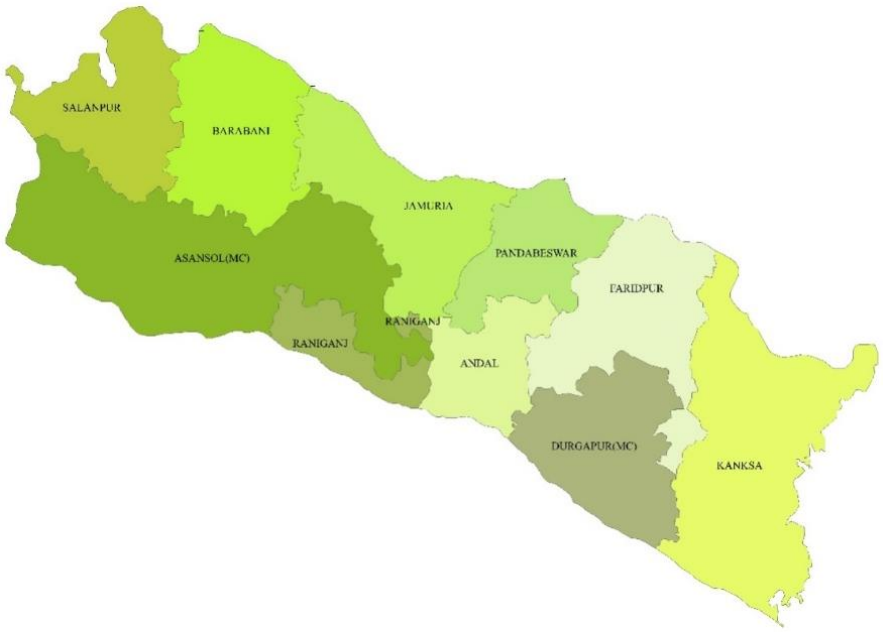
DISTRICT SURVEY REPORT
OF
PASCHIM BARDHAMAN DISTRICT

(For Mining of Minor Minerals)
As per Notification No. S.O.141 (E) New Delhi Dated 15th of January 2016, S.O.3611 (E) New DelhiDated 25th of July 2018 and Enforcement and Monitoring Guidelines for Sand Mining (EMGSM) January 2020, Issued by Ministry of Environment, Forest and Climate Change (MoEF&CC)



SEIAA Approval Date:

22nd August 2022

(As published in the Minutes of 70th Meeting of SEIAA under Miscellaneous Section, Point No.1)

July, 2022

PREPARED BY
Department of Industry, Commerce & Entreprises
Government of West Bengal

GOVERNMENT OF WEST BENGAL
DIRECTORATE OF MINES & MINERALS
4, ABANINDRANATH TAGORE ROAD
KOLKATA-700016

No. 1333 MD

Kolkata, 6th January, 2022.

TO WHOM IT MAY CONCERN

This is to certify that DSRs of concerned districts of West Bengal have been duly validated by respective district authorities and their suggestions/inputs, if any, have been duly incorporated in the DSRs. The DSRs have been finally scrutinised and accepted by the scrutiny committee of DMM, WB and the same have been forwarded to the Dept. of Industry, Commerce and Enterprises along with respective scrutiny reports for onward transmission to SEAC for necessary action.

Director of Mines and Minerals

Govt. of West Bengal

Table of Content

List of Plates

List of Annexure

List of Figure

List of Table

Abbreviations

% DEP – Departures

° C – Degree Centigrade

BGL – Below Ground Level

CD - Community Development

Cft- Cubic Feet

CGWB - Central Ground water Board

CRIS - Customized Rainfall Information System

Cum - Cubic meter

DGMS - Directorate General of Mines Safety

DGPS - Differential Global Positioning system.

DL&LRO - District Land & Land Reform officer

DSR - District Survey Report

EC – Environmental Clearance

EIA- Environment Impact Assessment

EMGSM - Enforcement and Monitoring Guideline for Sand Mining

ENVIS - Environmental Information System

ft – Feet

GIS - Geographical Information System

GMEC - Global Management and Engineering Consultant

GSI - Geological Survey of India

Ha – Hectare

hr - Hour

IMD – Indian Meteorological Department

ISRO - The Indian Space Research Organization

KM - Kilometer

LISS - Linear Imaging Self-Scanning Sensor

LOI - Letter of Intent

LULC - Land Use Land Cover

m^2 - Square meter

MBT - Main Boundary Thrust

MCT - Main Central Thrust

MFT - Main Frontal Thrust

Mcum – Million Cubic Meters

MMDR - Mines & Minerals (Development and Regulation) Act

MMR - Metalliferous Mines Regulation

MOEF & CC - Ministry of Environment, forest & Climate Change

Mph- miles per hour

M-Sand - Mineral Sand

MSME - Micro, Small & Medium Enterprises

Mt - Metric Ton

MT – Million Tons

NGT - National Green Tribunal

NH – National Highway

NIC - National Informatics Centre

OC - Officer In Charge

OGL - Original Ground level

PSU - Public Sector Unit

R/F – Rain Fall

SSMG - Sustainable Sand Mining Guidelines

WBMDTCL- West Bengal Mineral Development and Trading Corporation Limited

The WBMMCR, 2016 – The West Bengal Minor Mineral Concession Rules, 2016

Definitions

Riverbed: A riverbed is the area between two banks of river where sediment deposited. During the normal flow period, river water is contained in and flows along the riverbed. However, during a flood, the river overflows the riverbed and flows onto the floodplain.

Sandbars: The sandbar is the ridge of sand or coarse sediment that is built over a period of time.

Pre monsoon Sandbars: Sandbars which are identified from satellite imagery of pre monsoon period.

Post monsoon Sandbars: Sandbars which are identified from satellite imagery of post monsoon period.

Restricted Area: Sandbars or part of sandbars which are falling within restricted area. As per the Enforcement & Monitoring Guidelines for Sand Mining (EMGSM) 2020 the restricted zone for mining is a distance from the bank is ¼th of river width and not be less than 7.5 meters. Also, there is a no mining zone up to a distance of 1 kilometre (1 km) from major bridges and highways on both sides, or five times (5x) of the span (x) of a bridge/public civil structure (including water intake points) on up-stream side and ten times (10x) the span of such bridge on down-stream side, subjected to a minimum of 250 meters on the upstream side and 500 meters on the downstream side. No mining zone has been marked for an area up to a width of 100 meters from the active edge of embankments.

Potential Zone: Sandbars which are falling within the central $3/4^{th}$ part of the riverbed and which are not falling within the restricted area.

Potential Block: Each individual sand bars of potential zone is Potential Block.

River bed occurrence: River bed occurrence means sand, stone, boulder, pebbles, gravel accumulated in the river bed by natural phenomenon.

Replenishment: Quantum of sand deposited in a mined out void during monsoon period.

Aggradations: Aggradation (or alluviation) is the term used in geology for the increase in land elevation, typically in a river system, due to the deposition of sediment. Aggradation occurs in areas in which the supply of sediment is greater than the amount of material that the system is able to transport.

Act: It means the Mines and Minerals (Development and Regulation) Act, 1957(67 of 1957), as subsequently amended.

Mineral: It means minor minerals as defined in clause (e) of section 3 of the Act.

Sand: A natural resource, is a minor mineral as defined under S 3(e) of the Mines and Minerals (Development and Regulation) Act, 1957 (" MMDR Act").

Lease: It means a mining lease granted under West Bengal Minor Mineral Concession Rules, 2016.

Mining: Excavation of mineral by manual method or using machineries.

EXECUTIVE SUMMARY

Paschim Bardhaman district is a predominantly urban mining-industrial district in West Bengal. The headquarter of the district is Asansol. It was formed on 7 April 2017 after bifurcation of the erstwhile Bardhaman district as the 23rd district of West Bengal. The total geographical area of the district is 1603.17 sq. km.

The Paschim Bardhaman district comprises two subdivisions - Asansol Sadar and Durgapur. Asansol is the districts headquarter. There are two municipal corporations, eight community development blocks, 65 census towns and 62 Gram Panchayats in the district.

Paschim Bardhaman district has a tropical climate. The coldest month is January, while the hottest month is May. The monsoon is from June to September with an annual average rainfall of 1,044 mm. In monsoon period from June to September, wind blows from the south-west direction recognized as south-west monsoon.

Paschim Bardhaman district is well known for its coal resources which belong to Raniganj and Barakar Formation of Gondwana super-group. The district in its western part is a continuation of Chhotanagpur gneissic complex where as eastern part merged with the overlying Rajmahal trap. South-eastern part of the district merged with the margin Bengal Basin. The Gondwana seems to be occasionally traverse with the younger dykes which are potential sites development of stone aggregates. The margin between Chhotanagpur and Gondwana are often found to be clay bearing and are also linked with the potential economic mineral resources. Occurrences of lignite resources are also reported in the district as a part of younger Bengal Basin. A fairly good amount mono-mineralic gravel deposits is found to be spread over the Gondwana and is reported north-west of Durgapur city. A good stretch of morrum is found to be overlain the Gondwanas as well as the recent deposits of Bengal Basin. Atleast in few occurrences' quartzite deposits are also reported to be economically extracted.

Damodar and Ajay are the major two rivers defining the drainage of the district. Barakar River meets Damodar in the western part of the district which pours fairly good amount of construction sand in the river bed. Damodar River defines most of the southern boundary of the district while Ajay River defines the northern boundary shares with Birbhum district. Both Damodar and Ajay are found to be good source of construction sand which fed the requirements of the state.

Potential minor mineral blocks of Sand and other in-situ minerals have been identified and listed in this District Survey Report. Restriction zones are defined as per the Enforcement and Monitoring Guidelines for Sand Mining (EMGSM) guidelines 2020.

1 Preface

The need for District Survey Report (DSR) have been necessitated by Ministry of Environment, Forest and Climate Change (MoEF & CC) vide there Notification No. 125 (Extraordinary, Part II Section 3, Sub-section ii), S.O. 141 (E), dated 15th January 2016. The notification was addressed to bring certain amendments with respect to the EIA notification 2006 and in order to have a better control over the legislation. District level committee's have been introduced in the system. As a part of this notification, preparation of District Survey Reports has been introduced. Subsequently, MoEF & CC has published Notification No. 3611 (E), dt. 25th July, 2018 regarding inclusion of the "Minerals Other than Sand" and format for preparation of the DSR has been specified. Enforcement and Monitoring Guidelines for Sand Mining (EMGSM) January 2020, Issued by MoEF & CC is prepared in consideration of various orders/directions issued by Hon'ble NGT in matters pertaining to illegal sand mining and also based on the reports submitted by expert committees and investigation teams. This DSR has been prepared in conformity with the S O 141 (E), S O 3611 (E) and other sand mining guidelines published by MoEF & CC time to time as well as the requirement specified in WBMMCR, 2016.

The purpose of DSR is to identify the mineral potential areas where mining can be allowed; and also, to distinguish areas where mining will not be allowed due to proximity to infrastructural structures and installations, areas of erosion, areas of environmental sensitivities etc.

The DSR would also help to estimate the annual rate of replenishment wherever applicable.

Preparation of this DSR involved both primary and secondary data generation. The primary data generation involved the site inspection, survey, ground truthing etc. while secondary data has been acquired through various authenticated sources and satellite imagery studies. The secondary data related to district profile, local geology, mineralization and other activities are available in rather a piecemeal fashion

The DSR of Paschim Bardhaman district describes the general geographical profile of the district, distribution of natural resources, livelihood, climatic condition, inventory of minor minerals and revenue generation.

2 Introduction

The District Survey Report of Paschim Bardhaman District has been prepared as per the guide line of Ministry of Environment, Forests and Climate Change (MoEF&CC), Government of India vide Notification S.O.-1533(E) dated 14th Sept, 2006 and subsequent MoEF&CC Notification S.O. 141(E) dated 15th Jan, 2016. This report shall guide systematic and scientific utilization of natural resources, so that present and future generation may be benefitted at large. Further, MoEF&CC published a notification S.O. 3611(E) Dated 25th July, 2018 and recommended the format for District Survey Report.

The main objective of DSR is identification of areas of aggradations or deposition where mining can be allowed; and identification of areas of erosion and proximity to infrastructural structures and installations where mining should be prohibited and calculation of annual rate of replenishment and allowing time for replenishment after mining in that area. The DSR would also help to calculate the annual rate of replenishment wherever applicable and allow time for replenishment. Besides the sand mining, the DSR also include the potential development scope of in-situ minor minerals.

The objectives of the District Survey Report are as follows:

1. To identify and quantify minor mineral resources for its optimal utilization.
2. To regulate sand and gravel mining, identification of site-specific end-use consumers and reduction in demand and supply gaps.
3. To facilitate use information technology (IT) for surveillance of the sand mining at each step.
4. To enable environmental clearance for cluster of sand and gravel mines.
5. To restrict illegal mining.
6. To reduce occurrences of flood in the area.
7. To maintain the aquatic habitats.
8. To protect ground water in the area by limiting extraction of material in riverbeds to an elevation above the base flow.
9. To maintain data records viz. details of mineral resource, potential area, lease, approved mining plan, co-ordinates of lease hold areas, and revenue generation.
10. To design a scientific mining plan and estimate ultimate pit limit.
11. To frame a comprehensive guideline for mining of sand and other minor minerals.

The District Survey Report (DSR) comprises secondary data on geology, mineral resources, climate, topography, land form, forest, rivers, soil, agriculture, road, transportation, irrigation etc of the district collected from various published and un-published literatures and reports as well as various websites. Data on lease and mining activities in the district, revenue etc. have been collected from the DL & LRO office of the district and from West Bengal Mineral Development Corporation Limited.

2.1 Statutory Framework

2.1.1 Evolution of the Environmental Regulatory Framework:

Ministry of Environment, Forest and Climate Change (MoE &CC) has published several notifications time to time to formulate and implement the District Survey Report (DSR) for every district. Statutory Framework and its legal aspect with respect to DSR are tabulated in Table 2.1.

Table 2.1: Requirement of District Survey Report and its year wise modification of Guidelines

Year	Particulars
1994	The Ministry of Environment, Forest and Climate Change (MoEF & CC) published Environmental Impact Assessment Notification 1994 which is only applicable for the Major Minerals more than 5 ha.
2006	In order to cover the minor minerals also into the preview of EIA, the MoEF&CC has issued EIA Notification SO 1533 (E), dated 14th September 2006, made mandatory to obtain environmental clearance for both Major and Minor Mineral more than 5 Ha.
2012	Further, Hon'ble Supreme Court wide order dated the 27th February, 2012 in I.A. No.12- 13 of 2011 in Special Leave Petition (C) No. 19628-19629 of 2009, in the matter of Deepak Kumar etc. Vs. State of Haryana and Others etc., ordered that "leases of minor minerals including their renewal for an area of less than five hectares be granted by the States/Union Territories only after getting environmental clearance from MoEF"; and Hon'ble National Green Tribunal, order dated the 13th January, 2015 in the matter regarding sand mining has directed for making a policy on environmental clearance for mining leases in cluster for minor Minerals.
2016	The MoEF&CC in compliance of above Hon'ble Supreme Court's and NGT'S order has prepared "Sustainable Sand Mining Guidelines (SSMG), 2016" in consultation with State governments, detailing the provisions on environmental clearance (EC) for cluster, creation of District Environment Impact Assessment Authority, preparation of District survey report and proper monitoring of minor mineral. There by issued Notification dated 15.01.2016 for making certain amendments in the EIA Notification, 2006, and made mandatory to obtain EC for all minor minerals. Provisions have been made for the preparation of District survey report (DSR) for River bed mining and other minor minerals.
2016	The West Bengal Minor Minerals Concession Rules, 2016 amended the Mines and Minerals (Development and Regulation) Act, 1957 (Act 67 of 1957), to make the rules regulating the grant of mining licenses, prospecting license-cum-mining leases and mining leases in respect of minor minerals by auction process. The rule also incorporates EIA 2016 also includes SSMG

Year	Particulars
	2016 for minor mineral mining.
2018	MoEF&CC published a notification S.O. 3611(E) Dated 25th July, 2018 and recommended the format for District Survey Report .The notification stated about the objective of DSR i.e "Identification of areas of aggradations or deposition where mining can be allowed; and identification of areas of erosion and proximity to infrastructural structures and installations where mining should be prohibited and calculation of annual rate of replenishment and allowing time for replenishment after mining in that area".
2020	Enforcement and Monitoring Guidelines for Sand Mining (EMGSM) 2020 has been published modifying Sustainable sand Mining Guidelines, 2016 by MoEF&CC for effective enforcement of regulatory provisions and their monitoring. The EMGSM 2020 directed the states to carry out river audits, put detailed survey reports of all mining areas online and in the public domain, conduct replenishment studies of river beds, constantly monitor mining with drones, aerial surveys, ground surveys and set up dedicated task forces at district levels. The guidelines also push for online sales and purchase of sand and other riverbed materials to make the process transparent. They propose night surveillance of mining activity through night-vision drones.

2.1.2 Other Guidelines for Sand Mining in India:

The West Bengal Minor Minerals Concession Rules (WBMMCR), 2016

1) (a) No person shall undertake mining operation in any area prohibited by the 'Stale Government in the public interest by notification in the *Official Gazette*.
Provided that nothing in the sub-rule shall affect any mining operation undertaken in any area in accordance with the terms and conditions of a mining lease or mineral concession already granted.
(b) No person shall transport or store or cause to be transported or stored any mineral otherwise than in accordance with the provisions of these rules and the West Bengal Minerals (Prevention of Illegal Mining, Transportation and Storage) Rules, 2002.

(2) No minor mineral coming out in course of digging of wells or excavation of tanks shall be disposed of by the person digging or excavating without informing the District Authority as well as the Executive Officer of the *Panchayat Samiti* or the Executive Officer of the Municipality concerned, as the case may be, about such occurrence.
Provided that disposal of such minor mineral may be allowed on pre-payment of prices of such minor mineral at the prevailing market rate as determined on the basis of the rates published by the Public Works Department / concerned department of the State Government for the concerned area from time to time.

(3) No mining of river bed occurrences shall be allowed within 300 meters, upstream and downstream, measured from the centre line of any bridge, regulator or similar hydraulic structure and from the end point of bank protection works.

(4) No river bed mining shall be allowed beneath 3 meters of the river bed or ground water level, whichever is less.

(5) No mining operation in case of river bed occurrence shall be done within a distance of three (3) kilometers of a barrage axis or dam on a river unless otherwise permitted by the concerned Executive Engineer or Revenue Officer or authorized officer and such distance shall be reckoned across an imaginary line parallel to the 'barrage, or dam axis, as the case maybe.

(6) No extraction of river bed occurrence shall 'be allowed beyond the central one third of the river bed, or keeping a distance of 100 meter from the existing bank line whichever is less, unless otherwise permitted by the concerned Executive Engineer or Revenue Officer.

(7) No extraction of minerals other than river bed occurrence shall be allowed within fifty (50) meters from any road, public structure, embankment, railway line, bridge canal, road and other public works or buildings.

(8) No mining lease shall be granted without proof of existence of mineral contents in the area for which the application for a mining lease has been made in accordance with such parameters as may be prescribed by the Government from time to time.

N.B- The aforesaid application for mining lease shall succeed the competitive bidding for mining lease for a specified mineral(s).

Sustainable Sand Mining Management Guidelines (SSMMG), 2016 by MoEF&CC.

The sustainable sand Mining Management Guidelines 2016 has been prepared after extensive consultation with the States and Stakeholders over a period of one year. The main objective of the Guideline is to ensure sustainable sand mining and environment friendly management practices in order to restore and maintain the ecology of river and other sand sources.

a) Parts of the river reach that experience deposition or aggradation shall be identified first. The Lease holder/ Environmental Clearance holder may be allowed to extract the sand and gravel deposit in these locations to manage aggradation problem.

b) The distance between sites for sand and gravel mining shall depend on the replenishment rate of the river. Sediment rating curve for the potential sites shall be developed and checked against the extracted volumes of sand and gravel.

c) Sand and gravel may be extracted across the entire active channel during the dry season.

d) Abandoned stream channels on terrace and inactive flood plains be preferred rather than active channels and their deltas and flood plains. Stream should not be diverted to form inactive channel.

e) Layers of sand and gravel which could be removed from the river bed shall depend on the width of the river and replenishment rate of the river.

f) Sand and gravel shall not be allowed to be extracted where erosion may occur, such as at the concave bank.

g) Segments of braided river system should be used preferably falling within the lateral migration area of the river regime that enhances the feasibility of sediment replenishment.

h) Sand and gravel shall not be extracted within 200 to 500 meter from any crucial hydraulic structure such as pumping station, water intakes, and bridges. The exact distance should be ascertained by the local authorities based on local situation. The cross-section survey should cover a minimum distance of 1.0 km upstream and 1.0 km downstream of the potential reach for extraction. The sediment sampling should include the bed material and bed material load before, during and after extraction period. Develop a sediment rating curve at the upstream end of the potential reach using the surveyed cross- section. Using the historical or gauged flow rating curve, determine the suitable period of high flow that can replenish the extracted volume. Calculate the extraction volume based on the sediment rating curve and high flow period after determining the allowable mining depth.

h) Sand and gravel could be extracted from the downstream of the sand bar at river bends. Retaining the upstream one to two thirds of the bar and riparian vegetation is accepted as a method to promote channel stability.

Flood discharge capacity of the river could be maintained in areas where there are significant flood hazard to existing structures or infrastructure. Sand and gravel mining may be allowed to maintain the natural flow capacity based on surveyed cross- section history.

i) Alternatively, off-channel or floodplain extraction is recommended to allow rivers to replenish the quantity taken out during mining.

j) The Piedmont Zone (Bhabhar area) particularly in the Himalayan foothills, where riverbed material is mined, this sandy-gravelly track constitutes excellent conduits and holds the greater potential for ground water recharge. Mining in such areas should be preferred in locations selected away from the channel bank stretches.

k) Mining depth should be restricted to 3 meter and distance from the bank should be 3 meter or 10 percent of the river width whichever less.

The borrow area should preferably be located on the river side of the proposed embankment, because they get silted up in course of time. For low embankment less than 6 m in height, borrow area should not be selected within 25 m from the toe/heel of the embankment. In case of higher embankment the distance should not be less than 50 m. In order to obviate development of flow parallel to embankment, cross bars of width eight times the depth of borrow pits spaced 50 to 60 meters centre-to-centre should be left in the borrow pits.

l) Demarcation of mining area with pillars and geo-referencing should be done prior to start of mining.

Enforcement and Monitoring Guidelines for sand Mining, 2020 (MoEF&CC)

The Ministry of Environment Forest and Climate Change formulated the Sustainable Sand Management Guidelines 2016 which focuses on the Management of Sand Mining in the Country. But in the recent past, it has been observed that apart from management and systematic mining practices there is an urgent need to have a guideline for effective

enforcement of regulatory provision and their monitoring. Section 23 C of MMDR, Act 1957 empowered the State Government to make rules for preventing illegal mining, transportation and storage of minerals. But in the recent past, it has been observed that there was large number of illegal mining cases in the Country and in some cases, many of the officers lost their lives while executing their duties for curbing illegal mining incidence. The illegal and uncontrolled illegal mining leads to loss of revenue to the State and degradation of the environment.

a) Parts of the river reach that experience deposition or aggradation shall be identified. The Leaseholder/ Environmental Clearance holder may be allowed to extract the sand and gravel deposit in these locations to manage aggradation problem.
b) The distance between sites for sand and gravel mining shall depend on the replenishment rate of the river. Sediment rating curve for the potential sites shall be developed and checked against the extracted volumes of sand and gravel.
c) Sand and gravel may be extracted across the entire active channel during the dry season.
d) Abandoned stream channels on the terrace and inactive floodplains be preferred rather than active channels and their deltas and flood plains. The stream should not be diverted to form the inactive channel.
e) Layers of sand and gravel which could be removed from the river bed shall depend on the width of the river and replenishment rate of the river.
f) Sand and gravel shall not be allowed to be extracted where erosion may occur, such as at the concave bank.
g) Segments of the braided river system should be used preferably falling within the lateral migration area of the river regime that enhances the feasibility of sediment replenishment.
h) Sand and gravel shall not be extracted up to a distance of 1 kilometre (1 km) from major bridges and highways on both sides, or five times (5x) of the span (x) of a bridge/public civil structure (including water intake points) on up-stream side and ten times (10x) the span of such bridge on down-stream side, subjected to a minimum of 250 meters on the upstream side and 500 meters on the downstream side.
i) The sediment sampling should include the bed material and bed material load before, during and after the extraction period. Develop a sediment rating curve at the upstream end of the potential reach using the surveyed cross-section. Using the historical or gauged flow rating curve, determine the suitable period of high flow that can replenish the extracted volume. Calculate the extraction volume based on the sediment rating curve and high flow period after determining the allowable mining depth.
j) Sand and gravel could be extracted from the downstream of the sand bar at river bends. Retaining the upstream one to two-thirds of the bar and riparian vegetation is accepted as a method to promote channel stability.
k) The flood discharge capacity of the river could be maintained in areas where there is a significant flood hazard to existing structures or infrastructure. Sand and gravel mining may be allowed to maintain the natural flow capacity based on surveyed cross-section history. Alternatively, off-channel or floodplain extraction is recommended to allow rivers to replenish the quantity taken out during mining.

l) The Piedmont Zone (Bhabhar area) particularly in the Himalayan foothills, where riverbed material is mined, this sandy-gravelly track constitutes excellent conduits and holds the greater potential for groundwater recharge. Mining in such areas should be preferred in locations selected away from the channel bank stretches.

m) Mining depth should be restricted to 3 meters and distance from the bank should be ¼th or river width and should not be less than 7.5 meters.

n) The borrow area should preferably be located on the riverside of the proposed embankment because they get silted in the course of time. For low embankment, less than 6 m in height, borrow area should not be selected within 25 m from the toe/heel of the embankment. In the case of the higher embankment, the distance should not be less than 50 m. In order to obviate the development of flow parallels to the embankment, crossbars of width eight times the depth of borrow pits spaced 50 to 60 meter center-to-center should be left in the borrow pits.

o) Demarcation of mining area with pillars and geo-referencing should be done prior to the start of mining.

p) A buffer distance /un-mined block of 50 meters after every block of 1000 meters over which mining is undertaken or at such distance as may be the directed/prescribed by the regulatory authority shall be maintained.

q) A buffer distance /unmined block of 50 meters after every block of 1000 meters over which mining is undertaken or at such distance as may be the directed/prescribed by the regulatory authority shall be maintained.

r) River bed sand mining shall be restricted within the central 3/4th width of the river/rivulet or 7.5 meters (inward) from river banks but up to 10% of the width of the river, as the case may be and decided by regulatory authority while granting environmental clearance in consultation with irrigation department. Regulating authority while regulating the zone of river bed mining shall ensure that the objective to minimize the effects of riverbank erosion and consequential channel migration are achieved to the extent possible. In general, the area for removal of minerals shall not exceed 60% of the mine lease area, and any deviation or relaxation in this regard shall be adequately supported by the scientific report.

s) Mining Plan for the mining leases(non-government) on agricultural fields/Patta land shall only be approved if there is a possibility of replenishment of the mineral or when there is no riverbed mining possibility within 5 KM of the Patta land/Khatedari land. For government projects mining could be allowed on Patta land/Khatedari land but the mining should only be done by the Government agency and material should not be used for sale in the open market.

The minerals reserve for riverbed area is calculated on the basis of maximum depth of 3 meters and margins, width and other dimensions as mentioned in para (s) above. The area multiplied by depth gives the volume and volume multiplied with bulk density gives the quantity in Metric Ton. In case of riverbed, mineable material per hectare area available for actual mining shall not exceed the maximum quantity of 60,000 MT per annum.

2.2 Methodology of DSR Preparation

The steps followed during the preparation of District Survey Report are given in Figure 2.1. The individual steps are discussed in following paragraphs.

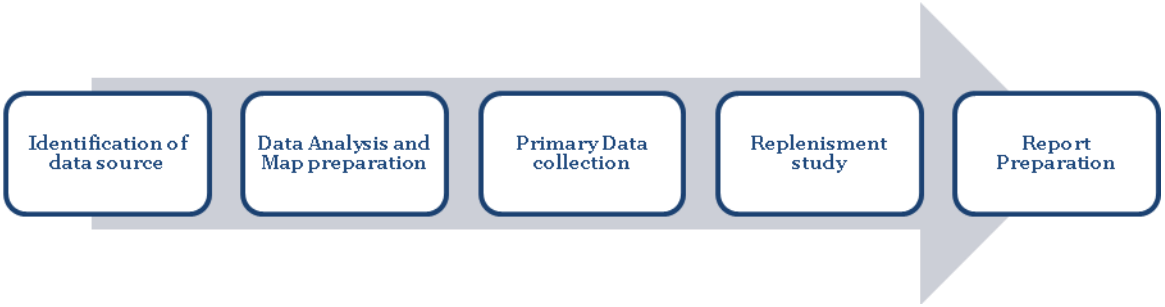


Figure 2.1: Steps followed in preparation of DSR

Data source Identification: District Survey Report has been prepared based on the Primary data base and secondary data base collected and collated from different sources. This is very critical to identify authentic data sources before compiling the data set. The secondary data sources which are used in this DSR are mostly taken from public domain and or from the published report in reputed journal. Information related to district profile has been taken from District Census report, 2011 and District Statistical Handbook published by the Govt. of West Bengal. Potential mineral resources of the district have been described based on the published report of Geological Survey of India (GSI) or any other govt. agencies like MECL etc. List of Mining lease, name of lease holder, lease/Block area, resource in already allotted mining lease, revenue from minor mineral sector etc. have been collected from the concern DL&LRO offices of the district. Satellite images have been used for map preparation related to physiography and land use/land cover of the district.

Data Analysis and Map preparation: Dataset which are captured during the report preparation, are gone through detail analysis work. District Survey Report involves the analytical implication of the captured dataset to prepare relevant maps.

Methodology adopted for preparation of relevant maps is explained below.

Land Use and Land Cover Map: Land Use and Land Cover classification is a complex process and requires consideration of many factors. The major steps of image classification may include determination of a suitable classification system via Visual Image Interpretation, selection of training samples, Satellite image (FCC-False Colour Composite) pre-processing, selection of suitable classification approaches, post-classification processing, and accuracy assessment.

Here LISS-III satellite Imagery has been taken for Supervised Classification as supervised classification can be much more accurate than unsupervised classification, but depends heavily on the training sites, the skill of the individual processing the image, and the spectral distinctness of the classes in broader scale.

According to the Visual Image Interpretation (Tone, Texture, Colour etc.) training set of the pixel has been taken. Pictorial descriptions of Land Use classification are explained in Figure 2.2.

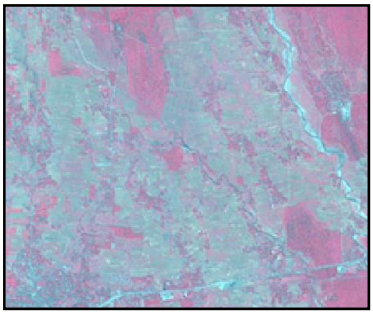
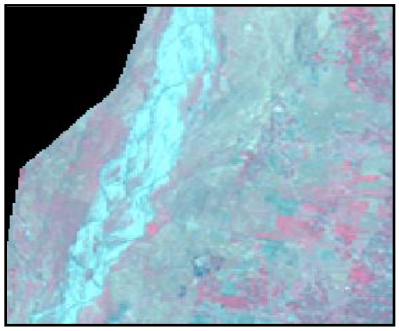
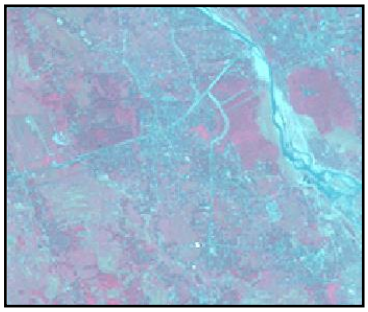
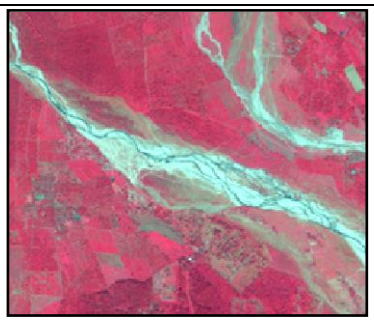
	
Agricultural Land - Based on their Geometrical shape, Red and Pink colour tone, Agricultural Land has been identified.	**Vegetation Covered Area** - Based on their continuous Red colour tone, Vegetation Covered Area has been identified.
	
Agricultural Fallow Land - Based on their Geometrical shape, Light and dark cyan with light pink colour tone, Agricultural Land has been identified.	**Bad Land Topography**- Light Yellowish mixed with cyan colour has been identified as Bad Land Topography.
	
Settlement – Area with Cyan Colour including geometrical shape has been recognised as Settlement Area.	**Water Bodies –** Dark blue colour has been classified as Water Bodies.

Figure 2.2: Pictorial description of Land Use Classification methods

Geomorphological Map: The major steps of preparing Geomorphological Map is identifying features like – Alluvial Fan, Alluvial Plain, Hilly Region etc. from Satellite Imagery (FCC-False Colour Composite) via Visual Image Interpretation and then digitisation has been taken into the consideration to prepare map including all the Geomorphological features according to their location. Pictorial descriptions of Geomorphological unit's classification are explained in Figure 2.3.

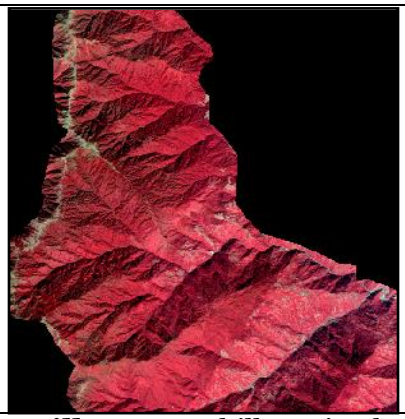
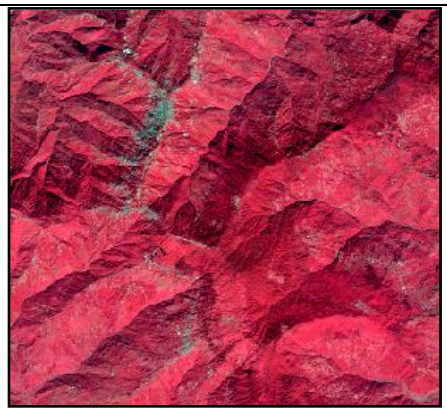
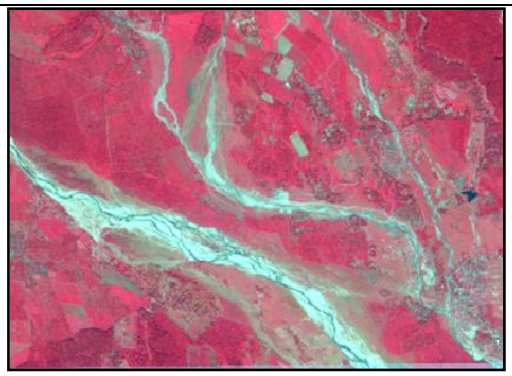
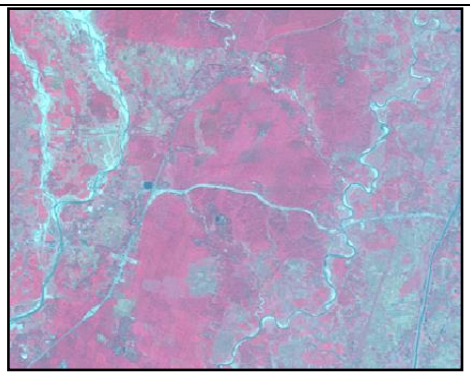
	
Upper Hills – Upper hilly region has been identified based on their high elevation and sharp edges of the land.	**Lower Hills** – Lower hilly has been identified based on their elevation and sharp edges which is comparatively less in height than upper hilly region.
	
Alluvial Fan- A fan-based deposition formed by stream where the velocity is abruptly decreased. In Satellite Imagery the flat area has been identified as Alluvial Fan just below the Lower hilly region.	**Alluvial Plain**- Alluvial plain is a largely flat landform created by the deposition of sediment over a long period. In satellite Imagery the flat land just below the Alluvial Fan has been identified as Alluvial Plain.

Figure 2.3: Pictorial description of Geomorphological Units Classification methods

Physiographical Map: The major step of preparing Physiographical Map is generating contour at a specific interval to show the elevation of the area using Cartosat DEM.

Block Map/Transportation Map/Drainage Map:

- Raw Data collected from **National Informatics Centre (NIC Website) during Sept 2020.**
- Data has been geo-referenced using GIS software.
- Digitization of block boundary, district boundary, state boundary, international boundary, and district headquarter, sub –district headquarter, places, road, railway, river, nala etc.
- Road name, River name, Railway name has been filled in attribute table of the Layers
- Final layout has been prepared by giving scale, legend, north arrow, etc.

Earthquake Map:

- Raw data collected from **Ministry of Earth Science.**
- Data has been geo-referenced using GIS software.
- Digitization of Earthquake zone and superimposed it over Block Boundary.
- Zone name has been filled in attribute table of the Layers
- Final layout has been prepared by giving scale, legend, north arrow, etc.

Soil Map:

- Raw data collected from **National Bureau of Soil Survey and Land Use Planning during Sept 2020.**
- Data has been geo-referenced using GIS software.
- Digitization of Soil classification zone and superimposed it over District Boundary.
- Soil classification has been filled in attribute table of the Layers.
- Final layout has been prepared by giving scale, legend, north arrow, etc.

Wildlife Sanctuary and National Park location Map:

- Raw data collected from **ENVIS Centre on Wildlife and Protected Areas during August 2020.**
- Data has been geo-referenced using GIS software.
- Digitization of Wildlife Sanctuary and National Park and superimposed it over Block Boundary.
- Wildlife Sanctuary and National Park name has been filled in attribute table of the Layers

Final layout has been prepared by giving scale, legend, north arrow, etc.

Primary Data Collection: To prepare DSR, capturing primary data or field data has also been carried out in the district. Field study involves assessment of the mineral resources of the district by means of pitting / trenching in specific interval. This provides clear picture of mineral matters characterization and their distribution over the area.

Replenishment study: One of the principal causes of environmental impacts from in-stream mining is the removal of more sediment than the system can replenish. Therefore, there is a need for replenishment study for riverbed sand in order to nullify the adverse impacts arising due to excess sand extraction. The annual rate of replenishment carried out on every river of the district to have proper assessment of the sand reserve for mining purposes.

Physical survey has been carried out by GPS/DGPS/ Total Station to define the topography, contours and offsets of the riverbed. The surveys clearly depict the important

attributes of the stretch of the river and its nearby important civil and other feature of importance. This information will provide the eligible spatial area for mining.

Report Preparation: The district survey report portrays general profile, geomorphology, land use pattern and geology of the district. The report then describes the availability and distribution of riverbed sands and other minor minerals in the district. Apart from delineation the potential mining blocks, the report also includes inventorization of the minerals, recent trends of production of minor minerals and revenue generation there from. Annual replenishment of the riverbed sand has been estimated using field observation, satellite imagery and empirical formula. The road network connecting arterial road to potential mining blocks has been identified. Potential environmental impacts of mining of these minerals, their mitigation measures along with risk assessment and disaster management plan have also been discussed. Finally the reclamation strategy for already mined out areas is also chalked out.

Demand and Utilisation of Sand

Sand is a multi-purpose topographical material. It is known as one of the three fundamental ingredients in concrete. The composition of sand is diverse. Mostly sand is made of silica which is a common element. It can also come from another source of minerals like quartz, limestone, or gypsum.

From beds to flood plains to coastlines- we can find the sand at almost everywhere. The robustness of sand has played a significant role in everyday life. We use sand practically every other day.

Sand extraction from river beds and brick earth mining for making raw bricks are the main mining activities in the district. With a spurt in construction of real estate sectors and various govt. sponsored projects, the demand for both sand and bricks has increased manifold. The extraction of sand is carried out either manually or through semi- mechanized system. The depth of mining for both river bed sand and brick earth is restricted due to statutory provision in the regulations pertaining to conservation and development of minor minerals.

River sand mining is a common practice as habitation concentrates along the rivers and the mining locations are preferred near the markets or along the transportation route, for reducing the transportation cost.

In the real world, there are a lot of situations where we can find uses of sand. Followings are the common sand uses.

1. While bunging metal, we can mix sand with clay binder for frameworks used in the foundries.
2. Sand can be used for cleaning up oil leak or any spill by dredging sand on that spill. The material will form clumps by soaking up, and we can quickly clean the mess.
3. Sand can be used as a road base which is a protective layer underneath all roads
4. Industrial sand is used to make glass, as foundry sand and as abrasive sand.
5. One creative usage of sand is serving as a candle holder. We can try putting some sand before pouring tea light or any candle in a glass. It holds the candle still and refrain the candle from rolling by giving it an excellent decoration.
6. Adds texture and aesthetic appeal to space.
7. Sand is mostly pure to handle, promptly available and economically wise.

8. We use sand in aquariums, fabricating artificial fringing reefs, and in human-made beaches
9. Sandy soils are ideal for growing crops, fruits and vegetables like watermelon, peaches, peanuts, etc.
10. Sand can light a path by filling mason jars with sand and tea light which is another inexpensive way to make a walkway glow.
11. Sand helps to improve resistance (and thus traffic safety) in icy or snowy conditions.
12. Sand is needed in the beaches where tides, storms or any form of preconceived changes to the shoreline crumble the first sand.
13. Sand containing silica is used for making glass in the automobile and food industry- even household products for the kitchen.
14. Sand is a strong strand which is used for plaster, mortar, concrete, and asphalt.
15. The usual bricks formulated of clay only are way weaker and lesser in weight than blocks made of clay mixed with sand.

3 General Profile of the district

3.1 General Information

Paschim Bardhaman district is a predominantly urban mining-industrial district in West Bengal. The headquarter of the district is Asansol. It was formed on 7 April 2017 after bifurcation of the erstwhile Bardhaman district as the 23rd district of West Bengal. The total geographical area of the district is 1603.17sq. Km. (*https://paschimbardhaman.gov.in/about-district*). A Location map of Paschim Bardhaman district is furnished below.

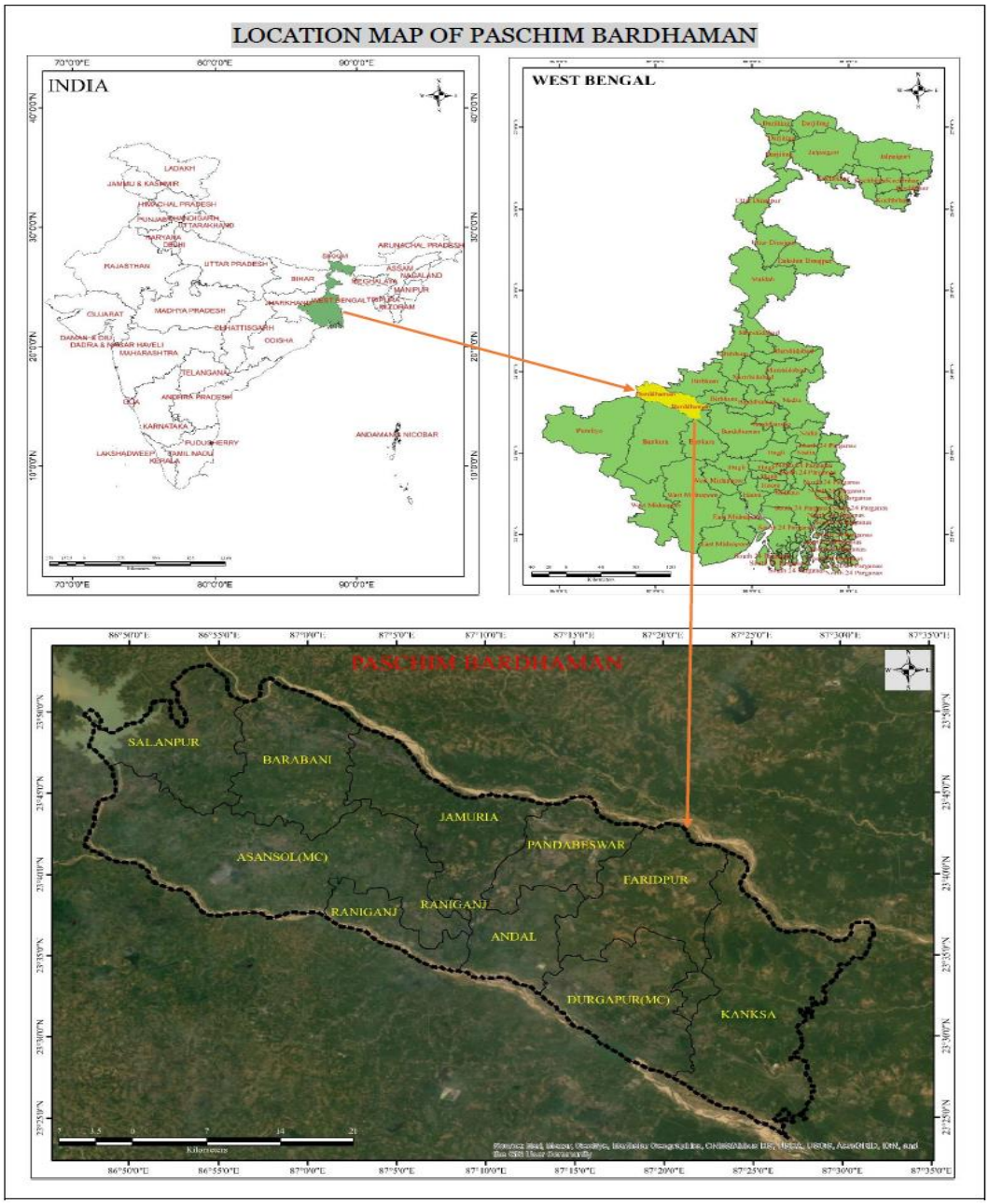


Figure 3.1: Location Map of Paschim Bardhaman
(Source: National Informatics Centre and ESRI Base Map)

Erstwhile Burdwan district stretched from the river Bhagirathi in the east to the state Jharkhand on the west. Western most subdivision was Asansol; the next one on the eastern side of it was Durgapur subdivision. Paschim Bardhaman district is formed with these two western subdivisions of Erstwhile Burdwan district. It is bordered by Dumka district of Jharkhand and Birbhum district of West Bengal in the north; East Burdwan district is in the east. To the south, across the Damodar River are the Purulia and Bankura districts while Dhanbad district of Jharkhand lies on the western side. Two mighty rivers -the Ajay and the Damodar, flows more or less, along the northern and southern boundary of the district.

Coordinates of Asansol, the district/subdivision headquarter is 23.68˚ North and 86.99˚ East. Durgapur, the other subdivision headquarter is located at 23.48° North latitude and 87.32° East longitude.

The Paschim Bardhaman district comprises two subdivisions - Asansol Sadar and Durgapur. Asansol is the district headquarters. The DM's Office is at Kanyapur, Asansol. Each subdivision is divided into one Municipal Corporation and 4-community development blocks and which, in turn, are divided into rural areas and census towns. In total, there are two municipal corporations, eight community development blocks, 65 census towns and 62 Gram Panchayats in the district. There are two urban agglomerations (UA) - Asansol UA and Durgapur UA. Asansol UA consists of Kulti, Bhanowara, Jamuria, Jemari, Raniganj, Amkula, Murgathaul, Raghunathchak and Ballavpur while Durgapur UA consists of Durgapur, Arrah, Bamunara, Amlajora, Kanksa, Panagarh, Mankar, Shibpur, Andal, Ukhra, Kajora, Pandabeswar, Ichhapur and Madhaiganj. Asansol Sadar subdivision: The geographical area of this subdivision is 831.89 square Kms. Its population as per 2011 census is 1672659. Asansol Sadar subdivision has 9 police stations, 1 municipal corporation 4 Community Development Blocks, 4 Panchayat Samitis, 35-Gram Panchayats, 181 Mouza, and 165 inhabited villages. The single municipal corporation is at Asansol, which is comprised of Asansol UA. The census towns are - Chittaranjan, Hindustan Cables Town, Domohani, Bhanowara Majiara, Pangachhiya,Charanpur, Kunustara,Topsi,Nimsa,Chinchuria, Kenda, Parasia, Ratibati, Ch apui, Jemari (J.K. Nagar Township), Banshra, Belebathan, Chelad, Murgathaul, Amkula, Baktarnagar, Egara, Sahebganj, Raghunathchak, Ballavpur and Kendra Khottamdi (partly). The subdivision has its headquarters at Asansol. There are 35-gram panchayats under four community development blocks. Barabani block consists of eight-gram panchayats, viz. Barabani, Itapara, Nuni, Panuria, Domohani, Jamgram, Panchgachhia and Punchrah. Jamuria block consists of ten-gram panchayats, viz. Bahadurpur, Dobrana, Madantor, Tapsi, Chinchuria, Hijalgara, Parasia, Churulia, Kenda and Shyamla. Raniganj block consists of six-gram panchayats, viz. Amrasota, Egra, Ratibati, Ballavpur, Jemeri and Tirat.

Salanpur block consists of eleven-gram panchayats, viz. Achhra, Dendua, Fulberia Bolkunda, Alladi, Ethora, Rupnarayanpur, Basudevpur Jemari, Jitpur–Uttarrampur, Salanpur, Kalya and Samdi. Durgapur subdivision: The geographical area of this subdivision is 771.28 square Kms and population as per 2011 census is 1209372. Durgapur subdivision has 6 police stations, 4 community development blocks, 4 Panchayat Samitis, 27-gram panchayats, 171

Mouza, 151 inhabited villages, 1 municipal corporation and 39 census towns (1 partly). The single municipal corporation is at Durgapur. The census towns are: Siduli, Khandra, ChakBankola, Ukhra, Mahira, DakshinKhanda, Parashkol, Kajora, Harisp ur, Palashban, Dignala, Andal(gram), Ondal, Baska, Bilpahari, Ramnagar, Dalurband, Debipur, Baidyanathpur, Mahal, Konardihi, Nabgram, Sankarpur, Haripur, Chhora, Bahula, Mandarbani, Banagram, Sirsha, Nabaghanapur, Sarpi, Ichhapur, Arra, Gopalpur, Bamunara, Amlajora, Kanksa, Prayagpur and Kendra Khottamdi (part) Durgapur–Faridpur block consists of six-gram panchayats, viz. Gaurbazar, Ichhapur, Laudoha, Gogla, Jemua and Pratappur. Kanksa block consists of seven-gram panchayats, viz. Amlajora, Bidbehar, Kanksa, Trilokchandrapur, Bankati, Gopalpur and Molandighi. Andal block consists of eight-gram panchayats, viz. Andal, Kajora, Madanpur, Sreerampur, Dakshinkhanda, Khandara, Ramprasadpur and Ukhra. Pandabeswar block consists of six-gram panchayats, viz. Baidyanathpur, Chhora, Kendra, Behula, Haripur and Nabagram.

Table 3.1: Block distribution of Paschim Bardhaman District

District	Sub Division	Block	Police Station	No of Gram Panchayat
Paschim Bardhaman	Asansol	Municipal Corporation	Asansol (North), Asansol (South), Asansol Women, Hirapur and Kulti	-
		Raniganj	Raniganj	6
		Jamuria	Jamuria	10
		Barabani	Barabani	8
		Salanpur	Chittaranjan, Salanpur	11
	Durgapur	Municipal Corporation	Durgapur Coke Oven and New Township	-
		Durgapur Faridpur	Faridpur-Durgapur	6
		Andal	Andal	8
		Kanksa	Kanksa	7
		Pandabeswar	Pandabeswar	6

(http://www.msmedikolkata.gov.in/uploads/2021/03/districtprofiles/2017-18/PASCHIM%20BARDHAMAN.pdf and District Industrial Profile, 2017-18, Paschim Bardhaman, MSME-Development Institute Kolkata, Govt of India)

A Block map of Paschim Bardhaman district is furnished below.

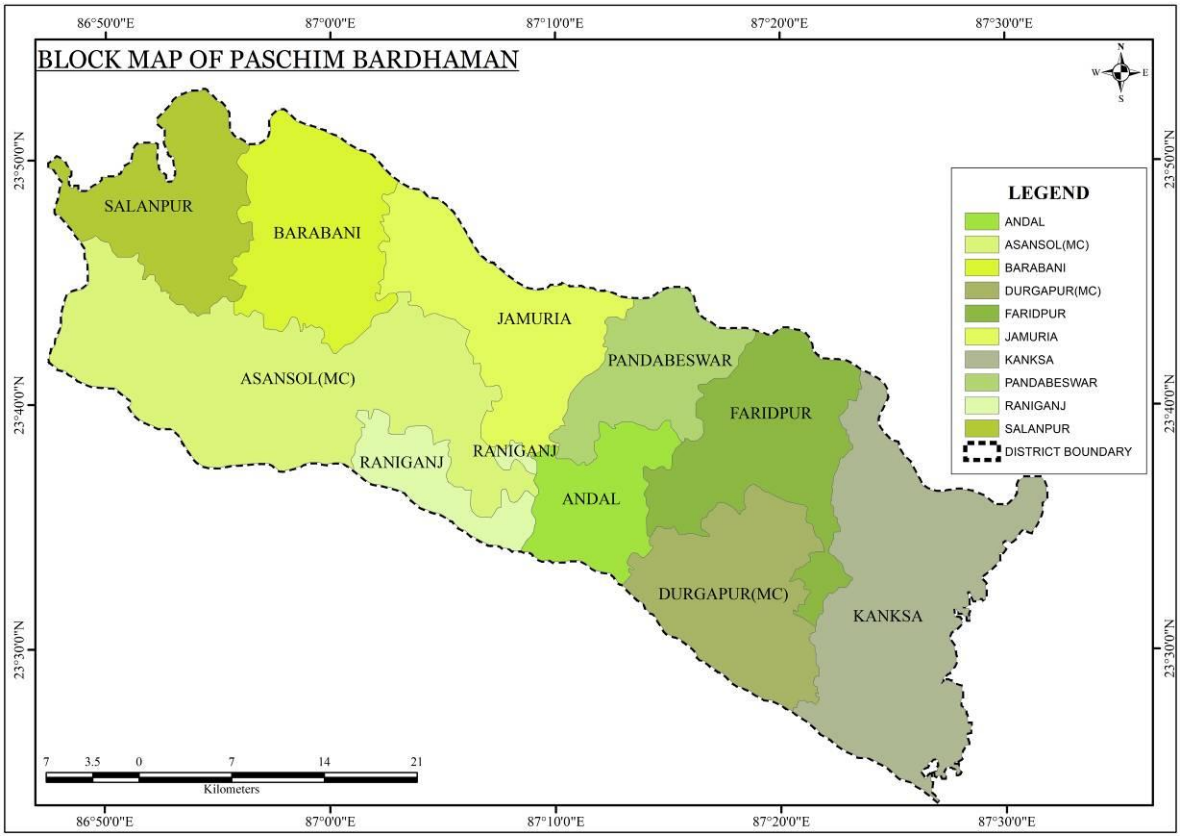


Figure 3.2: Block divisional map of Paschim Bardhaman

(Source: National Informatics Centre)

3.2 Climate Condition

Paschim Bardhaman district has a tropical climate. While the hottest month is May, the coldest is January. The monsoon season is from June to September with an annual average rainfall of 1,044 mm. Localised thunderstorms, called "Kalbaisakhi" in Bengali, are a special feature from March until the monsoon sets in. In monsoon period from June to September, wind blows from the south-west direction recognized as south-west monsoon.

During winter, *i.e.,* from December to February winds are mainly northerly or north-easterly with clear or patchily clouded sky. Temperatures are fairly cool between winter and spring. *(Ghosh et. al., 2018).*

3.2.1 Temperature

Summer

Paschim Bardhaman district experiences dry and hot summer with maximum temperature of near about≈ 40°C during summer. The district shows a fierce dry heat in the warmer months. The summers in Paschim Bardhaman usually start from month of March and last till the middle of June.

Monsoon

The arrival of the month of June marks the onset of monsoon in Paschim Bardhaman. The district receives a high average rainfall. June to September has shown maximum average rainfall with moderate temperature. The district received average rainfall of 1044 mm.

Winter

Winters in Paschim Bardhaman are pleasant and enjoyable, with mercury dropping to about 14°C or below. The winter starts from December and last till the month of February. Due to such favourable conditions, winter is deemed as the best time for the tourists to visit Paschim Bardhaman. (*Mukherjee and Banerjee, 2018).*

Monthly average temperature of Paschim Bardhaman district is furnished below.

Table 3.2: Monthly average temperature distribution of Paschim Bardhaman District

Month	Min Temp (˚C)	Max Temp (˚C)
JAN	10	24
FEB	13	28
MAR	18	32
APR	22	38
MAY	23	36
JUN	25	34
JUL	24	32
AUG	24	32
SEPT	22	32
OCT	20	31
NOV	13	29
DEC	10	26

(Climate-Data.Org)

3.3 Rainfall and Humidity

The average annual rainfall of the area is about 1044 mm. Rainfall during the monsoon period (June to September) constitutes 75 % of the annual rainfall.

The driest month is December, with 2 mm or 0.1 inch of rain. The greatest amount of precipitation occurs in July, with an average of 309 mm or 12.2 inch.

On an average the district has 70 rainy days in a year. The most prominent special weather phenomena of the district are the Nor'westers or Kalbaisakhis. Most of them strike with speed of 65 to 100 km/hr with rainfall ranging from 10 mm to 50 mm and marked by a consequent fall of temperature *(Ghosh et.al. 2018).*

The maximum and minimum relative humidity of the district during summer season varies from 75% to 85 % and 40% to 60% respectively. In winter time district's humidity varies from maximum 80% to 90 % and minimum 30% to 55% *(District Disaster Management Plan, 2015-2016).*

The following table shows the annual total rainfall recorded for the district along with the month(s) while maximum precipitation is recorded over 5 years from 2016-2020 (Table 3.3).

Table 3.3: Annual rainfall in mm recorded in Paschim Bardhaman District

The District Rainfall in mm (R/F) shown below are the arithmetic averages of Rainfall of Stations under the District						
YEAR	**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**
2016	13.5	29.3	15	0	120	182.5
2017	1.2	0	32.6	28.3	171.2	255.8
2018	0	0.1	15.1	82.6	43.5	158.1
2019	0	64	16.3	47.8	129.9	90.9
2020	26.6	1.1	64.6	65.8	212	298.4
YEAR	**JUL**	**AUG**	**SEPT**	**OCT**	**NOV**	**DEC**
2016	263.9	463.5	274.5	44.3	1.9	0
2017	464.1	252.9	178.2	260.1	14.5	9.1
2018	329.7	174.7	154.3	16	0	26.7
2019	195.8	233.1	215.8	191.7	16.8	11.1
2020	338.2	262.2	128.2	81	1.7	0

https://hydro.imd.gov.in/hydrometweb/(S(5mg03haiyer0tp45adbukh3i))/DistrictRaifall.aspx
Website of Indian Meteorological Department, Govt. of India

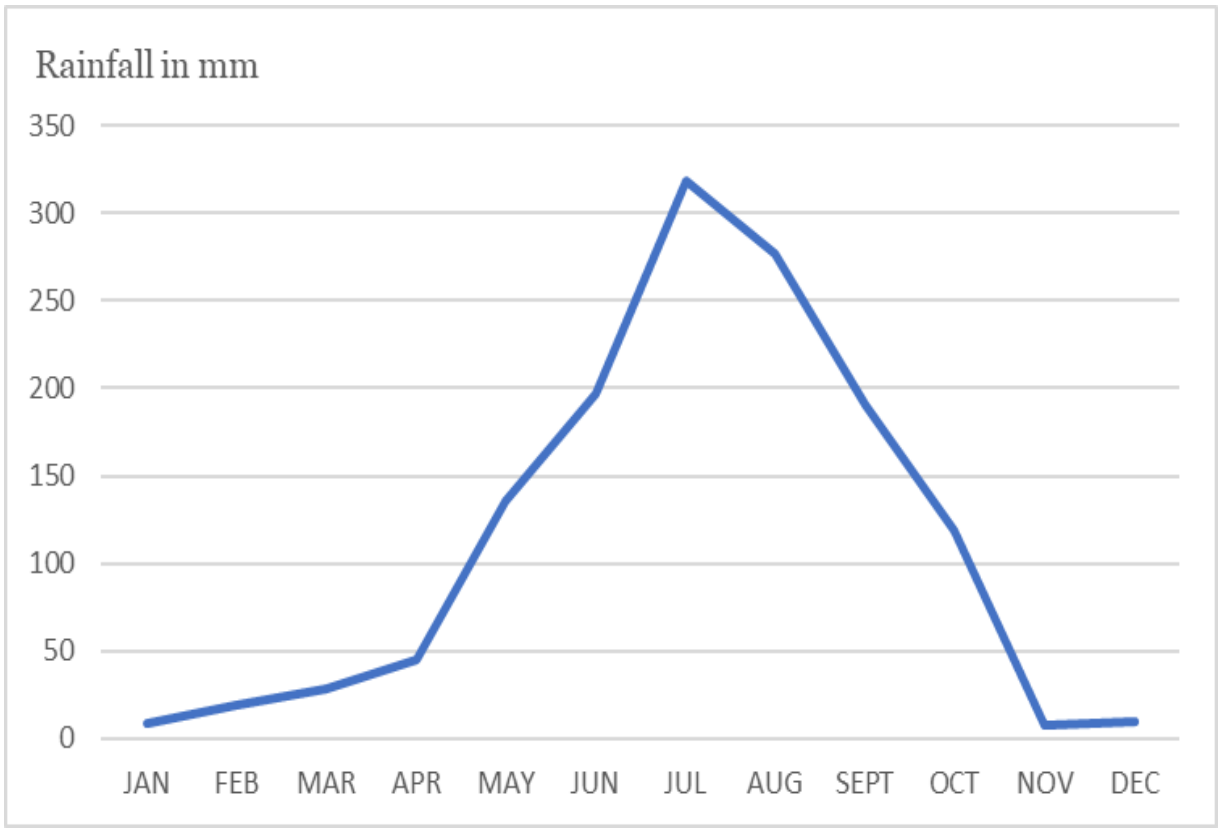


Figure 3.3: Graphical representation of the district rainfall

3.4 Topography and Terrain

Paschim Bardhaman district is a sort of an extension of the Chhotanagpur Plateau. It is a transitional zone between the Chhotanagpur Plateau, which constitutes a portion of peninsular shield in the west, and Ganga-Brahamaputra alluvial plain in the north and east. The rocky undulating topography with laterite soil is found in the western part of the district, which extends to the western part of Durgapur subdivision; barren, rocky and rolling laterite soil rising into rocky hillocks, the highest being 227 m. The eastern part of the district gradually slopes down to the rice plains of Bengal. The district is a part of the Ajay Damodar Barakar tract with the Ajay on the north, the Damodar on the south and the Barakar on the west. The Ajoy-Damodar inter-stream tract is made up of several myriads of minor rivers and streams which criss-cross the district. This diversifies the landscape and lends a special charm to the area around Asansol and Durgapur subdivision. (*http://www.msmedikolkata.gov.in/uploads/2021/03/districtprofiles/2017-18/PASCHIM%20BARDHAMAN.pdf)*

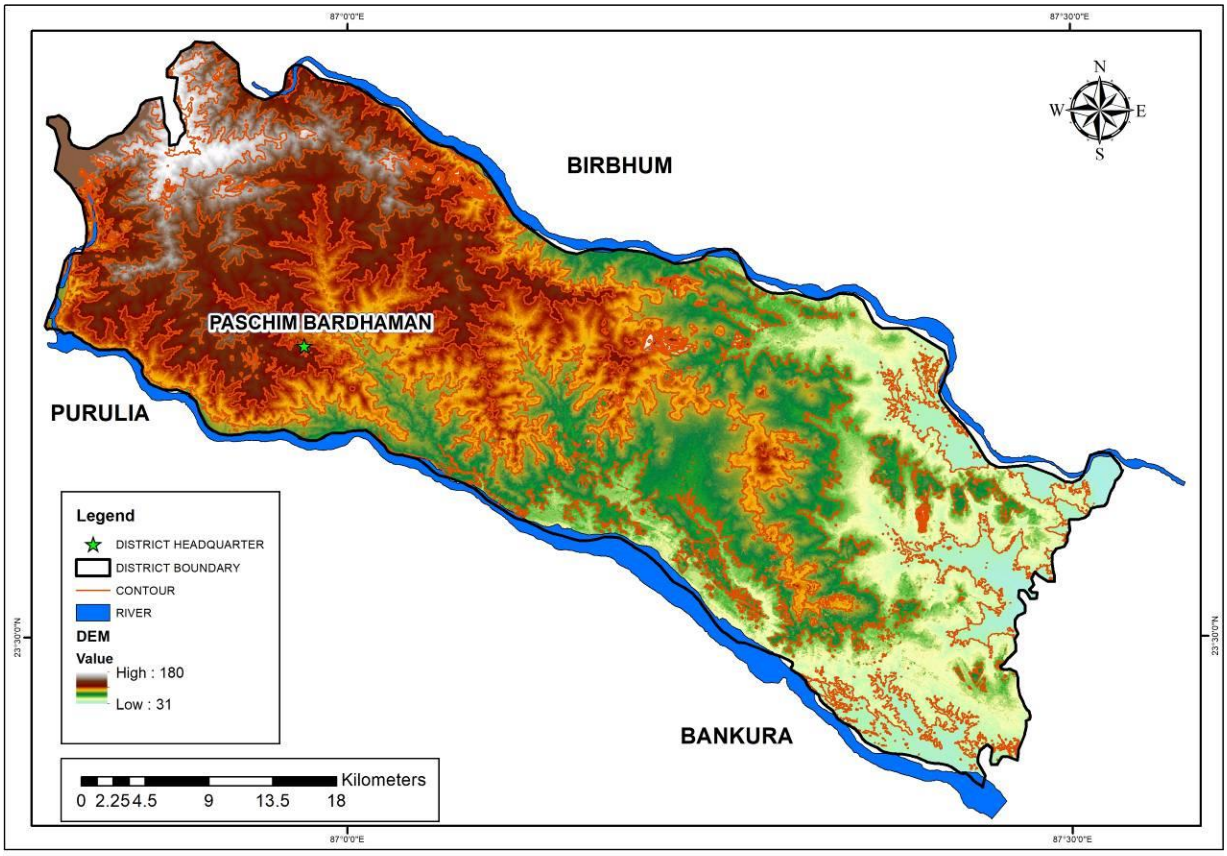


Figure 3.4: Physiographic map of Paschim Bardhaman District
(Cartosat-1, Bhuvan India)

3.5 Water courses and Hydrology

Figure 3.5 represents hydrogeological map of the district which includes Purba Bardhaman district. Rock type of the district mainly consist of Granite Gneisses, Migmatite, Schist, Sandstone with shale, Laterite, Sand, Silt and Clay. This rock group chiefly comprises the district profile. Thickness of the rock type is about 50 m and having yield value of 150 cum/day.

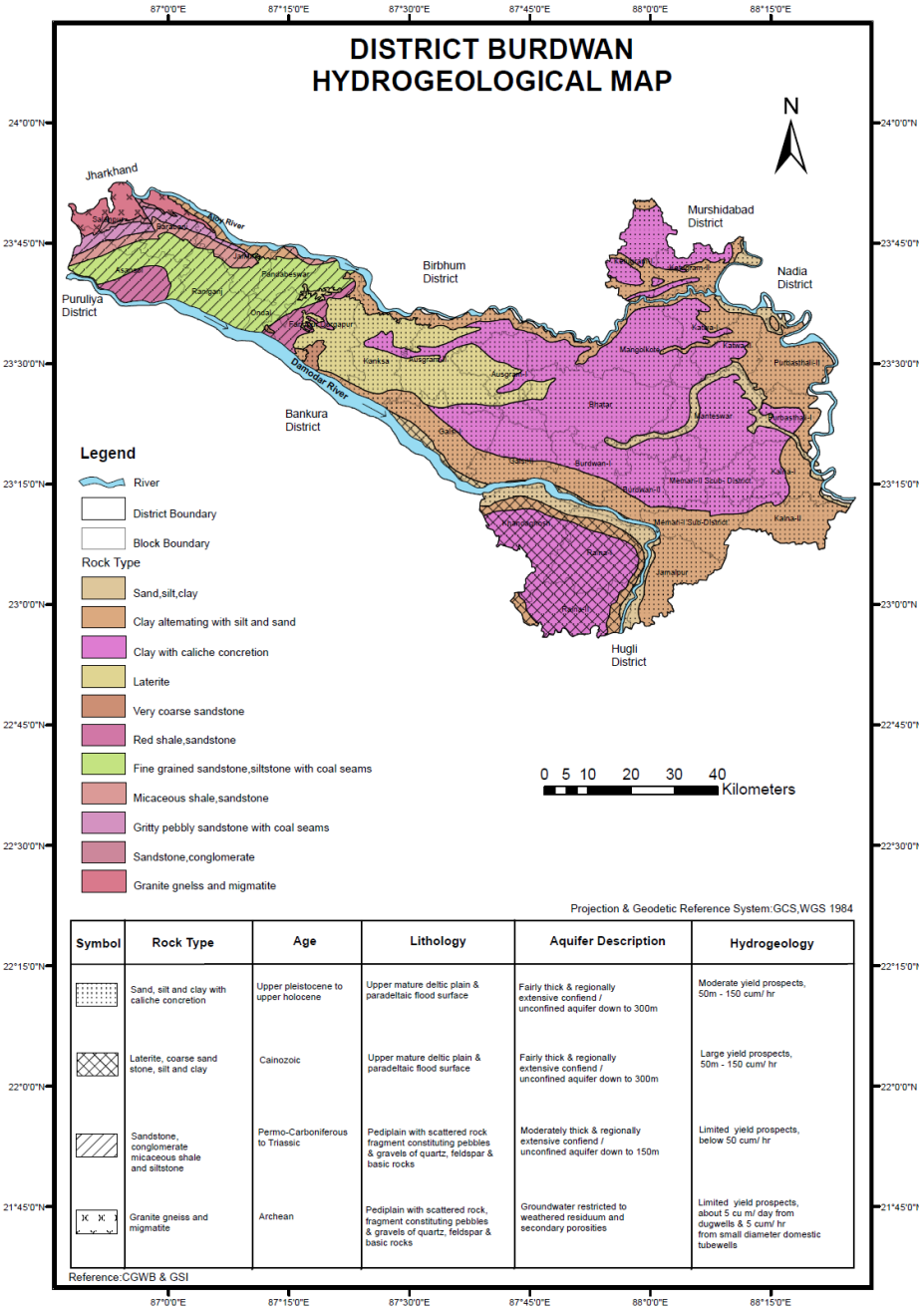


Figure 3.5: Hydrogeological map of undivided Bardhaman district
http://wbwridd.gov.in/swid/mapimages/BARDDHAMAN.pdf

3.6 Ground water development

Ground water systems are the result of complex combination of different lithological and structural types within an area that together constitutes an aquifer within which ground water accumulates and moves. In the major part of the district, ground water in thick unconsolidated Quaternaries and Tertiaries deposited under fluviatile environment, the sand and/or gravel in different proportions of this formation constitute the main aquifer and they occur down to 295 mbgl in the central and eastern part of the district. Deeper aquifers occur under semi-confined to confined condition. Groundwater in the western part of Upper- Palaeozoic- Mesozoic-Tertiary sequences of Gondwana Supergroup of sedimentaries occur under both unconfined and confined conditions down to 150.35 mbgl. Groundwater in the extreme north western small part of Salanpur Block occupied by the Archaean metamorphics occurs down to a depth of about 82 mbgl under both unconfined and confined conditions down to 150.35 mbgl. It mainly occurs under unconfined condition in the dug well zone and under semi confined to confined condition in the deeper horizons. In Bardhaman district, ground water occurs in semi-confined to confined aquifer conditions in the depth span of 12.00-38.00 mbgl, 31.00-55.00 mbgl and 70.00-88.00 mbgl.

http://cgwb.gov.in/Regions/GW-year-Books/GWYB-%202016-17/WB%20&%20Andaman.pdf

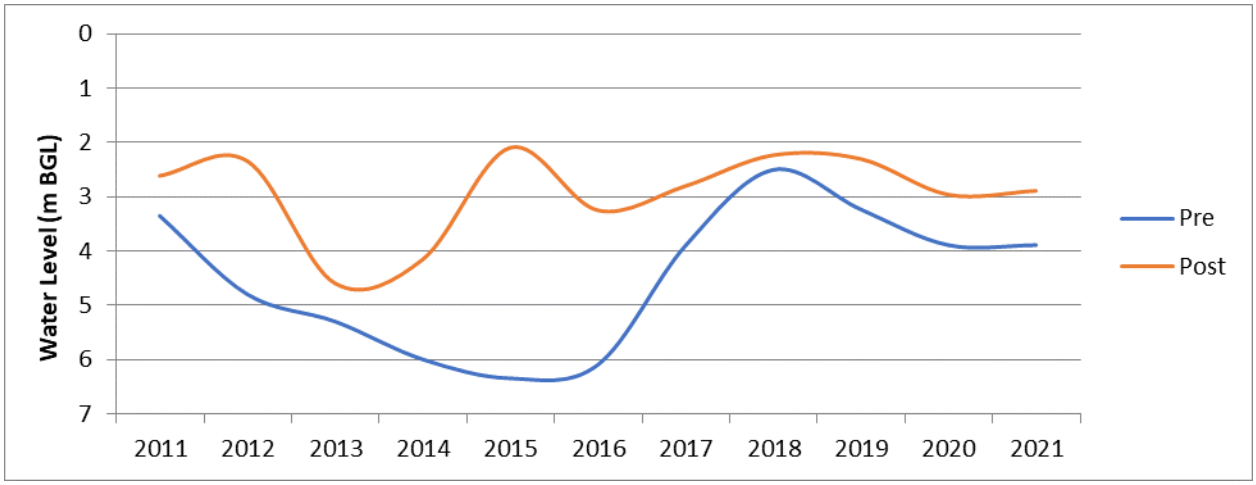
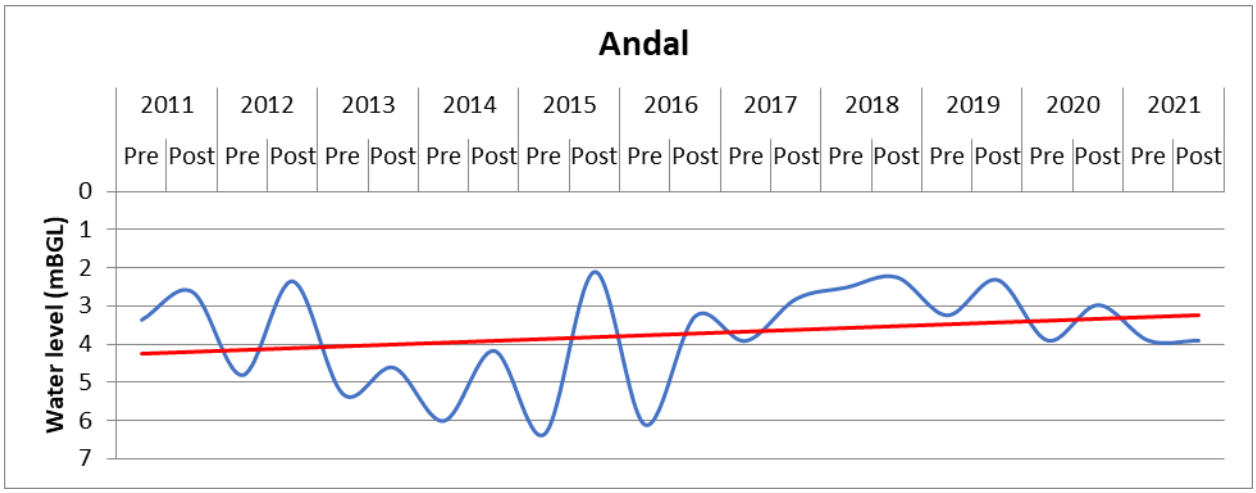
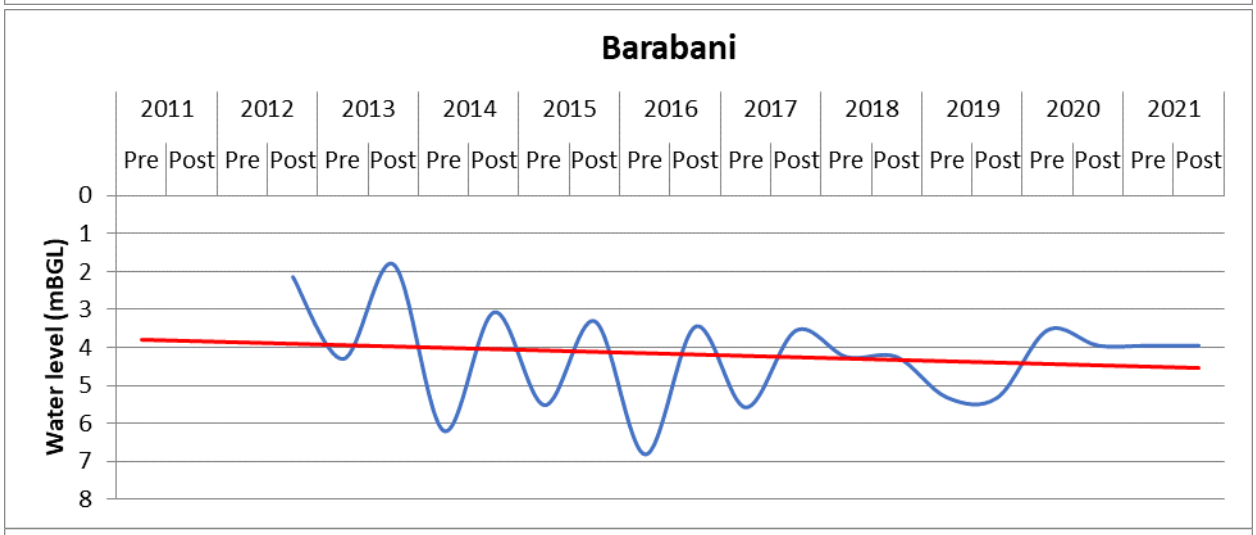
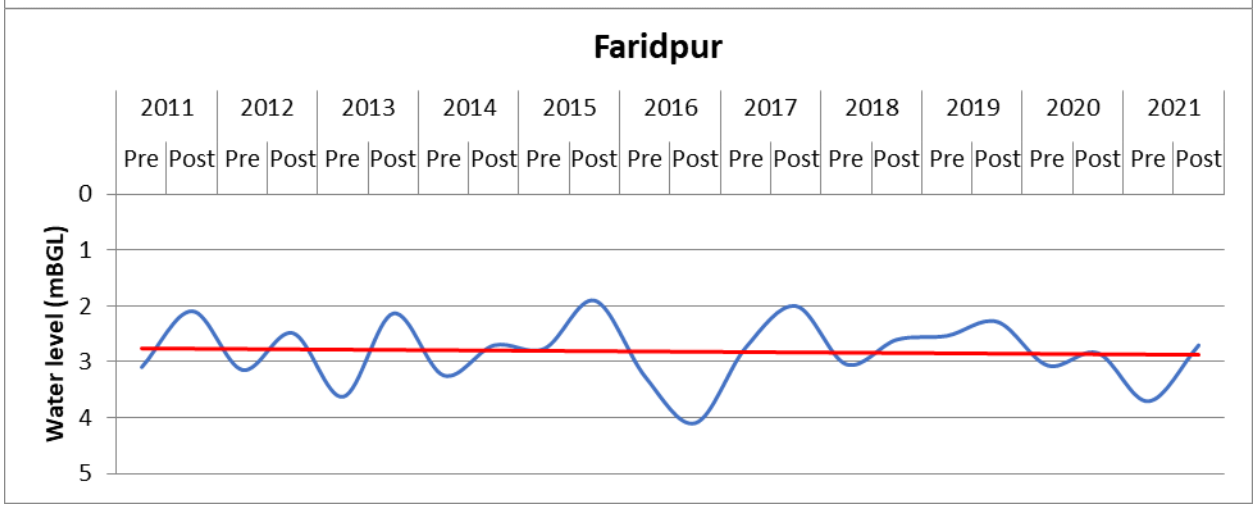


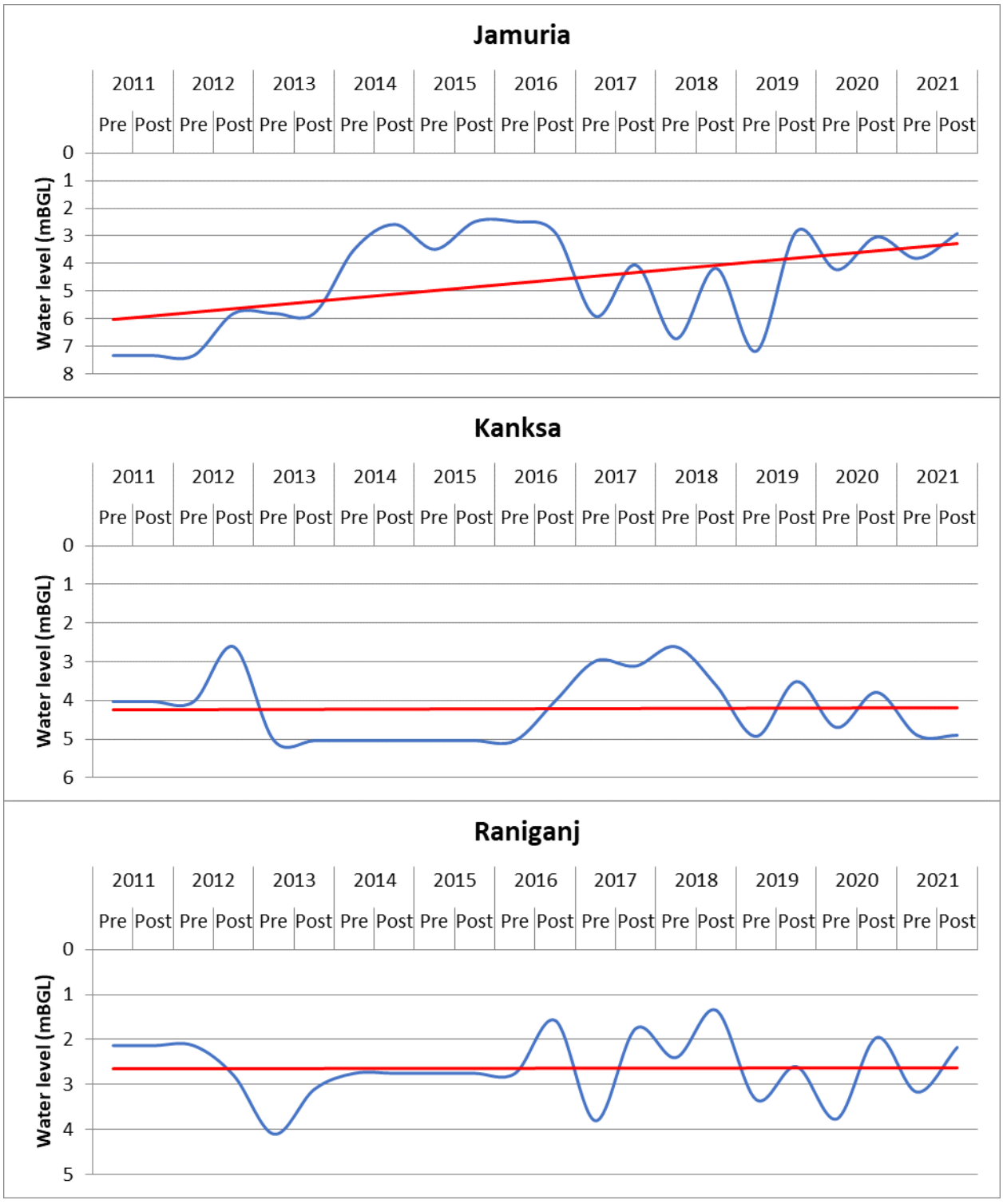
Figure 3.6: Graphical representation of pre-monsoon and post-monsoon data of two wells

Hydrographs showing variation in water level observed in between 2011 to 2021 in the district is given in Figure 3.7.


Andal
2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021
Pre Post Pre Post Pre Post Pre Post Pre Post Pre Post Pre Post Pre Post Pre Post Pre Post Pre Post
0 1 2 3 4 5 6 7
Water level (mBGL)


Barabani
2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021
Pre Post Pre Post Pre Post Pre Post Pre Post Pre Post Pre Post Pre Post Pre Post Pre Post Pre Post
0 1 2 3 4 5 6 7 8
Water level (mBGL)


Faridpur
2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021
Pre Post Pre Post Pre Post Pre Post Pre Post Pre Post Pre Post Pre Post Pre Post Pre Post Pre Post
0 1 2 3 4 5
Water level (mBGL)


Jamuria
2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021
Pre Post Pre Post Pre Post Pre Post Pre Post Pre Post Pre Post Pre Post Pre Post Pre Post Pre Post
Water level (mBGL)
0 1 2 3 4 5 6 7 8
Kanksa
2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021
Pre Post Pre Post Pre Post Pre Post Pre Post Pre Post Pre Post Pre Post Pre Post Pre Post Pre Post
Water level (mBGL)
0 1 2 3 4 5 6
Raniganj
2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021
Pre Post Pre Post Pre Post Pre Post Pre Post Pre Post Pre Post Pre Post Pre Post Pre Post Pre Post
Water level (mBGL)
0 1 2 3 4 5

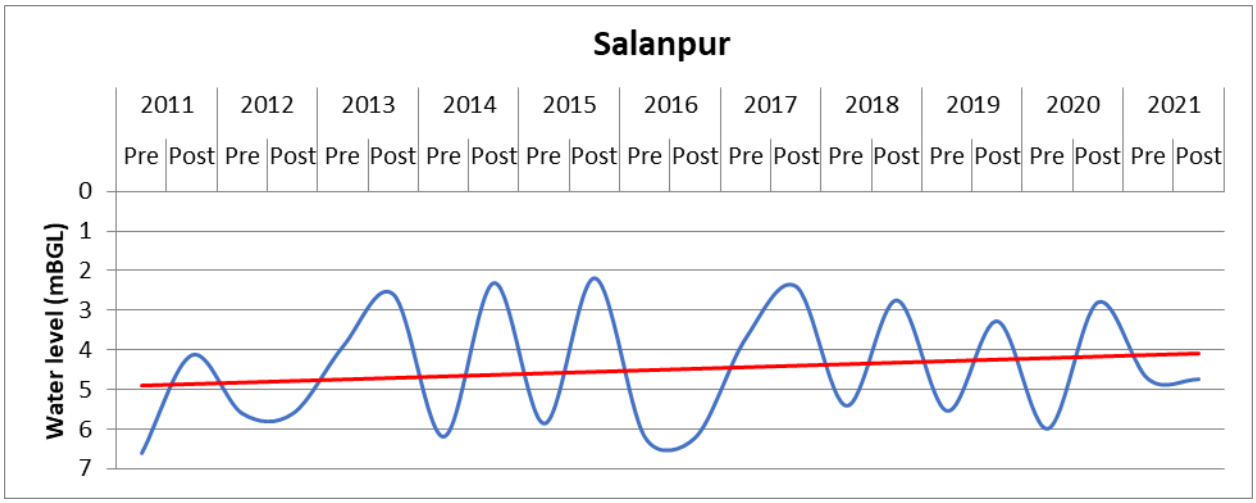


Figure 3.7: Block wise Hydrograph showing variation of water level during 2011 to 2021

3.7 Drainage System

Damodar River running west to south-east, is the major steam in the area. Damodar River is a river flowing across this state and Jharkhand. Rich in mineral resources, the valley is home to large-scale mining and industrial activity. The Damodar and its tributaries have been somewhat tamed with the construction of several dams. It has a number of tributaries and sub-tributaries, such as Barakar, Konar, Bokaro, Haharo, Jamunia, Ghari, Guaia, Khadia and Bhera. The Damodar Valley is spread across Hazaribagh, Ramgarh, Koderma, Giridih, Dhanbad, Bokaro & Chatra districts in Jharkhand and Bardhaman and Hooghly districts in West Bengal and partially covers Palamu, Ranchi, Lohardaga and Dumka districts in Jharkhand and Howrah, Bankura and Purulia districts in West Bengal with a command area of 24,235 km². The drainage in the study area is mainly Damodar River and its tributaries. The secondary tributaries are Talma, Choupai, Barajuri and Barjor.

Ajay River running west to south-east. The Ajay River starts the journey from the Chakai block of Jamui (Origin of Ajay River) and then enters Jharkhand state near Devipur. Afterward, at Simuji, it enters West Bengal near Chittaranjan. After entering West Bengal, first, it flows between West Bardhaman district and Jharkhand, and then West Bardhaman district and Birbhum district, and forms the borders between the West Bardhaman district and Jharkhand state, and West Bardhaman district and Birbhum district. Finally, the Ajay River enters Purba Bardhaman district's Katwa subdivision at Nareng village in Ketugram police station and joins Bhagirathi River in Katwa town. The 288 km long (179 miles) river has its 152 km (94 miles) in West Bengal alone. And its catchment area is 2300 square miles or 6000 square kilometers. While the Ajay flows through Alluvial plains in the Bradhaman district, its upper reaches flow through hilly

areas with laterite soil. Previously, one could find dense forests filled with trees like Palas, Piyasal, and Saltreese in the valley of the Ajay River. However, in recent times, the forests are being cleaned due to different activities like mining.
https://www.riversgraphy.com/ajay-river/#Course

Paschim Bardhaman system of the district is further explained in Chapter 7.2.

Table 3.4: Rivers and tributaries in Paschim Bardhaman District

Watershed	Flow Regime	Rivers and Tributaries	Length in Paschim Bardhaman (km)	River Area (sq.m)
Damodar	Middle	Damodar	78.31	79869025.45
		Barakar	12.32	3095649.66
Ajay	Middle	Ajay	82.60	41637865.85

A Drainage map of Paschim Bardhaman district is furnished as Figure 3.8 and in and in Plate 1A.

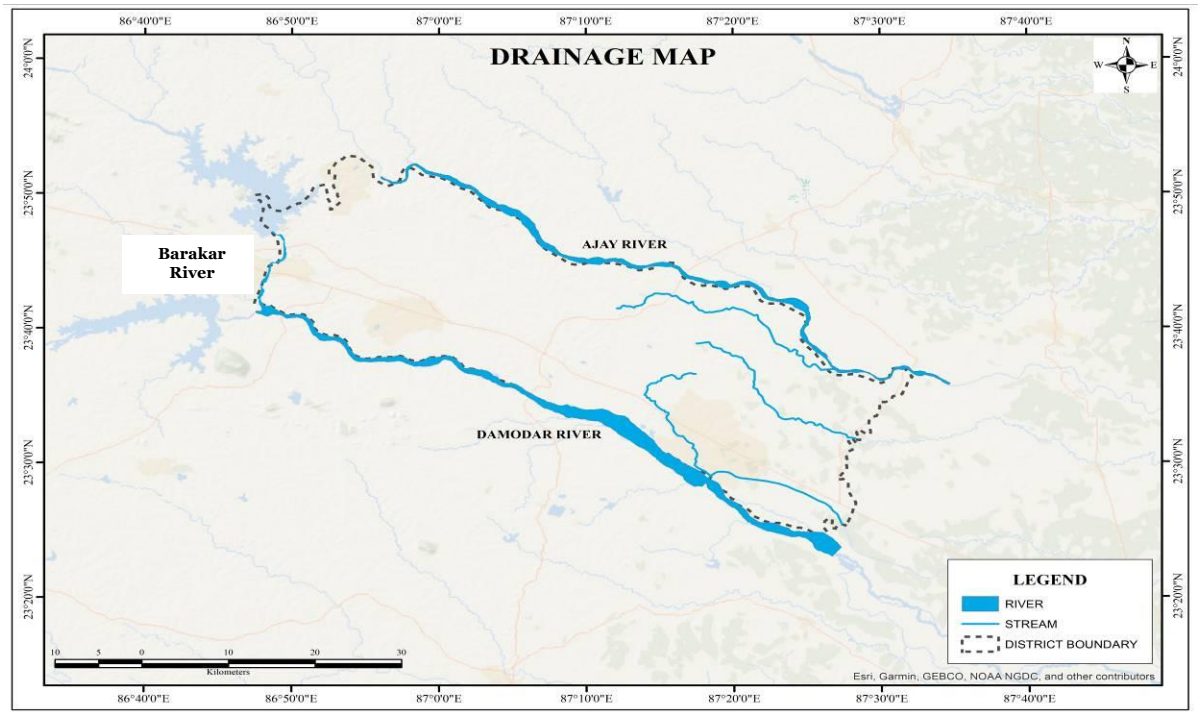


Figure 3.8: Drainage map of Paschim Bardhaman District

(Source: National Informatics Centre)

3.8 Demography

As per the 2011 Census of India data, Paschim Bardhaman district (after bifurcation of Bardhaman district in 2016), had a total population of 2,882,031. There were 1,497,479 (52%) males and 1,384,452 (48%) females. Population below 6 years was 322,268. 2,351,954 (81.61%) lived in urban areas, while 530,077 (18.39%) lived in rural areas.

As per the 2011 census data the total number of literates in Paschim Bardhaman district, after bifurcation of Bardhaman district in 2017, was 2,015,056 (78.75% of the population over 6

years) out of which males numbered 1,136,990 (85.44% of the male population over 6 years) and females numbered 806,010 (65.55% of the female population over 6 years). Scheduled castes and scheduled tribes made up 628,568 and 161,946 which is 21.81% and 5.62% of the population respectively.

In the 2011 census Hindus numbered 2,442,414 and formed 84.75% of the population in Paschim Bardhaman district. Muslims numbered 384,027 and formed 13.32% of the population. Sikhs were 14,754 forming 0.51% of the population, almost entirely in urban areas such as Asansol and Durgapur. Christians numbered 12,636 and formed 0.44% of the population. Other religions (including indigenous religions such as Sarna) numbered 42,954 and formed 1.49% of the population.

According to the Census 2011, 58.18% of the population in what is now Paschim Bardhaman district spoke Bengali, 26.78% Hindi, 7.64% Urdu and 4.47% Santali as their first language. *https://en.wikipedia.org/wiki/Paschim_Bardhaman_district*

Table 3.5: Demographic distribution of Paschim Bardhaman District

Subdivision	Head quarters	Area km2	Population-2011	Rural Population %-2011	Urban Population %-2011
Paschim Bardhaman district	Asansol	1,603.17	28,82,031	18.39	81.61
Durgapur	Durgapur	771.28	12,09,372	20.78	79.22
Asansol Sadar	Asansol	831.89	16,72,659	16.67	83.33

(Census, 2011)

Figure 3.9 shows the population distribution in Paschim Bardhaman District.

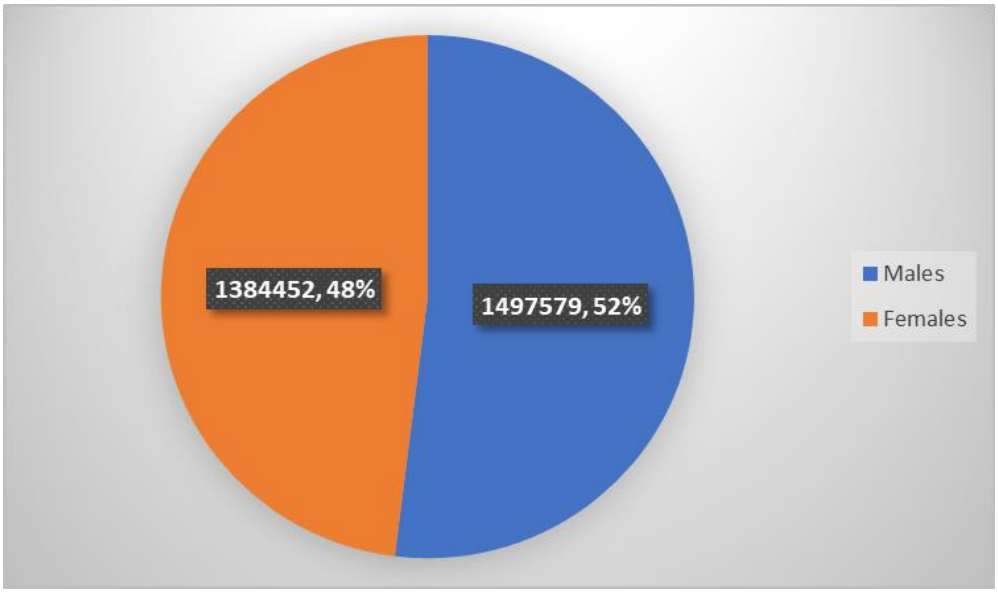


Figure 3.9: Population distribution in Paschim Bardhaman District

(Census, 2011)

Figure 3.10 shows the literacy rate in Paschim Bardhaman District.

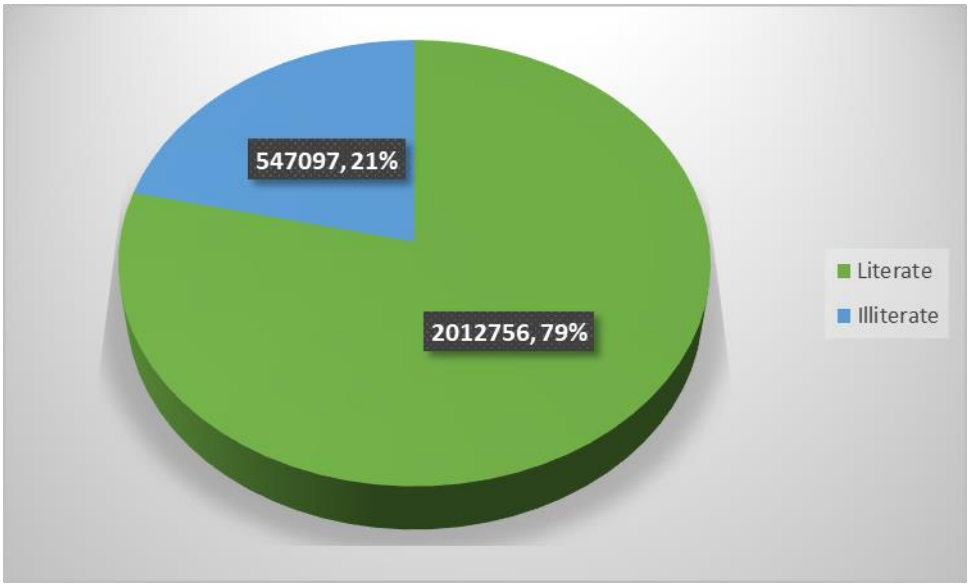


Figure 3.10: Map showing Literacy rate of Paschim Bardhaman District
(Census, 2011)

3.9 Cropping pattern

Cropping intensity may be defined as the ratio between net cultivated area and total cultivated area. It indicates the intensity of cultivation in a region in a crop year. Higher will be the gross cropped area higher will be the intensity of cropping. Suitable soil, climatic condition, irrigation facilities help the farmers to grow more than one crop and thus increasing the intensity of cropping. Paschim Bardhaman district covers total cropped area of 77735 ha as of 2014-15.

District Industrial Profile, 2017-2018, Paschim Bardhaman, Ministry of MSME, Govt. of India.

According to the report on, Agriculture Contingency Plan for District, Paschim Bardhaman (2007 - 08), high intensity of cropping (184%) was observed in Paschim Bardhaman. Paddy is the most important crop of the district and covers maximum of the gross cropped area. Among commercial crops, jute, sugarcane, potato and oilseeds are major crops. Major and most common cropping practice patterns of the district consist of paddy-wheat-vegetables, paddy-potato-sesame, paddy-vegetable-mustard and jute-paddy-vegetables.

District Disaster Management Plan, 2015-2016

The gross cropped area of the district is 832.1 ha, net sown area is 452 hectares, and area sown more than once is 380.1 hectares.

Agriculture Contingency Plan of Bardhaman

3.10 Land Form and Seismicity

The district Paschim Bardhaman is a fragment of Chhotanagpur plateau (*District Industrial Profile, 2017 - 18*). The western part of Paschim Bardhaman district shows the presence of hillocks and the elevated part of the Chhotanagpur Plateau gradually fuses to the riverine plains. Paschim Bardhaman district is prone to disasters like flood, drought, cyclone

etc., and in the past the district has experienced the intimidations of such disasters and falls under moderate damage risk zone in respect to seismicity proneness (*http://wbdmd.gov.in/pages/earthquake.aspx*). Paschim Bardhaman district is categorized under seismically active zone - III i.e., moderate seismic intensity zone. Bureau of Indian Standards, based on the past seismic history, grouped the country into four seismic zones, viz. Zone - II, Zone –III, Zone-IV and Zone-V. Of these, Zone V is the most seismically active region, while Zone II is the least.

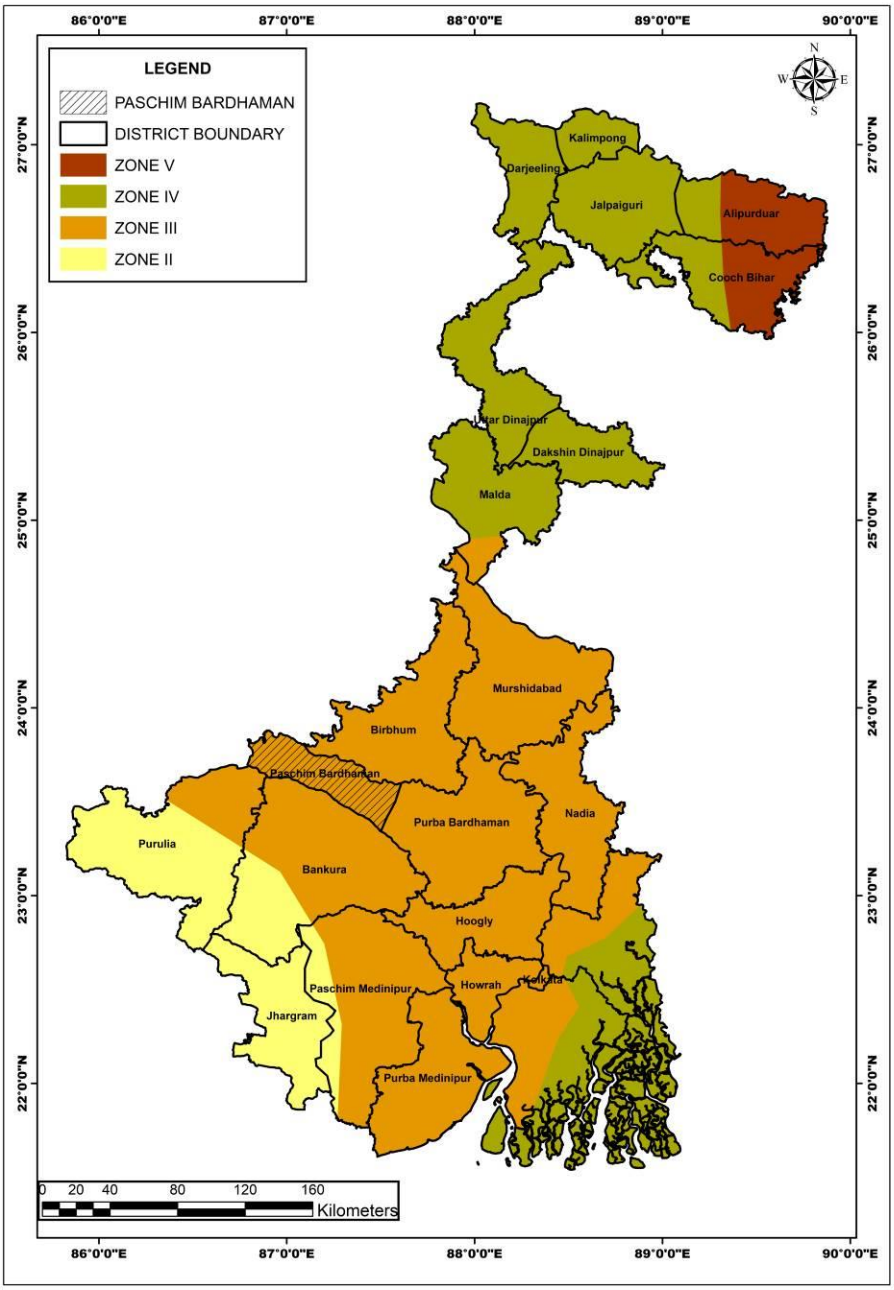


Figure 3.11: Earthquake zonation map of West Bengal highlighting the Paschim Bardhaman district position

https://pib.gov.in/PressReleasePage.aspx?PRID=1740656

Table 3.6: Details of vulnerable areas of paschim Bardhaman District
http://wbdmd.gov.in/writereaddata/uploaded/DP/DPPaschim%20Bardhaman20500.pdf

Type of hazard	Time of Occurrence	Vulnerable areas
Flood	June to October	AMC Ward no. 41, 27, 88, 90, 79, 08, 32, 09, 19, 70
		Jamuria -SidhaPur Darbar Danga
		Raniganj- Nupur
		Andal- Madanpur, Babuisol, Srirampur, Ramprasadpur
		Pandaveswar- Gobindpur, Konda, Metal Dhoara
		Durgapur-Faridpur- Gogla, Notundanga, Pansiuli, Gourbazar, Srikrishna Pur
		Kanksa- Shilampur, Amlajora, Shibpur
		Barabani- Roshna, Putulia, Parulberiya, Amulia
		Salanpur Bathanbari, Sidhabari, Kalipathar, Brindabani
		DMC- Ward no. 36, 36, 38, 39, 41, 43, 13, 14, 33, 34
Draught	March to May	Almost All the Blocks
Sunstroke	April to June	Entire Blocks
Cyclone	-	Entire Blocks
Earthquake	-	Entire Blocks

The Damodar River was once upon a time known as “Sorrow of Bengal” since this is flooded almost every year which receives huge quantum of water from the upland of the Chhotanagpur Plateau. Along with the catchment water, the river also receives a huge quantum of sediment loads. Several attempts have been undertaken from the historic period for flood control which has affected only after the Independence in 1948 when “Damodar Valley Corporation” has been formed. Damodar River was earlier known as the "River of Sorrows" as it used to flood many areas of Bardhaman, Hooghly, Howrah and Medinipur districts. Even now the floods sometimes affect the lower Damodar Valley, but the havoc it wreaked in earlier years is now a matter of history. The floods were virtually an annual ritual. In some years the damage was probably more. Many of the great floods of the Damodar are recorded in history — 1770, 1855, 1866, 1873–74, 1875–76, 1884–85, 1891–92, 1897, 1900, 1907, 1913, 1927, 1930, 1935 and 1943. In four of these floods (1770, 1855, 1913 and 1943) most of Bardhaman town was flooded. The first dam was built across the Barakar River, a tributary of the Damodar River at Tilaiya in 1953. The second one was built across the Konar River, another tributary of the Damodar River at Konar in 1955. Two dams across the rivers Barakar and Damodar were built at Maithon in 1957 and Panchet in 1958 respectively. Both the dams are some 8 kilometres (5 mi) upstream of the confluence point of the rivers. These four major dams are controlled and maintained by DVC. Durgapur Barrage was constructed downstream of the four dams in 1955, across the

Damodar River at Durgapur, with head regulators for canals on either side for feeding an extensive system of canals and distributaries. In 1978, the government of Bihar (that was before the formation of the state of Jharkhand) constructed the Tenughat Dam across the Damodar River outside the control of DVC. These dams restrict the regular water flow of the river which has definitely affected in the flood management of the downstream areas. However, the upper dams receive huge sediment loads from the uphill plateau region and get obstructed in the dams. Almost every year, during late monsoon, the upper dams releases water due bankfull situation of the river. The discharge water contains loads of sediments together. Usually, the river sediments are being divided into, bed load, suspended load and dissolved load. The sand depositions are form of bed load. These sediments ultimately got deposited in the lower regime of the river. The sediment load is mostly fine sands which has a potential for development as a construction material. Since the river is traversing coal mining potential areas, sands are also used for stowing as well.

https://en.wikipedia.org/wiki/Damodar_River

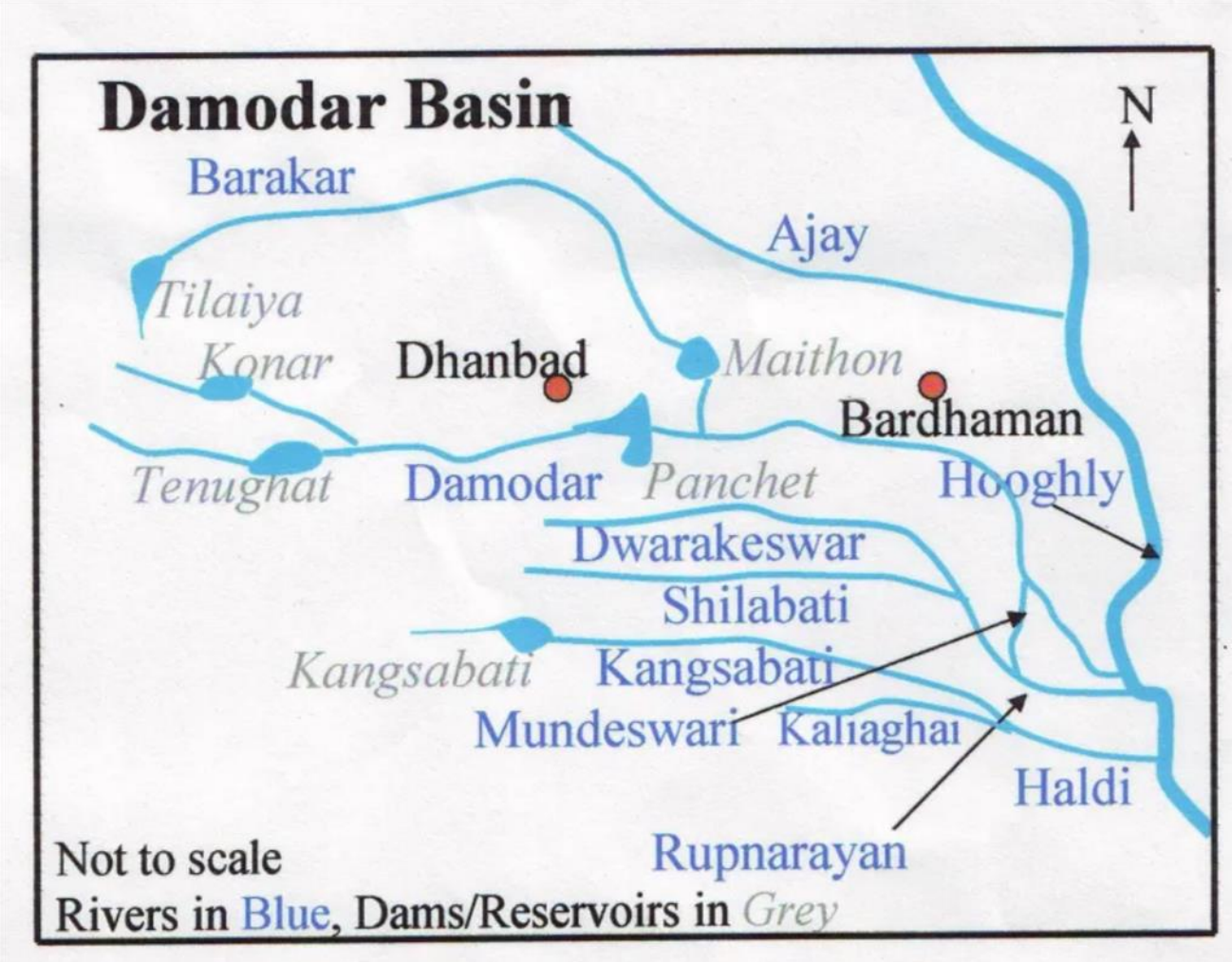


Figure 3.12: Map showing Dams/Reservoirs on Damodar River

3.11 Flora

Before 2017, Paschim Bardhaman was recognized as an important part of Bardhaman district. As the district experiences a climate which is transitional between CWg3 and AW1 types, where 'C' stands for 'warm temperate rainy climates with mild winter','W' for 'dry winter not compensated for by total rain in the rest of the year', 'g3' for 'eastern Ganges type of temperature trend' and 'AW1' for 'tropical savanna climates' (*http://Barddhaman.nic.in/home.htm*) and lies between Chhotanagpur Plateau and Gangetic plains for this reason it is rich in biodiversity. The forests of the district are characterized by tropical dry deciduous attributes. In the wasteland, scrub sand bushes are found (*Ghosh, et.al. 2018*).

The uplands of Asansol subdivision and the lateritic area of the district are in places covered with the predominant and principal floral species i.e. Sal (*Shorearobusta),* Mahua (*Madhuealatifolia*), Palas (*BuleaMonosperma*), Bans (*Bambusaarundinacea),* Arjun (*TerminaliaArjuna),* Shireesh (*Albiziasaman)* and Kend *(Diospyrosmelanoxylon).* The flora of the district is characterized by the arborescent species such as Simul (*Salmaliamalabarica*), Neem (*Azadirachta indica*), Amlaki (*Phyllanthus embica*), Narikel (*Cocosnucifera*), Khejur (Phoenixdactylifera),Tal (Borassusflabellifer),Bot (Ficusbengalensis), Asvattha (Ficusreligiosa,Krishnachuda (Caesalpinia pulcherrima), Aam (*Mangifera indica*) and shrubby species suchasashsheoda (Glycosmis pentaphylla), Pianj, Rasun, Rajanigandha (Polyanthes tuberosa),Ghentu or Bhat (*Clerodendroninfortunatum*), Gulancha (*Tinosporacordifolia*), Tulsi (*Ocimumsanctum*), Shiora (Streblus asper) and Dumur (*Ficus hispida*).

The common plants in hedges and waste land sarelal-bharenda (Jatrophagossypifolia), Ban-okra (Urenalobata), Ulu (Imperataarundinecea) etc. The common aquatic and marsh weeds found in the jheels and swamps in the easternparts of the district are Keshe (Saccharum spentaneum), Bena (Andropogon squarrosus), Ganj or pata-sola (Vallisneria spiralis), Jhangi (*Hydrilla verticillata*.), Pond weed (Potamogeten indicus), Kesar-dam (Jussiaea repens), Kush (Eragrostiscynosuroides), common Jhangi (Utriculariastellaris), Pana (Lemnapancicostata), Waterhyacinth (Eichorniacrassipes), Hogla (*Typhaangustata*), Padma (*Nelumbiumspeciosum*) etc. *District Gazetter, Bardhaman.*

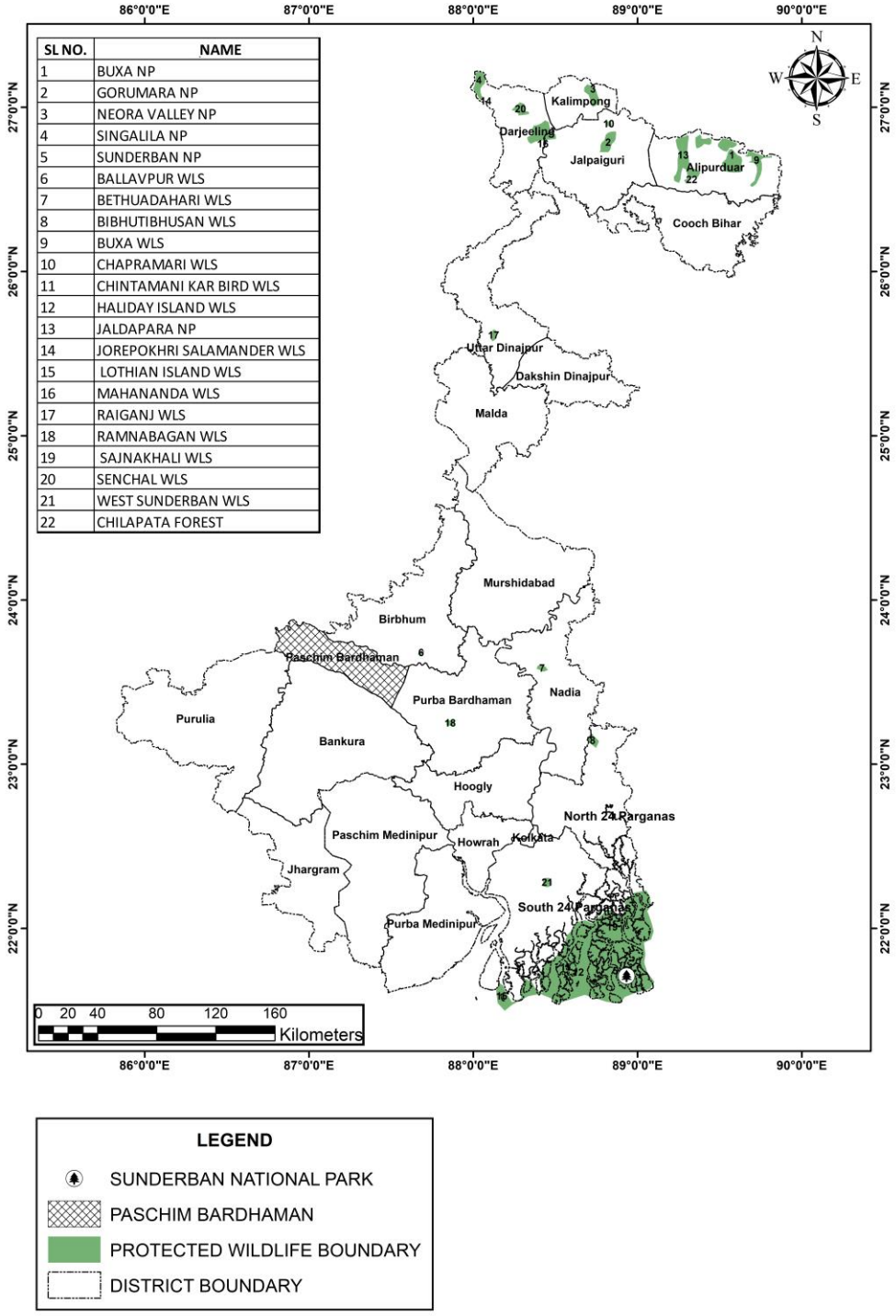
3.12 Fauna

Paschim Bardhaman has a rich ecological and wild life heritage. Wild life of Paschim Bardhaman includes diversified mammals, birds, reptiles, amphibians, fishes, birds and reptiles. A newly created research organization, and biodiversity portal of district of West Bengal named as, Biodiversity of Paschim Bardhaman, a sister-group of „Birding Durgapur" has already explored and documented that till date only in

Durgapur 238 species of bird, 99 species of butterfly, and about more than 60 species which is a positive indication of larger exploration in whole district. The group is also engaged to explore the species of plant, mollusc, amphibian, reptiles etc. (*https:// biodiversity of paschim Bardhaman.weebly.com*).

The District Gazetter, Bardhaman, depicted that, the mammalian carnivore of the district comprises of leopard (*Panthera pardus*), wolf (*Canis lupus*), hyaena (*Hyaena hyaena*), jackal (*Canis aureus*) and other smaller species, but hyaenas are not so common. Tigers (*Panthera tigris*) were formerly common in the district, especially in the jungles of the Asansol subdivision adjoining the Jharkhand, but have now a days entirely disappeared from this province of Paschim Bardhaman. Wolves are in frequently found and are mostly met with in the jungles north of Kanksa. Wild pigs (*Sus scrofa*) are numerous throughout the district and monkeys (*Cercopithecidaesp*.) also abound including the variety known as Hanuman.

The common avifauna of the district are pea-fowl (*Pavocristatus*), jungle-fowl (*Gallus sp*.), jungle crow (*Corvus macrorhynchos*), house crow (*Corvus splendens*), treepie (*Dendrocittavagabunda*), common babbler (*Turdoidescaudata*), gold frontedchloropsis (*Chloropsisaurifrons*), red-ventedbulbul (*Pycnonotuscafer*), red whiskeredbulbul (Pycnonotusjocosus), redspottedbluethroat (Lusciniasvecica), brown-backed robin (Erythropygiahartlaubi), Shama (Copsychusmalabaricus), Tickell's blueflycatcher (Cyornistickelliae), paradise flycatcher (Terpsiphonesp.), woodshrike (Tephrodornispondicerianus) , black drongo (Dicrurusmacrocercus), tailor bird (Orthotomussp.), streaked fantailwarbler (Cisticola juncidis) golden oriole (Oriolusoriolus), common mayna (Acridotheres tristis), piedmayna (Gracupica contra), white-backed munia (Lonchura striata), white throated munia (Euodicemalabarica), spitted munia (*Lonchurapunctulata*), red munia (*Amandavaamandava*), yellow-throatedsparrow (Petroniax anthocollis), house sparrow (Passerdomesticus), woodpecker (*Picidae sp*.), Indiacuckoo (Cuculus micropterus), pied crested cuckoo (Clamatorjacobinus), koel (*Eudynamyss*p.), parakeet (Melopsittacusundulatus), Nilkantha (*Coraciasbenghalensis*), bee-eater (Meropidaesp.), kingfisher (Alce dinessp .), hornbill (*Bucerotidaesp*), hoopoe (*Upupidaesp*.), hornedowl (*Bubovirginianus*), spotted owlet (Athene brama), jungle owlet (*Glaucidium radiatum*), griffon vulture (Gypsfulvus), long-billed vulture (Gyps indicus), scavenger vulture (Neophron percnopterus), lagger falcon (*Falcojugger*), small spotted eagle (*Clangaclanga*), brahminykite (*Haliasturindus*), pariahkite (*Milvus migrans*), sparrow hawk (*Accipiter nisus*) various types of pigeon and dove, goose, duck, teal, lap wing, white necked stork and several varieties of egret and heron. Distric's wildlife heritage is significantly enriched by some species of various migratory birds. Specifically, the low-lying swampy areas of Paschim Bardhaman are an excellent line of migration habitat of birds and provide a very good shelter for the migratory birds throughout the winter season.



SL NO.	NAME
1	BUXA NP
2	GORUMARA NP
3	NEORA VALLEY NP
4	SINGALILA NP
5	SUNDERBAN NP
6	BALLAVPUR WLS
7	BETHUADAHARI WLS
8	BIBHUTIBHUSAN WLS
9	BUXA WLS
10	CHAPRAMARI WLS
11	CHINTAMANI KAR BIRD WLS
12	HALIDAY ISLAND WLS
13	JALDAPARA NP
14	JOREPOKHRI SALAMANDER WLS
15	LOTHIAN ISLAND WLS
16	MAHANANDA WLS
17	RAIGANJ WLS
18	RAMNABAGAN WLS
19	SAJNAKHALI WLS
20	SENCHAL WLS
21	WEST SUNDERBAN WLS
22	CHILAPATA FOREST

Figure 3.13: District location with respect to Wild Life Sanctuary of West Bengal

(Source: http://wiienvis.nic.in/)

In the hilly areas, pythons (*Pythonidae sp*.) are found occasionally. Poisonous snakes are very common and include several kinds of cobra (*Serpentes sp*.), the kraits (*Bungarussp*.) and the deadly Russell's viper (*Daboiarusselii*). Other most frequently seen varieties are the Dhamna (*Ptyasmucosa*) and various species of harmless grass snakes (*Natrixnatrix*).

4 Geomorphology

4.1 General Landforms

General landform of an area represents natural and/or human influenced facets of the earth's crust and also involves portraying vertical and horizontal dimensions along with their arrangements. Distinctive landforms embrace not only hills, mountains, plateaus, plains, valleys but also include ocean front landscapes, submerged topographies, ridges of mid-oceans, volcanoes and the great ocean basins.

Paschim Bardhaman is a sort of an extension of the Chota-Nagpur Plateau. Almost rectangular shaped district Paschim Bardhaman is fundamentally an intermediate portion between Chotanagpur Plateau that constitutes a part of peninsular shield in west and alluvial plain of Ganga – Brahamaputra river system in the north and east. The district is influenced by the rivers e.g., Ajay on the north; Damodar on the south and the Barakar on the west and therefore, the district shares a portion of the Ajay Damodar - Barakar tract. Numbers of stream sand water ways criss-crosses the district and lends differentiated landscape. Ajay-Damodar inter-stream tract basically adorned the areas in and around the Asansol and Durgapur subdivision (*District Industrial Profile, Paschim Bardhaman, Ministry of MSME, and Government of India 2017-2018*).

The surface gradient of this province is southerly towards the Damodar and westerly towards the Barakar, northerly towards the Ajay (*Peterson, J.C.K.1910: 7*). The western part of Paschim Bardhaman district illustrates the occurrence of hillocks and the elevated area of the Chhotanagpur Plateau progressively slopes down to the riverine plain areas(*http://wbdmd.gov.in/pages/earthquake.aspx*). Report of National Bureau of Soil Survey & Land Use Planning, Indian Council of Agricultural Research, Regional Centre Calcutta (2013) that is entitled, "Soil survey and land use plan of Bardhaman district (West Bengal)" incarnated that, the western most province of Bardhaman district which is currently separated as Paschim Bardhaman district can be ordered into four (4) classes of slope profile e.g., (i) gently sloping predominantly in western part of the districts,(ii)gently sloping to moderately sloping in Salapur and Barabani areas,(iii) gently sloping to very gently sloping profile in Raniganj, Pandabeshwar, Andal, Asansol, parts of Durgapur and (iv)very gently sloping belt along the river bank of Ajay.

4.2 Soil and rock pattern

The rocky undulating topography with laterite soil found in Paschim Bardhaman district is a sort of extension of the Chhotanagpur plateau. For ages the area was heavily forested and infested with plunderers and marauders. This soil is found between the rivers Ajoy and Damodar, part of the district, which is highly porous, poor in organic matter content and acidic in nature. A soil map and their distribution is furnished in table 4.1 and figure 4.1.

Table 4.1: Description of District soil type

Code	Description
W036	Very deep, poorly drained, fine cracking soils occurring on level to nearly level low-lying alluvial plains with clayey surface associated with very deep, imperfectly drained, fine soils
W065	Very deep, moderately well drained, fine loamy soils occuring on very fently sloping flood plain with loamy surface, moderate erosion and moderate flooding associated with very deep, well drained, sandy soils
W067	Very deep, imperfectly drained, coarse loamy soils occuring on very gently sloping to undulating dissected upland with loamy surface and moderate erosion associated with very deep, moderately well drained, fine loamy soils
W068	Very deep, imperfectly drained, fine loamy soils occuring on very gently sloping to undulating dissected upland with loamy surface and moderate erosion associated with very deep, moderately well drained fine loamy soils
W069	Very deep, poorly drained, fine loamy soils developed on old alluvium occurring on gently sloping to undulating dissected upland with loamy surface and slight erosion associated with very deep, poorly drained, fine soils
W070	Very deep, poorly drained, fine soils occurring on nearly level upland with loam surface associated with very deep, poorly drained, fine soils
W094	Deep, well drained, loamy soils occurring on very gently sloping to undulating plain with loamy surface and moderate erosion associated with deep, moderately well drained, loamy soils
W096	Shallow, moderately well drained, gravelly loamy soils occurring on very gently sloping to undulating plain with gravelly loamy surface and moderate erosion associated with shallow, well drained, fine loamy soils
W107	Very deep, well drained, coarse loamy soils occurring on very gently sloping valleys on undulating plateau with loamy surface and moderate erosion associated with very deep, moderately well drained fine loamy soils
W114	Shallow, moderately well drained, coarse loamy soils occurring on gently sloping to undulating plain with gravelly loamy surface and moderate erosion associated with shallow, imperfectly drained, gravelly loamy soils

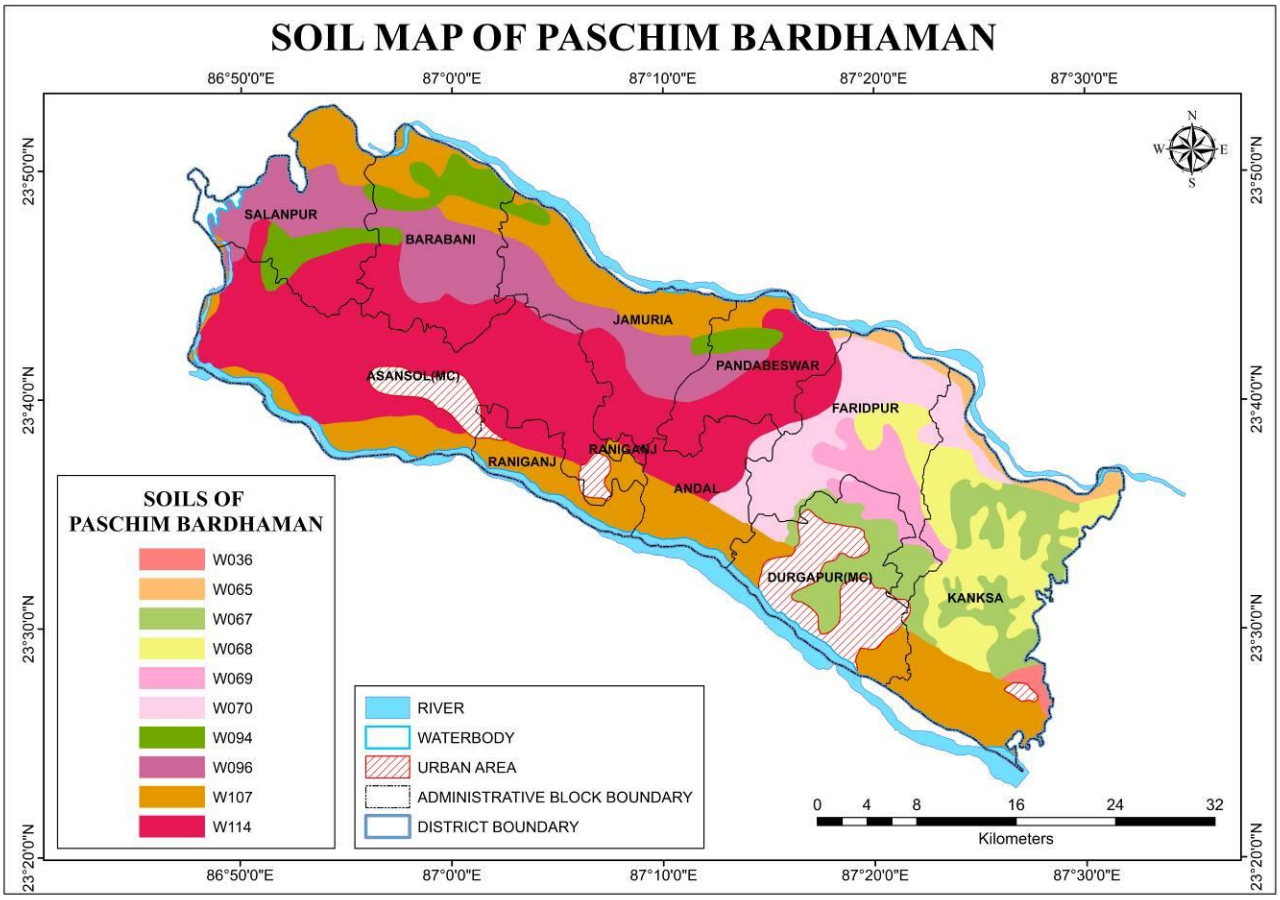


Figure 4.1: Soil Map of Paschim Bardhaman District
(https://esdac.jrc.ec.europa.eu/content/west-bengal-soils-sheet-2)

4.3 Different geomorphologic units

Geomorphologically the district consists of three (3) major physiographic zones namely (i) Floodplain (ii) Pediplain with scattered rocks (iii) Upper mature deltaic plain. As the geomorphology of the region is the expression of surface or subsurface litho-stratigraphy, therefore, the geomorphological profile of the district is transparently bestowing the soils are heterogeneous in their morphological characteristics such as soil depth, colour, texture, structure, drainage, slope etc. Paschim Bardhaman district lies at the eastern fringe of Chhotanagpur Plateau and possesses predominantly sandstone, conglomerate micaceous shale and siltstone along with granite gneiss and migmatite type of rocks. The region is highly eroded and dissected. The district consists of three (3) major physiographic zones are described briefly.

Upper Mature Deltaic Plain

This region is built up of the deltaic fans of the streams flowing from the western hills. (*Soil survey and land use plan of Bardhaman district, West Bengal National Bureau of Soil Survey & Land Use Planning, Indian Council of Agricultural Research, 2013*).

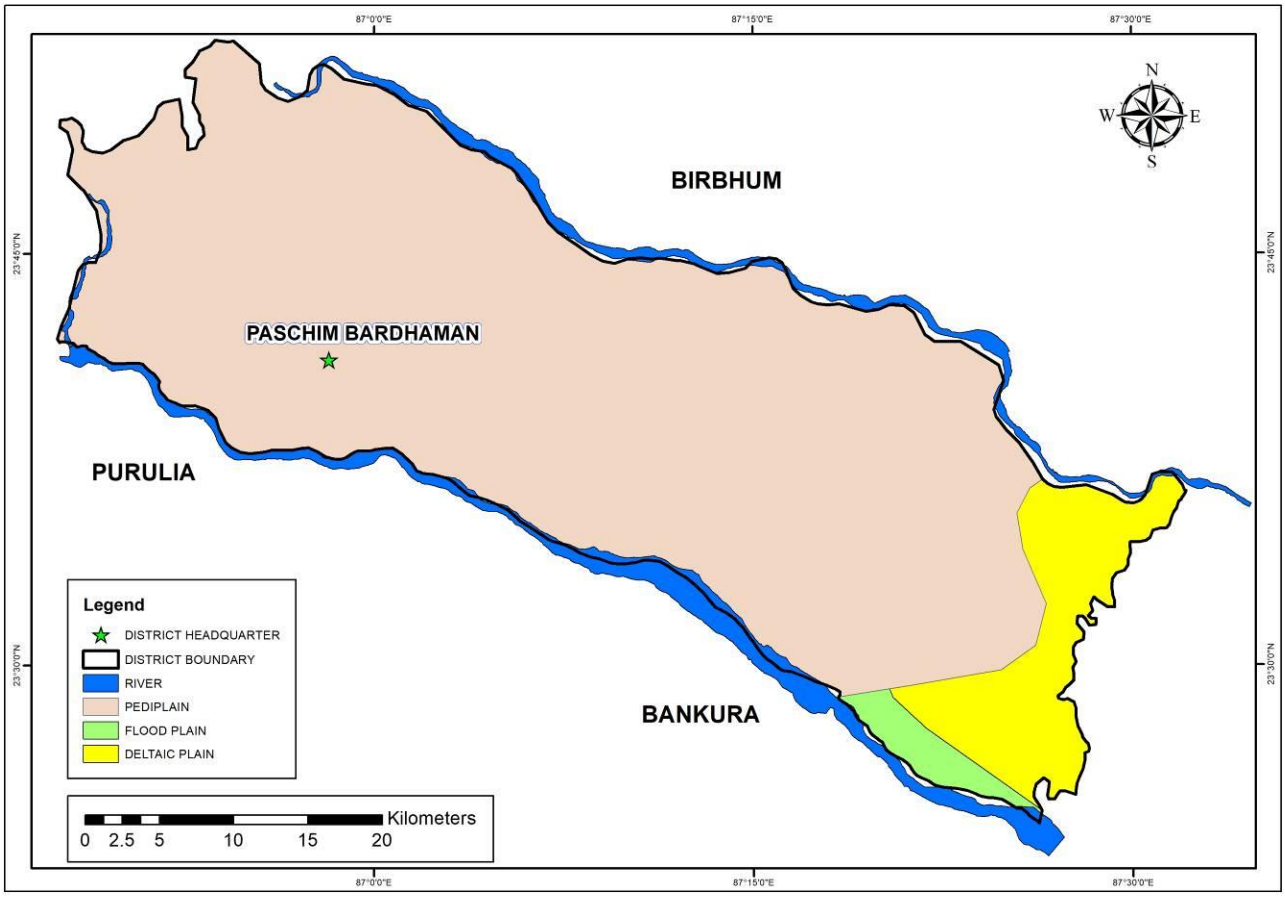


Figure 4.2: Geomorphological map of Paschim Bardhaman District

(Resourcesat-1and2 – Liss-3, Bhuvan India)

Pedi-plain with Scattered Rock

Pediplain with scattered rock fragment constituting pebbles & gravels of quartz, feldspar & basic rocks of Permo Carboniferous to Triassic and Archean ages (*Projection & Geodetic Reference System: GCS, WGS 1984; CGWB & GSI, 1984*). The western part of the district comprises the inter-fluve of the rivers.

Flood Plain

Flood plain is formed due to successive floods and deposition which gradually raised the tract above flood level. The riverine area has developed through alluviation. The river gradient has decreased from east to west. This part is mostly inter-bedded layers of sand and clay. This region extends from 80meter contour which is formed of alluvium brought by the river Damodar and Ajay. The surface is undulating, interspersed with low ridges and valleys (*Soil survey and land use plan of Bardhaman district, West Bengal National Bureau of Soil Survey & Land Use Planning, Indian Council of Agricultural Research, 2013*). Flood plain is mainly restrained in areas under jurisdiction of Faridpur and Kangsa police station.

5 Land use pattern of the district

Table 5.1 gives land utilization static of Paschim Bardhaman district. Figure 5.1 is pie diagram representing broad land use pattern of the district and Figure 5.2 is Land Use Land Cover map of the district.

Table 5.1: Classification of Land Utilisation Statistics in the district

(In thousand hectares)

Year	2009-10	2010-11	2011-12	2012-13	2013-14
Reporting Area	698.76	698.76	698.76	698.76	698.76
Forest Area	21.16	21.16	21.16	21.16	21.16
Area under Non-agricultural use	208.53	211.56	211.92	213.77	214.19
Barren & unculturable land	1.37	0.86	0.65	0.57	0.44
Permanent pastures & other grazing land	0.22	0.26	0.33	0.15	0.06
Land under misc. tree groves not included in Net area sown	1.42	1.99	0.87	0.83	0.98
Culturable waste land	5.6	4.88	6.09	4.45	3.74
Fallow land other than Current fallow	1.37	1.24	1.46	1.25	1.09
Current fallow	4.98	4.35	4.31	3.7	3.31
Net area sown	454.11	452.46	451.97	452.88	453.79

http://wbpspm.gov.in/publications/District%20Statistical%20Handbook

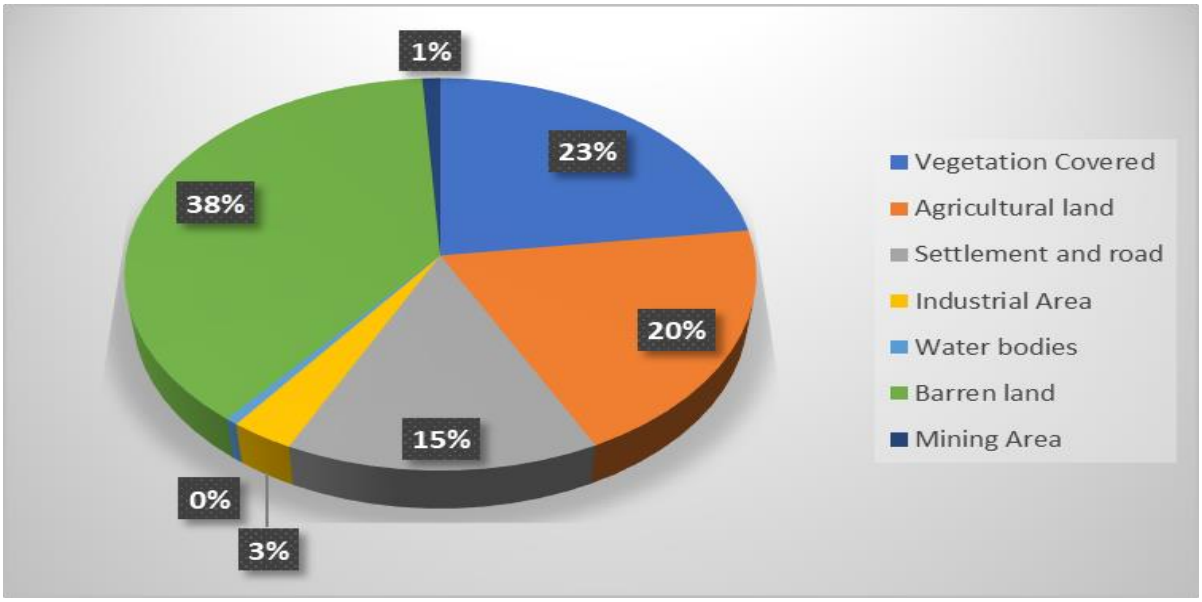


Figure 5.1: Land use pattern of Paschim Bardhaman District

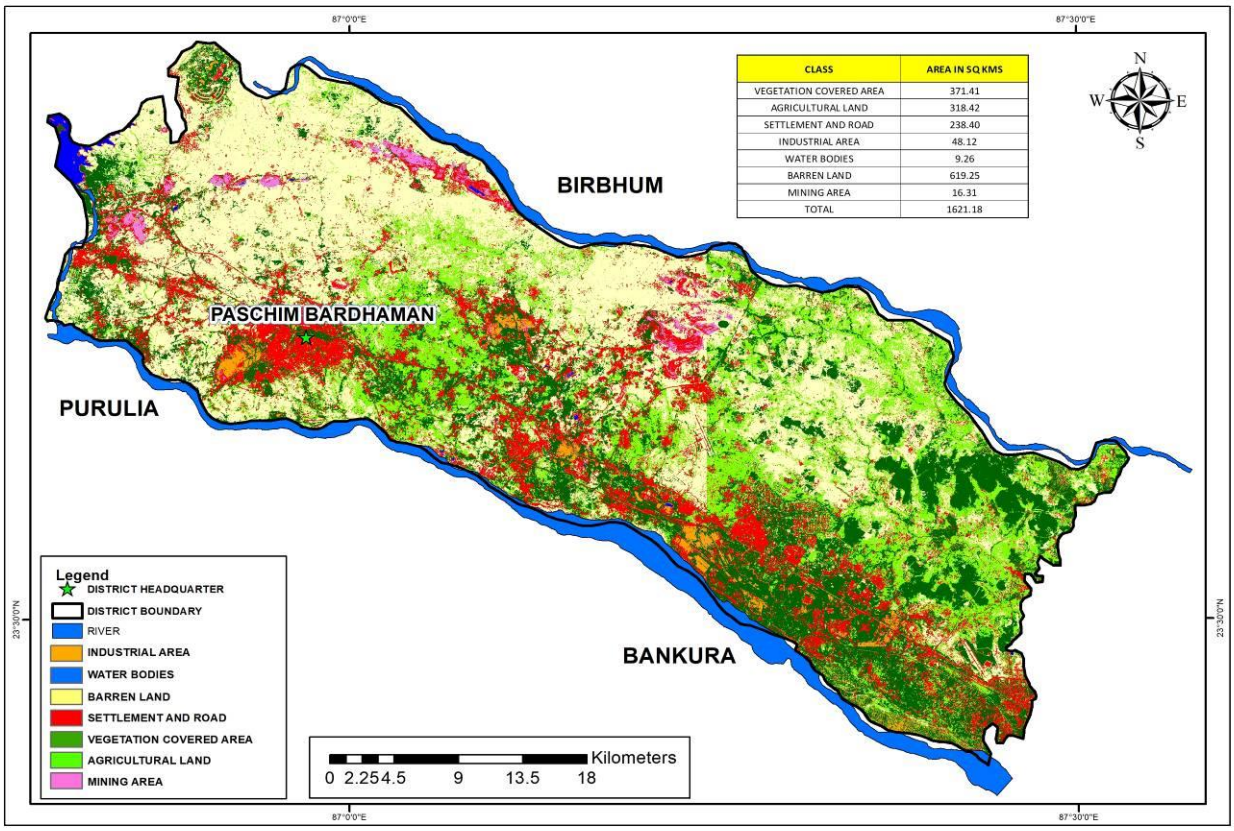


Figure 5.2: Land Use Land Cover map of Paschim Bardhaman District
(Resourcesat-1 and 2 – Liss-3, Bhuvan India)

5.1 Forest

The forest zones of the district are chiefly situated in the lateritic and red soil high lands in the Asansol subdivision. The Durgapur Forest also covers large part of neighbor district, Birbhum, beyond the Ajay River while the forest area within the Asansol subdivision forms a part of the forest area of Dumka District of Jharkhand (*http://Bardhaman.nic.in/home.htm*).

Upto the middle of 19th century, the region was intact from any kind of significant development due to its uncultivable red lateritic soil with dense and wild impenetrable jungles. The detection of presence of coal in the 18th century led to industrialization of the western part of the subdivision.

Most of the forests in the western part of the subdivision have been cleared but in the eastern part, some still exist in Kanksa and its adjoining Faridpur-Ukhra area. Kanksa Block accounts for 67.20% of the total notified forest area of the district and divided in to 5 forest beats. Ramnabagan Wildlife Sanctuary is spread over a part of this forest. The forests of West Bardhaman district mainly comprises of Sal and Kend trees. Besides these, Mohua, Palas, Simul, Neem, Shireesha, Arjun and Ashan are also available. The main forest products are timber, kendu leaves and fuel. The aggregate forest area of West Bardhaman is 43455.73 acre including

plantation and notified forest area is 24878.04 acre. *District Industrial Profile, 2017-2018, Paschim Bardhaman, Ministry of MSME, Govt. of India*.

Table 5.2: Classification of Forest Area, Out-turn of Forest Produce, Revenue and Expenditure of Forest Department

Item	Unit	2009-10	2010-11	2011-12	2012-13	2013-14
(1)	(2)	(3)	(4)	(5)	(6)	(7)
1. Area by class of Forest	-	-	-	-	-	-
Reserved forest	hectare	2762.58	2762.58	2762.58	3367.46	3367.46
Protected forest	"	19361.71	19361.71	19361.71	20567.33	20567.33
Unclassed state forest	"	5544.94	5544.94	5544.94	5386.65	5386.65
Khas forest	"	-	-	-	-	-
Vested waste land	"	-	-	-	-	-
Forest owned by corporate bodies	"	-	-	-	-	-
Forest owned by private individuals	"	-	-	-	-	-
Forest owned by civil authorities	"	-	-	-	-	-
Total		**27669.23**	**27669.23**	**27669.23**	**29321.44**	**29321.44**
2. Forest Produce	-		-	-	-	-
Timber	Thousand Cu. Metre	0.77	0.71	0.62	1.72	1.53
Fuel	"	4.65	1.85	2.14	8.51	7.07
Pulpwood	"	4.45	4.09	0.49	0.55	0.49
Pole	Number	9573	6864	12265	85406	81097
Post	"	23949	1246	42295	32909	1145
3. Revenue & Expenditure	-					
Revenue	Rs. in thousand	11,482.83	18,254.19	16815.74	34623.85	27886.02
Expenditure	"	1,04,857.32	124689.85	1,33,219.33	110065.53	134894.02

(http://wbpspm.gov.in/publications/District%20Statistical%20Handbook)

5.2 Agriculture and Irrigation

As of 2014-15 the total cropped area of the district is 77735 ha, the non-agricultural land is 62998 hectares, and the cultivable barren land is 2202 ha [*District*

Industrial Profile, 2017-2018, Paschim Bardhaman, Ministry of MSME, Govt. of India].

On an average about 58% of the total population belongs to the agricultural population while the non-agricultural sector accounts for the remaining 42%. The eastern, northern, southern and central areas of the district are extensively cultivated but the soils of the western portion being extreme lateritic type are unfit for cultivation except in the narrow valleys and depressions having rich soil. Rice is the most important crop of the district and covers maximum of the gross cropped area. Among commercial crops, jute, sugarcane, potato and oilseeds are major crops. Productivity of the major crops grown in the district is indicated below. Major cropping patterns include paddy, wheat, vegetables, paddy, potato, sesame, paddy, vegetable, mustard, jute *etc*. Irrigation is the application of controlled amounts of water to plants at needed intervals. Irrigation helps to grow agricultural crops, maintain landscapes, and re-nutritioning the sequestrated soils in dry areas and during dry periods and/or the time of less than average rainfall. Currently, Government attempts to minimize the drawbacks of agricultural issues by certain extent of advancement in the economic condition, education, technology manures, pesticides, irrigation facilities *etc*. The major sources of irrigation in the district are ponds, dug wells, LI points, drift/shallow tube-wells, rivers, creeks and canals [*District Disaster Management Plan, 2015-2016*].

As per "Agriculture Contingency Plan of Bardhaman" the major agricultural crops grown in the district are rice, wheat, pulses, oilseeds, jute and potato. Jute and rice are the kharif crops grown in the district, whereas rice, wheat, pulses, oilseeds and potato are the rabi crops grown in the district.

Apart from this, livestock rising, poultry farming and fisheries form major part of the agriculture of the district. The net irrigated area of the district of Bardhaman is 331.6 ha, the gross irrigated area is 693.3 ha, and the rain fed area is 138.8 ha. The sources of irrigation in the district are canals, tanks, open wells, bore-wells; lift irrigation schemes, micro irrigation practices etc.

Table 5.3: Production of Principal Crops in the district of Paschim Bardhaman

(Kilogram per hectare)

Crops		2009-10	2010-11	2011-12	2012-13	2013-14
(1)		(2)	(3)	(4)	(5)	(6)
Foodgrains :						
1.	**Rice**	**3050**	**2960**	**2951**	**3240**	**3338**
	Aus	2912	2852	3013	3095	2690
	Aman	2960	2893	3006	3092	3161
	Boro	3225	3093	2813	3628	3793
2.	Wheat	2443	2193	2413	2864	2691
3.	Barley	-	-	980	997	988
4.	Maize	2152	2080	2091	2097	2091
5.	Other Cereals	-	-	-	-	-

Total Cereals		**3048**	**2958**	**2948**	**3237**	**3335**
6.	Gram	618	1731	996	1585	1193
7.	Tur	214	911	329	1325	1250
8.	Other Pulses	767	985	1117	957	960
Total Pulses		**759**	**997**	**1094**	**1027**	**984**
Total Foodgrains		**3042**	**2947**	**2939**	**3228**	**3324**
Oil Seeds :						
1.	Rapeseed & Mustard	945	991	866	1168	1013
2.	Linseed	216	293	149	263	-
3.	Other Oil seeds	848	909	1069	1154	1077
Total Oil seeds		**901**	**951**	**955**	**1163**	**1041**
Fibres * :						
1.	Jute	17.2	21.1	18.3	15.5	21.2
2.	Mesta	11.6	0.3	0.9	12.5	13.2
3.	Other Fibres	3.0	7.8	5.0	5.1	5.0
Total Fibres		**17.1**	**20.8**	**18.3**	**15.48**	**21**
Miscellaneous crops :						
1.	Sugarcane	80830	95064	45180	45524	64403
2.	Potato	41117	37645	27675	32578	22336
3.	Tobacco	-	-	-	-	-
4.	Tea	-	-	-	-	-
5.	Chillies (dry)	1498	1501	1542	1461	1466
6.	Ginger	1910	1910	1901	1994	1944
Total Miscellaneous crops		**40042**	**37225**	**26876**	**31547**	**22532**

(http://wbpspm.gov.in/publications/District%20Statistical%20Handbook)

5.3 Horticulture

Practice of garden cultivation and management is known as Horticulture. Horticultural crops, i.e., fruits and vegetables acquire a place of importance as protective food. Horticulture provides much needed health supporting vitamins, minerals enriched foods. Besides, their value in human consumption, horticultural crops play an important role in commerce, particularly in export trade and processing industry in Paschim Bardhaman district. The major horticulture vegetable crops grown in the district are

brinjal, cabbage, cauliflower, cucurbits, ladies finger, tomatoes and the major horticulture fruit crops grown in the district are mango, banana, papaya, guava, jackfruit etc.

Table 5.4: Production of Fruits in the district

Name of Fruits / Vegetables	Prouduction (Thousand tonnes)				
	2009-10	2010-11	2011-12	2012-13	2013-14
(1)	(7)	(8)	(9)	(10)	(11)
A. Fruits :					
Mango	16.54	17.54	17.63	17.90	10.00
Banana	16.49	16.89	16.76	16.80	19.86
Pineapple	0.96	0.96	0.87	0.60	0.55
Papaya	14.23	14.33	14.51	14.54	17.50
Guava	8.93	9.13	9.36	9.40	9.46
Jackfruit	6.99	6.99	7.10	6.75	6.88
Litchi	2.85	2.85	2.89	2.90	2.91
Mandarin Orange	-	-	-	-	-
Other Citrus	3.16	3.26	3.87	3.88	3.95
Sapota	0.25	0.25	0.25	0.26	0.29
Others	3.92	3.96	4.15	4.20	4.25
Total	**74.32**	**76.16**	**77.39**	**77.23**	**75.65**

(http://wbpspm.gov.in/publications/District%20Statistical%20Handbook)

Located principally in temperate climate the district possesses an excellent floral diversity. The important flowers grown in the district and their production during 2009-2014 are shown in Table 5.5.

Table 5.5: Production of Flowers in the district

Name of Flower	Production					
	Unit	2009-10	2010-11	2011-12	2012-13	2013-14
(1)	(8)	(9)	(10)	(11)	(12)	(13)
Rose	Crore Cut flower	0.150	0.150	0.150	0.104	0.092
Chrysanthemum	"	-	-	-	-	-
Gladiolus	"	0.039	0.039	0.040	0.050	0.046
Tuberose	"	0.059	0.059	0.059	0.065	0.056

Marigold	' 000 MT	0.223	0.203	0.203	0.231	0.238
Jasmine	"	-	-	-	-	-
Seasonal Flower	"	0.058	0.038	0.040	0.051	0.050
Misc. Flower	"	0.039	0.035	0.035	0.039	0.039

(http://wbpspm.gov.in/publications/District%20Statistical%20Handbook)

5.4 Mining

The economic evolution of any society solely is influenced by the concrete infrastructure of the local industry. Paschim Bardhaman is accomplished with an economically rich infrastructure, suitable for any sort of industrial asset. Durgapur of Paschim Bardhaman is one of the biggest industrial hubs of India and was planned as an integrated industrial town. The state of West Bengal is candidly blessed with the enormous natural resources including prospective minerals and being a part of Chotonagpur plateau Paschim Bardhaman is extremely enriched with a number of minerals. The traditional industrial base of the district is principally sustained by coal, iron and steel and has experienced a rapid development and new industrial ventures, which comprises of minor minerals too. The district has a rich minor mineral base which is their liable indicator of bountiful convenience for commercial use and economic development. Basically, the accessibility and distribution of mineral resources are their flection of antiquated paragenetic ore-geological sequence. The Raniganj coalfield was the native land of the coal industry of India. Asansol sub-division of this district lies upon a mammoth coal reserve of the best type of non-coking coal reserves in the country and hence, the mining activity was started in this province as early as 1774, however efficient withdrawal of coal initiated in the second half of the nineteenth century by depending upon this coal stockpile

[*District Industrial Profile, 2017-2018, Paschim Bardhaman, Ministry of MSME, Govt. of India*].

Originally the area was known as 'Raniganj Coalfield' which has huge numbers of collieries that extracted coal from these reserves until all of non-coking coal mines were nationalized in 1975 and renamed as 'Eastern Coalfields Limited (ECL) which is the second highest coal reserve in India, after Talcher. 'Raniganj Coalfield' expanses over 443.50 sq.km area and is currently estimated to have over 30.61 billion tons of coal. There blocks of Raniganj Coalfield e.g., Raniganj measures spread over Raniganj, Pandaveswar, Kajora, Jhanjra, Bankola, Kenda, Sonepur, Kunustoria, Satgram, Sripur, Sodepur and partly over Salanpur area & Barakar measures. Barakar measures cover

two areas of ECL, Salanpur and Mugma. Coal of Raniganj measures exhibits high calorific value, high volatile content, extended flame and quick ignition which create high preference in high heat energy consuming industries like glass, ceramics, fertilizers, refractory etc. The area is also highly prospectus for coal-bed methane. Introductory assessment of ONGC specifies that four Damodar Valley coalfields as Jharia, Bokaro, North Karanpura and Raniganj will be the potential zones. Other important mineral resource mainly found in Asansol-Raniganj area is China clay. Mica is also mined in certain parts of Asansol area.

A good deposit of fire clay and the coarse-grained soft stones which are mandatory and utilized for manufacturing bricks and tiles are abundant in Durgapur sub-division.

Not only is that but also by the benevolence of magnificent river systems, maximum part of the area covered by deposited ordinary river sand. Rock formations of the area are alluvial rocky upland and undulating lateritic upland. These formations undergo series of metamorphic cycles, like weathering, erosion, transportation and deposition of sand material. Sand is a very abundant minor mineral resource of the district. Demand for river sand has enormously increased for infrastructural construction purposes like building construction, road construction and other concretized infrastructural developments. Therefore, in admissible and unscientific mining practices without proper mining plan of river sand from the riverbeds, not only initiate natural & environmental hazards but will also accelerate economic setback of the surrounding areas and need proper initiatives in this regard.

6 Geology

Archaean granite gneisses and migmatites of the Chotanagpur Gneissic Complex are exposed in a narrow east-west belt fringing the north-western part and constitute the oldest basement rocks. Over these, in a faulted, subsided semi-graben type structural trough, deposited the thick bedded sedimentary sequence of Gondwana Super Group comprising sandstone, shale, siltstone with prolific commercial coal seams. All these rocks are cut across by a number of high angle, transverse, gravity faults. Mostly the Lower Gondwana sequence is developed in this district, comprising the Talchir, Barakar, Barren Measure, Raniganj and Panchet Formations. Durgapur beds constitute the youngest unit above the Panchet Formation which is considered equivalent to Mahadeva Formation of Upper Gondwana developed elsewhere. The Gondwana sequence rocks are exposed in the western part of the district area. In parts of the central and in the broad, oval area of eastern part, laterite cover with red soil and Quaternary sequence of riverine sediments grouped under Sijua, Panskura and Diara formations are exposed. The Sijua formation is mainly clay with caliche concretions; Panskura formation constitute clay alternations with silt and sand at the bottom and Diara formation comprise bedded interfingering sand, silt and clay in the present-day shifting river channel courses. Geological succession of Bardhaman district is furnished below.

Table 6.1: Geological succession of Bardhaman (Purba and Paschim)

District Resource Map, Geological Survey of India, 2001
https://www.gsi.gov.in/webcenter/portal/OCBIS/pageMAPS/pageMapsSeries?_adf.ctrl-state=lekbxmwix_5

Lithology	Geologic Unit	Age	
Sand, Silt, Clay	Diara Formation	Quaternary	Upper Holocene to Recent
Clay Alternating with Silt and Sand	Paskura Formation		Middle to Upper Holocene
Clay with Caliche Aoncretion	Sijua Formation		Upper Pleistocene to Middle Holocene
Laterite	Laterite		Cainozoic
Very Coarse Sandstone	Durgapur Bed	Gondwana Super Group	Jurassic
Red Shale, Sandstone	Panchet Formation		Triassic
Fine Grained Sandstone, Siltstone with Coal Seams	Raniganj Formation		Permian
Micaceous Shale, Sandstone	Barren Measure Formation		Permian
Gritty Pebbly Sandstone with Coal Seams	Barakar Formation		Permian
Sandstone, Conglomerate	Talchir Formation		Carboniferous-Permian(?)
Granite Gneiss and Migmatite	Chhotanagpur Granite Gneissic Complex		Achaean(?)-Proterozoic

A District Resource Map of undivided Bardhaman district is furnished below in Figure No. 6.1.

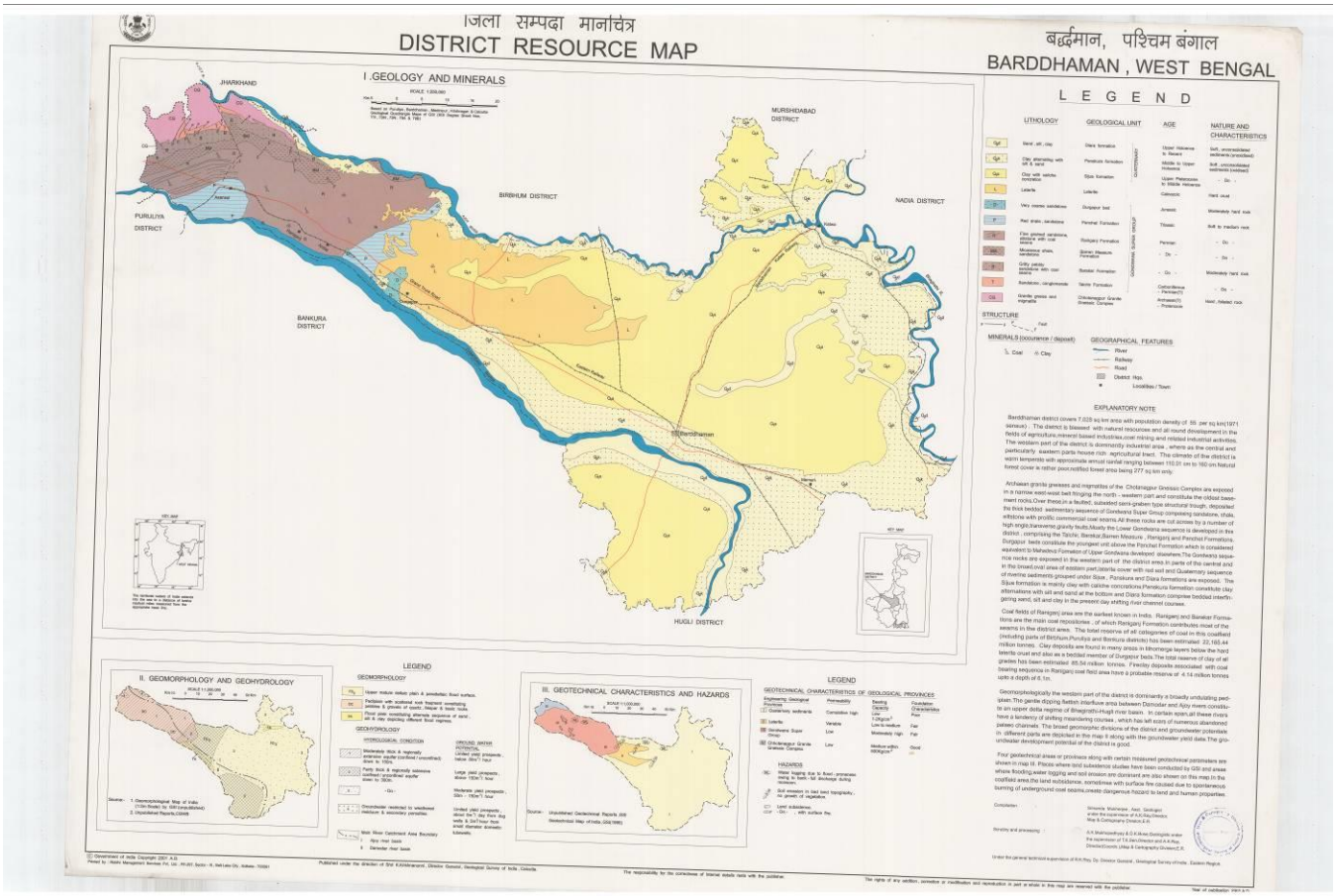


Figure No 6.1: District Resource Map of Paschim Bardhaman and Purba Bardhaman District (*District Resource Map, Geological Survey of India, 2001* *https://www.gsi.gov.in/webcenter/portal/OCBIS/pageMAPS/pageMapsSeries?_adf.ctrl-state=lekbxmwix_5*)

Coal fields of Raniganj area are the earliest known in India. Raniganj and Barakar Formations are the main coal repositories, of which Raniganj Formation contributes most of the seams in the district area. The total reserve of all categories of coal in this coalfield (including parts of Birbhum, Purulia and Bankura districts) has been estimated 22.165.44 million tonnes. Clay deposits are found in many areas in lithomerge layers below the hard laterite crust and also as a bedded member of Durgapur beds. The total reserve of clay of all grades has been estimated 85.54 million tones. Fireclay deposits associated with coal bearing sequence in Raniganj coal field area have a probable reserve of 4.14 million tonnes upto a depth of 6.1m.

7 Mineral wealth

7.1 Overview of mineral resources

The geological formation of Paschim Bardhaman District indicates the presence of quite a number of major minerals and minor minerals.

7.2 Details of Resources

7.2.1 Sand and other riverbed minerals:

I. Drainage System

Drainage system of the district comprises of 3 major river courses namely, Damodar, Ajay and Barakar. A brief description of each river courses is given below.

Damodar River is a river flowing across the Indian states of Jharkhand and West Bengal. Rich in mineral resources, the valley is home to large-scale mining and industrial activity. The Damodar River originates from the Sonajuria falls in the Chhotanagpur Plateau of Bihar. After completion of 368 miles towards the east, it reaches West Bengal and there it joins the Hooghly (Hugli) River. Through the hilly areas, it flows with extensive force and capable of washing away everything that comes on its way.

The basin of river Damodar has a very special shape and this influences its flood pattern. The river has about 70% of its basin just upstream of Durgapur town. This upper catchment of Jharkhand plateau, above Durgapur, generates heavy run-off during high rainfall and is carried to Durgapur in a short time. From here, this discharge travels through the river, bifurcating at Beguahana. One branch, the lower Damodar with very small capacity, reaches the Hoogly on the west bank. The major discharge passes through the Mundeswari to meet the Rupnarayan. Any major discharge along the downstream of Durgapur Barrage may cause flood depending upon the outfall condition of the Mundeswari at Harinkhola. In Kangsabati river system, the Kangsabati Dam has a limited flood storage capacity which is very nominal. *http://wbdmd.gov.in/Pages/Flood2.aspx*. The Chhotanagpur Plateau receives an average annual rainfall of around 1,400 mm, almost all of it in the monsoon months between June and August. The huge volume of water that flows down the Damodar and its tributaries during the monsoons used to be a fury in the upper reaches of the valley. In the lower valley it used to overflow its banks and flood large areas.

Damodar River was earlier known as the "River of Sorrows" as it used to flood many areas of Bardhaman, Hooghly, Howrah and Medinipur districts. Even now the floods sometimes affect the lower Damodar Valley, but the havoc it wreaked in earlier years is now a matter of history. The floods were virtually an annual ritual. In some years the damage was probably more. Many of the great floods of the Damodar are recorded in history — 1770, 1855, 1866, 1873–74, 1875–76, 1884–85, 1891–92, 1897, 1900, 1907, 1913, 1927, 1930, 1935 and 1943. In four of these floods (1770, 1855, 1913 and 1943) most of Bardhaman town was flooded.

It has a number of tributaries and subtributaries, such as Barakar, Konar, Bokaro, Haharo, Jamunia, Ghari, Guaia, Khadia and Bhera. The Damodar and the Barakar trifurcates the Chhotanagpur plateau. The rivers pass through hilly areas with great force, sweeping away whatever lies in their path. *https://www.riversgraphy.com/damodar-river*

The Barakar River is the main tributary of the Damodar River in eastern India. Originating near Padma in Hazaribagh district of Jharkhand it flows for 225 kilometres (140 mi) across the northern part of the Chota Nagpur Plateau, mostly in a west to east direction, before joining the Damodar near Dishergarh in Asansol, Bardhaman district of West Bengal. It has a catchment area of 6,159 square kilometres (2,378 sq mi). The main tributaries, Barsoti and Usri, flow in from the south and north respectively. Apart from the two main tributaries some fifteen medium or small streams join it. *https://en.wikipedia.org/wiki/Barakar_River*

The Ajay River starts the journey from the Chakai block of Jamui (Origin of Ajay River) and then enters Jharkhand state near Devipur. Afterward, at Simuji, it enters West Bengal near Chittaranjan. After entering West Bengal, first, it flows between West Bardhaman district and Jharkhand, and then West Bardhaman district and Birbhum district, and forms the borders between the West Bardhaman district and Jharkhand state, and West Bardhaman district and Birbhum district. Finally, the Ajay River enters Purba Bardhaman district's Katwa subdivision at Nareng village in Ketugram police station and joins Bhagirathi River in Katwa town. The 288 km long (179 miles) river has its 152 km (94 miles) in West Bengal alone. And its catchment area is 2300 square miles or 6000 sq. km. While the Ajay flows through alluvial plains in the Bradhaman district, its upper reaches flow through hilly areas with laterite soil. Previously, one could find dense forests filled with trees like Palas, Piyasal, and Saltreese in the valley of the Ajay River. However, in recent times, the forests are being cleaned due to different activities like mining. *https://www.riversgraphy.com/ajay*

Table 7.1: Drainage system with description of main rivers

Sl.No.	Name of the River	Altitude at Origin	Area drained (Sq. m)	Length in Paschim Bardhaman (km)
1	Ajay River	980 ft	41637865.85	82.60
2	Damodar River	2000.49 ft	79869025.45	78.31
3	Barakar River	4,430 ft	3095649.66	12.32

Table 7.2: Salient Features of important rivers and streams

S.No.	Name of the River or Stream	Total Length in the District (in Km)	Place of origin	Type
1	Ajay River	82.60	Chakai block of Jamui, Bihar	Non-perennial
2	Damodar River	78.31	Sonajuria falls in the	Non-perennial

S.No.	Name of the River or Stream	Total Length in the District (in Km)	Place of origin	Type
			Chota Nagpur Plateau of Bihar	
3	Barakar River	12.32	Padma in Hazaribagh district of Jharkhand	Non-perennial

II. Annual deposition of riverbed minerals

Annual deposition of riverbed minerals is dependent on various factors which are explained below.

A. Geomorphological studies

Geomorphological characteristic of a drainage basin is the foremost factor for annual deposition of sedimentary load. The study includes the following parameters:

i) Place of Origin

The place of origin of each of the five rivers is given in Table 7.3.

Table 7.3: Place of origin of rivers of Paschim Bardhaman district

Name of the River or Stream	Place of origin
Ajay River	Chakai block of Jamui, Bihar
Damodar River	Sonajuria falls in the Chhotanagpur Plateau of Bihar
Barakar River	Padma in Hazaribagh district of Jharkhand

ii) Catchment Area

River Ajay and Damodar form the main drainage system of Paschim Bardhaman district. Damodar River flows from north west to south east direction and demarcates the southern boundary of Paschim Bardhaman district. Ajay River flows from north-west to south-east direction and demarcates the northern boundary of Paschim Bardhaman district. Damodar River basin has a total catchment area of 25,820 sq km. Total Catchment area of Ajay River is about 6,000 sq km.

iii) General profile of river stream

Relative disposition of rivers in Paschim Bardhaman district along with the distribution of the section lines are shown in Figure 7.1. River profile has been studied along the cross section lines (Figures 7.2 and 7.3) which are chosen based on the drastic variation of the river width, proximity of the operating sand ghats and the position of the sand bars.

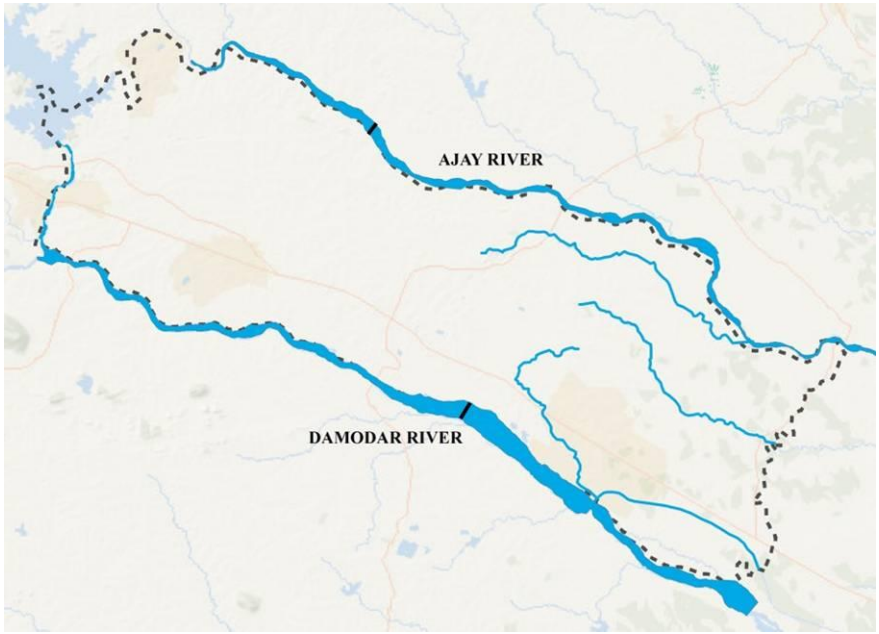


Figure 7.1: Map showing the major rivers along which profile section drawn

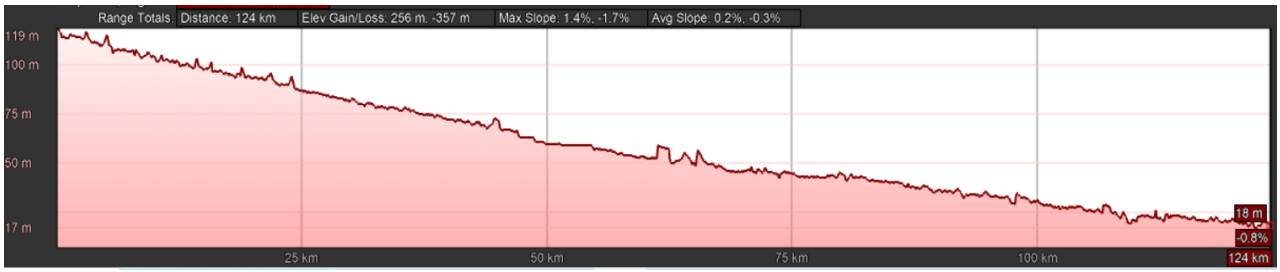


Figure 7.2A: Profile section of Ajay River

Figure 7.2B: Profile section of Damodar River

Figure 7.3A: Cross section view of Damodar River

Figure 7.3B: Cross section view of Ajay River

iv) Annual deposition factor

Annual deposition of riverbed materials depends on various factors, such as process of deposition, mode of sediment transport, sediment transportrate, and sediment yield of the river.

1. Process of deposition

Deposition is the processes where material being transported by a river is deposited. Deposition occurs when the forces responsible for sediment transportation are no longer sufficient to overcome the forces of gravity and friction, creating a resistance to motion; this is known as the null-point hypothesis. This can be when a river enters a shallow area or towards its mouth where it meets another body of water.

The principle underlying the null point theory is due to the gravitational force; finer sediments remain in the water column for longer durations allowing transportation outside the surf zone to deposit under calmer conditions. The gravitational effect or settling velocity determines the location of deposition for finer sediments, whereas a grain's internal angle of friction determines the deposition of larger grains on a shore profile.

Deposition of non-cohesive sediments: Large-grain sediments transported by either bedload or suspended load. In case of bedload, when there is insufficient bed shear stress and fluid turbulence are insufficient to keep the sediment moving, the grain cease horizontal movement and rapidly come to rest. In case of suspended load the grain settle longer distance vertically through the fluid before coming to rest.

Deposition of cohesive sediments: The cohesion of sediment occurs with the small grain sizes associated with silts and clays, or particles smaller than 4Φ or 62.5 μm. If these fine particles remain dispersed in the water column, Stokes law applies to the settling velocity of the individual grains. The face of a clay platelet has a slight negative charge where the edge has a slight positive charge when two platelets come into close proximity with each other the face of one particle and the edge of the other are electrostatically attracted, and then have a higher combined mass which leads to quicker deposition through a higher fall velocity.

2. Mode of sediment transport in rivers

Sediment transport in rivers provides a dynamic linkage between flow and channel form. Mainly there are three processes by which sediment load is transported and these are (i) rolling or traction, in which the particle moves along a sedimentary bed but is too heavy to be lifted from it; (ii) saltation; and (iii) suspension, in which particles remain permanently above the bed, sustained there by the turbulent flow of the water.

Another name for sediment transport is sediment load. The total load includes all particles moving as bedload, suspended load, and wash load.

Bed load: Bedload is the portion of sediment transport that rolls, slides or bounces along the bottom of a waterway. This sediment is not truly suspended, as it sustains intermittent contact with the streambed, and the movement is neither uniform nor continuous. Bedload occurs when the force of the water flow is strong enough to overcome the weight and cohesion of the sediment. While the particles are pushed along, they typically do not move as fast as the water around them, as the flow rate is not great enough to fully suspend them. Bedload transport can occur during low flows (smaller particles) or at high flows (for larger particles). Approximately 5-20% of total sediment transport is bedload. In situations where the flow rate is strong enough, some of the smaller bedload particles can be pushed up into the water column and become suspended.

Suspended load: While there is often overlap, the suspended load and suspended sediment are not the same thing. Suspended sediment are any particles found in the water column, whether the water is flowing or not. The suspended load, on the other hand, is the amount of sediment carried downstream within the water column by the water flow. Suspended loads require moving water, as the water flow creates small upward currents (turbulence) that keep the particles above the bed. The size of the particles that can be carried as suspended load is dependent on the flow rate. Larger particles are more likely to fall through the upward currents to the bottom, unless the flow rate increases, increasing the turbulence at the streambed. In addition, suspended sediment will not necessarily remain suspended if the flow rate slows.

Wash load: The wash load is a subset of the suspended load. This load is comprised of the finest suspended sediment (typically less than 0.00195 mm in diameter). The wash load is differentiated from the suspended load because it will not settle to the bottom of a waterway during a low or no flow period. Instead, these particles remain in permanent suspension as they are small enough to bounce off water molecules and stay afloat. However, during flow periods, the wash load and suspended load are indistinguishable.

3. Sediment Transport Rate

The rate at which sediment is moved past a cross section of the flow is called either the sediment transport rate or the sediment discharge. It's related to the sediment load, but it's different, just because different fractions of the sediment load are transported at different rates. It can be measured in mass per unit time, or in weight per unit time, or in volume per unit time. The sediment transport rate is commonly denoted by Qs.

4. Estimation of Sedimentation

There are two approaches to obtaining values describing sediment loads in streams. One is based on direct measurement of the quantities of interest, and the other on relations developed between hydraulic parameters and sediment transport potential.

The total bed material load is equal to the sum of the bedload and the bed material part of the suspended load; in terms of volume transport per unit width, qt = qb + qs. Here wash load, i.e. that part of the suspended load that is too fine to be contained in measurable quantities in the river bed, is excluded from qs.

There are number of equations to compute the total sediment load. Most of these equations have some theoretical and empirical bases.

In 1973, Ackers and White developed a general theory for sediment transport which was calibrated against the flume-transport data then available. Their functions have been widely accepted as one of the best available procedures for estimating the total bed over the full width of the flow section.

Dendy-Bolton formula is often used to calculate the sedimentation yield. But use of these equations to predict sediment yield for a specific location would be unwise because of the wide variability caused by local factors not considered in the equations development. However, they may provide a quick, rough approximation of mean sediment yields on a regional basis. Computed sediment yields normally would be low for highly erosive areas and high for well stabilized drainage basins with high plant density because the equations are derived from average values. The equations express the general relationships between sediment yield, runoff, and drainage area.

5. Sediment Yield

The water that reaches a stream and its tributaries carries sediment eroded from the entire area drained by it. The total amount of erosional debris exported from such a drainage basin is its sediment load or sediment discharge and the sediment yield is the sediment discharge divided by the total drainage area of the river upstream of the cross section at which the sediment discharge is measured or estimated. Sediment yield is generally expressed as a

volume or weight per unit area of drainage basin—e.g., as tons per square kilometre. Further, sediment yield is usually measured during a period of years, and the results are thus expressed as an annual average.

v) Replenishment Study as per EMGSM guidelines 2020:

Replenishment study for a river solely depends on estimation of sediment load for any river system and the estimation is a time consuming and should be done over a period. The process in general is very slow and hardly measurable on season to season basis except otherwise the effect of flood is induced which is again a cyclic phenomenon. Usually, replenishment or sediment deposition quantities can be estimated in the following ways as given below:

A. Replenishment study based on satellite imagery involves demarcation of sand bars potential for riverbed mining. Both pre and post monsoon images need to be analysed to established potential sand bars. Volume estimation of sand is done by multiplying Depth and Area of the sand bar. The sand bars are interpreted with the help of satellite imagery. Ground truthing has been done for 100% of the total identified sand bars. During ground truthing, width and length of each segment were physically measured. It has also been observed that in few cases, sand bars have attained more than 3 meters height from the average top level of the river beds. Considerations of sand resources have been restricted within 3 meters from the average top surface of the river bed.
B. Direct field measurement of the existing leases involving estimation of the volume diference of sand during pre- and post-monsoon periods. With systematic data acquisition, a model has been developed for calculation of sediment yield and annual replenishment with variable components.
C. The replenishment estimation based on a theoretical empirical formula with the estimation of bed-load transport comprising of analytical models to calculate the replenishment estimation.

V(A). Replenishment study based on field investigation:

Sedimentation in any river is dependent on sediment yield which depends on soil erosion in river's catchment area. Catchment yield is computed using Strange's Monsoon runoff tables for runoff coefficient against rainfall return period. Peak flood discharge is calculated by using Dickens, Jarvis and Rational formula at 25, 50 and 100 years return period. The estimation of bed load transport using Ackers and White Equation.

Methodology Adopted: To delineate replenishment percentage in the river bed of the district, below mentioned steps have been followed.

1. Field data collation

Field data collation was carried out during May- June 2020 for pre monsoon period and October- November 2020 for all the river ghats for post monsoon period. However, the nonoperational areas were covered through traverses. In both the cases, relative elevation levels were captured through GPS/DGPS/ Electronic Total Station. Thickness of the sand bars was measured through sectional profiles. In few instances, sieve analysis of the sands was carried out to to assess their particle size distribution.

Figure 7.4: Site View of River Barakar (March, 2020)

2. Selection of study profiles:

Study profiles are selected based on the occurrence of the sand bars in the channel profiles. Aerial extents of each of the profiles are mapped from satellite imagery.

3. Data compilation:

Following data were compiled for generation of the annual replenishment report:

- Elevation levels of the different sand ghats and sand bars as measured at site.
- Extents of the sand bars are measured from the pre monsoon satellite imagery.
- Sand production data of the district.

All these data were compiled while estimation of the replenished sand in the Paschim Bardhaman district.

4. Assessment of sediment load in the river:

Assessment of sediment load in a river is subjective to study of the whole catchment area, weathering index of the various rock types which acts as a source of sediments in the specific river bed, rainfall data over a period not less than 20 years, and finally the detail monitoring of the river bed upliftment with time axis. Again, the sediment load estimation is not a dependent variable of the district boundary, but it largely depends upon the aerial extents of the catchment areas, which crossed the district and state boundaries.

The major sand producing rivers of the Paschim Bardhaman district are Ajay, Damodar and Barakar rivers. Planning has been done for systematic sand mining in the rivers.

While calculation of the areas of sand bar, a classification system has been adopted with three categories of land identified within the channel areas which is as follows:

a. The untapped sand bars.
b. The sand bars worked in the pre-monsoon period.
c. Main channel course within the channel.

A summary of sediment load comparison between pre- and post-monsoon period for different rivers of Paschim Bardhaman district is given in Table 7.4 and details of each sand bars along with their sand resources in pre monsoon and post monsoon periods are provided in Annexure 2. Maps showing distribution of sand bars on rivers of the Paschim Bardhaman district during pre- and post-monsoon are depicted in Plate 2A and Plate 2B respectively.

Table 7.4: Sediment load comparison between Pre and Post Monsoon period for different rivers of Paschim Bardhaman district

River Name	Pre-Monsoon no of ghats	Post-Monsoon no of ghats	Pre-Monsoon Sediment Load (MCum)	Post Monsoon Sediment Load (MCum)	Variance (MCum)	Variance (%)
Ajay	12	10	4.69	4.79	0.09	**2**
Damodar	4	11	12.11	13.50	1.39	**11**
Barakar	9	9	2.00	2.72	0.72	**36**
Total =	**25**	**30**	**18.81**	**21.01**	**2.20**	**12**

Thus, in Paschim Bardhaman district, about 2.20 million cum of sand has been found as an incremental volume when compared between pre and post monsoon sand reserve data. The average replenishment and aggradation rate for the year comes to about 112%.

Long-term satellite imagery study has also been carried out for sand producing rivers of Paschim Bardhaman district to analyse the changes in river course. A representative map, showing long-term (from 1985-2010-to 2022) erosion-accretion areas on both the banks of Ajay River has been prepared and furnished as Plate No. 5. The map shows changes in river channel

cross-section through erosion and accretion of river bank. River channel is showing widening of river channel as compare between 1985 and 2022.

V(B). Replenishment estimation based on field investigation

The study was carried out on existing mining leases. In order to assess the annual replenishment rate, an approach of direct measurement methodology has been adopted. The depth and area of the mining leases are measured through DGPS/Total station just before the closure of the mines in pre-monsoon period and the same areas are resurveyed in the post-monsoon period. The difference between the depth of the surveyed areas are accounted for the volumetric measurement of the replenished sand.

Table 7.5 represents field measurement of replenishment rate estimated for major rivers.

Table 7.5: Replenishment rate of the district

River Name	Location	Area	Surface RL	Thickness	Volume	After mining floor RL	Surface RL after Replenishment	Thickness Replenished	Volume Replenished	Difference in RL	Replenishment Rate
		m2	m	m	cum	m	m	m	cum	m	%
Ajay	Barabani	34400.00	109.00	2.95	101480.00	106.05	108.95	2.90	99653.36	0.05	98.20%
Ajay	Jamuria	23700.00	84.00	2.90	68730.00	81.10	83.94	2.84	67355.40	0.06	98.00%
Ajay	Pandaveswar	21100.00	64.00	3.00	63300.00	61.00	63.93	2.93	61780.80	0.07	97.60%
Ajay	Kanksha	28600.00	55.00	2.87	82082.00	52.13	54.93	2.80	79947.87	0.07	97.40%
Damodar	Andal	46900.00	69.00	2.90	136010.00	66.10	68.96	2.86	133969.85	0.04	98.50%
Damodar	Jamuria	48700.00	67.00	2.96	144152.00	64.04	66.97	2.93	142566.33	0.03	98.90%

The average replenishment rate for the year 2020 is about 98.10%.

V(C). Replenishment estimation based on an empirical formula:

The river reaches with sand provide the resource and thus it is necessary to ascertain the rate of replenishment of the mineral. Regular replenishment study needs to be carried out to keep a balance between deposition and extraction.

Sediment load deposition in a river is dependent on catchment area, weathering index of the various rock types of the catchment area, land-use pattern of the area, rainfall data and grain size distribution of the sediments. Again, the sediment load estimation is not a dependent variable of the district boundary, but it largely depends upon the aerial extents of the catchment areas, which crosses the district and state boundaries.

i. Methodology of the study:

The replenishment estimation is based on a theoretical empirical formula with the estimation of bedload transport comprising of analytical models to calculate the replenishment estimation. Sedimentation in riverbed depends on catchment yield, peak flood discharge due to

rainfall, bed load transport rates and sediment yield characteristic of the river. Some of the common methods used for replenishment study are explained below.

a. Catchment yield calculation:

The total quantity of surface water that can be expected in a given period from a stream at the outlet of its catchment is known as yield of the catchment in that period. The annual yield from a catchment is the end product of various processes such as precipitation, infiltration and evapotranspiration operating on the catchment.

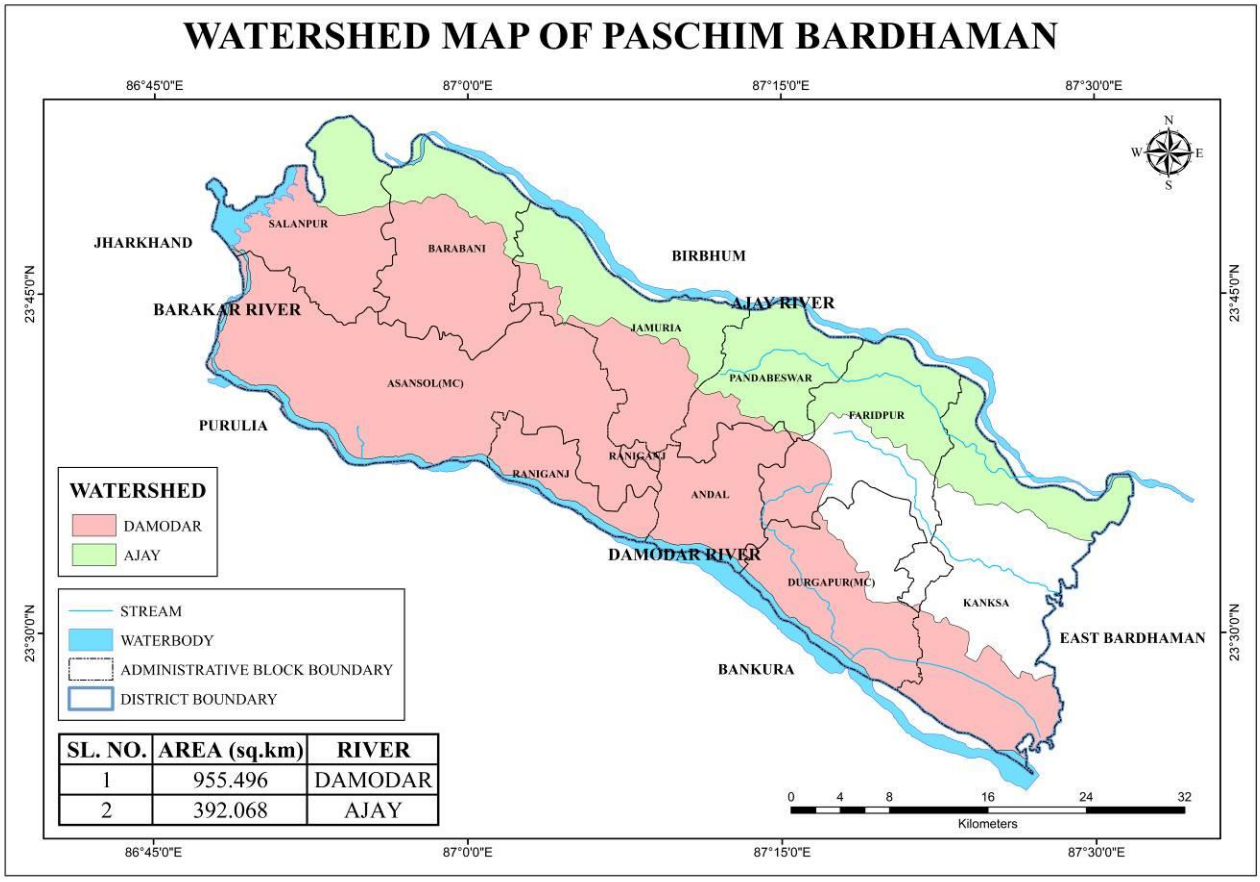


Figure 7.5: Watershed map of Paschim Bardhaman district

Catchment yield can be estimated using following formula:

Catchment yield (m^3) =Catchment area (m^2) × Runoff coefficient (%) × Rainfall (m)

The runoff generated from the watershed is analyzed using Strange's Tables to get the reliable yield results. Runoff from a catchment is dependent upon annual rainfall as well as catchment characteristics such as soil types and the type of groundcover / land usage. Remote sensing was used for demarcation of catchment area relevant to the drainage system. Runoff coefficient of the catchment has been established based on Stange's Table.

Strange (1892) studied the available rainfall and runoff and obtained yield ratios as functions of indicators representing catchment characleris1ics (Subramanya, 2008). Catchments are classified as good, average and bad according to the relative magnitudes of yield of sediment. For example, catchment with good forest cover and having soils of high permeability would be classified as bad, while catchment having soils of low permeability and having little or no vegetal cover is termed good. Based on the study Stange established runoff coefficient table as given in Table 7.6.

Table 7.6: Runoff coefficient of the catchment based on Strange's table

Total monsoon rainfall (mm)	Runoff coefficient (%)			Total monsoon rainfall (mm)	Runoff coefficient (%)		
	Good catchment	Average catchment	Bad catchment		Good catchment	Average catchment	Bad catchment
25.4	0.1	0.1	0.1	787.4	27.4	20.5	13.7
50.8	0.2	0.2	0.1	812.8	28.5	21.3	14.2
76.2	0.4	0.3	0.2	838.2	29.6	22.2	14.8
101.6	0.7	0.5	0.3	863.6	30.8	23.1	15.4
127	1	0.7	0.5	889	31.9	23.9	15.9
152.4	1.5	1.1	0.7	914.4	33	24.7	16.5
177.8	2.1	1.5	1	939.8	34.1	25.5	17
203.2	2.8	2.1	1.4	965.2	35.3	26.4	17.6
228.6	3.5	2.6	1.7	990.6	36.4	27.3	18.2
254	4.3	3.2	2.1	1016	37.5	28.1	18.7
279.4	5.2	3.9	2.6	1041.4	38.6	28.9	19.3
304.8	6.2	4.6	3.1	1066.8	39.8	29.8	19.9
330.2	7.2	5.4	3.6	1092.2	40.9	30.6	20.4
355.6	8.3	6.2	4.1	1117.6	42	31.5	21
381	9.4	7	4.7	1143	43.1	32.3	21.5
406.4	10.5	7.8	5.2	1168.4	44.3	33.2	22.1
431.8	11.6	8.7	5.8	1193.8	45.4	34	22.7
457.2	12.8	9.6	6.4	1219.2	46.5	34.8	23.2
482.6	13.9	10.4	6.9	1244.6	47.6	35.7	23.8
508	15	11.3	7.5	1270	48.8	36.6	24.4
533.4	16.1	12	8	1295.4	49.9	37.4	24.9
558.8	17.3	12.9	8.6	1320.8	51	38.2	25.5
584.2	18.4	13.8	9.2	1346.2	52.1	39	26
609.6	19.5	14.6	9.7	1371.6	53.3	39.9	26.6
635	20.6	15.4	10.3	1397	54.4	40.8	27.2
660.4	21.8	16.3	10.9	1422.4	55.5	41.6	27.7
685.8	22.9	17.1	11.4	1447.8	56.6	42.4	28.3
711.2	24	18	12	1473.2	57.8	43.3	28.9
736.6	25.1	18.8	12.5	1498.6	58.9	44.4	29.4

Total monsoon rainfall (mm)	Runoff coefficient (%)			Total monsoon rainfall (mm)	Runoff coefficient (%)		
	Good catchment	Average catchment	Bad catchment		Good catchment	Average catchment	Bad catchment
762	26.3	19.7	13.1	1524	60	45	30

(Subramanya, 2008)

Rainfall return period for 25, 50 and 100 years calculated as below:

As per Weibull's Formula (Subramanya, 2008)**,**

Return period/Recurrence interval = (n+1)/m

Where: n number of years on record;
m is the rank of observed occurrences when arranged in descending order.

b. Peak Flood Discharge Calculation:

The term "peak discharge" stands for the highest concentration of runoff from the basin area. The accurate estimation of flood discharge remains one of the major challenges as it depends upon physical characteristic of the catchment area and the flood intensity, duration and distribution pattern. There have been many different approaches for determining the peak runoff from an area. As a result, many different models (equations) for peak discharge estimation have been developed. Formulas used for Peak Discharge calculation areas below:

As per Dicken's formula (Subramanya, 2008)**,**

$$Q = CA^{3/4}$$

Where: Q is Maximum flood discharge (m^3/sec) in a river
A is Area of catchment in Sq. Km
C is Constant whose value varies widely between 2.8 to 5.6 for catchments in plains and 14 to 28 for catchments in hills

As per Jarvis formula (Subramanya, 2008)**,**

$$Q = CA^{1/2}$$

Where: Q is Maximum flood discharge (m^3/sec) in a river
A is Area of catchment in Sq. Km
C is Constant whose value varies between 1.77 as minimum and 177 as maximum. Limiting or 100 percent chance floods are given by the value of C of 177

As per Rational formula (Subramanya, 2008)**,**

$$Q = CIA$$

Where: Q is Maximum flood discharge (m^3/sec) in a river

A is Area of catchment in Sq. Km
C is Runoff coefficient which depends on the characteristics of the catchment area. It is a ratio of runoff: rainfall
I is Intensity of rainfall (in m/sec)

c. Bed Load Transport Calculation:

The most important problems in river engineering are to predict bed load transport rates in torrential floods flowing from mountainous streams. Three modes of transport namely; rolling, sliding and saltation may occur simultaneously in bed load transport. The different modes of transportation are closely related and it is difficult, if not impossible, to separate them completely. There are number of equations to compute the total sediment load. Most of these equations have some theoretical and empirical bases.

Ackers and White Equation:

Ackers and White (1973) used dimensional analysis based on flow power concept and their proposed formula is as follows.

$$C_t = C_s G_s \, (d_{50}/h) \, (V/U_*)^{n'} \, [(F_{gr}/A_1) - 1]^{m}$$

The dimensionless particle d_{gr} is calculated by:

$$d_{gr} = d_{50} \, (g(G_s-1)/v^2)^{1/3}$$

The particle mobility factor $F_{gr}$is calculated by:

$$F_{gr} = (U \times n'/(Gs-1) g \, d_{50})^{1/2} \times (V/(5.66 \log(10h/d_{50}))^{1-n'}$$

Where,

A_1 = Critical particle mobility factor
C_s = Concentration coefficient in the sediment transport function
C_t = Total sediment concentration
d_{50} = Median grainsize
d_{gr} = Dimensionless particle diameter
F_{gr} = Particle mobility parameter
g = Acceleration of gravity
D_s, S_g = Specific gravity
h = Water depth
m = Exponent in the sediment transport function
n' = Manning roughness coefficient
U_* = Shear velocity
V = Mean flow velocity
ν = Kinematic viscosity

Meyer – Peter's equation:

Meyer-Peter's equation (Ponce, 1989) is based on experimental work carried out at Federal Institute of Technology, Zurich. Mayer-Peter gave a dimensionless equation based on rational laws. Mayer- Peter equations gave an empirical formula of bed load transport rates in flumes and natural rivers. The simplified Meyer-Peter's equation is given below:

$$g_b = 0.417[\tau 0\ (\eta'/\ \eta)^{1.5} - \tau c]^{1.5}$$

Where,
gb = Rate of bed load transport (by weight) in N per m width of channel per second.

η' = Manning's coefficient pertaining to grain size on an unrippled bed and Strickler formula i.e. η' = (1/24) x d1/6 where d is the median size (d_{50}) of the bed sediment in m.

η = The actual observed value of the rugosity coefficient on rippled channels. Its value is generally taken as 0.020 for discharges of more than 11cumecs, and 0.0225 for lower discharges.

τc = Critical shear stress required to move the grain in N/m2 and given by equationτc = 0.687da, where da is mean or average size of the sediment in mm. This arithmetic average size is usually found to vary between d_{50} and d_{60}.

τ0= Unit tractive force produced by flowing water i.e. γwRS. Truly speaking, its value should be taken as the unit tractive force produced by the flowing water on bed = 0.97γwRS. R is the hydraulic mean depth of the channel (depth of flow for wider channel) and S is the bed slope.

d. Sediment Yield Estimation:

Sedimentation occurred as the velocity decreases along with its ability to carry sediment. Coarse sediments deposit first, then interfere with the channel conveyance, and may cause additional river meanders and distributaries. The area of the flowing water expands, the depth decreases, the velocity is reduced, and eventually even fine sediments begin to deposit. As a result, deltas may be formed in the upper portion of reservoirs. The deposited material may later be moved to deeper portions of the reservoir by hyraulic processes within the water body.

There are many sediment transport equations which are suitable for use in the prediction of the rate of replenishment of river. Some of the famous sediment equations are:

1. Dendy – Bolton Equation
2. Yang Equations
3. Engelund-Hansen Equation
4. Modified Universal Soil Loss Equation (MUSLE) developed by Williams and Berndt (1977)

Dendy–Bolton Equation:

Dendy–Bolton formula (Dendy and Bolton 1976) is often used to calculate the sedimentation yield because:-

- The formula uses catchment area and mean annual runoff as key determinants.
- It does not differentiate in basin wide smaller streams and their characteristics.
- Dendy and Bolton equation calculates all types of sediment yield i.e. sheet and rill erosion sediments, gully rosion sediments, channel bed and bank erosion sediments and mass movement etc.

Dendy-Bolton determined the combined influence of runoff and drainage area on sediment yield to compute the sediment yield. They developed two equations i.e. for run off less than 2 inch and for run off more than 2 inch, which are given below:

For run off less than 2 inch:

(Q<2in) $S=1289\times (Q)^{0.46}\times [1.43-0.26 \text{ Log } (A)]$

For run off more than 2 inches:

(Q > 2 in): $S= 1958\times (e^{-0.055\times Q}) \times [1.43-0.26 \text{ Log } (A)]$
Where: S = Sediment yield (tons/sq miles/yr)

Q = Mean Annual runoff (inch)

A = Net drainage are in sq mile

Dendy Bolton formula is often used to calculate the sedimentation yield. But use of these equations to predict sediment yield for a specific location would be unwise because of the wide variability caused by local factors not considered in the equations development. However, they may provide a quick, rough approximation of mean sediment yields ona regional basis for preliminary watershed planning. Computed sediment yields normally would be low for highly erosive areas and high for well stabilized drainage basins with high vegetation density because the equations are derived from average values. The equations express the general relationships between sediment yield, runoff, and drainage area. Many variables influence sediment yield from a drainage basin. They include climate, drainage area, soils, geology, topography, vegetation and land use. The effect of any of these variables may vary greatly from one geographic location to another, and the relative importance of controlling factors often varies within a given land resource area. Studies revealed that sediment yield per unit area generally decreases as drainage area increases. As drainage area increases, average land slopes usually decrease; andthere is less probability of an intense rainstorm over the entire basin. Both phenomena tendto decrease sediment yield per unit area.

Modified Universal Soil Loss Equation (MUSLE):

Modified universal soil loss equation (MUSLE) for estimation of sediment yield is also widely used (Wischmeier and Smith, 1978). MUSLE is a modification of the Universal Soil Loss Equation (USLE). USLE is an estimate of sheet and rill soil movement down a uniform slope using rain- fall energy as the erosive force acting on the soil (Wischmeier and Smith 1978). Depending on soil characteristics (texture, structure, organic matter, and permeability), some soils erode easily while others are inherently more resistant to the erosive action of rain- fall.

MUSLE is similar to USLE except for the energy component. USLE depends strictly upon rainfall as the source of erosive energy. MUSLE uses storm-based runoff volumes and runoff peak flows to simulate erosion and sediment yield (Williams 1995). The use of runoff

variables rather than rainfall erosivity as the driving force enables MUSLE to estimate sediment yields for individual storm events. The generalized formula of MUSLE is as below:

$$\mathbf{Y=11.8 \times (Q \times qP).56 \times K \times Ls \times C \times P}$$

Where,

Y = sediment yield of stream (t/yr/km2),
Q = average annual runoff (m3),
K = soil erodibility factor,
qP = Highest discharge recorded (m3/s),
Ls = gradient/slope length,
C = cover management factor,
P = erosion control practice

ii. Estimation of Replenishment:

The major sand producing rivers of the Paschim Bardhaman district are Damodar, Ajay and Barakar rivers. These rivers and its tributary rivers are forming the main catchment area.

For replenishment study, following assumption/calculation are taken in to consideration:

- Catchment area (Watershed area) against each river has been calculated based on remote sensing data.
- Rainfall runoff coefficient as per Strange's table for the catchment area is consider 45%, as the rainfall in the district is more than 1524mm and the characteristic of the catchment of the district is average in nature.
- Peak flood discharge of the river of the district calculated based on Dicken's formula which is more applicable to north Indian and central Indian catchment. Here Dicken constant C is taken as 12 in present study as per published literature by Saha (2002).
- Bed load transport has not been computed in the regional aspect of the district, as the values are highly dependent on local factors such as particle mobility factor, roughness coefficient, Shear velocity, Mean flow velocity, Kinematic viscosity etc.
- Sedimentation yield calculated as per Dendy and Bolton formula as the equations express the general relationships between sediment yield, runoff, and drainage area.
- Computed sediment yields by Dendy and Bolton formula normally would be low for highly erosive areas and high for well stabilized drainage basins with high plant density because the equations are derived from average values.
- Dendy and Boltan formula also says that actual sediments yield from individual drainage basins may vary 10-fold or even 100-fold from computed yields. Since the district river basin comprises of sedimentary rocks with good average rainfall therefore the estimated replenishment considered as 50-fold of computed results sediment yield.

The data estimated for each river in the district are given in Table 7.7.

Table 7.7: Replenishment parameter estimated for each river in the district

Estimation parameter	Damodar	Ajay
Catchment Area (m^2)	1027720000	398110000
Annual Rainfall (m) (in 2020)	1.48	1.48
Strange Runoff coefficient (%)	43%	43%
Annual Run-off (m) (in 2020)	0.3256	0.3256
Catchment Yield (m^3)	658604085	255124812.4
Peak Flood Discharge (m^3/sec)	68879082.30	33820775.45
Flow depth d (m)	1.6	1.2
Channel width b (m)	655	240
Mean velocity v (m/s)	0.06	0.05
Channel slope S_o (m/m)	0.001	0.001
Sediment Yield (Tons/year)	21666.01	9584.28
Estimated Annual Replenishment (in million m3)	0.57016	0.25222

Specific gravity of sand = 2.76 tonne per m^3

Sedimentation rate of a river is dependent on the annual rainfall of the district. Sedimentation rate for the period 2016-2020 of each river is presented in Table 7.8 and Figure 7.6.

Table 7.8: Sedimentation rate for the period 2016-2020 of each river

Year	Damodar	Ajay	Annual Rainfall
2016	24.61	28.1	1408.4
2017	14.03	16.02	1668
2018	59.48	67.92	1000.8
2019	37.55	42.88	1213.2
2020	21.08	24.07	1479.8

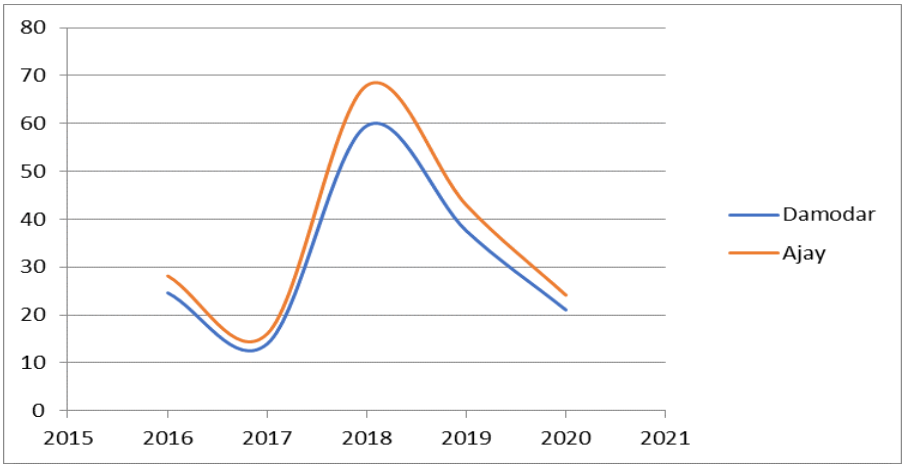


Figure 7.6: Graphical representation of year-wise sedimentation rate

The estimation of sedimentation rate based on empirical formula need critical analysis of different factors related to the LULC property of the catchment area, slope geometry, sediment erosion factor of catchment litho-type. This will help to assess replenishment rate more precisely.

Replenishment studies based on empirical formula for existing mining leases have also been conducted and are given in Table 7.9.

Table 7.9: River wise replenishment rate estimation based on empirical formula

River Name	Location	Lease Area	Surface RL Before mining	Mine out Thickness	Mine out Volume	Annual Rainfall-2020	Estimated Replenished Volume as per Dandy-Bolton	Replenishment Rate
		m2	m	m	cum	m	cum	%
Ajay	Barabani	34400.00	109.00	2.95	101480.00	1.48	75095.20	74.00%
Ajay	Jamuria	23700.00	84.00	2.90	68730.00		51410.04	74.80%
Ajay	Pandaveswar	21100.00	64.00	3.00	63300.00		47601.60	75.20%
Ajay	Kanksha	28600.00	55.00	2.87	82082.00		62382.32	76.00%
Damodar	Andal	46900.00	69.00	2.90	136010.00		105407.75	77.50%
Damodar	Jamuria	48700.00	67.00	2.96	144152.00		112438.56	78.00%

Illustration of Replenishment Estimation is given in Table 7.10.

Table 7.10: Illustration of replenishment rate calculation based on 3 methods

Based on Satellite imageries		Based on field investigation		Based on empirical formula	
Particulars	Estimation	Particulars	Estimation	Particulars	Estimation
River	Damodar	River Name	Damodar	River Name	Damodar
Total Premonsoon Sand Bar Area	4287918.158 (sq.m)	Mining Area	46900 (Sq.m)	Lease Area	46900 (Sq.m)
Average Pre monsoon Thickness	2.8 (m)	Pre monsoon RL	69 (m)	Surface RL Before mining	69 (m)
Total Volume	12.11 (Mcum)	Sand Thickness	2.90 (m)	Mine out Thickness	2.90 (m)
Total Postmonsoon Sand Bar Area	4732744.529 (sq.m)	Volume excavated (Cum)	136010.00 (Cum)	Mine out Volume (Cum)	136010.00 (Cum)
Average Postmonsoon Thickness	2.9 (m)	Post monsoon RL	68.96 (m)	Drainage area for lease block	0.051 (Sq.km)

Based on Satellite imageries		**Based on field investigation**		**Based on empirical formula**	
Total Volume	13.50 (M.cum)	Thickness	2.86 (m)	Monsoon Rainfall-2020	1.48 (m)
Total Pre and Post monsoon Volume Difference	1.39 (M.cum)	Volume deposited (Cum)	133969.85 (Cum)	Estimated Volume as per Dendy-Bolton (S = 1280 Q0.46[1.43 - 0.26 log(A)]) Where, Q is runoff, A is drainage area)	105407.75 (Cum)
Replenishment and Agrredation %	111%	Replenishment Rate	98.50%	Replenishment Rate	77.50%

vi) Total potential of minor mineral in the river bed

The major sand producing rivers of the Paschim Bardhaman district are Damodar, Ajay and Barakar rivers. Planning has been done for systematic sand mining in the rivers.

B. Geological studies

i) Lithology of the catchment area

Archaean granite gneisses and migmatites of the Chotanagpur Gneissic Complex are exposed in a narrow east-west belt fringing the north-western part and constitute the oldest basement rocks. Over these, in a faulted, subsided semi-graben type structural trough, deposited the thick bedded sedimentary sequence of Gondwana Super Group comprising sandstone, shale, siltstone with prolific commercial coal seams. All these rocks are cut across by a number of high angle, transverse, gravity faults. Mostly the Lower Gondwana sequence is developed in this district, comprising the Talchir, Barakar, Barren Measure, Raniganj and Panchet Formations. Durgapur beds constitute the youngest unit above the Panchet Formation which is considered equivalent to Mahadeva Formation of Upper Gondwana developed elsewhere. The Gondwana sequence rocks are exposed in the western part of the district area. In parts of the central and in the broad, oval area of eastern part, laterite cover with red soil and Quaternary sequence of riverine sediments grouped under Sijua, Panskura and Diara formations are exposed. The Sijua formation is mainly clay with caliche concretions; Panskura formation constitute clay alternations with silt and sand at the bottom and Diara formation comprise bedded interfingering sand, silt and clay in the present-day shifting river channel courses. Geological succession of Bardhaman district is furnished below.

ii) Tectonics and structural behavior of rocks

Paschim Bardhaman district is a sort of an extension of the Chota Nagpur Plateau. It is a transitional zone between the Chota Nagpur Plateau, which constitutes a portion of peninsular shield in the west, and Ganga-Brahamaputra alluvial plain in the north and east. The rocky undulating topography with laterite soil is found in the western part of the district, which

extends to the western part of Durgapur subdivision; barren, rocky and rolling laterite soil rising into rocky hillocks, the highest being 227 m. The eastern part of the district gradually slopes down to the rice plains of Bengal. The district is a part of the Ajay Damodar Barakar tract with the Ajay on the north, the Damodar on the south and the Barakar on the west. The Ajoy-Damodar inter-stream tract is made up of several myriads of minor rivers and streams which criss-cross the district. This diversifies the landscape and lends a special charm to the area around Asansol and Durgapur subdivision.

C. Climate Factors

i) Intensity of rainfall

The average annual rainfall of the area is about 1044 mm. Rainfall during the monsoon period (June to September) constitutes 75 % of the annual rainfall. The driest month is December, with 2 mm or 0.1 inch of rain. The greatest amount of precipitation occurs in July, with an average of 309 mm or 12.2 inch. On an average the district has 70 rainy days in a year. The most prominent special weather phenomena of the district are the Nor'westers or Kalbaisakhis. Most of them strike with speed of 65 to 100 km/hr with rainfall ranging from 10 mm to 50 mm and marked by a consequent fall of temperature.

ii) Climate zone

Paschim Bardhaman district has a tropical climate - hot and humid. While the hottest month is May, the coldest is January. The monsoon season is from June to September with an annual average rainfall of 1,044 mm. Localised thunderstorms, called "Kalbaisakhi" in Bengali, are a special feature from March until the monsoon sets in. In monsoon period from June to September, wind blows from the south-west direction recognized as south-west monsoon. During winter, i.e., from December to February winds are mainly northerly or north-easterly with clear or patchily clouded sky. Temperatures are fairly cool between winter and spring.

iii) Temperature variation

Paschim Bardhaman district experiences dry and hot summer with maximum temperature of near about≈ 40°C during summer. The district shows a fierce dry heat in the warmer months. The summers in Paschim Bardhaman usually start from month of March and last till the middle of June. The arrival of the month of June marks the onset of monsoon in Paschim Bardhaman. The district receives a high average rainfall. June to September has shown maximum average rainfall with moderate temperature. Winters in Paschim Bardhaman are pleasant and enjoyable, with mercury dropping to about 14°C or below. The winter starts from December and last till the month of February. Due to such favourable conditions, winter is deemed as the best time for the tourists to visit Paschim Bardhaman.

For the purpose of estimating mineable mineral potential, the thickness of the sand bar considered extractable based on base flow level is given in Table 7.11.

Table 7.11: River wise Thickness of sand bar considered mineable

River Name	Considered Mining Thickness (m)
Ajay	3
Damodar	3
Barakar	2

Based on geomorphology, geology, climate and mineable thickness of sand bar the annual deposition of riverbed minerals (sand and gravel) has been estimated.

Sand bar area recommended for mineral concession in the table is calculated as per the Enforcement and Monitoring Guidelines for Sand Mining (EMGSM) 2020. As per guidelines, mining depth restricted to 3 meters depth and distance from the bank is ¼th of river width and not less than 7.5 meters. Also, mining is prohibitated up to a distance of 1 kilometre (1 km) from major bridges and highways on both sides, or five times (5x) of the span (x) of a bridge/public civil structure (including water intake points) on up-stream side and ten times (10x) the span of such bridge on down-stream side, subjected to a minimum of 250 meters on the upstream side and 500 meters on the downstream side. The annual minable mineral potential is given in Table 7.12.

Table 7.12: Annual mineable mineral potential

Sl. No.	River or Stream	Portion of the river stream recommended for mineral concession (%)	Length of area recommended for mineral concession (in meter)	Average width of area recommended for mineral concession (in meters)	Area recommended for mineral concession (in Sqm)	Mineable mineral potential (in Mcum) (60% of total mineral potential
1	Ajay	3	2600	435	1132966.281	2.04
2	Damodar	4	4685	672	3150271.545	5.67
3	Barakar	29	1650	542	894430.9702	1.07
Total Mineable volume						8.78

III. Riverbed Mineral Potential

Sand is the important riverbed mineral found to be potential for mining. Considerable quantity of quality sands is found to occur in part of Damodar, Ajay and Barakar Rivers. Table 7.13 summarizes the potential riverbed mineral deposits of the district. Smaller patches are also available locally in the other smaller rivers as well. Sand mining can be developed on cluster approach with restricted usage of Machinery's for lifting of sands. The rivers in the north Bengal are filled by Gravels and boulders. Development of river bed material with huge boulders also requires usage of machinery's to increase more production in turn revenue.

Table 7.13: Resources of Potential Riverbed Mineral

Boulder (Mcum)	Pebbles/ Gravel (Mcum)	Sand/White sand (Mcum)	Total Mineable, Mineral Potential (Mcum)
0	0	8.78	8.78

Based on satellite imagery study and field investigation, potential zones for riverbed deposits for each river of the district have been identified and the details of the zones are provided in Table 7.14.

Table 7.14: Potential Zone of Riverbed Mineral

Sl. No	Rivers or Streams	Location of potential zones						Potential area (in sq.m)
		Administrative Block	Mouza	JL No.	Zone	Co-ordinates		
1	Ajay River	Barabani	Parulberia	1	1	23° 50' 42.576" N	86° 56' 57.606" E	498505.7387
						23° 51' 55.077" N	86° 58' 0.881" E	
2		Jamuria	Andharia	1	2	23° 48' 46.147" N	87° 4' 9.277" E	299078.3294
						23° 46' 34.538" N	87° 6' 37.603" E	
3		Jamuria	Chichurbil, Sidhpur	5, 47	3	23° 44' 48.874" N	87° 10' 1.151" E	174814.1417
						23° 44' 48.521" N	87° 11' 0.755" E	
4		Kansa	Kanchanpur , Soshipur	2, 8	4	23° 40' 25.133" N	87° 24' 54.214" E	122181.7324
						23° 39' 32.831" N	87° 24' 37.004" E	
5		Kansa	Basudha	35	5	23° 36' 23.382" N	87° 30' 34.955" E	38386.3386
						23° 36' 37.665" N	87° 30' 44.890" E	
6	Damodar River	Kansa	Basudha	35	6	23° 24' 42.594" N	87° 26' 10.647" E	9099.1716
						23° 24' 43.726" N	87° 25' 37.948" E	
7		Durgapur (MC)	Raturia, Arjunpur	90, 206	7	23° 29' 37.096" N	87° 16' 54.829" E	1552495.3506
						23° 32' 56.846" N	87° 12' 51.052" E	
8		Andal	Srirampur, Baska,Tiar mana	56, 50, 49	8	23° 32' 56.846" N	87° 12' 51.052" E	1504921.3979
						23° 34' 3.003" N	87° 8' 25.853" E	
9		Raniganj (M)	Ballavpur, Raghunathp ur	27, 26	9	23° 34' 30.136" N	87° 7' 10.957" E	83755.6251
						23° 34' 39.557" N	87° 6' 48.354" E	
10	Barakar River	Asansol (MC)	Sanctoria, Ramnagar	38, 11	10	23° 41' 45.435" N	86° 48' 2.031" E	554012.379
						23° 43' 51.450" N	86° 48' 17.224" E	
11		Asansol (MC)	Borira	9	11	23° 45' 1.529" N	86° 49' 7.371" E	230125.528
						23° 45' 41.664" N	86° 49' 35.163" E	
12		Asansol (MC)	Debipur	1	12	23° 46' 27.534" N	86° 49' 26.150" E	98430.9844
						23° 46' 53.703" N	86° 49' 15.613" E	
13		Salanpur	Hadla	23	13	23° 46' 53.703" N	86° 49' 15.613" E	11862.0788
						23° 46' 56.753" N	86° 49' 12.105" E	

NO MINING ZONE:

As per the Enforcement and Monitoring Guidelines for Sand Mining (EMGSM) 2020 the restricted zone for mining is a distance from the bank is ¼th of river width and not be less than 7.5 meters. Also, there is a no mining zone up to a distance of 1 kilometre (1 km) from major bridges and highways on both sides, or five times (5x) of the span (x) of a bridge/public civil structure (including water intake points) on up-stream side and ten times (10x) the span of such bridge on down-stream side, subjected to a minimum of 250 meters on the upstream side and 500 meters on the downstream side.

No mining zone has been marked for an area up to a width of 100 meters from the active edge of embankments. Also, the concave side of the river is marked as no mining zone, as mining is this area will affect the course of river in future and will erode the river bank. A representative map of no mining zone shown on River Barakar of Paschim Bardhaman district is given in Figure 7.7. Table 7.15 summarized the area of no mining zones demarcated for each river of the district.

Table 7.15: No mining zone in the district

District Name	RIVER NAME	ZONE	Block Name	RESTRICTED AREA (SQ MTS)
Paschim Bardhaman	AJAY RIVER	1	Barabani	87424.2009
		2	Jamuria	330609.8122
		3	Jamuria	54778.5181
		4	Kansa	28691.3968
		5	Kansa	6291.3955
	DAMODAR RIVER	6	Kansa	154115.5218
		7	Durgapur (MC)	689079.2344
		8	Andal	721792.6617
		9	Raniganj (M)	17485.5661
	BARAKAR RIVER	10	Asansol (MC)	68920.9594
		11	Asansol (MC)	35109.2579
		12	Asansol (MC)	6759.9600
		13	Salanpur	774.5214

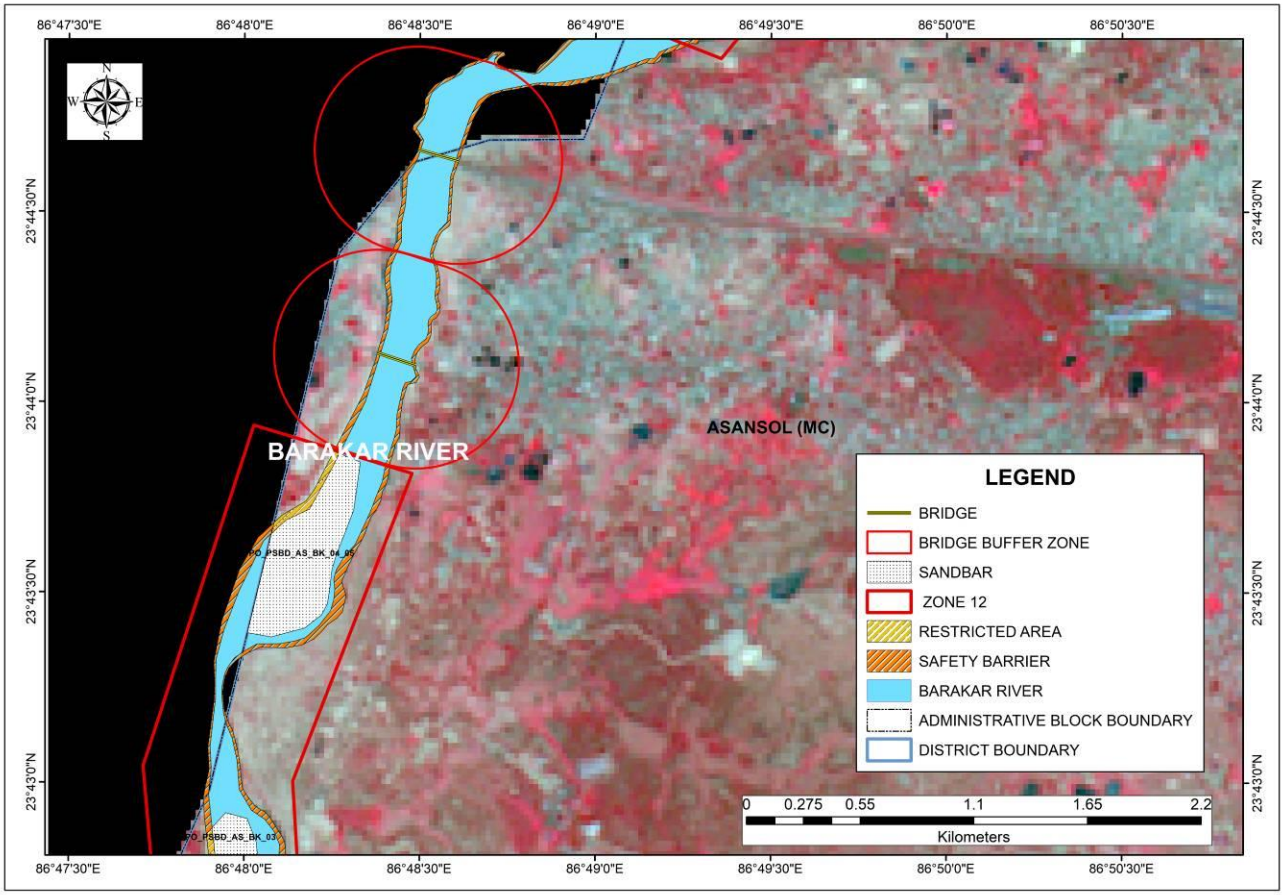


Figure 7.7: A representative map showing no-mining zone demarcated on Barakar River

7.2.2 In-situ Minerals:

I. Mineral Reserve

Paschim Bardhaman district is having diversified mineral deposits of both major and minor minerals. While coal is the predominant major mineral of the district. It has also a potential sand reserve suitable for construction activity. The other minor mineral occurrences include Blackstone, Quartz, Quartzite, China-clay, gravel, morrum etc. As such systematic G2 level exploration has not been carried out in the district but a discrete approach has been followed in order to grant the mining lease based on reported occurrences.

II. Mineral Potential

In this district survey report zones are identified based on the following criteria/ observation:

a. Extended zones beyond the existing leases has been identified both with ground validation and satellite imagery studies to define potential zones.
b. The areas with specific rock exposures, satellite imagery studies alongwith ground truthing is also is being opted to define potential mineralized zones.
c. Atleast in few instances potential zones are defined based on available geological maps/information superimposed in satellite imagery.

The lists of identified potential zones with respect to in-situ minor minerals are furnished in Table 7.16.

Table 7.16: In-situ Minerals Occurrences

Sl. No.	Name of the Mineral Zone Code	Name of the Mineral	Host rock of mineralization	Area of mineralized zone (sq.m)	Depth of mineralization	Whether virgin or partially excavated	Nature of land (whether free for mining/ forest / agriculture)	Mineral reserve (approx) mentioning grade	Administrative block	Co-ordinate		Infrastructure available near the mineralized zone
1	PB_BS_ZONE1	Black Stone	Dyke	4.74	30	Partialy Excavated	Agricultural	Partially explored	Baraboni	23° 47' 6.166" N	86° 57' 23.949" E	Road network available
										23° 47' 7.578" N	86° 57' 28.287" E	
										23° 46' 58.563" N	86° 57' 34.199" E	
										23° 46' 56.806" N	86° 57' 28.477" E	
2	PB_BS_ZONE2	Black Stone	Dyke	3.02	30	Partialy Excavated	Agricultural	Partially explored	Baraboni	23° 47' 30.837" N	86° 57' 21.626" E	Road network available
										23° 47' 31.285" N	86° 57' 25.459" E	
										23° 47' 23.422" N	86° 57' 26.397" E	
										23° 47' 22.560" N	86° 57' 21.703" E	
3	PB_BS_ZONE3	Black Stone	Dyke	22.39	40	Partialy Excavated	Agricultural	Partially explored	Baraboni	23° 46' 50.963" N	86° 57' 41.800" E	Road network available
										23° 46' 33.034" N	86° 58' 0.226" E	
										23° 46' 32.333" N	86° 57' 39.835" E	
										23° 46' 48.380" N	86° 57' 34.228" E	
4	PB_CC_ZONE1	China Clay	Sandstone	0.47	30	Partialy Excavated	Agricultural	Partially explored	Kanksa	23° 40' 25.015" N	87° 24' 48.787" E	Road network available
										23° 40' 27.258" N	87° 24' 49.690" E	
										23° 40' 26.530" N	87° 24' 51.538" E	
										23° 40' 24.182" N	87° 24' 51.166" E	

Sl. No.	Name of the Mineral Zone Code	Name of the Mineral	Host rock of mineralization	Area of mineralized zone (sq.m)	Depth of mineralization	Whether virgin or partially excavated	Nature of land (whether free for mining/ forest / agriculture)	Mineral reserve (approx) mentionning grade	Administrative block	Co-ordinate		Infrastructure available near the mineralized zone
5	PB_GL_ZONE1	Gravel	Sandstone	1770.86	20	Partialy Excavated	Agricultural	Partially explored	Faridpur	23° 36' 57.072" N	87° 15' 55.828" E	Road network available
										23° 38' 25.139" N	87° 17' 6.547" E	
										23° 37' 7.656" N	87° 19' 23.169" E	
										23° 35' 13.876" N	87° 18' 35.812" E	
7	PB_GR_ZONE1	Granite	Granite Gneiss	11.6	30	Partialy Excavated	Agricultural	Partially explored	Jamuria	23° 48' 17.314" N	87° 4' 11.051" E	Road network available
										23° 48' 25.107" N	87° 4' 14.926" E	
										23° 48' 28.548" N	87° 4' 16.620" E	
										23° 48' 30.284" N	87° 4' 19.763" E	
										23° 48' 29.251" N	87° 4' 22.587" E	
										23° 48' 25.824" N	87° 4' 26.793" E	
										23° 48' 14.059" N	87° 4' 17.445" E	
										23° 50' 17.895" N	86° 54' 18.181" E	
										23° 49' 46.093" N	86° 54' 11.396" E	
										23° 49' 48.146" N	86° 53' 53.812" E	
9	PB_GR_ZONE2	Granite	Granite Gneiss	9.05	40	Partialy Excavated	Agricultural	Partially explored	Salanpur	23° 47' 24.090" N	86° 50' 48.853" E	Road network available
										23° 47' 17.259" N	86° 50' 57.836" E	
										23° 47' 11.854" N	86° 50' 53.086" E	

Sl. No.	Name of the Mineral Zone Code	Name of the Mineral	Host rock of mineralization	Area of mineralized zone (sq.m)	Depth of mineralization	Whether virgin or partially excavated	Nature of land (whether free for mining/ forest / agriculture)	Mineral reserve (approx) mentioning grade	Administrative block	Co-ordinate		Infrastructure available near the mineralized zone
										23° 47' 10.485" N	86° 50' 51.883" E	
										23° 47' 13.919" N	86° 50' 47.985" E	
										23° 47' 16.353" N	86° 50' 45.223" E	
										23° 47' 19.070" N	86° 50' 42.140" E	
										23° 47' 19.745" N	86° 50' 43.042" E	

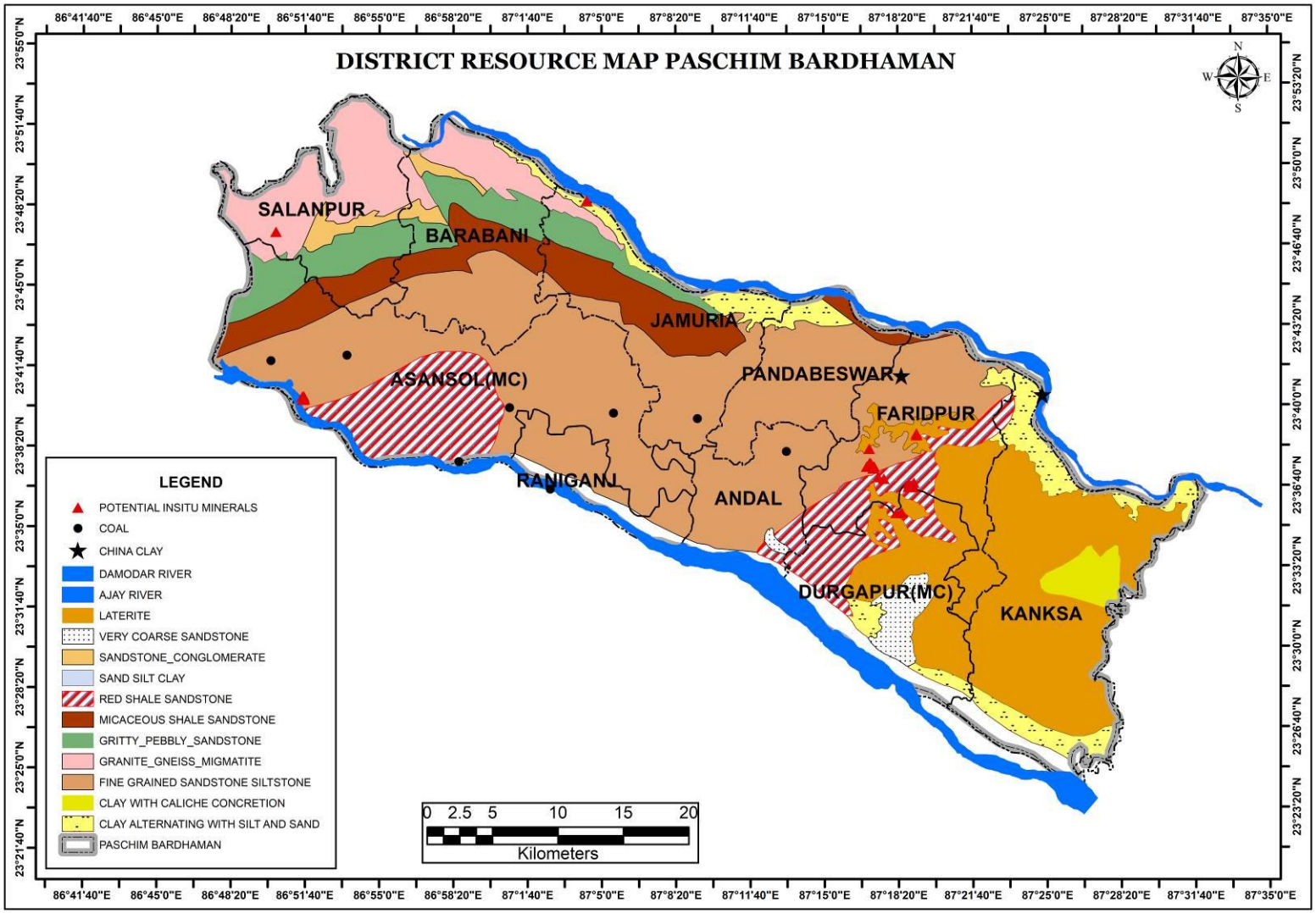


Figure 7.8: In-situ mineral occurrences shown on geological map of Paschim Bardhaman district

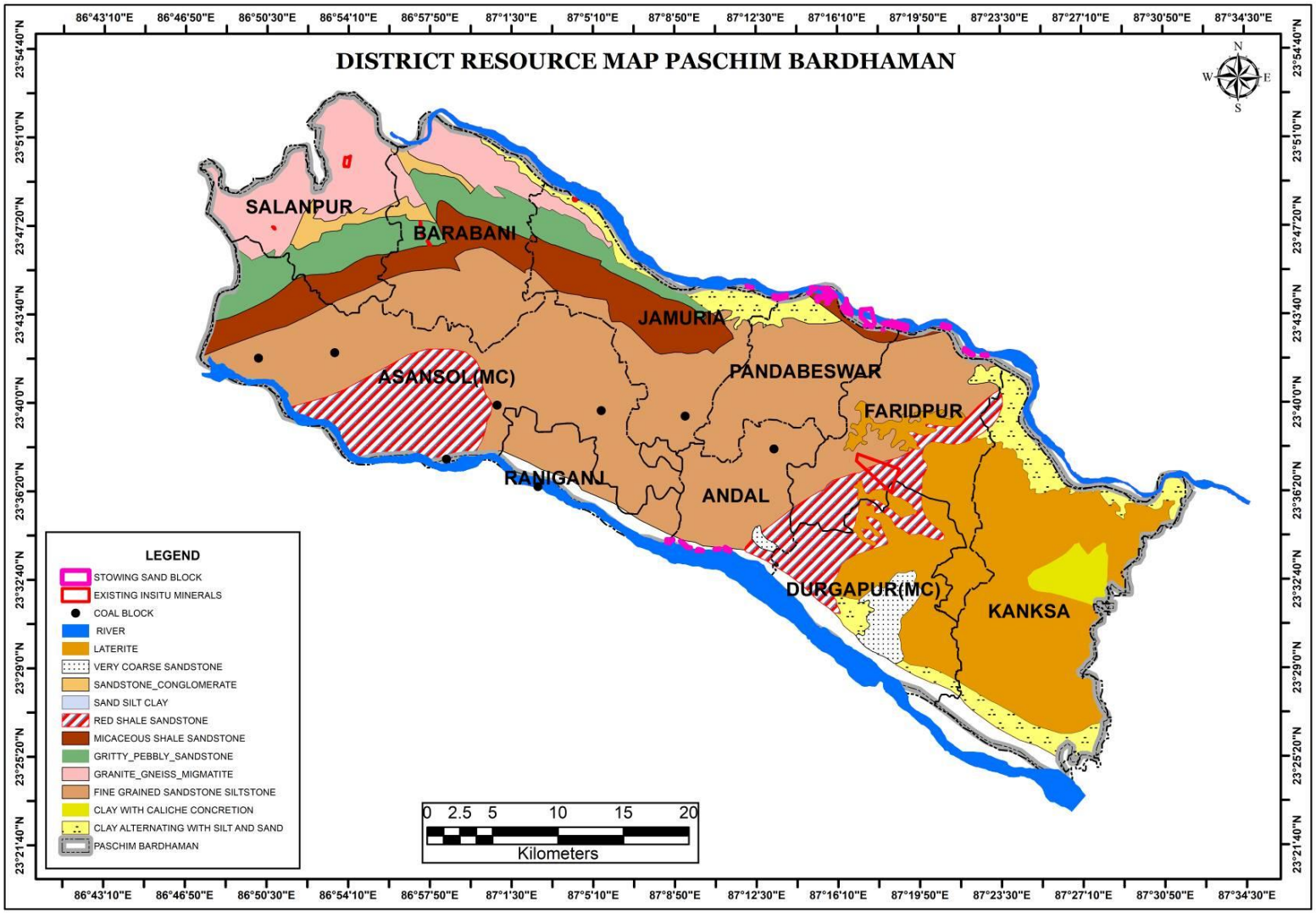


Figure 7.9: Existing mining leases of In-situ minerals along with In-situ mineral occurrences shown on geological map of Paschim Bardhaman district

8 Overview of mining activity in the district

8.1 General overview

Paschim Bardhaman district is a predominantly urban mining-industrial district in West Bengal. Coal excavation is one of the main major mineral mining of the district.

Coal mining in India first started in the Raniganj Coalfield. In 1774, John Sumner and Suetonius Grant Heatly of the British East India Company found coal near Ethora, presently in Salanpur CD Block. In 1973, the Government of India took over the management of all non-coking coal mines in the country and in 1975 Coal India was formed to manage the coking and non-coking coal mines. Eastern Coalfields has been producing around 30 million tonnes per annum from its open cast mines, it has been modernising its underground mines to produce around 10 million tonnes per annum from its underground mines.

Collection of sand from Ajay, Damodar and Barakar river-bed is one of the main minor mineral sources of the district.

8.2 List of existing mining leases of the districts

Details of existing mining leases and approved mining plans (other than sand) of the districts is furnished below.

Table 8.1: Details of mining leases of the districts (Sand)

Office of the Addl. District Magistrate and District Land & Land Reforms Officer, Paschim Bardhaman

Sl. No.	Block Name	Name of River	Mouza Name	Area (In Acre.)	Area (in Hect)	JL No.	Plot No.	Coordinates		Bidder Name	Remarks	Status
1	Jamuria	Ajay	Desher Mohan	9.44	3.82	14	583(P)	23°46'57.9"N	87°06'29.1"E	KOILASH MAHATO	Applied On 29/04/21	Applied for EC
2	Jamuria	Ajay	Desher Mohan	8.9	3.6	14	583(P)	23°46'48.8"N	87°06'34.4"E	DEBNATH ENTERPRIS E	Applied on 27/05/21	Applied for EC
3	Jamuria	Ajay	Desher Mohan	9.33	3.78	14	583(P)	23°46'41.8"N	87°06'38.9"E	M/S GANESH NANDY	Applied on 18/11/21	Applied for EC
4	Jamuria	Ajay	Desher Mohan	8.65	3.5	14	583(P)	23°46'34.6"N	87°06'43.2"E	LALU DUTTA	Applied on 17/11/21	Applied for EC
5	Jamuria	Ajay	Desher Mohan	6.82	2.76	14	1565(P)	23°45'04.6"N	87°08'59.1"E	LALTU DUTTA	Applied On 15/11/21	Applied for EC
6	Jamuria	Ajay	Desher Mohan	6.86	2.78	44	1565(P)	23°45'02.6"N	87°09'5.9"E	RELIANCE STONE PRODUCT		Under Process
7	Barabani	Ajay	Parulbaria	5.96	2.41	1	2366(P)	23°51'49.56"N	86°58'47.41"E			Less than3 bidders, proposed for re- auction
8	Barabani	Ajay	Parulbaria	5.9	2.39	1	2366(P)	23°51'42.00" N	86°58'56.59"E	M/S NATIONAL TRADERS	Applied On 13/11/20	Applied for EC
9	Barabani	Ajay	Putulia	9.44	3.82	13	1108(P)	23°51'8.91"N	87°0'28.78"E	SARAN ALCOHOL PVT. LTD.	Applied On 24/06/20	Applied for EC
10	Barabani	Ajay	Putulia	9.62	3.89	13	1108(P)	23°51'5.61"N	87°0'35.01"E	SHREE NATHJI DISTRIBUT ORS		Erroneous Payment of 1st installed
11	Barabani	Ajay	Putulia	9.38	3.8	13	1108(P)	23°51'2.20"N	87°0'41.75"E	MAIHAR DEVELOPERS	Applied on 24/06/20	Applied for EC
12	Barabani	Ajay	Rasunpur	9.02	3.65	16	1673(P)	23°49'26.17"N	87°3'1.68"E	AJAY TIWARI	Applied On 24/06/20	Applied for EC
13	Barabani	Ajay	Rasunpur	10.29	4.16	16	1673(P)	23°49'13.36"N	87°3'15.76"E	STARNET MARKETI NG PVT. LTD.		Under Process

Sl. No.	Block Name	Name of River	Mouza Name	Area (In Acre.)	Area (in Hect)	JL No.	Plot No.	Coordinates		Bidder Name	Remarks	Status
14	Barabani	Ajay	Rasunpur	4.44	1.8	16	1673(P)	23°49'7.52"N	87°3'28.89"E	LIBRA RETAILER PVT. LTD.	Applied On 24/06/20	Applied for EC
15	Pandaveswar	Ajay	Deshlopa	5.21	2.11	8	610(P)	23°43'17.8"N	87°18'46.8"E	BINODSHAW	EC	RUNNING
16	Pandaves war	Ajay	Deshlopa	3.81	1.54	8	610(P)	23°43'15.6"N	87°18'53.1"E	BINODSHAW	EC	RUNNING
17	Kanksha	Ajay	Rautdihi	7.06	2.86	25	953(P)	23°38'2.045" N	87°25'50.691"E	SRI MANOJ KUMAR SINGH	EC	RUNNING
18	Kanksha	Ajay	Kotalpukur	8.15		30	915(P)	23°36'45.037 "N	87°27'57.981"E	SK SAIFULUD DIN	EC	RUNNING
19	Kanksha	Ajay	Satkahania	5.2	2.1	34	675(P)	23°36'5.696" N	87°29'50.593"E	AJAY PRATAP SINGH	EC	RUNNING
20	Kanksha	Ajay	Basudha	8.6	3.48	35	4785(P)	23°36'53.587 "N	87°31'0.125" E	M/S RAJEN ROY	EC	RUNNING
21	Kanksha	Ajay	Basudha	7.83	3.17	35	4785(P)	23°36'58.166 "N	87°31'9.779" E	ANIRUDDHA BANERJEE	EC	RUNNING
22	Kanksha	Ajay	Basudha	9.02	3.65	35	3(P), 4785(P)	23°36'59.861 "N	87°31'17.404 "E			To be Re-surveyed
23	Kanksha	Ajay	Basudha	9.79	3.96	35	1255(P), 4787(P)	23°37'1.483" N	87°31'26.375 "E			To be Re-surveyed
24	Kanksha	Ajay	Basudha	7.35	2.97	35	1255(P), 4787(P)	23°37'1.597" N	87°31'33.322 "E	ANIRUDDHA BANERJEE		Prayed for adjustment; EC not approved
25	Jamuria	Ajay	Semalya	8.27	3.35	66	2780(P)	23°44'40.741 "N	87°12'47.419"E	CHANDA ENTERPRISE	EC	RUNNING
26	Jamuria	Ajay	Chinchurbil	7.66	3.1	5	1283(P)	23°47'28.7"N	87°6'9.5"E	INDIA DIGITAL ENTERTAI NMENT PVT. LTD.	EC	RUNNING
27	Salanpur	Ajay	Fatepur	6.2	2.51	103	3(P)	23°52'4.9"N	86°55'56.4"E	RUPUCHAK ENTERPRISES	EC	Deed to be executed
28	Salanpur	Ajay	Fatepur	6	2.43	103	3(P)	23°51'57.7"N	86°55'58.7"E	ANIL KUMAR SINGH	EC	Deed to be executed
29	Andal	Damo dar	Tialmana	11.59	4.69	49	51(P), 52(P), 54(P), 55, 57(P), 56(P), 61(P), 62(P), 63(P), 64(P), 65, 60(P), 73(P), 42(P)	23°34'2.44"N	87°9'9.142"E	HEMENDRA OJHAA NDCO	EC	RUNNING

Sl. No.	Block Name	Name of River	Mouza Name	Area (In Acre.)	Area (in Hect)	JL No.	Plot No.	Coordinates		Bidder Name	Remarks	Status
30	Salanpur	Ajay	Fatepur	7.8	3.16	103	3	23°51'49.5"N	86°55'58.9"E	RAINBOW INFRA STRUCURE AND HOUSING DEVELOPMENT LTD.		Prayed for refund of 1/3rd bid amount. Deed not executed.
31	Jamuria	Ajay	Birkulti	10.04	4.06	15	2065(P)	23°45'52.0"N	87°07'26.8"E	Bikalpa Traders Pvt. Ltd.	EC	Deed executed but not Registered yet
32	Jamuria	Ajay	Birkulti	5.85	2.37	15	2065(P)	23°45'48.2"N	87°07'35.3"E	Bikalpa Traders Pvt. Ltd.	EC	RUNNING
33	Jamuria	Ajay	Birkulti	7.38	2.99	15	2065(P)	23°45'43.9"N	87°07'41.8"E	Bikalpa Traders Pvt. Ltd.	EC	RUNNING
34	Jamuria	Ajay	Birkulti	8.54	3.46	15	2065(P)	23°45'38.7"N	87°07'51.1"E	Bikalpa Traders Pvt. Ltd.	EC	Deed executed but not Registered yet
35	Barabani	Ajay	Putulia	8.49	3.44	13	1108(P)	23°50'59.10" N	87°0'48.26"E	Ankur Biochem Pvt. Ltd.	EC	RUNNING
36	Barabani	Ajay	Putulia	8.99	3.64	13	1108(P)	23°50'55.59" N	87°0'55.16"E	Surya Narayan Singh	EC(P)	RUNNING
37	Barabani	Ajay	Rasunpur	10.43	4.22	16	1673(P)	23°49'18.42" N	87°3'8.69"E	Sudheswar Kumar	EC	RUNNING
38	Kanksha	Kunur	Keshabpur	0.56	0.23	66	539(P)	23°32'45.433 "N	87°25'37.2"E		EC	RUNNING
39	Kanksha	Ajay	Radhanagar	3.55	1.54	24	514(P)	23°38'09.52" N	87°25'41.56" E	Banshidhar Construction Pvt. Ltd.	EC	Prayed for adjustment. EC issued, Deed not executed
40	Pandaves war	Ajay	Kendra khottadi	4.87	1.97	1	3331(P)	23°44'41.5"N	87°14'48.9"E	Coinage Hotel and Resorts Pvt. Ltd.	EC(P)	RUNNING
41	Andal	Damodar	Tialmana	10.16	4.11	49	66(P), 67(P)	23°33'56.17" N	87°9'23.38"E	Chinmoy MANDAL	EC	RUNNING
42	Andal	Damo dar	Tialmana	10.01	4.05	49	66(P), 67(P)	23°33'53.03" N	87°9'31.66"E	Premi Arora	EC	RUNNING
43	Andal	Damo dar	Tialmana	10.03	4.06	49	66(P), 67(P)	23°33'49.32" N	87°9'41.50"E	Vaishno Devi Enterprises	EC	RUNNING
44	Jamuria	Ajay	Semalya	8.44	3.42	66	2780(P)	23°45'0.60"N	87°11'49.66" E	AMBEY ABASAN PVT. LIMITED	EC	Deed executed but not registered yet
45	Jamuria	Ajay	Semalya	6.81	2.76	66	2780(P)	23°45'0.46"N	87°11'49.66" E	TRIUMPH SALES ANDSERVIC ES	EC	RUNNING
46	Jamuria	Damodar	Nupur	10.82	4.38	31	1891(P), 2396(P)	23°34'21.015 "N	87°11'49.66" E	KIRANKHA N	EC	RUNNING

Sl. No.	Block Name	Name of River	Mouza Name	Area (In Acre.)	Area (in Hect)	JL No.	Plot No.	Coordinates		Bidder Name	Remarks	Status
47	Jamuria	Damodar	Nupur	12.03	4.87	31	1891(P), 2396(P)	23°34'17.312 "N	87°11'49.66" E	ANKUR BIOCHEM PVT. LTD.	EC	RUNNING
48	Jamuria	Ajay	Fatepur	6.9	2.79	103	3(P)	23°51'41.3"N	87°11'49.66" E	SUDIP KUMAR DEY	EC	RUNNING
49	Jamuria	Ajay	Baidyanathpur	2.23	0.9	5	1268(P)	23°43'37.4"N	87°11'49.66" E	BALAJI TRADING CO	EC	RUNNING
50	Jamuria	Damodar	Tialmana	11.36	4.6	49	5 (P), 42(P), 41(P), 40(P), 39(P), 44(P)	23°34'6.093" N	87°11'49.66" E	TRIUMPH SALES AND SERVICES	EC	Deed executed but not registered yet

Table 8.2: Details of existing mining leases and approved mining plans (other than sand) of the districts

Office of Chief Mining Officer, Asansol

Sl. No.	Block	Minerals	Name of Mouza (JL No)	Plot No	Area in Acres	Name of the holder	LATITUDE	LONGITUDE
1	Barabani	Dolerite Dyke	Amdiha (24)	115, 117, 118, 119	4.48	Sanjay Kumar	23° 47' 30.7000" N	86° 57' 24.5000" E
							23° 47' 30.4000" N	86° 57' 22.6000" E
							23° 47' 26.5000" N	86° 57' 23.4000" E
							23° 47' 23.2000" N	86° 57' 22.5000" E
							23° 47' 24.0000" N	86° 57' 25.9000" E
							23° 47' 26.8000" N	86° 57' 25.4000" E
2	Barabani	Dolerite Dyke	Baliapur (25)	776	3.50	Ujjal Das	23° 46' 34.7000" N	86° 57' 45.5500" E
							23° 46' 38.2300" N	86° 57' 45.4600" E
							23° 46' 40.1400" N	86° 57' 45.0400" E
							23° 46' 43.6500" N	86° 57' 41.8100" E
							23° 46' 44.8300" N	86° 57' 42.2200" E
							23° 46' 43.8100" N	86° 57' 44.0000" E
							23° 46' 35.4000" N	86° 57' 49.9700" E
							23° 46' 34.8300" N	86° 57' 51.2100" E
							23° 46' 34.1400" N	86° 57' 51.1100" E
3	Barabani	Dolerite Dyke	Amdiha (24)	381, 382	5.19	M/s Shiv Shakti Mines & Minerals Dipak Kumar Maji	23° 47' 06.1584" N	86° 57' 27.2520" E
							23° 47' 06.5472" N	86° 57' 26.5176" E
							23° 47' 02.0364" N	86° 57' 26.8344" E
							23° 46' 58.2852" N	86° 57' 28.7136" E
							23° 46' 59.0808" N	86° 57' 32.9832" E
							23° 47' 00.3336" N	86° 57' 31.8924" E
							23° 46' 59.9448" N	86° 57' 30.1608" E
4	Salanpur	Granite	Maheshpur (24)	83	2.75	M/s Maa Kali Stone Quarry Arup Kumar Mandal	23° 47' 18.6300" N	86° 50' 44.4300" E
							23° 47' 17.6400" N	86° 50' 49.8200" E
							23° 47' 13.4100" N	86° 50' 51.1000" E
							23° 47' 14.5400" N	86° 50' 47.7400" E
							23° 47' 15.7200" N	86° 50' 48.0700" E
							23° 47' 15.7600" N	86° 50' 48.4300" E
							23° 47' 16.3500" N	86° 50' 48.8800" E
5	Barabani	Granite	Baliapur (25)	1215, 1217, 1219	3.34	Cemix Structural Private Limited Sri Subrata Bharadwaj	23° 50' 12.0000" N	86° 54' 00.0000" E
							23° 49' 48.6000" N	86° 54' 10.0000" E
							23° 50' 10.5000" N	86° 54' 12.0000" E
							23° 50' 13.2000" N	86° 54' 13.0000" E
							23° 50' 14.0000" N	86° 54' 14.0000" E
							23° 50' 15.0000" N	86° 54' 15.0000" E
							23° 49' 49.0000" N	86° 53' 58.0000" E
							23° 49' 52.0000" N	86° 53' 59.0000" E
							23° 49' 54.0000" N	86° 53' 57.0000" E
							23° 50' 13.5000" N	86° 54' 11.0000" E
6	Faridpur	Gravel	Bansgora (38)	1 to 500	1199.19	Sujit Biswas and Subir Biswas	23° 37' 15.7730" N	87° 18' 55.9300" E
							23° 36' 18.1830" N	87° 18' 32.8140" E
							23° 37' 36.3210" N	87° 17' 00.6060" E
							23° 37' 53.2940" N	87° 17' 04.2370" E
7	Jamuria	Granite	Baguli (02)	20	7.39	Chinmoy Mondal	23° 48' 28.0800" N	87° 04' 17.2900" E
							23° 48' 29.3800" N	87° 04' 19.3800" E
							23° 48' 29.5900" N	87° 04' 20.0600" E
							23° 48' 29.4100" N	87° 04' 21.2900" E
							23° 48' 28.9400" N	87° 04' 21.9700" E

Sl. No.	Block	Minerals	Name of Mouza (JL No)	Plot No	Area in Acres	Name of the holder	LATITUDE	LONGITUDE
							23° 48' 28.5800" N	87° 04' 22.8400" E
							23° 48' 28.0800" N	87° 04' 22.5100" E
							23° 48' 26.5300" N	87° 04' 24.8500" E
							23° 48' 27.0000" N	87° 04' 25.1400" E
							23° 48' 26.8200" N	87° 04' 25.4600" E
							23° 48' 26.4600" N	87° 04' 25.7900" E
							23° 48' 25.7400" N	87° 04' 25.6100" E
							23° 48' 25.5600" N	87° 04' 25.7500" E
							23° 48' 24.9800" N	87° 04' 25.8200" E
							23° 48' 24.1200" N	87° 04' 24.3800" E
							23° 48' 23.4700" N	87° 04' 23.4800" E
							23° 48' 23.4700" N	87° 04' 22.7300" E
							23° 48' 24.0500" N	87° 04' 21.0400" E
							23° 48' 24.0800" N	87° 04' 20.3200" E
							23° 48' 24.2300" N	87° 04' 19.9600" E
							23° 48' 24.3000" N	87° 04' 19.1600" E
							23° 48' 24.4400" N	87° 04' 18.6200" E
							23° 48' 26.2800" N	87° 04' 17.5100" E

8.3 Detail of production of sand and other minerals

Four years production of minor minerals (sand and other than sand) of Paschim Bardhaman District is furnished in Table 8.3.

Table 8.3: Details of production of sand in Paschim Bardhaman district

Office of the Addl. District Magistrate and District Land & Land Reforms Officer, Paschim Bardhaman

Sl. No.	Year	Name of mineral	Total Production in cft.	Total Production in cum
1	2017-2018	Sand	8653176	245028.34
2	2018-2019	Sand	21476159	608131.36
3	2019-2020	Sand	27377587	775239.61
4	2020-2021	Sand	31241232	884644.83

Conversion factor: 1 cum=35.315 cft

9 Details of revenue generated from mineral sector

Revenue generated from minor mineral (sand and other than sand) in Paschim Bardhaman District is furnished in Table 9.1.

Table 9.1: District revenue generation from mineral sector (sand and other than sand)

(In Rs.)

Year	Royalty	Cess	Total revenue
Sand			
2017-2018	13066296	9046010	22112306
2018-2019	32429000	3067826	35496826
2019-2020	41340157	3799815	45139972
2020-2021	47174260	-	31241232
Other than sand			
2017-2018	18329598	1875184	20204782
2018-2019	27561261	3243029	30804290
2019-2020	41312615	2366668	43679283

10 Transport (Railway, road)

Entire Paschim Bardhaman is covered with road networks and the maximum concentration and the road transport are adequate in terms of bus availability and goods flow. NH 18 (NH 32) connects this district with Jamshedpur, Bokaro, Chas and Dhanbad. National Highway 60A connects Paschim Bardhhaman with State Highway 9 at Bankura and subsequently to NH 2 at Durgapur with high road density. Currently, Highway 5 also plays an important role in district's transport network as it connects the towns like Raghunathpur, Adra, Santaldih and Neturia to NH 2 at Neamatpur and Asansol. Paschim Bardhhaman has excellent road connectivity with Raniganj-Asansol industrial belt. South Bengal State Transport Corporation runs 4 buses from Paschim Bardhaman to Kolkata via State Highway 5 thus connecting towns and cities like Raghunathpur, Adra, Neturia to the industrial belt of Asansol, Raniganj, Durgapur and Bardhhaman. There are also many private bus operators on this route.

A transportation map of Paschim Bardhaman district has been prepared and presented in Figure 10.1.

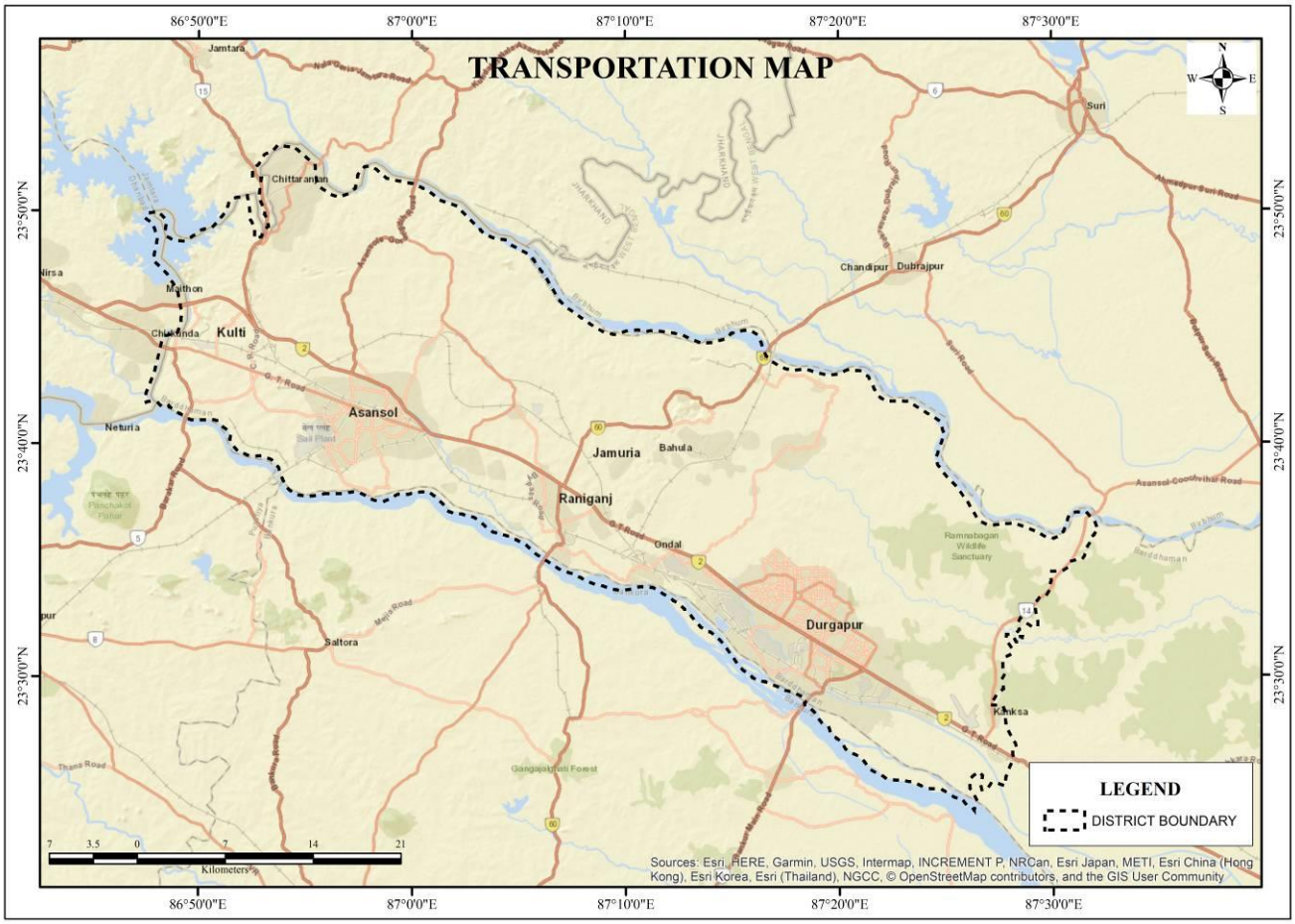


Figure 10.1: Transportation map of Paschim Bardhaman District
(*National Informatics Centre*)

The transportation via train is another important conveyance medium of Paschim Bardhhaman. Factually, Narayankuri ghat, on the bank of river Damodar, was used by Carr Tagore & Company for transporting coal to Kolkata by boat in the middle of the nineteenth century (*Asansol, RailIndia;2017*). Fluctuating water levels of the rain-fed river Damodar created problems for transportation and hindered business flow. Therefore, in order to capture the profitable coal transport business, East Indian Railway laid lines up to Raniganj in the year of1855 (Asansol, Rail India; 2017). As a result of that, it captured the complete coal transport business. Afterward, the line was extended to Asansol in1863 (*Asansol, Rail India; 2017*). Currently, Asansol Division of Eastern Railway handles around1, 300 wagons of coal every day. The Howrah-Delhi main line via Asansol and Patna of East Indian Railway was made operable in 1871 and the Grand Chord from Sitarampur to Mughalsarai was completed in1901, shortening the travel distance between Howrah and Delhi. Bengal Nagpur Railway linked its operations in the Nagpur-Chandil sector to Asansol in 1887. With all these links Asansol emerged as a major railway junction. Asansol has an electric loco shed and an EMU shed. There is a diesel loco shed at Andal and Andal also has a large goods yard, apart from those at Sitrampur and Barakar (The Chronology of Railway development in Eastern Indian, 2017). Presently the district is functioned by three numbers of rail networks provided by the South Eastern Railways. One-line tracks from Jharkhand in the South through the district up to Asansol passing through Adra division. Another line goes between Bankura and Dhanbad also via the Adra Division and the third The Railway Divisional Headquarter Adra railway division, which is one of the major rail divisions of South Eastern Railway, is situated on the North-East part of Paschim Bardhhaman district. *(www.wikipedia.org).*

The nearest international airport is Netaji Subhas Chandra Bose International Airport at Dum Dum in Kolkata. Domestic airport that serves the city is Kazi Nazrul Islam Airport. The airport is located in Andal and is roughly 15 km from Durgapur City Centre. It is around 25 km away from the Asansol City Bus Terminus and there is also a private airport located at Burnpur Riverside Area.

A transportation map demarcating approach road to the potential sand blocks from the nearest National Highway/ Sate Highway has been prepared and presented in Figure 10.2.

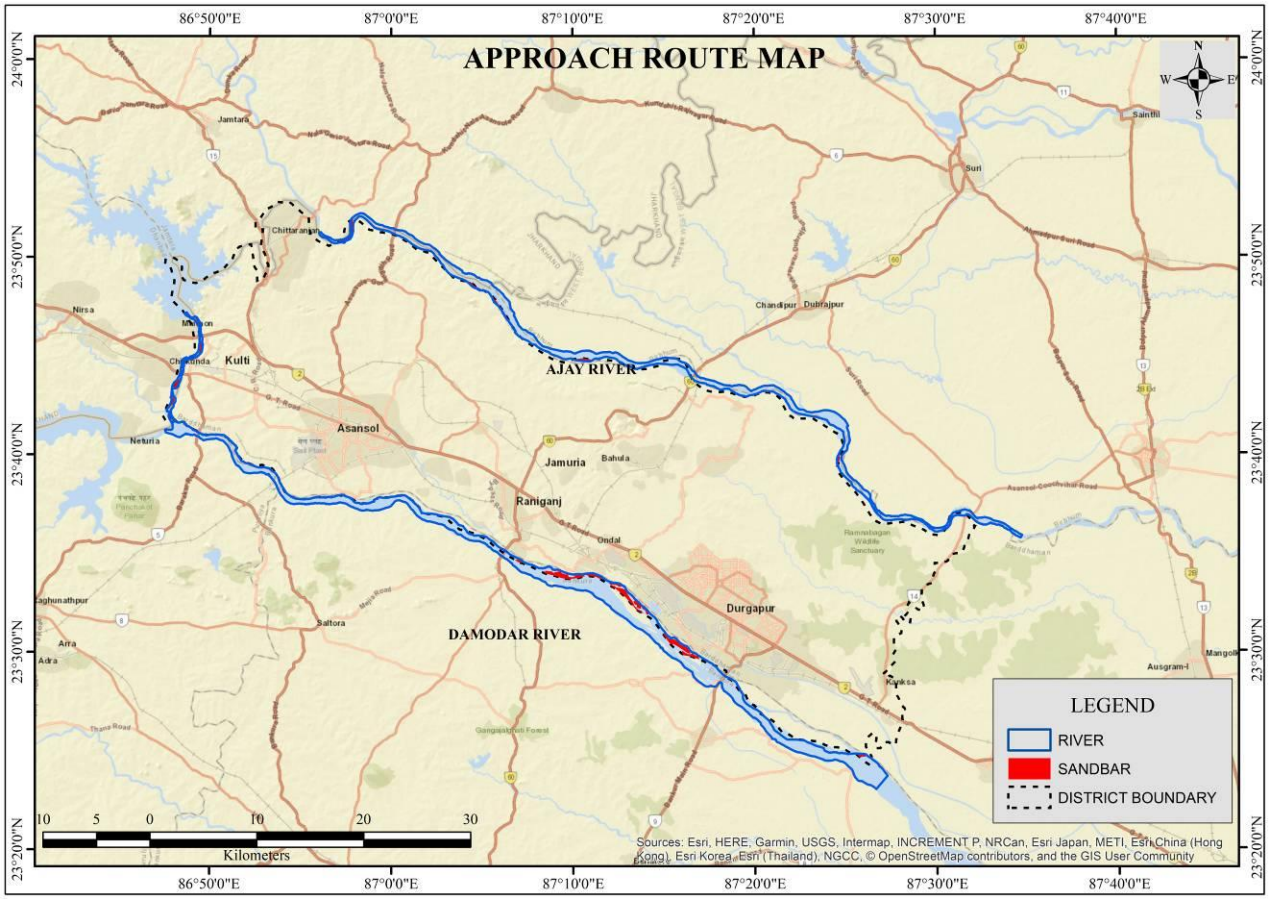


Figure 10.2: Map showing approach road to potential sand bars

11 Remedial measure to mitigate the impact of mining

11.1 Environmental Sensitivity

Paschim Bardhaman area represents a unique geo- environmental setup. As human population increases, forests are being depleted for the extension of agricultural lands, introduction of new settlements, roadways etc

Due to unprecedented growth of population during the last few decades, nature has started reacting sharply to the accumulated human guilt. Soil erosion and its conservation play an important role.

The land use practices play the most important role in determining the stability factors in respect of landslide hazards. Stone quarrying from the slope is another way of human intervention that causes occasional slope failure.

11.2 Sand mining Impact

Another serious environmental problem around the globe in recent years is of sand and gravel mining. Sand mining is a process of extraction of sand from an open pit, river bed, sea beaches, ocean floor, river banks, deltas and island dunes. The extracted sand could be utilised for various types of manufacturing, such as concrete used in the construction of building and other structures. The sand can also be used as an abrasive. The demand for sand will increase with population growth and urbanization. The high demand of sand has has led to unsustainable sand mining process resulting in illegal mining.

Although most jurisdictions have legal limit on the location and volume of sand that can be mined, illegal sand extraction is taking place in many parts of the country due to rapid urbanisation and industrialisation.

Removal or extraction of too much sand from rivers leads to erosion of river banks. Deltas can recede due to sand mining. These destructive effects of sand mining ultimately results in loss of fertile land and property. It also destabilizes the ground and causes failure of engineering structures.

In-stream mining directly alters the channel geometry and bed elevation. Removing sediment from the channel disrupts the pre-existing balance between sediment supply and transporting capacity, typically inducing incision upstream and downstream of the extraction site. The resultant incision alters the frequency of floodplain inundation along the river courses, lowers valley floor water table and frequently leads to destruction of bridges and channelization structures.

Sand Mining in beaches disturbs the ecosystem of different fauna of the beaches. The sand mining from natural barriers, made up of sand, causes flooding of the natural habitat. The

sand mining activity destroys the aesthetic beauty of beaches and river bank and makes the ecosystem unstable. If there are popular tourist destination, tourism potential of such areas will decline.

It can be concluded that there has been little in depth research on the environmental, social and political effects of land use practices and calls for urgent attention by the competent authority.

11.3 Remedial measure

11.3.1 Sustainable Mining Practices:

- The depth of mining in riverbed shall not exceed 3 meter or base flow level whichever is less, provided that where the Joint Inspection Committee certifies about excessive deposit or over accumulation of mineral in certain reaches requiring channelization, it can go above 3 meters.
- Mining shall be done in layers of 1 meter depth to avoid ponding effect and after first layer is excavated, the process will be repeated for the next layers.
- No stream should be diverted for the purpose of sand mining. No natural water course and/ or water resources are obstructed due to mining operations.
- No blasting shall be resorted to in river mining and without permission at any other place.

11.3.2 Monitoring the Mining of Mineral and its Transportation:

- For each mining lease site the access should be controlled in a way that vehicles carrying mineral from that area are tracked and accounted for.
- There should be regular monitoring of the mining activities in the State to ensure effective compliance of stipulated EC conditions and of the provisions under the Minor Mineral Concessions Rules framed by the State Government.

11.3.3 Noise Management:

- Noise arising out of mining and processing shall be abated and controlled at source to keep within permissible limit.
- Restricted sand mining operation has to be carried out between 6 am to 7 pm.

11.3.4 Air Pollution and Dust Management:

- The pollution due to transportation load on the environment will be effectively controlled and water sprinkling will also be done regularly.
- Air pollution due to dust, exhaust emission or fumes during mining and processing phase should be controlled and kept in permissible limits specified under environmental laws.

- The mineral transportation shall be carried out through covered trucks only and the vehicles carrying the mineral shall not be overloaded. Wheel washing facility should be installed and used.

11.3.5 Bio-Diversity Protection:

- Restoration of flora affected by mining should be done immediately. Five times the number of trees destroyed by mining to be planted preferably of indigenous species. Each EC holder shall have to undertake plantation of trees over at least 20% of the total area of lease in the same plot or plots utilised for such working.
- No mining lease shall be granted in the forest area without forest clearance in accordance with the provisions of the Forest Conservation Act, 1980 and the rules made there under.
- Protection of natural home of any wild animal shall have to be ensured.
- No felling of tree near quarry is allowed. For mining lease within 10km of the National Park / Sanctuary or in Eco-Sensitive Zone of the Protected Area, recommendation of Standing Committee of National Board of Wild Life (NBWL) have to be obtained as per the Hon'ble Supreme Court order in I.A. No. 460 of 2004.
- Spring sources should not be affected due to mining activities. Necessary protection measures are to be incorporated.

11.3.6 Management of Instability and Erosion:

- Removal, stacking and utilization of top soil should be ensured during mining. Where top soil cannot be used concurrently, it shall be stored separately for future use keeping in view that the bacterial organism should not die and should be spread nearby area.
- The EC should stipulate conditions for adequate steps to check soil erosion and control debris flow etc. by constructing engineering structures
- Use of oversize material to control erosion and movement of sediments
- No overhangs shall be allowed to be formed due to mining and mining shall not be allowed in area where subsidence of rocks is likely to occur due to steep angle of slope.
- No extraction of stone / boulder / sand in landslide prone areas.
- Controlled clearance of riparian vegetation to be undertaken.

11.3.7 Waste Management:

- Site clearance and tidiness is very much needed to have less visual impact of mining.
- Dumping of waste shall be done in earmarked places as approved in Mining Plan.
- Rubbish burial shall not be done in the rivers.

11.3.8 Pollution Prevention:

- Take all possible precautions for the protection of environment and control of pollution.
- Effluent discharge should be kept to the minimum and it should meet the standards prescribed.

11.3.9 Protection of Infrastructure:

- Mining activities shall not be done for mine lease where mining can cause danger to site of flood protection works, places of cultural, religious, historical, and archeological importance.
- For carrying out mining in proximity to any bridge or embankment, appropriate safety zone should be worked out on case to case basis, taking into account the structural parameters, location aspects and flow rate, and no mining should be carried out in the safety zone so worked out.

Mining shall not be undertaken in a mining lease located in 300-500 meter of bridge, 300 meter upstream and downstream of water supply / irrigation scheme, 100 meters from the edge of National Highway and railway line, 50 meters from a reservoir, canal or building, 25 meter from the edge of State Highway and 10 meters from the edge of other roads except on special exemption by the Sub-Divisional level Joint Inspection Committee.

12 Suggested reclamation plan for already mined out areas

As per statute all mines/quarries are to be properly reclaimed before final closure of the mine. Reclamation plans should include:

a) A baseline survey of river cross section. The study of cross section is basis for delineating channel form. Cross-sections must be surveyed between two monumented endpoints set on the river banks, and elevations should be referenced based on benchmark set in the area;

b) The proposed mining cross-section data should be plotted over the baseline data to illustrate the vertical extent of the proposed excavation;

c) The cross-section of the replenished bar should be the same as the baseline data. This illustrates that the bar elevation after the bar is replenished will be the same as the bar before extraction;

d) A planimetric map showing the aerial extent of the excavation and extent of the riparian buffers;

e) A planting plan developed by a plant ecologist familiar with the flora of the river for any areas such as roads that need to be restored;

f) Each EC holder shall have to undertake plantation of trees over at least 20% of the total area of the plot or plots of land as subject to such working in accordance with a plan approved by the concerned Divisional Forest Officer holding jurisdiction, provided further the competent authority l.e, The Divisional Forest Officer may fix up norms for plantation of trees in a particular area regarding choice of species, spacing, nos of trees and maintenance etc.

g) A monitoring plan has to establish.

13 Risk assessment and disaster management plan

Risk analysis is the systematic study of risks encountered during various stages of mining operation. Risk analysis seek to identify the risks involved in mining operations, to understand how and when they arise, and estimate the impact (financial or otherwise) of adverse outcomes. The sand mining operation in the district is mainly done manually.

13.1 Identification of risk due to river sand mining

There is no land degradation due to mining activities as mining is done only on river bed dry surface. There will be no OB or waste generation as the sand is exposed in the river bed and is completely saleable. There will be neither any stacking of soil nor creation of OB dumps. The mining activity will carry out upto a maximum depth of 3m below the surface level. So, there is no chance of slope failure, bench failure in the mines. However, there are some identified risk in the mining activity which are as follows:

1. Accident during sand loading and transportation
2. Inundation/ Flooding
3. Quick Sand Condition

13.2 Mitigation measures

13.2.1 Measures to prevent accidents during loading and transportation:

- During the loading, trucks should be brought to a lower level so that the loading operation suits the ergonomic condition of the workers.
- The workers will be provided with gloves and safety shoes during loading.
- Opening of the side covers of the truck should be done carefully and with warning to prevent injury to the loaders.
- Mining operations will be done during daylight only.
- The truck will be covered with tarpaulin and maintained to prevent any spillage.
- To avoid danger while reversing the trackless vehicles especially at the embankment and tipping points, all areas for reversing of lorries should be made man free as far as possible.
- All transportation within the main working will be carried out directly under the supervision and control of the management.
- Overloading should not be permitted and the maximum permissible speed limit should be ensured.
- There will be regular maintenance of the trucks and the drivers will have valid driving license.

13.2.2 Measures to prevent incidents during Inundation/ Flooding:

To minimize the risk of flooding/ inundation following measures should be under taken:

- Mining will be completely closed during the monsoon months.
- Proper weather information particularly on rain should be kept during the operational period of mines so that precautionary measures will be undertaken.

13.2.3 Measures for mitigation to quick sand condition:

- Quick sand zone and deep-water zone will be clearly demarcated and all the mines workers will be made aware of the location.
- Mining will be done strictly as per the approved mining plan.

13.3 Disaster management plan

As the depth of mining will be maximum of 3m below the surface level considering local condition, the risk related to mining activity is much less. The mining operation will be carried out under the supervision of experienced and qualified Mines Manager having Certificate of Competency to manage the mines granted by DGMS. All the provisions of Mines Act 1952, MMR 1961 and Mines Rules 1955 and other laws applicable to mine will strictly be complied. During heavy rainfall and during the monsoon season the mining activities will be closed. Proper coordination with Irrigation Department should be maintained so that at the time of releasing water, if any, from the dam suitable warning/information is given in advance. Special attention and requisite precautions shall be taken while working in areas of geological weakness like existence of slip, fault etc. The mining site will be supplied with first aid facilities and the entire mines worker will have access to that.

14 Conclusions and Recommendations

The District Survey Report has been prepared in conformity with the S O 141 (E), S O 3611 (E) and other sand mining guidelines published by MoEF & CC time to time as well as the requirement specified in The WBMMCR, 2016.

Potential areas of economic mineralization and mineral deposition have been identified and list is furnished in the report. Estimation of annual sand deposition by replenishment study been incorporated.

The district survey report has been prepared by utilizing both primary and secondary data. The primary data generation involved the satellite imagery study, site inspection, survey, ground truthing etc. while secondary data has been acquired through various authenticated sources and satellite imagery studies.

The district survey report of Paschim Bardhaman district also describes the general geographical profile of the district, distribution of natural resources, livelihood, climatic condition and sources of revenue generation.

Paschim Bardhaman district is well known for its coal resources which belong to Raniganj and Barakar Formation of Gondwana super-group. The district in its western part is a continuation of Chotanagpur gneissic complex where as eastern part merged with the overlying Rajmahal trap. South-eastern part of the district merged with the margin Bengal Basin. The Gondwana seems to be occasionally traverse with the younger dykes which are potential sites development of stone aggregates. The margin between Chhotanagpur and Gondwana are often found to be clay bearing and are also linked with the potential economic mineral resources. Occurrences of lignite resources are also reported in the district as a part of younger Bengal Basin. A fairly good amount mono-mineralic gravel deposits is found to be spread over the Gondwana and is reported north-west of Durgapur city. A good stretch of morrum is found to be overlain the Gondwanas as well as the recent deposits of Bengal Basin. Atleast in few occurrences' quartzite deposits are also reported to be economically extracted.

Major sand producing rivers of the district are Damodar, Ajay and Barakar. The rivers are mostly running west to south-east in the district. Both Damodar and Ajay are found to be good source of construction sand which fed the requirements of the state.

The district is generating considerable revenue from mining of minor minerals such as riverbed sand deposits. However, in-stream mining directly alters the channel geometry and bed elevation. Therefore, mining of riverbed should be carried out scientifically and based on statutory guidelines for conservation of land, river channels and sustainable development of the society.

14.1 Conclusion

I. The river beds of the district are enriched with sand which is highly potential for mining.

II. The replenishment study has been carried out during the preparation of this DSR. Both field-based surveys coupled with satellite imagery study and empirical studies were carried out to determine the rate of replenishment in each river of the district.

III. The determined values of various methods as adopted for replenishment study gives a comparable value and in all cases the values are found to be much more as compared to the capping limit (60%) as suggested in the Enforcement & Monitoring Guidelines for Sand Mining (EMGSM) January 2020, Issued by Ministry of Environment, Forest and Climate Change (MoEF & CC) 2020.

IV. Field base study shows variation of replenishment from 97.40 to 98.90% in the district and for theoretical replenishment study based on mining lease shows variation from 74% to 78% with an average of 75.92% of replenishment rate in the district.

V. The total potential river bed deposit for the district comes to about 8.78 Mcum.

VI. Nine nos of potential in-situ minor mineral zones have been identified in the district.

14.2 Recommendation

1. The mining lease distribution for the district must be carried out by involving a district level committee constituted with inter-disciplinary members of various departments including irrigation and waterways, DL&LRO, forest, biodiversity, wetland management, SWID or any other relevant department which the district authority may find suitable to include.
2. While recommending for Mining Leases, the District Level Committee should ensure the protection of Biodiversity Zones as recorded by relevant Government Agenesis from time to time.
3. During finalization of mining leases for the district, strict adherence of Supreme Court orders No 1501 dated 03/06/2022 should be followed.
4. Efforts should be given to restrict distribution of mining leases along the confluence zone of the rivers where rich aquatic habitats are reported.
5. Since the state of West Bengal has royalty system in volumetric measurement, specific gravity for sand and gravel has not been determined during this study. However, during the finalization of mining lease if it is found necessary to conduct such test may be initiated by the state government on case-to-case basis.
6. It is recommended to have a periodical review along with primary data collection during pre- and post-monsoon periods to record the seasonal variance of the sedimentation rate on annual basis and update replenishment rate of the district.

References

^ *"Census of India 2011: District Census Handbook, Bardhaman, Part XII B" (PDF). Brief History of the district, pages 9 - 11. Directorate of Census Operations, West Bengal. Retrieved 12 April 2017.*
^ *"List of Paleolithic sites in India". Important India. Archived from the original on 18 April 2017. Retrieved 18 April 2017.*
^ *"Bardhaman district". History and Background. Bardhaman district authorities. Retrieved 18 April 2017.*
^ *"Asansol". History. Railindia. Archived from the original on 7 May 2017. Retrieved 18 April 2017.*
^ Chattopadhyay, Akkori, *Bardhaman Jelar Itihas O Lok Sanskriti* (History and Folk lore of Bardhaman District.), (in Bengali), Vol I, pp 367-370, Radical Impression. ISBN 81-85459-36-3
^ *"Bengal District Gazetteers, Burdwan by JCK Peterson" (PDF). History, Page 51. First published in 1910, reprinted in 1997 by the Government of West Bengal. Retrieved 13 April 2017.*
^ *"About Durgapur". ADDA. Archived from the original on 18 April 2017. Retrieved 13 April 2017.*
^ Chattopadhyay, Akkori, Vol I, pp 345-365
^ *"Bardhaman District". History and Background. Bardhaman district administration. Retrieved 13 April 2017.*
^ b *"পূর্ব ও পশ্চিম, আজ বর্ধমান জেলা ভাগের আনুষ্ঠানিক ঘোষনা মুখ্যমন্ত্রীর" (in Bengali). ABP Ananda, 7 April 2017. 7 April 2017. Retrieved 9 April 2017.*
^ *"Census of India 2011, West Bengal: District Census Handbook, Barddhaman" (PDF). Physiography, pages 13-14. Directorate of Census Operations, West Bengal. Retrieved 20 April 2017.*
^ Chattopadhyay, Akkori, *Bardhaman Jelar Itihas O Lok Sanskriti*, Vol I, pp 14-15.
^ *"Paschim Bardhamanthe 23rd District of West Bengal". Egiye Bangla, official portal of the Government of West Bengal. Retrieved 21 April 2017.*
^ *"Directory of District, Sub division, Panchayat Samiti/ Block and Gram Panchayats in West Bengal, March 2008". West Bengal. National Informatics Centre, India. 19 March 2008. Archived from the original on 25 February 2009. Retrieved 6 December 2008.*
^ a b *"Administrative Units". Official website of Bardhaman district. Retrieved 6 December 2008.*
^ *"Population, Decadal Growth Rate, Density and General Sex Ratio by Residence and Sex, West Bengal/ District/ Sub District, 1991 and 2001". West Bengal. Directorate of census operations. Retrieved 6 December 2008.*[dead link]
^ *"District Statistical Handbook 2014 Bardhaman". Table 2.1. Department of Statistics and Programme Implementation, Government of West Bengal. Archived from the original on 21 January 2019. Retrieved 12 March 2019.*
^ *"Directory of District, Subdivision, Panchayat Samiti/ Block and Gram Panchayats in West Bengal". Bardhaman - Revised in March 2008. Panchayats and Rural Development Department, Government of West Bengal. Retrieved 17 February 2017.*
^ *"The Kolkata Gazette" (PDF). Notification No. 335/MA/O/C-4/1M-36/2014 dated 3 June 2015. Department of Municipal Affairs, Government of West Bengal. Archived from the original (PDF) on 12 March 2017. Retrieved 9 March 2017.*
^ *"District Statistical Handbook 2014 Bardhaman". Table 2.1. Department of Statistics and Programme Implementation, Government of West Bengal. Archived from the original on 21 January 2019. Retrieved 12 March 2019.*
^ *"Directory of District, Subdivision, Panchayat Samiti/ Block and Gram Panchayats in West Bengal". Bardhaman - Revised in March 2008. Panchayats and Rural Development Department, Government of West Bengal. Retrieved 17 February 2017.*
^ *"District Statistical Handbook 2014 Burdwan". Table 2.2, 2.4(a). Department of Statistics and Programme Implementation, Government of West Bengal. Archived from the original on 21 January 2019. Retrieved 12 March 2019.*
^ a b *"2011 Census - Primary Census Abstract Data Tables". West Bengal – District-wise. Registrar General and Census Commissioner, India. Retrieved 16 April 2017.*
^ *"C-1 Population By Religious Community". Census. Retrieved 10 July 2021.*
^ *"C1 Population by Religious Community". West Bengal. Registrar General and Census Commissioner, India. Retrieved 17 April 2017.*
^ a b *"C-16 Population By Mother Tongue". censusindia.gov.in. Retrieved 25 March 2021.*
^ Akkori Chattopadhyay, *Bardhaman Jelar Itihas O Lok Sanskriti* , Vol I, pp. 46-51, (Bengali), Radical, 2001, ISBN 81-85459-36-3
^ *"Coal India Limited". History. CIL. Archived from the original on 4 February 2018. Retrieved 4 March 2017.*
^ *"Eastern Coalfields aim higher output from underground mining". The Hindu Business Line, 12 October 2014. Retrieved 4 March 2017.*
^ *"Eastern Coalfields". Planning. ECL. Retrieved 4 March 2017.*
^ *"Asansol". railindia. Archived from the original on 7 May 2017. Retrieved 9 February 2017.*
^ *"The Chronology of Railway development in Eastern Indian". railindia. Archived from the original on 16 March 2008. Retrieved 19 April 2017.*
^ a b *"Steel Authority of India Limited". IISCO Steel Plant. SAIL. Archived from the original on 3 August 2017. Retrieved 4 March 2017.*
^ *"PM Dedicates to the Nation SAIL's Modernised & Expanded IISCO Steel Plant at Burnpur". Press Release. SAIL. Archived from the original on 22 March 2016. Retrieved 4 March 2017.*
^ *"Chairman, SAIL reviews performance of ISP, Burnpur". Press Release 7 March 2015. SAIL. Archived from the original on 13 October 2018. Retrieved 30 March 2017.*
^ *"Chittaranjan Locomotive Works". Indian Railways. Archived from the original on 19 March 2014. Retrieved 4 March 2017.*
^ *"Ballavpur Paper Mnfg. Ltd". BPML. Retrieved 7 July 2018.*
^ a b *"Brief Industrial Profile of Burdwan district" (PDF). Micro Small and Medium Industries. Retrieved 13 April 2017.*
^ *"Bardhaman district". Industries. Bardhaman district administration. Retrieved 20 April 2017.*
^ *"Steel Authority of India". About Durgapur Steel Plant. SAIL. Archived from the original on 3 August 2017. Retrieved 4 March 2017.*
^ *"Damodar Valley Corporation". Reservoirs and Barrages. DVC. Retrieved 20 April 2017*

PLATE 1

DRAINAGE MAP OF THE DISTRICT

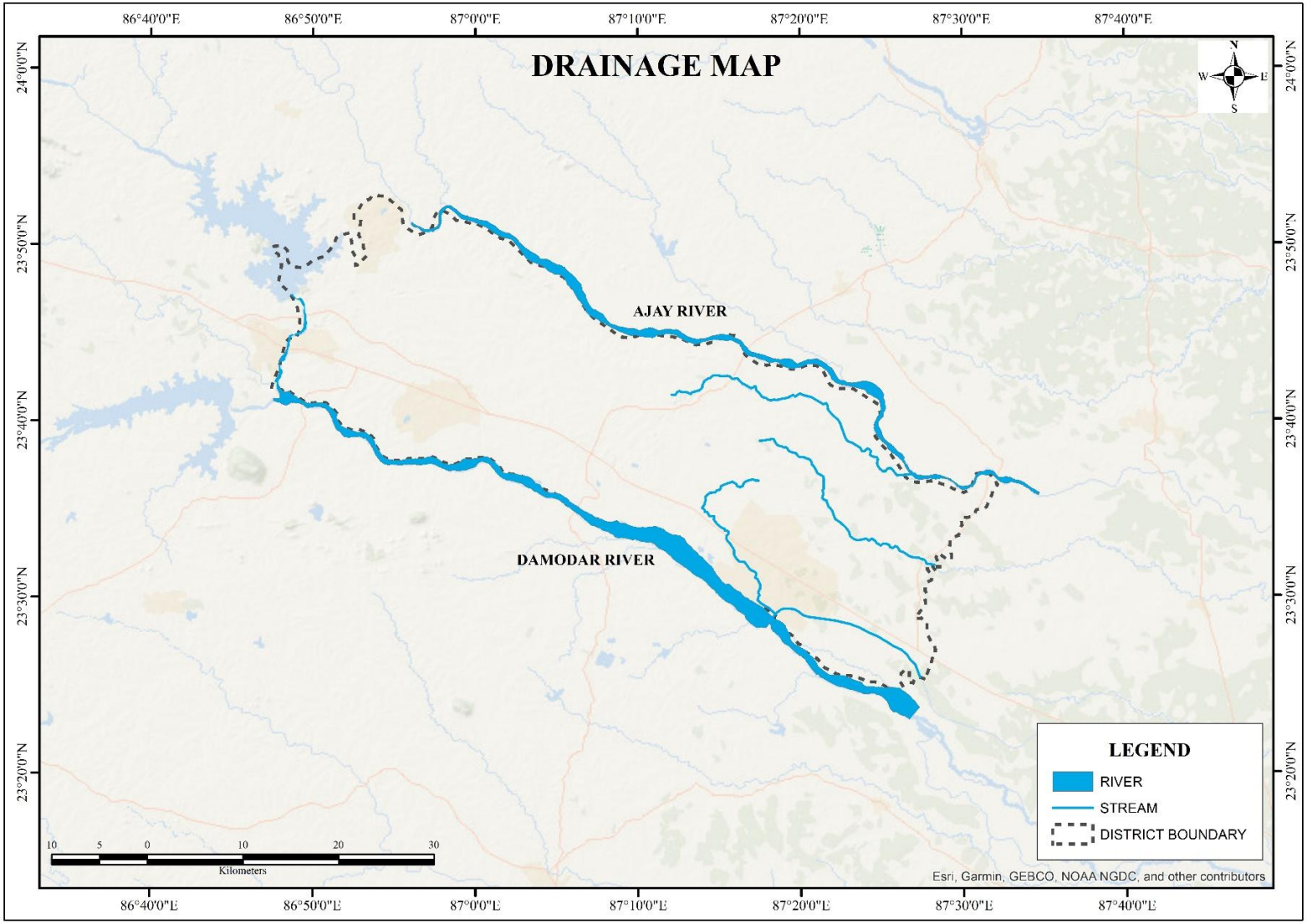


Plate 1A: Drainage Map of the District *(Source: National Informatics Centre -NIC Website, Sept 2020)*

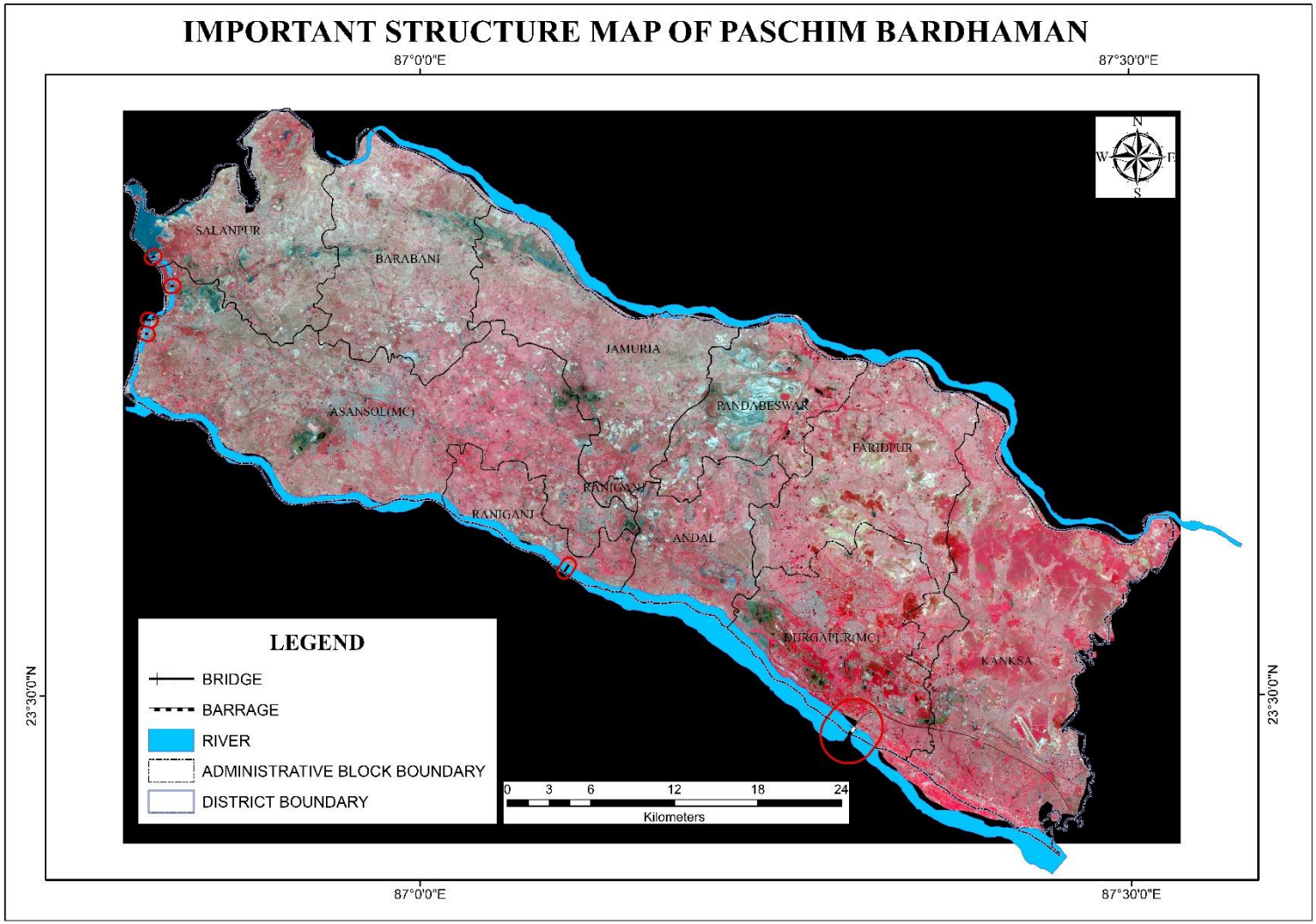


Plate No 1B: Location Map of dams, barrages, bridge showing on drainage system of the district*(Source: National Informatics Centre -NIC Website, Sept 2020)*

PLATE 2A

DISTRIBUTION MAP OF SAND BARS ON RIVERS DURING PRE-MONSOON PERIOD OF PASCHIM BARDHAMAN DISTRICT

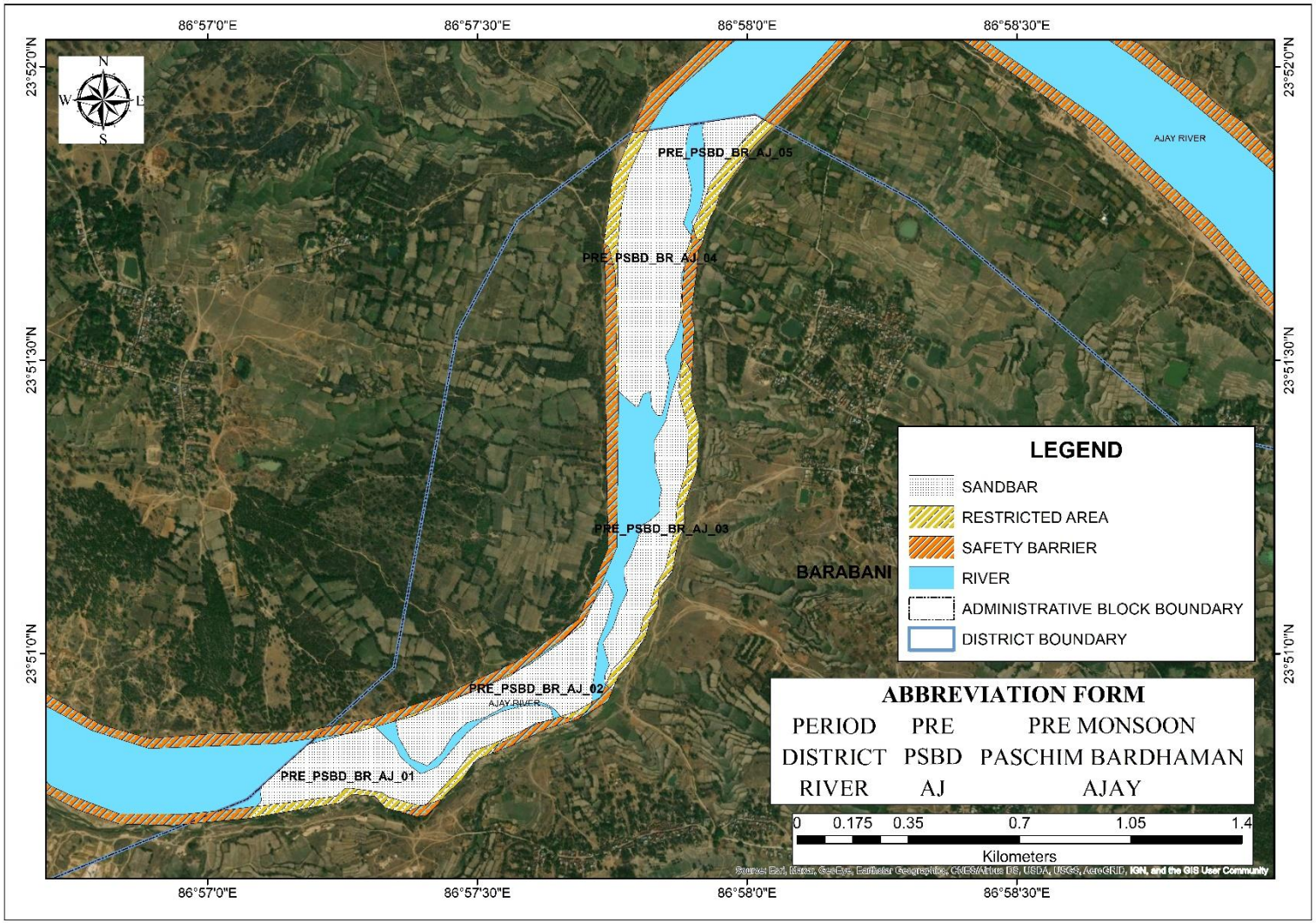


Plate 2A1: Distribution Map of Sand Bars on Ajay River During Pre-Monsoon Period of Paschim Bardhaman District*(Source: ISRO RESOURCE Sat 2 LISS III Sensor, March 2020)*

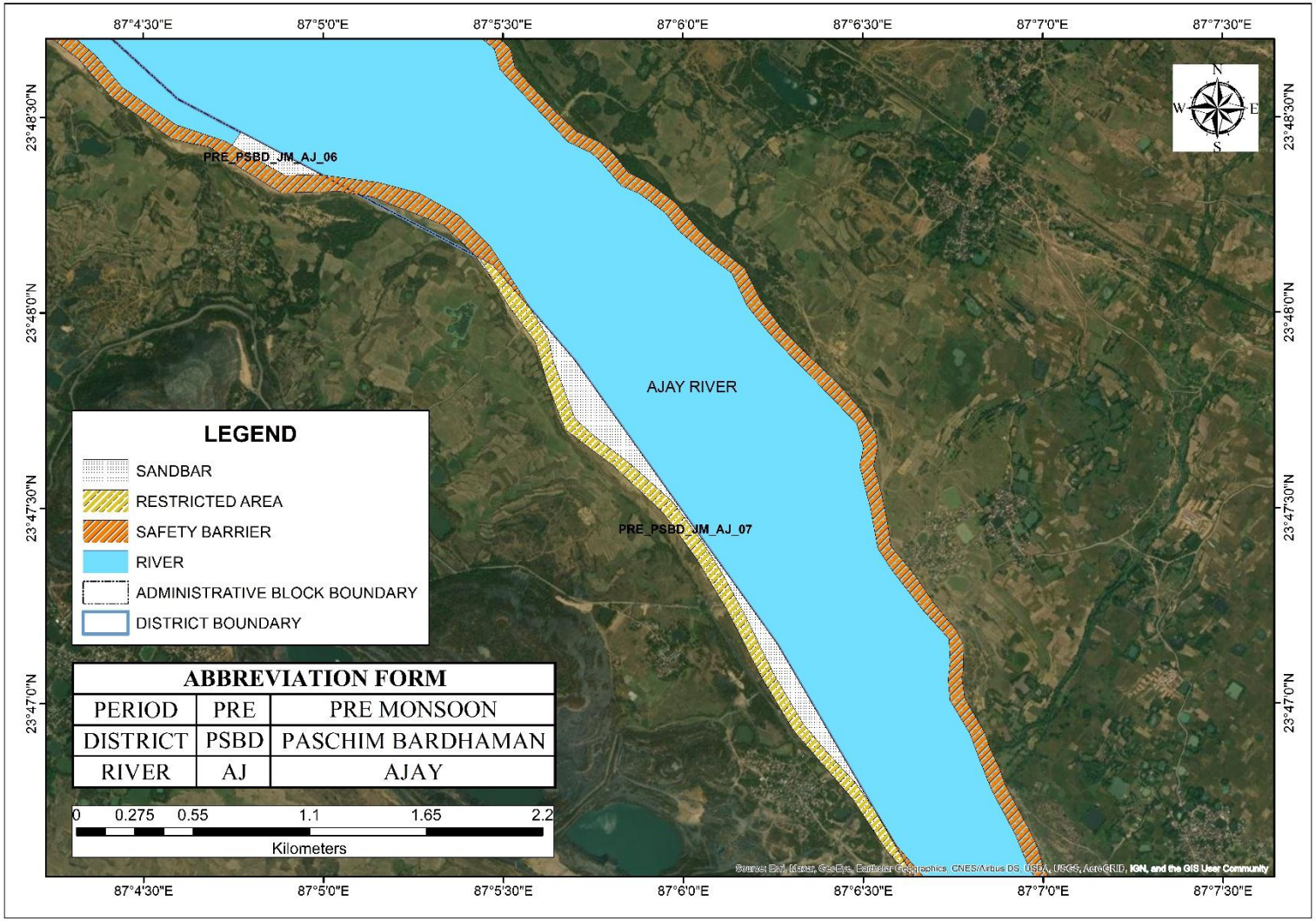


Plate 2A2: Distribution Map of Sand Bars on Ajay River During Pre-Monsoon Period of Paschim Bardhaman District*(Source: ISRO RESOURCE Sat 2 LISS III Sensor, March2020)*

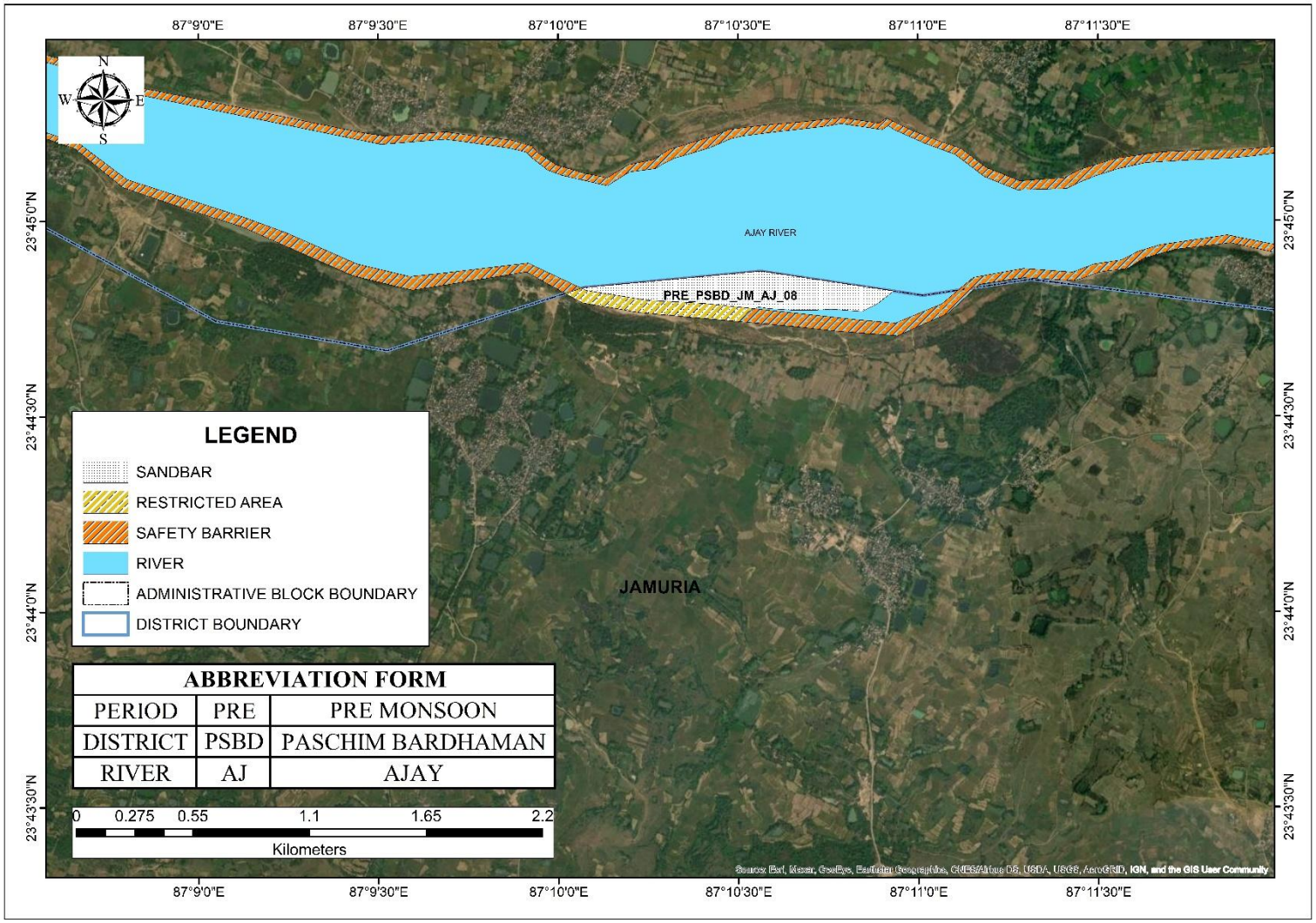


Plate 2A3: Distribution Map of Sand Bars on Ajay River During Pre-Monsoon Period of Paschim Bardhaman District*(Source: ISRO RESOURCE Sat 2 LISS III Sensor, March2020)*

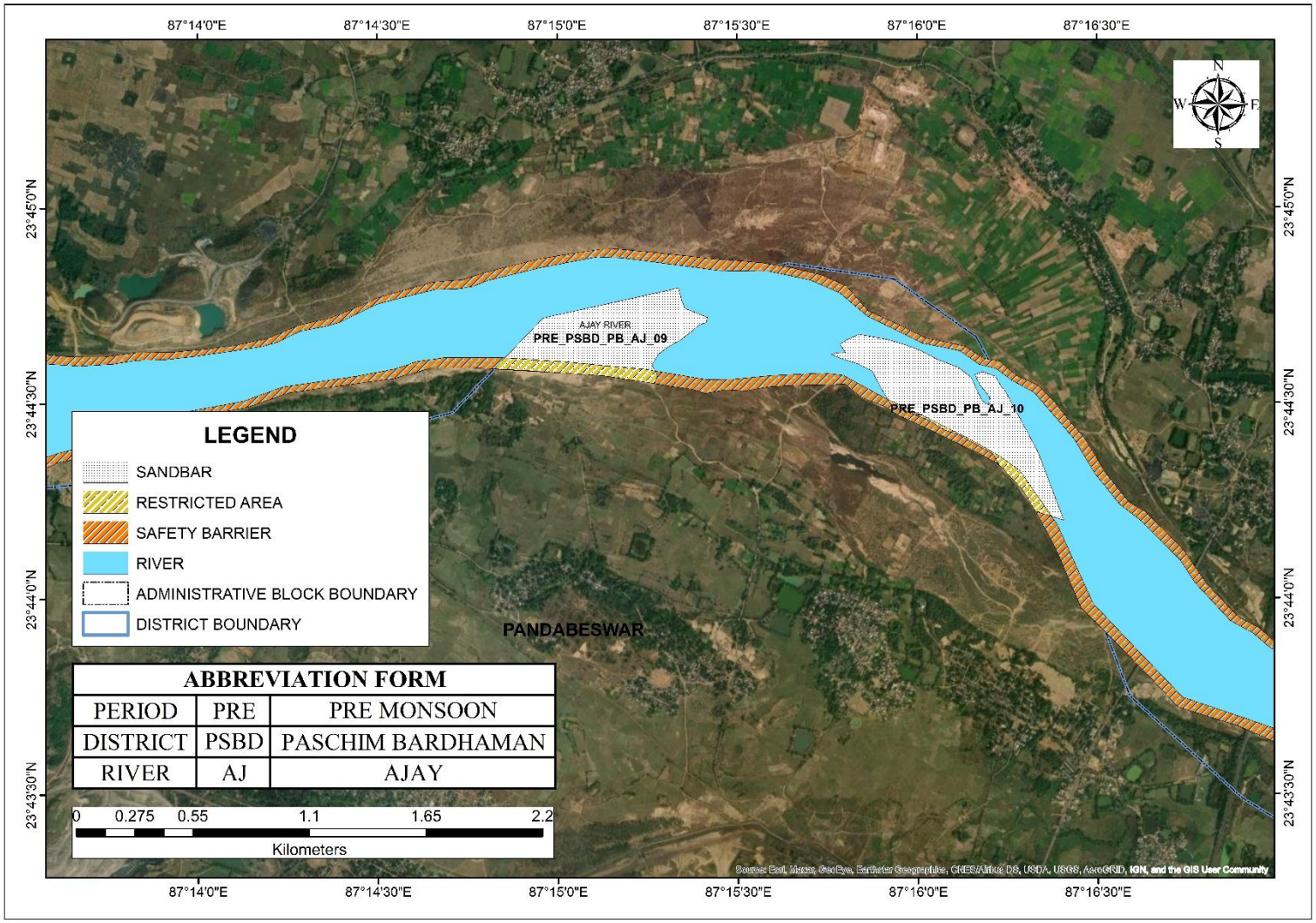


Plate 2A4: Distribution Map of Sand Bars on Ajay River During Pre-Monsoon Period of Paschim Bardhaman District*(Source: ISRO RESOURCE Sat 2 LISS III Sensor, March2020)*

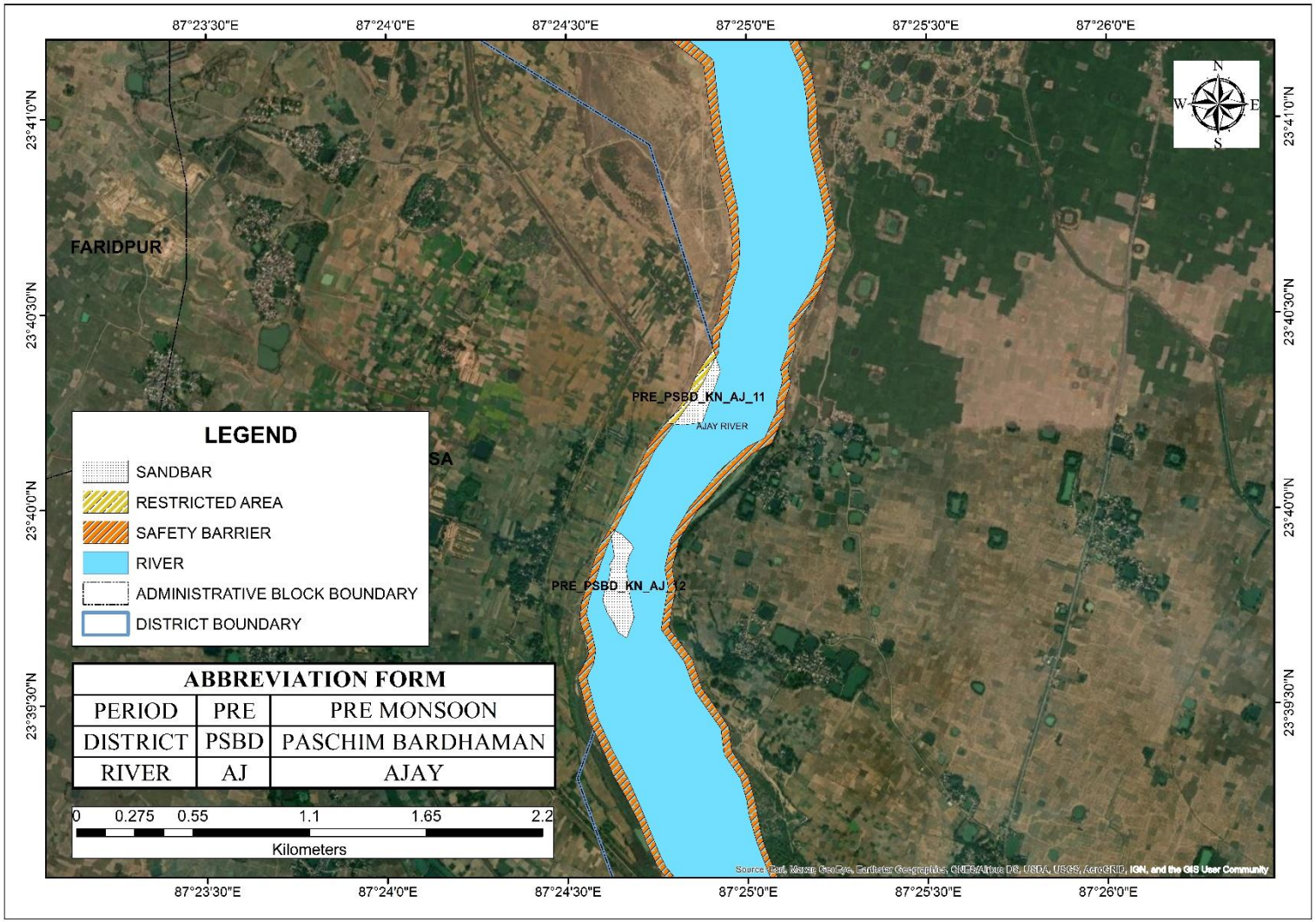


Plate 2A5: Distribution Map of Sand Bars on Ajay River During Pre-Monsoon Period of Paschim Bardhaman District*(Source: ISRO RESOURCE Sat 2 LISS III Sensor, March2020)*

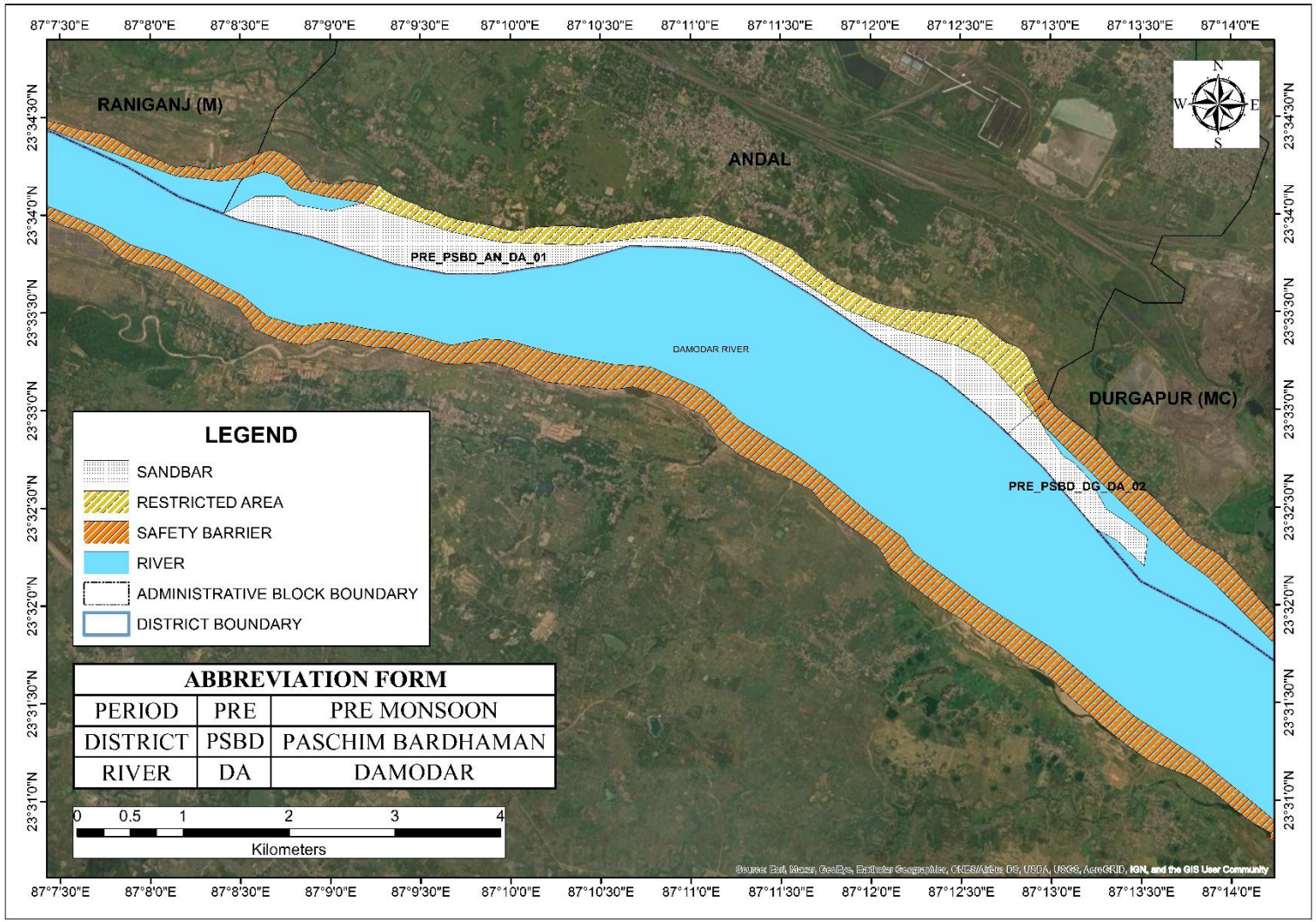


Plate 2A6: Distribution Map of Sand Bars on Damodar River During Pre-Monsoon Period of Paschim Bardhaman District*(Source: ISRO RESOURCE Sat 2 LISS III Sensor, March2020)*

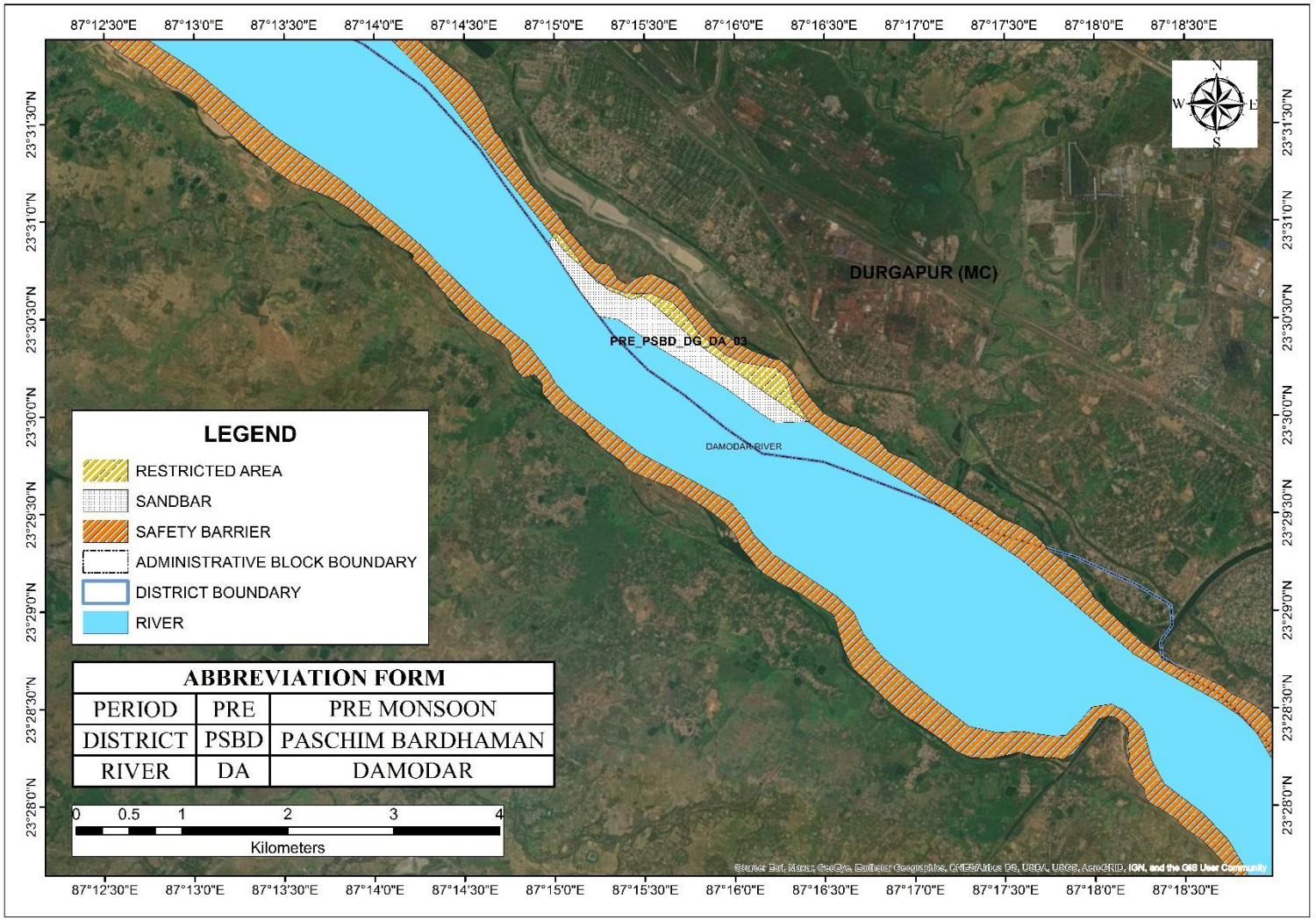


Plate 2A7: Distribution Map of Sand Bars on Damodar River During Pre-Monsoon Period of Paschim Bardhaman District*(Source: ISRO RESOURCE Sat 2 LISS III Sensor, March2020)*

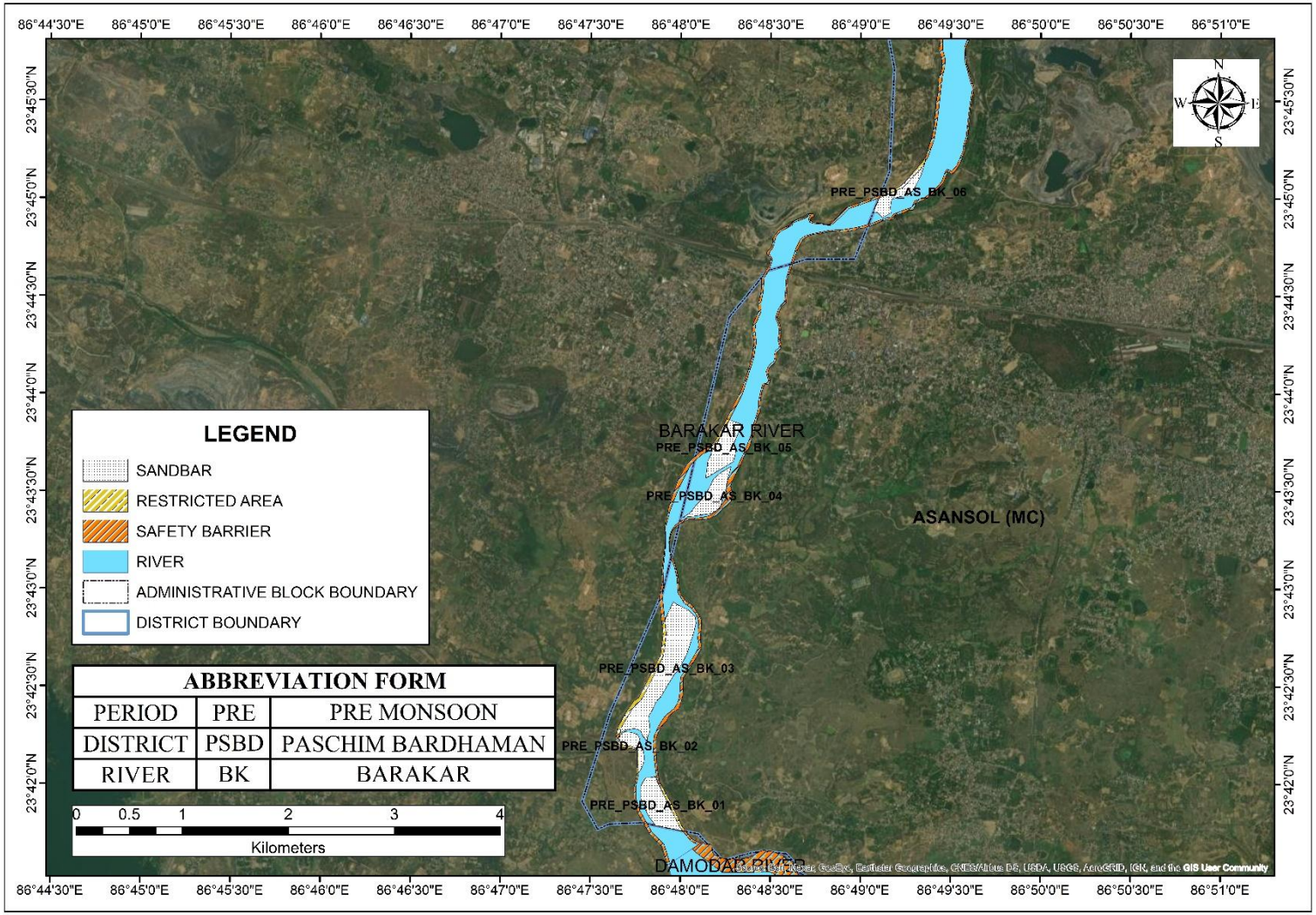


Plate 2A8: Distribution Map of Sand Bars on Barakar River During Pre-Monsoon Period of Paschim Bardhaman District*(Source: ISRO RESOURCE Sat 2 LISS III Sensor, March2020)*

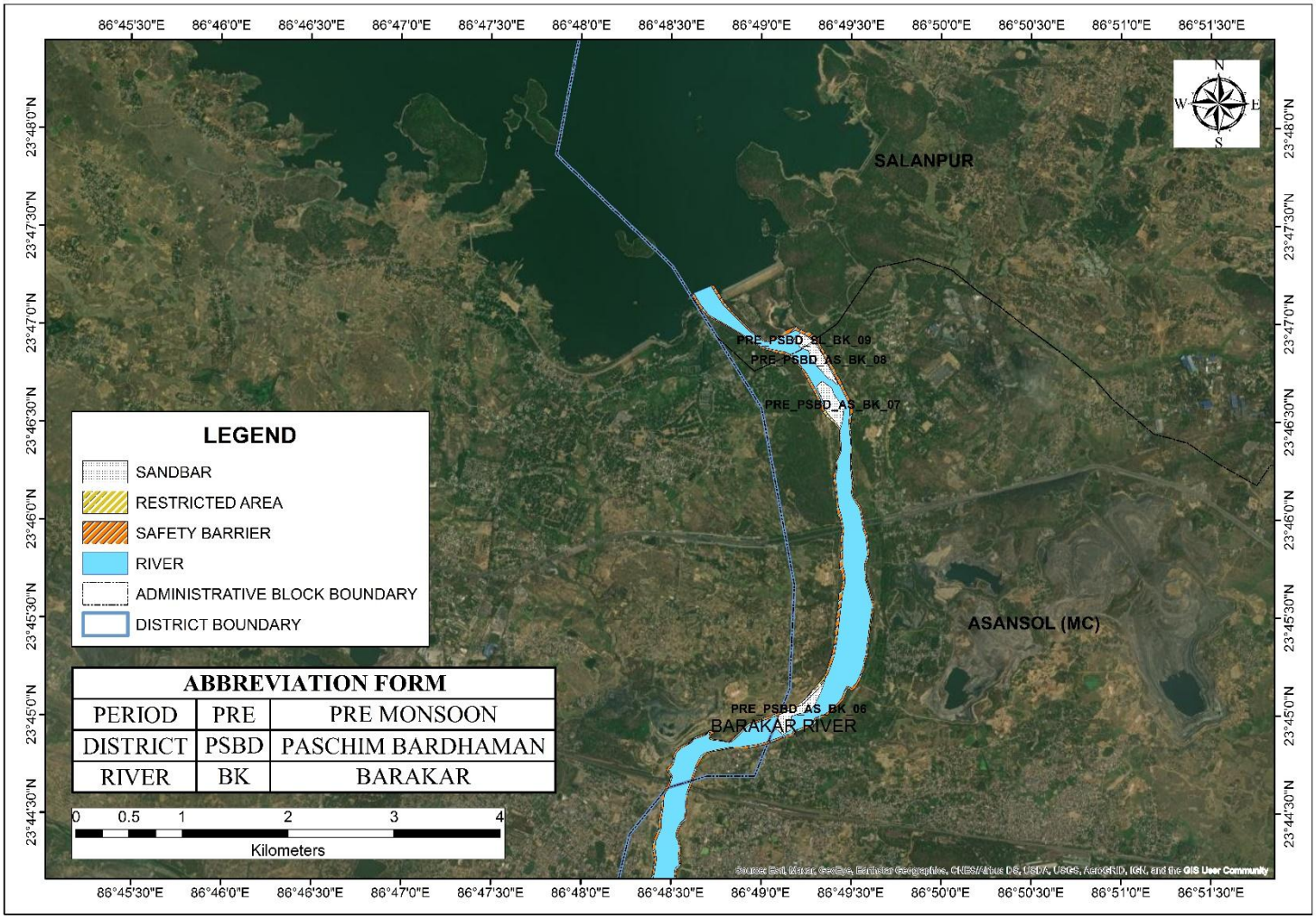


Plate 2A9: Distribution Map of Sand Bars on Barakar River During Pre-Monsoon Period of Paschim Bardhaman District*(Source: ISRO RESOURCE Sat 2 LISS III Sensor, March2020)*

PLATE 2B

DISTRIBUTION MAP OF SAND BARS ON RIVERS DURING POST-MONSOON PERIOD OF PASCHIM BARDHAMAN DISTRICT

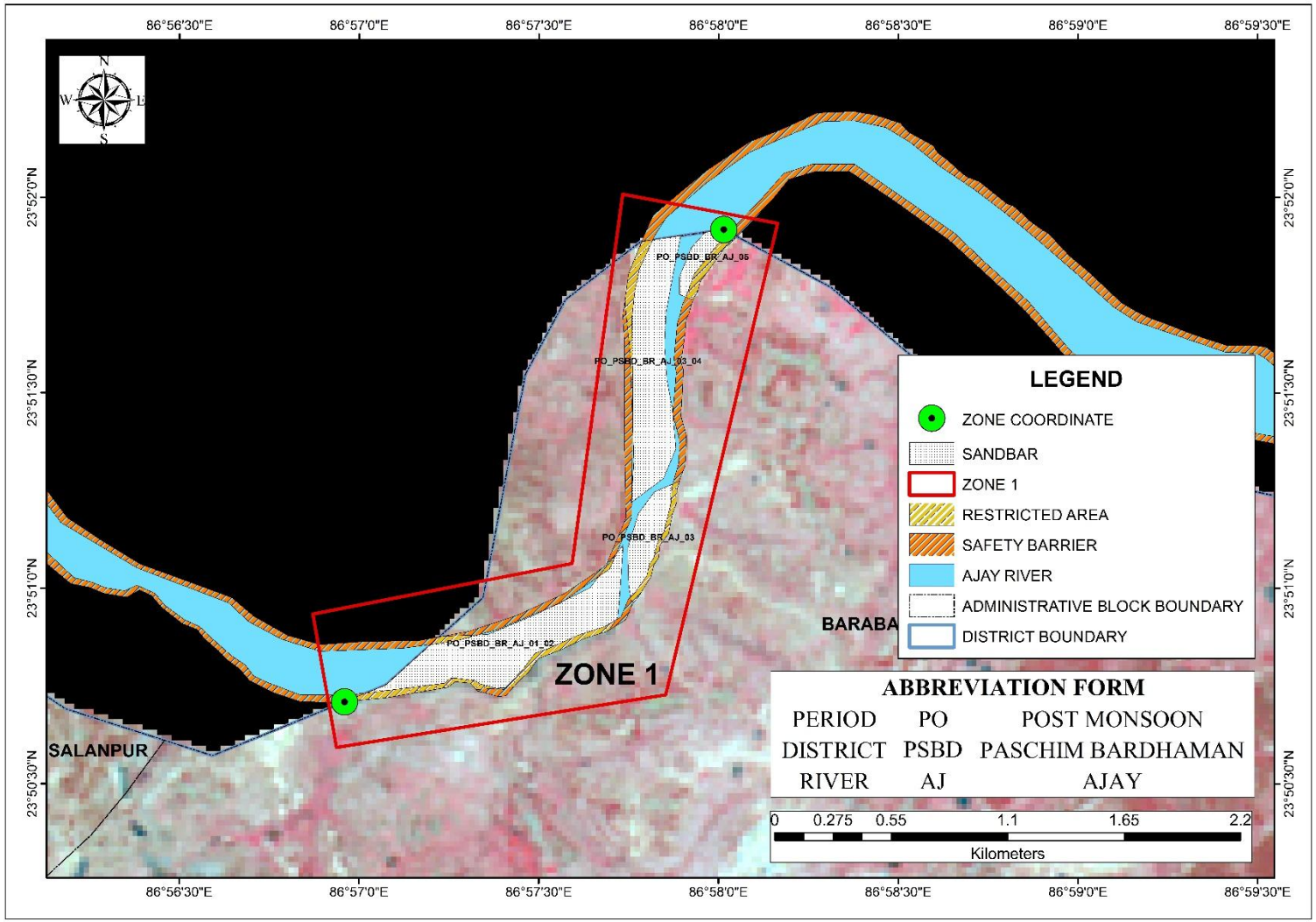


Plate 2B1: Distribution Map of Sand Bars with potential zones on AjayRiver During Post-Monsoon Period of Paschim Bardhaman District*(Source: ISRO RESOURCE Sat 2 LISS III Sensor, November 2020)*

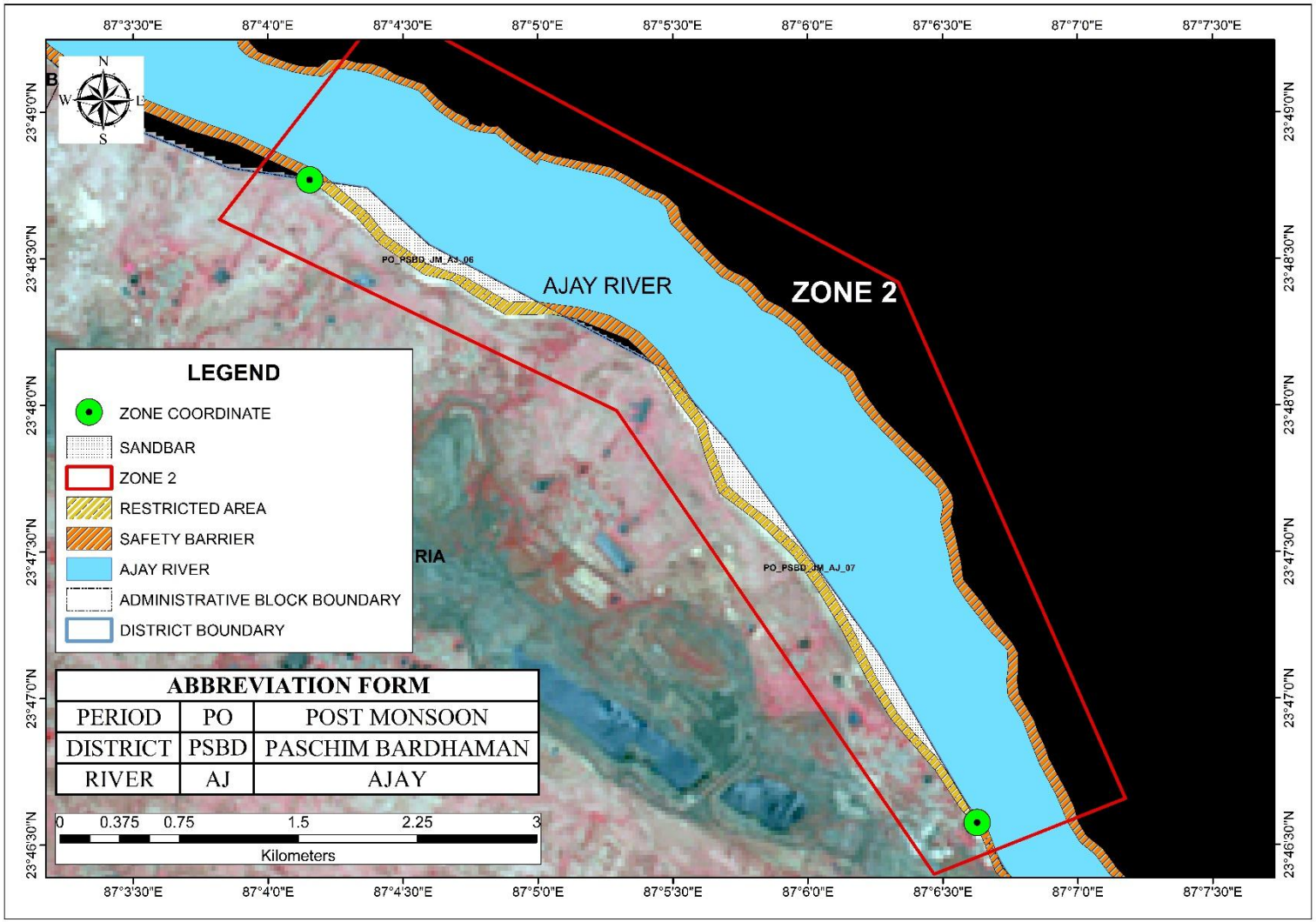


Plate 2B2: Distribution Map of Sand Bars with potential zones on AjayRiver During Post-Monsoon Period of Paschim Bardhaman District*(Source: ISRO RESOURCE Sat 2 LISS III Sensor, November2020)*

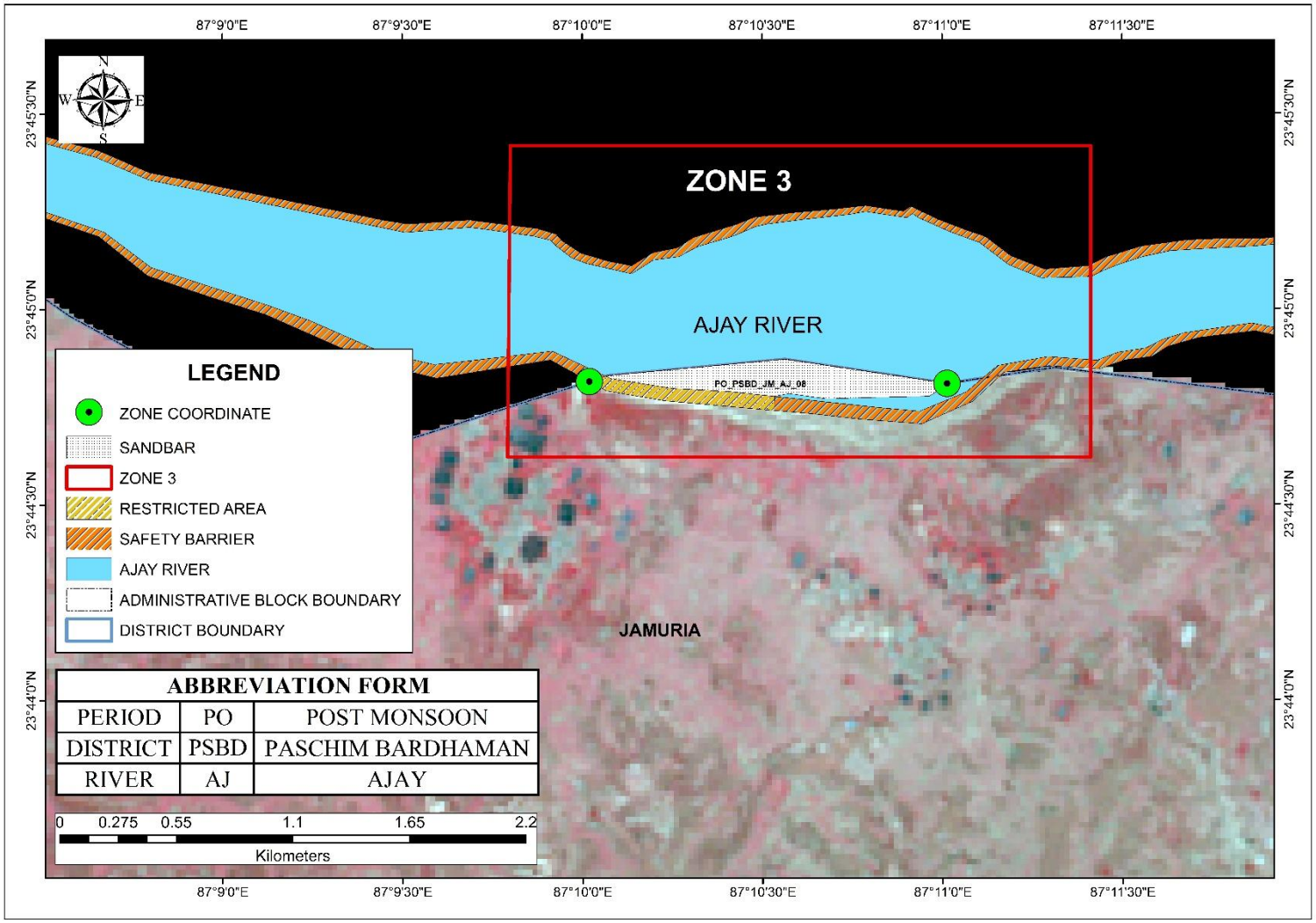


Plate 2B3: Distribution Map of Sand Bars with potential zones on AjayRiver During Post-Monsoon Period of Paschim Bardhaman District*(Source: ISRO RESOURCE Sat 2 LISS III Sensor, November2020)*

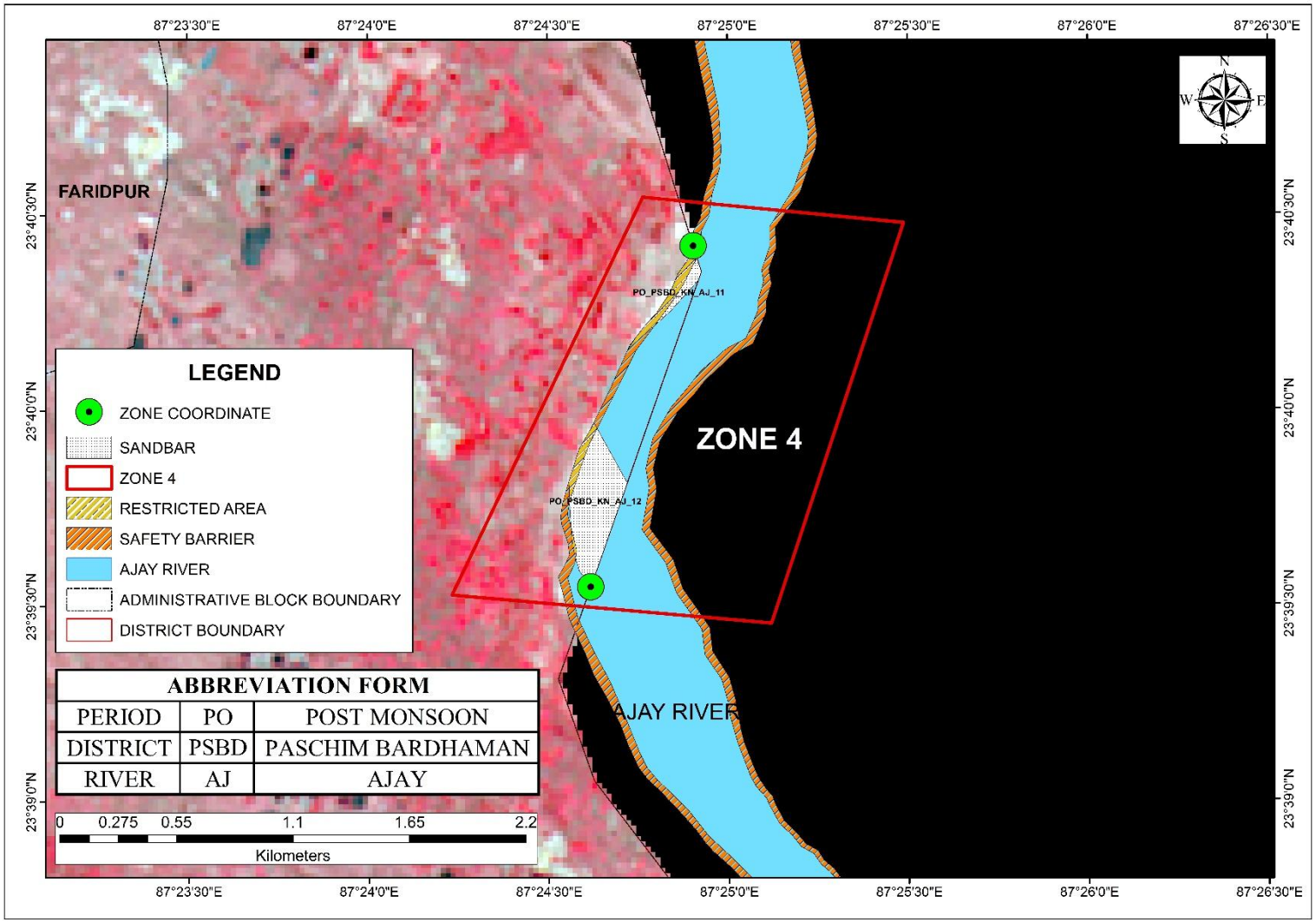


Plate 2B4: Distribution Map of Sand Bars with potential zones on AjayRiver During Post-Monsoon Period of Paschim Bardhaman District*(Source: ISRO RESOURCE Sat 2 LISS III Sensor, November2020)*

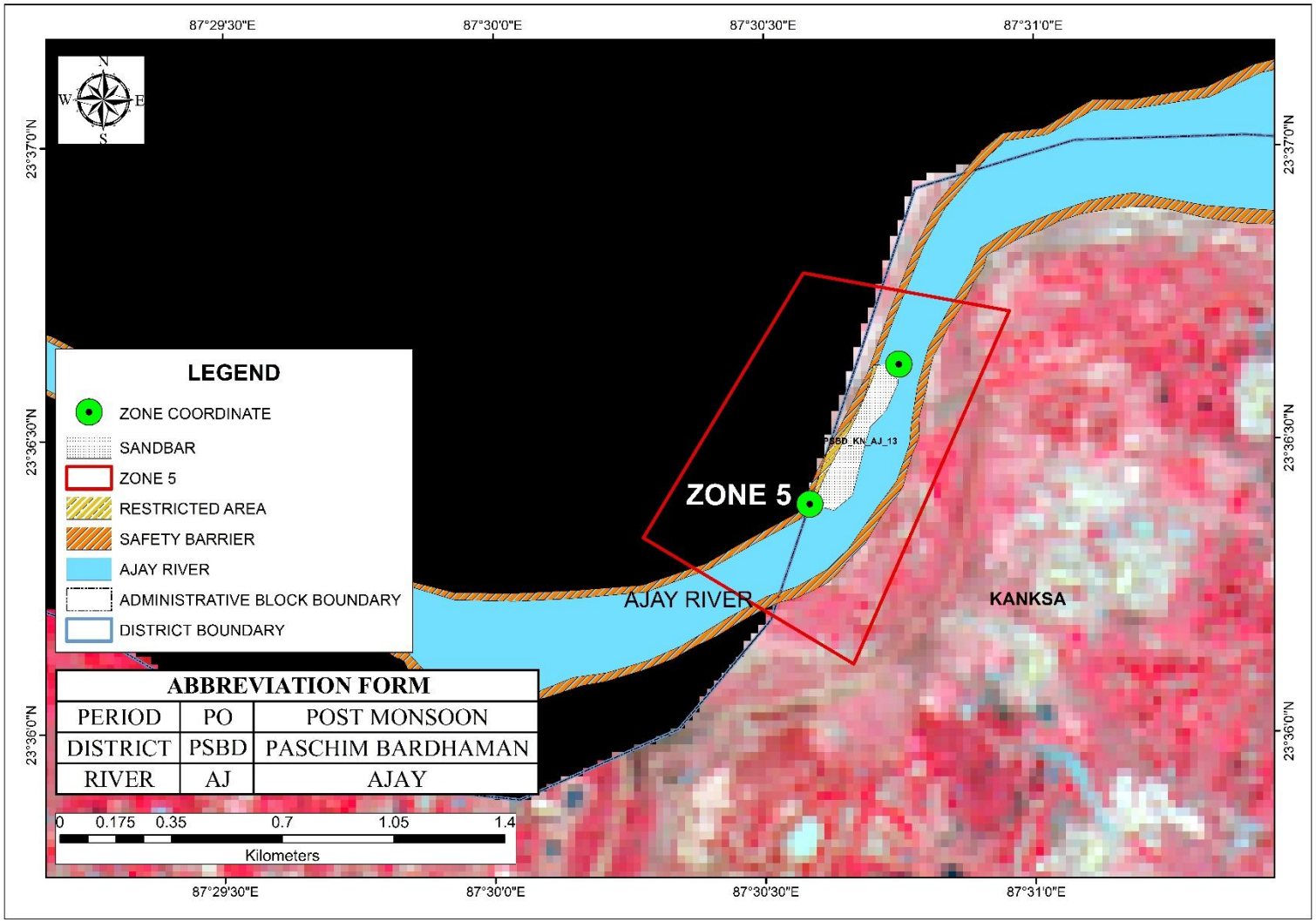


Plate 2B5: Distribution Map of Sand Bars with potential zones on AjayRiver During Post-Monsoon Period of Paschim Bardhaman District*(Source: ISRO RESOURCE Sat 2 LISS III Sensor, November2020)*

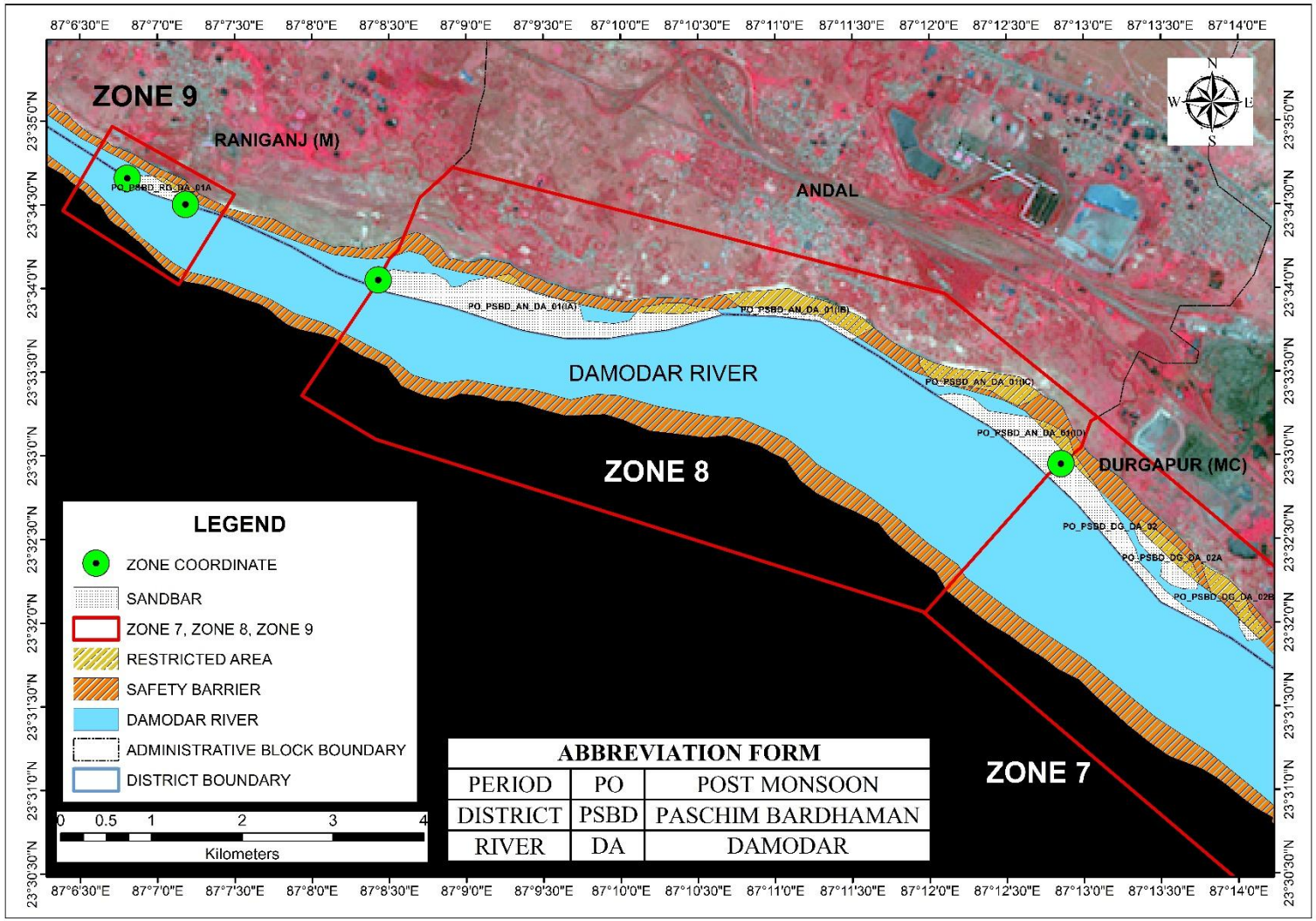


Plate 2B6: Distribution Map of Sand Bars with potential zones on DamodarRiver During Post-Monsoon Period of Paschim Bardhaman District*(Source: ISRO RESOURCE Sat 2 LISS III Sensor, November2020)*

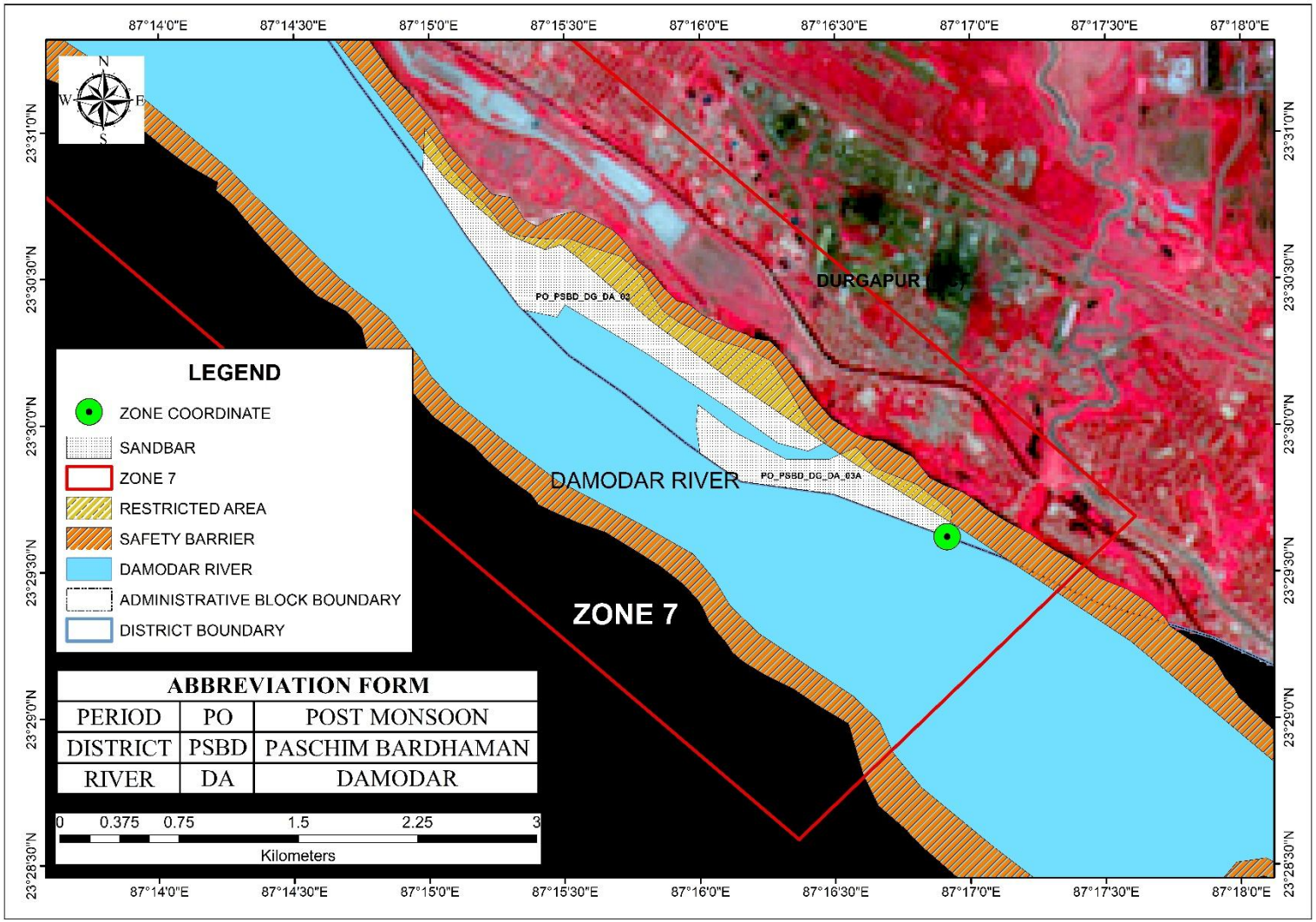


Plate 2B7: Distribution Map of Sand Bars with potential zones on DamodarRiver During Post-Monsoon Period of Paschim Bardhaman District*(Source: ISRO RESOURCE Sat 2 LISS III Sensor, November2020)*

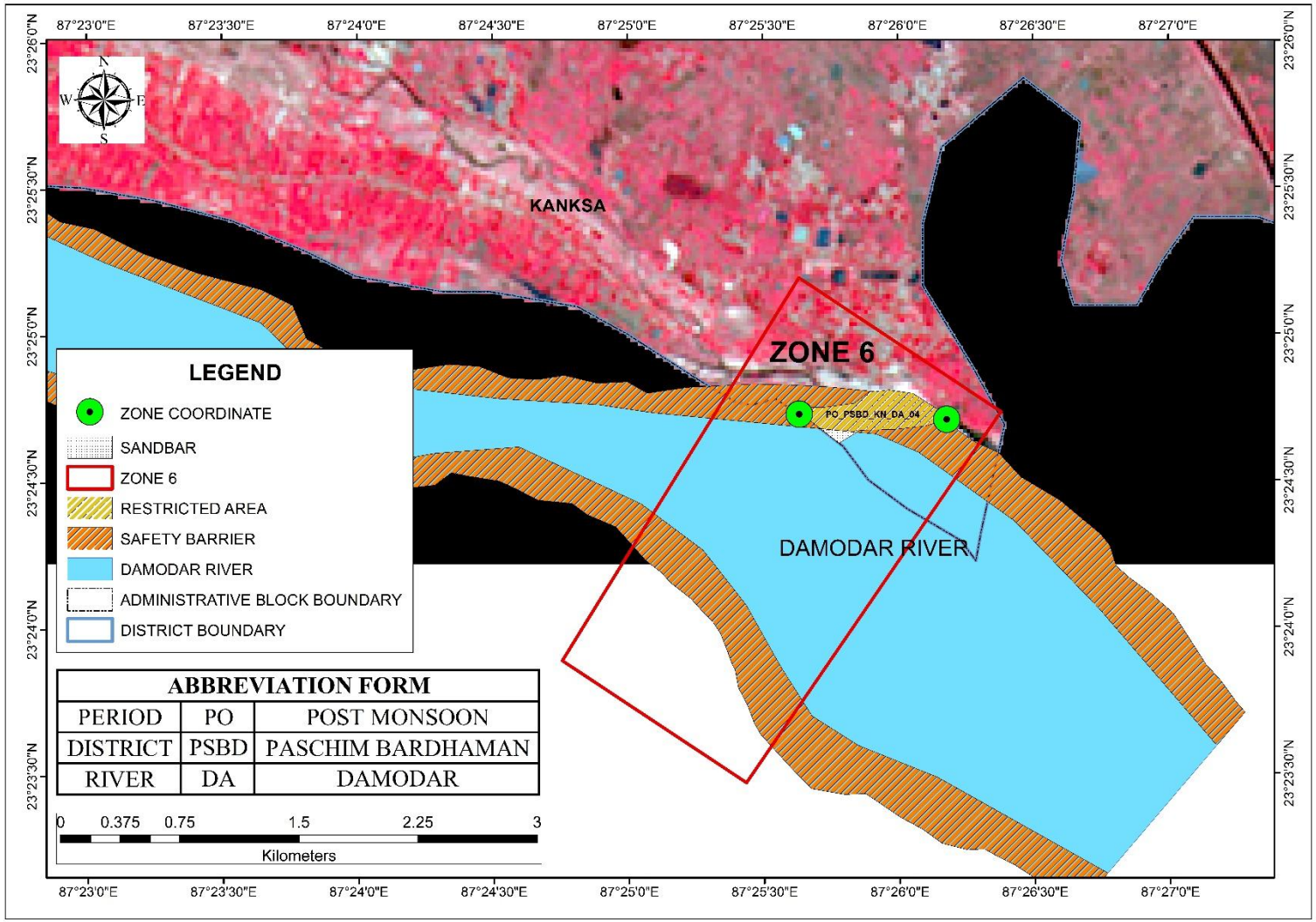


Plate 2B8: Distribution Map of Sand Bars with potential zones on DamodarRiver During Post-Monsoon Period of Paschim Bardhaman District*(Source: ISRO RESOURCE Sat 2 LISS III Sensor, November2020)*

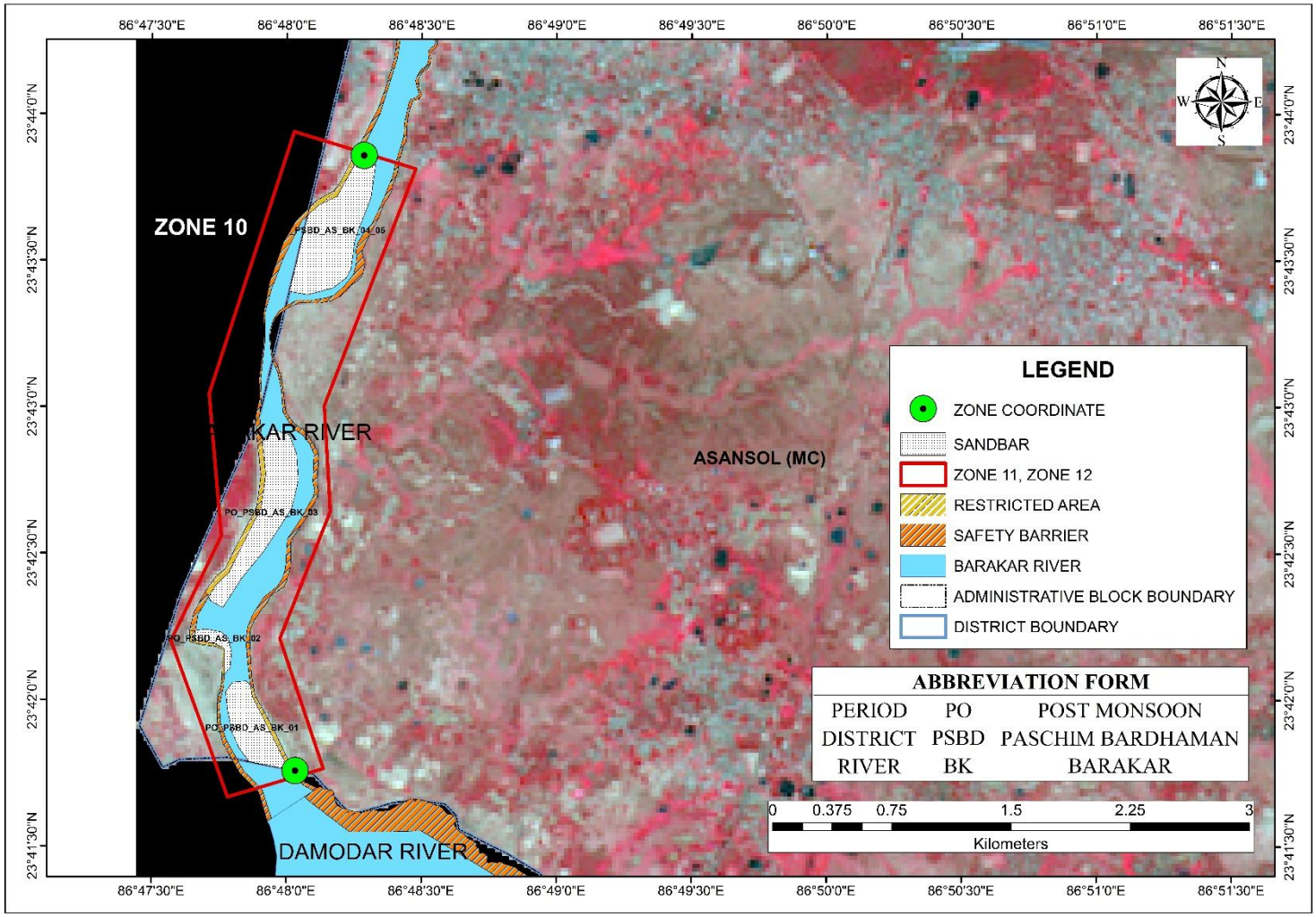


Plate 2B9: Distribution Map of Sand Bars with potential zones on Barakar River During Post-Monsoon Period of Paschim Bardhaman District*(Source: ISRO RESOURCE Sat 2 LISS III Sensor, November2020)*

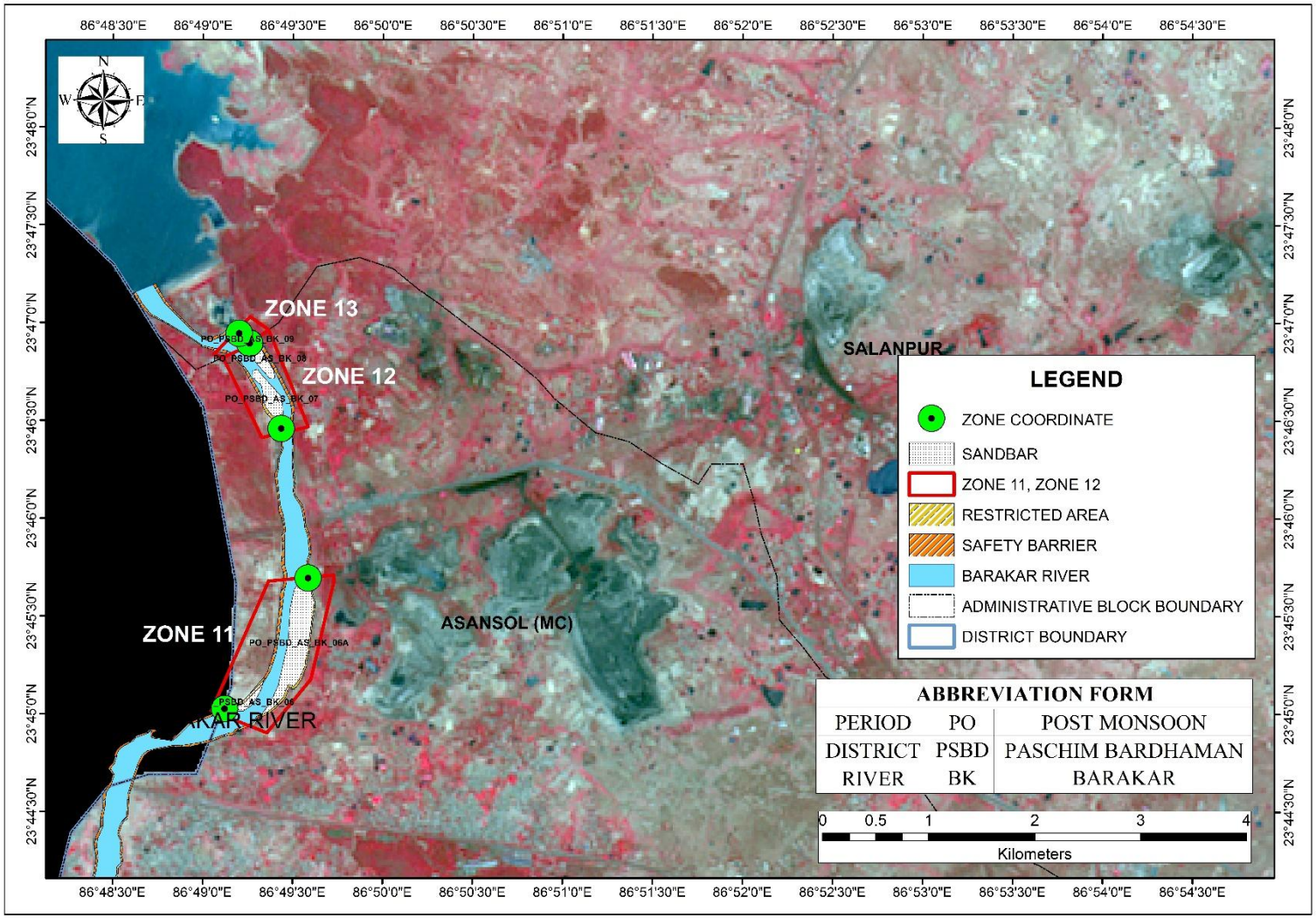
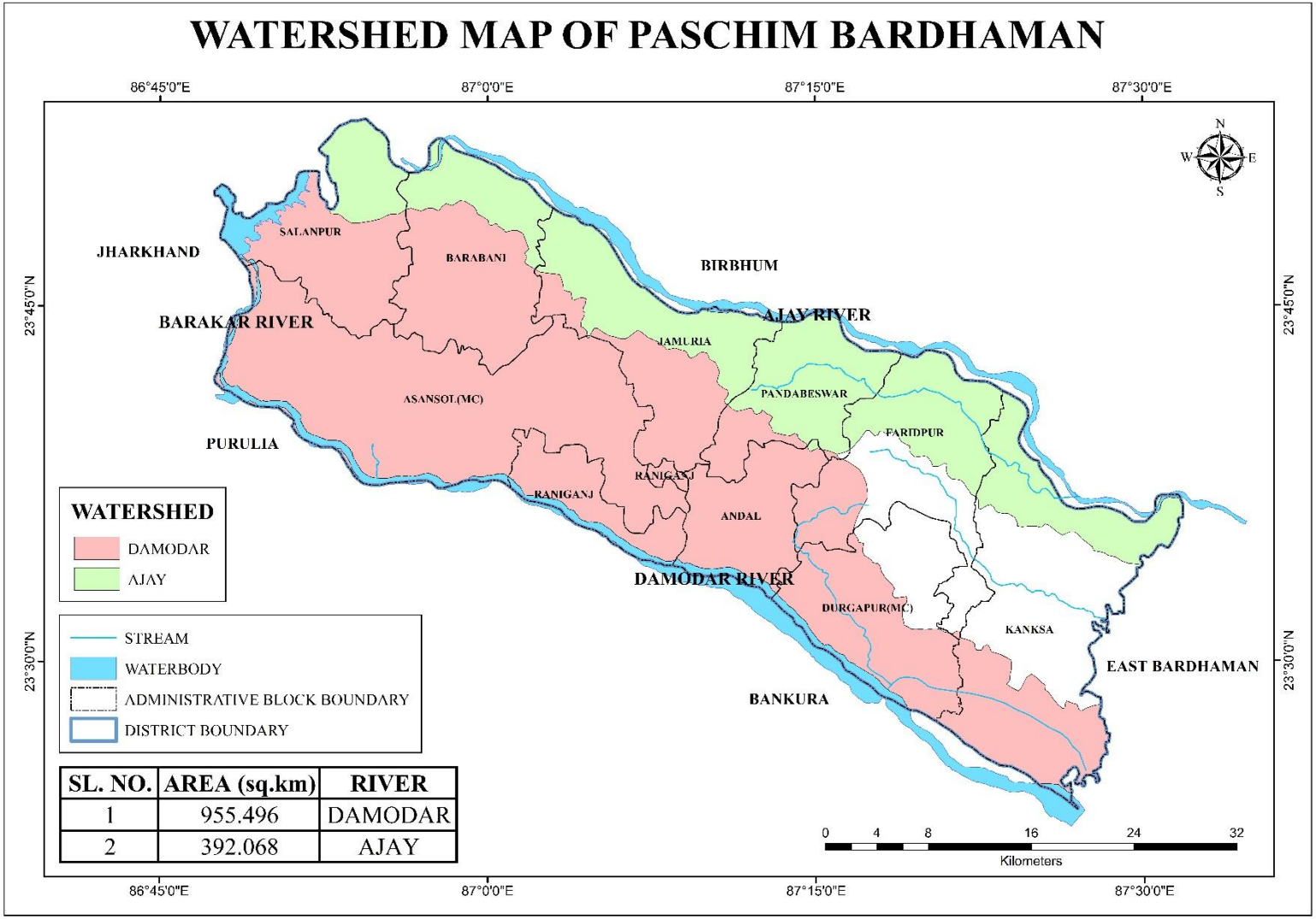


Plate 2B10: Distribution Map of Sand Bars with potential zones on Barakar River During Post-Monsoon Period of Paschim Bardhaman District*(Source: ISRO RESOURCE Sat 2 LISS III Sensor, November2020)*

PLATE 3

WATERSHED MAP OF THE DISTRICT



SL. NO.	AREA (sq.km)	RIVER
1	955.496	DAMODAR
2	392.068	AJAY

Plate 3A: Watershed Map of Paschim Bardhaman District *(Source: World Wild Fund for Nature, September 2020)*

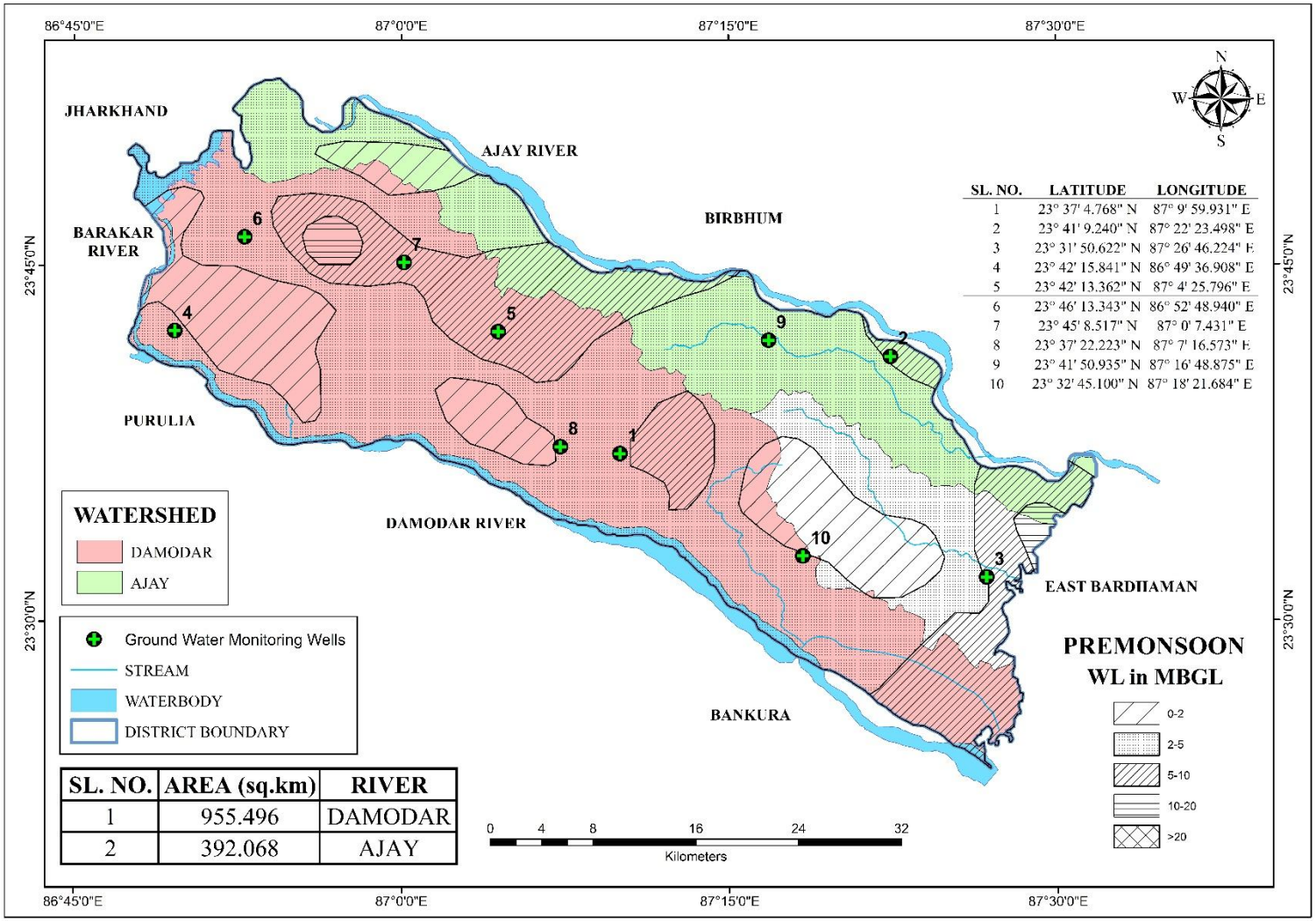


Plate 3B: District Watershed map showing Ground Water level during Pre monsoon period*(Source: World Wild Fund for Nature, September 2020)*

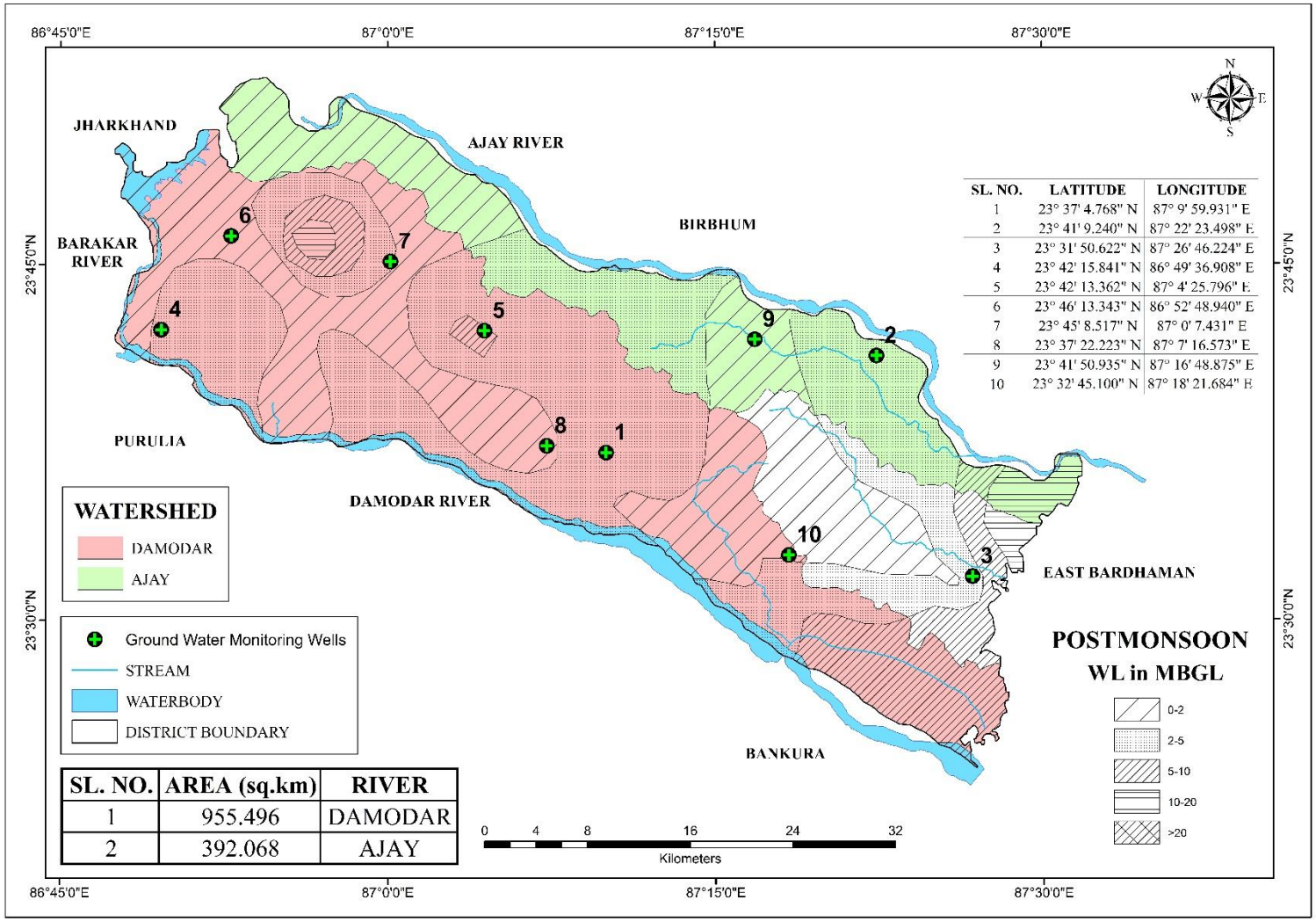


Plate 3C: District Watershed map showing Ground Water level during Post monsoon period *(Source: World Wild Fund for Nature, September 2020)*

PLATE 4

FIELD SURVEY PHOTOGRAPHS

	
4A: Picture of Ajay Riverbed deposit(Date: 15-05-22, Lat: 23° 50' 47.688" Nand Long: 86° 57' 27.476" E)	**4B:Picture of Ajay Riverbed deposit(Date: 15-05-22, Lat: 23° 51' 16.003" Nand Long: 86° 57' 52.345" E)**
	
4C:Picture of Damodar Riverbed deposit(Date: 20-05-22, Lat: 23° 34' 0.319" Nand Long: 87° 8' 54.238" E)	**4D:Picture of Barakar Riverbed deposit(Date: 20-05-22, Lat: 23° 42' 11.373" Nand Long: 86° 47' 44.233" E)**

PLATE 5

LONG TERM EROSION-ACCRETION MAP OF RIVER BANK

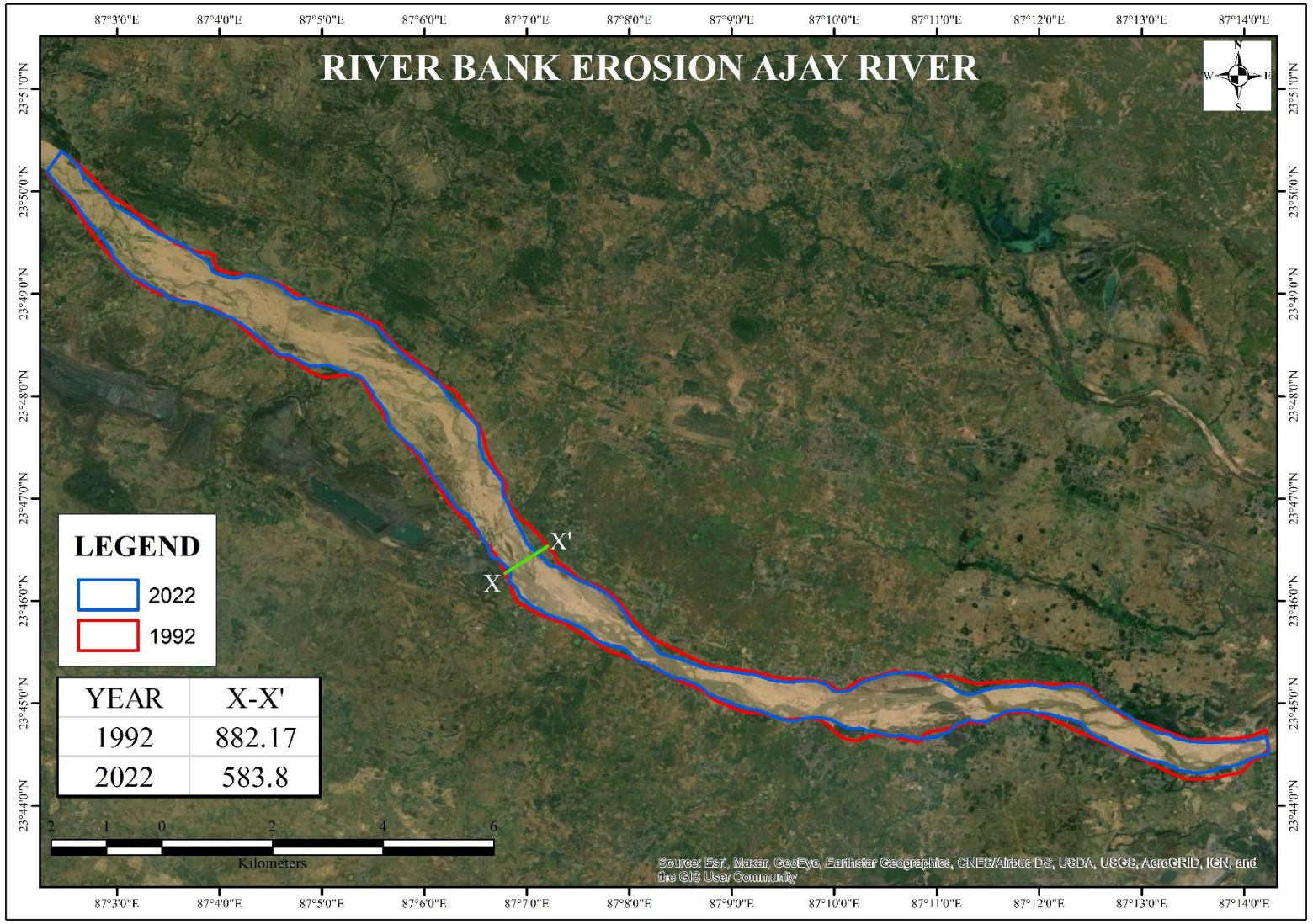


Plate 5: Map showing long-term (10-year or more) erosion-accretion areas on both the banks of Ajay River, Paschim Bardhaman*(Source: ISRO RESOURCE Sat 2 LISS III Sensor)*

Annexure 1
Compliance as per Enforcement & Monitoring Guidelines for sand Mining, 2020 (MoEF& CC) for preparation of District Survey Report

Sl. No.	Particulars	Status
1	District Survey Report for sand mining shall be prepared before the auction/e-auction/grant of the mining lease/Letter of Intent (LoI) by Mining department or department dealing the mining activity in respective states.	Noted.
2	In order to make the inventory of River Bed Material, a detailed survey of the district needs to be carried out, to identify the source of River Bed Material and alternative source of sand (M-Sand). The source will include rivers, de-siltation of reservoir/dams, Patta lands/Khatedari Land, M-sand etc.	Complied with and explained in Chapter 7.
3	District Survey Report is to be prepared in such a way that it not only identifies the mineral-bearing area but also define the mining and no mining zones considering various environmental and social factors.	Complied with and furnished in pg no 74-76.
4	Identification of the source of Sand & M-Sand. The sources may be from Rivers, Lakes, Ponds, Dams, De-silting locations, Patta land/Khtedari lands. The details in case of Rivers such as [name, length of river, type (Perennial or Non-Perennial), Villages, Tehsil, District], in case of Lakes, Ponds, Dams, De-silting locations [Name, owned/maintained by (State Govt./PSU), area, Villages, Tehsil, District] in case of Patta land/Khtedari lands [Owner Name, Sy No, Area, Agricultural/Non-Agricultural, Villages, Tehsil, District], in case of M-Sand Plant [Owner Name, Sy No, Area, Quantity/Annum, Villages, Tehsil, District], needs to be recorded.	Complied with and given in table 7.3.
5	Defining the sources of Sand/M-Sand in the district is the next step for identification of the potential area of deposition/aggradation wherein mining lease could be granted. Detailed survey needs to be carried out for quantification of minerals. The purpose of mining in the river bed is for channelization of rivers so as to avoid the possibility of flooding and to maintain the flow of the rivers. For this, the entire river stretch needs to be surveyed and original ground level (OGL) to be recorded and area of aggradation/deposition needs to be ascertained by comparing the level difference between the outside riverbed OGL and water level. Once the area of aggradation/deposition is identified, then the quantity of River Bed Material available needs to be calculated. The next step is channelization of the river bed and for this central ¾th part of the river, width needs to be identified on a map. Out of the ¾th part area, where there is a deposition/aggradation of the material needs to be identified. The remaining ¼th area needs to be kept as no mining zone for the protection of banks. The specific gravity of the material also needs to be ascertained by analyzing the sample from a NABL accredited lab. Thus, the quantity of material available in metric ton needs to be calculated for mining and no mining zone.	Complied with and given in table 7.11.

Sl. No.	Particulars	Status
6	The permanent boundary pillars need to be erected after identification of an area of aggradation and deposition outside the bank of the river at a safe location for future surveying. The distance between boundary pillars on each side of the bank shall not be more than 100 meters.	Benchmark Pillars are established in strategic locations while boundary pillars will be fixed while fixation of the mining lease boundary subsequent to district level verification.
7	Identifying the mining and no mining zone shall follow with defining the area of sensitivity by ascertaining the distance of the mining area from the protected area, forest, bridges, important structures, habitation etc. and based on the sensitivity the area needs to be defined in sensitive and non-sensitive area.	Complied with and furnished in pg no 93 to 96.
8	Demand and supply of the Riverbed Material through market survey needs to be carried out. In addition to this future demand for the next 5 years also needs to be considered.	Complied with and given in pg no 8.
9	It is suggested that as far as possible the sensitive areas should be avoided for mining, unless local safety condition arises. Such deviation shall be temporary & shall not be a permanent feature.	Complied with and furnished in pg no 93 to 96.
10	Sand and gravel could be extracted from the downstream of the sand bar at river bends. Retaining the upstream one to two-thirds of the bar and riparian vegetation is accepted as a method to promote channel stability.	Noted. The DSR is compose of all the potential sand zones for defining the resources. In a subsequent phase blocking of potential zones shall be done in due consultation with the district level committee. The areas mentioned in the observation points shall be excluded while blocking of sand mining leases which are part of these potential zones marked in this DSR.
11	The final area selected for the mining should be then divided into mining lease as per the requirement of State Government. It is suggested the mining lease area should be so selected as to cover the entire deposition area. Dividing a large area of deposition/aggradation into smaller mining leases should be avoided as it leads to loss of mineral and indirectly promote illegal mining.	Shall be Complied with.
12	Cluster situation shall be examined. A cluster is formed when one mining lease of homogenous mineral is within 500 meters of the other mining lease. In order to reduce the cluster formation mining lease size should be defined in such a way that distance between any two clusters preferably should not be less than 2.5 Km. Mining lease should be defined in such a way that the total area of the mining leases in a cluster should not be more than 10 Ha.	Noted. Due care will be taken while distribution of mining leases either to prevent cluster situation or keeping the prescribed distance in between two mining clusters.
13	The number of a contiguous cluster needs to be ascertained. Contiguous cluster is formed when one cluster is at a distance of 2.5 Km from the other cluster.	Noted and shall be complied with.

Sl. No.	Particulars	Status
14	The mining outside the riverbed on Patta land/Khatedari land be granted when there is possibility of replenishment of material. In case, there is no replenishment then mining lease shall only be granted when there is no riverbed mining possibility within 5 KM of the Patta land/Khatedari land. For government projects, mining could be allowed on Patta land/Khatedari land but the mining should only be done by the Government agency and material should not be used for sale in the open market. Cluster situation as mentioned in para k above is also applicable for the mining in Patta land/Khatedari land.	Noted.
15	The State Government should define the transportation route from the mining lease considering the maximum production from the mines as at this stage the size of mining leases, their location, the quantity of mineral that can be mined safely etc. is available with the State Government. It is suggested that the transportation route should be selected in such a way that the movement of trucks/tippers/tractors from the villages having habitation should be avoided. The transportation route so selected should be verified by the State Government for its carrying capacity.	Noted and final transport route will be submitted during preparation of mine plan.
16	Potential site for mining having its impact on the forest, protected area, habitation, bridges etc, shall be avoided. For this, a sub-divisional committee may be formed which after the site visit shall decide its suitability for mining.	Shall be Complied with.
17	Public consultation-The Comments of the various stakeholders may be sought on the list of mining lease to be auctioned. The State Government shall give an advertisement in the local and national newspaper for seeking comments of the general public on the list of mining lease included in the DSR. The DSR should be placed in the public domain for at least one month from the date of publication of the advertisement for obtaining comments of the general public. The comments so received shall be placed before the sub-divisional committee for active consideration. The final list of sand mining areas [leases to be granted on riverbed &Patta land/Khatedari land, de-siltation location (ponds/lakes/dams), M-Sand Plants (alternate source of sand)] after the public hearing needs to be defined in the final DSR.	After publication of the West Bengal Sand Mining Policy, 2021, it is now eminent that State owned The West Bengal Mineral Development and Trading Corporation Limited (WBMDTCL) shall be responsible for mining of sand/ gravel/ river bed materials in whole state of West Bengal. However, the existing mining leases which were in effect before hand of this Gazzate notification July 2021 will be in operation till the year 2027-28. In order to have the rational distribution of mining leases as per the prevailing norms and guidelines grant of mining leases in the state of West Bengal shall be carried out in phases till all the blocks are under the ambit of WBMDTCL. This DSR thus consist of the identified potential sand deposite areas within which the existing and future mining leases shall occur. The details of the mining leases as and when granted shall follow the procedure described in EMGSM 2020 and prevailing norms.
18	The LOI should not be granted for mining area falling on both riverbed and outside riverbed. Therefore, in the same lease, both types of area should not be included.	Shall be Complied with.

Annexure 2
Estimation of Sand Resources based on sediment load comparison between pre- and post-monsoon period of Paschim Bardhaman district

Abbreviation used in the table as below

ABBREVIATION FORM		
PERIOD	PRE	PRE MONSOON
	PO	POST MONSOON
DISTRICT	PSBD	PASCHIM BARDHAMAN
BLOCK	AS	ASANSOL (MC)
	SL	SALANPUR
	BR	BARABANI
	JM	JAMURIA
	RG	RANIGANJ
	PB	PANDABESWAR
	KN	KANSA
	FP	FARIDPUR
	AN	ANDAL
	DG	DURGAPUR (MC)
RIVER	AJ	AJAY
	DA	DAMODAR
	BK	BARAKAR

Pre monsoon						Post monsoon						Difference in Mcum
SL No	Sand Bar_Code	RL (m)	Area in sq.m.	Sand Thickness in m.	Sand Volume in M. Cum	SL No	Sand Bar_Code	RL (m)	Area in sq.m.	Sand Thickness in m.	Sand Volume in M. Cum	
Estimation of Sand Resources in Pre monsoon period & Post monsoon period in sand bar regions of Ajay River												
1	PRE_PSBD_BR_AJ_01	113.90	132348.4063	2.70	0.36	1	PO_PSBD_BR_AJ_01_02	114	259781.6506	2.80	0.73	0.08
2	PRE_PSBD_BR_AJ_02	113.90	102166.1542	2.80	0.29							
3	PRE_PSBD_BR_AJ_03	113.60	103450.1652	2.60	0.27	2	PO_PSBD_BR_AJ_03	114	68584.70518	3.00	0.21	-0.06
4	PRE_PSBD_BR_AJ_04	112.70	180199.0508	2.70	0.49	3	PO_PSBD_BR_AJ_03_04	113	217789.6532	3.00	0.65	0.17
5	PRE_PSBD_BR_AJ_05	112.70	38550.64438	2.60	0.10	4	PO_PSBD_BR_AJ_05	113	39773.93075	2.90	0.12	0.02
6	PRE_PSBD_JM_AJ_06	100.80	28183.30392	2.70	0.08	5	PO_PSBD_JM_AJ_06	101	253433.8197	2.90	0.73	0.66
7	PRE_PSBD_JM_AJ_07	94.60	377508.2731	2.60	0.98	6	PO_PSBD_JM_AJ_07	95	376254.3219	3.00	1.13	0.15
8	PRE_PSBD_JM_AJ_08	79.90	217905.6777	2.70	0.59	7	PO_PSBD_JM_AJ_08	80	229592.6598	2.80	0.64	0.05
9	PRE_PSBD_PB_AJ_09	75.00	249942.0029	2.50	0.62		PO_PSBD_PB_AJ_09					-0.62
10	PRE_PSBD_PB_AJ_10	69.00	280410.5341	2.50	0.70		PO_PSBD_PB_AJ_10					-0.70
11	PRE_PSBD_KN_AJ_11	59.80	37224.91885	2.60	0.10	8	PO_PSBD_KN_AJ_11	60	27874.12077	2.80	0.08	-0.02
12	PRE_PSBD_KN_AJ_12	52.80	45301.93131	2.80	0.13	9	PO_PSBD_KN_AJ_12	53	122999.0084	3.00	0.37	0.24
	PRE_PSBD_KN_AJ_13					10	PO_PSBD_KN_AJ_13	48	44677.73416	3.00	0.13	0.13
Estimation of Sand Resources in Pre monsoon period & Post monsoon period in sand bar regions of Damodar River												
1	PRE_PSBD_ON_DA_01	69	3032168.616	2.85	8.64	1	PO_PSBD_RG_DA_01A	72	101241.1912	3.00	0.30	-1.88
						2	PO_PSBD_ON_DA_01(IA)	70	1139279.833	2.90	3.30	
						3	PO_PSBD_ON_DA_01(IB)	68	388614.624	2.80	1.09	
						4	PO_PSBD_ON_DA_01(IC)	67	277039.2938	2.90	0.80	
						5	PO_PSBD_ON_DA_01(ID)	70	421780.3093	3.00	1.27	
2	PRE_PSBD_DG_DA_02	67	399213.8815	2.80	1.12	6	PO_PSBD_DG_DA_02	70	462199.65	2.90	1.34	1.35

Pre monsoon						Post monsoon						Difference in Mcum
SL No	Sand Bar_Code	RL (m)	Area in sq.m.	Sand Thickness in m.	Sand Volume in M. Cum	SL No	Sand Bar_Code	RL (m)	Area in sq.m.	Sand Thickness in m.	Sand Volume in M. Cum	
						7	PO_PSBD_DG_DA_02A	66	235089.5159	2.80	0.66	
						8	PO_PSBD_DG_DA_02B	66	175039.5312	2.70	0.47	
3	PRE_PSBD_DG_DA_03	66	856535.6603	2.75	2.36	9	PO_PSBD_DG_DA_03	66	974191.0082	2.70	2.63	1.42
						10	PO_PSBD_DG_DA_03A	66	395054.8797	2.90	1.15	
4	PRE_PSBD_KN_DA_04					11	PO_PSBD_KN_DA_04	53	163214.6934	3.00	0.49	0.49
Estimation of Sand Resources in Pre monsoon period & Post monsoon period in sand bar regions of Barakar River												
1	PRE_PSBD_AS_BK_01	97.80	114078.0956	2.50	0.29	1	PO_PSBD_AS_BK_01	98	122995.9349	2.70	0.33	0.05
2	PRE_PSBD_AS_BK_02	94.80	41703.61206	2.50	0.10	2	PO_PSBD_AS_BK_02	95	30472.01332	2.70	0.08	-0.02
3	PRE_PSBD_AS_BK_03	95.80	294764.8452	2.50	0.74	3	PO_PSBD_AS_BK_03	96	215815.0724	2.70	0.58	-0.15
4	PRE_PSBD_AS_BK_04	96.80	74890.38276	2.50	0.19	4	PO_PSBD_AS_BK_04_05	97	253650.3179	2.70	0.68	0.26
5	PRE_PSBD_AS_BK_05	96.80	94459.30959	2.50	0.24							
6	PRE_PSBD_AS_BK_06	99.80	66709.24517	2.50	0.17	5	PO_PSBD_AS_BK_06	100	30300.58463	2.70	0.08	-0.08
						6	PO_PSBD_AS_BK_06A	98	234934.2012	2.70	0.63	0.63
7	PRE_PSBD_AS_BK_07	98.80	56800.02248	2.50	0.14	7	PO_PSBD_AS_BK_07	99	65572.76793	2.70	0.18	0.04
8	PRE_PSBD_AS_BK_08	99.80	39716.02628	2.50	0.10	8	PO_PSBD_AS_BK_08	100	39618.17652	2.70	0.11	0.01
9	PRE_PSBD_SL_BK_09	99.80	15505.86638	2.50	0.04	9	PO_PSBD_SL_BK_09	100	12636.60027	2.70	0.03	0.00

Annexure 3
Boundary Coordinates of Potential Blocks of Paschim Bardhaman District

Abbreviation used in the table as below

ABBREVIATION FORM		
DISTRICT	PSBD	PASCHIM BARDHAMAN
BLOCK	AS	ASANSOL (MC)
	SL	SALANPUR
	BR	BARABANI
	JM	JAMURIA
	RG	RANIGANJ
	PB	PANDABESWAR
	KN	KANSA
	FP	FARIDPUR
	AN	ANDAL
	DG	DURGAPUR (MC)
RIVER	AJ	AJAY
	DA	DAMODAR
	BK	BARAKAR

CODE	POINT NO	LATITUDE	LONGITUDE
PSBD_BR_AJ_01_02	1	23° 50' 47.688" N	86° 57' 27.476" E
	2	23° 50' 46.001" N	86° 57' 25.792" E
	3	23° 50' 44.721" N	86° 57' 24.463" E
	4	23° 50' 44.631" N	86° 57' 22.865" E
	5	23° 50' 45.346" N	86° 57' 20.143" E
	6	23° 50' 45.827" N	86° 57' 19.395" E
	7	23° 50' 46.239" N	86° 57' 16.027" E
	8	23° 50' 46.239" N	86° 57' 15.316" E
	9	23° 50' 45.447" N	86° 57' 14.344" E
	10	23° 50' 44.654" N	86° 57' 7.684" E
	11	23° 50' 44.102" N	86° 57' 2.820" E
	12	23° 50' 43.954" N	86° 57' 1.285" E
	13	23° 50' 45.135" N	86° 57' 4.438" E
	14	23° 50' 51.372" N	86° 57' 11.982" E
	15	23° 50' 51.900" N	86° 57' 16.172" E
	16	23° 50' 52.857" N	86° 57' 19.889" E
	17	23° 50' 52.916" N	86° 57' 21.490" E
	18	23° 50' 55.946" N	86° 57' 29.421" E
	19	23° 50' 57.076" N	86° 57' 31.917" E
	20	23° 50' 57.755" N	86° 57' 33.680" E
	21	23° 50' 58.159" N	86° 57' 34.310" E
	22	23° 51' 0.078" N	86° 57' 38.549" E
	23	23° 51' 1.811" N	86° 57' 40.001" E
	24	23° 51' 2.988" N	86° 57' 41.835" E
	25	23° 51' 5.278" N	86° 57' 42.904" E
	26	23° 51' 6.687" N	86° 57' 44.085" E
	27	23° 50' 58.703" N	86° 57' 43.489" E
	28	23° 50' 55.537" N	86° 57' 43.190" E
	29	23° 50' 55.143" N	86° 57' 42.896" E
	30	23° 50' 54.093" N	86° 57' 40.906" E
	31	23° 50' 52.887" N	86° 57' 36.790" E
	32	23° 50' 50.786" N	86° 57' 31.702" E
	33	23° 50' 50.029" N	86° 57' 29.383" E
PSBD_BR_AJ_03	1	23° 50' 59.428" N	86° 57' 46.105" E
	2	23° 50' 58.697" N	86° 57' 45.336" E
	3	23° 51' 0.631" N	86° 57' 44.985" E
	4	23° 51' 6.137" N	86° 57' 44.833" E
	5	23° 51' 11.506" N	86° 57' 46.628" E
	6	23° 51' 14.810" N	86° 57' 49.321" E

CODE	POINT NO	LATITUDE	LONGITUDE
	7	23° 51' 16.003" N	86° 57' 52.345" E
	8	23° 51' 15.535" N	86° 57' 52.199" E
	9	23° 51' 13.057" N	86° 57' 52.050" E
	10	23° 51' 8.721" N	86° 57' 50.891" E
	11	23° 51' 6.828" N	86° 57' 49.732" E
	12	23° 51' 4.694" N	86° 57' 49.209" E
	13	23° 51' 3.593" N	86° 57' 48.423" E
	14	23° 51' 1.941" N	86° 57' 48.050" E
PSBD_BR_AJ_03_04	1	23° 51' 16.875" N	86° 57' 50.817" E
	2	23° 51' 13.225" N	86° 57' 45.529" E
	3	23° 51' 14.824" N	86° 57' 45.548" E
	4	23° 51' 19.490" N	86° 57' 45.877" E
	5	23° 51' 25.191" N	86° 57' 45.672" E
	6	23° 51' 29.075" N	86° 57' 45.719" E
	7	23° 51' 41.601" N	86° 57' 45.566" E
	8	23° 51' 45.662" N	86° 57' 46.014" E
	9	23° 51' 49.104" N	86° 57' 46.836" E
	10	23° 51' 53.461" N	86° 57' 49.006" E
	11	23° 51' 54.098" N	86° 57' 53.686" E
	12	23° 51' 47.710" N	86° 57' 52.305" E
	13	23° 51' 42.342" N	86° 57' 51.259" E
	14	23° 51' 37.386" N	86° 57' 50.961" E
	15	23° 51' 31.880" N	86° 57' 51.412" E
	16	23° 51' 27.475" N	86° 57' 52.311" E
	17	23° 51' 26.733" N	86° 57' 52.384" E
	18	23° 51' 26.720" N	86° 57' 52.383" E
	19	23° 51' 26.705" N	86° 57' 52.387" E
	20	23° 51' 21.418" N	86° 57' 52.911" E
PSBD_BR_AJ_05	1	23° 51' 45.441" N	86° 57' 54.848" E
	2	23° 51' 44.708" N	86° 57' 54.506" E
	3	23° 51' 45.095" N	86° 57' 53.504" E
	4	23° 51' 47.848" N	86° 57' 53.503" E
	5	23° 51' 52.254" N	86° 57' 55.447" E
	6	23° 51' 54.657" N	86° 57' 57.792" E
	7	23° 51' 55.077" N	86° 58' 0.881" E
	8	23° 51' 54.641" N	86° 58' 1.759" E
	9	23° 51' 52.910" N	86° 57' 59.935" E
	10	23° 51' 48.195" N	86° 57' 55.932" E
PSBD_JM_AJ_06	1	23° 48' 32.798" N	87° 4' 35.784" E

CODE	POINT NO	LATITUDE	LONGITUDE
	2	23° 48' 21.146" N	87° 4' 59.761" E
	3	23° 48' 21.232" N	87° 4' 59.055" E
	4	23° 48' 21.097" N	87° 4' 53.594" E
	5	23° 48' 26.333" N	87° 4' 43.648" E
	6	23° 48' 28.884" N	87° 4' 35.421" E
	7	23° 48' 34.670" N	87° 4' 26.447" E
	8	23° 48' 39.421" N	87° 4' 22.185" E
	9	23° 48' 45.448" N	87° 4' 14.428" E
	10	23° 48' 44.423" N	87° 4' 21.969" E
	11	23° 48' 34.149" N	87° 4' 34.179" E
PSBD_JM_AJ_07	1	23° 46' 50.471" N	87° 6' 27.482" E
	2	23° 46' 43.799" N	87° 6' 31.720" E
	3	23° 46' 47.708" N	87° 6' 28.745" E
	4	23° 46' 52.874" N	87° 6' 23.589" E
	5	23° 46' 56.799" N	87° 6' 20.002" E
	6	23° 47' 4.236" N	87° 6' 15.221" E
	7	23° 47' 13.256" N	87° 6' 10.441" E
	8	23° 47' 19.728" N	87° 6' 6.632" E
	9	23° 47' 24.961" N	87° 6' 3.046" E
	10	23° 47' 30.953" N	87° 5' 58.188" E
	11	23° 47' 36.601" N	87° 5' 51.386" E
	12	23° 47' 41.147" N	87° 5' 45.031" E
	13	23° 47' 43.696" N	87° 5' 41.966" E
	14	23° 47' 52.646" N	87° 5' 38.308" E
	15	23° 47' 56.157" N	87° 5' 37.487" E
	16	23° 48' 0.532" N	87° 5' 34.576" E
	17	23° 48' 0.046" N	87° 5' 35.029" E
	18	23° 47' 52.691" N	87° 5' 41.895" E
	19	23° 47' 46.067" N	87° 5' 47.024" E
	20	23° 47' 32.850" N	87° 5' 57.258" E
	21	23° 47' 24.888" N	87° 6' 3.423" E
	22	23° 47' 15.998" N	87° 6' 10.306" E
	23	23° 47' 15.998" N	87° 6' 10.306" E
	24	23° 47' 15.997" N	87° 6' 10.307" E
	25	23° 47' 15.195" N	87° 6' 10.928" E
	26	23° 47' 9.096" N	87° 6' 15.650" E
	27	23° 47' 4.784" N	87° 6' 18.390" E
	28	23° 47' 0.117" N	87° 6' 21.354" E
	29	23° 46' 56.590" N	87° 6' 23.595" E

CODE	POINT NO	LATITUDE	LONGITUDE
PSBD_JM_AJ_08	1	23° 44' 52.260" N	87° 10' 33.754" E
	2	23° 44' 48.519" N	87° 11' 0.745" E
	3	23° 44' 48.521" N	87° 11' 0.755" E
	4	23° 44' 48.613" N	87° 11' 1.440" E
	5	23° 44' 46.559" N	87° 10' 57.790" E
	6	23° 44' 46.364" N	87° 10' 47.471" E
	7	23° 44' 46.166" N	87° 10' 40.741" E
	8	23° 44' 46.999" N	87° 10' 34.461" E
	9	23° 44' 46.589" N	87° 10' 31.993" E
	10	23° 44' 46.565" N	87° 10' 31.992" E
	11	23° 44' 47.319" N	87° 10' 24.403" E
	12	23° 44' 47.812" N	87° 10' 14.833" E
	13	23° 44' 49.337" N	87° 10' 4.666" E
	14	23° 44' 49.677" N	87° 10' 3.881" E
	15	23° 44' 49.769" N	87° 10' 4.193" E
	16	23° 44' 51.043" N	87° 10' 19.301" E
	17	23° 44' 52.262" N	87° 10' 33.746" E
PSBD_KN_AJ_11	1	23° 40' 15.079" N	87° 24' 50.412" E
	2	23° 40' 12.889" N	87° 24' 47.747" E
	3	23° 40' 14.085" N	87° 24' 48.726" E
	4	23° 40' 16.626" N	87° 24' 50.752" E
	5	23° 40' 19.305" N	87° 24' 52.628" E
	6	23° 40' 21.436" N	87° 24' 53.756" E
	7	23° 40' 23.272" N	87° 24' 54.841" E
	8	23° 40' 21.112" N	87° 24' 55.569" E
	9	23° 40' 19.810" N	87° 24' 55.068" E
PSBD_KN_AJ_12	1	23° 39' 32.973" N	87° 24' 37.058" E
	2	23° 39' 32.831" N	87° 24' 37.004" E
	3	23° 39' 35.337" N	87° 24' 35.044" E
	4	23° 39' 37.277" N	87° 24' 34.483" E
	5	23° 39' 38.378" N	87° 24' 34.655" E
	6	23° 39' 41.477" N	87° 24' 33.880" E
	7	23° 39' 41.972" N	87° 24' 33.734" E
	8	23° 39' 43.738" N	87° 24' 33.576" E
	9	23° 39' 45.772" N	87° 24' 33.509" E
	10	23° 39' 46.193" N	87° 24' 33.596" E
	11	23° 39' 51.777" N	87° 24' 35.602" E
	12	23° 39' 54.845" N	87° 24' 36.859" E
	13	23° 39' 57.109" N	87° 24' 38.114" E

CODE	POINT NO	LATITUDE	LONGITUDE
	14	23° 39' 48.746" N	87° 24' 43.123" E
PSBD_KN_AJ_13	1	23° 36' 24.261" N	87° 30' 39.703" E
	2	23° 36' 22.719" N	87° 30' 37.643" E
	3	23° 36' 23.306" N	87° 30' 35.264" E
	4	23° 36' 26.435" N	87° 30' 36.734" E
	5	23° 36' 28.444" N	87° 30' 37.918" E
	6	23° 36' 31.819" N	87° 30' 39.892" E
	7	23° 36' 36.225" N	87° 30' 42.010" E
	8	23° 36' 37.600" N	87° 30' 42.508" E
	9	23° 36' 37.665" N	87° 30' 44.890" E
	10	23° 36' 35.687" N	87° 30' 44.789" E
	11	23° 36' 32.938" N	87° 30' 43.471" E
	12	23° 36' 31.223" N	87° 30' 41.690" E
	13	23° 36' 28.817" N	87° 30' 40.934" E
PSBD_RG_DA_01A	1	23° 34' 32.925" N	87° 7' 11.191" E
	2	23° 34' 30.136" N	87° 7' 10.957" E
	3	23° 34' 30.443" N	87° 7' 9.876" E
	4	23° 34' 32.216" N	87° 7' 3.645" E
	5	23° 34' 34.036" N	87° 6' 57.455" E
	6	23° 34' 34.560" N	87° 6' 56.592" E
	7	23° 34' 35.243" N	87° 6' 55.466" E
	8	23° 34' 37.029" N	87° 6' 52.522" E
	9	23° 34' 38.945" N	87° 6' 49.364" E
	10	23° 34' 39.557" N	87° 6' 48.354" E
	11	23° 34' 40.560" N	87° 6' 54.509" E
	12	23° 34' 40.307" N	87° 6' 58.168" E
PSBD_AN_DA_01(IA)	1	23° 34' 2.798" N	87° 8' 52.449" E
	2	23° 34' 0.319" N	87° 8' 54.238" E
	3	23° 34' 0.728" N	87° 8' 57.823" E
	4	23° 34' 2.584" N	87° 9' 1.185" E
	5	23° 34' 3.904" N	87° 9' 9.424" E
	6	23° 33' 59.821" N	87° 9' 22.886" E
	7	23° 33' 59.708" N	87° 9' 23.279" E
	8	23° 33' 58.015" N	87° 9' 26.941" E
	9	23° 33' 56.563" N	87° 9' 33.435" E
	10	23° 33' 56.215" N	87° 9' 35.388" E
	11	23° 33' 54.848" N	87° 9' 40.129" E
	12	23° 33' 54.099" N	87° 9' 44.014" E
	13	23° 33' 51.389" N	87° 9' 44.629" E

CODE	POINT NO	LATITUDE	LONGITUDE
	14	23° 33' 48.291" N	87° 9' 45.522" E
	15	23° 33' 47.246" N	87° 9' 57.393" E
	16	23° 33' 48.272" N	87° 10' 3.442" E
	17	23° 33' 50.129" N	87° 10' 5.012" E
	18	23° 33' 51.235" N	87° 10' 6.135" E
	19	23° 33' 50.672" N	87° 10' 23.133" E
	20	23° 33' 51.897" N	87° 10' 34.783" E
	21	23° 33' 52.151" N	87° 10' 37.044" E
	22	23° 33' 50.509" N	87° 10' 39.649" E
	23	23° 33' 47.984" N	87° 10' 29.787" E
	24	23° 33' 44.986" N	87° 10' 18.349" E
	25	23° 33' 44.362" N	87° 10' 12.417" E
	26	23° 33' 43.709" N	87° 10' 6.214" E
	27	23° 33' 42.000" N	87° 9' 55.012" E
	28	23° 33' 42.008" N	87° 9' 47.054" E
	29	23° 33' 42.017" N	87° 9' 38.679" E
	30	23° 33' 45.046" N	87° 9' 21.415" E
	31	23° 33' 53.405" N	87° 8' 53.747" E
	32	23° 33' 57.162" N	87° 8' 36.165" E
	33	23° 33' 57.250" N	87° 8' 35.756" E
	34	23° 33' 58.590" N	87° 8' 29.485" E
	35	23° 34' 0.395" N	87° 8' 24.358" E
	36	23° 34' 4.803" N	87° 8' 26.885" E
	37	23° 34' 5.781" N	87° 8' 27.446" E
	38	23° 34' 6.741" N	87° 8' 31.844" E
	39	23° 34' 5.910" N	87° 8' 37.219" E
	40	23° 34' 5.284" N	87° 8' 43.939" E
	41	23° 34' 5.074" N	87° 8' 48.195" E
PSBD_AN_DA_01(IB)	1	23° 33' 42.329" N	87° 11' 32.037" E
	2	23° 33' 41.227" N	87° 11' 29.842" E
	3	23° 33' 42.140" N	87° 11' 28.197" E
	4	23° 33' 48.087" N	87° 11' 17.477" E
	5	23° 33' 49.885" N	87° 11' 0.590" E
	6	23° 33' 50.074" N	87° 10' 54.732" E
	7	23° 33' 50.203" N	87° 10' 50.734" E
	8	23° 33' 53.192" N	87° 10' 46.338" E
	9	23° 33' 53.328" N	87° 10' 47.553" E
	10	23° 33' 52.278" N	87° 11' 2.784" E
	11	23° 33' 49.990" N	87° 11' 16.669" E

CODE	POINT NO	LATITUDE	LONGITUDE
	12	23° 33' 45.435" N	87° 11' 26.743" E
PSBD_AN_DA_01(ID)	1	23° 32' 56.846" N	87° 12' 51.052" E
	2	23° 32' 52.686" N	87° 12' 45.690" E
	3	23° 32' 58.080" N	87° 12' 39.533" E
	4	23° 33' 10.146" N	87° 12' 23.686" E
	5	23° 33' 11.714" N	87° 12' 20.780" E
	6	23° 33' 14.474" N	87° 12' 15.666" E
	7	23° 33' 16.480" N	87° 12' 11.947" E
	8	23° 33' 20.469" N	87° 12' 4.552" E
	9	23° 33' 21.195" N	87° 12' 3.207" E
	10	23° 33' 22.105" N	87° 12' 8.658" E
	11	23° 33' 21.411" N	87° 12' 13.697" E
	12	23° 33' 20.374" N	87° 12' 17.055" E
	13	23° 33' 17.444" N	87° 12' 20.597" E
	14	23° 33' 15.720" N	87° 12' 23.021" E
	15	23° 33' 14.677" N	87° 12' 31.045" E
	16	23° 33' 13.635" N	87° 12' 38.137" E
	17	23° 33' 13.077" N	87° 12' 40.144" E
	18	23° 33' 11.680" N	87° 12' 41.730" E
	19	23° 33' 4.650" N	87° 12' 48.662" E
	20	23° 32' 58.972" N	87° 12' 53.943" E
	21	23° 32' 58.189" N	87° 12' 52.878" E
PSBD_AN_DA_01(IC)	1	23° 33' 24.649" N	87° 12' 9.494" E
	2	23° 33' 24.521" N	87° 12' 3.622" E
	3	23° 33' 27.703" N	87° 12' 0.307" E
	4	23° 33' 24.940" N	87° 12' 8.376" E
PSBD_DG_DA_02	1	23° 32' 0.161" N	87° 13' 49.535" E
	2	23° 31' 55.756" N	87° 13' 53.843" E
	3	23° 31' 56.742" N	87° 13' 51.784" E
	4	23° 32' 2.444" N	87° 13' 39.875" E
	5	23° 32' 7.247" N	87° 13' 29.842" E
	6	23° 32' 16.697" N	87° 13' 21.085" E
	7	23° 32' 25.339" N	87° 13' 13.075" E
	8	23° 32' 30.505" N	87° 13' 8.328" E
	9	23° 32' 40.388" N	87° 12' 59.244" E
	10	23° 32' 42.569" N	87° 12' 57.239" E
	11	23° 32' 52.686" N	87° 12' 45.690" E
	12	23° 32' 56.846" N	87° 12' 51.052" E
	13	23° 32' 58.189" N	87° 12' 52.878" E

CODE	POINT NO	LATITUDE	LONGITUDE
	14	23° 32' 58.972" N	87° 12' 53.943" E
	15	23° 32' 54.312" N	87° 12' 58.277" E
	16	23° 32' 47.924" N	87° 13' 5.270" E
	17	23° 32' 44.272" N	87° 13' 7.617" E
	18	23° 32' 38.070" N	87° 13' 12.833" E
	19	23° 32' 32.215" N	87° 13' 16.556" E
	20	23° 32' 26.187" N	87° 13' 20.092" E
	21	23° 32' 21.539" N	87° 13' 21.391" E
	22	23° 32' 17.575" N	87° 13' 25.490" E
	23	23° 32' 11.372" N	87° 13' 31.452" E
	24	23° 32' 4.821" N	87° 13' 40.025" E
PSBD_DG_DA_02A	1	23° 32' 13.871" N	87° 13' 44.286" E
	2	23° 32' 11.698" N	87° 13' 43.770" E
	3	23° 32' 11.878" N	87° 13' 38.358" E
	4	23° 32' 13.261" N	87° 13' 33.881" E
	5	23° 32' 16.365" N	87° 13' 29.594" E
	6	23° 32' 19.462" N	87° 13' 30.159" E
	7	23° 32' 22.215" N	87° 13' 30.164" E
	8	23° 32' 24.459" N	87° 13' 25.128" E
	9	23° 32' 28.422" N	87° 13' 21.402" E
	10	23° 32' 33.243" N	87° 13' 19.544" E
	11	23° 32' 34.308" N	87° 13' 20.297" E
	12	23° 32' 19.981" N	87° 13' 36.518" E
	13	23° 32' 13.981" N	87° 13' 44.122" E
PSBD_DG_DA_02B	1	23° 31' 53.939" N	87° 14' 7.814" E
	2	23° 31' 53.257" N	87° 14' 3.334" E
	3	23° 31' 58.080" N	87° 14' 0.356" E
	4	23° 32' 1.195" N	87° 14' 0.111" E
	5	23° 31' 53.967" N	87° 14' 7.854" E
PSBD_DG_DA_03	1	23° 30' 38.850" N	87° 15' 18.002" E
	2	23° 30' 35.946" N	87° 15' 25.834" E
	3	23° 30' 36.973" N	87° 15' 29.194" E
	4	23° 30' 34.489" N	87° 15' 32.772" E
	5	23° 30' 21.246" N	87° 15' 49.315" E
	6	23° 30' 9.033" N	87° 16' 7.203" E
	7	23° 29' 56.262" N	87° 16' 27.561" E
	8	23° 29' 54.640" N	87° 16' 24.028" E
	9	23° 29' 56.304" N	87° 16' 17.315" E
	10	23° 30' 3.343" N	87° 16' 6.582" E

CODE	POINT NO	LATITUDE	LONGITUDE
	11	23° 30' 14.525" N	87° 15' 48.468" E
	12	23° 30' 24.673" N	87° 15' 30.128" E
	13	23° 30' 22.198" N	87° 15' 28.332" E
	14	23° 30' 23.624" N	87° 15' 20.911" E
	15	23° 30' 24.555" N	87° 15' 19.905" E
	16	23° 30' 24.693" N	87° 15' 19.756" E
	17	23° 30' 28.822" N	87° 15' 16.410" E
	18	23° 30' 33.281" N	87° 15' 12.797" E
	19	23° 30' 38.477" N	87° 15' 8.587" E
	20	23° 30' 48.782" N	87° 15' 1.166" E
	21	23° 30' 51.398" N	87° 14' 59.281" E
	22	23° 30' 52.235" N	87° 14' 58.613" E
	23	23° 30' 56.156" N	87° 14' 58.822" E
	24	23° 30' 50.230" N	87° 15' 3.917" E
PSBD_DG_DA_03A	1	23° 29' 58.799" N	87° 16' 7.244" E
	2	23° 29' 52.997" N	87° 16' 19.099" E
	3	23° 29' 52.980" N	87° 16' 28.726" E
	4	23° 29' 53.985" N	87° 16' 31.191" E
	5	23° 29' 51.639" N	87° 16' 34.930" E
	6	23° 29' 40.072" N	87° 16' 55.523" E
	7	23° 29' 37.096" N	87° 16' 54.829" E
	8	23° 29' 45.857" N	87° 16' 29.647" E
	9	23° 29' 46.253" N	87° 16' 26.544" E
	10	23° 29' 48.474" N	87° 16' 9.129" E
	11	23° 29' 49.008" N	87° 16' 8.297" E
	12	23° 29' 54.284" N	87° 16' 0.065" E
	13	23° 30' 0.052" N	87° 15' 59.187" E
	14	23° 30' 4.181" N	87° 15' 59.643" E
PSBD_KN_DA_04	1	23° 24' 39.987" N	87° 25' 50.707" E
	2	23° 24' 37.752" N	87° 25' 46.764" E
	3	23° 24' 40.715" N	87° 25' 42.662" E
PSBD_AS_BK_01	1	23° 41' 46.292" N	86° 48' 0.323" E
	2	23° 41' 45.638" N	86° 48' 0.898" E
	3	23° 41' 47.264" N	86° 47' 51.809" E
	4	23° 41' 49.977" N	86° 47' 49.560" E
	5	23° 41' 53.244" N	86° 47' 47.967" E
	6	23° 41' 57.974" N	86° 47' 46.932" E
	7	23° 42' 1.587" N	86° 47' 46.552" E
	8	23° 42' 3.482" N	86° 47' 48.044" E

CODE	POINT NO	LATITUDE	LONGITUDE
	9	23° 42' 3.744" N	86° 47' 51.127" E
	10	23° 42' 2.886" N	86° 47' 52.053" E
	11	23° 42' 0.653" N	86° 47' 52.468" E
	12	23° 41' 47.960" N	86° 47' 59.327" E
PSBD_AS_BK_02	1	23° 42' 6.321" N	86° 47' 47.479" E
	2	23° 42' 5.067" N	86° 47' 46.159" E
	3	23° 42' 10.446" N	86° 47' 46.178" E
	4	23° 42' 11.373" N	86° 47' 44.233" E
	5	23° 42' 12.262" N	86° 47' 39.522" E
	6	23° 42' 14.094" N	86° 47' 39.829" E
	7	23° 42' 14.401" N	86° 47' 42.047" E
	8	23° 42' 13.803" N	86° 47' 45.505" E
	9	23° 42' 12.515" N	86° 47' 47.096" E
	10	23° 42' 9.677" N	86° 47' 47.848" E
PSBD_AS_BK_03	1	23° 42' 24.822" N	86° 47' 50.067" E
	2	23° 42' 18.794" N	86° 47' 45.871" E
	3	23° 42' 20.167" N	86° 47' 43.160" E
	4	23° 42' 20.960" N	86° 47' 42.715" E
	5	23° 42' 23.384" N	86° 47' 44.289" E
	6	23° 42' 25.934" N	86° 47' 47.200" E
	7	23° 42' 35.095" N	86° 47' 52.120" E
	8	23° 42' 39.331" N	86° 47' 54.393" E
	9	23° 42' 46.146" N	86° 47' 55.392" E
	10	23° 42' 52.832" N	86° 47' 54.611" E
	11	23° 42' 55.201" N	86° 47' 56.935" E
	12	23° 42' 54.260" N	86° 48' 0.580" E
	13	23° 42' 50.476" N	86° 48' 2.175" E
	14	23° 42' 44.970" N	86° 48' 2.650" E
	15	23° 42' 39.118" N	86° 48' 1.164" E
	16	23° 42' 35.501" N	86° 47' 58.647" E
	17	23° 42' 30.420" N	86° 47' 55.010" E
PSBD_AS_BK_04_05	1	23° 43' 24.298" N	86° 48' 10.347" E
	2	23° 43' 22.915" N	86° 48' 4.648" E
	3	23° 43' 23.564" N	86° 48' 0.594" E
	4	23° 43' 30.447" N	86° 48' 2.392" E
	5	23° 43' 39.214" N	86° 48' 4.682" E
	6	23° 43' 41.362" N	86° 48' 7.231" E
	7	23° 43' 43.053" N	86° 48' 11.154" E
	8	23° 43' 49.665" N	86° 48' 15.106" E

CODE	POINT NO	LATITUDE	LONGITUDE
	9	23° 43' 51.810" N	86° 48' 16.267" E
	10	23° 43' 50.465" N	86° 48' 19.840" E
	11	23° 43' 46.679" N	86° 48' 19.285" E
	12	23° 43' 42.893" N	86° 48' 18.729" E
	13	23° 43' 39.105" N	86° 48' 17.146" E
	14	23° 43' 36.092" N	86° 48' 15.843" E
	15	23° 43' 33.510" N	86° 48' 15.005" E
	16	23° 43' 30.498" N	86° 48' 14.636" E
	17	23° 43' 28.175" N	86° 48' 14.266" E
	18	23° 43' 26.367" N	86° 48' 13.240" E
PSBD_AS_BK_06	1	23° 45' 0.866" N	86° 49' 13.666" E
	2	23° 45' 0.776" N	86° 49' 10.769" E
	3	23° 45' 1.232" N	86° 49' 8.713" E
	4	23° 45' 2.244" N	86° 49' 11.228" E
	5	23° 45' 3.280" N	86° 49' 13.881" E
	6	23° 45' 9.103" N	86° 49' 20.005" E
	7	23° 45' 9.120" N	86° 49' 20.016" E
	8	23° 45' 7.583" N	86° 49' 19.639" E
	9	23° 45' 4.312" N	86° 49' 17.681" E
	10	23° 45' 2.504" N	86° 49' 16.281" E
PSBD_AS_BK_06A	1	23° 45' 10.190" N	86° 49' 31.998" E
	2	23° 45' 8.381" N	86° 49' 30.299" E
	3	23° 45' 8.879" N	86° 49' 29.233" E
	4	23° 45' 9.051" N	86° 49' 28.728" E
	5	23° 45' 7.690" N	86° 49' 27.888" E
	6	23° 45' 5.177" N	86° 49' 26.957" E
	7	23° 45' 2.386" N	86° 49' 24.231" E
	8	23° 45' 0.422" N	86° 49' 21.467" E
	9	23° 44' 59.824" N	86° 49' 19.680" E
	10	23° 45' 3.457" N	86° 49' 22.636" E
	11	23° 45' 8.794" N	86° 49' 25.245" E
	12	23° 45' 21.962" N	86° 49' 28.499" E
	13	23° 45' 32.114" N	86° 49' 29.140" E
	14	23° 45' 38.224" N	86° 49' 30.534" E
	15	23° 45' 40.722" N	86° 49' 32.494" E
	16	23° 45' 41.552" N	86° 49' 34.845" E
	17	23° 45' 40.306" N	86° 49' 35.229" E
	18	23° 45' 35.507" N	86° 49' 36.675" E
	19	23° 45' 34.337" N	86° 49' 37.144" E

CODE	POINT NO	LATITUDE	LONGITUDE
	20	23° 45' 33.029" N	86° 49' 37.052" E
	21	23° 45' 26.765" N	86° 49' 36.051" E
	22	23° 45' 19.830" N	86° 49' 35.200" E
	23	23° 45' 18.573" N	86° 49' 34.996" E
	24	23° 45' 16.404" N	86° 49' 34.251" E
	25	23° 45' 14.684" N	86° 49' 34.123" E
PSBD_AS_BK_07	1	23° 46' 31.734" N	86° 49' 26.723" E
	2	23° 46' 28.009" N	86° 49' 26.215" E
	3	23° 46' 29.190" N	86° 49' 25.393" E
	4	23° 46' 32.078" N	86° 49' 22.510" E
	5	23° 46' 34.107" N	86° 49' 20.974" E
	6	23° 46' 36.417" N	86° 49' 19.944" E
	7	23° 46' 37.921" N	86° 49' 20.077" E
	8	23° 46' 40.673" N	86° 49' 19.512" E
	9	23° 46' 42.993" N	86° 49' 16.705" E
	10	23° 46' 45.316" N	86° 49' 16.608" E
	11	23° 46' 45.662" N	86° 49' 18.197" E
	12	23° 46' 43.427" N	86° 49' 20.070" E
	13	23° 46' 40.505" N	86° 49' 23.065" E
	14	23° 46' 37.669" N	86° 49' 25.780" E
	15	23° 46' 34.831" N	86° 49' 26.532" E
PSBD_AS_BK_08	1	23° 46' 45.496" N	86° 49' 23.526" E
	2	23° 46' 42.743" N	86° 49' 24.090" E
	3	23° 46' 42.913" N	86° 49' 22.220" E
	4	23° 46' 45.320" N	86° 49' 19.880" E
	5	23° 46' 47.468" N	86° 49' 17.914" E
	6	23° 46' 50.047" N	86° 49' 15.854" E
	7	23° 46' 52.630" N	86° 49' 13.966" E
	8	23° 46' 54.789" N	86° 49' 17.282" E
	9	23° 46' 52.828" N	86° 49' 18.868" E
	10	23° 46' 49.622" N	86° 49' 20.809" E
PSBD_AS_BK_09	1	23° 46' 54.789" N	86° 49' 17.282" E
	2	23° 46' 52.630" N	86° 49' 13.966" E
	3	23° 46' 53.656" N	86° 49' 12.296" E
	4	23° 46' 56.753" N	86° 49' 12.105" E
	5	23° 46' 56.841" N	86° 49' 13.881" E
	6	23° 46' 56.622" N	86° 49' 14.493" E
	7	23° 46' 56.565" N	86° 49' 14.614" E
	8	23° 46' 54.848" N	86° 49' 17.234" E

Annexure 4
Map showing of Potential Blocks of Paschim Bardhaman District

POTENTIAL BLOCK PSBD_BR_AJ_01_02 OF AJAY RIVER

86°57'0"E 86°57'30"E 86°58'0"E

23°51'0"N

N W E S

PSBD_BR_AJ_03

PSBD_BR_AJ_01_02

AJAY RIVER

BARABANI

LEGEND

- COORDINATE
- POTENTIAL BLOCK
- SAFETY BARRIER
- RIVER
- ADMINISTRATIVE BLOCK BOUNDARY
- DISTRICT BOUNDARY

ABBREVIATION FORM		
DISTRICT	PSBD	PASCHIM BARDHAMAN
BLOCK	BR	BARABANI
RIVER	AJ	AJAY

PSBD_BR_AJ_01_02					
POINT_NO	LATITUDE	LONGITUDE	POINT_NO	LATITUDE	LONGITUDE
1	23° 50' 47.688" N	86° 57' 27.476" E	17	23° 50' 52.916" N	86° 57' 21.490" E
2	23° 50' 46.001" N	86° 57' 25.792" E	18	23° 50' 55.946" N	86° 57' 29.421" E
3	23° 50' 44.721" N	86° 57' 24.463" E	19	23° 50' 57.076" N	86° 57' 31.917" E
4	23° 50' 44.631" N	86° 57' 22.865" E	20	23° 50' 57.755" N	86° 57' 33.680" E
5	23° 50' 45.346" N	86° 57' 20.143" E	21	23° 50' 58.159" N	86° 57' 34.310" E
6	23° 50' 45.827" N	86° 57' 19.395" E	22	23° 51' 0.078" N	86° 57' 38.549" E
7	23° 50' 46.239" N	86° 57' 16.027" E	23	23° 51' 1.811" N	86° 57' 40.001" E
8	23° 50' 46.239" N	86° 57' 15.316" E	24	23° 51' 2.988" N	86° 57' 41.835" E
9	23° 50' 45.447" N	86° 57' 14.344" E	25	23° 51' 5.278" N	86° 57' 42.904" E
10	23° 50' 44.654" N	86° 57' 7.684" E	26	23° 51' 6.687" N	86° 57' 44.085" E
11	23° 50' 44.102" N	86° 57' 2.820" E	27	23° 50' 58.703" N	86° 57' 43.489" E
12	23° 50' 43.954" N	86° 57' 1.285" E	28	23° 50' 55.537" N	86° 57' 43.190" E
13	23° 50' 45.135" N	86° 57' 4.438" E	29	23° 50' 55.143" N	86° 57' 42.896" E
14	23° 50' 51.372" N	86° 57' 11.982" E	30	23° 50' 54.093" N	86° 57' 40.906" E
15	23° 50' 51.900" N	86° 57' 16.172" E	31	23° 50' 52.887" N	86° 57' 36.790" E
16	23° 50' 52.857" N	86° 57' 19.889" E	32	23° 50' 50.786" N	86° 57' 31.702" E
			33	23° 50' 50.029" N	86° 57' 29.383" E

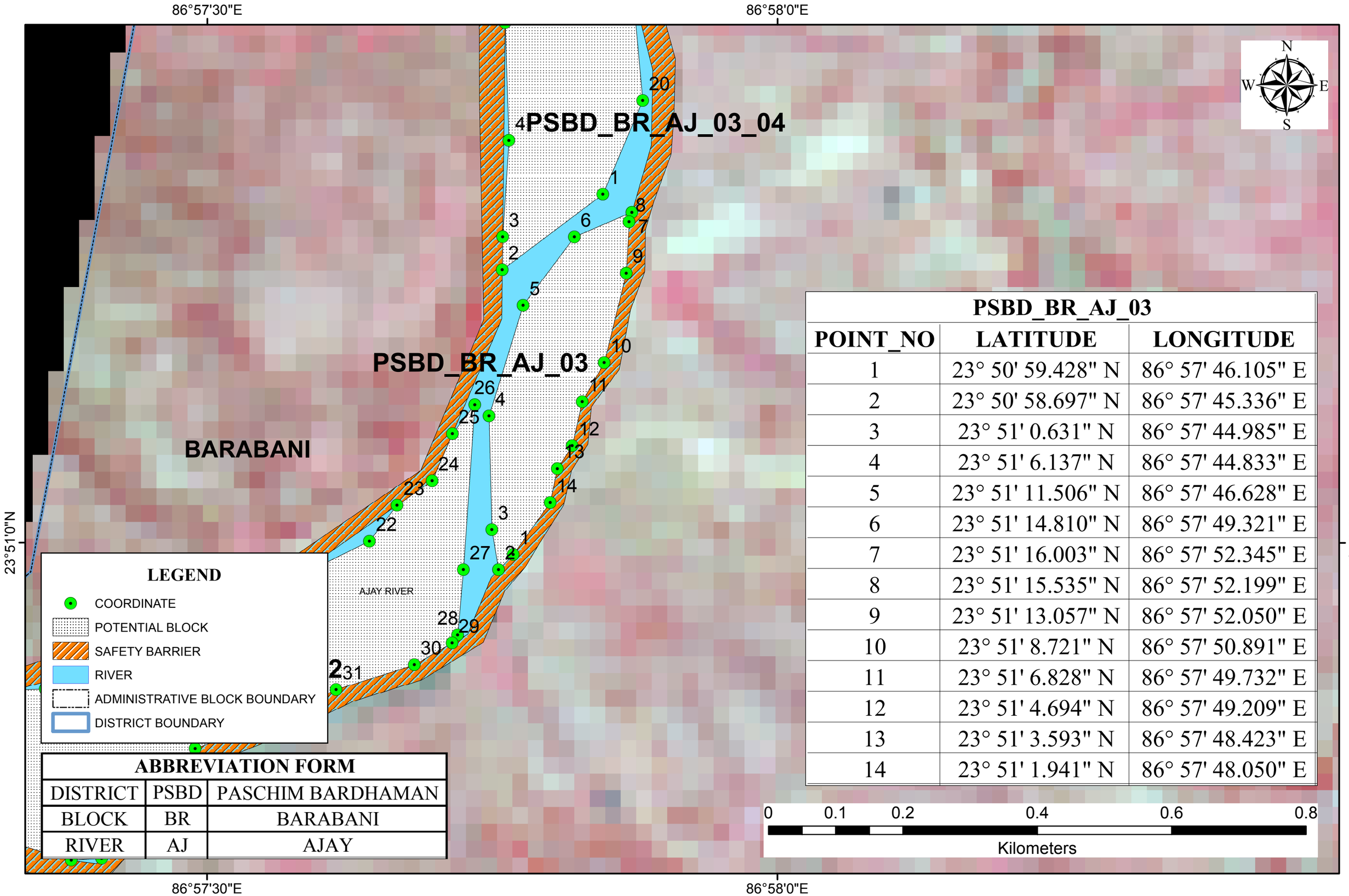
0 0.1 0.2 0.4 0.6 0.8

Kilometers

23°50'30"N

86°57'0"E 86°57'30"E 86°58'0"E

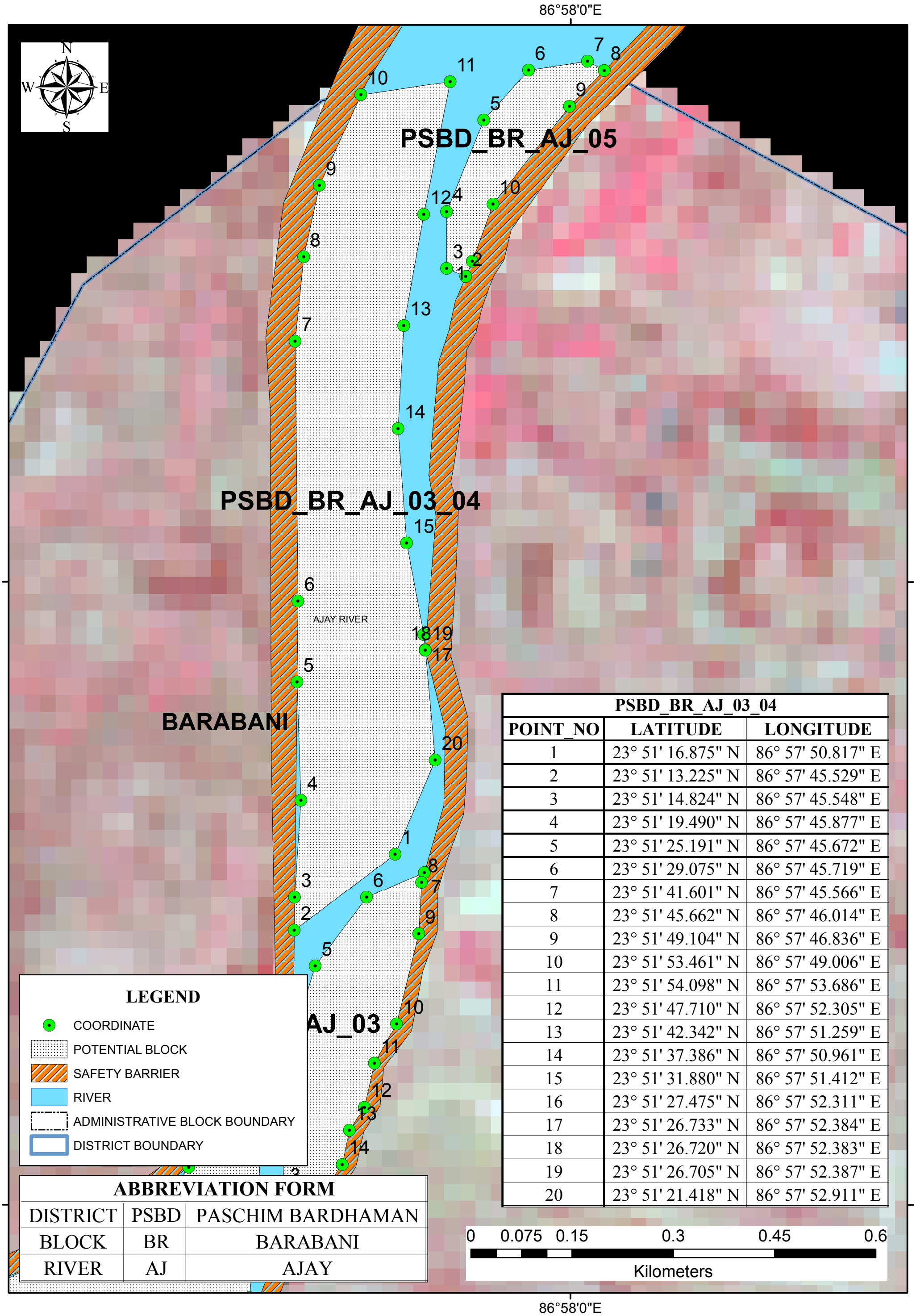
POTENTIAL BLOCK PSBD_BR_AJ_03 OF AJAY RIVER



PSBD_BR_AJ_03		
POINT_NO	LATITUDE	LONGITUDE
1	23° 50' 59.428" N	86° 57' 46.105" E
2	23° 50' 58.697" N	86° 57' 45.336" E
3	23° 51' 0.631" N	86° 57' 44.985" E
4	23° 51' 6.137" N	86° 57' 44.833" E
5	23° 51' 11.506" N	86° 57' 46.628" E
6	23° 51' 14.810" N	86° 57' 49.321" E
7	23° 51' 16.003" N	86° 57' 52.345" E
8	23° 51' 15.535" N	86° 57' 52.199" E
9	23° 51' 13.057" N	86° 57' 52.050" E
10	23° 51' 8.721" N	86° 57' 50.891" E
11	23° 51' 6.828" N	86° 57' 49.732" E
12	23° 51' 4.694" N	86° 57' 49.209" E
13	23° 51' 3.593" N	86° 57' 48.423" E
14	23° 51' 1.941" N	86° 57' 48.050" E

ABBREVIATION FORM		
DISTRICT	PSBD	PASCHIM BARDHAMAN
BLOCK	BR	BARABANI
RIVER	AJ	AJAY

POTENTIAL BLOCK PSBD_BR_AJ_03_04 OF AJAY RIVER



PSBD_BR_AJ_03_04		
POINT_NO	LATITUDE	LONGITUDE
1	23° 51' 16.875" N	86° 57' 50.817" E
2	23° 51' 13.225" N	86° 57' 45.529" E
3	23° 51' 14.824" N	86° 57' 45.548" E
4	23° 51' 19.490" N	86° 57' 45.877" E
5	23° 51' 25.191" N	86° 57' 45.672" E
6	23° 51' 29.075" N	86° 57' 45.719" E
7	23° 51' 41.601" N	86° 57' 45.566" E
8	23° 51' 45.662" N	86° 57' 46.014" E
9	23° 51' 49.104" N	86° 57' 46.836" E
10	23° 51' 53.461" N	86° 57' 49.006" E
11	23° 51' 54.098" N	86° 57' 53.686" E
12	23° 51' 47.710" N	86° 57' 52.305" E
13	23° 51' 42.342" N	86° 57' 51.259" E
14	23° 51' 37.386" N	86° 57' 50.961" E
15	23° 51' 31.880" N	86° 57' 51.412" E
16	23° 51' 27.475" N	86° 57' 52.311" E
17	23° 51' 26.733" N	86° 57' 52.384" E
18	23° 51' 26.720" N	86° 57' 52.383" E
19	23° 51' 26.705" N	86° 57' 52.387" E
20	23° 51' 21.418" N	86° 57' 52.911" E

ABBREVIATION FORM		
DISTRICT	PSBD	PASCHIM BARDHAMAN
BLOCK	BR	BARABANI
RIVER	AJ	AJAY

POTENTIAL BLOCK PSBD_BR_AJ_05 OF AJAY RIVER

86°57'30"E 86°58'0"E 86°58'30"E

23°52'0"N

N W E S

AJAY RIVER

PSBD_BR_AJ_05

PSBD_BR_AJ_03_04

ANI

PSBD_BR_AJ_05		
POINT_NO	LATITUDE	LONGITUDE
1	23° 51' 45.441" N	86° 57' 54.848" E
2	23° 51' 44.708" N	86° 57' 54.506" E
3	23° 51' 45.095" N	86° 57' 53.504" E
4	23° 51' 47.848" N	86° 57' 53.503" E
5	23° 51' 52.254" N	86° 57' 55.447" E
6	23° 51' 54.657" N	86° 57' 57.792" E
7	23° 51' 55.077" N	86° 58' 0.881" E
8	23° 51' 54.641" N	86° 58' 1.759" E
9	23° 51' 52.910" N	86° 57' 59.935" E
10	23° 51' 48.195" N	86° 57' 55.932" E

LEGEND

- COORDINATE
- POTENTIAL BLOCK
- SAFETY BARRIER
- RIVER
- ADMINISTRATIVE BLOCK BOUNDARY
- DISTRICT BOUNDARY

ABBREVIATION FORM		
DISTRICT	PSBD	PASCHIM BARDHAMAN
BLOCK	BR	BARABANI
RIVER	AJ	AJAY

0 0.1 0.2 0.4 0.6 0.8

Kilometers

23°51'30"N

86°57'30"E 86°58'0"E 86°58'30"E

POTENTIAL BLOCK PSBD_JM_AJ_06 OF AJAY RIVER

87°4'0"E 87°4'30"E 87°5'0"E

23°48'30"N

PSBD_JM_AJ_06		
POINT_NO	LATITUDE	LONGITUDE
1	23° 48' 32.798" N	87° 4' 35.784" E
2	23° 48' 21.146" N	87° 4' 59.761" E
3	23° 48' 21.232" N	87° 4' 59.055" E
4	23° 48' 21.097" N	87° 4' 53.594" E
5	23° 48' 26.333" N	87° 4' 43.648" E
6	23° 48' 28.884" N	87° 4' 35.421" E
7	23° 48' 34.670" N	87° 4' 26.447" E
8	23° 48' 39.421" N	87° 4' 22.185" E
9	23° 48' 45.448" N	87° 4' 14.428" E
10	23° 48' 44.423" N	87° 4' 21.969" E
11	23° 48' 34.149" N	87° 4' 34.179" E

ABBREVIATION FORM		
DISTRICT	PSBD	PASCHIM BARDHAMAN
BLOCK	JM	JAMURIA
RIVER	AJ	AJAY

AJAY RIVER

PSBD_JM_AJ_06

URIA

LEGEND

- COORDINATE
- POTENTIAL BLOCK
- SAFETY BARRIER
- RIVER
- ADMINISTRATIVE BLOCK BOUNDARY
- DISTRICT BOUNDARY

0 0.1 0.2 0.4 0.6 0.8

Kilometers

87°4'0"E 87°4'30"E 87°5'0"E

POTENTIAL BLOCK PSBD_JM_AJ_07 OF AJAY RIVER

87°5'30"E 87°6'0"E 87°6'30"E

23°48'0"N 23°47'30"N 23°47'0"N

AJAY RIVER

PSBD_JM_AJ_07

N W E S

PSBD_JM_AJ_07		
POINT_NO	LATITUDE	LONGITUDE
1	23° 46' 50.471" N	87° 6' 27.482" E
2	23° 46' 43.799" N	87° 6' 31.720" E
3	23° 46' 47.708" N	87° 6' 28.745" E
4	23° 46' 52.874" N	87° 6' 23.589" E
5	23° 46' 56.799" N	87° 6' 20.002" E
6	23° 47' 4.236" N	87° 6' 15.221" E
7	23° 47' 13.256" N	87° 6' 10.441" E
8	23° 47' 19.728" N	87° 6' 6.632" E
9	23° 47' 24.961" N	87° 6' 3.046" E
10	23° 47' 30.953" N	87° 5' 58.188" E
11	23° 47' 36.601" N	87° 5' 51.386" E
12	23° 47' 41.147" N	87° 5' 45.031" E
13	23° 47' 43.696" N	87° 5' 41.966" E
14	23° 47' 52.646" N	87° 5' 38.308" E
15	23° 47' 56.157" N	87° 5' 37.487" E
16	23° 48' 0.532" N	87° 5' 34.576" E
17	23° 48' 0.046" N	87° 5' 35.029" E
18	23° 47' 52.691" N	87° 5' 41.895" E
19	23° 47' 46.067" N	87° 5' 47.024" E
20	23° 47' 32.850" N	87° 5' 57.258" E
21	23° 47' 24.888" N	87° 6' 3.423" E
22	23° 47' 15.998" N	87° 6' 10.306" E
23	23° 47' 15.998" N	87° 6' 10.306" E
24	23° 47' 15.997" N	87° 6' 10.307" E
25	23° 47' 15.195" N	87° 6' 10.928" E
26	23° 47' 9.096" N	87° 6' 15.650" E
27	23° 47' 4.784" N	87° 6' 18.390" E
28	23° 47' 0.117" N	87° 6' 21.354" E
29	23° 46' 56.590" N	87° 6' 23.595" E

ABBREVIATION FORM		
DISTRICT	PSBD	PASCHIM BARDHAMAN
BLOCK	JM	JAMURIA
RIVER	AJ	AJAY

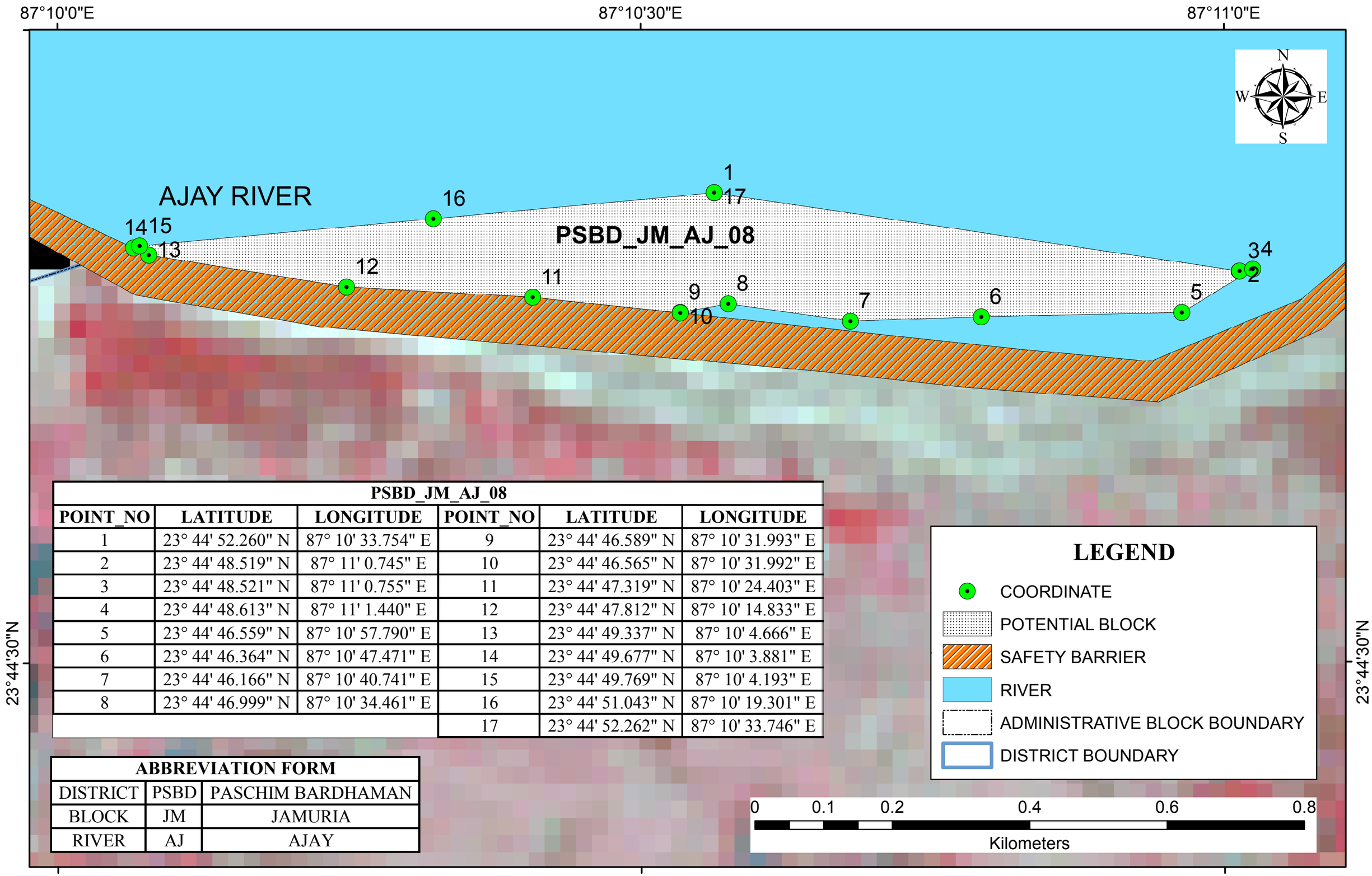
LEGEND

- COORDINATE
- POTENTIAL BLOCK
- SAFETY BARRIER
- RIVER
- ADMINISTRATIVE BLOCK BOUNDARY
- DISTRICT BOUNDARY

0 0.1 0.2 0.4 0.6 0.8

Kilometers

POTENTIAL BLOCK PSBD_JM_AJ_08 OF AJAY RIVER



PSBD_JM_AJ_08					
POINT_NO	LATITUDE	LONGITUDE	POINT_NO	LATITUDE	LONGITUDE
1	23° 44' 52.260" N	87° 10' 33.754" E	9	23° 44' 46.589" N	87° 10' 31.993" E
2	23° 44' 48.519" N	87° 11' 0.745" E	10	23° 44' 46.565" N	87° 10' 31.992" E
3	23° 44' 48.521" N	87° 11' 0.755" E	11	23° 44' 47.319" N	87° 10' 24.403" E
4	23° 44' 48.613" N	87° 11' 1.440" E	12	23° 44' 47.812" N	87° 10' 14.833" E
5	23° 44' 46.559" N	87° 10' 57.790" E	13	23° 44' 49.337" N	87° 10' 4.666" E
6	23° 44' 46.364" N	87° 10' 47.471" E	14	23° 44' 49.677" N	87° 10' 3.881" E
7	23° 44' 46.166" N	87° 10' 40.741" E	15	23° 44' 49.769" N	87° 10' 4.193" E
8	23° 44' 46.999" N	87° 10' 34.461" E	16	23° 44' 51.043" N	87° 10' 19.301" E
			17	23° 44' 52.262" N	87° 10' 33.746" E

ABBREVIATION FORM		
DISTRICT	PSBD	PASCHIM BARDHAMAN
BLOCK	JM	JAMURIA
RIVER	AJ	AJAY

LEGEND

- COORDINATE
- POTENTIAL BLOCK
- SAFETY BARRIER
- RIVER
- ADMINISTRATIVE BLOCK BOUNDARY
- DISTRICT BOUNDARY

POTENTIAL BLOCK PSBD_KN_AJ_11 OF AJAY RIVER

87°24'30"E

87°25'0"E

23°40'0"N

PSBD_KN_AJ_11		
POINT_NO	LATITUDE	LONGITUDE
1	23° 40' 15.079" N	87° 24' 50.412" E
2	23° 40' 12.889" N	87° 24' 47.747" E
3	23° 40' 14.085" N	87° 24' 48.726" E
4	23° 40' 16.626" N	87° 24' 50.752" E
5	23° 40' 19.305" N	87° 24' 52.628" E
6	23° 40' 21.436" N	87° 24' 53.756" E
7	23° 40' 23.272" N	87° 24' 54.841" E
8	23° 40' 21.112" N	87° 24' 55.569" E
9	23° 40' 19.810" N	87° 24' 55.068" E

ABBREVIATION FORM		
DISTRICT	PSBD	PASCHIM BARDHAMAN
BLOCK	KN	KANSA
RIVER	AJ	AJAY

PSBD_KN_AJ_11

PSBD_KN_AJ_12

AJAY RIVER

1 2 3 4 5 6 7 8 9 11 14

N W E S

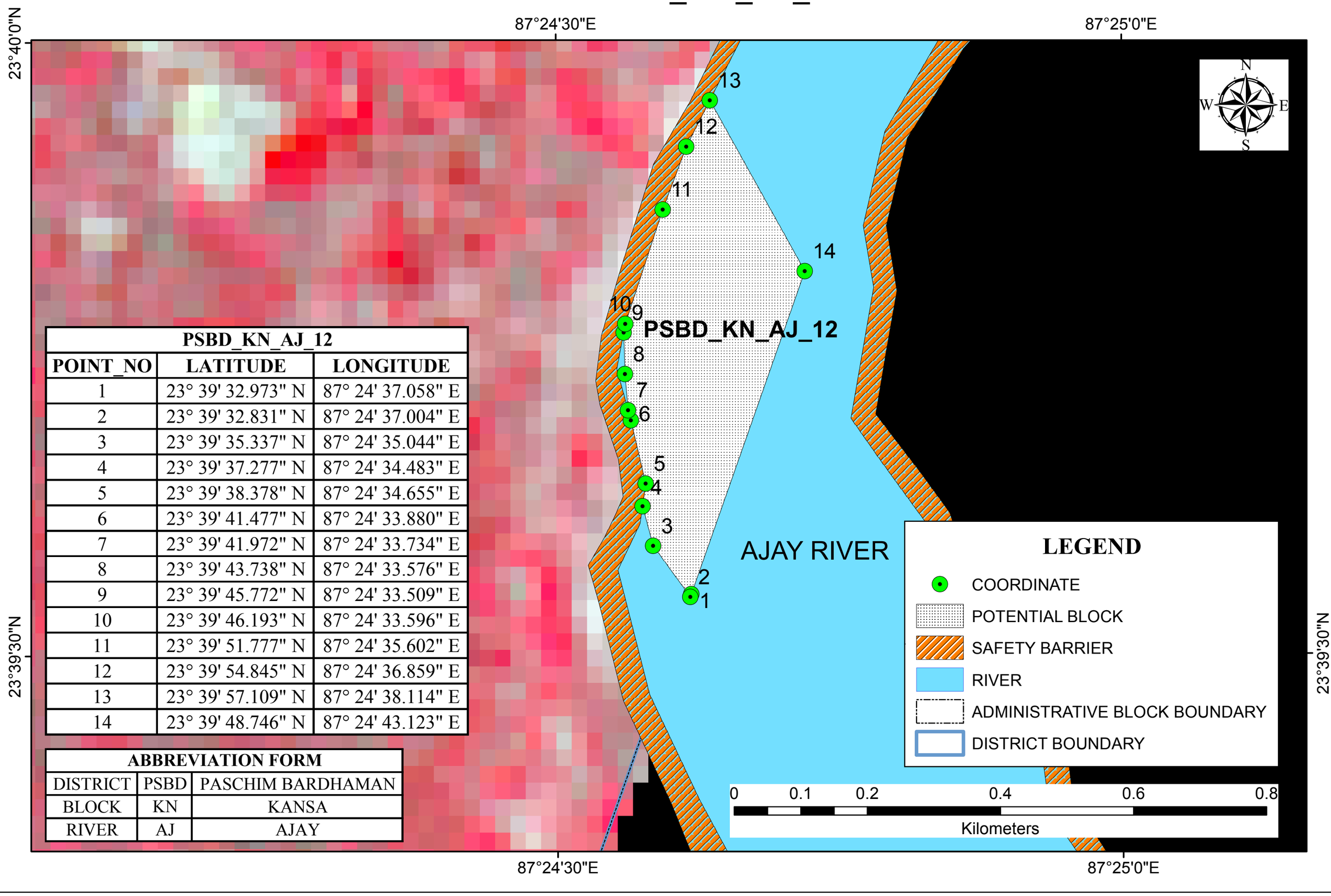
LEGEND

- COORDINATE
- POTENTIAL BLOCK
- SAFETY BARRIER
- RIVER
- ADMINISTRATIVE BLOCK BOUNDARY
- DISTRICT BOUNDARY

0 0.1 0.2 0.4 0.6 0.8

Kilometers

POTENTIAL BLOCK PSBD_KN_AJ_12 OF AJAY RIVER



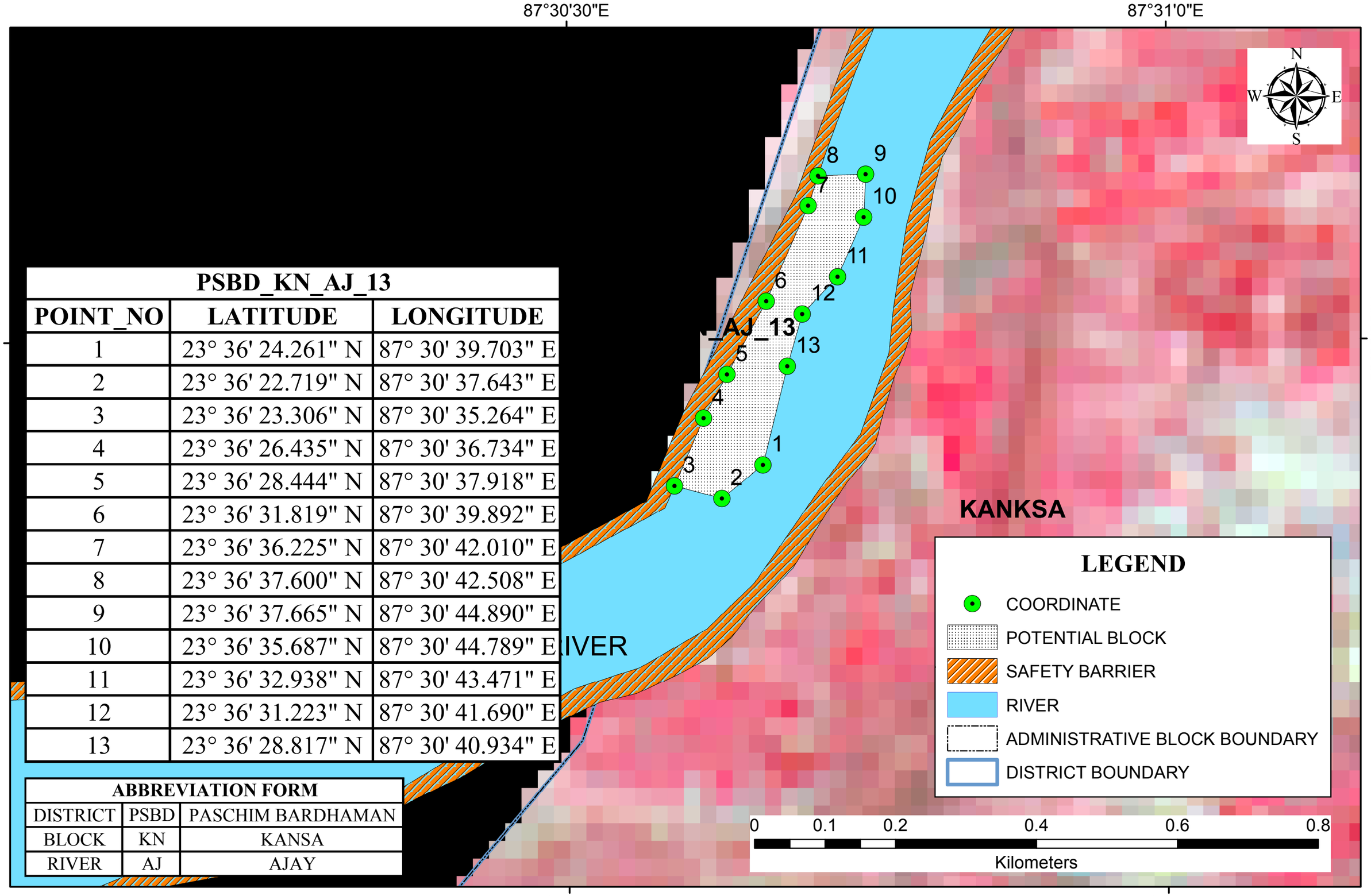
PSBD_KN_AJ_12		
POINT_NO	LATITUDE	LONGITUDE
1	23° 39' 32.973" N	87° 24' 37.058" E
2	23° 39' 32.831" N	87° 24' 37.004" E
3	23° 39' 35.337" N	87° 24' 35.044" E
4	23° 39' 37.277" N	87° 24' 34.483" E
5	23° 39' 38.378" N	87° 24' 34.655" E
6	23° 39' 41.477" N	87° 24' 33.880" E
7	23° 39' 41.972" N	87° 24' 33.734" E
8	23° 39' 43.738" N	87° 24' 33.576" E
9	23° 39' 45.772" N	87° 24' 33.509" E
10	23° 39' 46.193" N	87° 24' 33.596" E
11	23° 39' 51.777" N	87° 24' 35.602" E
12	23° 39' 54.845" N	87° 24' 36.859" E
13	23° 39' 57.109" N	87° 24' 38.114" E
14	23° 39' 48.746" N	87° 24' 43.123" E

ABBREVIATION FORM		
DISTRICT	PSBD	PASCHIM BARDHAMAN
BLOCK	KN	KANSA
RIVER	AJ	AJAY

POTENTIAL BLOCK PSBD_KN_AJ_13 OF AJAY RIVER

PSBD_KN_AJ_13		
POINT_NO	LATITUDE	LONGITUDE
1	23° 36' 24.261" N	87° 30' 39.703" E
2	23° 36' 22.719" N	87° 30' 37.643" E
3	23° 36' 23.306" N	87° 30' 35.264" E
4	23° 36' 26.435" N	87° 30' 36.734" E
5	23° 36' 28.444" N	87° 30' 37.918" E
6	23° 36' 31.819" N	87° 30' 39.892" E
7	23° 36' 36.225" N	87° 30' 42.010" E
8	23° 36' 37.600" N	87° 30' 42.508" E
9	23° 36' 37.665" N	87° 30' 44.890" E
10	23° 36' 35.687" N	87° 30' 44.789" E
11	23° 36' 32.938" N	87° 30' 43.471" E
12	23° 36' 31.223" N	87° 30' 41.690" E
13	23° 36' 28.817" N	87° 30' 40.934" E

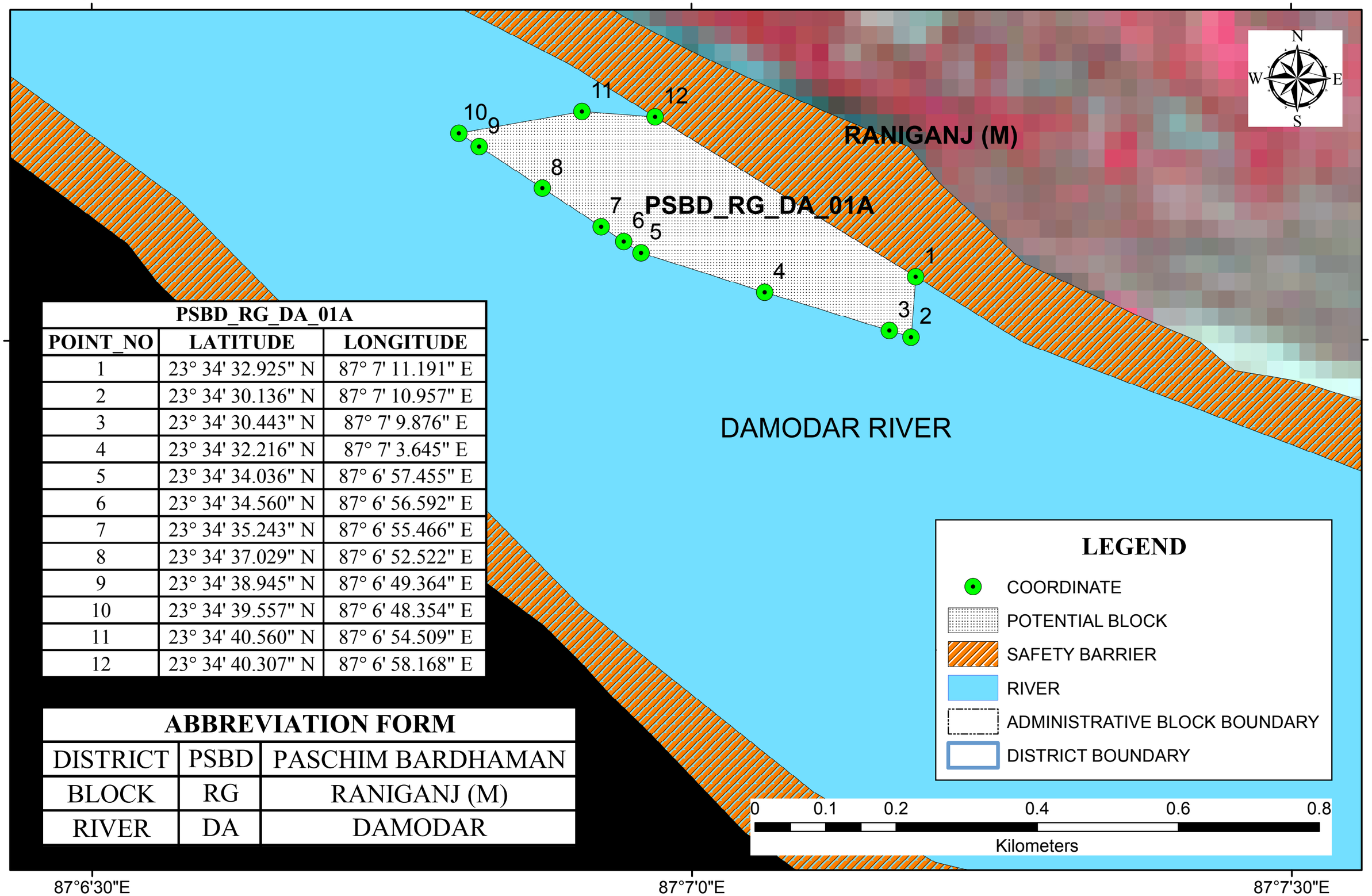
ABBREVIATION FORM		
DISTRICT	PSBD	PASCHIM BARDHAMAN
BLOCK	KN	KANSA
RIVER	AJ	AJAY



POTENTIAL BLOCK PSBD_RG_DA_01A OF DAMODAR RIVER

87°6'30"E 87°7'0"E 87°7'30"E

23°34'30"N

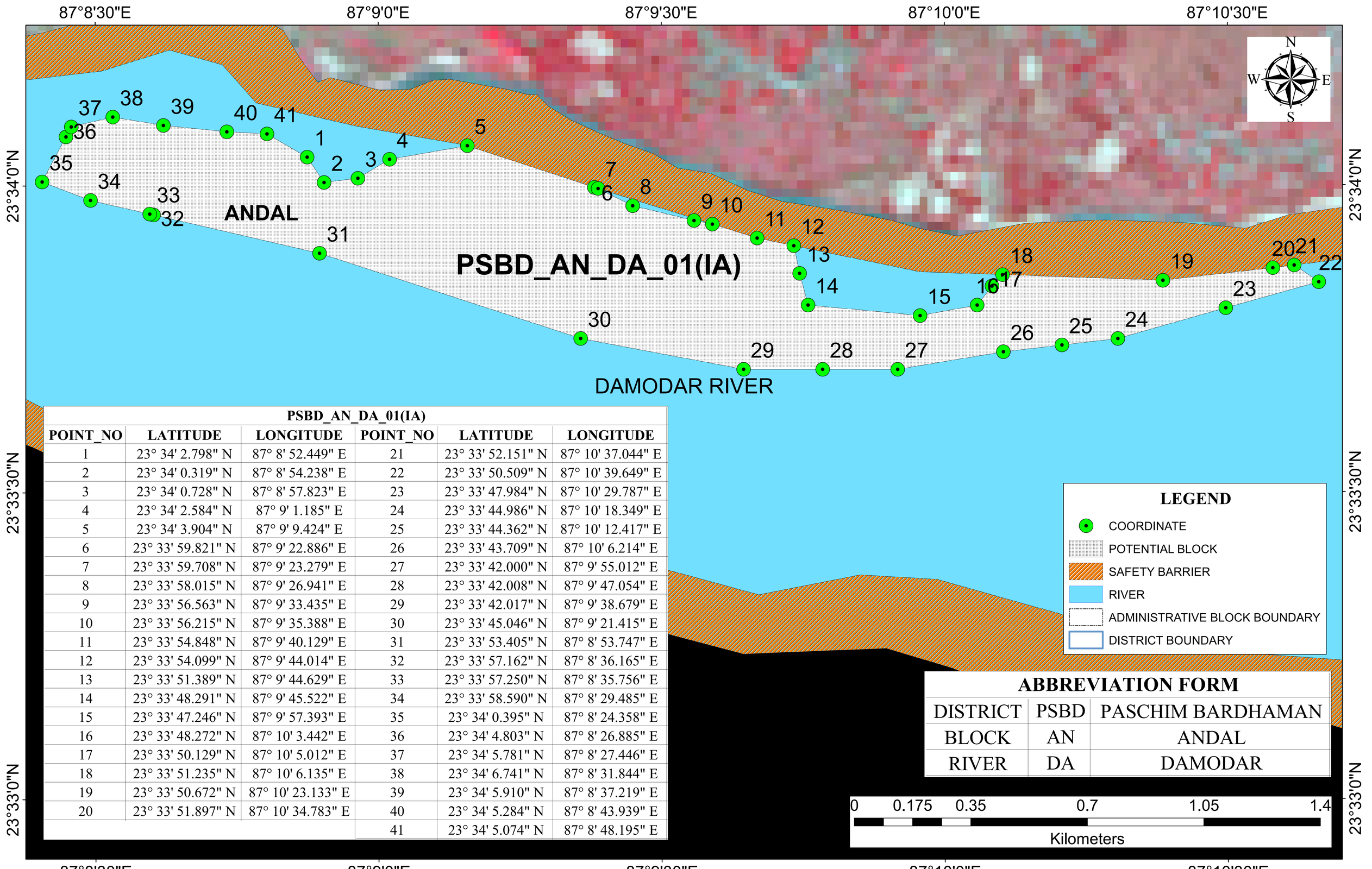


PSBD_RG_DA_01A		
POINT_NO	LATITUDE	LONGITUDE
1	23° 34' 32.925" N	87° 7' 11.191" E
2	23° 34' 30.136" N	87° 7' 10.957" E
3	23° 34' 30.443" N	87° 7' 9.876" E
4	23° 34' 32.216" N	87° 7' 3.645" E
5	23° 34' 34.036" N	87° 6' 57.455" E
6	23° 34' 34.560" N	87° 6' 56.592" E
7	23° 34' 35.243" N	87° 6' 55.466" E
8	23° 34' 37.029" N	87° 6' 52.522" E
9	23° 34' 38.945" N	87° 6' 49.364" E
10	23° 34' 39.557" N	87° 6' 48.354" E
11	23° 34' 40.560" N	87° 6' 54.509" E
12	23° 34' 40.307" N	87° 6' 58.168" E

ABBREVIATION FORM		
DISTRICT	PSBD	PASCHIM BARDHAMAN
BLOCK	RG	RANIGANJ (M)
RIVER	DA	DAMODAR

87°6'30"E 87°7'0"E 87°7'30"E

POTENTIAL BLOCK PSBD_AN_DA_01(IA) OF DAMODAR RIVER



PSBD_AN_DA_01(IA)

POINT_NO	LATITUDE	LONGITUDE	POINT_NO	LATITUDE	LONGITUDE
1	23° 34' 2.798" N	87° 8' 52.449" E	21	23° 33' 52.151" N	87° 10' 37.044" E
2	23° 34' 0.319" N	87° 8' 54.238" E	22	23° 33' 50.509" N	87° 10' 39.649" E
3	23° 34' 0.728" N	87° 8' 57.823" E	23	23° 33' 47.984" N	87° 10' 29.787" E
4	23° 34' 2.584" N	87° 9' 1.185" E	24	23° 33' 44.986" N	87° 10' 18.349" E
5	23° 34' 3.904" N	87° 9' 9.424" E	25	23° 33' 44.362" N	87° 10' 12.417" E
6	23° 33' 59.821" N	87° 9' 22.886" E	26	23° 33' 43.709" N	87° 10' 6.214" E
7	23° 33' 59.708" N	87° 9' 23.279" E	27	23° 33' 42.000" N	87° 9' 55.012" E
8	23° 33' 58.015" N	87° 9' 26.941" E	28	23° 33' 42.008" N	87° 9' 47.054" E
9	23° 33' 56.563" N	87° 9' 33.435" E	29	23° 33' 42.017" N	87° 9' 38.679" E
10	23° 33' 56.215" N	87° 9' 35.388" E	30	23° 33' 45.046" N	87° 9' 21.415" E
11	23° 33' 54.848" N	87° 9' 40.129" E	31	23° 33' 53.405" N	87° 8' 53.747" E
12	23° 33' 54.099" N	87° 9' 44.014" E	32	23° 33' 57.162" N	87° 8' 36.165" E
13	23° 33' 51.389" N	87° 9' 44.629" E	33	23° 33' 57.250" N	87° 8' 35.756" E
14	23° 33' 48.291" N	87° 9' 45.522" E	34	23° 33' 58.590" N	87° 8' 29.485" E
15	23° 33' 47.246" N	87° 9' 57.393" E	35	23° 34' 0.395" N	87° 8' 24.358" E
16	23° 33' 48.272" N	87° 10' 3.442" E	36	23° 34' 4.803" N	87° 8' 26.885" E
17	23° 33' 50.129" N	87° 10' 5.012" E	37	23° 34' 5.781" N	87° 8' 27.446" E
18	23° 33' 51.235" N	87° 10' 6.135" E	38	23° 34' 6.741" N	87° 8' 31.844" E
19	23° 33' 50.672" N	87° 10' 23.133" E	39	23° 34' 5.910" N	87° 8' 37.219" E
20	23° 33' 51.897" N	87° 10' 34.783" E	40	23° 34' 5.284" N	87° 8' 43.939" E
			41	23° 34' 5.074" N	87° 8' 48.195" E

ABBREVIATION FORM

DISTRICT	PSBD	PASCHIM BARDHAMAN
BLOCK	AN	ANDAL
RIVER	DA	DAMODAR

POTENTIAL BLOCK PSBD_AN_DA_01(IB) OF DAMODAR RIVER

87°11'0"E

87°11'30"E

23°33'30"N

ANDAL

PSBD_AN_DA_01(IB)

DAMODAR RIVER

PSBD_AN_DA_01(IB)		
POINT_NO	LATITUDE	LONGITUDE
1	23° 33' 42.329" N	87° 11' 32.037" E
2	23° 33' 41.227" N	87° 11' 29.842" E
3	23° 33' 42.140" N	87° 11' 28.197" E
4	23° 33' 48.087" N	87° 11' 17.477" E
5	23° 33' 49.885" N	87° 11' 0.590" E
6	23° 33' 50.074" N	87° 10' 54.732" E
7	23° 33' 50.203" N	87° 10' 50.734" E
8	23° 33' 53.192" N	87° 10' 46.338" E
9	23° 33' 53.328" N	87° 10' 47.553" E
10	23° 33' 52.278" N	87° 11' 2.784" E
11	23° 33' 49.990" N	87° 11' 16.669" E
12	23° 33' 45.435" N	87° 11' 26.743" E

ABBREVIATION FORM		
DISTRICT	PSBD	PASCHIM BARDHAMAN
BLOCK	AN	ANDAL
RIVER	DA	DAMODAR

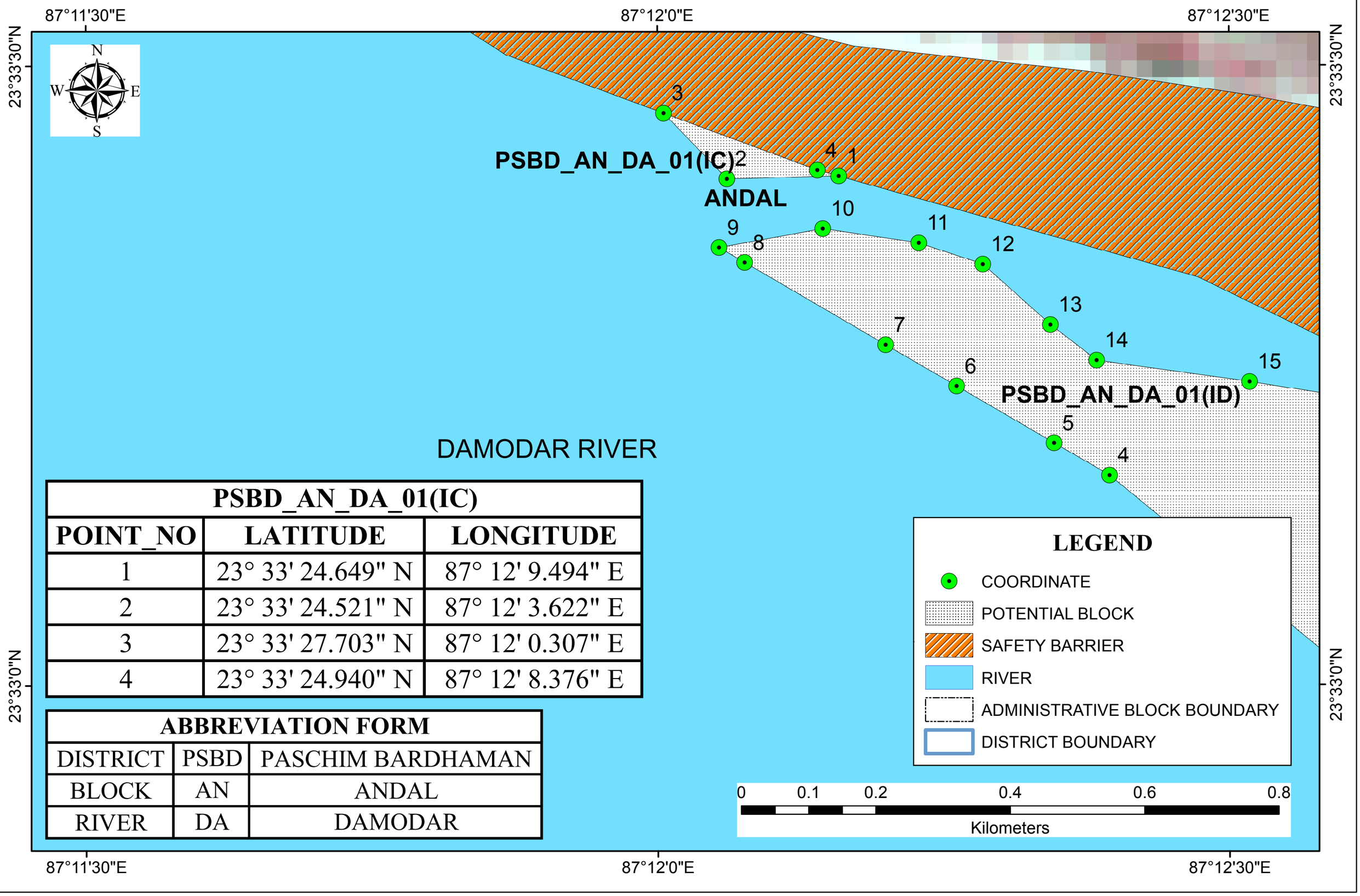
LEGEND

- COORDINATE
- POTENTIAL BLOCK
- SAFETY BARRIER
- RIVER
- ADMINISTRATIVE BLOCK BOUNDARY
- DISTRICT BOUNDARY

0 0.1 0.2 0.4 0.6 0.8

Kilometers

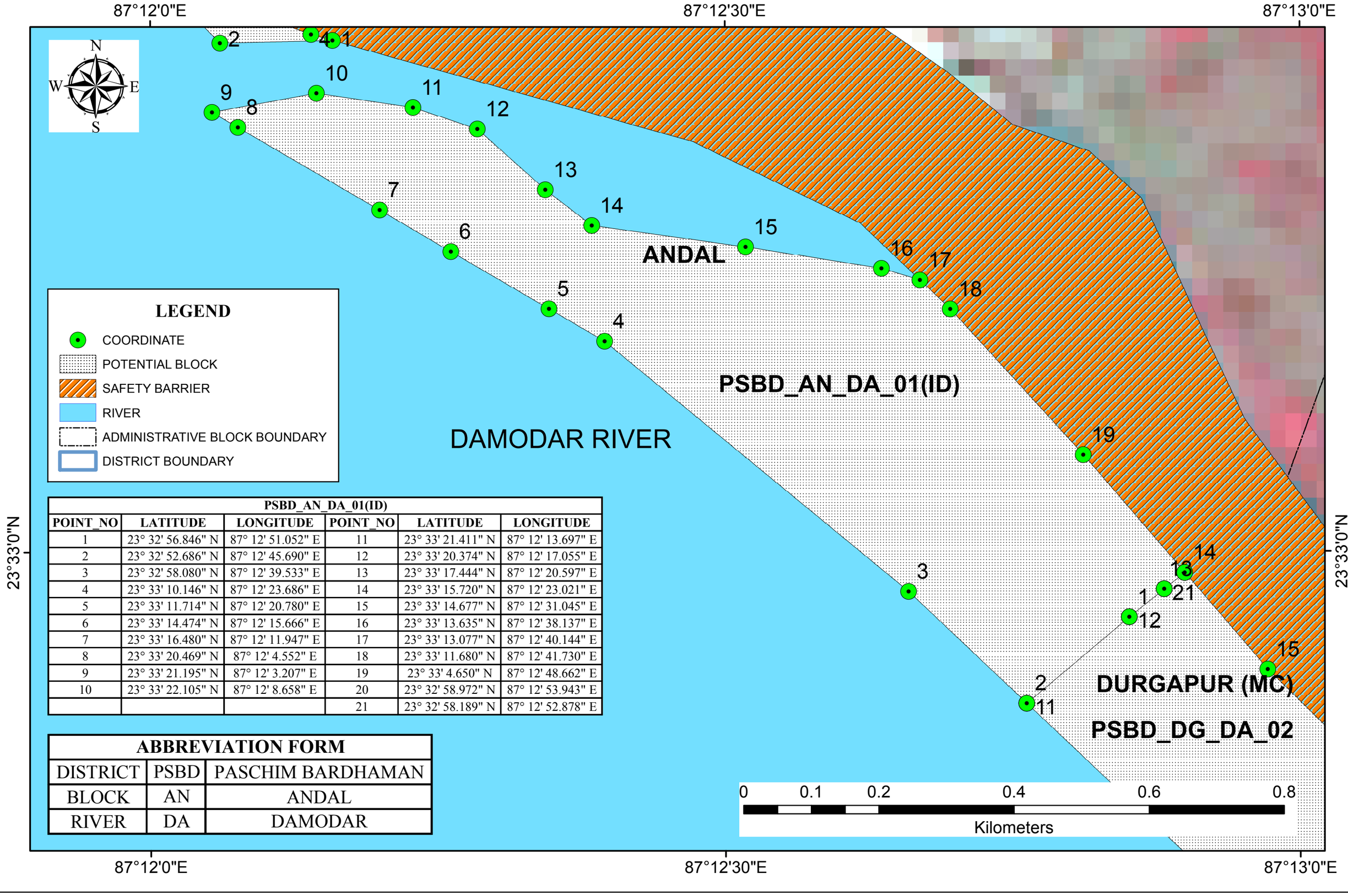
POTENTIAL BLOCK PSBD_AN_DA_01(IC) OF DAMODAR RIVER



PSBD_AN_DA_01(IC)		
POINT_NO	LATITUDE	LONGITUDE
1	23° 33' 24.649" N	87° 12' 9.494" E
2	23° 33' 24.521" N	87° 12' 3.622" E
3	23° 33' 27.703" N	87° 12' 0.307" E
4	23° 33' 24.940" N	87° 12' 8.376" E

ABBREVIATION FORM		
DISTRICT	PSBD	PASCHIM BARDHAMAN
BLOCK	AN	ANDAL
RIVER	DA	DAMODAR

POTENTIAL BLOCK PSBD_AN_DA_01(ID) OF DAMODAR RIVER



PSBD_AN_DA_01(ID)					
POINT_NO	LATITUDE	LONGITUDE	POINT_NO	LATITUDE	LONGITUDE
1	23° 32' 56.846" N	87° 12' 51.052" E	11	23° 33' 21.411" N	87° 12' 13.697" E
2	23° 32' 52.686" N	87° 12' 45.690" E	12	23° 33' 20.374" N	87° 12' 17.055" E
3	23° 32' 58.080" N	87° 12' 39.533" E	13	23° 33' 17.444" N	87° 12' 20.597" E
4	23° 33' 10.146" N	87° 12' 23.686" E	14	23° 33' 15.720" N	87° 12' 23.021" E
5	23° 33' 11.714" N	87° 12' 20.780" E	15	23° 33' 14.677" N	87° 12' 31.045" E
6	23° 33' 14.474" N	87° 12' 15.666" E	16	23° 33' 13.635" N	87° 12' 38.137" E
7	23° 33' 16.480" N	87° 12' 11.947" E	17	23° 33' 13.077" N	87° 12' 40.144" E
8	23° 33' 20.469" N	87° 12' 4.552" E	18	23° 33' 11.680" N	87° 12' 41.730" E
9	23° 33' 21.195" N	87° 12' 3.207" E	19	23° 33' 4.650" N	87° 12' 48.662" E
10	23° 33' 22.105" N	87° 12' 8.658" E	20	23° 32' 58.972" N	87° 12' 53.943" E
			21	23° 32' 58.189" N	87° 12' 52.878" E

ABBREVIATION FORM		
DISTRICT	PSBD	PASCHIM BARDHAMAN
BLOCK	AN	ANDAL
RIVER	DA	DAMODAR

POTENTIAL BLOCK PSBD_DG_DA_02 OF DAMODAR RIVER

87°12'30"E 87°13'0"E 87°13'30"E 87°14'0"E 87°14'30"E

23°33'0"N 23°32'30"N 23°32'0"N

ANDAL

PSBD_AN_DA_01(ID)

PSBD_DG_DA_02

PSBD_DG_DA_02A

DURGAPUR (MC)

N W E S

ABBREVIATION FORM		
DISTRICT	PSBD	PASCHIM BARDHAMAN
BLOCK	DG	DURGAPUR (MC)
RIVER	DA	DAMODAR

PSBD_DG_DA_02

POINT_NO	LATITUDE	LONGITUDE	POINT_NO	LATITUDE	LONGITUDE
1	23° 32' 0.161" N	87° 13' 49.535" E	13	23° 32' 58.189" N	87° 12' 52.878" E
2	23° 31' 55.756" N	87° 13' 53.843" E	14	23° 32' 58.972" N	87° 12' 53.943" E
3	23° 31' 56.742" N	87° 13' 51.784" E	15	23° 32' 54.312" N	87° 12' 58.277" E
4	23° 32' 2.444" N	87° 13' 39.875" E	16	23° 32' 47.924" N	87° 13' 5.270" E
5	23° 32' 7.247" N	87° 13' 29.842" E	17	23° 32' 44.272" N	87° 13' 7.617" E
6	23° 32' 16.697" N	87° 13' 21.085" E	18	23° 32' 38.070" N	87° 13' 12.833" E
7	23° 32' 25.339" N	87° 13' 13.075" E	19	23° 32' 32.215" N	87° 13' 16.556" E
8	23° 32' 30.505" N	87° 13' 8.328" E	20	23° 32' 26.187" N	87° 13' 20.092" E
9	23° 32' 40.388" N	87° 12' 59.244" E	21	23° 32' 21.539" N	87° 13' 21.391" E
10	23° 32' 42.569" N	87° 12' 57.239" E	22	23° 32' 17.575" N	87° 13' 25.490" E
11	23° 32' 52.686" N	87° 12' 45.690" E	23	23° 32' 11.372" N	87° 13' 31.452" E
12	23° 32' 56.846" N	87° 12' 51.052" E	24	23° 32' 4.821" N	87° 13' 40.025" E

LEGEND

- COORDINATE
- POTENTIAL BLOCK
- SAFETY BARRIER
- RIVER
- ADMINISTRATIVE BLOCK BOUNDARY
- DISTRICT BOUNDARY

0 0.175 0.35 0.7 1.05 1.4

Kilometers

POTENTIAL BLOCK PSBD_DG_DA_02A OF DAMODAR RIVER

87°13'0"E 87°13'30"E 87°14'0"E

23°32'30"N 23°32'0"N

PSBD_DG_DA_02A		
POINT_NO	LATITUDE	LONGITUDE
1	23° 32' 13.871" N	87° 13' 44.286" E
2	23° 32' 11.698" N	87° 13' 43.770" E
3	23° 32' 11.878" N	87° 13' 38.358" E
4	23° 32' 13.261" N	87° 13' 33.881" E
5	23° 32' 16.365" N	87° 13' 29.594" E
6	23° 32' 19.462" N	87° 13' 30.159" E
7	23° 32' 22.215" N	87° 13' 30.164" E
8	23° 32' 24.459" N	87° 13' 25.128" E
9	23° 32' 28.422" N	87° 13' 21.402" E
10	23° 32' 33.243" N	87° 13' 19.544" E
11	23° 32' 34.308" N	87° 13' 20.297" E
12	23° 32' 19.981" N	87° 13' 36.518" E
13	23° 32' 13.981" N	87° 13' 44.122" E

ABBREVIATION FORM		
DISTRICT	PSBD	PASCHIM BARDHAMAN
BLOCK	DG	DURGAPUR (MC)
RIVER	DA	DAMODAR

DURGAPUR (MC)

PSBD_DG_DA_02A

PSBD_DG_DA_02

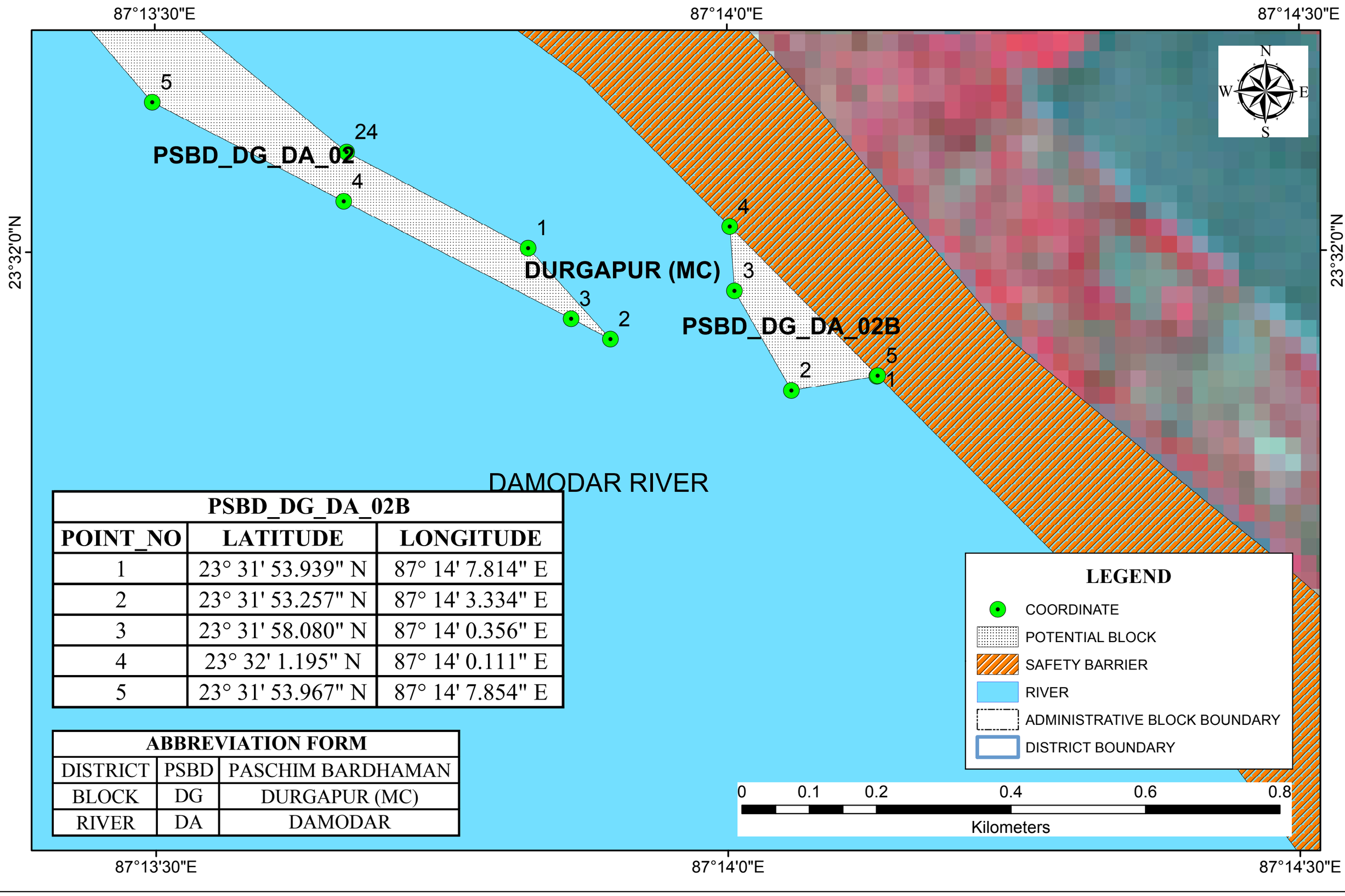
LEGEND

- COORDINATE
- POTENTIAL BLOCK
- SAFETY BARRIER
- RIVER
- ADMINISTRATIVE BLOCK BOUNDARY
- DISTRICT BOUNDARY

0 0.1 0.2 0.4 0.6 0.8

Kilometers

POTENTIAL BLOCK PSBD_DG_DA_02B OF DAMODAR RIVER



PSBD_DG_DA_02B		
POINT_NO	**LATITUDE**	**LONGITUDE**
1	23° 31' 53.939" N	87° 14' 7.814" E
2	23° 31' 53.257" N	87° 14' 3.334" E
3	23° 31' 58.080" N	87° 14' 0.356" E
4	23° 32' 1.195" N	87° 14' 0.111" E
5	23° 31' 53.967" N	87° 14' 7.854" E

ABBREVIATION FORM		
DISTRICT	PSBD	PASCHIM BARDHAMAN
BLOCK	DG	DURGAPUR (MC)
RIVER	DA	DAMODAR

POTENTIAL BLOCK PSBD_DG_DA_03 OF DAMODAR RIVER

87°15'0"E 87°15'30"E 87°16'0"E 87°16'30"E

23°30'30"N

23°30'0"N

DURGAPUR (MC)

PSBD_DG_DA_03

DAMODAR RIVER

PSBD_DG_DA_03					
TITUDE	LONGITUDE	POINT_NO	LATITUDE	LONGITUDE	
38.850" N	87° 15' 18.002" E	13	23° 30' 22.198" N	87° 15' 28.332" E	
946" N	87° 15' 25.834" E	14	23° 30' 23.624" N	87° 15' 20.911" E	
	7° 15' 29.194" E	15	23° 30' 24.555" N	87° 15' 19.905" E	
	15' 32.772" E	16	23° 30' 24.693" N	87° 15' 19.756" E	
	15' 49.315" E	17	23° 30' 28.822" N	87° 15' 16.410" E	
	16' 7.203" E	18	23° 30' 33.281" N	87° 15' 12.797" E	
	27.561" E	19	23° 30' 38.477" N	87° 15' 8.587" E	
	028" E	20	23° 30' 48.782" N	87° 15' 1.166" E	
	5" E	21	23° 30' 51.398" N	87° 14' 59.281" E	
		22	23° 30' 52.235" N	87° 14' 58.613" E	
		23	23° 30' 56.156" N	87° 14' 58.822" E	
		1	23° 30' 50.230" N	87° 15' 3.917" E	

LEGEND

- COORDINATE
- POTENTIAL BLOCK
- SAFETY BARRIER
- RIVER
- ADMINISTRATIVE BLOCK BOUNDARY
- DISTRICT BOUNDARY

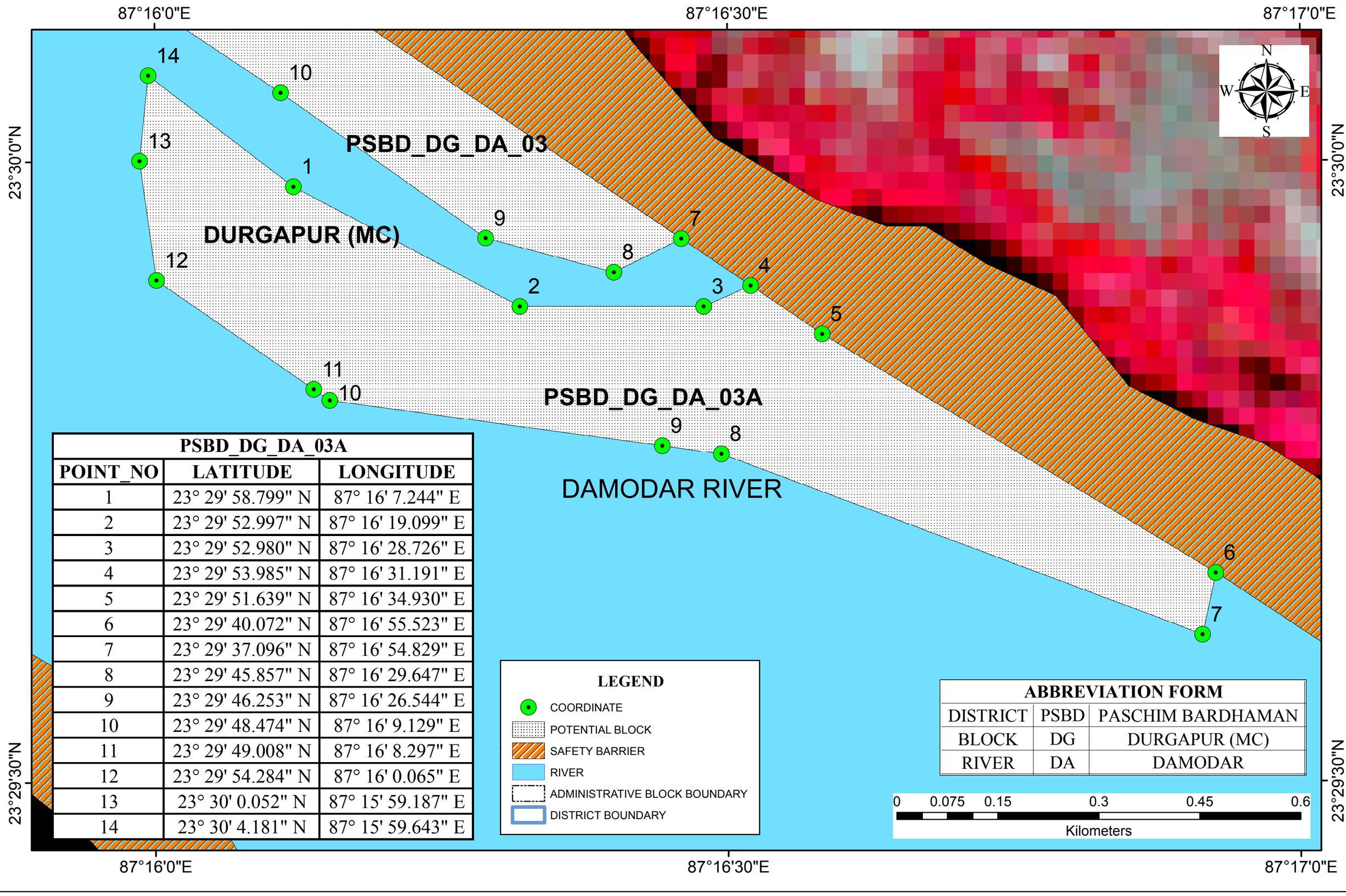
ABBREVIATION FORM		
DISTRICT	PSBD	PASCHIM BARDHAMAN
BLOCK	DG	DURGAPUR (MC)
RIVER	DA	DAMODAR

0 0.175 0.35 0.7 1.05 1.4

Kilometers

N S E W

POTENTIAL BLOCK PSBD_DG_DA_03A OF DAMODAR RIVER



PSBD_DG_DA_03A		
POINT_NO	LATITUDE	LONGITUDE
1	23° 29' 58.799" N	87° 16' 7.244" E
2	23° 29' 52.997" N	87° 16' 19.099" E
3	23° 29' 52.980" N	87° 16' 28.726" E
4	23° 29' 53.985" N	87° 16' 31.191" E
5	23° 29' 51.639" N	87° 16' 34.930" E
6	23° 29' 40.072" N	87° 16' 55.523" E
7	23° 29' 37.096" N	87° 16' 54.829" E
8	23° 29' 45.857" N	87° 16' 29.647" E
9	23° 29' 46.253" N	87° 16' 26.544" E
10	23° 29' 48.474" N	87° 16' 9.129" E
11	23° 29' 49.008" N	87° 16' 8.297" E
12	23° 29' 54.284" N	87° 16' 0.065" E
13	23° 30' 0.052" N	87° 15' 59.187" E
14	23° 30' 4.181" N	87° 15' 59.643" E

LEGEND

- COORDINATE
- POTENTIAL BLOCK
- SAFETY BARRIER
- RIVER
- ADMINISTRATIVE BLOCK BOUNDARY
- DISTRICT BOUNDARY

ABBREVIATION FORM		
DISTRICT	PSBD	PASCHIM BARDHAMAN
BLOCK	DG	DURGAPUR (MC)
RIVER	DA	DAMODAR

0 0.075 0.15 0.3 0.45 0.6

Kilometers

POTENTIAL BLOCK PSBD_KN_DA_04 OF DAMODAR RIVER

87°25'30"E

87°26'0"E

23°24'30"N

N

W

E

S

3

1

PSBD_KN_DA_04

2

KANKSA

DAMODAR RIVER

LEGEND

- COORDINATE
- POTENTIAL BLOCK
- SAFETY BARRIER
- RIVER
- ADMINISTRATIVE BLOCK BOUNDARY
- DISTRICT BOUNDARY

PSBD_KN_DA_04		
POINT_NO	LATITUDE	LONGITUDE
1	23° 24' 39.987" N	87° 25' 50.707" E
2	23° 24' 37.752" N	87° 25' 46.764" E
3	23° 24' 40.715" N	87° 25' 42.662" E

ABBREVIATION FORM		
DISTRICT	PSBD	PASCHIM BARDHAMAN
BLOCK	KN	KANSA
RIVER	DA	DAMODAR

0 0.1 0.2 0.4 0.6 0.8

Kilometers

POTENTIAL BLOCK PSBD_AS_BK_01 OF BARAKAR RIVER

86°47'30"E

86°48'0"E

23°42'0"N

ASANSOL (MC)

PSBD_AS_BK_01

BARAKAR RIVER

DAMODAR RIVER

PSBD_AS_BK_01		
POINT_NO	LATITUDE	LONGITUDE
1	23° 41' 46.292" N	86° 48' 0.323" E
2	23° 41' 45.638" N	86° 48' 0.898" E
3	23° 41' 47.264" N	86° 47' 51.809" E
4	23° 41' 49.977" N	86° 47' 49.560" E
5	23° 41' 53.244" N	86° 47' 47.967" E
6	23° 41' 57.974" N	86° 47' 46.932" E
7	23° 42' 1.587" N	86° 47' 46.552" E
8	23° 42' 3.482" N	86° 47' 48.044" E
9	23° 42' 3.744" N	86° 47' 51.127" E
10	23° 42' 2.886" N	86° 47' 52.053" E
11	23° 42' 0.653" N	86° 47' 52.468" E
12	23° 41' 47.960" N	86° 47' 59.327" E

ABBREVIATION FORM		
DISTRICT	PSBD	PASCHIM BARDHAMAN
BLOCK	AS	ASANSOL (MC)
RIVER	BK	BARAKAR

LEGEND

- COORDINATE
- POTENTIAL BLOCK
- SAFETY BARRIER
- RIVER
- ADMINISTRATIVE BLOCK BOUNDARY
- DISTRICT BOUNDARY

0 0.075 0.15 0.3 0.45 0.6

Kilometers

N

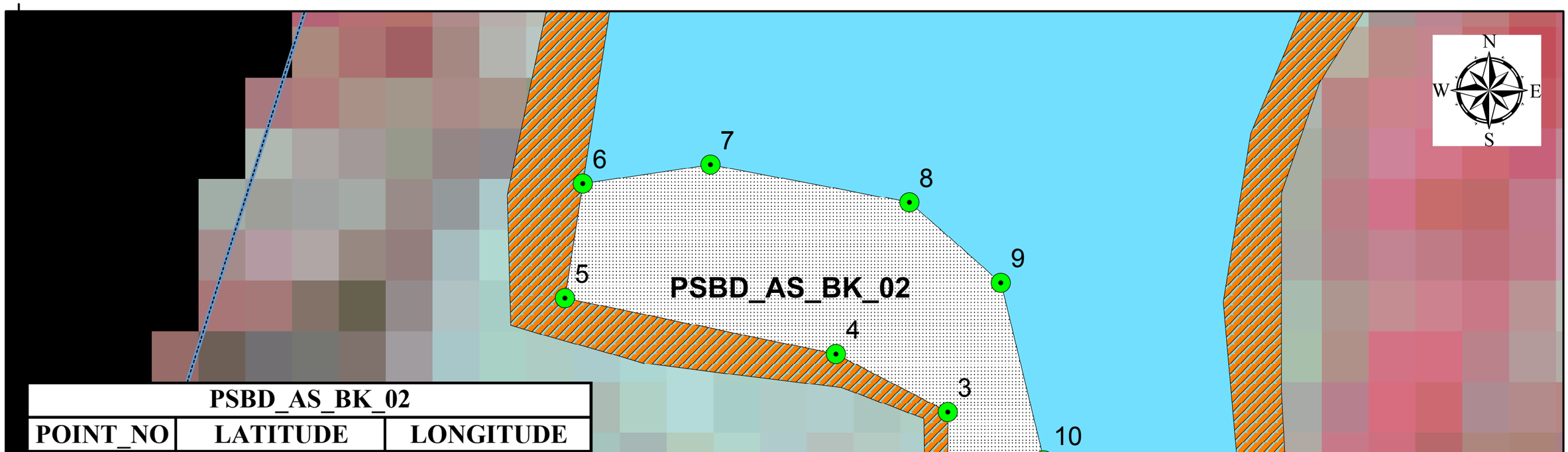
S

E

W

POTENTIAL BLOCK PSBD_AS_BK_02 OF BARAKAR RIVER

86°47'30"E



PSBD_AS_BK_02		
POINT_NO	LATITUDE	LONGITUDE
1	23° 42' 6.321" N	86° 47' 47.479" E
2	23° 42' 5.067" N	86° 47' 46.159" E
3	23° 42' 10.446" N	86° 47' 46.178" E
4	23° 42' 11.373" N	86° 47' 44.233" E
5	23° 42' 12.262" N	86° 47' 39.522" E
6	23° 42' 14.094" N	86° 47' 39.829" E
7	23° 42' 14.401" N	86° 47' 42.047" E
8	23° 42' 13.803" N	86° 47' 45.505" E
9	23° 42' 12.515" N	86° 47' 47.096" E
10	23° 42' 9.677" N	86° 47' 47.848" E

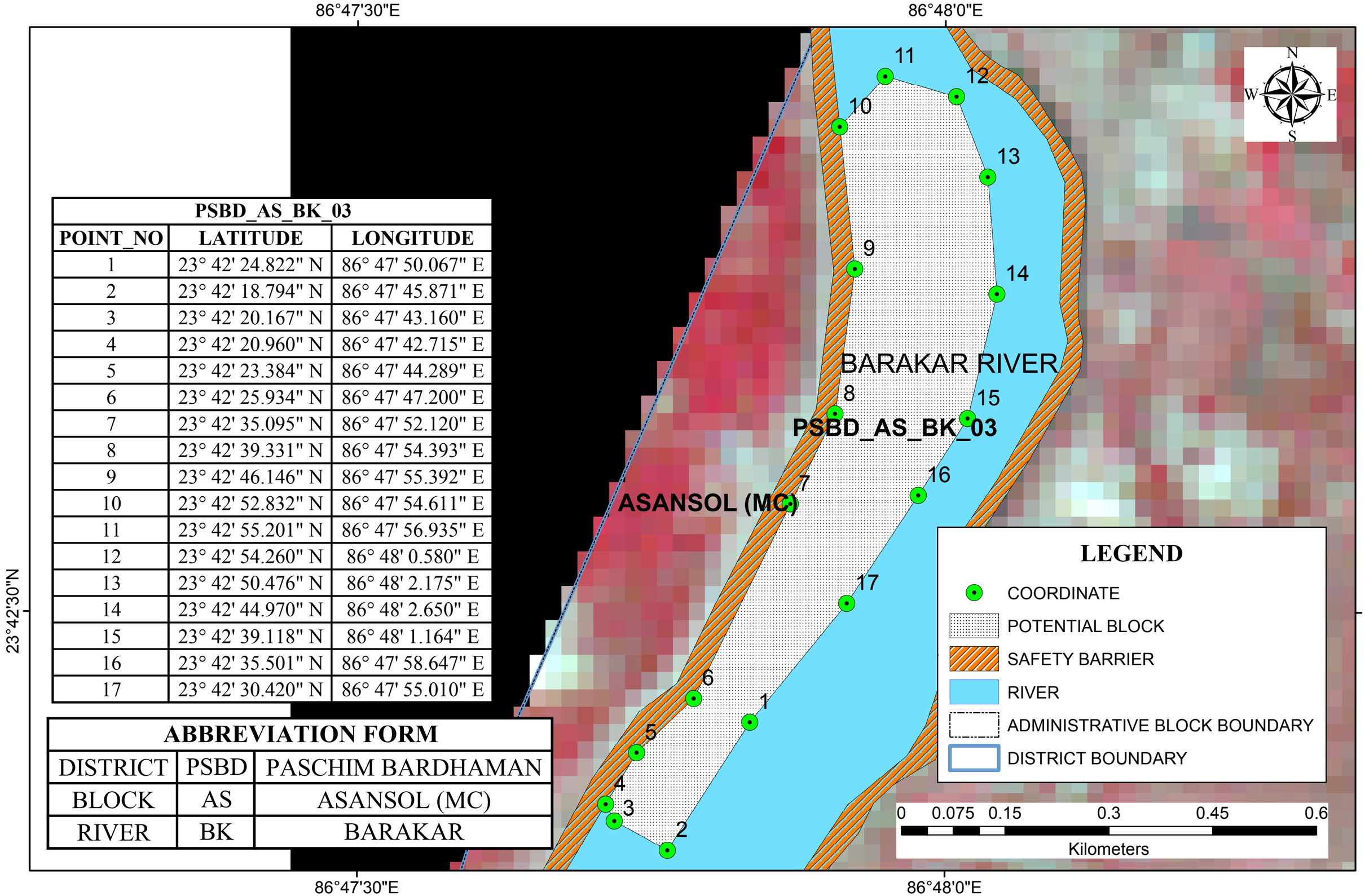
ABBREVIATION FORM		
DISTRICT	PSBD	PASCHIM BARDHAMAN
BLOCK	AS	ASANSOL (MC)
RIVER	BK	BARAKAR

86°47'30"E

POTENTIAL BLOCK PSBD_AS_BK_03 OF BARAKAR RIVER

PSBD_AS_BK_03		
POINT_NO	LATITUDE	LONGITUDE
1	23° 42' 24.822" N	86° 47' 50.067" E
2	23° 42' 18.794" N	86° 47' 45.871" E
3	23° 42' 20.167" N	86° 47' 43.160" E
4	23° 42' 20.960" N	86° 47' 42.715" E
5	23° 42' 23.384" N	86° 47' 44.289" E
6	23° 42' 25.934" N	86° 47' 47.200" E
7	23° 42' 35.095" N	86° 47' 52.120" E
8	23° 42' 39.331" N	86° 47' 54.393" E
9	23° 42' 46.146" N	86° 47' 55.392" E
10	23° 42' 52.832" N	86° 47' 54.611" E
11	23° 42' 55.201" N	86° 47' 56.935" E
12	23° 42' 54.260" N	86° 48' 0.580" E
13	23° 42' 50.476" N	86° 48' 2.175" E
14	23° 42' 44.970" N	86° 48' 2.650" E
15	23° 42' 39.118" N	86° 48' 1.164" E
16	23° 42' 35.501" N	86° 47' 58.647" E
17	23° 42' 30.420" N	86° 47' 55.010" E

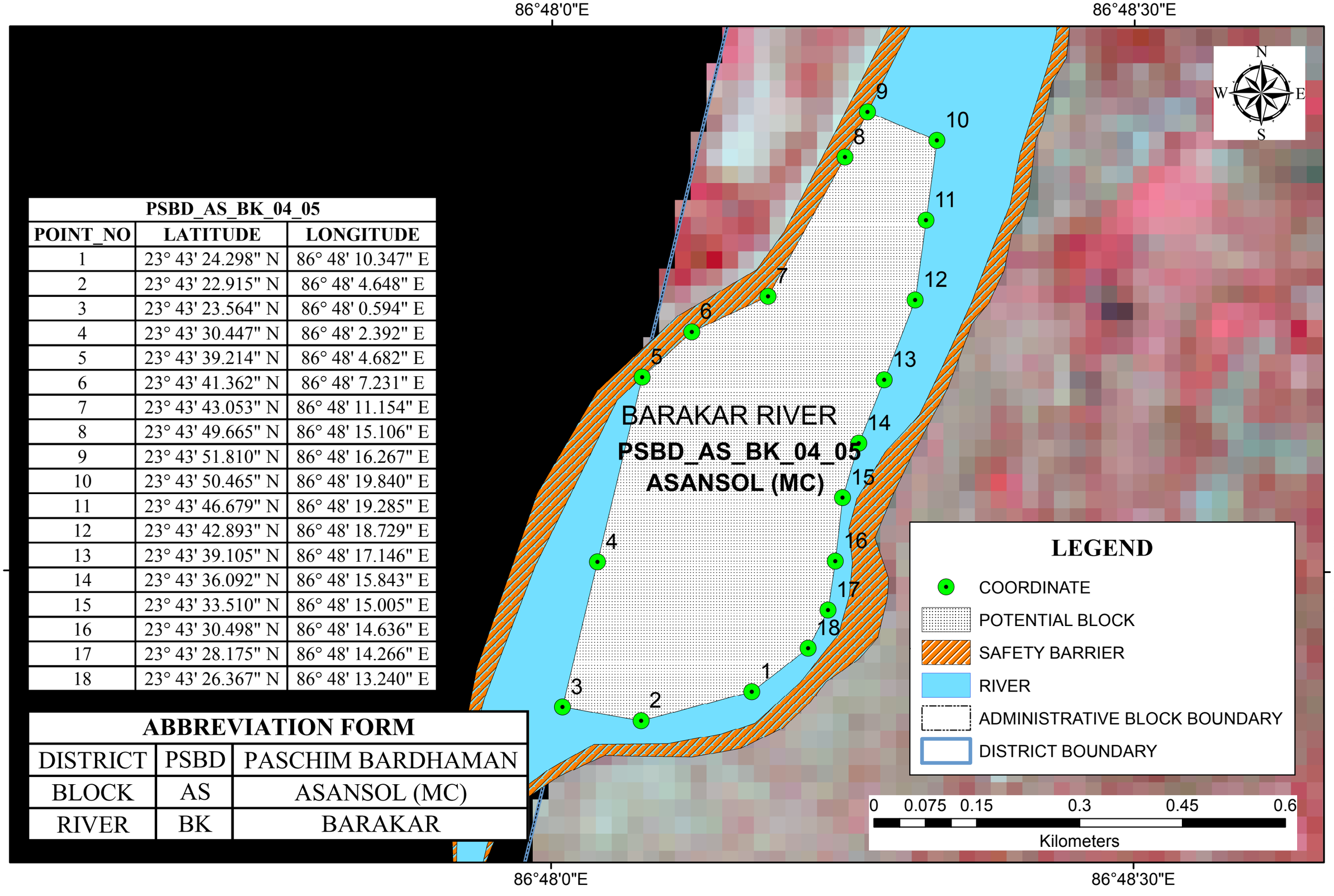
ABBREVIATION FORM		
DISTRICT	PSBD	PASCHIM BARDHAMAN
BLOCK	AS	ASANSOL (MC)
RIVER	BK	BARAKAR



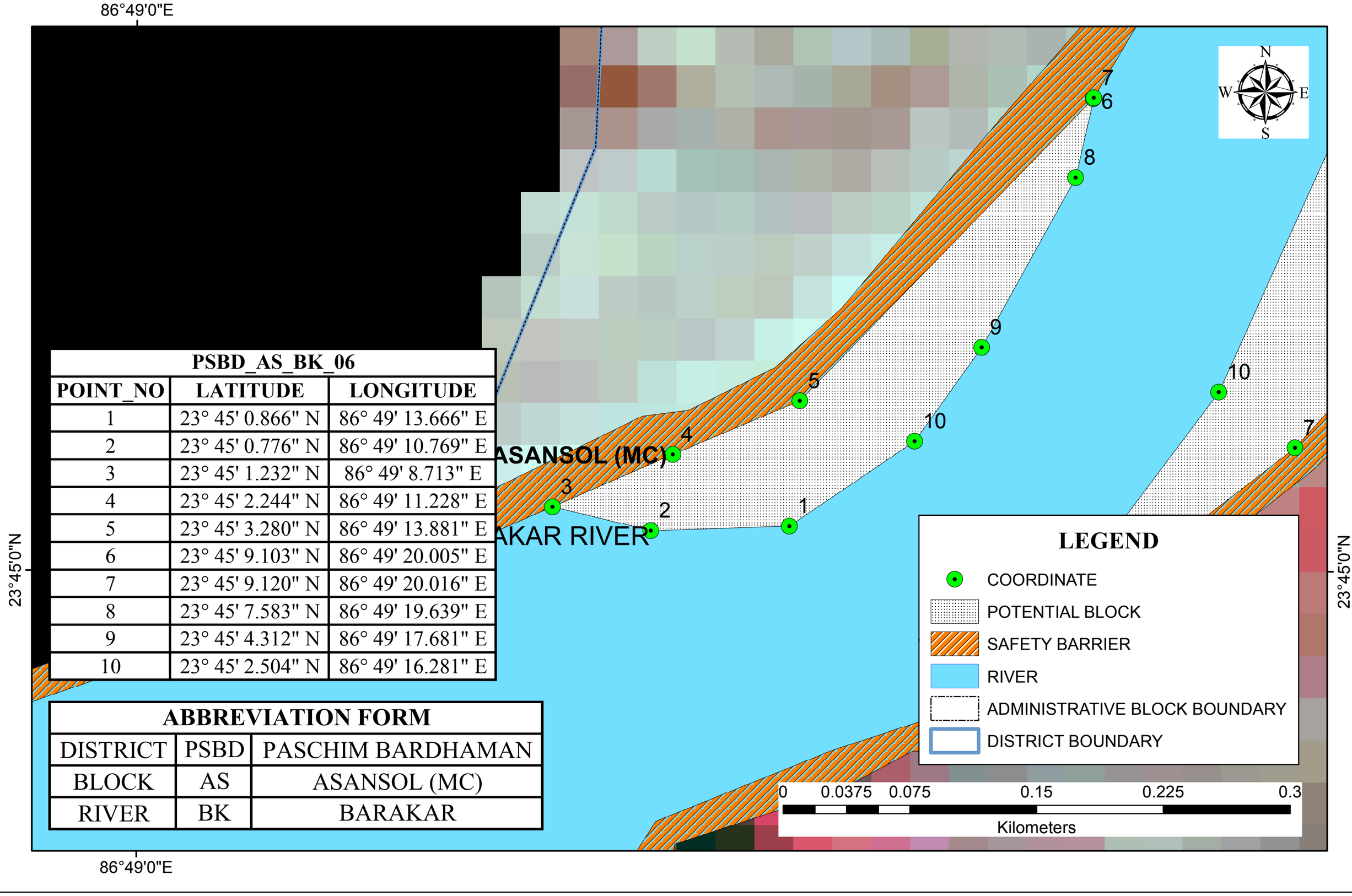
POTENTIAL BLOCK PSBD_AS_BK_04_05 OF BARAKAR RIVER

PSBD_AS_BK_04_05		
POINT_NO	LATITUDE	LONGITUDE
1	23° 43' 24.298" N	86° 48' 10.347" E
2	23° 43' 22.915" N	86° 48' 4.648" E
3	23° 43' 23.564" N	86° 48' 0.594" E
4	23° 43' 30.447" N	86° 48' 2.392" E
5	23° 43' 39.214" N	86° 48' 4.682" E
6	23° 43' 41.362" N	86° 48' 7.231" E
7	23° 43' 43.053" N	86° 48' 11.154" E
8	23° 43' 49.665" N	86° 48' 15.106" E
9	23° 43' 51.810" N	86° 48' 16.267" E
10	23° 43' 50.465" N	86° 48' 19.840" E
11	23° 43' 46.679" N	86° 48' 19.285" E
12	23° 43' 42.893" N	86° 48' 18.729" E
13	23° 43' 39.105" N	86° 48' 17.146" E
14	23° 43' 36.092" N	86° 48' 15.843" E
15	23° 43' 33.510" N	86° 48' 15.005" E
16	23° 43' 30.498" N	86° 48' 14.636" E
17	23° 43' 28.175" N	86° 48' 14.266" E
18	23° 43' 26.367" N	86° 48' 13.240" E

ABBREVIATION FORM		
DISTRICT	PSBD	PASCHIM BARDHAMAN
BLOCK	AS	ASANSOL (MC)
RIVER	BK	BARAKAR



POTENTIAL BLOCK PSBD_AS_BK_06 OF BARAKAR RIVER



PSBD_AS_BK_06		
POINT_NO	LATITUDE	LONGITUDE
1	23° 45' 0.866" N	86° 49' 13.666" E
2	23° 45' 0.776" N	86° 49' 10.769" E
3	23° 45' 1.232" N	86° 49' 8.713" E
4	23° 45' 2.244" N	86° 49' 11.228" E
5	23° 45' 3.280" N	86° 49' 13.881" E
6	23° 45' 9.103" N	86° 49' 20.005" E
7	23° 45' 9.120" N	86° 49' 20.016" E
8	23° 45' 7.583" N	86° 49' 19.639" E
9	23° 45' 4.312" N	86° 49' 17.681" E
10	23° 45' 2.504" N	86° 49' 16.281" E

ABBREVIATION FORM		
DISTRICT	PSBD	PASCHIM BARDHAMAN
BLOCK	AS	ASANSOL (MC)
RIVER	BK	BARAKAR

POTENTIAL BLOCK PSBD_AS_BK_06A OF BARAKAR RIVER

PSBD_AS_BK_06A		
POINT_NO	LATITUDE	LONGITUDE
1	23° 45' 10.190" N	86° 49' 31.998" E
2	23° 45' 8.381" N	86° 49' 30.299" E
3	23° 45' 8.879" N	86° 49' 29.233" E
4	23° 45' 9.051" N	86° 49' 28.728" E
5	23° 45' 7.690" N	86° 49' 27.888" E
6	23° 45' 5.177" N	86° 49' 26.957" E
7	23° 45' 2.386" N	86° 49' 24.231" E
8	23° 45' 0.422" N	86° 49' 21.467" E
9	23° 44' 59.824" N	86° 49' 19.680" E
10	23° 45' 3.457" N	86° 49' 22.636" E
11	23° 45' 8.794" N	86° 49' 25.245" E
12	23° 45' 21.962" N	86° 49' 28.499" E
13	23° 45' 32.114" N	86° 49' 29.140" E
14	23° 45' 38.224" N	86° 49' 30.534" E
15	23° 45' 40.722" N	86° 49' 32.494" E
16	23° 45' 41.552" N	86° 49' 34.845" E
17	23° 45' 40.306" N	86° 49' 35.229" E
18	23° 45' 35.507" N	86° 49' 36.675" E
19	23° 45' 34.337" N	86° 49' 37.144" E
20	23° 45' 33.029" N	86° 49' 37.052" E
21	23° 45' 26.765" N	86° 49' 36.051" E
22	23° 45' 19.830" N	86° 49' 35.200" E
23	23° 45' 18.573" N	86° 49' 34.996" E
24	23° 45' 16.404" N	86° 49' 34.251" E
25	23° 45' 14.684" N	86° 49' 34.123" E

ABBREVIATION FORM		
DISTRICT	PSBD	PASCHIM BARDHAMAN
BLOCK	AS	ASANSOL (MC)
RIVER	BK	BARAKAR

86°49'0"E 86°49'30"E 86°50'0"E

23°45'30"N 23°45'0"N

ASANSOL (MC)

R RIVER

N S E W

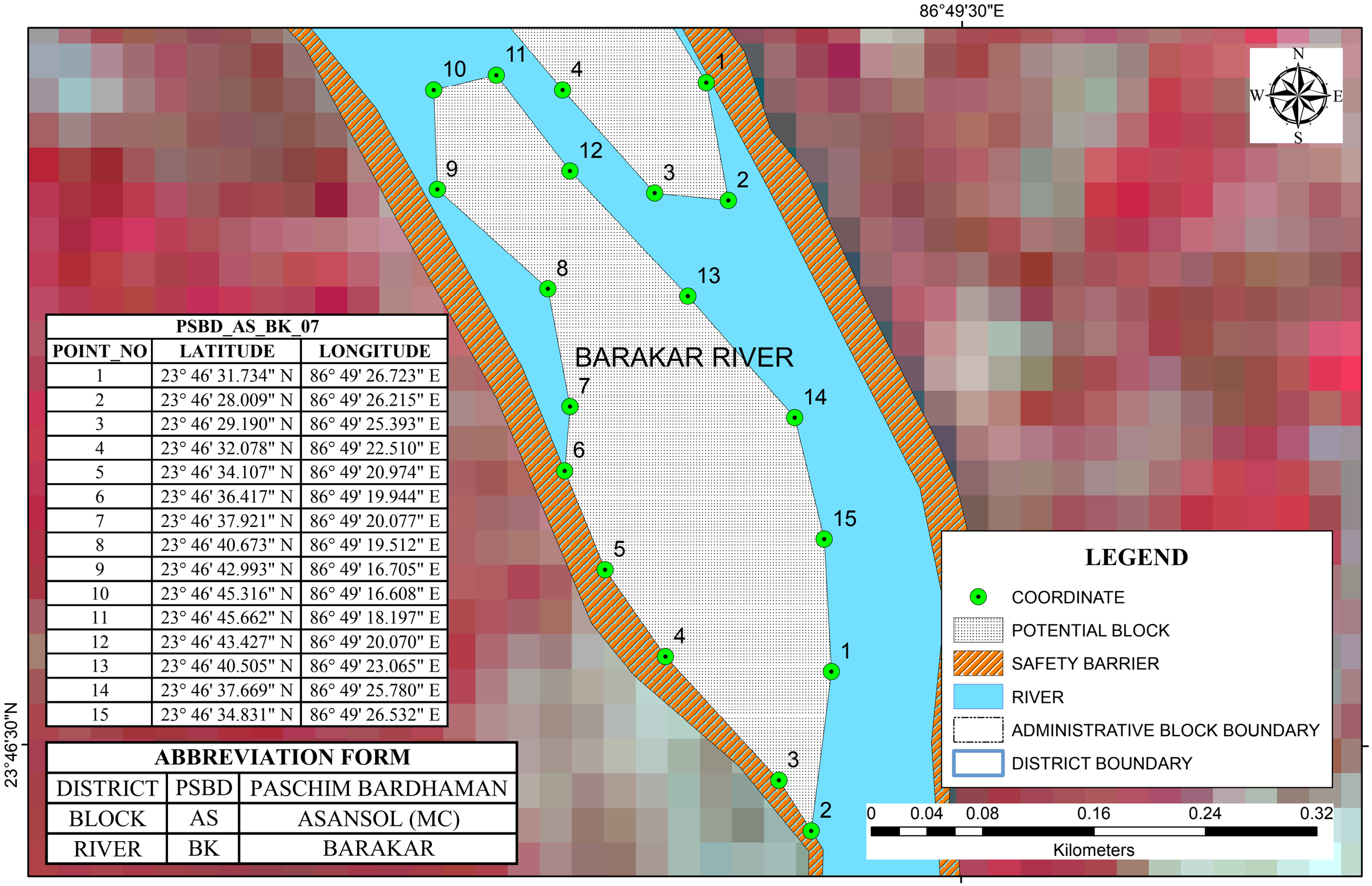
LEGEND

- COORDINATE
- POTENTIAL BLOCK
- SAFETY BARRIER
- RIVER
- ADMINISTRATIVE BLOCK BOUNDARY
- DISTRICT BOUNDARY

0 0.1 0.2 0.4 0.6 0.8

Kilometers

POTENTIAL BLOCK PSBD_AS_BK_07 OF BARAKAR RIVER

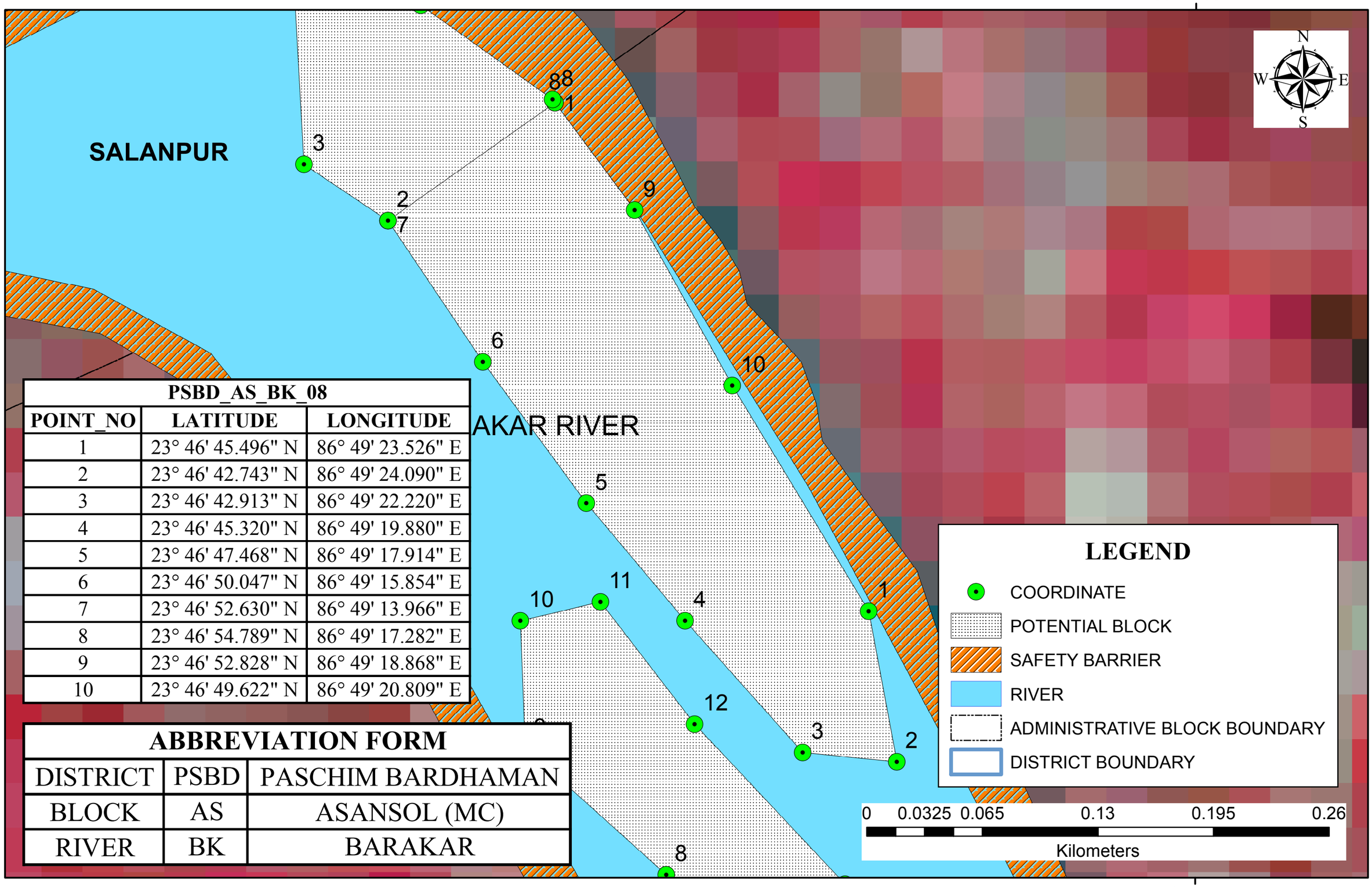


PSBD_AS_BK_07		
POINT_NO	LATITUDE	LONGITUDE
1	23° 46' 31.734" N	86° 49' 26.723" E
2	23° 46' 28.009" N	86° 49' 26.215" E
3	23° 46' 29.190" N	86° 49' 25.393" E
4	23° 46' 32.078" N	86° 49' 22.510" E
5	23° 46' 34.107" N	86° 49' 20.974" E
6	23° 46' 36.417" N	86° 49' 19.944" E
7	23° 46' 37.921" N	86° 49' 20.077" E
8	23° 46' 40.673" N	86° 49' 19.512" E
9	23° 46' 42.993" N	86° 49' 16.705" E
10	23° 46' 45.316" N	86° 49' 16.608" E
11	23° 46' 45.662" N	86° 49' 18.197" E
12	23° 46' 43.427" N	86° 49' 20.070" E
13	23° 46' 40.505" N	86° 49' 23.065" E
14	23° 46' 37.669" N	86° 49' 25.780" E
15	23° 46' 34.831" N	86° 49' 26.532" E

ABBREVIATION FORM		
DISTRICT	PSBD	PASCHIM BARDHAMAN
BLOCK	AS	ASANSOL (MC)
RIVER	BK	BARAKAR

POTENTIAL BLOCK PSBD_AS_BK_08 OF BARAKAR RIVER

86°49'30"E



PSBD_AS_BK_08		
POINT_NO	LATITUDE	LONGITUDE
1	23° 46' 45.496" N	86° 49' 23.526" E
2	23° 46' 42.743" N	86° 49' 24.090" E
3	23° 46' 42.913" N	86° 49' 22.220" E
4	23° 46' 45.320" N	86° 49' 19.880" E
5	23° 46' 47.468" N	86° 49' 17.914" E
6	23° 46' 50.047" N	86° 49' 15.854" E
7	23° 46' 52.630" N	86° 49' 13.966" E
8	23° 46' 54.789" N	86° 49' 17.282" E
9	23° 46' 52.828" N	86° 49' 18.868" E
10	23° 46' 49.622" N	86° 49' 20.809" E

ABBREVIATION FORM		
DISTRICT	PSBD	PASCHIM BARDHAMAN
BLOCK	AS	ASANSOL (MC)
RIVER	BK	BARAKAR

86°49'30"E

POTENTIAL BLOCK PSBD_SL_BK_09 OF BARAKAR RIVER

PSBD_AS_BK_09		
POINT_NO	LATITUDE	LONGITUDE
1	23° 46' 54.789" N	86° 49' 17.282" E
2	23° 46' 52.630" N	86° 49' 13.966" E
3	23° 46' 53.656" N	86° 49' 12.296" E
4	23° 46' 56.753" N	86° 49' 12.105" E
5	23° 46' 56.841" N	86° 49' 13.881" E
6	23° 46' 56.622" N	86° 49' 14.493" E
7	23° 46' 56.565" N	86° 49' 14.614" E
8	23° 46' 54.848" N	86° 49' 17.234" E

ABBREVIATION FORM		
DISTRICT	PSBD	PASCHIM BARDHAMAN
BLOCK	SL	SALANPUR
RIVER	BK	BARAKAR

SALANPUR

BARAKAR RIVER

LEGEND

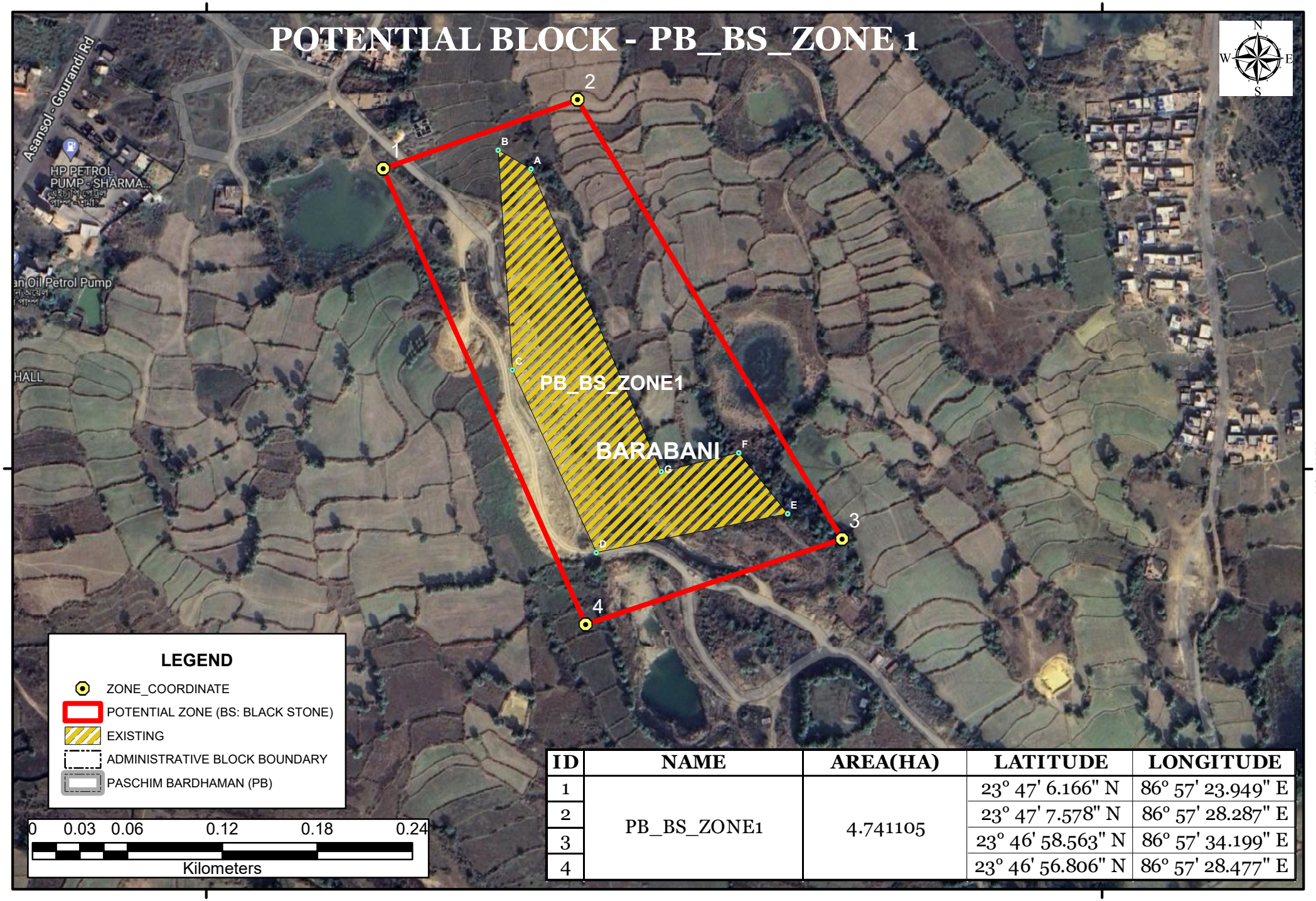
- COORDINATE
- POTENTIAL BLOCK
- SAFETY BARRIER
- RIVER
- ADMINISTRATIVE BLOCK BOUNDARY
- DISTRICT BOUNDARY

0 0.0175 0.035 0.07 0.105 0.14

Kilometers

Annexure 5
Map showing of Potential In-situ mineral Blocks of Paschim Bardhaman District

POTENTIAL BLOCK - PB_BS_ZONE 1



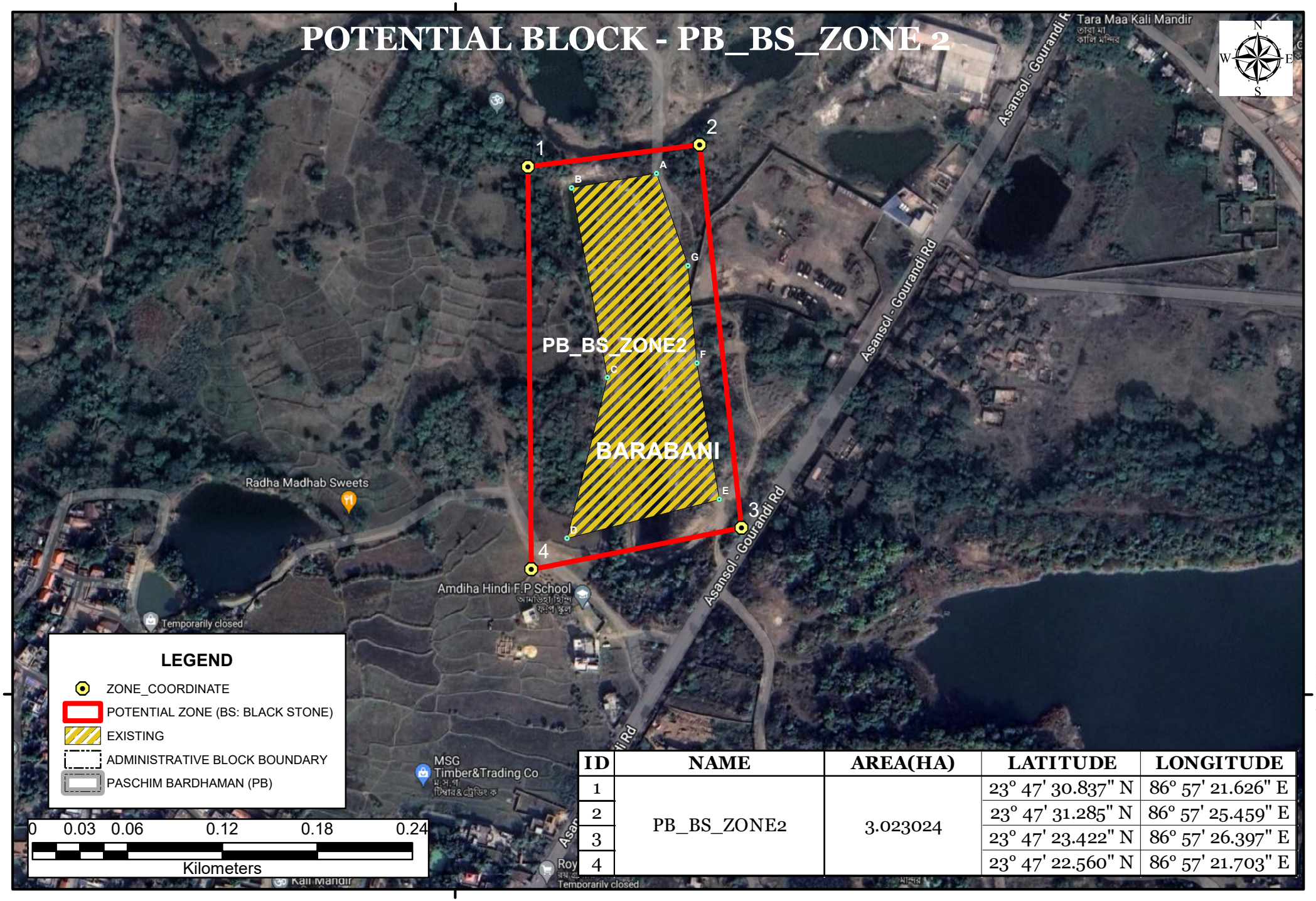
LEGEND

- ZONE_COORDINATE
- POTENTIAL ZONE (BS: BLACK STONE)
- EXISTING
- ADMINISTRATIVE BLOCK BOUNDARY
- PASCHIM BARDHAMAN (PB)

0 0.03 0.06 0.12 0.18 0.24
Kilometers

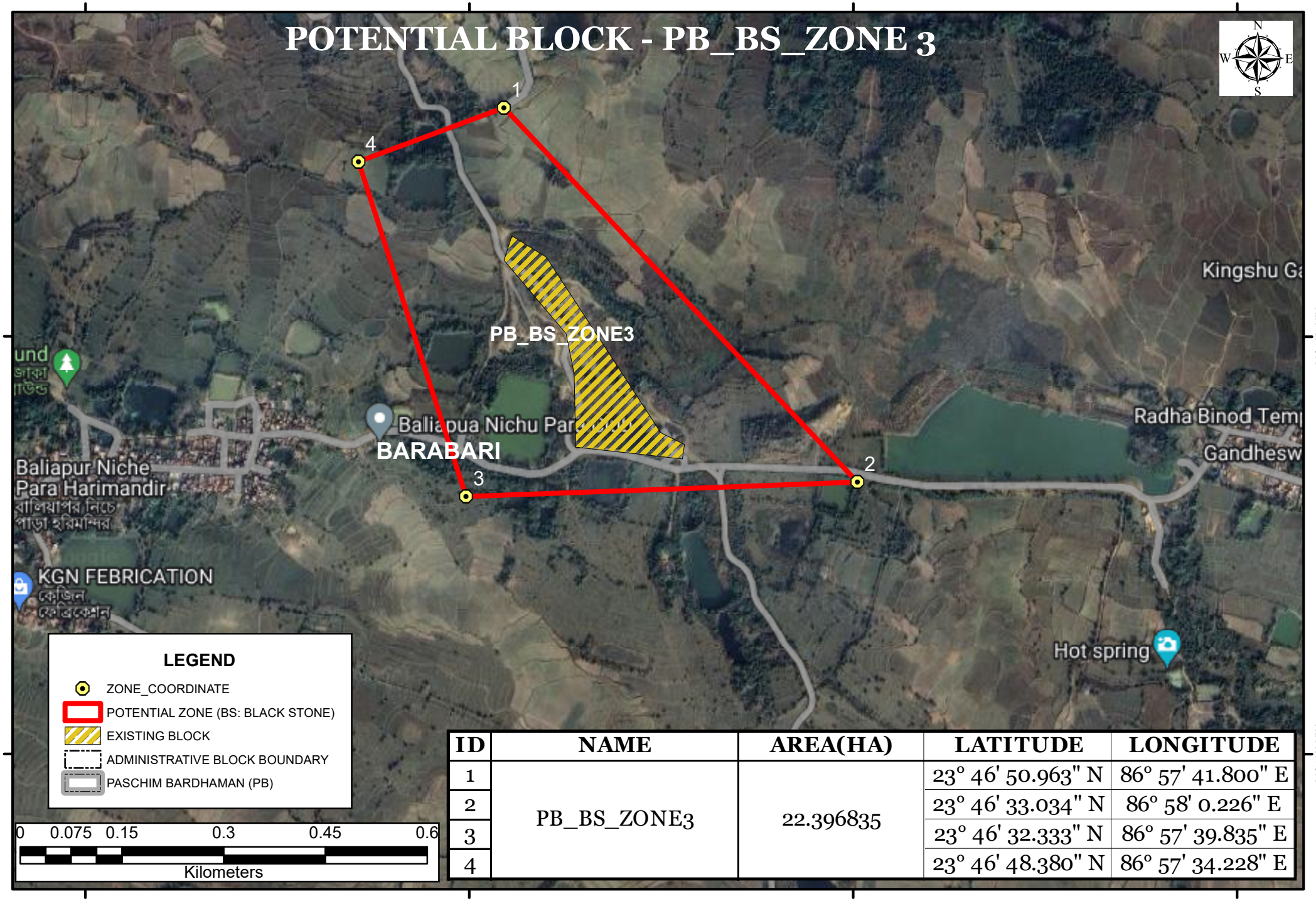
ID	NAME	AREA(HA)	LATITUDE	LONGITUDE
1	PB_BS_ZONE1	4.741105	23° 47' 6.166" N	86° 57' 23.949" E
2			23° 47' 7.578" N	86° 57' 28.287" E
3			23° 46' 58.563" N	86° 57' 34.199" E
4			23° 46' 56.806" N	86° 57' 28.477" E

POTENTIAL BLOCK - PB_BS_ZONE 2



ID	NAME	AREA(HA)	LATITUDE	LONGITUDE
1	PB_BS_ZONE2	3.023024	23° 47' 30.837" N	86° 57' 21.626" E
2			23° 47' 31.285" N	86° 57' 25.459" E
3			23° 47' 23.422" N	86° 57' 26.397" E
4			23° 47' 22.560" N	86° 57' 21.703" E

POTENTIAL BLOCK - PB_BS_ZONE 3

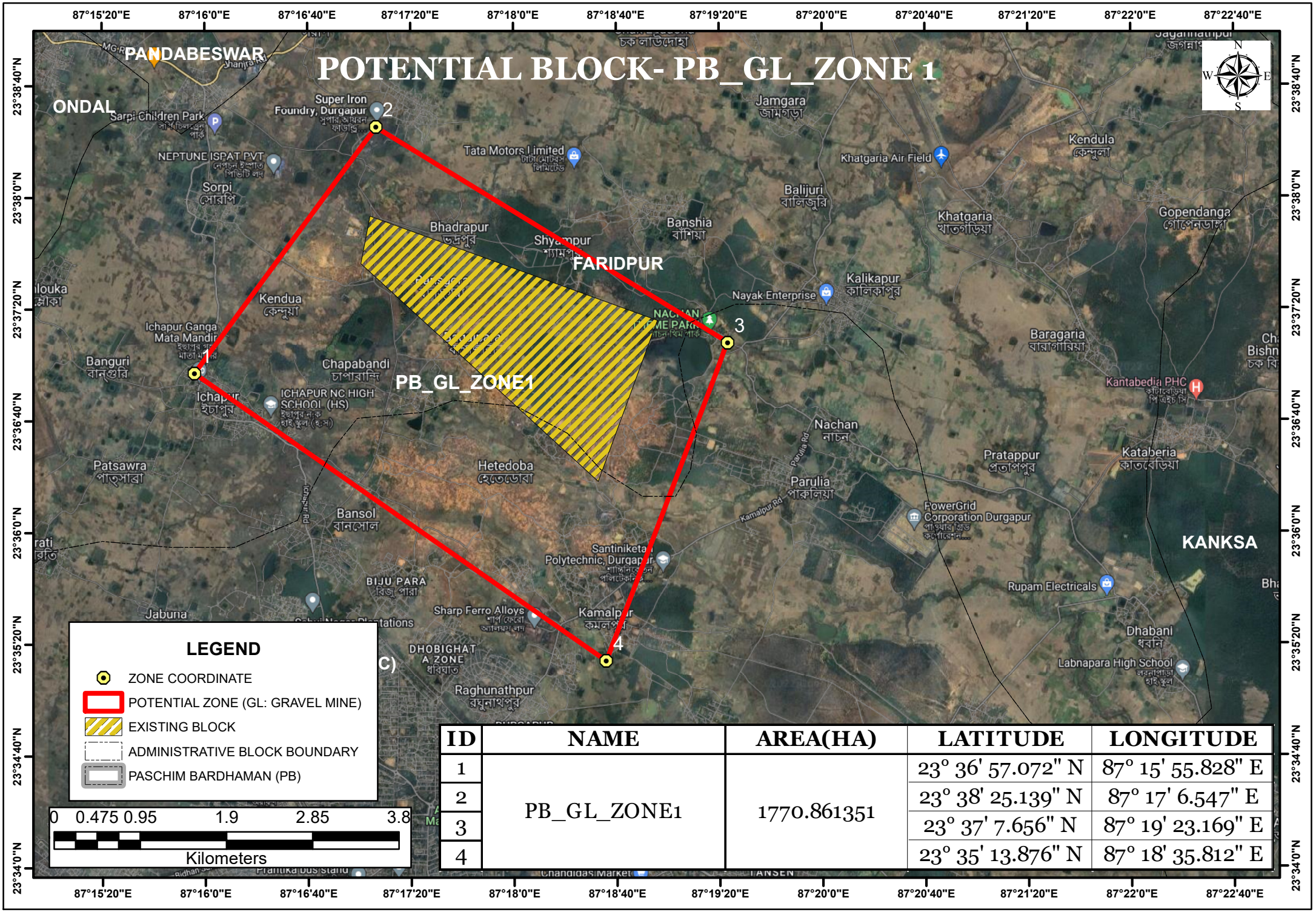


ID	NAME	AREA(HA)	LATITUDE	LONGITUDE
1	PB_BS_ZONE3	22.396835	23° 46' 50.963" N	86° 57' 41.800" E
2			23° 46' 33.034" N	86° 58' 0.226" E
3			23° 46' 32.333" N	86° 57' 39.835" E
4			23° 46' 48.380" N	86° 57' 34.228" E

POTENTIAL BLOCK - PB_CC_ZONE 1

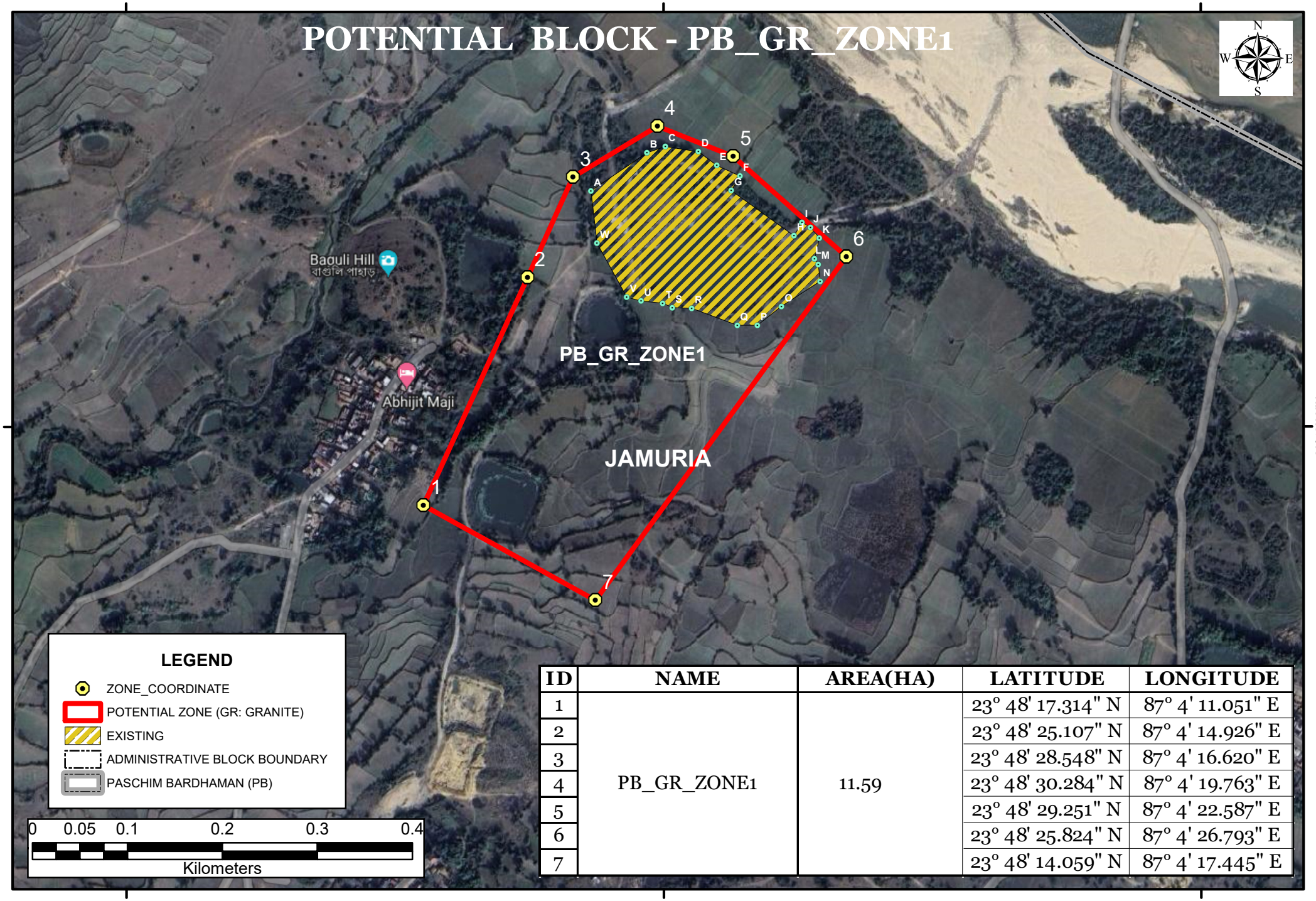
ID	NAME	AREA(HA)	LATITUDE	LONGITUDE
1	PB_CC_ZONE1	0.465884	23° 40' 25.015" N	87° 24' 48.787" E
2			23° 40' 27.258" N	87° 24' 49.690" E
3			23° 40' 26.530" N	87° 24' 51.538" E
4			23° 40' 24.182" N	87° 24' 51.166" E

POTENTIAL BLOCK- PB_GL_ZONE 1



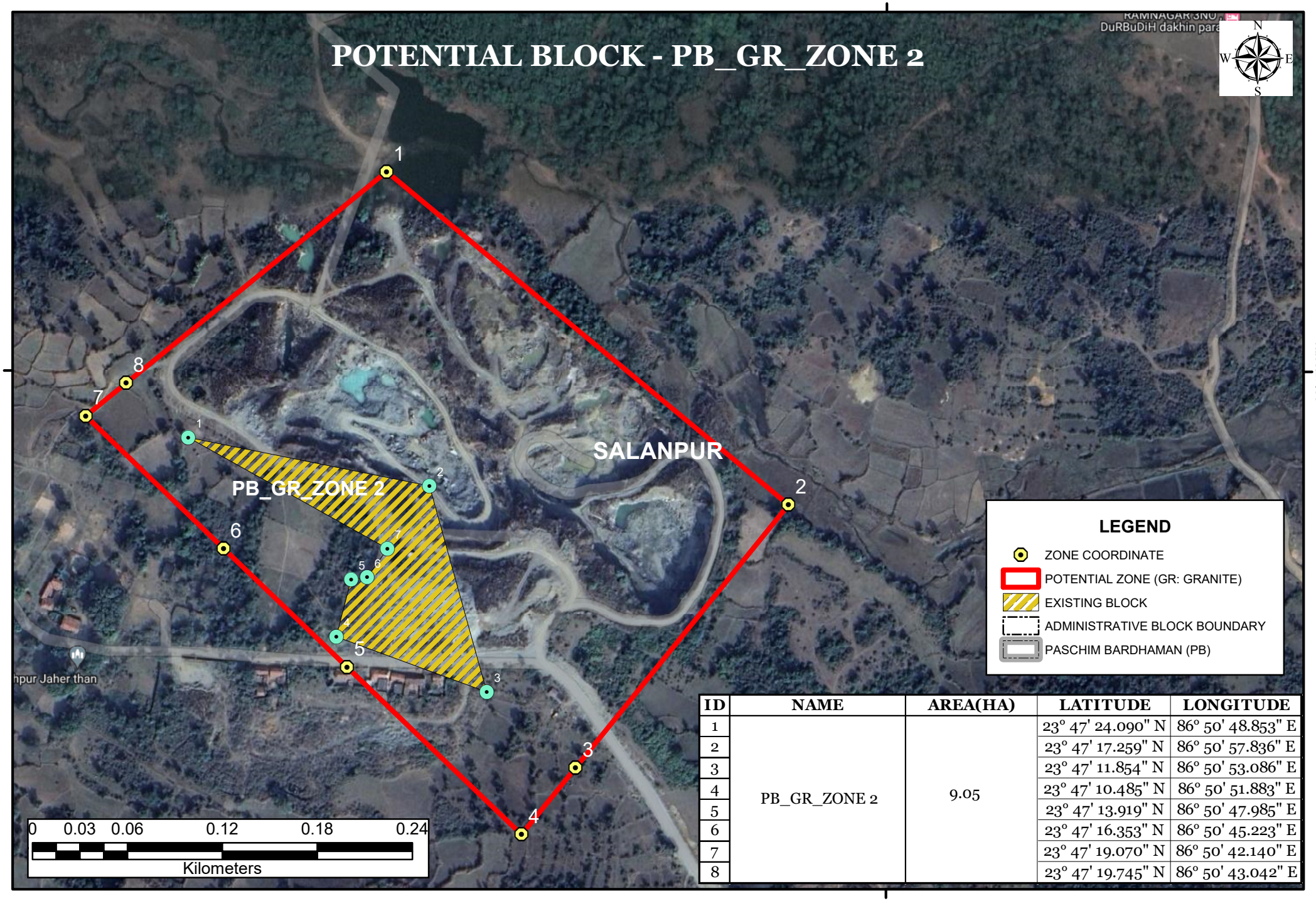
ID	NAME	AREA(HA)	LATITUDE	LONGITUDE
1	PB_GL_ZONE1	1770.861351	23° 36' 57.072" N	87° 15' 55.828" E
2			23° 38' 25.139" N	87° 17' 6.547" E
3			23° 37' 7.656" N	87° 19' 23.169" E
4			23° 35' 13.876" N	87° 18' 35.812" E

POTENTIAL BLOCK - PB_GR_ZONE1



ID	NAME	AREA(HA)	LATITUDE	LONGITUDE
1	PB_GR_ZONE1	11.59	23° 48' 17.314" N	87° 4' 11.051" E
2			23° 48' 25.107" N	87° 4' 14.926" E
3			23° 48' 28.548" N	87° 4' 16.620" E
4			23° 48' 30.284" N	87° 4' 19.763" E
5			23° 48' 29.251" N	87° 4' 22.587" E
6			23° 48' 25.824" N	87° 4' 26.793" E
7			23° 48' 14.059" N	87° 4' 17.445" E

POTENTIAL BLOCK - PB_GR_ZONE 2



ID	NAME	AREA(HA)	LATITUDE	LONGITUDE
1	PB_GR_ZONE 2	9.05	23° 47' 24.090" N	86° 50' 48.853" E
2			23° 47' 17.259" N	86° 50' 57.836" E
3			23° 47' 11.854" N	86° 50' 53.086" E
4			23° 47' 10.485" N	86° 50' 51.883" E
5			23° 47' 13.919" N	86° 50' 47.985" E
6			23° 47' 16.353" N	86° 50' 45.223" E
7			23° 47' 19.070" N	86° 50' 42.140" E
8			23° 47' 19.745" N	86° 50' 43.042" E

Annexure 6
SEIAA 70th Meeting (22nd August, 2022) Minutes of Meeting

--***--

State Environment Impact Assessment Authority
Pranisampad Bhawan, 5th Floor, Sector-III, Salt Lake, Kolkata - 700106
(West Bengal)
Minutes of SEIAA Meeting

--***--

Subject:- 70th meeting of SEIAA

Venue:- Conference Room of Environment Department, Prani Sampad Bhavan, 5th Floor, LB Block, Sector III, Salt Lake, Kolkata 700106.

From :- 22 Aug 2022

To :- 22 Aug 2022

1. Proposal No. :- **SIA/WB/MIS/220603/2021** File No- **EN/T-II-1/138/2021** Proposed development of an affordable Housing Complex under Pradhan Mantri Awas Yojana at Premises No. 39/1, Shalimar Road, L.R. Dag No. – 12, 13, 39, 40, 41, 42, 44, 45, 60, 61, 62, 63, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 21, 22, 24, 1, 2, 11, L.R. Khatian No. – 170, 9, 15, 17, J.L. No. – 1, Mouza – Shibpur, Ward No. – 39, Borough – VI, under Howrah Municipal Corporation, P.S. – Shibpur, Howrah – 711103, West Bengal by **M/s. Ideal Riverview Projects Pvt. Ltd.**	Type- **EC**

INTRODUCTION

The proponent made online application vide proposal no. **SIA/WB/MIS/220603/2021** dated **09 Aug 2021** along with copies of EIA/EMP seeking environment clearance under the provisions of the EIA Notification, 2006 for the above mentioned project. The proposed project activity is listed at SL.No. **8(a) Building and Construction projects** , under Category **"B2 "** of EIA Notification 2006 and the proposal is appraised at State level.

SEAC recommended the proposed project for Environmental Clearance with the following additional conditions :-

a) Construction activity shall be carried out complying all statutory rules / regulations and sanction plan.
b) Waterbodies shall be maintained as per the approval of Competent Authority.

PROJECT DETAILS

The project of M/s **IDEAL RIVERVIEW PROJECTS PVT. LTD.** located in as follows :

State of the project				
S. No.	**State**	**District**	**Tehsil**	**Village**
(1.)	West Bengal	Howrah	Domjur	Shibpur

14. **Project configuration/product details**

S. No.	Project configuration/product details	Quantity	Unit	Other Unit	Mode of Transport/Transmission of Product	Other Mode of Transport
Eight (8) Residential Towers: Tower 1 to 5 – G + 12 Tower 6 to 8 – G + 1 and						

1 no. Club Block – G storied.	

Raw Material Requirement details

S. No.	Item	Quantity per annum	Unit	Other Unit	Source	Mode of Transport/Transmission of Product	Other Mode of Transport	Distance of Source from Project Site(Kilometers)
NIL								

DELIBERATION IN SEIAA

SEIAA considered the recommendation of SEAC and accepted the same.

RECOMMENDATIONS OF SEIAA

The application for EC is approved based on the Howrah Municipal Corporation Building Permit BRC No. 356/19-20 dated 04.02.2021.

Conclusion

Recommended

S.No	Conditions
(1)	**I. Statutory compliance:** i. The project proponent shall obtain all necessary clearance/ permission from all relevant agencies including town planning authority before commencement of work. All the construction shall be done in accordance with the local building byelaws. ii. The approval of the Competent Authority shall be obtained for structural safety of buildings due to earthquakes, adequacy of firefighting equipment etc. as per National Building Code including protection measures from lightening etc. iii. The project proponent shall obtain forest clearance under the provisions of Forest (Conservation) Act, 1986, in case of the diversion of forest land for non-forest purpose involved in the project. iv. The project proponent shall obtain clearance from the National Board for Wildlife, if applicable. v. The project proponent shall obtain Consent to Establish / Operate under the provisions of Air (Prevention & Control of Pollution) Act, 1981 and the Water (Prevention & Control of Pollution) Act, 1974 from the concerned State Pollution Control Board/ Committee. vi. The project proponent shall obtain the necessary permission for drawl of ground water /surface water required for the project from the competent authority. vii. A certificate of adequacy of available power from the agency supplying power to the project along with the load allowed for the project should be obtained. viii. All other statutory clearances such as the approvals for storage of diesel from Chief Controller of Explosives, Fire Department, Civil Aviation Department shall be obtained, as applicable, by project proponents from the respective competent authorities. ix. The provisions of the Solid Waste (Management) Rules, 2016, e-Waste (Management) Rules, 2016, and the Plastics Waste (Management) Rules, 2016 shall be followed.

x. The project proponent shall follow the ECBC/ECBC-R prescribed by Bureau of Energy Efficiency, Ministry of Power strictly.

xi. The project proponent should strictly comply with the guidelines for High Rise Buildings, issued by MoEF, GoI vide No. 21-270/2008-IA.III dated 07.02.2012.

xii. The project proponent shall comply with the EMP as proposed in terms of Office Memorandum issued by the MoEF & CC vide F. No. 22-65/2017-IA.III dated 30.09.2020.

II. Air quality monitoring and preservation

i. Notification GSR 94(E) dated 25.01.2018 of MoEF&CC regarding Mandatory Implementation of Dust Mitigation Measures for Construction and Demolition Activities for projects requiring Environmental Clearance shall be complied with.

ii. A management plan shall be drawn up and implemented to contain the current exceedance in ambient air quality at the site.

iii. The project proponent shall install system to carryout Ambient Air Quality monitoring for common/criterion parameters relevant to the main pollutants released (e.g. PM10 and PM25) covering upwind and downwind directions during the construction period.

iv. Diesel power generating sets proposed as source of backup power should be of enclosed type and conform to rules made under the Environment (Protection) Act, 1986. The height of stack of DG sets should be equal to the height needed for the combined capacity of all proposed DG sets. Use of low sulphur diesel is mandatory. The location of the DG sets may be decided in consultation with State Pollution Control Board.

v. Construction site shall be adequately barricaded before the construction begins. Dust, smoke & other air pollution prevention measures shall be provided for the building as well as the site. These measures shall include screens for the building under construction, continuous dust/ wind breaking walls all around the site (at least 3 meter height). Plastic/tarpaulin sheet covers shall be provided for vehicles bringing in sand, cement, murram and other construction materials prone to causing dust pollution at the site as well as taking out debris from the site.

vi. Sand, murram, loose soil, cement, stored on site shall be covered adequately so as to prevent dust pollution.

vii. Wet jet shall be provided for grinding and stone cutting.

viii. Unpaved surfaces and loose soil shall be adequately sprinkled with water to suppress dust.

ix. All construction and demolition debris shall be stored at the site (and not dumped on the roads or open spaces outside) before they are properly disposed. All demolition and construction waste shall be managed as per the provisions of the Construction and Demolition Waste Rules 2016.

x. The diesel generator sets to be used during construction phase shall be low sulphur diesel type and shall conform to Environmental (Protection) prescribed for air and noise emission standards.

xi. The gaseous emissions from DG set shall be dispersed through adequate stack height as per CPCB standards. Acoustic enclosure shall be provided to the DG sets to mitigate the noise pollution. Low sulphur diesel shall be used. The location of the DG set and exhaust pipe height shall be as per the provisions of the Central Pollution Control Board (CPCB) norms.

xii. For indoor air quality the ventilation provisions as per National Building Code of India.

III. Water quality monitoring and preservation

i. The natural drainage system should be maintained for ensuring unrestricted flow of water. No construction shall be allowed to obstruct the natural drainage through the site, on wetland and water bodies. Check dams, bio-swales, landscape, and other sustainable urban drainage systems (SUDS) are allowed for maintaining the drainage pattern and to harvest rain water.

ii. Buildings shall be designed to follow the natural topography as much as possible. Minimum

	cutting and filling should be done.
	iii. Total fresh water use shall not exceed the proposed requirement as provided in the project details.
	iv. The quantity of fresh water usage, water recycling and rainwater harvesting shall be measured and recorded to monitor the water balance as projected by the project proponent. The record shall be submitted to the Regional Office of Ministry of Environment, Forest and Climate Change (MoEF&CC) along with State Level Environment Impact Assessment Authority (SEIAA) and West Bengal Pollution Control Board (WBPCB) along with six monthly Monitoring reports.
	v. A certificate shall be obtained from the local body supplying water, specifying the total annual water availability with the local authority, the quantity of water already committed, the quantity of water allotted to the project under consideration and the balance water available. This should be specified separately for ground water and surface water sources, ensuring that there is no impact on other users.
	vi. At least 20% of the open spaces as required by the local building bye-laws shall be pervious. Use of Grass pavers, paver blocks with at least 50% opening, landscape etc. would be considered as pervious surface.
	vii. Installation of dual pipe plumbing for supply of recycled water and other for flushing, landscape irrigation, car washing, thermal cooling, conditioning etc. and for supplying fresh water for drinking, cooking and bathing etc. shall to be done.
	viii. Use of water saving devices/ fixtures (viz. low flow flushing systems; use of low flow faucets tap aerators etc.) for water conservation shall be incorporated in the building plan.
	ix. Separation of grey and black water should be done by the use of dual plumbing system. In case of single stack system separate recirculation lines for flushing by giving dual plumbing system be done.
	x. Water demand during construction should be reduced by use of pre-mixed concrete, curing agents and other best practices referred.
	xi. The local bye-law provisions on rain water harvesting should be followed. If local byelaw provision is not available, adequate provision for storage and recharge should be followed as per the Ministry of Urban Development Model Building Byelaws, 2016. Rain water harvesting recharge pits/storage tanks shall be provided for ground water recharging as per the CGWB norms.
	xii. A rain water harvesting plan needs to be designed where the recharge bores of minimum one recharge bore per 5,000 square meters of built up area and storage capacity of minimum one day of total fresh water requirement shall be provided. In areas where ground water recharge is not feasible, the rain water should be harvested and stored for reuse. The ground water shall not be withdrawn without approval from the Competent Authority.
	xiii. All recharge should be limited to shallow aquifer.
	xiv. No ground water shall be used during construction phase of the project.
	xv. Any ground water dewatering should be properly managed and shall conform to the approvals and the guidelines of the State Water Investigation Directorate (SWID) in the matter. Formal approval shall be taken from the SWID for any ground water abstraction or dewatering.
	xvi. Sewage shall be treated in the STP with tertiary treatment. The treated effluent from STP shall be recycled/re-used for flushing, AC make up water and gardening.
	xvii. No sewage or untreated effluent water would be discharged through storm water drains.
	xviii. Onsite sewage treatment of capacity of treating 100% waste water to be installed. The installation of the Sewage Treatment Plant (STP) shall be certified by an independent expert and a report in this regard shall be submitted to the Regional Office of MoEF&CC along with SEIAA and WBPCB before the project is commissioned for operation. Treated waste water shall be reused on site for landscape, flushing, cooling tower, and other end-uses.

Excess treated water shall be discharged as per statutory norms notified by MoEF&CC. Natural treatment systems shall be promoted.

xix. Periodical monitoring of water quality of treated sewage shall be conducted. Necessary measures should be made to mitigate the odour problem from STP.

xx. Sludge from the onsite sewage treatment, including septic tanks, shall be collected, conveyed and disposed as per the Ministry of Urban Development, Central Public Health and Environmental Engineering Organization (CPHEEO) Manual on Sewerage and Sewage Treatment Systems, 2013.

IV. Noise monitoring and prevention

i. Ambient noise levels shall conform to residential area/commercial area/industrial area/silence zone both during day and night as per Noise Pollution (Control and Regulation) Rules, 2000. Incremental pollution loads on the ambient air and noise quality shall be closely monitored during construction phase. Adequate measures shall be made to reduce ambient air and noise level during construction phase, so as to conform to the stipulated standards by CPCB / SPCB.

ii. Noise level survey shall be carried out as per the prescribed guidelines and report in this regard shall be submitted to Regional Office of the MoEF&CC along with SEIAA and WBPCB as a part of six-monthly compliance report.

iii. Acoustic enclosures for DG sets, noise barriers for ground-run bays, ear plugs for operating personnel shall be implemented as mitigation measures for noise impact due to ground sources.

V. Energy Conservation measures

i. Compliance with the Energy Conservation Building Code (ECBC) of Bureau of Energy Efficiency shall be ensured. Buildings in the States which have notified their own ECBC, shall comply with the State ECBC.

ii. Outdoor and common area lighting shall be LED.

iii. Concept of passive solar design that minimize energy consumption in buildings by using design elements, such as building orientation, landscaping, efficient building envelope, appropriate fenestration, increased day lighting design and thermal mass etc. shall be incorporated in the building design. Wall, window, and roof u-values shall be as per ECBC specifications.

iv. Energy conservation measures like installation of CFLs/ LED for the lighting the area outside the building should be integral part of the project design and should be in place before project commissioning.

v. Solar, wind or other Renewable Energy shall be installed to meet electricity generation equivalent to 1% of the demand load or as per the state level/ local building bye-laws requirement, whichever is higher.

vi. Solar power shall be used for lighting in the apartment to reduce the power load on grid. Separate electric meter shall be installed for solar power. Solar water heating shall be provided to meet 20% of the hot water demand of the commercial and institutional building or as per the requirement of the local building bye-laws, whichever is higher. Residential buildings are also recommended to meet its hot water demand from solar water heaters, as far as possible.

VI. Waste Management

i. A certificate from the competent authority handling municipal solid wastes, indicating the existing civic capacities of handling and their adequacy to cater to the M.S.W. generated from project shall be obtained.

ii. Disposal of muck during construction phase shall not create any adverse effect on the neighboring communities and be disposed taking the necessary precautions for general safety and health aspects of people, only in approved sites with the approval of competent authority.

iii. Separate wet and dry bins must be provided in each unit and at the ground level for facilitating segregation of waste. Solid waste shall be segregated into wet garbage and inert materials.

iv. Organic waste compost/ Vermiculture pit/ Organic Waste Converter within the premises with a minimum capacity of 0.3 kg /person/day must be installed.

v. All non-biodegradable waste shall be handed over to authorized recyclers for which a written tie up must be done with the authorized recyclers.

vi. Any hazardous waste generated during construction phase, shall be disposed off as per applicable rules and norms with necessary approvals of the State Pollution Control Board.

vii. Use of environment friendly materials in bricks, blocks and other construction materials, shall be required for at least 20% of the construction material quantity. These include Fly Ash bricks, hollow bricks, AACs, Fly Ash Lime Gypsum blocks, Compressed earth blocks, and other environment friendly materials.

viii. Fly ash should be used as building material in the construction as per the provision of Fly Ash Notification of September, 1999 and amended as on 27th August, 2003 and 25th January, 2016. Ready mixed concrete must be used in building construction.

ix. Any wastes from construction and demolition activities related thereto shall be managed so as to strictly conform to the Construction and Demolition Waste Management Rules, 2016.

x. Used CFLs and TFLs should be properly collected and disposed off/sent for recycling as per the prevailing guidelines/ rules of the regulatory authority to avoid mercury contamination.

VII. Water Body Conservation:-

i. Existing water bodies should not be lined and their embankments should not be cemented. The water body is to be kept in natural conditions without disturbing the ecological habitat.

VIII. Green Cover

i. The unit should strictly abide by The West Bengal Trees (Protection and Conservation in Non-Forest Areas) Act, 2006 and subsequent rules. The proponent should undertake plantation of trees over at least 20% of the total area.

ii. No tree can be felled/transplanted unless exigencies demand. Where absolutely necessary, tree felling shall be with prior permission from the concerned regulatory authority. Old trees should be retained based on girth and age regulations as may be prescribed by the Forest Department. Plantations to be ensured species (cut) to species (planted).

iii. The proponent should plant at least 1060 nos. trees. The landscape planning should include plantation of native species. The species with heavy foliage, broad leaves and wide canopy cover are desirable. Water intensive and/or invasive species should not be used for landscaping. The project proponent should follow plantation plan approved by Divisional Forest Officer, Howrah Division vide Memo no. 2428/28-02 dated 03.08.2021.

iv. Where the trees need to be cut with prior permission from the concerned Local Authority, compensatory plantation in the ratio of 1:10 (i.e. planting of 10 trees for every 1 tree that is cut) shall be done and maintained. Plantations to be ensured species (cut) to species (planted). Area for green belt development shall be provided as per the details provided in the project document.

v. Topsoil should be stripped to a depth of 20 cm from the areas proposed for buildings, roads, paved areas, and external services. It should be stockpiled appropriately in designated areas and reapplied during plantation of the proposed vegetation on site.

IX. Transport

i. A comprehensive mobility plan, as per MoUD best practices guidelines (URDPFI), shall be prepared to include motorized, non-motorized, public, and private networks. Road should be designed with due consideration for environment, and safety of users. The road system can be designed with these basic criteria.

a. Hierarchy of roads with proper segregation of vehicular and pedestrian traffic.

b. Traffic calming measures.
c. Proper design of entry and exit points.
d. Parking norms as per local regulation.

ii. Vehicles hired for bringing construction material to the site should be in good condition and should have a pollution check certificate and should conform to applicable air and noise emission standards and to be operated only during non-peak hours.

iii. A detailed traffic management and traffic decongestion plan shall be drawn up to ensure that the current level of service of the roads within a 05 kms radius of the project is maintained and improved upon after the implementation of the project. This plan should be based on cumulative impact of all development and increased habitation being carried out or proposed to be carried out by the project or other agencies in this 05 Kms radius of the site in different scenarios of space and time and the traffic management plan shall be duly validated and certified by the State Urban Development department and the P.W.D./competent authority for road augmentation and shall also have their consent to the implementation of components of the plan which involve the participation of these departments.

X. Human health issues

i. All workers working at the construction site and involved in loading, unloading, carriage of construction material and construction debris or working in any area with dust pollution shall be provided with dust mask.

ii. For indoor air quality the ventilation provisions as per National Building Code of India.

iii. Emergency preparedness plan based on the Hazard identification and Risk Assessment (HIRA) and Disaster Management Plan shall be implemented.

iv. Provision shall be made for the housing of construction labour within the site with all necessary infrastructure and facilities such as fuel for cooking, mobile toilets, mobile STP, safe drinking water, medical health care, crèche etc. The housing may be in the form of temporary structures to be removed after the completion of the project.

v. Occupational health surveillance of the workers shall be done on a regular basis.

vi. A First Aid Room shall be provided in the project both during construction and operations of the project.

XI. Environment Management Plan (EMP)

i. The project proponent should submit the proposed EMP on a six monthly basis. The Office Memorandum issued by the MoEF & CC vide F. No. 22-65/2017-IA.III dated 30.09.2020 should be strictly followed.

ii. Need based activities for local people is part of the EMP. Details of such activities submitted by the Project Proponent.

iii. The company shall have a well laid down environmental policy duly approved by the Board of Directors. The environmental policy should prescribe for standard operating procedures to have proper checks and balances and to bring into focus any infringements/deviation/violation of the environmental / forest / wildlife norms /conditions. The company shall have defined system of reporting infringements /deviation / violation of the environmental / forest / wildlife norms / conditions and / or shareholders / stake holders. The copy of the board resolution in this regard shall be submitted to the Regional Office of MoEF&CC along with SEIAA and WBPCB as a part of six-monthly report.

iv. A separate Environmental Cell both at the project and company head quarter level, with qualified personnel shall be set up under the control of Senior Executive, who will directly report to the head of the organization.

v. Action plan for implementing EMP and environmental conditions along with responsibility matrix of the company shall be prepared and shall be duly approved by competent authority

The year wise funds earmarked for environmental protection measures shall be kept in separate account and not to be diverted for any other purpose.

vi. Year wise progress of implementation of action plan shall be reported to the Regional Office of MoEF&CC along with SEIAA and WBPCB along with the Six Monthly Compliance Report.

XII. Additional conditions

a) Construction activity shall be carried out complying all statutory rules / regulations and sanction plan.

b) Waterbodies shall be maintained as per the approval of Competent Authority.

XIII. Miscellaneous

i. The environmental clearance accorded shall be valid for a period of 10 years for the proposed project.

ii. The project proponent shall prominently advertise it at least in two local newspapers of the District or State, of which one shall be in the vernacular language within seven days indicating that the project has been accorded environment clearance and the details of MoEFCC/SEIAA website where it is displayed.

iii. The copies of the environmental clearance shall be submitted by the project proponents to the Heads of local bodies, Panchayats and Municipal Bodies in addition to the relevant offices of the Government who in turn has to display the same for 30 days from the date of receipt.

iv. The project proponent shall upload the status of compliance of the stipulated environment clearance conditions, including results of monitored data on their website and update the same on half-yearly basis.

v. The project proponent shall submit six-monthly reports on the status of the compliance of the stipulated environmental conditions on the website of the Ministry of Environment, Forest and Climate Change at environment clearance portal with a copy to SEIAA and WBPCB.

vi. The project proponent shall submit the environmental statement for each financial year in Form-V to the concerned State Pollution Control Board as prescribed under the Environment (Protection) Rules, 1986, as amended subsequently and put on the website of the company.

vii. The project proponent shall inform the Regional Office of the MoEF&CC along with SEIAA and WBPCB, the date of financial closure and final approval of the project by the concerned authorities, commencing the land development work and start of production operation by the project.

viii. The project authorities must strictly adhere to the stipulations made by the State Pollution Control Board and the State Government.

ix. The project proponent shall abide by all the commitments and recommendations made in the EIA/EMP report and also that during their presentation to the State Expert Appraisal Committee (SEAC).

x. No further expansion or modifications in the plant shall be carried out without prior approval of the SEIAA.

xi. Concealing factual data or submission of false/fabricated data may result in revocation of this environmental clearance and attract action under the provisions of Environment (Protection) Act, 1986.

xii. The SEIAA may revoke or suspend the clearance, if implementation of any of the above conditions is not satisfactory.

xiii. The SEIAA reserves the right to stipulate additional conditions if found necessary. The Company in a time bound manner shall implement these conditions.

xiv. The Regional Office of the MoEF&CC/SEIAA/WBPCB shall monitor compliance of the stipulated conditions. The project authorities should extend full cooperation to the officer(s)

	of the Regional Office of MoEF&CC / SEIAA/WBPCB by furnishing the requisite data / information/monitoring reports. xv. The above conditions shall be enforced, inter-alia under the provisions of the Water (Prevention & Control of Pollution) Act, 1974, the Air (Prevention & Control of Pollution) Act, 1981, the Environment (Protection) Act, 1986, Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016 and the Public Liability Insurance Act, 1991 along with their amendments and Rules and any other orders passed by the Hon'ble Supreme Court of India / High Courts and any other Court of Law relating to the subject matter. xvi. Any appeal against this EC shall lie with the National Green Tribunal, if preferred, within a period of 30 days as prescribed under Section 16 of the National Green Tribunal Act, 2010.

2. Proposal No. :- **SIA/WB/MIS/74824/2022** File No- **EN/T-II-1/024/2022** Proposed Common Bio Medical Waste Treatment Facility at Plot nos. 9571, 9519, 9520, 9521, 9541, 9543, 9544, 9554, 9555, 9556, 9557, 9558, 9559, 9562, 9563, 9566, 9567, 9568, 9569, 9570, Mouza-Saharjora, J.L. no 26, P.S.- Barjora, Dist – Bankura, PIN – 722202, West Bengal by **M/s. SNG Envirosolutions Private Limited**	Type- **EC**

INTRODUCTION

The proponent made online application vide proposal no. **SIA/WB/MIS/74824/2022** dated **19 Jul 2022** along with copies of EIA/EMP seeking environment clearance under the provisions of the EIA Notification, 2006 for the above mentioned project. The proposed project activity is listed at SL.No. **7(d)(a)Common Bio-Medical Waste Treatment Facility** , under Category **"B1 "** of EIA Notification 2006 and the proposal is appraised at State level.

The **Common Bio Medical Waste Treatment Facility proposed by M/S SNG Envirosolutions Private Limited** of M/s **SURENDRA SINGH** located in State **West Bengal** was initially received in the SEIAA on **06 Apr 2022** for obtaining Terms of Reference (ToR) as per EIA Notification, 2006. The Project was appraised by the State Expert Appraisal Committee (INFRA-2) [SEAC] during its **41st SEAC meeting** held between **25 May 2022** to **25 May 2022** and prescribed ToRs to the project for undertaking detailed EIA study for obtaining Environmental Clearance. Accordingly, the project proponent had obtained ToR from SEIAA for the proposal vide no. 1314/EN/T-II-1/024/2022 dated 11.07.2022 against proposal no. SIA/WB/MIS/74824/2022.

A field inspection of the project site to ascertain the present status of the project was conducted by WBPCB & SEAC on 18.12.2021. It was reported that no construction activity was started. No human settlement was observed in and around the project site within 500m.

SEAC recommended the proposed project for Environmental Clearance with the following additional conditions:

i. ETP discharge shall conform the stipulated standards.

ii. Adequate storage area to be constructed for storing BMW.

iii. Monitoring of wastewater quality to be done in regular interval.

PROJECT DETAILS

The project of M/s **SURENDRA SINGH** located in as follows :

State of the project				
S. No.	**State**	**District**	**Tehsil**	**Village**
(1.)	West Bengal	Bankura	Barjora	Mauza-Saharjora

The production details / project configuration is as follows :

Project configuration/product details						
S. No.	**Project configuration/product details**	**Quantity**	**Unit**	**Other Unit**	**Mode of Transport/Transmission of Product**	**Other Mode of Transport**
(1.)	Biomedical waste	7050	9	beds	Road	

Raw Material Requirement is as follows :

Raw Material Requirement details								
S. No.	**Item**	**Quantity per annum**	**Unit**	**Other Unit**	**Source**	**Mode of Transport/Transmission of Product**	**Other Mode of Transport**	**Distance of Source from Project Site(Kilometers)**
(1.)	Biomedical Waste	7050	9	beds	HCF	Road		75

DELIBERATION IN SEIAA

SEIAA considered the recommendation of SEAC and accepted the same.

RECOMMENDATIONS OF SEIAA

The application for EC is approved.

Conclusion

Recommended

S.No	Conditions
(1)	I. **Statutory compliance:** i. The project proponent shall obtain forest clearance under the provisions of Forest (Conservation) Act, 1986, in case of the diversion of forest land for non-forest purpose involved in the project. ii. The project proponent shall obtain clearance from the National Board for Wildlife, if applicable. iii. The project proponent shall prepare a Site-Specific Conservation Plan & Wildlife Management

Plan and approved by the Chief Wildlife Warden. The recommendations of the approved Site-Specific Conservation Plan / Wildlife Management Plan shall be implemented in consultation with the State Forest Department. The implementation report shall be furnished along with the six-monthly compliance report. (in case of the presence of schedule-I species in the study area)

iv. The project proponent shall obtain Consent to Establish / Operate under the provisions of Air (Prevention & Control of Pollution) Act, 1981 and the Water (Prevention & Control of Pollution) Act, 1974 from the concerned State Pollution Control Board/Committee.

v. Transportation and handling of Bio-medical Wastes shall be as per the Biomedical Wastes (Management and Handling) Rules, 20016 including the section 129 to 137 of Central Motor Vehicle Rules 1989.

vi. Project shall fulfill all the provisions of hazardous Wastes (Management, handling and Transboundary Movement) Rules, 2016 including collection and transportation design etc. and also guidelines for Common Hazardous Waste Incineration — 2005, issued by CPCB Guidelines of CPCB/MPPCB for Bio-medical Waste Common Hazardous Wastes incinerators shall be followed.

vii. The project proponent shall obtain the necessary permission from the Central Ground Water Authority, in case of drawl of ground water / from the competent authority concerned in case of drawl of surface water required for the project.

viii. A certificate of adequacy of available power from the agency supplying power to the project along with the load allowed for the project should be obtained.

ix. All other statutory clearances such as the approvals for storage of diesel from Chief Controller of Explosives, Fire Department, Civil Aviation Department shall be obtained, as applicable by project proponents from the respective competent authorities.

II. **Air quality monitoring and preservation**

i. The project proponent shall install emission monitoring system including Dioxin and furans to monitor stack emission with respect to standards prescribed in Environment (Protection) Rules 1986 and connected to SPCB and CPCB online servers and calibrate these systems from time to time according to equipment supplier specification through labs recognised under Environment (Protection) Act, 1986 or NABL accredited laboratories.

ii. Periodical air quality monitoring in and around the site including VOC, HC shall be carried out.

iii. Incineration plants shall be operated (combustion chambers) with such temperature, retention time and turbulence, so as to achieve Total Organic Carbon (TOC) content in the slag and bottom ashes less than 3%, or their loss on ignition is less than 5% of the dry weight of the material.

iv. Venturi scrubber (alkaline) should be provided with the incinerator with stack of adequate height (Minimum 30 meters) to control particulate emission within 50mg/Nm3.

v. Appropriate Air Pollution Control (APC) system shall be provided for fugitive dust from all vulnerable sources, so as to comply prescribed standards. All necessary air pollution control devises (quenching, Venturi scrubber, mist eliminator) should be provided for compliance of emission standards.

vi. Masking agents should be used for odour control.

III. **Water quality monitoring and preservation**

i. The project proponent shall install effluent monitoring system with respect to standards prescribed in Environment (Protection) Rules 1986 through labs recognized under Environment (Protection) Act, 1986 or NABL accredited laboratories.

ii. Waste water generated from the facility shall be treated in the ETP and treated waste water shall be reused in the APCD connected to the incinerator. The water quality of treated effluent shall

		meet the norms prescribed by State Pollution Control Board. Zero discharge should be maintained.
	iii.	Process effluent/any waste water should not be allowed to mix with storm water.
	iv.	Total fresh water use shall not exceed the proposed requirement as provided in the project details. Prior permission from competent authority shall be obtained for use of fresh water.
	v.	Sewage Treatment Plant shall be provided to treat the wastewater generated from the project. Treated water shall be reused within the project.
	vi.	A certificate from the competent authority for discharging treated effluent/ untreated effluents into the Public sewer/ disposal/drainage systems along with the final disposal point should be obtained.
	vii.	The leachate from the facility shall be collected and treated to meet the prescribed standards before disposal.
	viii.	Magnetic flow meters shall be provided at the inlet and outlet of the ETP & all ground water abstraction points and records for the same shall be maintained regularly.
	ix.	Rain water runoff from hazardous waste storage area shall be collected and treated in the effluent treatment plant.
	IV.	**Noise monitoring and prevention**
	i.	The ambient noise levels should conform to the standards prescribed under E(P)A Rules, 1986 viz. 75 dB(A) during day time and 70 dB(A) during night time.
	V.	**Energy Conservation measures**
	i.	Provide solar power generation on roof tops of buildings, for solar light system for all common areas, street lights, parking around project area and maintain the same regularly;
	ii.	Provide LED lights in their offices and residential areas
	VI.	**Waste management**
	i.	Incinerated ash shall be disposed at approved TSDF and MoU made in this regard shall be submitted to the Ministry prior to the commencement.
	ii.	The solid wastes shall be segregated as per the norms of the Solid Waste Management Rules, 2016.
	iii.	A certificate from the competent authority handling municipal solid wastes should be obtained, indicating the existing civic capacities of handling and their adequacy to cater to the M.S.W. generated from project.
	iv.	Any wastes from construction and demolition activities related thereto shall be managed so as to strictly conform to the Construction and Demolition Rules, 2016
	v.	No landfill site is allowed within the CBWTF site.
	vi.	The Project proponent shall not store the Hazardous Wastes more than the quantity that has been permitted by the CPCB/SPCB.
	VII.	**Green Belt**
	i.	Green belt shall be developed in area as provided in project details, with native tree Green belt shall be developed in an area equal to 33% of the plant area with a native tree species in accordance with CPCB guidelines. The greenbelt shall inter alia cover the entire periphery of the plant. The project proponent should follow the plantation plan submitted and uploaded in the PARIVESH portal by them.
	VIII.	**Public hearing and Human health issues**
	i.	Feeding of materials/Bio-medical waste should be mechanized and automatic no manual feeding is permitted.

ii. Proper parking facility should be provided for employees & transport used for collection & disposal of waste materials.

iii. Necessary provision shall be made for fire-fighting facilities within the complex.

iv. Emergency preparedness plan based on the Hazard identification and Risk Assessment (HIRA) and Disaster Management Plan shall be implemented.

v. Emergency plan shall be drawn in consultation with SPCB/CPCB and implemented in order to minimize the hazards to human health or environment from fires, explosion or any unplanned sudden or gradual release of hazardous waste or hazardous waste constituents to air, soil or surface water.

vi. Provision shall be made for the housing of construction labour within the site with all necessary infrastructure and facilities such as fuel for cooking, mobile toilets, mobile STP, safe drinking water, medical health care, crèche etc. The housing may be in the form of temporary structures to be removed after the completion of the project.

vii. Occupational health surveillance of the workers shall be done on a regular basis.

IX. **Environment Management Plan (EMP)**

i. The project proponent should submit the proposed EMP on a six-monthly basis. The Office Memorandum issued by the MoEF & CC vide F. No. 22-65/2017-IA.III dated 30.09.2020 should be strictly followed.

ii. Need based activities for local people is part of the EMP. Details of such activities submitted by the Project Proponent.

iii. The company shall have a well laid down environmental policy duly approve by the Board of Directors. The environmental policy should prescribe for standard operating procedures to have proper checks and balances and to bring into focus any infringements/deviation/violation of the environmental / forest /wildlife norms/conditions. The company shall have defined system of reporting infringements /deviation / violation of the environmental / forest / wildlife norms / conditions and / or shareholders / stake holders. The copy of the board resolution in this regard shall be submitted to the Regional Office of Ministry of Environment, Forest and Climate Change (MoEF&CC) along with State Level Environment Impact Assessment Authority (SEIAA) and West Bengal Pollution Control Board (WBPCB) as a part of six-monthly report.

iv. A separate Environmental Cell both at the project and company head quarter level, with qualified personnel shall be set up under the control of senior Executive, who will directly to the head of the organization.

v. Action plan for implementing EMP and environmental conditions along with responsibility matrix of the company shall be prepared and shall be duly approved by competent authority. The year wise funds earmarked for environmental protection measures shall be kept in separate account and not to be diverted for any other purpose.

vi. Year wise progress of implementation of action plan shall be reported to the Regional Office of MoEF&CC along with SEIAA and WBPCB along with the Six Monthly Compliance Report.

vii. Self-environmental audit shall be conducted annually. Every three years third party environmental audit shall be carried out.

X. **Additional conditions**

i. ETP discharge shall conform the stipulated standards.

ii. Adequate storage area to be constructed for storing BMW.

iii. Monitoring of wastewater quality to be done in regular interval.

XI. **Miscellaneous**

i. The environmental clearance accorded shall be valid for a period of 10 years for the proposed project.

ii. The project proponent shall prominently advertise it at least in two local newspapers of the District or State, of which one shall be in the vernacular language within seven days indicating that the project has been accorded environment clearance and the details of MoEFCC/SEIAA website where it is displayed.

iii. The copies of the environmental clearance shall be submitted by the project proponents to the Heads of local bodies, Panchayats and Municipal Bodies in addition to the relevant offices of the Government who in turn has to display the same for 30 days from the date of receipt.

iv. The project proponent shall upload the status of compliance of the stipulated environment clearance conditions, including results of monitored data on their website and update the same on half-yearly basis.

v. The project proponent shall submit six-monthly reports on the status of the compliance of the stipulated environmental conditions on the website of the MoEF&CC at environment clearance portal with a hard copy to SEIAA/WBPCB.

vi. The project proponent shall submit the environmental statement for each financial year in Form-V to the concerned State Pollution Control Board as prescribed under the Environment (Protection) Rules, 1986, as amended subsequently and put on the website of the company.

vii. The criteria pollutant levels namely; SPM, RSPM, SO2, NOx (ambient levels as well as stack emissions) or critical sectoral parameters, indicated for the project shall be monitored and displayed at a convenient location near the main gate of the company in the public domain.

viii. The project proponent shall inform the Regional Office of the MoEF&CC along with SEIAA and WBPCB, the date of financial closure and final approval of the project by the concerned authorities, commencing the land development work and start of production operation by the project.

ix. The project authorities must strictly adhere to the stipulations made by the State Pollution Control Board and the State Government.

x. The project proponent shall abide by all the commitments and recommendations made in the EIA/EMP report, commitment made during Public Hearing and also that during their presentation to the State Expert Appraisal Committee (SEAC).

xi. No further expansion or modifications in the plant shall be carried out without prior approval of the SEIAA.

xii. Concealing factual data or submission of false/fabricated data may result in revocation of this environmental clearance and attract action under the provisions of Environment (Protection) Act, 1986.

xiii. The SEIAA may revoke or suspend the clearance, if implementation of any of the above conditions is not satisfactory.

xiv. The SEIAA reserves the right to stipulate additional conditions if found necessary. The Company in a time bound manner shall implement these conditions.

xv. The Regional Office of the MoEF&CC/SEIAA/WBPCB shall monitor compliance of the stipulated conditions. The project authorities should extend full cooperation to the officer (s) of the Regional Office of MoEF&CC/SEIAA/WBPCB by furnishing the requisite data / information/monitoring reports.

xvi. The above conditions shall be enforced, inter-alia under the provisions of the Water (Prevention &

		Control of Pollution) Act, 1974, the Air (Prevention & Control of Pollution) Act, 1981, the Environment (Protection) Act, 1986, Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016 and the Public Liability Insurance Act, 1991 along with their amendments and Rules and any other orders passed by the Hon'ble Supreme Court of India / High Courts/NGT and any other Court of Law relating to the subject matter.
	xvii.	Any appeal against this EC shall lie with the National Green Tribunal, if preferred, within a period of 30 days as prescribed under Section 16 of the National Green Tribunal Act, 2010.

3. Proposal No. :- **SIA/WB/IND2/79688/2021** File No- **EN/T-II-1/128/2021** Proposed expansion of capacity from 52 KTPA to 67 KTPA at Asansol Durgapur Development Authority (ADDA), J.L. No. 85 & 92, (Plot No. mentioned in Annexure – 1), Village Sagarbhanga, Taluk Durgapur, District Paschim Burdaman, PIN – 713 211, West Bengal by **M/s. Graphite India Limited (VIOLATION CASE)**	Type- **EC**

INTRODUCTION

The proponent made online application vide proposal no. SIA/WB/IND2/79688/2021 dated 09.07.2022 along with copies of EIA/EMP seeking environment clearance under the provisions of the EIA Notification, 2006 for the above-mentioned project. The proposed project activity is listed at SL. No. 5(e) Petrochemical based processing (processes other than cracking & reformation and not covered under the complexes) under Category "B1" of EIA Notification 2006.

The PP had obtained ToR for the proposal vide Memo no. 376/EN/T-II-1/128/2021 dated 10.03.2022 against proposal no. SIA/WB/IND2/67209/2021.

SEAC considered the O.M. of MoEF&CC vide F No. 22-23/2018.IA.III [E 115231] dated 05.07.2022 along with O.M. dated 31.10.2019 and 30.12.2019 and decided that since the project activity falls within the Durgapur Municipal Corporation area which is declared as Severely Polluted Area, the same may be considered at MoEF&CC. Hence, the expansion proposal was forwarded to SEIAA for taking necessary action.

DELIBERATION IN SEIAA

SEIAA considered the recommendation of SEAC and observed that since the project proponent had already made a presentation before the SEAC, the appraisal of the project shall be completed by SEAC and thereafter the case with the recommendations of the SEAC should be sent to SEIAA for onward transmission to MoEF&CC as per O.M. dated 31.10.2019 and 30.12.2019.

RECOMMENDATIONS OF SEIAA

Referred back to SEAC.

CONCLUSION

Referred back to SEAC.

4. Proposal No. :- **SIA/WB/NCP/28789/2017** File No- **EN/T-II-1/002/2018** Proposed Setting up New AIIMS, Kalyani at Mouza-Basantpur, JL No.-90 & Mouza- Ghoragacha, JL No.-91, P.S- Chakdah, Dist-Nadia, West Bengal by **M/s. HSCC INDIA LTD.**	Type- **EC**

INTRODUCTION

The proponent made online application vide proposal no. **SIA/WB/NCP/28789/2017** dated **28 Aug 2018** along with copies of EIA/EMP seeking environment clearance under the provisions of the EIA Notification, 2006 for the above mentioned project. The proposed project activity is listed at SL.No. 8(b) Townships and Area Development projects under Category "B1" of EIA Notification 2006 and the proposal is appraised at State level.

The PP had obtained ToR for the proposal vide Memo no. 122-2N-07/2018(E) dated 07.03.2018 from SEAC against proposal no. SIA/WB/NCP/21443/2017. The project had received stipulated conditions for environmental clearance for the project vide Memo No. 2279/EN/T-II-1/002/2018 dated 21.11.2019 for a built-up area of 222786.81 sq.m. over a land area of 727731 Sq.m.

The project was placed in the 59th meeting of SEIAA held on 12.05.2022 and the EC application vide proposal no. SIA/WB/NCP/28789/2017 was referred to SEAC for appraisal. The other two applications against the same project vide proposal nos. SIA/WB/NCP/30106/2018 and SIA/WB/NCP/30107/2018 are to be withdrawn by project proponent.

Based on the submission and presentation made by the project proponent during the 43rd SEAC meeting held on 15.06.2022, the committee observed that the project proponent has undertaken construction activity without obtaining prior EC. It was submitted by the PP that about 95% of the envisaged construction activities under Phase – I and Phase – II of the proposed project has been completed. The SEAC also observed that the PP has applied for grant of EC for the project. But, since the project proposal is to be considered under violation category, the SEAC recommended that the project proponent may apply afresh in the PARIVESH portal for issuance of Terms of Reference under violation category.

PROJECT DETAILS

The project of M/s **HSCC INDIA LTD** located in as follows :

State of the project				
S. No.	**State**	**District**	**Tehsil**	**Village**
(1.)	West Bengal	Nadia	Chakdah	

14. **Project configuration/product details**

S. No.	Project configuration/product details	Quantity	Unit	Other Unit	Mode of Transport/Transmission of Product	Other Mode of Transport
NIL						

Raw Material Requirement details

S. No.	Item	Quantity per annum	Unit	Other Unit	Source	Mode of Transport/Transmission of Product	Other Mode of Transport	Distance of Source from Project Site(Kilometers)
NIL								

DELIBERATION IN SEIAA

SEIAA considered the recommendation of SEAC and accepted the same.

RECOMMENDATIONS OF SEIAA

The application for EC is rejected.

Conclusion

Rejected

5. Proposal No. :- **SIA/WB/NCP/75645/2018** File No- **EN/T-II-1/061/2018** Proposed Residential Building at Premises No.46A/1, Biplabi Barin Ghosh Sarani (Formerly an apportioned portion of premises No. 46A, Biplabi Barin Ghosh Sarani), Kolkata-700067, Ward No-14, Borough No –III, P.S.- Maniktala Under KMC, West Bengal by **M/s. Swastik Projects Pvt. Ltd.**	Type- **EC**

INTRODUCTION

The proponent made online application vide proposal no. **SIA/WB/NCP/75645/2018** dated **16 Jul 2018** along with copies of EIA/EMP seeking environment clearance under the provisions of the EIA Notification, 2006 for the above mentioned project. The proposed project activity is listed at SL.No. 8(a) Building and Construction projects, under Category " B2" of EIA Notification 2006 and the proposal is appraised at State level.

PROJECT DETAILS

The project of M/s **SWASTIK PROJECTS PVT. LTD.** located in as follows :

State of the project				
S. No.	**State**	**District**	**Tehsil**	**Village**
(1.)	West Bengal	Kolkata	Kolkata	

14. **Project configuration/product details**

S. No.	Project configuration/product details	Quantity	Unit	Other Unit	Mode of Transport/Transmission of Product	Other Mode of Transport
NIL						

Raw Material Requirement details

S. No.	Item	Quantity per annum	Unit	Other Unit	Source	Mode of Transport/Transmission of Product	Other Mode of Transport	Distance of Source from Project Site(Kilometers)
NIL								

DELIBERATION IN SEIAA

SEIAA considered the recommendation of SEAC and observed the following :-

a) **The PP is requested to upload the following documents in the PARIVESH Portal –**

1. **Land ownership document (Title Deed / Lease Deed).**
2. **Development Agreement (if any).**
3. **Mutation Certificate**
4. **Challan of onetime processing fee as per Notification No 924/T-II-1/021/2022 dated 23.05.2022 issued by Dept. of Environment, GoWB after obtaining the Payment Ref. No. from the Dept. of Environment. Notification and details can be accessed in the link http://environmentwb.gov.in/pdf/Notification.**

b) **The earlier EC issued vide No. 2176/EN/T-II-1/081/2012 dated 25.09.2017 is cancelled.**

RECOMMENDATIONS OF SEIAA

Therefore, the application for EC is deferred for additional information.

Conclusion

Deferred

6. Proposal No. :- **SIA/WB/MIS/80934/2022** File No- **EN/T-II-1/048/2022** Proposed setting up of Medical Institution and Hospital Building of All India Institute of Medical Sciences (AIIMS), Kalyani at Mouza – Basantpur, JL No. 90, LR Plot No. 83 & Mouza – Ghoragacha, JL No. 91, LR Plot No. 124, 389, PS – Chakdah, Dist – Nadia, West Bengal by M/s. HSCC INDIA LTD. (VIOLATION CASE)	Type-**TOR**

INTRODUCTION

This has reference to your online application vide proposal no. **SIA/WB/MIS/80934/2022** dated **19 Jul 2022** along with the copies of EIA/EMP seeking Terms of reference (TOR) under the provisions of the EIA Notification, 2006 for the above mentioned proposed project. The proposed project activity is listed at S.No. **8(b) Townships and Area Development projects.** under Category **B** of EIA Notification, 2006 and the proposal is appraised at state level.

PROJECT DETAILS

The project of M/s **HSCC INDIA LTD** located in as follows :

State of the project			
S. No.	**State**	**District**	**Tehsil**
(1.)	West Bengal	Nadia	Chakdah

Town/Village : **Basantpur**

The salient features of the project submitted by the project proponent is available at Report under online proposal no. **SIA/WB/MIS/80934/2022**

DELIBERATION IN SEIAA

SEIAA considered the recommendation of SEAC and accepted the same.

RECOMMENDATIONS OF SEIAA

SEIAA approved the proposal for ToR under violation category.

Conclusion

Recommended

S.No	Conditions
(1)	**Annexure – 2** **A) Terms of Reference for EIA and preparation of Environment Management Plan (EMP)** 1. Project description, its importance and the benefits. 2. Project site details (location on toposheet of the study area of 10m, coordinates. google Map, layout map land use geological features and geo-hydrological status of the study area, drainage), 3. Land use as per the approved Master Plan of the area. Permission/approvals required from the land owning agencies. Development Authorities, Local Body, Water Supply & Sewerage Board. Etc., 4. Land acquisition status and R&R details. 5. Forest and Wildlife and eco-sensitive zones. if any in the study area of 10 km - Clearances require under the Forest (Conservation) Act. 1980, the Wildlife (Protection) Act, 1972 and/or the Environment (Protection) Act, 1986. 6. Baseline environmental study for ambient air (PM10, PM2.5, S02, NOx CO), water (both surface and ground) noise and soil for one month (except monsoon period) as per MoEF&CC/CPCB guidelines at minimum 5 locations in the study area of 10 km. 7. Details on flora and fauna and socio-economic aspects in the study area. 8. Likely Impact of the project on the environmental parameters (ambient air, surface and ground water, land, flora and fauna and socio-economic etc.). 9. Source of water for different identified purposes with the permissions required from the concerned authorities, both for surface water and the ground water (by CGWA) as the case may be. Rain water harvesting, etc. 10. Waste water management (treatment, reuse and disposal) for the project and also the study area. 11. Management of solid waste and the construction & demolition wasta for the project vis-à-vis the Solid Waste Management Rules, 2016 and the Construction Demolition Rules, 2016. 12. Energy efficient measures (LED lights, solar power, etc.) during construction as well as during operational phase of the project. 13. Assessment of ecological damage with respect to air, water, land and other environmental attributes. The collection and analysis of data shall be done by an environmental laboratory duly notified under the Environment (Protection) Act 1986. or an environmental laboratory accredited by NABL. or a

laboratory of a Council of Scientific and Industrial Research (CSIR) institution working in the field of environment.

14. Preparation of EMP comprising remediation plan and natural and community resource augmentation plan corresponding to the ecological damage assessed and economic benefits derived due to Violation.
15. The remediation plan and the natural and community resource augmentation plan to be prepared as an independent chapter in the EIA report by the accredited consultants.

B) Additional ToRs:-

1) The unit should abide by The West Bengal Trees (Protection and Conservation in Non-For Areas) Act, 2006 and subsequent rules. The proponent should undertake plantation of trees over least 20% of the total area. DFO approved plantation plan should be submitted.

2) The project proponent should submit a compliance report of the Notifications issued by SEIA WB vide No. 3435/EN/T-II-1/011/2018 dated 30.10.2018 and No. 2495/EN/T-II-1/011/2018 da 17.12.2019.

3) Notary Affidavit as per the enclosed format given in **Annexure – 3**.

4) Related documents mentioned in **Annexure – 4**.

5) Salient features of the project as per **Annexure – 5**.

6) Damage Assessment Plan.

7) Remedial Plan.

8) Community Augmentation Plan.

9) Present status of construction of the project along with photographs.

10) Authenticated documents for the total project cost compared to the cost incurred till the date submission of the EC application along with EIA/EMP.

11) Gross turn-over till the date of submission of EC application to be certified by Charte Accountant.

12) Complete land documents along with mutation and conversion in the name of project propone Summary of the land schedule to be submitted.

13) Permission from the competent authority regarding water supply for the entire water requirement.

14) Concurrence for waste water discharge, storm water discharge, solid waste etc. from the compet authority.

15) EMP as per Office Memorandum of MoEF & CC vide F. No. 22-65/2017.IA.III dated 30.09.2020 be submitted. Items like hand washing station, toilet facility with running water, sch infrastructure including incinerator for used sanitary napkins in case of girls' schools, provision sufficient service water supply and treatment of drinking water, training on environmer awareness including MSW segregation etc. in nearby schools to be considered. Restoration and maintenance of local water bodies, computer literacy training for the local youth may also considered. Evidence of collecting data on the need of the locality should be submitted.

16) Social part of EMP should be recast as stipulated.

17) Plan for installation of digital display board for showing all environmental parameters and EI data.

18) Onsite sanitation and safe drinking water facility during construction phase.

19) Details of STP and ETP along with scaled up drawings and flow diagram to be submitted. Efflu analysis for the inlet to equalisation tank and from each individual process / unit operations to submitted. Complete water balance in this regard should be provided.

20) Drainage network of the site. Treated water discharge point to be indicated.

21) While submitting the land use plan within the project area, the details (exact width) of undergrou service lines including fire, electrical, sewerage and drainage should be depicted with a differ colour in order to assess that the area required for exclusive tree plantation does not overlap w these underground service lines. The plan should be certified by the project architect.

22) Mouza map showing all the dag nos.

23) All mandatory documents i.e. all sanction plans, Building Permit, NOC from WBF&ES, A Clearance etc. to be uploaded in the PARIVESH portal.

24) The provision of water meter with totaliser at freshwater inlets, ETP discharge and recycling lines

25) Subsurface hydro-geological study of the area.

26) Arsenic monitoring in wells at different depths.

27) Detailed plan of solar power plant including PV array should be submitted. Area of roof provided to be shown in the plan. Solar PV and solar heating to be shown separately with g metering plan.

28) Water Balance with breakup of hospital and domestic fresh and wastewater. Back-up borewell mention with capacity and pumping schedule. Groundwater quality especially As-content should monitored. Specifying location and depth of borewell.

29) STP/ETP flowchart and details with disinfection.

30) ETP to be properly designed taking into account pathogens contained in the raw water.

31) Source of total requirement of water from provider.

32) Parking area should be demarcated on the plan with mention of the number of cars. Charging poi for the electrical vehicles should be provided. Parking area should not interfere with green ar Parking area may be finished with hollow paver blocks.

33) Facilities should be marked-up on the plan.

34) DFO approved tree plantation plan in 1:100 scale mentioning spacing of the trees and their nan and numbers may be furnished.

35) Calculation of total population to be recast as per NBC, 2016.

36) Calculation of carrying capacity of the canal vis-à-vis the storm water discharge connected to can

37) Modified water balance to be submitted separately for dry and rainy season.

38) Disposal plan for the radio-active waste generated. The detail to be given in the EIA report.

39) Provide all the following documents related to High Rise Building as per MoEF&CC, vide No. 2 270/2008-IA.III dated 07.02.2012:

a) Microclimate (sunshine & shadow analysis and its effect on energy consumption).
b) Air circulation (effect on natural ventilation and wind speed).
c) Day lighting (how dependence on artificial lighting during daytime is affected).

40) Display board for environmental information during operation stage shall be installed. T following information shall be provided: -

- Daily consumption and quality of drinking water.
- Quality & quantity of inlet & outlet effluent from STP.
- Data from ambient air quality monitoring station.
- Data from ambient noise monitoring station.
- Details of solar power utilization.
- Details of the beneficiary of the EMP-need based activities.

Annexure – 3

UNDERTAKING for Building projects
(To be done on Non-Judicial Stamp Paper of valuation Rs.10/- and duly notarized)

I, son of _____(Father's Name)_____, resident _____(Address)_____ presently working ____(Designation)_____ of M/s. _____(Organization Name)_____ am authorized person of the above named organization, do hereby solemnly declare and state as follows :

1) THAT M/s._____ are the project proponent in respect of the _____(Pro Name)_____.

2. THAT M/s._____ has constructed _____ sq.mt. built-up area at prem No._____.

3. THAT in terms of EIA Notification 2006 and amendments thereof, our project falls within the purv of environment clearance.

4. THAT M/s._____ has failed to get prior environmental clearance as per statu provisions of EIA Notification due to the reasons mentioned below: (please mentioned the reasons) –

i.
ii.
iii.
iv.

5. THAT M/s._____ has submitted the application form for obtaining necessary Te of Reference / Environmental Clearance as per EIA Notification, 2006 and its amendments issued by the Mini of Environment, Forest & Climate Change & Standard Operating Procedure (SoP) issued by MoEF&CC vid OM dated 07.07.2021 which was upheld by hon'ble Supreme Court vide its order dated 09.12.2021 (MoEF& O.M. No.22-21/2020-IA.III[E 138949] dated 28.01.2022).

6. Now I, on behalf of the Project Proponent undertake the followings :-

a) To comply with all statutory requirements/norms, for obtaining Environmental Clearance;
b) To take all necessary permissions/licences/clearances from the concerned Government Departments an submit compliance before the State Level Appraisal Committee, West Bengal;
c) To take all measures for the protection of the environment as may be prescribed by the Central Governn or the State Government from time to time at the expenses of the project proponent.

7. THAT the project proponent also undertakes not to repeat such violation in future, in case of violat the ToR/EC shall be liable to be terminated.

The above-mentioned statements are true to the best of my knowledge and belief.

DEPONENT

Annexure – 4

1. Compliance report of the Notification issued by SEIAA, WB vide No. 3435/EN/T-II-1/011/2018 dated 30.10.2018.
2. NABET Accredited Certificate
3. Project Cost (detailed breakup including present value of land cost to be submitted)
4. Details of Court Cases, if any
5. Land Documents
   - Porcha
   - Local body mutation
   - Land Conversion
6. Sanctioned plan
7. Building Configuration
   - As per Stipulation
   - As per Sanctioned Plan
   - Present Status and Configuration
8. Land use distribution plan showing % of land use as per sanctioned plan.
9. Services (STP, Rainwater Harvesting, Composter, Solar Power etc.) layout plan and its status of configuration.
10. Whether the services are adequate enough with respect to the status of occupancy.
11. All statutory clearance from competent authority as applicable.
    - Sources of water supply and its permission
    - Tree felling permission
    - Relocation of water body
    - PCCF clearance
    - Clearance from WBF&ES

- Airport Authority clearance
- DFO certified plantation plan.

12. Concurrence from competent authority regarding water supply, disposal of solid waste and liquid waste.
13. Drainage Pattern (both inside and outside)
14. Final place of discharge for the treated waste water and recipient water body.

Annexure – 5

Land Area	
Block details	
Nos. of beds	
Expected Population (as per NBC, 2016)	
Total Water requirement (as per NBC, 2016)	
Fresh Water requirement	
Wastewater generated	
Wastewater recycled	
Wastewater discharged	
Solid waste generation & disposal (as per NBC, 2016)	
Biomedical waste generation & disposal	
Total Built-up Area	
Complete Area Statement along with percentage of the total land area adding upto 100%	
1. Ground Coverage with percentage of the total land area	
2. Service Area with percentage of the total land area	
3. Waterbody Area (if any), with percentage of the total land area	
4. Exclusive Tree Plantation Area with percentage of the total land area	
5. Other Green Area with percentage of the total land area	
6. Total Paved Area with percentage of the total land area	
7. Area for services	
8. Other area, if any.	
Peak power demand load for the project	
Solar power plant generation in KW & % of the connected load	
No. of Parking spaces proposed	
No. of Trees proposed	
Backup Power	
Project Cost (Rs.)	

MISCELLANEOUS

1. Discussion on draft DSRs of Bankura and Paschim Bardhaman.

   The DSRs of Bankura and Paschim Bardhaman are approved.

Annexure – 1

SCHEDULE OF PLOTS:

1) J.L.Nos:	...	88 & 92
2) Area of Plot:	...	60.45 Acres
3) Name of Pargana:	...	Silwpur & Sergarh
4) Name of Mouza:	...	Gopinathpur, Nadiha
5) Name of Police Station:	...	Durgapur
6) Sub Registration Office:	...	Gopalnath,
7) District:	...	Burdwan.

GOPINATHPUR, J.L.No.88

C.S.Plot No.	Kh.No:	Touzi No:
C.S.Plot in Part 1191	1880	1
C.S.Plot in Part 1192E	3994	1
C.S.Plot in Part 1193E	702	1
C.S.Plot in Part 1207E	841,3853	1
C.S.Plot in Part 1210E	3994	1
C.S.Plot in Part 1209 E	1550	1
C.S.Plot in Full 1211E	3994	1
C.S.Plot in Full 1212E	3994	1
C.S.Plot in Part 1213N	1060	1
C.S.Plot in Part 1214N	751	1
C.S.Plot in Part 1215N	2962	1
C.S.Plot in Part 1216N	1328SP,2850,2863,2846, 2835,2841,2843,2849	
C.S.Plot in Part 1217N	3182	1
C.S.Plot in Full 1220	3994	1
C.S.Plot in Full 1230	3994	1
C.S.Plot in Full 1231	2673	1
C.S.Plot in Full 1232	613	1
C.S.Plot in Full 1233	2502	1
C.S.Plot in Full 1234S	1142	1
C.S.Plot in Full 1235	610	1
C.S.Plot in Part 1236N	615	1
C.S.Plot in Full 1237	2417	1
	52	C.S.Plot in Part 1238

C.S.PLOT NO:	12. RH.NO:	TOUZI NO:
C.S.Plot in Part 1238	1960	3092
C.S.Plot in Part 1241N	613	1
C.S.Plot in Part 1243N	909	1
C.S.Plot in Full 1222 2484E	616	1
C.S.Plot in Part 1245N	346	1
C.S.Plot in Part 1247N	3707	1
C.S.Plot in Part 1250N	2676	1
C.S.Plot in Part 6129	602	1
C.S.Plot in Part 6131	341	1
C.S.Plot in Part 6132WS	341	1
C.S.Plot in Full 6133W	474	1
C.S.Plot in Part 6134W	1029	1
C.S.Plot in Full 6135W	181	1
C.S.Plot in Full 6136	474	1
~~C.S.Plot in Full 6136~~	474	
C.S.Plot in Full 6137	1029	1
C.S.Plot in Full 6138	101	1
C.S.Plot in Full 6139	474	1
C.S.Plot in Full 6140	1029	1
C.S.Plot in Full 6142	1193	1
C.S.Plot in Full 6143S	1193	1
C.S.Plot in Full 6144	2340,1850	1
C.S.Plot in Full 6145	1193	1
C.S.Plot in Full 6146	1193	1
C.S.Plot in Full 6147	60	1
C.S.Plot in Full 6148	788	1
C.S.Plot in Full 6149	1274	1
C.S.Plot in Full 6150	928	1
C.S.Plot in Full 6151	525	1
~~C.S.Plot in Full 6151~~	525	
C.S.Plot in " 6152	347,1296	1
C.S.Plot in Part 6153N	2670	1
C.S.Plot in Part 6154N	908	1
	53	C.S.Plot in Part 6155

C.S.PLOT NO:	KH.NO:	TOUZI NO:
C.S.Plot in Part 6155	938	1
C.S.Plot in Part 6156	89	1
C.S.Plot in Part 6181N	1098	1
C.S.Plot in Part 6182N	3170,3088	1
C.S.Plot in Part 6213 N	603	1
C.S.Plot in Full 6214	347/1,1286	1
C.S.Plot in Full 6215	89	1
C.S.Plot in Full 6216	1046	1
C.S.Plot in Full 6217	1046	1
C.S.Plot in Full 6218	544	1
C.S.Plot in Full 6219	938	1
C.S.Plot in Full 6220	347/1,1286	1
C.S.Plot in Full 6221	4166	1
C.S.Plot in Full 6222	4166	1
C.S.Plot in Full 6223	3999	1
C.S.Plot in Full 6224	1061	1
C.S.Plot in Full 6225	88	1
C.S.Plot in Full 6226	4165	1
C.S.Plot in Full 6227	83	1
C.S.Plot in Full 6228	88	1
C.S.Plot in Full 6229	88	1
C.S.Plot in Full 6230	88	1
C.S.Plot in Full 6231	88	1
C.S.Plot in Full 6232	83	1
C.S.Plot in Full 6233	4165	1
C.S.Plot in Full 6234	88	1
C.S.Plot in Full 6235	4166	1
C.S.Plot in Full 6236	4165	1
C.S.Plot in Full 6237	3963	1
C.S.Plot in Full 6238	4165	1
C.S. Plot in Full 6239	2789	1
C.S.Plot in Full 6240	88	1
C.S.Plot in Full 6241	3972	1
	C.S.Plot in Part 6242	

C.S.Plot No:	Kil.No:	Touzi No:
C.S.Plot in Part 6242 N	3908	1
C.S.Plot in Part 6243 N	3212,3124,3098,3470,3477, 3499,3596	1
C.S.Plot in Part 6252 N	4006	1
C.S.Plot in Part 6253 N	709	1
C.S.Plot in Part 6254 N	4006	1
C.S.Plot in Full 6256	3152	3092
C.S.Plot in Full 6256	1244	1
C.S.Plot in Full 6257	69	1
C.S.Plot in Full 6260	59	1
C.S.Plot in Full 6261	1590	1
C.S.Plot in Full 6263	1590	1
C.S.Plot in Full 6264	1214	1
C.S.Plot in Full 6265	708	1
C.S.Plot in Full 6266	1046	1
C.S.Plot in Full 6267	1244	1
C.S.Plot in Full 6268	1240	1
C.S.Plot in Full 6269	878	1
C.S.Plot in Full 6270	876,877	1
C.S.Plot in Full 6271	1046	1
C.S.Plot in Full 6272	709	1
C.S.Plot in Full 6273	1045	1
C.S.Plot in Full 6274	1046	1
C.S.Plot in Full 6275	1046	1
C.S.Plot in Full 6276	644	1
C.S.Plot in Full 6277	1668	1
C.S.Plot in Full 6278	1660,1671	1
C.S.Plot in Full 6279	1227	1
C.S.Plot in Full 6280	8517	1
C.S.Plot in Full 6281	1227	1
C.S.Plot in Full 6282	8776,1227	1
	C.S.Plot in Full 6283	

C.S.PLOT NO:	KH.NO:	TOUR NO:
C.S.Plot in Full 6283	2617	1
C.S.Plot in Full 6284	1227	1
C.S.Plot in Full 6285	1051	1
C.S.Plot in Full 6286	583	1
C.S.Plot in Full 6287	929	1
C.S.Plot in Full 6288	929	1
C.S.Plot in Full 6289	754	1
C.S.Plot in Full 6290	754	1
C.S.Plot in Full 6337/6338	88	1
C.S.Plot in Full 6216/6538	4166	1
MOURA MARTHA JL.NO.92		
C.S.Plot in Part 1937/W	159	10
C.S.Plot in Part 1941/W	158	10
C.S.Plot in Part 1942/W	159	10
C.S.Plot in Part 1945/W	127	10
C.S.Plot in Part 1946/W	2740,961	10
C.S.Plot in Part 1947/W	158	10
C.S.Plot in Part 1954/W	231	10
C.S.Plot in Full 1955	155	10
C.S.Plot in Full 1956	1859,1383,1857,1858	10
C.S.Plot in Part 1958/W	159	10
C.S.Plot in Full 1959	462	10
C.S.Plot in Part 1971	251	10
C.S.Plot in - 1973	292	10
C.S.Plot in Part 1974/W	251	10
C.S.Plot in Full 1975	1371	10
C.S.Plot in Full 1976	2942	10
C.S.Plot in Full 1977	493	4158
C.S.Plot in Full 1978	493	4158
C.S.Plot in Full 1979	493	4158
C.S.Plot in Full 1980	474	4158
C.S.Plot in Full 1981		

C.S.PLOT NO:	KH.NO:	TOUZI NO:
C.S.Plot in Full 1981	493	4158
C.S.Plot in Full 1982	490	4158
C.S.Plot in Full 1983	490	4158
C.S.Plot in Full 1984	490	4158
C.S.Plot in Full 1985	493	4158
C.S.Plot in Full 1986	493	4158
C.S.Plot in Part 1987N	2835,2836,2927,2838	10
C.S.Plot in Part 1988N	490	4158
C.S.Plot in Part 1989N	473,1780,2025,2027,2024	4158
C.S.Plot in Full 1990	474	4159
C.S.Plot in Full 1991	492	4158
C.S.Plot in Full 1992	474	4158
C.S.Plot in Full 1993	492	4159
C.S.Plot in Full 1995	1009 to 1011	10
C.S.Plot in Full 1994	492	4158
C.S.Plot in Full 1996	2920	10
C.S.Plot in Full 1997	1334,1336,1466,1837	10
C.S.Plot in Part 1998(N)	851,851	10
C.S.Plot in Full 1999	492	4158
C.S.Plot in Full 2000	474	4158
C.S.Plot in Full 2001	1012	10
C.S.Plot in Full 2002	1012	10
C.S.Plot in Part 2003(W)	153	10
C.S.Plot in Part 2004(W)	1822,1785,1736,1821	10
C.S.Plot in Part 2009E	1566	10
C.S.Plot in Part 2010E	358,2331,2742	10
C.S.Plot in Part 2011E	478	4158
C.S.Plot in Part 2012E	455	10
C.S.Plot in Full 2013	478	4158
C.S.Plot in Full 2014	298	10
C.S.Plot in Full 2015	1660,1761,1783	10
C.S.Plot in Full 2016	1171	10
C.S.Plot in Full 2019	1783,1660,1761	10
C.S.Plot in Full 2020	1085,1082,1252	10

C.S.Plot in Full 2021

C.S.PLOT NO:	KH.NO.	TOUAT NO:
C.S.Plot in Full 2021	1012	10
C.S.Plot in Full 2022	1001 to 1008	10
C.S.Plot in Full 2023	1002,1085,1252	10
C.S.Plot in Full 2025	1001 to 1008	10
C.S.Plot in Full 2026	1012	10
C.S.Plot in Full 2027	727	10
C.S.Plot in Full 2028	747	10
C.S.Plot in Part 2030	503	4158
C.S.Plot in Part 2031	503	4158
MOUZA - GOPIKANPUR		
C.S.Plot in Full 6141	191,474/1,1028,1153	1
C.S.Plot in Part 6219	2838	1
C.S.Plot in Part 6256	611	1
C.S.Plot in Part 6259	615	1
C.S.Plot in Full 6262	1671	1
C.S.Plot in Part 6278	1650,1671	1
MOUZA - HATIHA		
C.S.Plot in Part 1038	412	10
C.S.Plot in Part 1057	312	10
C.S.Plot in Part 1060	100	10
C.S.Plot in Part 1072	851	10
C.S.Plot in Full 2017	1606,1781,1783	10
C.S.Plot in Full 2018	1001 to 1008	10
C.S.Plot in Full 2024	2520,2523,2524,2529	10
C.S.Plot in Full 2028	885	10
C.S.Plot in Part 2030	503	4158
C.S.Plot in Part 2031	503	4158

CERTIFICATE OF POSSESSION.

Certified that I have this day the 3rd March, 1965 received possession at the hand of Shri Sudhir Kanti Chaudhuri, Surveyor, Durgapur Development Authority of 50.45 acres of land mentioned in the schedule below situated in mouza - Gopinathpur, Jl.No.86, and mouza Nadha, Jl.No.92, P.S.Durgapur Dist. Burdwan out of the area acquired under Declaration No.20060 L.A. dated the 3.12.64 published at pages 3865-3866, Part-1 of Calcutta Gazettee Extraordinary of the 4th idem, for Development of Industries in Durgapur Area (Block 'X' south of Station Approach Road) and passes has delivered under Section 17(1) of the L.A.Act 1 of 1894 under G.O.No. 2090/L.A. dated 9.12.64 pending the terms and conditions of the demise of the said land being finally settled by the Development & Planning (Durgapur Industries) Deptt. Govt. of West Bengal.

SCHEDULE OF PLOTS.

Gopinathpur, Jl. No.86

C.S.Plot in	L.R.No.	Khatian No.	C.S.Plot No.	Jl.No.	Khatian No.
C.S.Plot in Part 1191	1660	1	C.S.Plot in Full 1237	2417	1
C.S.Plot in Part 1192	3994	1	" " " Part 1238	1969	3097
C.S.Plot in Part 1193	702	1	C.S.Plot in Part 1241	613	1
C.S.Plot in Part 1207	241,3853	1	C.S.Plot in Part 1243	909	1
C.S.Plot in Part 1210	3994	1	C.S.Plot in Full 1244 6484	616	1
C.S.Plot in Part 1209	1660	1	C.S.Plot in Part 1246	346	1
C.S.Plot in Full 1211	3994	1	C.S.Plot in Part 1247	1707	1
C.S.Plot in Full 1212	3994	1	C.S.Plot in Part 1250	2676	1
C.S.Plot in Part 1213	1660	1	C.S.Plot in Part 6129	602	1
C.S.Plot in Part 1214	761	1	C.S.Plot in Part 6131	341	1
C.S.Plot in Part 1215	2662	1	C.S.Plot in Part 6132	341	1
C.S.Plot in Part 1216	-				

C.S.Plot in Part 1216...

...t in	Z.U.No.	Touzi No.	C.S.Plot in	Z.U.No.	Touzi No.
...t in Part 1216	132859, 2836,2853, 2842,2835, 2841,2843, 2849	1	C.S.Plot in Full 6133	474	1
			C.S.Plot in Part 6134	1029	1
			C.S.Plot in Full 6131	88	1
...t in Part 1217	3182	1	C.S.Plot in Full 6232	88	1
...t in Full 1229	3804	1	C.S.Plot in Full 6233	4165	1
...t in Full 1230	3804	1	C.S.Plot in Full 6234	88	1
...t in Full 1231	2675	1	C.S.Plot in Full 6235	4165	1
...t in Full 1232	613	1	C.S.Plot in Full 6236	4165	1
...t in Full 1233	2502	1	C.S.Plot in Full 6237	2863	1
...t in Full 1234	1148	1	C.S.Plot in Full 6238	4166	1
...t in Full 1235	612	1	C.S.Plot in Full 6239	2729	1
...t in Part 1236	613	1	C.S.Plot in Full 6240	88	1
...t in Full 6135	191	1	C.S.Plot in Full 6241	3972	1
...t in Full 6136	474	1	C.S.Plot in Part 6242	3929	1
...t in Full 6137	1029	1	C.S.Plot in Part 6243	3212, 3164, 3098, 3470, 3477, 3499, 3596	1
...t in Full 6138	191	1			
...t in Full 6139	474	1			
...t in Full 6140	1029	1			
...t in Full 6142	1183	1	C.S.Plot in Part 6252	4006	1
...t in Full 6143	1183	1	C.S.Plot in Part 6253	709	1
...t in Full 6144	2540,1256	1			
...t in Full 6145	1183	1	C.S.Plot in Full 6255	1051	1
...t in Full 6146	1183	1	C.S.Plot in Full 6256	693	1
...t in Full 6147	90	1	C.S.Plot in Full 6257	929	1
...t in Full 6148	708	1	C.S.Plot in Full 6258	929	1
...t in Full 6149	1974	1	C.S.Plot in Full 6282	754	1
...t in Full 6150	638	1	C.S.Plot in Full 6290	754	1
...t in Full 6151	325	1	C.S.Plot in Full 6213 6309	88	1
...t in Full 6152	374,1256	1			
...t in Part 6153	2570	1	C.S.Plot in Full 6215 6339	4165	1
" " " 6154	938	1			

...C.S.Plot in Part 6155...

C.S.Plot No.	Kh.No.	Touzi No.	C.S.Plot No.	Kh.No.	Touzi No.	S.Plot
C.S.Plot in Part 6155	838	1	Mouza Jadida M.No.82			.Plot
C.S.Plot in Part 6156	89	1				.Plot
C.S.Plot in Part 6161	1698	1	C.S.Plot in Part 1937	159	10	.Plot
C.S.Plot in Part 6162	3170,3078	1	C.S.Plot in Part 1941	158	10	.Plot
C.S.Plot in Part 6213	603	1	C.S.Plot in Part 1942	159	10	.Plot
C.S.Plot in Full 6214	847/1,1856	1	C.S.Plot in Part 1945	127	10	.Plot
C.S.Plot in Full 6215	89	1	C.S.Plot in Part 1946	2740,961	10	.Plot
" " 6215	1046	1	C.S.Plot in Part 1947	158	10	.Plot
C.S.Plot in Full 6217	1046	1	C.S.Plot in Part 1964	231	10	.Plot
C.S.Plot in Full 6218	844	1	C.S.Plot in Full 1965	158	10	Plot
" " 6219	838	1	C.S.Plot in Full 1966	1869,1883 1857,1858	10	Plot
C.S.Plot in Full 6220	847/1,1856	1				Plot
C.S.Plot in Full 6221	4165	1	C.S.Plot in Part 1968	159	10	Plot
C.S.Plot in Full 6222	4165	1	C.S.Plot in Full 1971	492	4168	Plot
C.S.Plot in Full 6223	3009	1	C.S.Plot in Full 1972	474	4158	Plot
C.S.Plot in Full 6224	1561	1	C.S.Plot in Full 1973	492	4168	Plot
C.S.Plot in Full 6225	88	1	C.S.Plot in Full 1974	492	4168	Plot
C.S.Plot in Full 6226	4165	1	C.S.Plot in Full 1975	1009 to 1011	10	Plot
C.S.Plot in Full 6227	83	1				Plot
C.S.Plot in Full 6228	88	1	C.S.Plot in Full 1976	2926	10	Plot
C.S.Plot in Full 6229	88	1	C.S.Plot in Full 1977	1834,1836 1468,1837	10	Plot
C.S.Plot in Full 6230	88	1				Plot
C.S.Plot in Part 6254	4005	1	C.S.Plot in Part 1978	831,261	10	Plot
C.S.Plot in Full 6255	3152	3092	C.S.Plot in Full 1979	492	4168	Plot
C.S.Plot in Full 6256	1844	1	C.S.Plot in Full 2000	474	4158	
C.S.Plot in Full 6257	89	1	C.S.Plot in Full 2001	1012	10	Plot
C.S.Plot in Full 6260	89	1	C.S.Plot in Full 2002	1012	10	Plot
C.S.Plot in Full 6261	1590	1	C.S.Plot in Part 2003	153	10	Plot
C.S.Plot in Full 6263	1590	1	C.S.Plot in Part 2004	1822,1725 1735,1821	10	Plot
C.S.Plot in Full 6264	1844	1				Plot
C.S.Plot in Full 6265	708	1	C.S.Plot in Part 2009	1686	10	Plot
C.S.Plot in Full 6266	1046	1	C.S.Plot in Part 2010	358,2331, 2742	10	Plot
C.S.Plot in Full 6267	1844	1				Plot

C.S.Plot in Full 6268...61

C.S.Plot No.	MM.No.	Tourt No.	C.S.Plot No.	MM.No.	Tourt No.
C.S.Plot in Full 6268	1040	1	C.S.Plot in Part 2011	478	4158
C.S.Plot in Full 6269	876	1	C.S.Plot in Part 2012	465	10
C.S.Plot in Full 6270	876,877	1	C.S.Plot in Full 2013	478	4158
C.S.Plot in Full 6171	1046	1	C.S.Plot in Full 2014	293	10
C.S.Plot in Full 6272	338	1	C.S.Plot in Full 2015	1661,1781 1783	10
C.S.Plot in Full 6273	1046	1	C.S.Plot in Full 2016	1371	10
C.S.Plot in Full 6274	1046	1	C.S.Plot in Full 2019	1783,1686 1781	10
C.S.Plot in Full 6275	1046	1	C.S.Plot in Full 2020	1095,1092 1262	10
C.S.Plot in Full 6276	644	1	C.S.Plot in Full 2021	1012	10
C.S.Plot in Full 6277	1808	1	C.S.Plot in Full 2022	1001 to 1006	10
C.S.Plot in Full 6278	1670,1671	1	C.S.Plot in Full 2023	1092,1095 1262	10
C.S.Plot in Full 6279	1227	1	C.S.Plot in Full 2025	1001 to 1006	10
C.S.Plot in Full 6280	2517	1	C.S.Plot in Full 2026	1012	10
C.S.Plot in Full 6281	1227	1	C.S.Plot in Full 2027	727	10
C.S.Plot in Full 6282	2776,1227	1	C.S.Plot in Full 2029	747	10
C.S.Plot in Full 6283	2517	1	C.S.Plot in Part 2030	503	4158
C.S.Plot in Full 6284	1227	1	C.S.Plot in Part 2031	503	4158
<u>In Madhu Mo.No.82.</u>					
C.S.Plot in Full 1969	462	10			
C.S.Plot in Part 1971	251	10			
C.S.Plot in Full 1973	278	10			
C.S.Plot in Part 1974	251	10			
C.S.Plot in Full 1975	1371	10			
" " 1976	2943	10			
C.S.Plot in Full 1977	493	4158			
C.S.Plot in Full 1978	493	4158			
C.S.Plot in Full 1979	493	4158			
C.S.Plot in Full 1980	474	4158			
C.S.Plot in Full 1981	493	4158			
C.S.Plot in Full 1982	490	4158			
C.S.Plot in Full 1983	490	4158			
C.S.Plot in Full 1984	490	4158			

C.S.Plot No.	Kh.No.	Tousi No.	C.S.Plot No.	Kh.No.	Tousi No.
C.S.Plot in Full 1985	493	4156			
C.S.Plot in Full 1986	493	4188			
C.S.Plot in Part 1987	2935,2936 2937,2938	10			
C.S.Plot in Part 1988	490	4158			
C.S.Plot in Part 1989	473,1780 2025,2027 2024	4158			
C.Plot in Full 1990	474	4168			

C.S.PLOTS OF LAND PROPER FOR A.R NOT YET DELIVERED TO DURGAPUR DEVELOPMENT AUTHORITY.

Vested land in Mouza Gopinathpur, Jl.No.85

C.S.Plot in Full	Kh.No.	Tousi No.	C.S.Plot No.	Kh.No.	Tousi No.
C.S.Plot in Full 6141	201, 474/1 1089,1183	1	C.S.Plot in Part 1938	412	10
C.S.Plot in Part 6210	2838	1	C.S.Plot in Full 1957	438	10
C.S.Plot in Part 6252	613	1	C.S.Plot in Part 1960	100	10
C.S.Plot in " 6260	613	1	C.S.Plot in Part 1978	551	10
C.S.Plot in Full 6262	1671	1	C.S.Plot in Full 2017	1660,1781 1783	10
C.S.Plot in Part 6278	1660, 1671	1	C.S.Plot in Full 2018	1001 to 1009	10
			C.S.Plot in Full 2024	2520,2523 2526,2529	10
			C.S.Plot in Full 2028	805	10
			C.S.Plot in Part 2030	503	4158
			C.S.Plot in Part 2031	503	4158

B.) Total area including vested land (shown in red line) = 55.00 acres.

Vested land (shown in green) = (-) 4.55 acres.

Possession delivered to M/s.Graphite India Ltd.-50.45 Acres.

Altogether

Altogether measuring area more or less 60.45 acres bounded in red colour in Mouza Gopinathpur, J.L.No.85 and Mouza Paschim, J.L.No.82, P.S. Durgapur, Sub-Registrar Office Gopalnath, Pargana Sikarpur & Sergath, Dist-Burdwan.

Area bounded on the

North by - Sargarthanga Village,

South by - Govt. acquired land (E.Rly.siding

East by - Open land, Sargarthanga Village

West by - Circular road to Bishan Ch.Mukherjee (demolished) and Hindusthan Refractories.

Possession made over by :

Name :Sd/- Samar Kundu

Designation: Draughtsman
D.D.A.

DATE

Name : Sd/- Thakur Kanti Choudhuri

Designation: Surveyor
Durgapur Development
Authority.

Name : Sd/- Madan Mohan Maity

Designation: Attn.

Date: 3.3.65

Name : Sd/- B. K. Sinha

Estate Officer
Durgapur Development Authority

Date : 3.3.65

Possession taken over by:

Name: For Graphite India Ltd.,
Sd/- Illegible,
Designation: Authorised representative.

Date : 3.3.65

WITNESSED BY:

Name: Sd/- A.K. Gupta,

Designation: Secretary
Durgapur Development
Authority
Durgapur-2.

64