Hydrogeological Investigation Report

for

RAMCO INDUSTRIES LTD.

(1,20,000 Ton / Annum Asbestos Fibre Cement Sheet Project)

At

Industrial Area, Bihiya

P.O.: Bihiya

Dist. Bhojpur

(BIHAR)

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1.0 INTRODUCTION ;

M/s Ramco Industries Limited (RIL) has established and operating an Asbestos Fiber Cement Sheet Plant at, Industrial Area, Bihiya, Dist. Bhojpur, Bihar.

Ramco Industries Limited (RIL) has obtained Environmental Clearance under EIA Notification 2006 from Ministry of Environment, Forest & Climate Change, Govt. of India vide F. No. J-11011/17/2010-IA II (I) dt: 17.01.2011.

Water requirement of RIL is 80 m^3/day for process, cooling & domestic purposes. RIL has obtained permission of 80 m^3/day ground water withdrawal from Directorate of Under Ground Water Resources, Govt. of Bihar, on 22nd Feb.'2010.

There are no government sources in the surrounding area to supply raw water which can cater to the industrial needs. The daily demand of water is being met through the supply from the bore wells inside the project premises. RIL is recycling & reusing the treated waste water in manufacturing process inside the premises. Domestic waste water is being sent to septic tank inside the premises and dispersed in underground strata through soak pit inside the premises. No waste water is being discharge outside the premises to comply Zero Discharge.

2.0 PROJECT LOCATION

Project area of Ramo Industries Ltd. is situated within Industrial Area Bihiya, P.O.: Bihiya, Dist. Bhojpur in the state of Bihar. Geo Co-ordinates of Project Site is as under ;

Latitude	25°33'10.56"N
Longitude	84°27'44.16"E

2.1 ENVIRONMENTAL SETTINGS ;

Environmental settings around the project area of RAMCO Industries Ltd. is enumerated in table below ;

PARTICULARS	***DETAILS***	
• Location	**BIADA Industrial Area, Block Bihiya, Dist. Bhojpur (BIHAR)**	
• Elevation above mean sea level	Max$^{m.}$ Elevation	64.0 m. above MSL
	Min$^{m.}$ Elevation	71.0 m. above MSL
• Total Plant Area	**20 Acres**	
• Nearest Railway Station	**Bihiya (2 Km.)**	
• Nearest Highway	**SH – 102 (1 km.)**	
• Nearest Village / Town	**Bihiya (1.5 km.)**	
• Nearest River	**River Ganga (15 km. N)**	
• Ecologically sensitive zone	**None**	
• Reserved forests	**None**	
• Wild Life Sanctuary	**None**	

FIG NO. 1 **PROJECT LOCATION OF RAMCO INDUSTRIES LTD.**

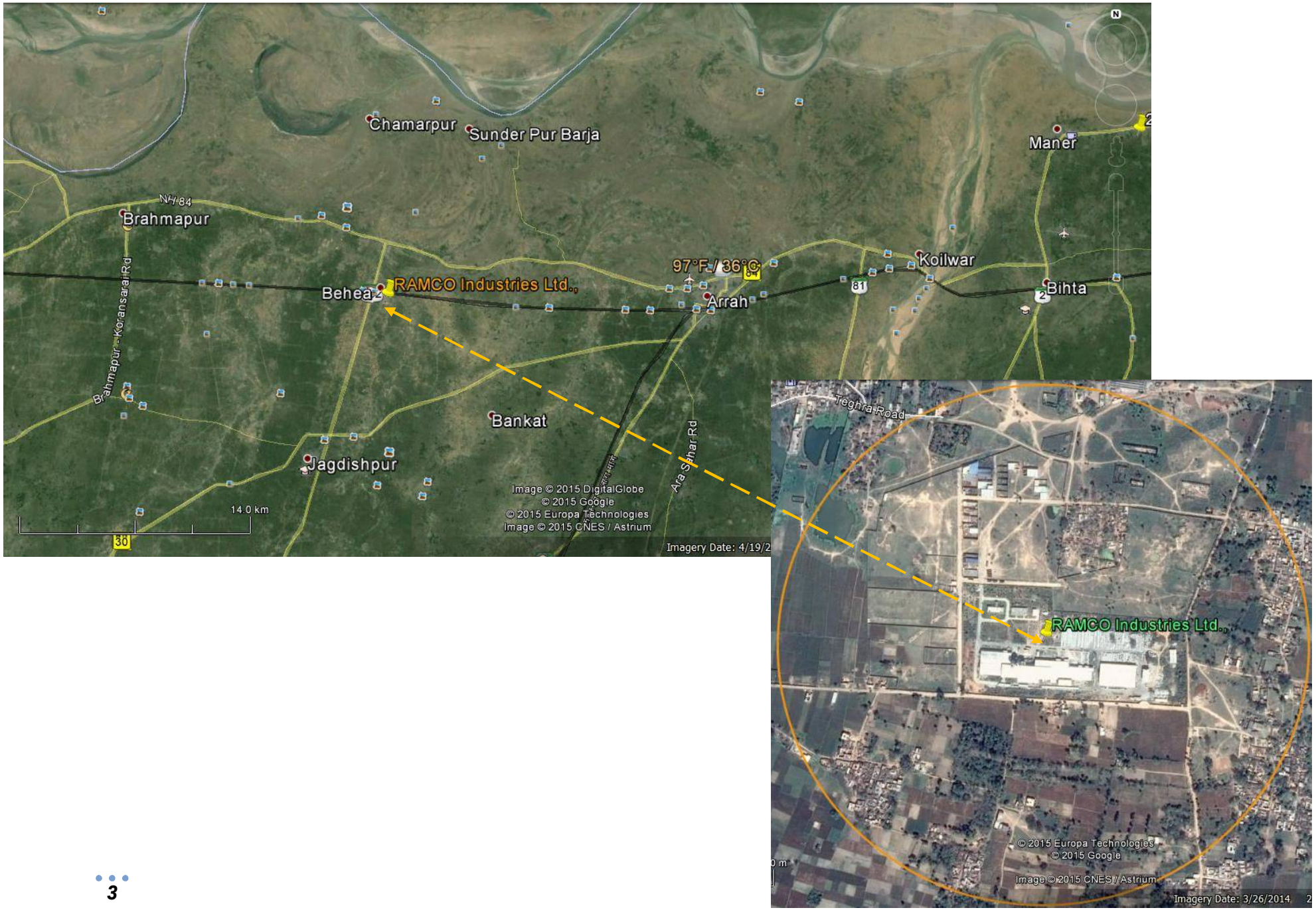
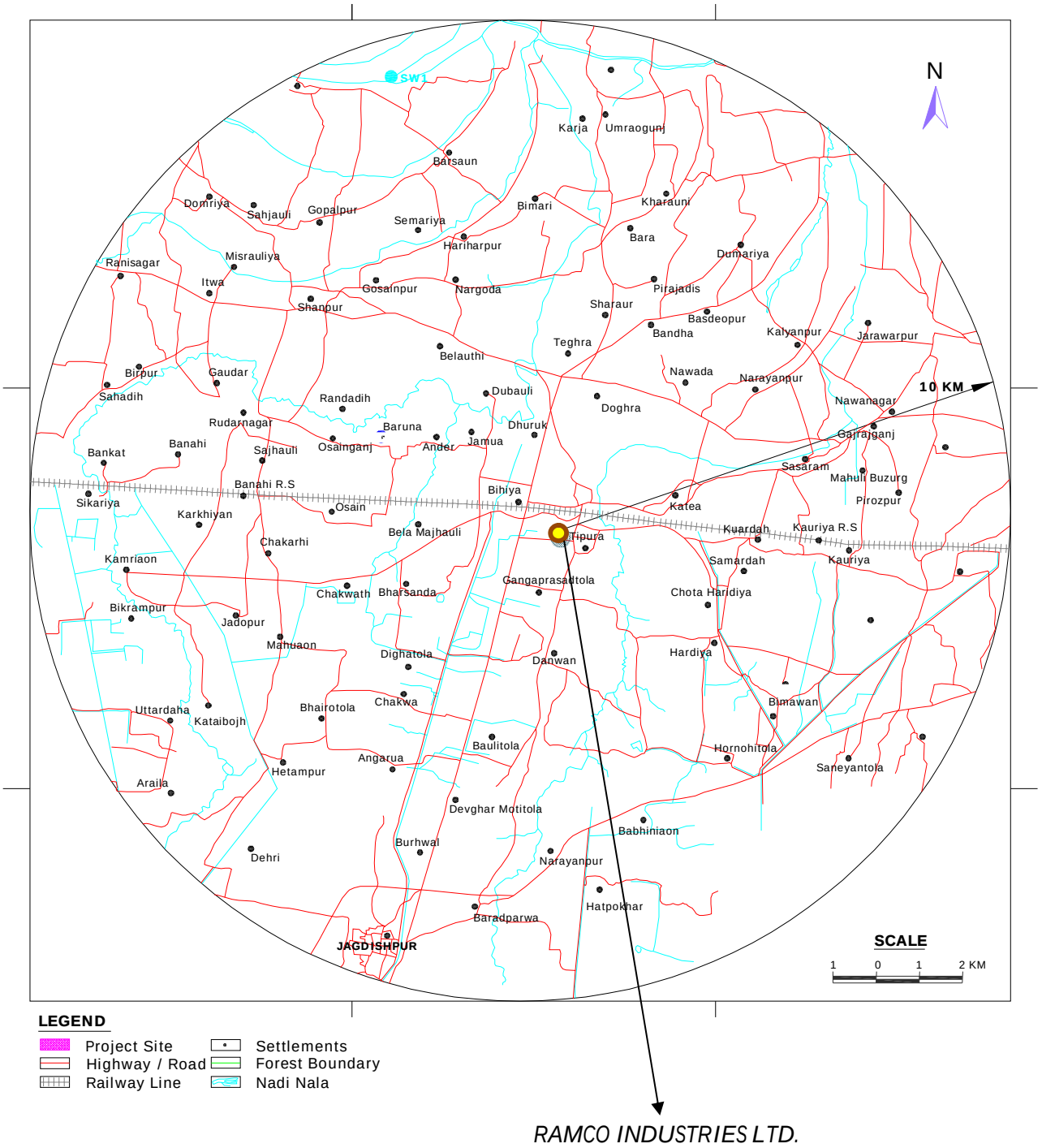


FIG NO. 2 **DRAINAGE SYSTEM OF RAMCO INDUSTRIES LTD. PROJECT AREA**



3.0 JUSTIFICATION ;

Having a deep concern regarding good environmental practices and conservation of natural resources, Ramco Industries Ltd. (RIL) is carrying out the present study to assess the ground water potential and development stage. To continue abstraction of ground water for fulfilling the needs of RIL project, it is required to conduct Hydrogeologcial study within and around the RIL project area for justifying the abundant ground water availability in the area.

4.0 OBJECTIVE

The primary objective of the present investigation of ground water hydrology within and around the project area of the RAMCO Industries Ltd. at, Industrial Area, Bihiya, Dist. Bhojpur, is to identify the abundant availability of ground water area in the region.

As per Environmental Clearance, issued by MoEF & CC, Govt. of India vide F. No. J-11011/17/2010-IA II (I) dt: 17.01.2011, specific condition No. X, **"After the 5 yrs. Operation of plant, no ground water shall be used and only rain water shall be used."**

With the present report RIL will approach MoEF & CC, Govt. of India for permission to continuance of ground water withdrawal by RIL for its operation.

5.0 STUDY METHODOLOGY

Detail study of Hydro-geological conditions of the project and study area by site survey, water sample collection & secondary published data & literature of Central Ground Water Board, Govt. of India. Water levels were observed, recorded and ground water samples were collected and analysed for chemical and bacteriological characterization.

6.0 BRIEF DESCRIPTION OF PROJECT ;

RIL is manufacturing 1,20,000 TPA Asbestos Fiber Cement Sheet. Asbestos Fibre, Cement, Fly Ash & Pulp are being used as raw materials for producing Asbestos Fiber Cement Sheet. Raw material requirement details are as under ;

Raw Material	Quantity
Asbestos fibre	10200 TPA
Cement	54000 TPA
Fly ash	31800 TPA
Pulp	600 TPA

Fibre Cement Corrugated roofing sheets, accessories and flat sheets are manufactured using raw asbestos fibre, Portland cement, fly ash and Pulp. Different grades of asbestos fibre are milled in the Edge Runner Mill (ERM). Slurry is formed with Asbestos Fibre, Cement and Fly ash. This Slurry is fed in to a Sheeting Machine where Sheet is formed. These Sheets are cut in to required size and corrugated. The Sheets are separated from the interleaves and cured.

Land Details;

The total land allotted by Bihar Industrial Area Development Authority (BIADA) to RIL project is about 20.0 acres (8.094 ha). Out of which an area about 2.5-acres is being used for factory building, 2.5-acres for service and utility building and 8.0-acre for greenbelt development. The detailed break-up of the land use is given in table below ;

Land use	Land Area(Acre)
Main factory building	2.5
Service and Utility buildings	2.5
Sheet Stacking Area	3.0
Green Belt Area	8.0
Lorry Parking Area	2.0

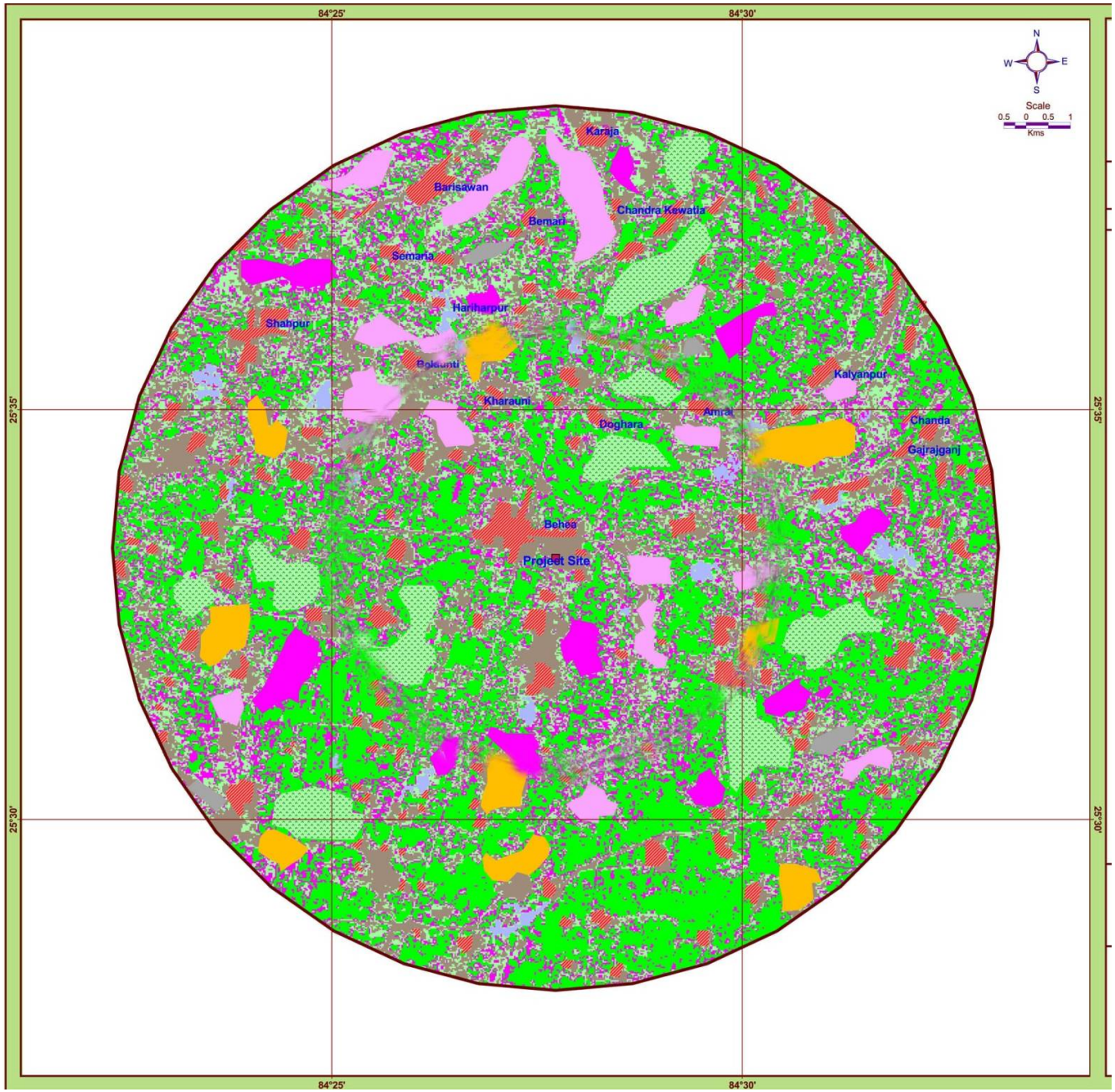
Curing Bay	2.0
Loading shed	
Total	**20.0**

Water Requirement ;

Water requirement in the plant is mainly for fibre milling, slurry formation in the production process, domestic and gardening. The water requirement of the RIL plant is being sourced from the bore wells. The break-up of the water requirement details are given in table below ;

Sr. No.	Category	Requirement (KLD)
1	Process make-up	62.0
2	Domestic consumption	8.0
3	Green Belt development	10.0
Total		**80.0**

FIG. NO. 3 **LAND USE LAND COVER MAP OF RAMCO INDUSTRIES LTD.**



Ramco Industries Project Site
Double Crop Land
Dry Crop Land
Builtl-up Land
Fallow Land
Land with scrub
Land without scrub
Plantation
Salt affected Land
Barren land
Water Body

National Remote Sensing Centre, Hyderabad
IRS P6 - LISS III - FCC -27-February-2010

7.0 CLIMATIC CONDITIONS ;

The district by and large is homogenous. It is of moderate type characterized by quite hot summers to moderately cold winters. The day temperature generally ranges from 21.1 ºC in January to 38.7 ºC in May and night temperature from 7.3 ºC in December to 27.7 ºC in June. The summer begins in April and peaks in June/July with the temperature soaring up to 43 °C till the moisture laden monsoon wind bring some much-needed relief to the parched fields. The rains last through August & September and continue into early October.

8.0 RAINFALL ;

The annual average rainfall in the district is around 640 mm during last 4-5 years. The timely and well-distributed rainfall during Kharif and Rabi has a deciding influence on the land use and cropping pattern of the district. Last 5 yrs. Rainfall of the district is as under ;

Year	Rainfall in mm. (Source IMD Data)
2009	403.0
2010	571.3
2011	644.8
2012	649.4
2013	930.3
Average Rainfall	**639.76 mm.**

9.0 GEOLOGY OF STUDY AREA ;

Bhojpur district is mainly covered with alluvium and hard rocks of Vindhyan Supergroup are situated at the southwestern side beyond the district boundary. The north and northeast parts of the district are covered with Newer Alluvium and younger flood plains (diara formations) while the central and southern parts are covered with Older Alluvium and older flood plains. The entire area of the district has a general slope towards the north and northeast. The general elevation with

respect to mean sea level is 50-90 m. The gradient is 0.6 m/km approximately from south to north.

10.0 HYDROGEOLOGY OF STUDY AREA ;

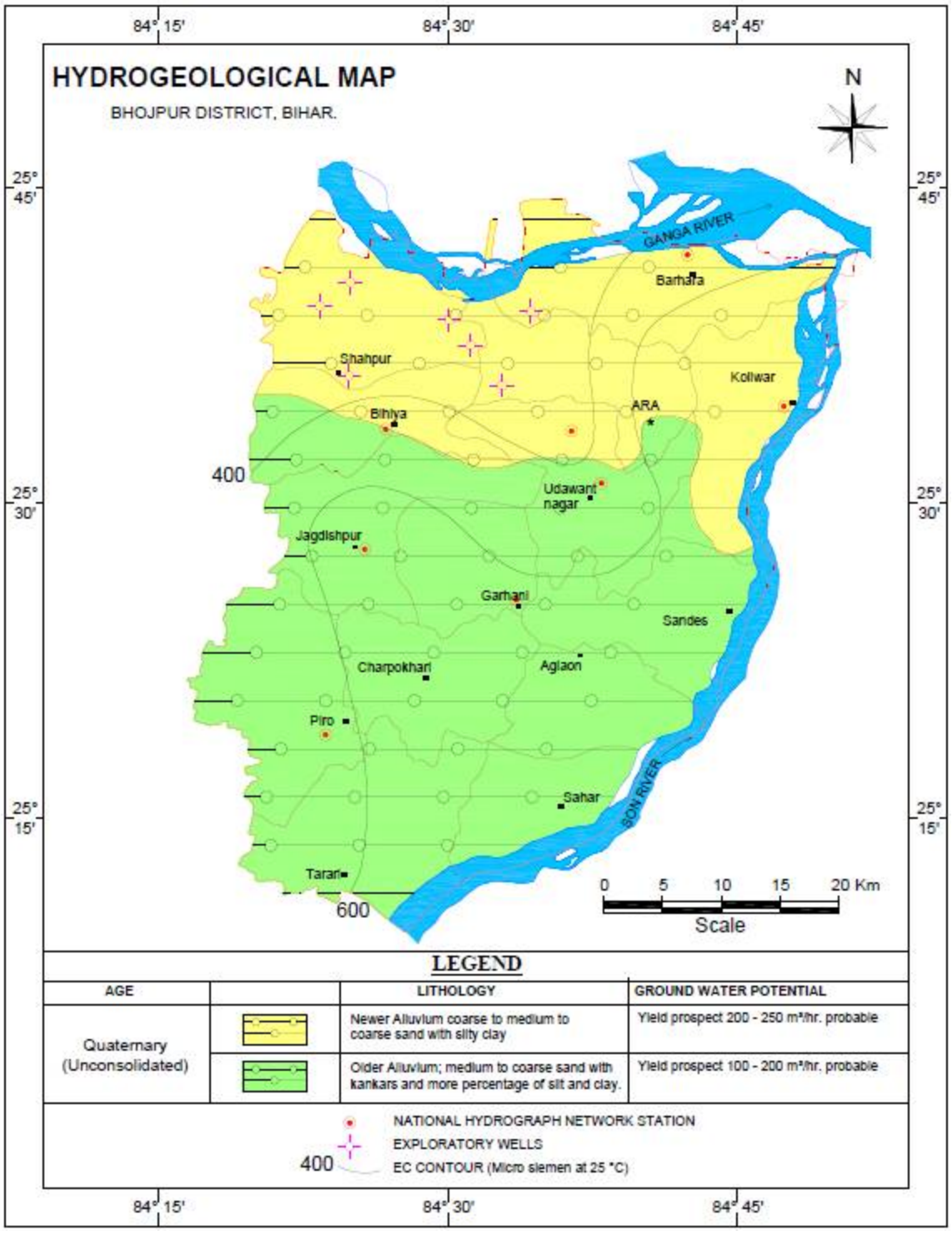
The district Bhojpur is occupied by Quaternary Alluvium (Figure 4), which makes the potential aquifers. Beyond the major clay zone (within 100 – 130 m bgl) up to 250 – 300 m bgl, a total of 100 – 120 m thick aquifer with fining upward character from very coarse sand to fine to medium sand is found along the northern part of the district. Above the major clay zone (100 – 130 m bgl) are found medium to coarse sand zones up to an average depth of 30 m bgl. From 0 to 30 m bgl are found clay, silty clay, sandy clay zones with occasional fine sand layers, which sustain the dug wells in the area. In the southern parts of the district away from present river courses, which have remained unexplored, the thickness of above potential aquifers is expected to be decreasing and the sand/clay ratio would be also decreasing.

The district in general possesses alluvium soil. The soils are of poorly drained type. The area adjoining the rivers Ganga, Sone, Dharmawati, and Gangi consists of sandy loam, loamy sand and sand, whereas, the area away from the river channels consist of silty sand to sandy silt. The soils in general are fine textured away from the river course and rivulets and coarse textured along their courses. The soils of coarse textured have got mixed with silt and fine sand due to the mixing of canal water being used perennially for irrigation.

The results of exploration indicate that the Transmissivity varies from 4749 m^2/day to 15886 m^2/day while the Storativity varies within 0.067 to $0.4x10^{-4}$. The discharge varies within 150 to 200 m^3/hr with draw down within 3 – 10 m.

SOURCE : (Source : Ground Water Information Booklet of Bhojpur Distt. by CGWB, MER, Patna, Bihar)

FIG. NO. 4 : **HYDROGEOLOGICAL MAP OF BHOJPUR DISTRICT**



SOURCE : (Source : Ground Water Information Booklet of Bhojpur Distt. by CGWB, MER, Patna, Bihar)

11.0 CATEGORIZATION OF GROUND WATER AVAILABILITY ;

Precipitation is the principal source of recharge of ground water in the area. Apart from the other sources of recharges in the district include return flow of irrigation water, seepage from canals, tanks ponds & streams.

The ground water resource assessment has been evaluated by CGWA based on the recommendations of the Ground water Estimation Committee – 1997 (GEC – 1997). The ground water assessment has been carried on block-wise basis. In the future ground water development point of view, all the blocks in the district falls under 'Safe' category.

SOURCE : (Dynamic Ground Water Resources of India CGWB, 2011)

12.0 GROUND WATER LEVEL & FLOW ;

In the pre-monsoon period the water level was found to be more than 8 m bgl. In the north and northwestern part of the district along the river Ganga. This may be due to the effluent nature of the Ganga river. Shallowest water levels of less than 4 m bgl were found along the river Sone in south and southeastern parts of the district. In the central parts, in the SW-NE trend, the water levels were found to be within 4-8 m bgl.

In the post-monsoon period the deepest water level of 7 m bgl were found in the north, NE parts of the district including Koilwar, Behia and Jagdishpur. In the areas adjoining to the river Sone, the water level was within 2 m bgl, the shallowest. In the remaining areas, it was within 2 – 4 m bgl.

SOURCE : (Source : Ground Water Information Booklet of Bhojpur Distt. by CGWB, MER, Patna, Bihar)

Water level data of Pre Monsoon 2013 was compared to Pre Monsoon 2012 and the analysis shows that in general there is rise in water level in entire state. About 60% of the wells analysed are showing rise in the water level. Out of this 51% wells have shown a rise in 0-2 m range. About 7% of the wells have shown rise in 2-4 m range. About 2% of the wells have shown rise in more than 4 m range. About 40% of the wells analysed are showing falls in the water level. Out of this 38% of the total wells have shown a fall within 0-2 m range. Only 2% of

monitoring wells shows fall in water level in the range of more than 2 m. Maximum 6.22 m rise in water level has been recorded in the State and Maximum 3.98 m fall in water level has been recorded in the State.

SOURCE : (Ground Water Level Scenario in India Pre Monsoon 2013, CGWB, Govt. of India)

FIG. NO. 5 : **WATER LEVEL OF BIHAR STATE DURING PRE MONSOON**

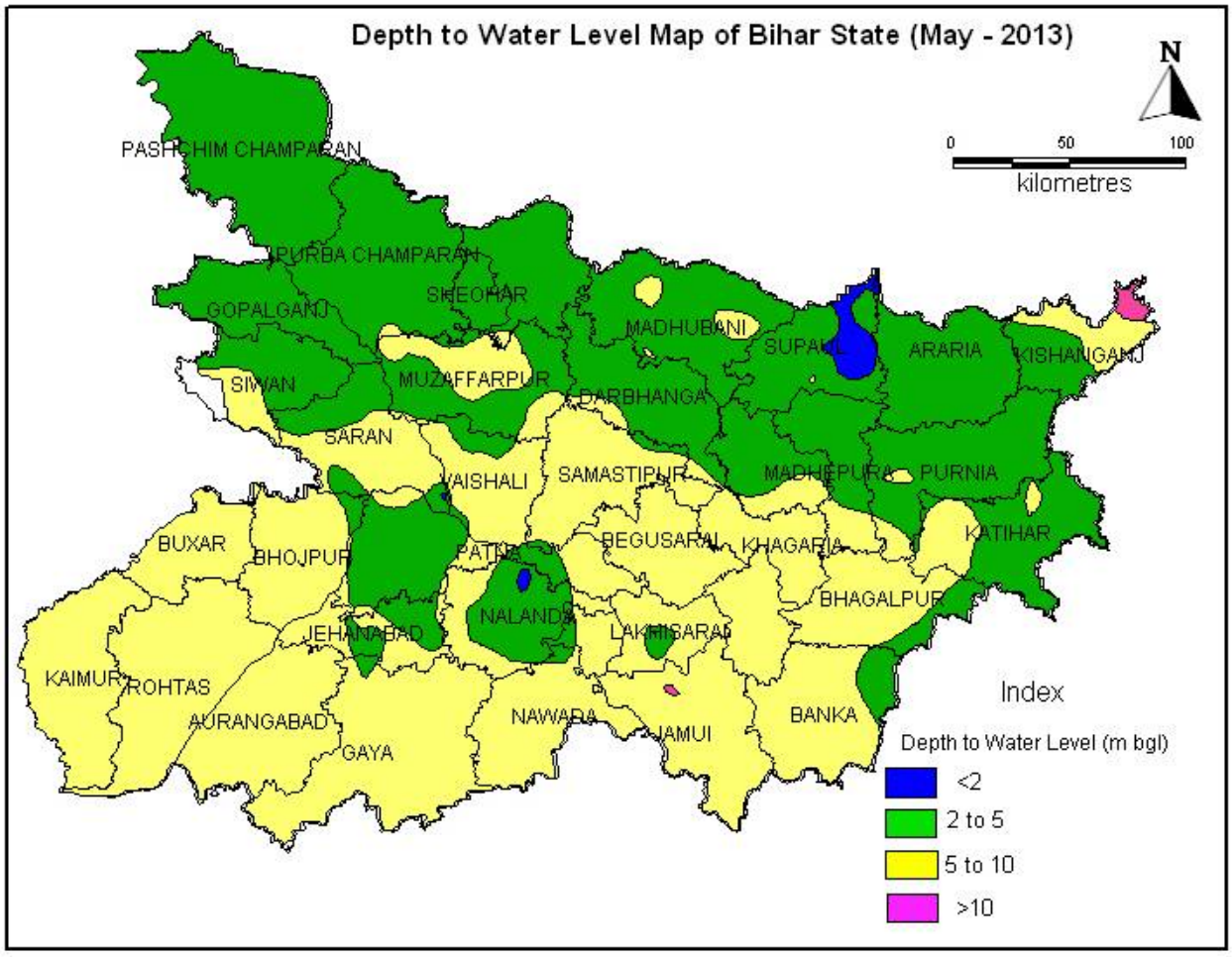
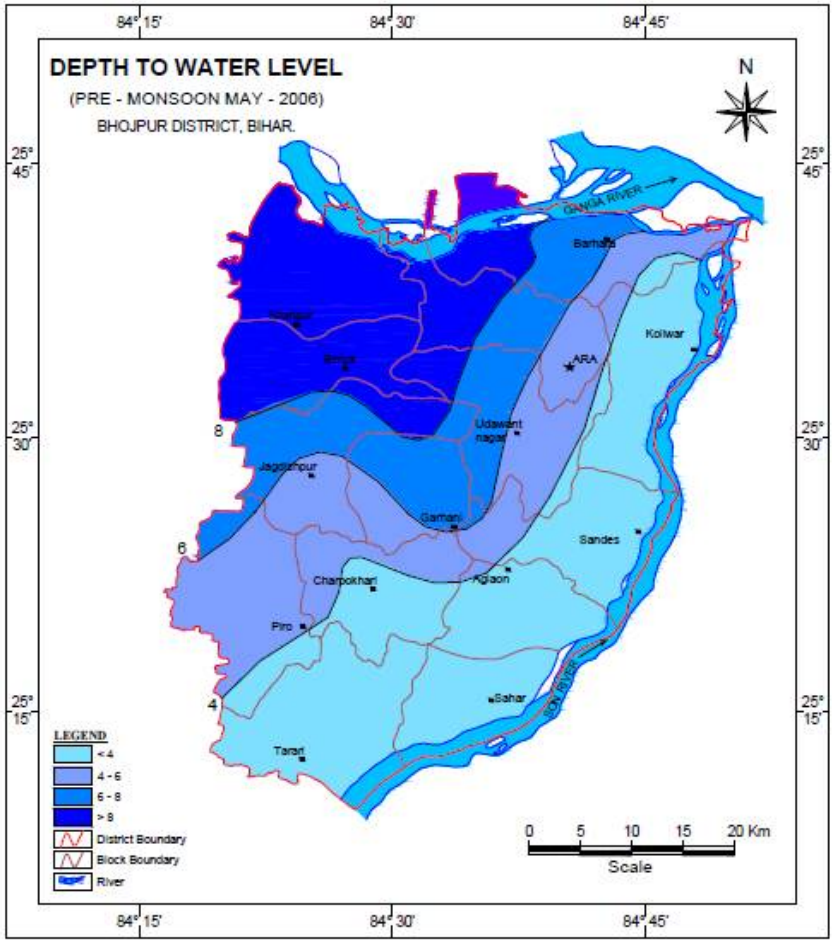
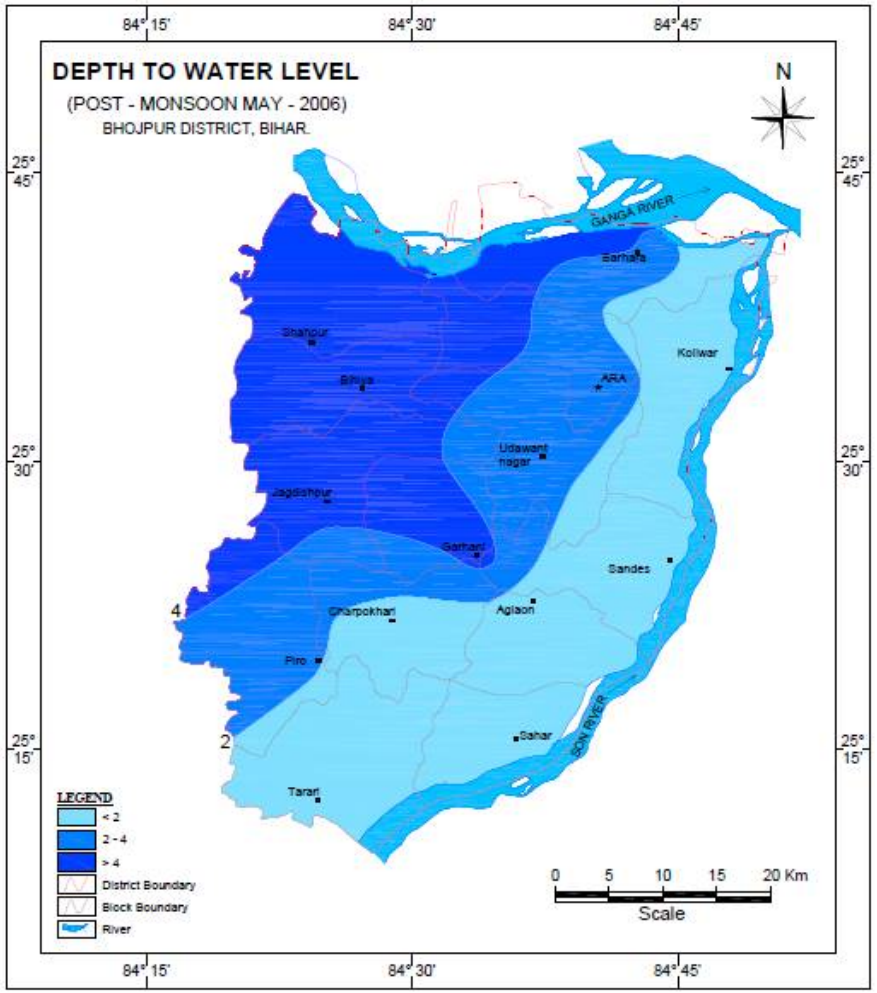


FIG. NO. 6 : **WATER LEVEL OF BHOJPUR DISTRICT**





PRE- MONSOON	POST -MONSOON

SOURCE : (Source : Ground Water Information Booklet of Bhojpur Distt. by CGWB, MER, Patna, Bihar)

TABLE NO. 1 : GROUND WATER RESOURCES AVAILABILITY, UTILIZATION AND DEVELOPMENT STAGE IN STATE OF BIHAR & PROJECT AREA

State / DIstrict	Annual Replenishable Ground Water Resource					Natural Discharge During Non Monsoon Period	Net Ground Water Availability	Annual Ground Water Draft			Projected demand for Domestic and Industrial uses upto 2025	Net Ground Water Availability for Future Irrigation use	Stage of Ground Water Development
	Monsoon Season		Non Monsoon Season		TOTAL			Irrigation	Domestic & Industrial Water Supply	Total			
	Recharge from Rainfall	Recharge From Other Sources	Recharge from Rainfall	Recharge From Other Sources									
	All figures in bcm : billion cubic meter												
Bihar State	19.54	3.95	3.40	2.44	29.34	2.47	26.86	10.25	1.70	11.95	2.51	14.1	44 %
Bhojpur District	0.479	0.185	0.073	0.12	0.858	0.06	0.79	0.30	0.04	0.35	0.06	0.42	45 %

SOURCE : (Dynamic Ground Water Resources of India CGWB, 2011)

13.0 GROUND WATER DEVELOPMENT OF STUDY AREA ;

During field visits it has been observed that the Project Area is very productive in nature as far a ground water is concerned. As per lithological study of some sites drilled by local / different agency it reveals that very good granular zones comprising different grades of sands even at some places good quantities of gravel and pebbles are available in the area.

After studying the Report of Dynamic Ground Water Resources (CGWA) and data obtained during site study on seasonal water level fluctuation in and around the project area, it has been concluded that still an ample scope for ground water development is possible in the study area.

14.0 HYDROCHEMISTY ;

Ground water quality in the phreatic aquifer is generally good and can be safely used for drinking and irrigation uses. However , high concentration beyond the permissible limits of various chemical constituents has also been reported in different parts of the state, like high loads of arsenic, fluoride and iron from geogenic sources. Similarly, anthropogenic source like high nitrate has been reported in isolated pockets linked to high use of fertilizers.

To study the hydrochemistry of the Project and near by areas water samples from 2 nos. borewells inside premises of RIL & 2 Nos. tubewell of study area were selected.

All the water samples were collected and analysed by MoEF Recognised (Gazette Notification No. S.O. 592(E) Dt: 08.03.2013) & NABL Accredited Laboratory (Certificate No.T-0023 Dt: 28.05.2015), Shiva Test House, Rajhans Niketan, Rukunpura, Bailey Road, Patna – 800014 (Bihar). Hydrochemistry of ground water collected from within and around the project premises of RIL were shown herewith.

FIG. NO. 7 **: GROUND WATER SAMPLING (20.09.2015) WITHIN & AROUND THE PROJECT AREA OF RAMCO INDUSTRIES LTD., INDUSTRIAL AREA, BIHIYA, DIST. BHOJPUR, BIHAR**

Ground Water samples were collected and analysed by MoEF Recognised (Gazette Notification No. S.O. 592(E) Dt: 08.03.2013) & NABL Accredited Laboratory (Certificate No.T-0023 Dt: 28.05.2015), Shiva Test House, Rajhans Niketan, Rukunpura, Bailey Road, Patna – 800014 (Bihar)

GROUND WATER SAMPLE COLLECTION FROM BIHIYA BLOCK OFFICE

GROUND WATER SAMPLE COLLECTION FROM TUBEWELL AT PHINGI

Table No. 2 : **GROUND WATER CHARACTERISTICS OF PROJECT & STUDY AREA OF RAMCO INDUSTRIES LTD., INDUSTRIAL AREA, BIHIYA, DIST. BHOJPUR, BIHAR**

[(WATER SAMPLES analysed by MoEF Recognised (Gazette Notification No. S.O. 592(E) Dt: 08.03.2013) & NABL Accredited Laboratory (Certificate No.T-0023 Dt: 28.05.2015), Shiva Test House, Rajhans Niketan, Rukunpura, Bailey Road, Patna – 800014 (Bihar)]

SN.	Parameters	Limit as per IS 10500 : 2012		Method of Test	Results in mg/l. except colour, Odour, Taste, Turbidity, & pH			
		Limit (mg/l.) Acceptable	Permissible Limit in the absence of alternative source		Ground Water Sample from Borewell near Godown within the premises of RIL	Ground Water Sample from Borewell near labour room within the premises of RIL	Ground Water Sample from Tubewell at Phingi	Ground Water Sample from Tubewell at Block Office Bihiya
1	Colour	5.0 Hazen Limit	25	IS 3025 (Part-4)	< 5.00	< 5.00	< 5.00	< 5.00
2	Odour	Unobjectionable	---	IS 3025 (Part-5)	Unobjectionable	Unobjectionable	Unobjectionable	Unobjectionable
3	Taste	Agreeable	---	IS 3025 (Part-7)	Agreeable	Agreeable	Agreeable	Agreeable
4	pH	6.5 to 8.5	--	IS 3025 (Part-11)	7.12	6.88	6.91	7.21
5	Turbidity on NTU	1.00	5.00	IS 3025 (Part-10)	<1.0	<1.0	<1.0	<1.0
6	Total Dissolved Solids (TDS)	500.00	2000.00	IS 3025 (Part-16)	418.0	472.0	460.0	432.0
7	Total Hardness as $CaCO_3$	300.00	600.00	IS 3025 (Part-21)	244.0	282.0	276.0	270.0
8	Calcium as Ca	75.00	200.00	IS 3025 (Part-40)	52.0	60.0	56.0	50.0
9	Magnesium as Mg	30.00	100.00	IS 3025 (Part-46)	27.0	32.0	33.0	35.0
10	Iron as Fe	0.30	No relaxation	APHA 3500 (Fe B)	0.19	0.21	0.27	0.24
11	Residual Free Chlorine	0.20	1.00	IS 3025 (Part-26)	<0.1	<0.1	<0.1	<0.1
12	Total Alkalinity as $CaCO_3$	200.00	600.00	IS 3025 (Part-23)	270.0	316.0	284.0	296.0
13	Chloride as Cl	250.00	1000.00	IS 3025 (Part-32)	24.0	32.0	22.0	16.0
14	Sulphate as SO_4	200.00	400.00	APHA (4500-E)	18.0	16.0	20.0	10.0
15	Nitrate as NO_3	45.00	No relaxation	APHA (4500 NO_3)	16.0	12.0	30.0	44.0
16	Fluoride as F	1.00	1.50	APHA 4500 (F D)	0.42	0.48	0.68	0.57
17.	Arsenic as As	0.01	0.05	APHA (3114 B)	<0.01	<0.01	<0.01	<0.01
18.	Coliform per 100 ml.	Shall not be detectable		IS 1622 : 1981	Not Detectable	Not Detectable	Not Detectable	Not Detectable

15.0 RAIN WATER HARVESTING & CONSERVATION ;

It is the activity of direct collection of Rain Water. The conservation of Rain Water so collected can stored for direct use or can be re-charged into the Ground Water. The main goal is to minimize flow of Rain Water through Drains / nallahas in the river without making any use of the same. It is known fact that the Ground Water level is depleting and going down and down in the last decades. Thus Rain Water Harvesting and Conservation aims at optimum utilization of the natural resource, that is Rain Water, which is the first form of water that we known in the hydrological cycle and hence is a primary source of water for us. The River, lake and Ground water are the secondary sources of Water in present times. In absence of rain water harvesting and conservation, we depend entirely on such secondary sources of water and in the process it is forgotten that rain is the ultimate source that feeds to these secondary sources. The value of this important primary sources of water must not be lost. Rain water Harvesting & Conservation means to understand the value of Rain water and to make the optimum use of Rain Water at the place where it falls.

The artificial recharge to ground water is a process by which the ground water reservoir is augmented at a rate exceeding that obtained under natural conditions of replenishment. Any man made scheme of facilities that adds water to an aquifer may considered being an artificial recharge system. Theoretically this implies that the vertical hydraulic conductivity is high, while the horizontal hydraulic conductivity is moderate.

Artificial recharge techniques normally address to following issue ;

a) To enhance the sustainable yield in area where over development has depleted
b) To utilize the rainfall runoff, which is going to sewer or storm water drain.
c) Conversation and storage of excess surface water for future requirements, since this requirement often change within a season or period.
d) Surface water is inadequate to meet our demand and we have to depend on ground water.

e) Due to rapid urbanization, infiltration of rainwater in to the sub soil has decrease drastically and recharge water has diminished.

f) To arrest seawater ingress.

g) To improve the vegetation cover and reduce flood hazards.

h) To raise the water levels in wells and borewells that are drying up. To remove bacteriological and other impurities from sewage and waste water of that water is suitable for reuse.

i) To improve the qualities of existing ground water through dilution.

j) To reduce power consumption.

The basic purpose of artificial recharge of ground water is to restore supplies from aquifers depleted due to excessive ground water utilization.

16.0 TECHNIQUES OF RAIN WATER HARVESTING :

(i) Storage of rainwater for future use

(ii) Recharge to ground water

Rainwater harvesting can also be collecting, filtering and recharging ground water through percolation pits open wells or borewells.

The sub-surface reservoirs are very attractive and technically feasible alternatives for storing surplus monsoon runoff, the sub-surface reservation can store substantial quantity of water. The sub-surface geological formations may be considered as Warehouse for storing water that come from sources located on the land surface. Besides suitable lithological conditions other consideration for creating sub-surfaces storage are favorable geological structure and hypsographic units whose dimension and shape will allow retention of substantial volume of water in porous and permeable formation. The sub-surface reservoirs, located in suitable hydro geological situations are environment friendly and economically viable proportions the sub-surface storage has advantages of being free from the adverse effects like inundation of large surface area, loss of cultivable land, displacement of local population, substation evaporation losses and sensitivity to earthquakes. No gigantic structures are needed to store water.

The storage of rain water on surface is a traditional technique and structures used were under ground tanks, ponds check dams weirs etc. Recharge to ground water is a new concept of rainwater harvesting.

17.0 NEED FOR RAIN WATER HARVESTING :

Rain water harvesting and conservation can be understood by the fact that even Mawsynram (Meghalaya), which receives about 11,800 mm. rainfalls annually, suffers from acute shortage of drinking water to the reasons that rain water is not harvested and conserved and is allowed to drain away. The annual average rainfall over India is computed to be 1170 mm., which is much higher than the global average of 800 mm. However, this rainfall in India occurs during short periods of intensity and because of such high intensity and short duration most of the rain falling on the surface tends to flow away last living little scope for re-charging of Ground Water resulting thereby lack of water in most part of the country even for domestic uses.

It is needed to implement measure to make sure that rainwater falling over a region is tapped to the maximum possible extent through rainwater harvesting and conservation, either by recharging it into the Ground Water resources or storing it for direct use.

a) Pits, b) Trenches, c) Dug wells, d) Handpumps, e) Recharge wells, f) Recharge shafts, g) Lateral shafts with borewells, h) Spreading techniques.

The Government of India has also realized the importance and necessity of rainwater Harvesting so Ministry of Urban Development & Poverty Alleviation has issued Gazette notification of making suitable provision in the building bye-laws 1983.

18.0 AREA EXTENT ;

The total areal extent of Ramco Industries Ltd., is 20 Acres (80920 square meters), consisting of factory sheds, utility buildings, canteen, residential area etc. The break up details of different areas are given in the following table.

Type of Area	Area is M^2
Roof Area	10000
Roads & Paved Areas	2000
Open Area	2500
Green Belt Area	32368
TOTAL	46868

19.0 PRESENT WATER DEMAND OF RIL

Sr. No.	Particulars	Requirement m3/day	No. of Working Days	Annual Water Requirement
1	Industrial Process Makeup	62	300	18600 m^3
2	Residential / Domestic	8	300	2400 m^3
3	Landscaping / Gardening / Green Belt Development	10	250	2500 m^3
Total		**80**		**23500 m^3**

The major areas of water requirement in the process operation are Milling, Fibre Disintegration, Cement Section, Fly Ash section, Mixing and Curing. Water is added in the milling section to prevent crushing of fibres. Water is also added in the Cement/Fly-Ash section to prevent dust generation. Further water is also added in the Turbo Mixer to enable formation of Slurry. Water is also added in the Storage-Mixer to maintain homogeneity of the mix.

One of the significant factors in the proposed process of the RIL is that the entire water will be re-cycled for re use in the process operations. The re-cycling is effected by use of Back Water System in the Vat Machine. The entire water used in the Milling section, Cement/Fly-Ash section, Turbo Mixer and U-Mixer comes along with the Slurry, from which, the Vacuum System sucks the water. This sucked water is then pumped to the Water tanks. Water from the water tanks are then reused in the process operations. Any trace of water in the mix during sheet

formation is also circulated within the machine to keep the felt wet by use of Water Re-circulating System.

The entire process operation is carried out in Wet Condition. However, the entire water is re-cycled for re-use in the process operation. The daily requirement of raw water is only to make-up for loss due to Evaporation and Absorption. Hence, it's apparent that utmost effort will be made by RIL to Conserve Water by maximum re-use.

Only source of wastewater generation is domestic sewage. This will be treated in a Septic Tank followed by dispersion in under ground strata through Dispersion Trenches.

20.0 SOURCE OF WATER ;

Water requirement of RIL is 80 m^3/day for process, cooling & domestic purposes. Total water requirement is being met from the ground water sources. RIL has obtained permission of 80 m^3/day ground water withdrawal from Directorate of Under Ground Water Resources, Govt. of Bihar, on 22nd Feb.'2010

21.0 *RECHARGE WELLS ;*

An important factor for selection of location and capacity for a recharge well is the aquifer characteristics in the region. The design of a recharge well considers the following factors ;

a. Run off rate of rain water from the source of collection.
b. Filtration / de-silting of water.
c. First flush device
d. Bypass arrangement for excess runoff rate.
e. Good percolation efficiency.

It is possible to collect the entire rainwater from rooftops of all buildings and use a common recharge facility. But this will call for a huge network of pipelines cutting across the road / landscapes and a high capacity recharge well. In such a

case the excess run off is likely to be high, thus reducing the quantity of harvested water. And in many cases a proper gradient may not be available for the gravity flow of water making it impossible to transport all the water to the recharge well. To eliminate these constraints, it is proposed that a set of buildings depending on vicinity and topography of adjoining land be connected to one recharge well.

22.0 RAIN WATER HARVESTING POTENTIAL :-

The total precipitation in the project site, covering 46868 square meters with an annual average rainfall of 0.64 m, is in the order of **14802 m^3**. The runoff co-efficient for roof area, roads and paved area, open area and green belt area can taken as 0.85, 0.5, 0.25 & 0.35, respectively.

The water harvesting potential is the total amount of water that is received in the form of rainfall over an area, out of this, the amount that can be effectively harvested i.e.

Water Harvesting Potential = Average Annual Rainfall (m.) x Collection Efficiency

(R)

Collection Efficiency = Area of the Catchment (m^2.) x Run Off Coefficient

(A) (C)

Area and Runoff Co-efficient

Type of Area	Area is M^2	Run-Off Coefficient
Roof Area	10000	0.85
Roads & Paved Areas	2000	0.50
Open Area	2500	0.25
Green Belt Area	32368	0.35

23.0 RAIN WATER HARVESTING POTENTIAL OF RAMCO INDUSTRIES LTD. :-

- Average Annual Rainfall Data (as er IMD Data) : 639.76 mm. i.e. 0.64 m.
- Roof Surface Catchment Area : 10000 m^2
- Runoff Coefficient for roof surface = 0.85
- Rainwater Harvesting Potential of Roof Area = R x A x C
  = 0.69 x 10000 x 0.85
  = 5865 M^3 --- **[A]**
- Roads & Paved Surface Catchment Area : 2000 m^2
- Runoff Coefficient for Paved Area = 0.50
- Rainwater Harvesting Potential of Paved Area = R x A x C
  = 0.69 x 2000 x 0.50
  = 690 M^3 ------ **[B]**
- Open Catchment Area : 2500 m^2
- Runoff Coefficient for Open Catchment Area = 0.25
- Rainwater Harvesting Potential of Open Area = R x A x C
  = 0.69 x 2500 x 0.25
  = 431 M^3 -------- **[C]**
- Green Belt Catchment Area : 32368 m^2
- Runoff Coefficient for Green Belt Area = 0.35
- Rainwater Harvesting Potential of Green Belt Area = R x A x C
  = 0.69 x 32368 x 0.35
  = 7816 M^3 -------- **[D]**
- Therefore, Total Annual
  Water Harvesting Potential = A+ B + C + D
  = 5865 + 690 + 431 + 7816
  = **14802 M^3**

24.0 ARTIFICIAL GROUND WATER RECHARGE STRUCTURE

The artificial recharge structure consists of filtration chambers and recharge wells. The filtration chamber works as a temporary storage tank besides a filtration chamber. The dimension of the chamber are decided according to the anticipated recharge rate and the maximum anticipated harvested runoff from the rooftop.

The filtration chamber should be filled with filtration material of 20 to 100 mm size pebble of a layer of 0.50 m at the bottom overlain by a layer of gravel of 5.0 to 20 mm of 0.5 m thick layer of gravel which is be overlain by 0.5 thick layer of coarse sand of 2 to 5mm size. The top 1.5 m depth of the filtration chamber is to accommodate temporarily the incoming harvested rooftop rain water. The temporary storage will get recharged in due course of time and the structure will be ready to receive the runoff generated from the next spell of rainfall. The structure be provided with an outlet pipe for excess flow which the structure receive and is more than the recharge rates of the wells and the temporary storage capacity of the structure. The schematic diagram of the typical rain water harvesting structure is shown in figure below ;

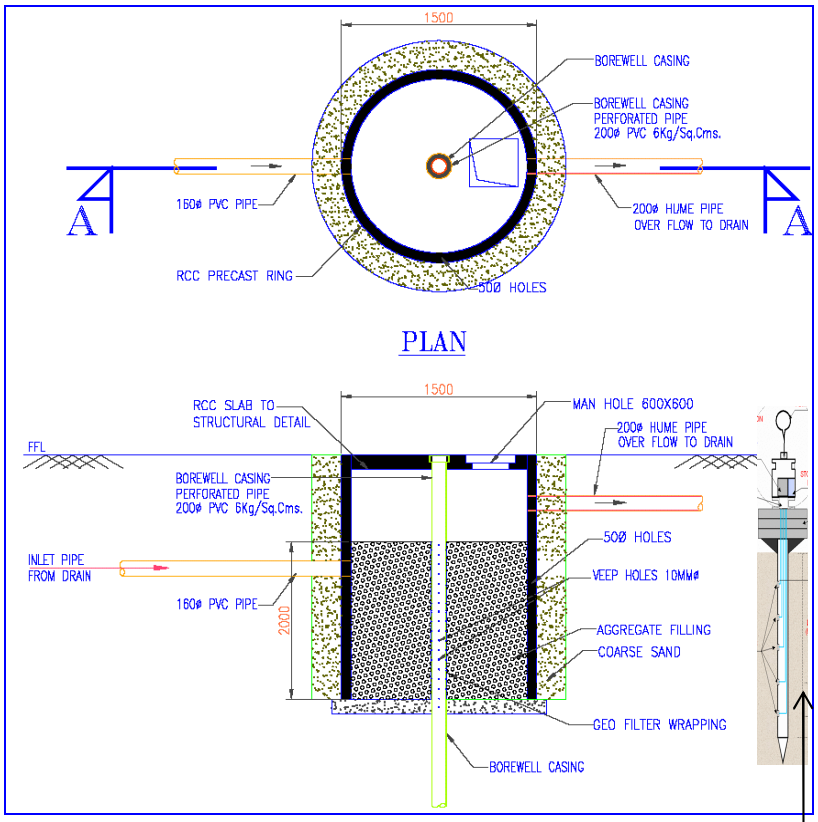


FIG. NO. 8 **TYPICAL RAINWATER HARVESTING STRUCTURE**

25.0 RECHARGE OPTIONS AT THE STUDY SITE

Based on the prevailing ground water conditions at the study site, the water potential of the shallow alluvial aquifer can be improved by impounding the water in site-specific artificial recharge structures. There is tremendous scope for large scale ground water recharge in the factory premise. Therefore recharge shafts & recharge wells and roof top rain water harvesting structures are provided at appropriate points for augmenting the recharge to shallow alluvial aquifer.

26.0 ARTIFICIAL RECHARGE TO GROUND WATER

- Total pumping from ground water sources **= 23,500 m^3 per annum**
- Considering 50 % of the annual extraction to be of recharged (As per CGWA norms for safe block), the quantity of water to be recharged into the aquifer system **= 11,750 m^3 per annum**
- **Total Runoff Water being Recharge = 14,802 m^3 per annum**

  The above calculation indicates that recharge potential of the RIL Project Premises is more than 50 % compared to the total withdrawal. The ground water withdrawal is easily being recharged by Storage cum Recharge Pond with Shafts on the and Recharge Wells within premises at appropriate points adjoining the storm water drains within the plant premise. As the subsurface formations consists of medium to coarse grained sand, the rate of infiltration and recharge to ground water is very good.

27.0 OBSERVATION ;

a) It can be observed from the present study that the project area falls under safe category as per the recommendations of the Ground water Estimation Committee – 1997 (GEC –1997) and all the blocks in the district falls under 'Safe' category. (CGWB 2014 Report: Dynamic Ground Water Resources of India)

b) In the pre-monsoon period the water level of study area varies between 4-8 m. bgl.

c) In the post-monsoon period the water level of the study area varies between 2-4 m. bgl.

d) There is seasonal water level fluctuation in and around the project area but still an ample scope for ground water development is possible in the study area.

e) Ground water characteristics of the study area are well within the Drinking Water Standards of IS 10500:2012.

f) Ramco Industries Ltd. is recharging ground water aquifer more than 50% in comparison to their annual ground water usage.

28.0 **CONCLUSION ;**

From the above facts it can be concluded that in view of present ground water condition of the project area, ground water withdrawal of 80 m^3/day ($max^{m.}$) will not exert unbearable load on the ground water aquifer of the area. However, Ramco Industries Limited is compensating the ground water withdrawal by recharging of ground water aquifer through rain water harvesting technique.

* * * * *

Permission for Ground Water Withdrawal
from Ground Water Directorate, Govt. of Bihar

निदेशक का कार्यालय, भूगर्भ जल निदेशालय, बिहार, पटना

पत्रांक:- 79.

प्रेषक:-

ई0 एन0 पासवान,
निदेशक,
भूगर्भ जल निदेशालय, बिहार, पटना ।

सेवा में,

मेसर्स रैमको इंण्डस्ट्रीज लिमिटेड,
ओरस कौरपोरेट सेन्टर, छटी मंजिल,
98-ए डी0 राधा कृष्ण रोड,
पी0बी0नं0-2949, माईलापुर,
चेन्नई-600004.

पटना, दिनांक:- 22/2/10.

विषय:- भोजपुर जिला के सिकियाँ प्रखंड में कार्डवरे सिमेंट सीट का प्लांट लगाने हेतु प्रतिवर्ष 3 ह0 मीटर भूगर्भ जल उपयोग करने की सहमति प्रदान करने के संबंध में ।

प्रसंग:- आपका पत्रांक 4480 दिनांक 9/11/2009.

महाशय,

उपर्युक्त विषय एवं प्रसंग के क्रम में भोजपुर जिला के सिकियाँ प्रखण्ड में कार्डवर सिमेंट प्लांट लगाने के निमित्त प्रतिवर्ष 80 मीटर प्रतिदिन अर्थात 3 ह0 मीटर सीमान्तर्गत अधीक्षण अभियंता (मुख्यालय) कोआंग (लघु जल संसाधन विभाग, पटना के पत्रांक 42 (गो0) दिनांक 3/2/10 के आलोक में भूगर्भ जल के उपयोग करने की सहमति दी जाती है ।

विश्वस्तभाजन,

भूगर्भ जल निदेशालय, बिहार, पटना

22/2/10