

**GEOHYDROLOGICAL STUDIES OF THE MINE AREA
OF M/S ARPAN FERRO ALLOYS,
MOHAGAONGHAT MANGANESE ORE MINE,
MOHAGAONGHAT, KATANGI, BALAGHAT M.P.**

AND

**CONSERVATION PLAN OF SURROUNDING WATER
RESERVOIR**

A REPORT

SUBMITTED

BY

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BALAGHAT M.P.

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CERTIFICATE

This is to certify that the report of "Geohydrological studies of the mine area of M/S Arpan Ferro-alloys, Mohagaonghat manganese ore Mine, Mohagaonghat, Katangi, Balaghat" has been prepared by Geological Association and Research Center under my guidance.

The field work, collection of well inventory data, rock and water samples etc. has been done by Shri Akhilesh Patle, Shri Manish Invati, Shri Sourabh Uikey and Shri Venkatesh Gedam, all members of GARC.

The maps have been generated by Shri Ankit Upadhyay, GIS and Remote Sensing Expert by Arc GIS 10.1 software.

The entire work has been done under my supervision and monitoring.



(Dr. Santosh Saksena)

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INTRODUCTION

Water is a prime natural resource, a basic need and a precious national asset. It is an important natural resource, essential to sustain life on Earth. It is one of the principal elements, which influence economic, industrial and agricultural growth.

The study area (Latitude $21^{\circ}34'10''\text{N}$ - $21^{\circ}38'20''\text{N}$ Longitude $79^{\circ}45'50''\text{E}$ - $79^{\circ}50'5''\text{E}$) is covered by Survey of India Toposheet No. 55 O/14. The area selected for study is number of times greater than the total area of the mine, so that a complete picture of the geomorphology, geology, drainage, lineaments etc. can be drawn in order to appraise the geohydrological conditions.

Groundwater conditions are very poor in this area and because of paucity of irrigation facilities, the villagers have to depend solely on rainfall. One tank is adjoining the mines area which can be developed to provide sufficient water for irrigation. A plan of its development has been formulated.

The study area is approachable by all weather roads from Waraseoni and Katangi.

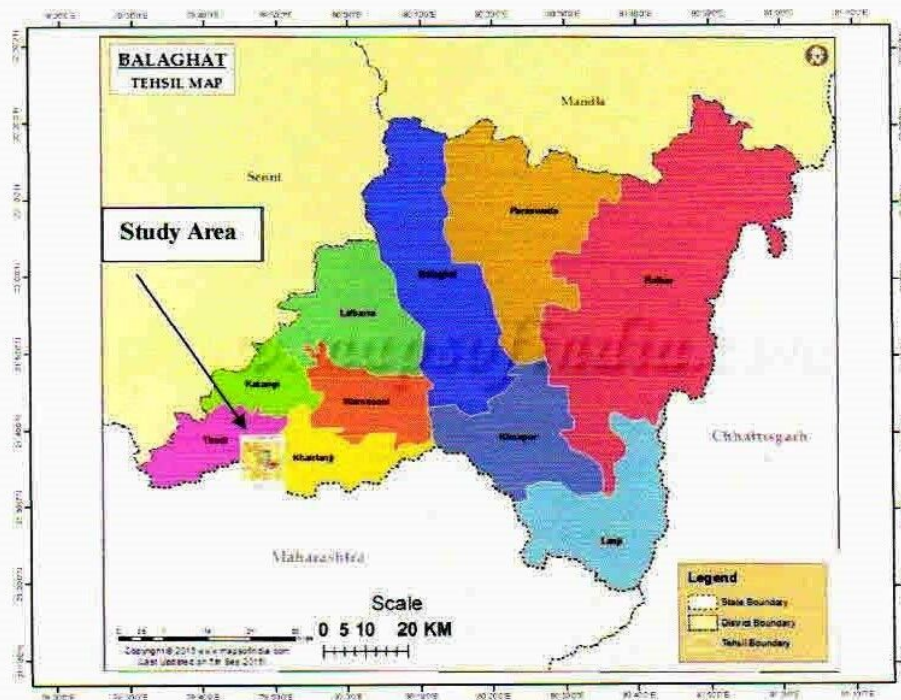
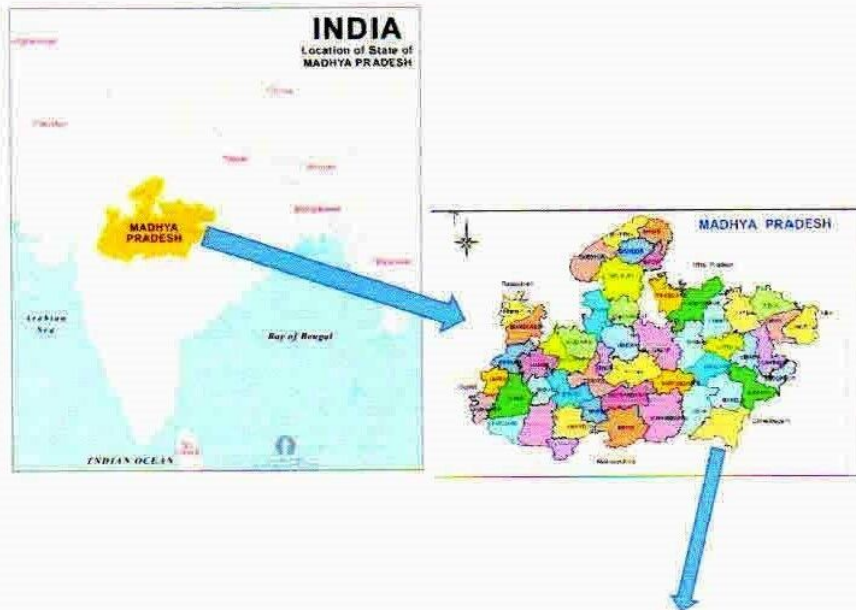
PHYSIOGRAPHY

The study area has a long hill range in the mine area, extending from northeast to southwest and tapering in southwest. The surrounding area is almost plain, which has paddy fields.

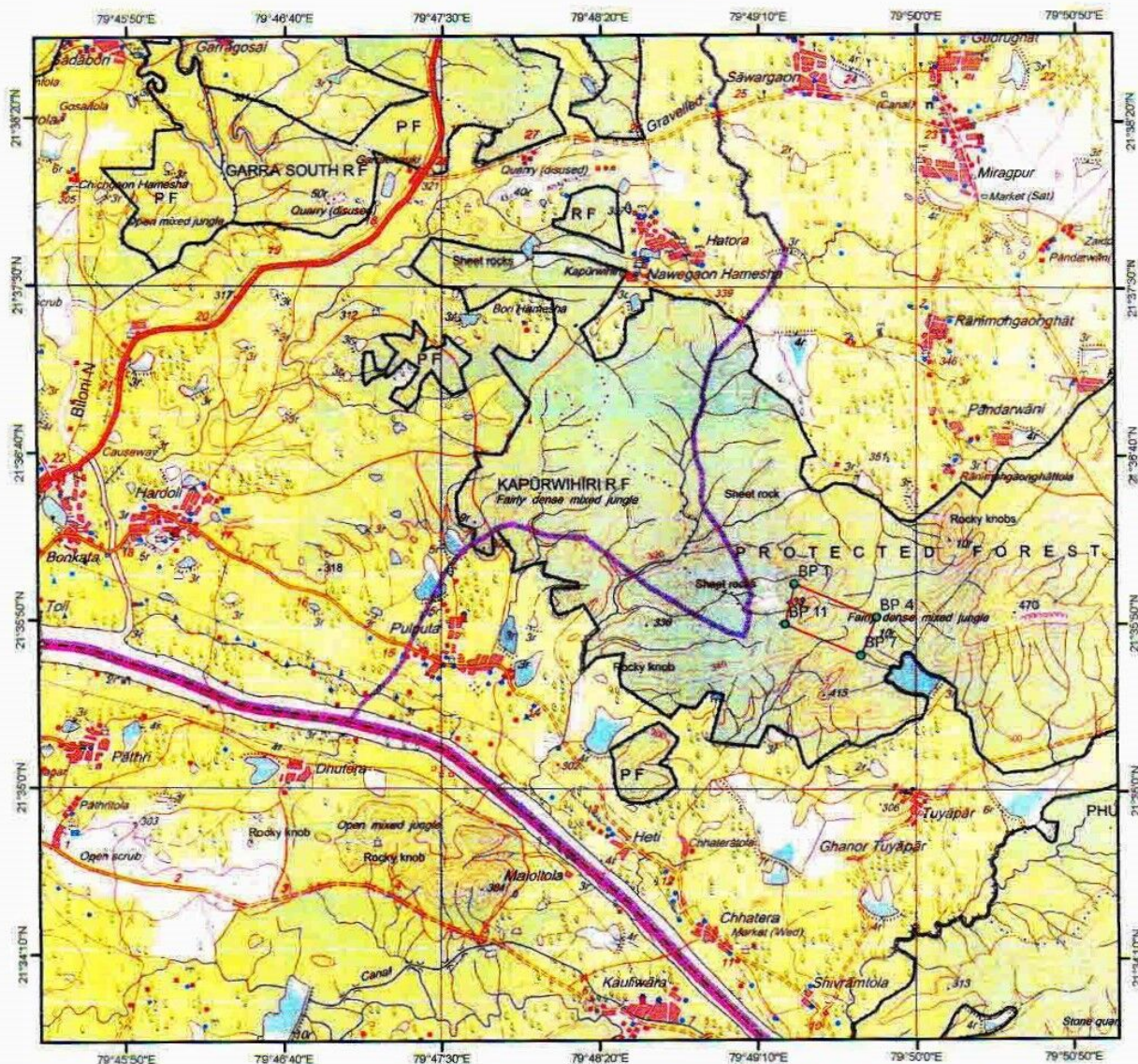
Beyond the mine area, the entire northwest to southwest area has sloppy and hilly part and drainage from this area is towards south where numbers of tanks have been developed.

LOCATION MAP OF STUDY AREA

VILLAGE – MOHGAONGHAT, TEH – KHAIRLANJI, DISTT. BALAGHAT



TOPOGRAPHICAL MAP OF STUDY AREA **VILLAGE - MOHGAONGHAT, DISTRICT - BALAGHAT** **TOPOSHEET NO. 55 O/14**



Legend

- Lease Area Boundary
- Study Area Boundary



Roads, metalled according to importance, distance stone Cart-track, pack-track, road pass, Footpath with bridge Bridges: with piers without, Causeway, Foot or Ferry Riverbank with wall or bank, embankment, Canal Dam, masonry or rock, Rock dam, Weir River banks: stony, 2 to 3 metres, over 6 metres Very high water channel, with island & rocks, tidal river Submerged rocks, Shoal, Shanty, Reefs Works: Irrigation, Tubewell, Spring, Tanks, perennials dry Embankments, road or rail, bank, Broken ground Railways, broad gauge, metre gauge, etc. 2 to 3 metres, etc. Subsidiary gauges, etc. 2 to 3 metres, etc. Mineral lines, tramway, Railway, etc. 2 to 3 metres, etc. Canals with sub-irrigation, sluice, etc. Small streams, Rills, etc. 2 to 3 metres, etc.	Towns or Villages: inhabited, deserted, fort Huts: permanent, temporary, Tower, Antiquities Temples, Chhatris, Churches, Mosques, Sagar, Tomb, Grave Lighthouses, Lightships, Buoy, Signal, Lighthouse, Anchorage Mine, Mine or shaft, Gravel, Sand Palace, palace, etc. Palace, Convent, Bungalow, Other, etc. Boundary, International State boundary, International Boundary pillars, survey, ancient, village, etc. Height, triangulation, station, point, etc. BM 633, BM 634, etc. Post office, Telegraph office, Combined office, Police station Bungalows, etc. or temporary, inspection, Rest-house Circuit house, Camping ground, Forest, etc. Special names: Administrative, Locality or land
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CLIMATE

The temperature of the area ranges from 8⁰C to 43⁰C. Minimum temperature is in January and maximum in May. The average annual rainfall is 1153.6 mm.

SOILS

The area has two types of soil. The mine area has no soil cover, but the area south of the mine area has soil which is suitable for paddy crop. As per the classification of Agricultural Survey of India, the soil in this area is deep, moderately well drained clayey soil with moderate erosion. It is associated with slightly deep well drained loamy soil.

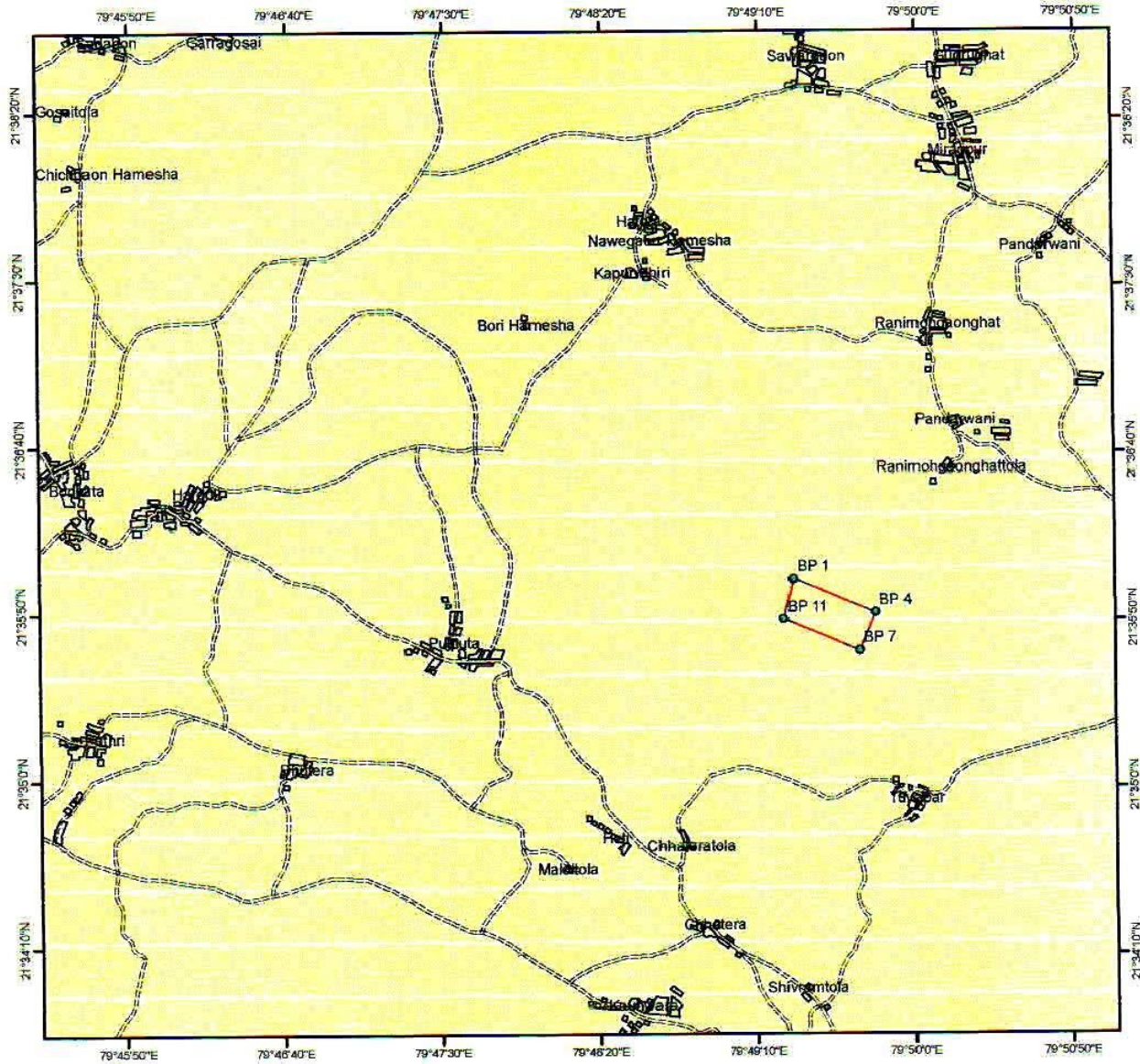
Remaining area has deep, moderately well drained clayey soil on very gentle sloping and moderately dissected with moderate erosion. It is associated with slightly deep, well drained loamy soil.

LAND COVER/LAND USE

The area has Phulchur forest in the south, beyond the mine area. The study area has forest which is mixed jungle. In the west is Kapurwihiri forest which is mixed jungle. A small forest is in southern area near the river.

The area north and south of mine area is plain land which is used for agriculture.

SETTLEMENT MAP OF STUDY AREA



DRAINAGE

Being a hilly area the drainage is widespread and of different types. The drainage from the mine area is towards south. Initially, the drainage is almost parallel but the second order streams take a dendritic pattern. The entire drainage enters a big lake east of Tuyapar village. Further south, parallel drainage is again seen.

In the west, beyond the mine area, there is a network of drainage which is dendritic and directed towards south. This drainage feeds number of lakes and ultimately the river.

The dendritic drainage from the mine area towards southwest reaches a big lake near Ghanar village. As the drainage is coming from the entire ridge, the quantity of water will be more and that is why the lake is very big.

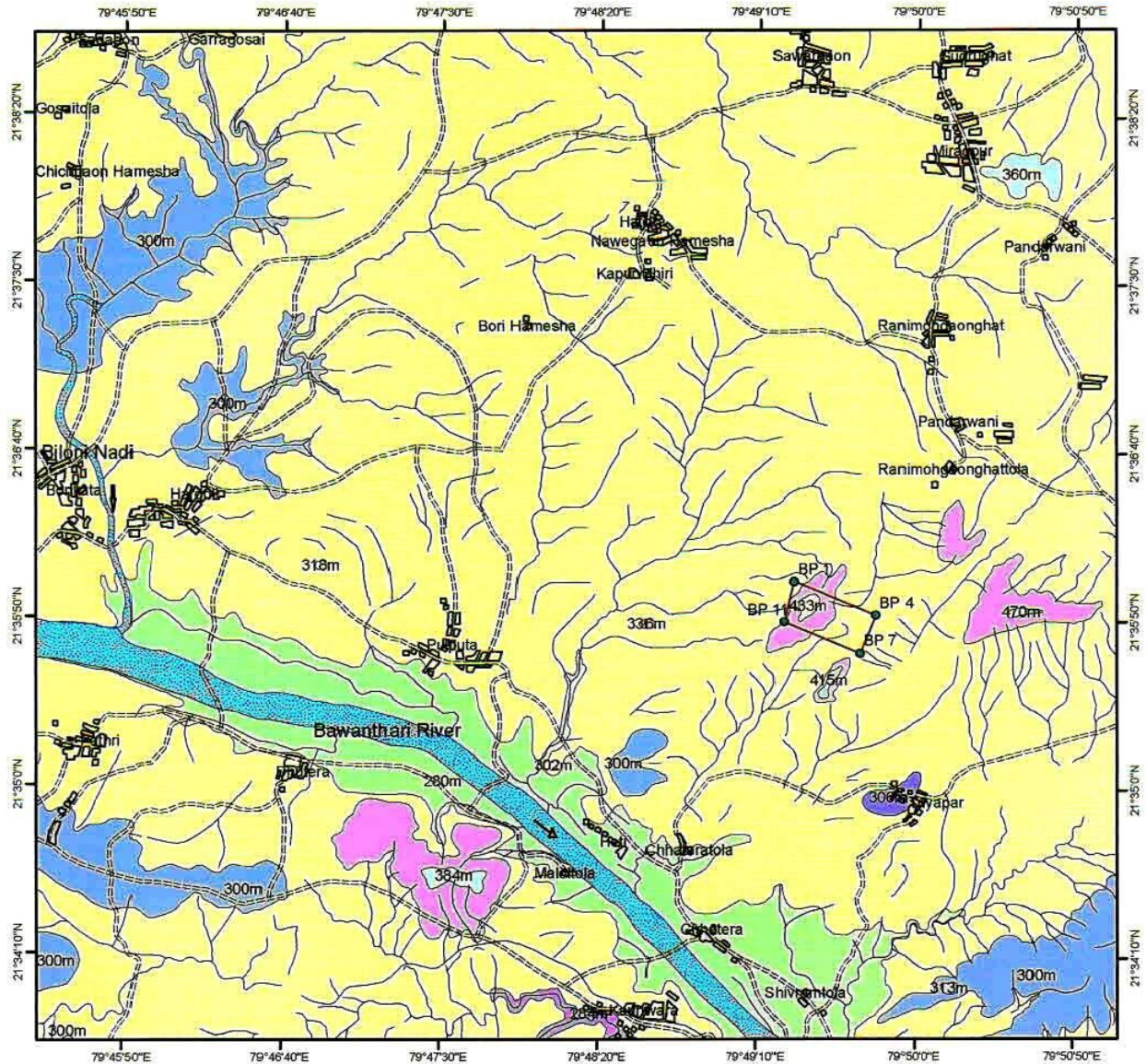
Looking at the drainage pattern in the area, there are fairly good chances of development of water resources. If properly planned and executed scientifically, the area can have perennial sources of water and sufficient groundwater storage.

GEOLOGY

The rocks of Balaghat area are of Pre-Cambrian and Archean age. The Bharweli- Ukwā groups of rock, extending upto Waraseoni and Tirodi, are the main manganiferous ore producing belt of central India.

After lot of study, field work and controversy, finally the stratigraphy of the area has been worked out. The area is divided into two major groups – the older is Sausar Group and the younger is Bharweli Group – separated by a Tectonic Contact.

PHYSIOGRAPHIC MAP OF STUDY AREA



Scale
0 0.5 1 2 KM



In the study area, the Biotite Schist/ Gneiss are the main rock types. At places, Granite Gneiss/Migmatite and Pegmatite Veins are encountered. The Biotite schist/ Gneiss have been hardened by the manganese solutions.

There had been intensive folding in this area which has rendered varying strikes and dip directions. The amount of dip ranges from 40° - 60° . The general strike direction is northeast-southwest and the dip is towards northwest. As such, clear folding is not seen, but looking at the variation in dip directions and amount it is concluded that the rocks have been folded.

GEOMORPHOLOGY

There are deep and long escarpments in the northeast and southwest directions and the ridge slopes towards south, draining all the rain water towards the lakes and river. The heights contour value is 470 m above MSL and the lowest contour vale is 280 m above MSL.

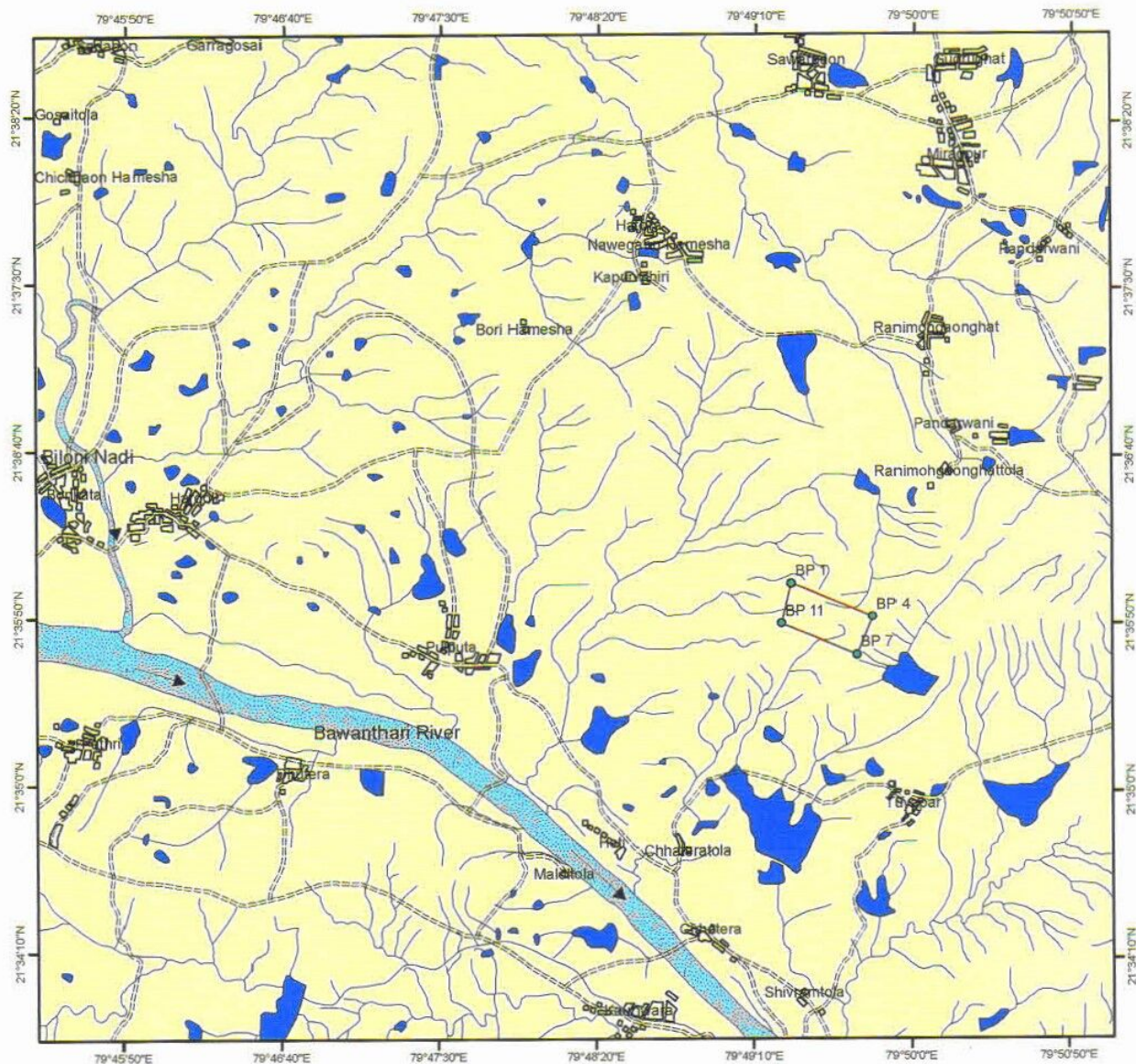
The contour values suddenly fall in northwest and southeast directions. The northern most part of the area has a long pediplain, almost parallel to the escarpments. It has been developed by extensive erosion. In fact it is be product of coalescence of several pediments. There is a long chain of pediments in between the pediplain and escarpments.

The entire area around the mine is surrounded by forest. If the groundwater conditions are improved, the forest will also be benefitted.

GROUNDWATER OCCURRENCE AND MOVEMENT

The occurrence and movement of groundwater depends upon the availability of water, rock formation present in the area, topography, geology, structures, geomorphology and hydrological properties of the water bearing material. Massive rocks are aquifuse present in the study area. Fractures rock act as aquiclude and the weathered rocks and alluvial covered zone comes under

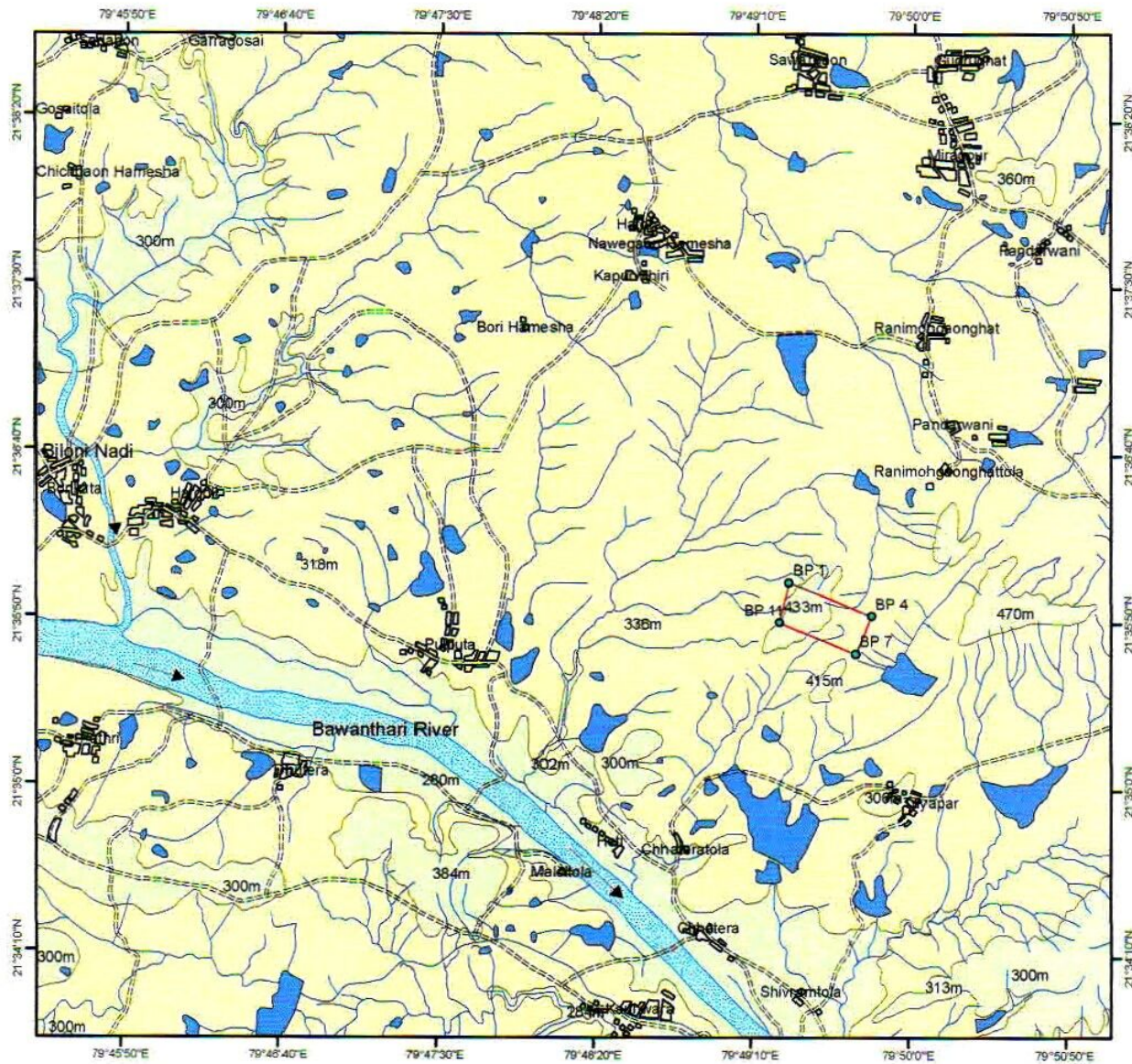
DRAINAGE AND SURFACE WATERBODIES MAP OF STUDY AREA



Scale
0 0.5 1 2 KM

Legend	
	Bawanthari River
	Biloni Nadi
	Lease Area Boundary
	Roads
	Settlement
	Surface Waterbodies
	Tributaries
	Study Area Boundary

GEOMORPHOLOGICAL MAP OF STUDY AREA



Legend

	Bawanthari River		Settlement
	Biloni Nadi		Surface Waterbodies
	Denudation Hills		Tributaries
	Lease Area Boundary		Pediplain
	Roads		

act as aquiclude and the weathered rocks and alluvial covered zone comes under the water bearing formations as aquifer. These formations, on the basis of their hydrological properties can be classified as follows-

1. Unconsolidated alluvium/ soil zone
2. Weathered rock zone
3. Fractured and jointed rock zone
4. Massive rock zone

1. Unconsolidated alluvium/ soil zone- These zone occupies almost 50-55% of the area surrounding the mine area. It has variable thickness. It is a productive aquifer yielding good quality of groundwater. This zone is composed of boulder, cobble, pebble, sand, silt, clay etc. the sand rich alluvial/ soil zone is highly porous and contains huge amount of water. The presence of clayey bands and mixture of clayey loamy soil reduces its permeability. This zone is unconfined aquifer

2. Weathered rock zone – This zone contains partially weathered rocks which has been decomposed and disintegrated. This zone also contains good quality of water.

3. Fractured and jointed rock zone- This zone is not widely distributed. It contains less quantity of water along the secondary pore space. It is a confined aquifer.

4. Massive rock zone- It is exposed in the central part of the study area. Secondary porosity is developed in deeper zones but the more compact rocks do not have any opening. This zone has no water.

GROUNDWATER INVENTORY

For conducting groundwater survey in the study area 19 representative wells spread throughout the area have been taken into consideration for the inventory. The area is covered by forests from all sides and is very thinly populated. There are only number of villages and well. The pre-monsoon groundwater levels have been measured, recorded and analyzed.

WELL INVENTORY DATA

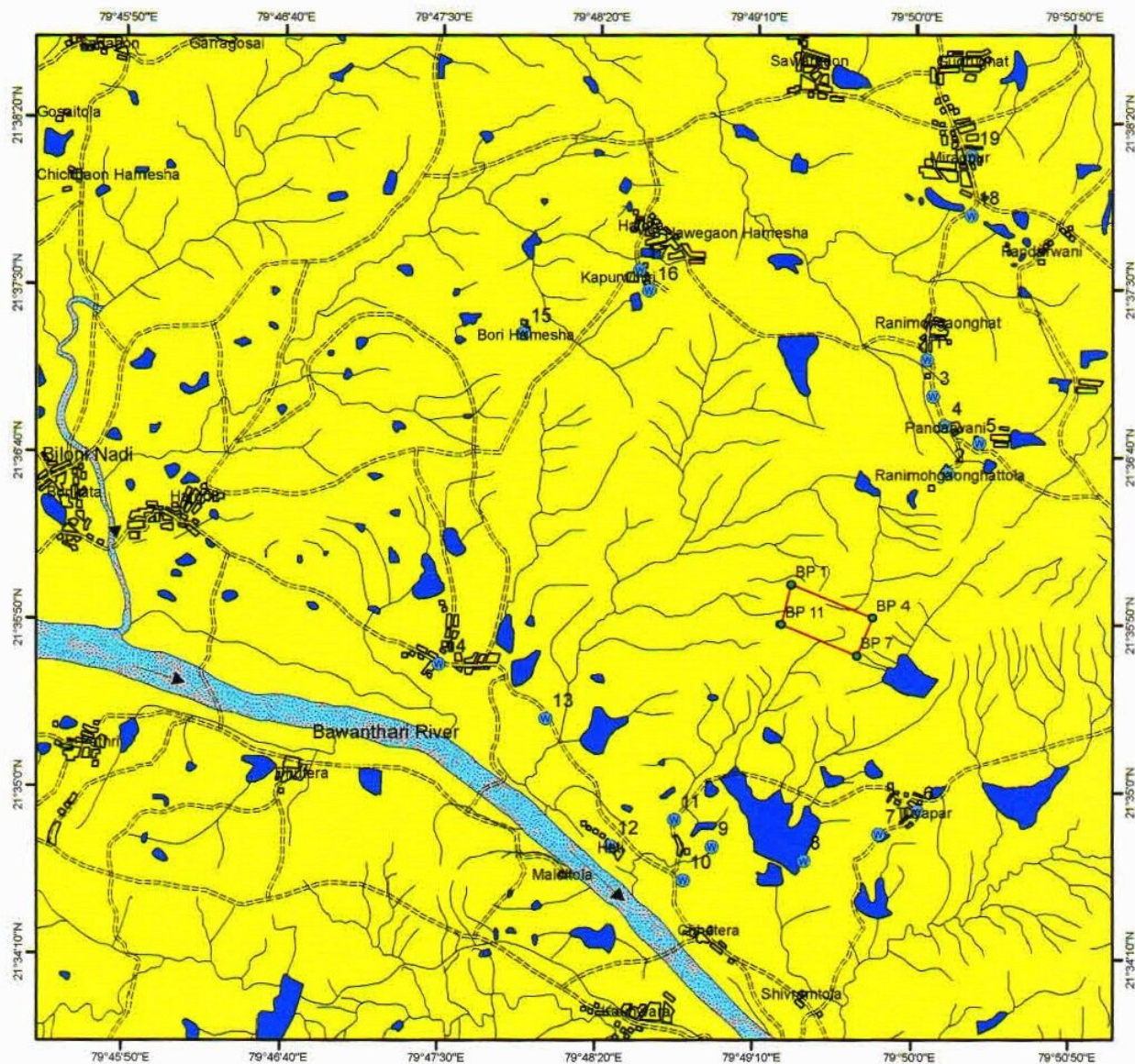
S. No.	Village name	Height of Parapet (m)	Depth of bedrock (m)	Actual depth of bedrock (m)	Depth of water level (m)	Actual depth of water level (m)	MS L (m)	Reduced level (m)	Coordinates
		A	B	B-A	C	C-A			
1	Mohagao Ghat 1	1.6	8.5	6.9	7.3	0.4	352	351	21°37'9" N 79°50'4" E
2	Mohagao Ghat 2	1.1	11.1	10	9.1	8	365	357	21°36'35" N 79°50'11" E
3	Mohagao Ghat 3	0.0	12	12	10	10	362	352	21°36'58" N 79°50'6" E
4	Panderwani 1	0.0	7.2	7.2	7.5	7.5	356	348	21°36'49" N 79°50'10" E
5	Panderwani 2	0.0	9.1	9.1	8.2	8.2	358	350	21°36'44" N 79°50'21" E
6	Tuiyapar 1	1.1	12.2	11.1	9.3	8.2	302	294	21°34'54" N 79°50'2" E
7	Tuiyapar 2	1.1	9.2	8.1	9	7.9	303	295	21°34'47" N 79°49'50" E
8	Tuiyapar 3	0.8	7	6.2	5.8	5	286	281	21°34'39" N 80°49'26" E
9	Chhatera 1	0.0	7	7	4.2	4.2	286	282	21°34'43" N 79°48'57" E

10	Chhatera 2	0.4	16	15.6	14.1	13.7	287	273	21°34'33" N 79°48'48" E
11	Chhatera 3	0.0	8.2	8.2	7	7	287	280	21°34'51" N 79°48'45" E
12	Puliputta 1	0.0	26	26	14	14	285	271	21°34'43" N 79°48'25" E
13	Puliputta 2	0.5	10.4	9.9	9	8.5	285	276	21°35'21" N 79°48'4" E
14	Puliputta 3	0.5	6.7	6.2	3	2.5	287	284	21°35'37" N 79°47'30" E
15	Navegao 1	1	7	6	Dry	Dry	330	330	21°37'16" N 79°47'56" E
16	Navegao 1	0.0	9.4	9.4	9.1	9.1	345	336	21°37'29" N 79°48'36" E
17	Kapurbihri	0.4	5.3	4.9	5.1	4.7	343	338	21°37'35" N 79°48'33" E
18	Miragpur 1	0.9	9	8.1	5.8	4.9	355	350	21°37'52" N 79°50'18" E
19	Miragpur 2	1	11.3	10.3	8.4	7.4	368	361	21°38'10" N 79°50'18" E

GROUNDWATER FEATURES

The surface drainage is from north to south and the groundwater also flows in the same direction. Some groundwater contours are in the west and central part of the study area. The highest contour value is 361 m above MSL, which is in the central part and the lowest contour value is 271 m above MSL in deep south. There are two basins surrounding a mount in south, as is evident in the map. Another prominent basin is in west which is near the lineament and it can be a potential zone for groundwater development. A basin is also situated in the central part, south of Miragpur. The groundwater flowing from north to

WELL LOCATION MAP OF STUDY AREA



Scale
0 0.5 1 2 KM

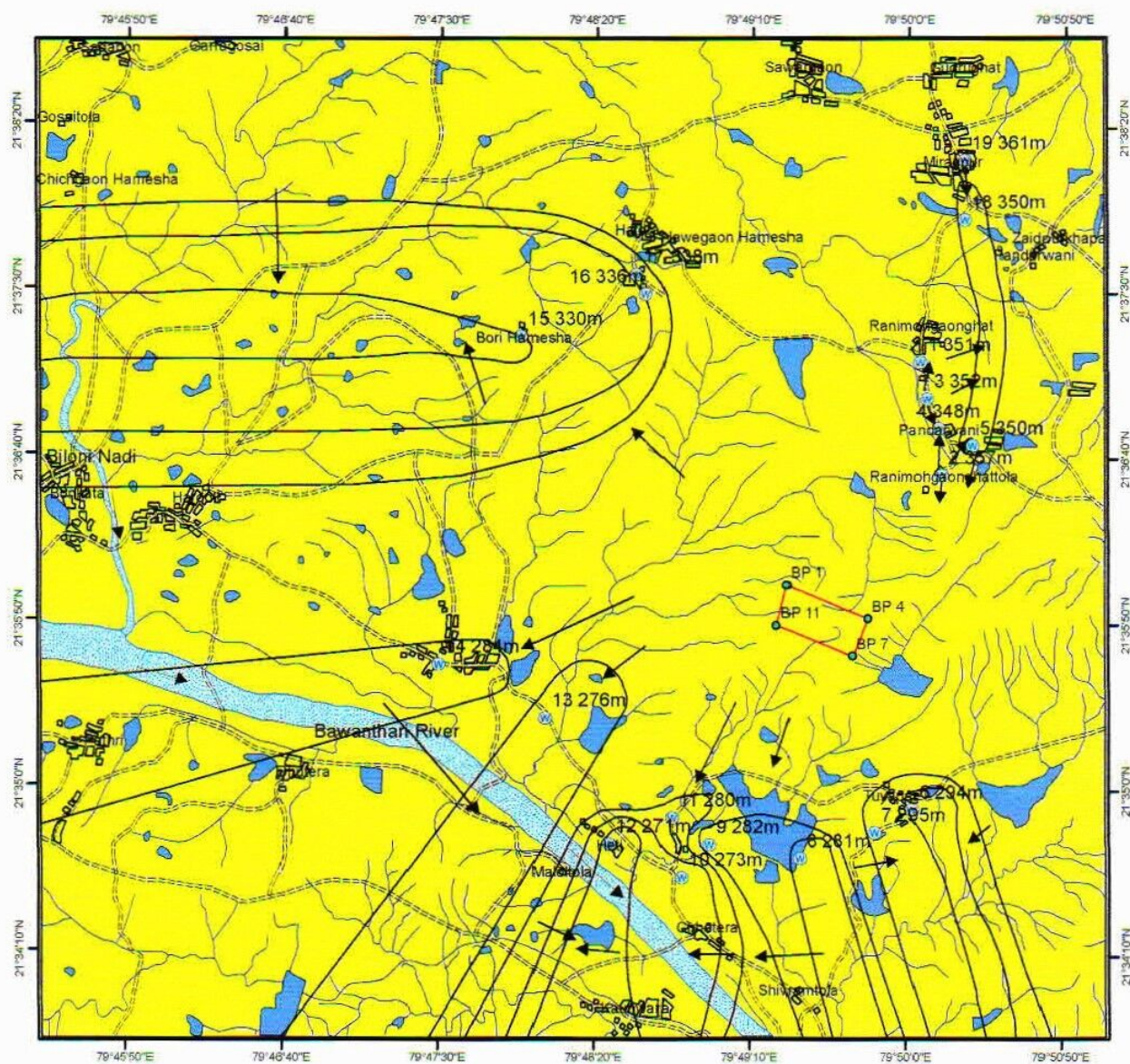
Legend

- Bawanthari River
- Biloni Nadi
- Lease Area Boundary
- Roads
- Settlement
- Surface Waterbodies
- Tributaries
- Study Area Boundary

S.N.	LATITUDE	LONGITUDE
1	21°37'9.053"N	79°50'3.903"E
2	21°36'35.285"N	79°50'11.094"E
3	21°36'58.054"N	79°50'6.052"E
4	21°36'48.926"N	79°50'10.027"E
5	21°36'43.978"N	79°50'20.961"E
6	21°34'54.097"N	79°50'2.013"E
7	21°34'47.033"N	79°49'50.059"E
8	21°34'38.947"N	79°49'25.985"E
9	21°34'42.926"N	79°48'56.927"E
10	21°34'33.06"N	79°48'47.999"E
11	21°34'50.33"N	79°48'45.046"E
12	21°34'43.044"N	79°48'25.147"E
13	21°35'20.993"N	79°48'4.092"E
14	21°35'37.369"N	79°47'29.842"E
15	21°37'15.707"N	79°47'55.969"E
16	21°37'28.898"N	79°48'35.614"E
17	21°37'34.56"N	79°48'33.175"E
18	21°37'52.339"N	79°50'18.125"E
19	21°38'10.408"N	79°50'17.981"E



WELL LOCATION AND WATERTABLE CONTOUR MAP OF STUDY AREA

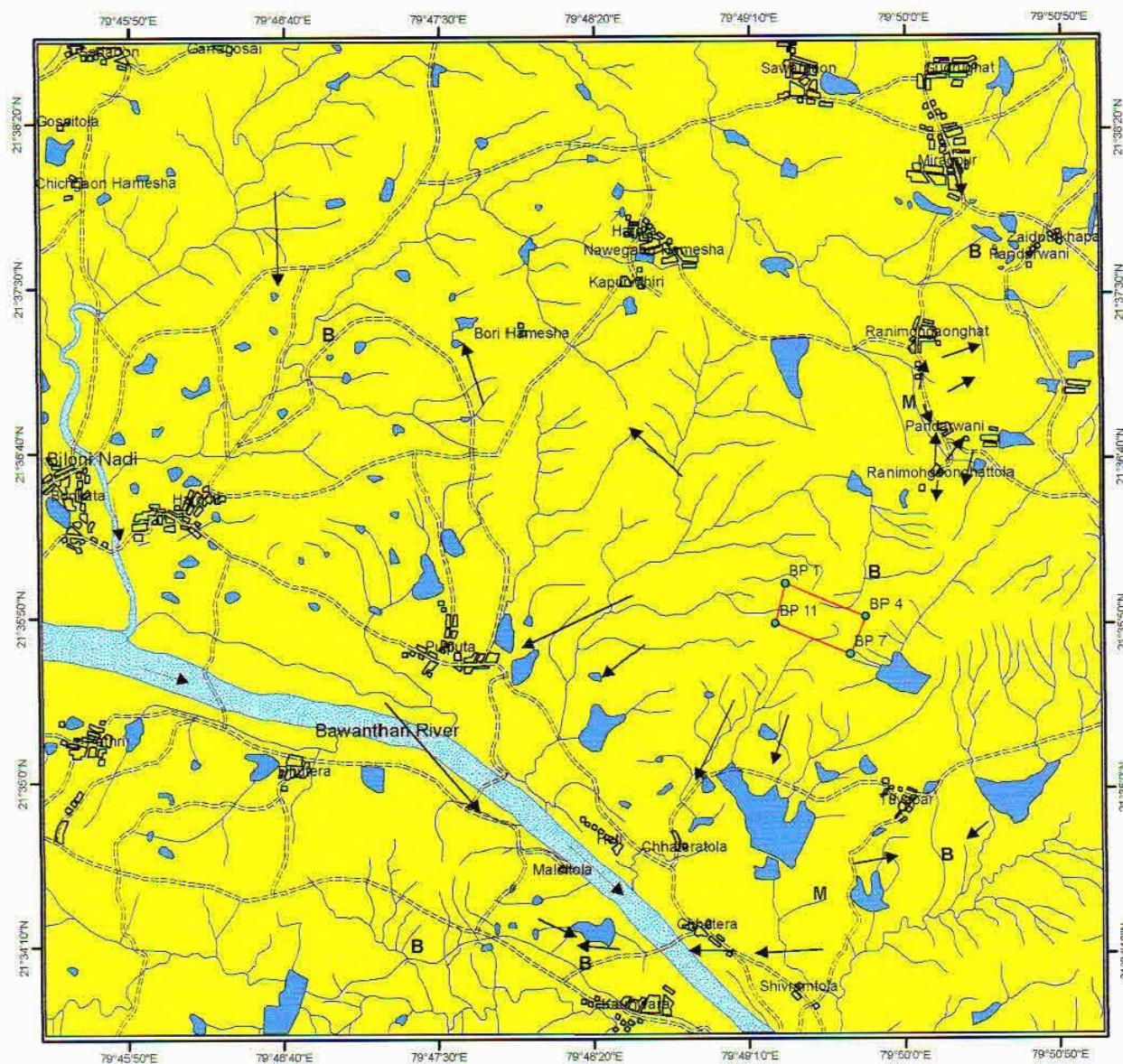


Legend

Bawanthari River	Surface Waterbodies
Biloni Nadi	Tributaries
Lease Area Boundary	Watertable Contours
Roads	Well location
Settlement	Study Area Boundary



HYDRAULIC GRADIENT MAP OF STUDY AREA



Scale
0 0.5 1 2 KM

Legend

- | | |
|---------------------|---------------------|
| Bawanthari River | Settlement |
| Biloni Nadi | Surface Waterbodies |
| Hydraulic Gradient | Tributaries |
| Lease Area Boundary | Study Area Boundary |
| Roads | |

the central part, south of Miragpur. The groundwater flowing from north to south crosses the mine area.

QUALITY OF WATER

Water is basic to all life forms- plants, animals and human beings. Water has a fairly constant composition, as is evident from the analysis report.

Water samples have been collected from different places in the early morning to avoid contamination by the users. The wells which are regularly used for domestic and irrigational purposes were selected for sampling. The collected samples were taken carefully to the laboratory of Groundwater Survey Department, Balaghat for analysis.

The results of the analysis are given in the table.

Drinking Water Standards established by different organization

Sr. no.	Constituents	Units	U.S. Environmental Protection Agencies		ECAF& UNESCO 1963		ICMAR 1975		WHO 1971		S.I.	
			Primary std.	Secondary std.	Permissible std.	Excessive limit	Permissible std.	Excessive limit	Highest desirable	Maximum permissible	Highest desirable	Maximum permissible
1.	Physical											
	Turbidity	JTV	-				5	25	5	25	10	25
	Colour	Hazen	-	-	-	-	5	25	5	50	5	50
	Taste & Odour	-	-	-	-	-	Not disgreable	-	Unobjectionable	-		Unobjectionable
2.	Chemical		-									
	pH				7.0-8.5	6.5-9.2	7.0-8.5	6.5-9.2	7.0-8.5	6.5-9.2	6.5-8.5	8.5-9.2
	T.D.S	Mg/l	-	500	500	1500	500	1500	500	1500	500	1500
	TH as CaCO ₃	Mg/l					300	600	100	500	300	600
	Calcium	Mg/l	-	-	75	200	75	200	75	200	75	200
	Magnesium	Mg/l	-	-	50	150	50	150	-	150	30	100
	Iron	Mg/l	-	0.3	0.3	1	0.3	1.0	0.05	1.5	.03	1
	Copper	-	-	1	1	1.5	1	3	0.05	1.5	0.05	1.5
	Zinc	-	-	5	5	15	5	15	5	15	5	15
	Chloride	-	-	250	200	600	250	1000	200	600	250	1000

	Phenolic Substance	-	-	-	0.001	0.002	0.001	0.002	0.001	0.002	0.001	0.002
	Fluoride	-	2.2	-	1.5	1	2	0.6-0.9	0.8-1.78	0.6-1.2	0.6-1.2	1.5
	Nitrates	-	10	-	50	100	20	50	50	-	45	No relaxation
	Sulphate	-	-	250	200	400	250	400	200	400	150	-
3.	Toxic elemental											
	Arsenic	Mg/l	0.05	-	-	0.2	-	0.2	-	0.05	0.05	No relaxation
	Mercury	-	0.002	-	-	-	-	-	-	0.001	0.001	No relaxation
	Cadmium	-	0.01	-	-	-	-	0.01	-	0.01	0.01	No relaxation
	Chromium	-	0.05	-	-	0.05	-	0.01	-	-	0.05	No relaxation
	Cyanide as CN	-	-	-	-	0.01	-	-	-	0.05	0.05	-
	Lead	-	0.05	-	-	0.1	-	0.01	-	0.1	0.1	-
	Selenium	-	0.01	-	-	0.05	-	0.05	-	0.01	0.01	-
4.	Radio Activity											
	Gross alpha emitter	Pci/l	-	-	-	-	-	-	-	3	-	-
	Gross beta emitter	Pci/l	-	-	-	-	-	-	-	30	-	-

CHEMICAL ANALYSIS OF WATER SAMPLES

(Water source- Dug well and Reservoir)

S. No	Location	Analysis									
		Temp.	pH	EC	TDS	TH	CaH	MgH	Ca ⁺	Mg ⁺	Cl ⁻
1	Mohagao n Ghat 1	33.6	7.22	245	157.8	120	77	49	29.7	10.6	68.9
2	Panderwani 2	32.8	7.11	214	136.4	110	55	54	21.4	12.6	58.66
3	Reservoir	33.8	7.4	330	210.4	72	66	12	25.2	10.95	44.21
4	Chhatera 2	33.5	7.64	490	314.6	84	55	30	21.5	8.77	30.20
5	Puliputta 1	33.2	7.65	640	410.16	90	62	38	25	9.64	50.84
6	Navegao n 1	33.8	7.80	281	182.33	110	60	45	26.8	12.67	30.20
7	Kapurbihari	34.1	7.75	320	450.24	90	45	46	18.4	12.33	30.82
8	Miragpur 2	34.4	7.62	610	390.7	72	45	33	17.7	8.77	30.20

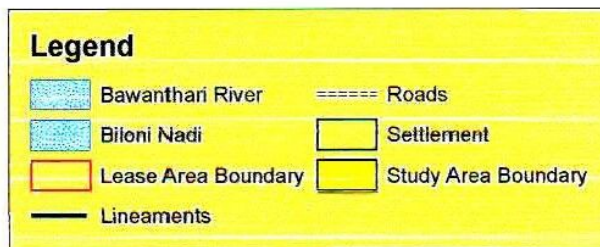
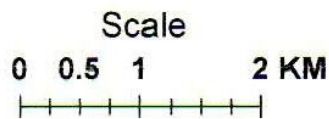
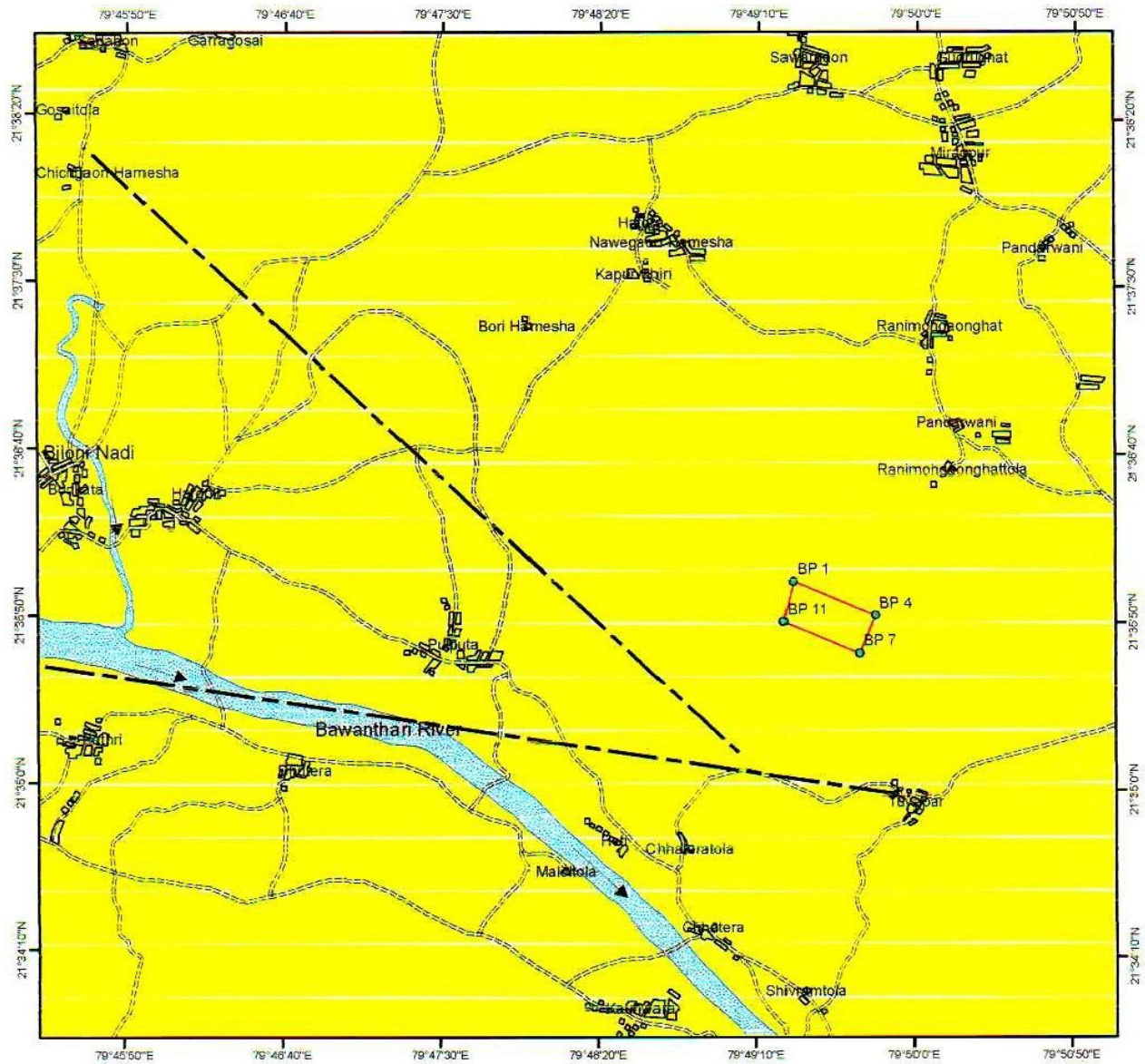
DISCUSSION

The analysis was done considering ten parameters. On comparison of the analysis with Indian Standard of Drinking Water it is observed that pH, TH, CaH, MgH, Ca, Mg and CL are within highest desirable range. However, EC and TDS are slightly high in village Pandarwani 2 and Reservoir, but within permissible limit. Suitable methods for purification of drinking water should be adopted by the villagers.

LINEAMENTS

A lineament is a map-able, simple or composite linear feature of a surface, whose parts are aligned in a rectilinear or slightly curvilinear

LINEAMENTS MAP OF STUDY AREA



relationship and which differ distinctly from the pattern of the adjacent features and presumably reflects a subsurface phenomenon. Lineament may be a joint, fracture, fault etc. that has gone deep into the earth and is the best indicator of groundwater recharge and potential zone, expressed in the aerial photograph or landsat imagery.

In the study area, two prominent lineaments have been identified. One lineament is from the northwestern corner of the study area and extends towards southeast. This lineament crosses Garra South and Kaapurihiri Reserve Forest and is almost at the fag end of the mining lease area. The second lineament is from southwest and extends up to southeast. It crosses the river and ends near Tuyapar village. Looking at the hydraulic gradients, almost entire groundwater movement is towards south and southwest. It crosses the lineament at several places.

GIS STUDIES

Geomorphic Information System (GIS) is a set of computer tools that allows working with data that are tied to a particular location. It is a database that is specially designed to work with map data. GIS works with many different applications- land use planning, environmental and groundwater management etc.

Different pairs of thematic maps were superimposed for GIS studies. They are as follows-

1. Interrelation of geomorphology and water table contours

The central part of the study area is a hilly tract and there are no villages in this area. Maximum water table contours are towards south. Some contours are in west and central part. There is complete harmony between the geomorphology and water table contours.

2. Interrelation of lineaments, surface water bodies and drainage

Maximum drainage of groundwater is from north to south. The major lineament extending from west to east crosses the river and some tanks. It also crosses number of streams. There are maximum villages in this area.

3. Interrelation of lineaments, hydraulic gradients and water table contours.

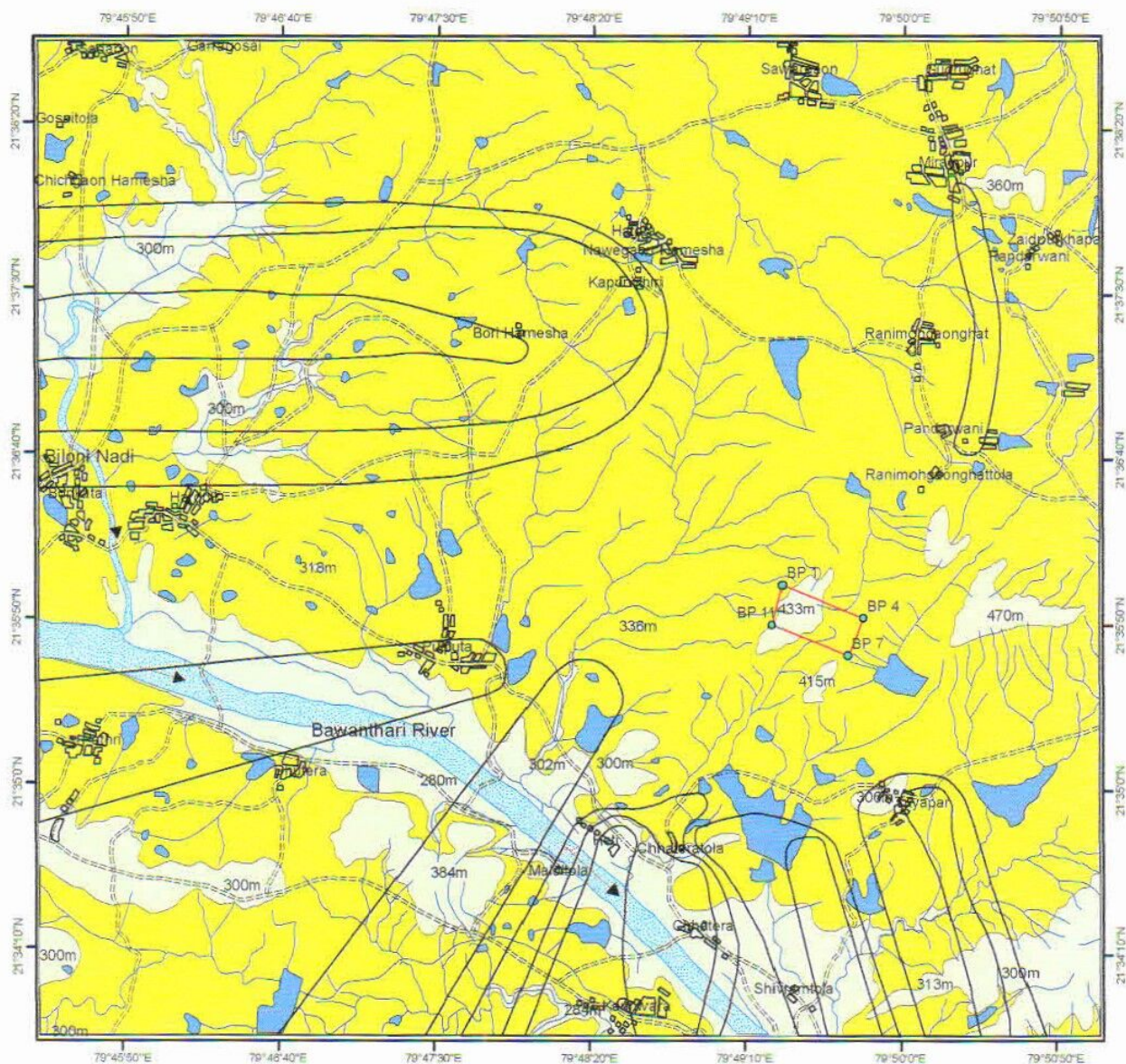
Maximum hydraulic gradients are dipping towards the major lineament in the west-east direction. Some of the hydraulic gradients are almost parallel to the lineament which is in northwest-southeast direction. Some of the contours in the south cut across the lineament from west to east and similar conditions are around the other lineament. Three prominent groundwater basins are very near to the west-east lineament and one basin crosses the northwest-south-east lineament. This is a favorable condition.

GROUNDWATER POTENTIALS

The mine area and its surrounding are hilly and covered with forest. The soil cover on the hills is scanty and maximum water flows down. The soil cover in the remaining area has alluvium and clay which has good porosity and permeability and paddy field are in this area. The fractured and jointed zone in the hills has poor permeability but where secondary porosity is developed by the tectonic activity and infiltration of water is possible. The groundwater potential of these rocks depends upon their fracture-joint system and their intensity.

The weathering depends upon the environmental factors like climate, topography, vegetation and slope conditions, apart from rock types. The degree

SUPERIMPOSED MAP OF GEOMORPHOLOGY AND WATERTABLE CONTOURS MAP OF STUDY AREA

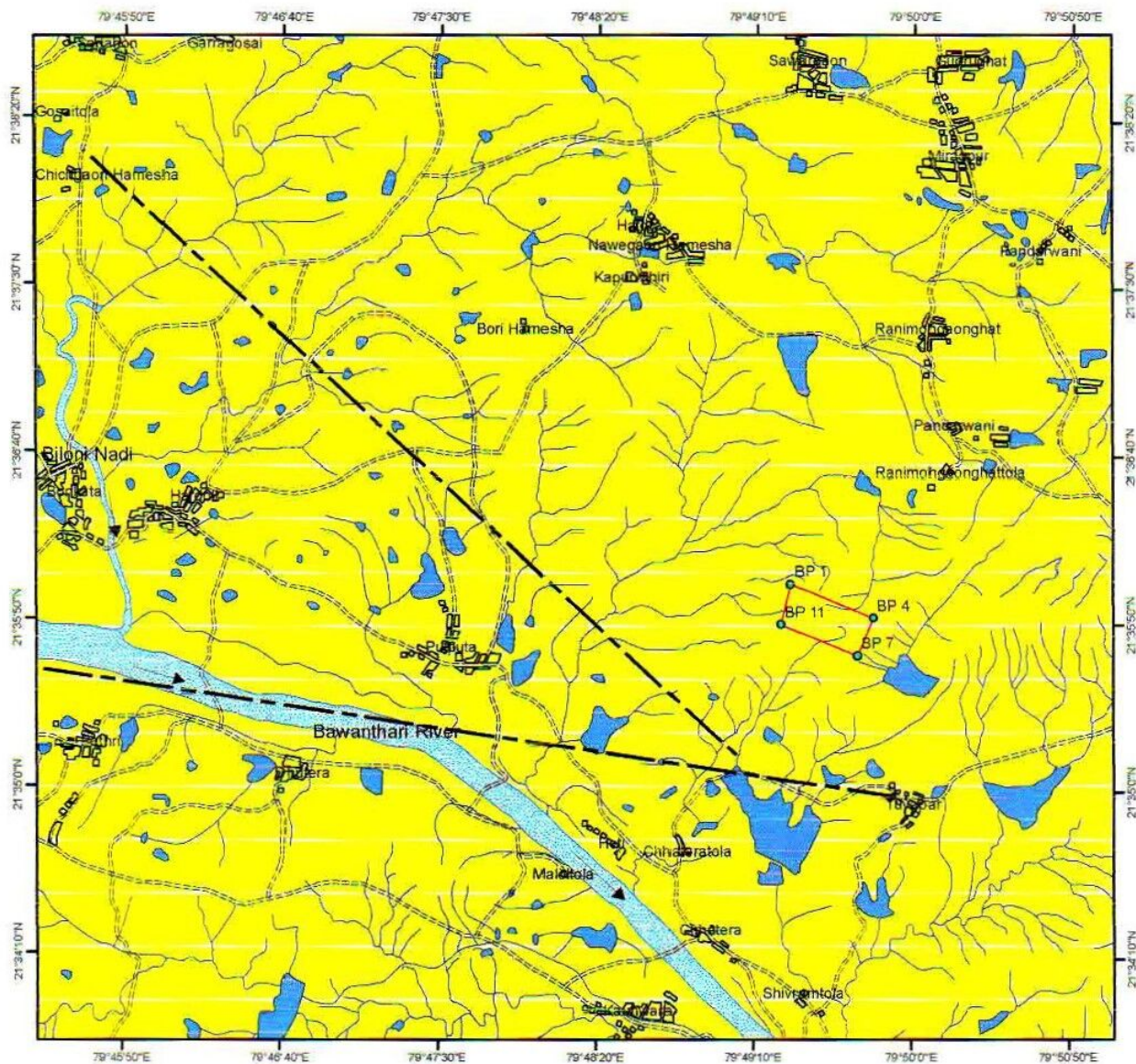


Scale
0 0.5 1 2 KM

Legend

	Bawanthari River		Settlement
	Biloni Nadi		Surface Waterbodies
	Denudation Hills		Tributaries
	Lease Area Boundary		Watertable Contours
	Roads		Pediplain

SUPERIMPOSED MAP OF LINEAMENTS AND DRAINAGE AND SURFACE WATERBODIES MAP OF STUDY AREA

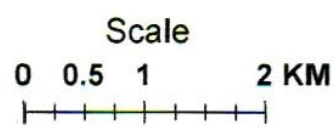
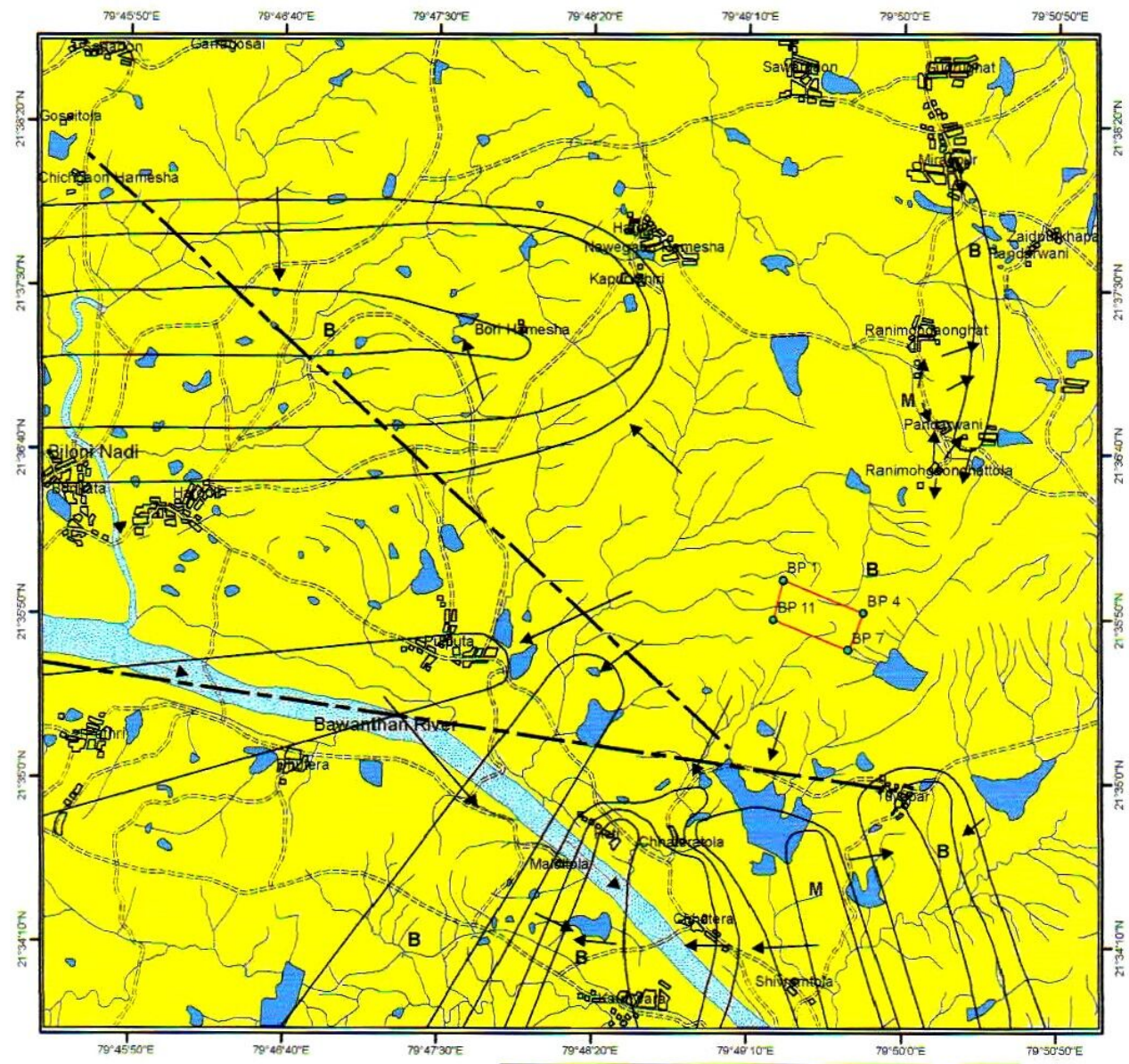


Legend

Bawanthari River	Settlement
Biloni Nadi	Surface Waterbodies
Lease Area Boundary	Tributaries
Lineaments	Study Area Boundary
Roads	



SUPERIMPOSED MAP OF LINEAMENTS AND WATERTABLE CONTOURS AND HYDRAULIC GRADIENT MAP OF STUDY AREA



Legend

Bawanthari River	Settlement
Biloni Nadi	Surface Waterbodies
Hydraulic Gradient	Tributaries
Lease Area Boundary	Watertable Contours
Lineaments	Study Area Boundary
Roads	

of weathering is another factor influencing the permeability of the disintegrated rocks. In completely weathered rocks, the primary minerals are usually replaced by clay minerals and hence the residue would be almost clayey, as seen in the central and southern part of the study area.

The groundwater potential of an area depends on the rainfall and particularly, on run in. The run in depends on the rate of infiltration and recharging areas, drainage density, topography, lithology, vegetation etc.

Considering all the factors, it is concluded that this area is of medium rainfall and most of the rainwater runs off from north to south and very little part of it infiltrates. The soil cover in the remaining area, which covers almost 50-55% of the entire area, receives the water from the hilly tract and it is infiltrated. Drainage density is high, which is a favorable factor.

For a complete assessment of the groundwater conditions it is imperative to evaluate the annual groundwater recharge and annual groundwater draft. Then only water budget can be drafted. For annual groundwater draft, complete demographic data is required.

CONSERVATION PLAN OF SURROUNDING WATER RESERVOIR

The reservoir adjoining the mine lease area has to be developed for conservation of water. Salient features of the reservoir are-

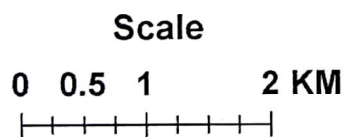
Total area of the Reservoir- 9.436 Hectare

Co-ordinates

1. Latitude $21^{\circ}35'41.842''$ N- Longitude $79^{\circ}49'57.66''$ E
2. Latitude $21^{\circ}35'33.104''$ N- Longitude $79^{\circ}49'51.392''$ E



WATER TANK NEAR LEASE AREA BOUNDARY



S.N.	LATITUDE	LONGITUDE
1	21°35'41.842"N	79°49'57.66"E
2	21°35'33.104"N	79°49'51.392"E
3	21°35'27.3"N	79°50'3.142"E
4	21°35'32.267"N	79°50'7.629"E

Water Tank Area 9.436 Hec.

Legend	
	Water Tank Boundary
	Lease Area Boundary
	Study Area Boundary

3. Latitude 21°35'27.3"N- Longitude 79°50'3.142"E
4. Latitude 21°35'32.267"N- Longitude 79°50'7.629"E

EXCAVATION OF PART OF PERIPHERY OF THE RESERVOIR

Periphery- 1.5 Km. (including length of the earthen dam which is 20 m long). A part of the periphery can be excavated to increase the size of the reservoir and its water holding capacity.

The Formula for excavation work is

$$k = PD/S$$

Where,

k= constant

P= Number of labors

D= Number of days

S= Cubic meter (cum) of soil excavated

Supposing 25 labors work for 6 day and excavate 500 cum of soil, then-

$$k = PD/S$$

$$= (25 \times 6) / 500$$

$$= 3/10 \text{ cum per day/labor}$$

The part of the periphery of the reservoir which is towards BP 7 from where the drainage is coming is about 100 m in length.

If this part of the periphery is excavated up to 2m depth and 2m width the volume of soil to be excavated will be $100 \times 2 \times 2 = 400 \text{ cum}$.

As per the above formula a labor can excavate 3/10 cum/day. If 50 labors are employed for the work, they will excavate the entire periphery of 400 cum @ 15cum/day in 26.66 days.

The Govt. rates the payment of unskilled labor is Rs. 258=00 /day
Therefore the payment for 50 labors working for 27 days will be-
 $50 \times 27 \times 258 = \text{Rs. } 3,48,000=00$

DESILTING OF THE BASE OF EARTHEN DAM

The earthen dam is 20 m long. Maximum silting is at the base of the dam, which has to be removed. The labor rates and working is the same as in the case of excavation.

Therefore, for desilting 20 m length, 1.5 m width and 2 m depth, as per the above formula a labor can excavate 3/10 cum/day. If 10 labors are employed for the work, they will desilt 60 cum @ 3cum/day in 20 days.

The Govt. rates the payment of unskilled labor is Rs. 258=00 /day
Therefore the payment for 10 labors working for 20 days will be-
 $10 \times 20 \times 258 = \text{Rs. } 51,600=00$

REPAIR AND MAINTENANCE OF EARTHEN DAM

This work can only be done after inspection of the dam by an expert engineer. Tentatively, a budget of Rs. 1,00,000=00 can be allotted for this work.

GRAND TOTAL OF EXPENDITURE ON CONSERVATION

PLAN OF SURROUNDING WATER RESERVOIR

$$3,48,000 + 51,000 + 1,00,000$$

$$= \text{Rs. } 4,99,600=00$$

(Rupees four lakhs ninety thousand and six hundred only)

CONCLUSION

In general, the groundwater conditions in hard rock terrain of Archean and Pre-Cambrian age are poor. It depends on the permeability of soil, weathered, fractured and jointed zones. Geomorphology and drainage also play an important role. In the study area, the hilly tract in centre and southern part

drains the rainwater towards south which has resulted in form of number of lakes. The drainage is scattered and drainage density is high.

The water table contours and hydraulic gradients depict that there are groundwater basins in the south near village Tuyapar, Hoti and Maloltola. In between, there is a mount near village Shivramtola. In the west there is a big groundwater basin near village Bori and Hamesha. Another groundwater basin is south of village Miragpur. A basin is also near the mining lease area but some part of the groundwater runs in the south direction, as is evident from the hydraulic gradients. The soil cover on the hilly tract is very thin and maximum water runs down the slopes. Therefore, construction of contour trenches will be futile. By opencast mining the water will be collected in pits which will be directed towards the Reservoir. There will be no ill-effect on agriculture by irrigating this water, as it has no pollutants.

There are no notified and endangered species of plants in this area, which may be affected due to mining activity. Therefore, biological environment will not have any significant impact due to proposed mining activity. The impact on biological environment because of the dust generated will be minimized by well developed green belt in and around the mining lease area. It will also compensate for the deforestation done during the development of the mine.



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