

A total number of 29 villages are in the core zone area, where the proposed well sites are located. According to Census of India, 2011, the average household size was found to be 4.6 which is comparable to the Jorhat district average (4.3) and Assam state average (4.5). The sex ratio of the core zone villages was found to be 931 females per 1000 males, which is in close compliance with the sex ratio of Jorhat district (962) and State of Assam (958). The literacy rate was observed to be 81.3 % which marginally lower than the literacy rate of Jorhat district (82.1%) and significantly higher than that of State of Assam (73.18%). The working population within the core zone villages comprises of 44.9% of the total and the remaining constitutes the non-working population. The working population is categorised as Cultivators, Agricultural Labourers, Household Industry Workers and Other Workers, which comprises of 29.3 %, 10.7%, 6.3% and 53.8% respectively of the total working population in the 32 core zone villages.

Impact Assessment and Mitigation Measures

Site Selection & Land Procurement

Impact

An area of approximately 300m X 300m would be taken on temporary short-term lease basis for the construction of well pad (drill site) for exploratory and appraisal wells and the Quick Production unit/ Early Production unit. For the preparation of suitable access roads connecting to well pads, accommodating OHL and other utilities in future, a width of 30m (approx.) RoU would be required. The drill sites are planned to be located in the proposed drill sites are located in tea gardens, agricultural lands and homestead plantation areas. Their procurement for project purposes would result in loss of landowner's income for the lease period. The site selection, procurement of land on lease and well site restoration the severity of impact is considered to be medium, extent is categorized as low and the duration of this impact will correspond with the project life i.e. medium impact. Considering these factors in terms of the area of the block, it is marked low on the scale of impact significance.

Mitigation Measures

- During the construction of the access road adequate cross drainage structures to be provided considering the topography of the alignment.
- Levelling and grading operations would be undertaken with minimal disturbance to the existing contour, thereby maintaining the general slope of site;
- The excavated material from the drill site should be stored (temporarily /permanently) in uncultivated land and should be away from any drainage channel.

Site Clearance and Grading

Impact

The site preparation works at campsite and drill site may result in clearance of vegetation, dust generation and loss of topsoil. The earthworks to be carried would typically involve excavation, levelling / grading; and rolling and compaction.

Mitigation Measures

- Water sprinkling to be carried out, while working in proximity of agricultural fields or settlements/habitations;
- Runoff from drill sites shall be channelized properly;
- If any tree felling is involved, permission from the concern department to be undertaken.

Construction/Site Preparation of Drill Site/Well Pad

Impact

Construction of cellar pit, water storage pit and drilling waste storage pits would result in excavation of soil from each site. Noise from construction activity would be generated from bull dozer, DG sets and concrete-mixing plant.

Mitigation Measures

- Temporary storage sheds to be provided for storing of construction material such as cement;
- Excavated soil to be used for construction at other project sites;
- Detailed Health & Safety Plan to be provided to all civil contractors, as part of their contract with Vedanta Limited (Division: Cairn Oil & Gas).

Campsite Installation

Impact

The campsites would be located in the vicinity of the drill site. A typical campsite would require portable cabins to accommodate about drilling crew and the contractor personnel. Installation of porta-cabins with associated facilities would involve Health and Safety issues pertaining to transportation, loading - unloading of cabins and installation of cabins.

Mitigation Measures

- Crane to be is equipped with a legible, durable load chart that shows the manufacturer's recommended load configurations and maximum load weights; and
- Surface conditions to be examined prior to movement of crane.

Transportation of Drilling Rig and Other Components –

Impact

Transportation of drilling rig, drilling equipment, materials and manpower would involve movement of about trailer loads spread over days use the existing roads till they reach the access road for each well site. The potential impacts may include congestion of roads, wear and tear of existing roads and oil leaks from vehicle maintenance areas.

Mitigation Measures

- Movement of rig & associated machinery to be avoided to the extent possible during peak traffic hours
- All vehicles (light, medium and heavy) to be required to have valid PUC (Pollution under Check) certificate.
- Periodic maintenance of all project vehicles and machinery to be carried out.

Drilling and Well Testing

Impact

During drilling operation Water for WBM preparation would be 600 to 1000 m^3/Well, for SBM preparation would be 150 to 300 m^3/Well, for drilling water consumption would be 30-50 m^3/day/well and water for domestic use would be 20-30 m^3/day/well. During Early Production

Mitigation Measures

Water requirement for all the project activities would be sourced locally through approved/ authorized sources of surface water and/ or ground water (e.g. PHD bore wells, privately owned bore wells, Irrigation Dept./ Water Resources Dept. of State Govt.). In case, required water could not be sourced from locally available approved sources, ground water would be extracted after obtaining permission from CGWA/ State Govt.

Handling, transport and storage of Chemicals and wastes

Impact

The drilling operations would involve generation of spent drilling mud, drill cuttings, waste oil, used containers, etc. The drill site would also involve storage of hazardous chemicals and fuels which has the potential to contaminate soil and groundwater.

Mitigation Measures

- Separate drill cutting disposal pits to be provided for WBM and SBM

- Drill pits to be provided with HDPE lining on bottom and side surfaces
- The drill cuttings from the drilling operations associated with water-based mud would be used for filling low lying areas as a sub grade construction material in construction of well pads, etc.,. Synthetic base mud would be re-used.
- Used hazardous chemical barrels and waste oil to be sent to SPCB authorized vendors
- Fuel tanks to be provided with secondary containment facilities and maintained as per statutory requirements.
- All mixing tanks and chemical storage area to be paved and provided with secondary containment.

Air emissions

Impact

The drilling activities would lead to emissions during operation of diesel generator sets and flaring activities during well testing. Fugitive dust emissions from the proposed project would be principally associated with emissions during site preparation and primarily due to handling and transportation of fill material and re-entrainment of dust during movement of the vehicles on unpaved roads. During Early Production emission from DG,GEG and Flaring is also envisaged.

Mitigation Measures

- DG set emissions shall be as per CPCB standards In case of ground flaring to minimize the effects of flaring, the flare pit would be designed as per the CPCB/MoEFCC guidelines.In case of elevated flaring system : Elevated flare system would be adopted, with adequate height;
- Location of the flare stack would be decided at the design stage taking into consideration nearest habitations, vegetation, public amenities or any sensitive locations
- Efforts would be made to avoid flaring of crude and crude oil would be effectively separated at the drill site and stored in barrels/tankers for transportation to the nearest terminal for management; and

- Carry out regular water sprinkling at the site during dry season especially during the construction / site preparation and decommissioning activities;
- Proper handling of materials to ensure minimal emission of dust.
- Movement of construction vehicles will be minimised, and a limited speed will be enforced along the access and approach roads;
- All diesel-powered equipment will be regularly maintained, and idling time reduced to minimise emissions;
- Low sulphur diesel will be used in diesel powered equipment;
- Vehicle / equipment air emissions will be controlled by good practice procedures (such as turning off equipment when not in use);
- No cold venting of natural gas would be resorted instead flaring would be done with combustion efficient elevated flare tip; and
- Location of flare stacks to be selected considering the sensitive receptors adjoining the site

Noise Generation

Impact

The noise generation sources would include DG sets, pumps for rig, mud-pumps, control room and quarters and other miscellaneous equipment.

Mitigation Measures

- Installation of adequate engineering control on equipment and machinery (like mufflers & noise enclosures for DG sets and mud pumps) to reduce noise levels at source, carrying out proper maintenance and subjecting them to rigid noise control procedures.
- Providing Personnel Protective Equipment (PPEs) like ear plugs/muffs to workers at site.
- The DG set would be designed with acoustic enclosure and noise conformance labelling as per CPCB standards.
- Periodical monitoring of noise level within buffer area around well pad.
- Undertaking preventive maintenance of vehicles to reduce noise levels.

Surface Water Quality

Impact

Site clearance and stripping of top soil during site construction would result in an increase in soil erosion potential leading to an increased sediment load in the surface run-off during monsoon. Also, surface run off from drilling waste (cuttings and drilling mud), hazardous waste (waste oil, used oil etc) and chemical storage areas may lead to the pollution of receiving water bodies viz. natural drainage channels etc. By assessing from the severity, extent and duration of impact, it is scaled medium on the basis of its impact significance.

Mitigation Measures

- Adequate treatment of waste water to meet the CPCB Water Discharge Standards for Oil and Gas Industries/CTE & CTO condition.
- Waste mud to be stored in the HDPE lined pit.
- Drainage and sediment control systems at the well site will be efficiently designed.
- All chemical and fuel storage areas, process areas will have proper bunds so that contaminated run-off cannot escape into the storm-water drainage system.

Ground water

Impact

In absence of supply of surface water resource, the potential impacts on groundwater resource would be due to ground water abstracted for domestic needs and for civil construction activities.

Mitigation Measures

All water storages in the drill sites would be kept covered and leakage prevented;

Soil Quality

Impact

Potential impact on soil quality is envisaged in the form of increase in soil erosion and loss of soil fertility resulting from site clearance and top soil stripping during well site preparation. The impact from accidental spillage resulting from storage and handling of mud chemicals is also envisaged. The impact arising from the proposed project on the soil quality is considered temporary as the proper reinstatement of site will be undertaken in case the wells are not indicative of any commercially exploitable hydrocarbon reserves and specific mitigation measures will be implemented to stabilize the topsoil and to preserve the fertility characteristics during site restoration. The impact is therefore considered to be of medium significance.

Mitigation Measures

- The top soil would be stored properly
- Manage spills of contaminants on soil using spill kits;

- Storage of Soild & other wastes in designated areas within drill sites/production facilities;
- Adopt best practices e.g. use pumps and dispensing nozzle for transfer of fuel, use drip trays etc.

Road and Traffic

Impact

During various phases of projects like construction, drilling, early production and decommissioning various types of vehicle / equipment movement would be involved. The vehicular movement is expected to be more in construction phase due to movement of machinery & manpower.

Mitigation Measures

- Speed limits would be maintained by vehicles involved in transportation of raw material and drilling rig.
- Regular supervision would be done to control vehicular traffic movement along defined traffic routes.
- Entry of vehicles into the drilling site area is prohibited except for material movement.
- Adequate parking would be provided outside the drilling location.

Terrestrial Ecological environment

Impact

The Potential Impacts on the existing floral and faunal diversity may arise due to following activities

1. Vegetation Clearance.
2. Illimitation from Site.
3. Generation of Noise

Mitigation Measures

- The working area would always be kept minimum;
- For felling of trees prior approval from concern Department shall be obtained;
- Appropriate shading of lights to prevent unwanted scattering;
- ;
- Fencing would be done on the camp site to avoid any unfortunate encounter with faunal species.

Socio economic environment

Impact

Road infrastructure could be damaged due to heavy traffic movement. Influx of population is anticipated in all stages of the project cycle particularly during exploratory drilling. The drill site would involve the operation of about 50 onsite workers during drilling phase. Interaction between workers with villagers of nearby areas might give rise to various issues like conflict of workers with the local population, nuisance caused by workers due to improper sanitation facilities, etc.

Mitigation

- The shortest distance as far as available / feasible would be considered for access road.
- The village road identified for accessing proposed project footprints, would be strengthened and widened as per requirement.
- Concerns of local panchayat regarding any impact on their common property resources (like of use of village road, water resource etc.) due to project activities, would be proactively identified and addressed;

Occupational Health & Safety Risks

Impact

The impacts during construction and operation phases, are anticipated to arise primarily from-

- Operation of construction machineries/equipment;
- Exposure to high noise generation areas.

Mitigation Measures

- Periodic onsite surveillance to be conducted so that the workers use the designated PPEs all the time;
- Health surveillance would be conducted of personnel working in the aforesaid areas;
- Regular health and safety awareness to be provided to workers.

Community Health & Safety

Impact

Community health and safety of inhabitants residing close to the drilling site stands to get affected from frequent heavy vehicular movement along village access roads and due to noise from drilling rig operations.

Mitigation

- Proper hoardings in English and local language should be displayed during construction and operation phase to prevent people from encroaching the fenced area.
- Traffic management plan will be developed and implemented at site.

Operation of Campsites

Impact

It is anticipated that, at any given time, there would be about 80 - 100 personnel working on site including technical staff, drilling crew, security staff etc. who would be accommodated at each campsite associated with drilling. Water for domestic use would be 20-30 m^3/day/well. Each campsite is anticipated to generate 25-30 kg/day/well of domestic waste. Inadequate disposal and handling of waste would pollute the surroundings.

Mitigation Measures

- Safe Drinking water will be provided.
- Segregation of waste at the source of generation to be put in practice.
- Food waste to be collected and disposed appropriately
- The sewage from each porta-cabin to be connected to a mobile STP.

Demobilization and Abandonment

Impact

If hydrocarbons are not found, a full abandonment plan would be implemented. The impacts from decommissioning of drill sites may include noise generation and soil contamination due to demolition of cutting pits and chemical storage areas.

Mitigation Measures

- All the wastes to be completely removed from the site and sent to designated authorized disposal facilities prior to commencement of demolition work.

- Prior to commencement of any demolition, a planned programme of site clearance would be formulated. All pits, cellars and holes would be removed, and filled to ground level, any oil or otherwise contaminated soil would be removed and disposed properly.
- Roads and other paving would be removed to sufficient depth to allow soil replacement and revegetation.

Environment Management and Monitoring Plan

A comprehensive environmental monitoring plan has been developed for the project. Monitoring of ambient air quality, noise levels, soil and groundwater quality to be carried out by MoEF&CC/NABL/Assam SPCB recognized laboratories for pre and post drilling operations to assess the effectiveness of the environment management plan and adopt appropriate corrective measures if it found that those are not functioning properly.

HSE Organization Structure

Vedanta Limited (Division: Cairn Oil & gas) has an existing established Health, Safety and Environment (HSE) management system for its operations. The HSE structure comprises of a corporate HSE team based in Gurgaon office and an on-site team.

Vedanta Limited (Division: Cairn Oil & Gas) shall ensure that the contractual documentation emphasizes on the need to comply with all legal requirements and Environment Management and Monitoring Plan (EMMP). Vedanta Limited (Division: Cairn Oil and Gas) shall either directly or through its contractors, to arrange for periodic trainings of the project crew on legal requirements and EMMP. Vedanta Limited (Division: Cairn Oil and Gas) shall undertake regular inspections of drill and camp sites and document them to ensure compliance to legal requirements and the EMMP.

Proposed CER (Corporate Environmental Responsibilities) Strategy

As per MoEF&CC office memorandum number F. No 22-65/2017-IA-III dated 1st May 2018, Corporate Environmental Responsibility requirement would be fulfilled.