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SCIENTIFIC REPLENISHMENT STUDY

FOR BAJRI/SAND MINE LEASES IN THE STATE OF RAJASTHAN

[Phase-III Report]

Job No. 091017026

March, 2018

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CHAPTER-I
Introduction

1. Sand Mining

Sand Mining is a process of the actual removal of sand from the foreshore including rivers, streams and lakes. Sand is mined from beaches and inland dunes and dredged from river bed.The sand is dug up, the valuable minerals are separated in water by using their different density, and the remaining ordinary sand is re-deposited. River sand is vital for human well-being andfor sustenance of rivers. River sand is one of the world's most plentiful resources (perhaps asmuch as 20% of the Earth's crust is sand) and has the ability to replenish itself. As a resource, sand by definition is 'a loose, incoherent mass of mineral materials and is a product of naturalprocesses. These processes are the disintegration of rocks and corals under the influence ofweathering and abrasion.

Sand has become a very important mineral for society due to its many uses mainly in infrastructural activities. Sand and gravel have long been used as aggregate for construction of roads and buildings. Today, the demand for these materials continues to rise. In India, the main source of sand is from river flood plain sand mining, in-stream mining, coastal sand mining, paleo channel sand mining, and sand mining from agricultural fields.

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. River sand mining can damage private and public properties as well as aquatic habitats. Excessive removal of sand may significantly distort the natural equilibrium of a stream channel.The role of sand is very vital with regards to the protection of thecoastal environment. It acts as a buffer against strong tidal waves and storm surges by reducing their impacts as they reach the shoreline. Sand is also a habitat for crustacean species and otherrelated marine organisms.

1.1 Sand Mining in the State of Rajasthan

According to clause (e) of Section 3 of the Mines and Minerals (Development & Regulation) Act (MMDR) Act, 1957 and as per Rule 70 of the Mineral Conservation Rules (MCR), 1960; **sand is classified as minor mineral based on the end use**. Mines and Minerals (Development & Regulation) Act, 1957, under section 15, **empowers the State Government tomake rules in respect of minor mineral**. Mining Leases for the mineral Bajri are granted asprovided in Rajasthan Minor Mineral Concession (Amendments) Rules, 2012 notified videDepartment Notification No. F.14 (1) Mines/ Gr. II/ 2011 dated 23-05-2012 *i.e.* RMMCR, 1986.

In exercise of the powers conferred by Section 15 of the Mines and Minerals (Development & Regulation) Act, 1957(Central Act No. 67 of 1957), the State Government of Rajasthan made rules for regulating the grant of quarry license, mining lease and other mineral concessions in respect of minor minerals. As per the Notification of Government of Rajasthan dated 28 February, 2017, "Bajri" means weathered detritus consisting of graded particles of varying sizes obtained from

loose weathered rock material from the provenance, usually found in river beds or basins or paleo channels, also covers river sand.

The following provisions *interalia* for the mining of Bajri/sand is applicable that:

i. As per Rule 18 (Amended Rules, 2012) of RMMCR, 1986 clause 32 stipulates "*In case of mining lease of mineral Bajri, the lease/ leases shall abstain from mining beyond depth of 3.0 m from the surface and below the water in such a manner that natural path of river/ nallah is not altered*".

ii. As per notification no. F-14(1)Mines/Gr11/2012 dated 21 June, 2012 from Dy. Secretary to Government of Rajasthan clause 3 "*No person shall excavate Bajri beyond the depth of 3.0 m from the surface below the water level of river/nallah and within 45 m of any rail/ road bridge."*

The value of particle size (d_{mm}) for various types of alluvial materials are described as under:

Table-1.1: Value of particle size (dmm) for various types of alluvial materials

Type of material	Sub-type	Average Grain size in mm
Silt	Very fine	0.05-0.08
	Fine	0.12
	Medium	0.16
	Standard	0.32
Sand	Medium	0.51
	Coarse	0.73
Bajri & Sand	Fine	0.89
	Medium	1.29
	Coarse	2.42
Gravel	Medium	7.28
	Heavy	26.10
Boulders	Small	50.10
	Medium	72.50
	Large	188.80

(*Source: Irrigation Engineering & Hydraulic Structures by S.K. Garg)*

1.2 Impact of Sand Mining

Bajri/sand mining has many positive impacts on the economy and on the quality of life of people. However, if extracted in excess amount beyond the replenishment rate, it has an adverse and destructive impact, on the river system, making it unsustainable. The impacts of sand mining are as under:

A. Positive Impacts

Sand deposition eventually leads to reduction inconveyance capacity of river leading to flood in rivers.Proper dredging of sand keeps the bed at the desired level.Thus if dredging is not done, due to continuous depositionof sand, the depth of river may get reduced. This will result in flooding of water and loss of properties. It also facilitates the navigation in the channel. Sand is the main fineaggregate in concrete. Riverbeds are major sources of cleansand. There is a change in traditional housing of people in India and sand has become one of the essential material for construction.

B. Negative Impacts

Taking into consideration the places of occurrences of the adverse environmental impacts of river sand mining, Kitetu and Rowan (1997) classified the impacts broadly into two categories namely off-site impacts and on-siteimpacts. The off-site impacts are, primarily, transport related, whereas, the on-site impacts are generally channelrelated. The on-site impacts are classified into excavation impacts and water supply impacts. The impacts associated with excavation are channel bed lowering, migration of excavated pits and undermining of structures, bank collapse, caving, bank erosion and valley widening and channel instability. The impacts on water supply arereduced ground water recharge to local aquifers, reduction in storage of water for people and livestock especiallyduring drought periods, contamination of water by oil, gasoline and conflicts between miners and localcommunities. Many reports show that depletion of sand in the streambed and along coastal areas causes the deepening of rivers and estuaries, and the enlargement of river mouths and coastal inlets. It may also lead to saline-water intrusion from the nearby sea. Thus in-stream sand mining results in the destruction of aquatic and riparian habitat through large changes in the channel morphology. Impacts include bed degradation, bed coarsening, lowered water tables near the streambed, and channel instability.

It is well understood that mining changes the physical characteristics of the river basin, disturbs the closely linkedflora and fauna, and alters the local hydrology, soil structure as well as the socio-economic condition of thebasin. In general, it was reported that in-stream mining resulted in channel degradation and erosion, head cutting, increased turbidity, stream bank erosion *etc.* All these changes adversely affect fish and other aquatic organisms either directly by damage to organisms or through habitat degradation or indirectlythrough disruption of food web.

Ministry of Environment, Forests & Climate Change (MoEFCC), Government of India, in the*Sustainable Sand Mining Management Guidelines, 2015* has identified the following impacts on account of sand and gravel mining:

i. Extraction of bed material in excess of replenishment by transport from upstream causes the bed to lower (degrade) upstream and downstream of the site of removal.
ii. In-stream habitat is impacted by increase in river gradient, suspended load, sediment transport, sediment deposition. Excessive sediment deposition for replenishment increases turbidity which prevents penetration of light required for photosynthesis and reduces food availability of aquatic fauna.
iii. Riparian habitat including vegetative cover on and adjacent to the river banks controls erosion, provide nutrient inputs into the stream and prevents intrusion of pollutants in the stream through runoff. Bank erosion and change of morphology of the river can destroy the riparian vegetative cover.

iv. Bed degradation are responsible for channel shifting, causing loss of properties and degradation of landscape, it can also undermine bridge supports, pipe lines or other structures.
v. Degradation may change the morphology of the river bed, which constitutes one aspect of the aquatic habitat.
vi. Degradation can deplete the entire depth of gravelly bed material, exposing other substrates that may underlie the gravel, which could in turn affect the quality of aquatic habitat. Lowering of ground water table in the flood plain because of lowering of riverbed level as well as river water level takes place because of extraction and draining out of excessive ground water from the adjacent areas. So, if a floodplain aquifer drains to the stream, groundwater levels can be lowered as a result of bed degradation.
vii. Lowering of the water table can destroy riparian vegetation.
viii. Excessive pumping of ground water in the process of mining in abandoned channels depletes ground water causing scarcity of irrigation and drinking water. In extreme cases it may create ground fissures and subsidence in adjacent areas.
ix. Flooding is reduced as bed elevations and flood heights decrease, reducing hazard for human occupancy of floodplains and the possibility of damage to engineering works.
x. The supply of overbank sediments to floodplains is reduced as flood heights decrease.
xi. Rapid bed degradation may induce bank collapse and erosion by increasing the heights of banks.
xii. Polluting ground water by reducing the thickness of the filter material especially if mining is taking place at top of recharge fissures.
xiii. Choking of filter materials for ingress of ground water from river by dumping of finer material, compaction of filter zone due to movement of heavy vehicles. It also reduces the permeability and porosity of the filter material.
xiv. Removal of gravel from bars may cause downstream bars to erode if they subsequently receive less bed material than is carried downstream from them by fluvial transport.
xv. Ecological effects on bird nesting, fish migration, angling, etc.
xvi. Direct destruction from heavy equipment operation; discharges from equipment and refueling.
xvii. Bio-security and pest risks.
xviii. Impacts on coastal processes.

The other deleterious impacts of indiscrete mining include-

Loss of riparian habitat resulting from direct removal of vegetation along the stream bank to facilitate the use of a dragline or through the process of lowering the water table, bank undercutting, and channel incision.

The physical composition and stability of substrates are altered as a result of in-stream mining and most of these physical effects may exacerbate sediment entrainment in the channel.

1.3 Sustainable Sand Mining Guidelines - MoEFCC

Sand is naturally occurring granular material composed of finely divided rock and mineral particles between 0.06 mm to 2 mm in diameter. Sand is formed due to weathering of rocks due to mechanical forces. In the process the weathered rocks forms gravel and then to sand.

Sand and gravel together known as aggregate, represent the highest volume of raw material used on earth. The mining of aggregate has been continuing for many years. Now the mining of aggregates has reached a level threatening the environment and ecosystem besides also reaching a level of scarcity that would threaten the economy. It is recommended that sand & aggregate mining, and quarrying should be done only after sound scientific assessment and adopting best practices to limit the impact on the environment.

It is also felt that the greater use of substitute material (manufactured sand) & construction technology, and sustainable use of the resource could drastically reduce adverse impact of mining on the environment.

The Guidelines has been based on the following principles:

- Uncontrolled sand mining is not sustainable.
- Compliance with present and future legislation and regulations on the subject is mandatory and not voluntary.
- Each lease holder should be given the opportunity to self-regulate to the extent that it can demonstrate compliance with legislation and regulations.
- Where self- regulation fails to deliver compliance with legislation and regulations, increased formal enforcement and monitoring should be implemented with punitive measures applied in line with the legal framework.
- There is a need to protect the environment and the right of the population to live in clean and safe surroundings, with the need to use natural resources in a way that will make a positive and sustainable contribution to the economy.

The main objectives of the Guidelines are:

- To ensure that sand and gravel mining is done in environmentally sustainable and socially responsible manner.
- To ensure availability of adequate quantity of aggregate in sustainable manner.
- To apply river model studies in identifying the aggradation zones and quantities suitable for mining.
- To improve the effectiveness of monitoring of mining and transportation of mined out material.
- Ensure conservation of the river equilibrium and its natural environment by protection and restoration of the ecological system.
- Avoid aggradation at the downstream reach especially those with hydraulic structures such as jetties, water intakes etc.
- Ensure the rivers are protected from bank and bed erosion beyond its stable profile.
- No obstruction to the river flow, water transport and restoring the riparian rights and in-stream habitats.
- Avoid pollution of river water leading to water quality deterioration.
- To prevent depletion of ground water reserves due to excessive draining out of ground water.
- To prevent ground water pollution by prohibiting sand mining on fissures where it works as filter prior to ground water recharge.

- To maintain the river equilibrium with the application of sediment transport principles in determining the locations, period and quantity to be extracted.
- Streamlining and simplifying the process for grant of environmental clearance (EC) for sustainable mining.

1.4 Genesis of the present study

Government of Rajasthan has issued Letters of Intent to successful bidders for dry mining of mineral Bajri/River Sand from various rivers and their tributaries tehsil-wise in various districts of the State of Rajasthan in the year 2013. As per the conditions of Letter of Intent, it was mandatory to obtain environmental clearance (EC) from MoEFCC, Government of India. Presentations were given in the Expert Appraisal Committee of MoEFCC and MoEFCC has recommended for the environmental clearance to the competent authority. However, all the sand mining project of Rajasthan was deliberated again in 11th Meeting held at October 24-25, 2016. The EAC opined that "*the proposals of sand mining from Rajasthan are not in perennial rivers. These are, in effect, paleo sand deposits and are not replenished annually during monsoon season. The mined out areas are not replenished adequately and may turn into permanent depressions*." It was decided by MoEFCC to advise all applicants to carry out scientific replenishment study and submit the report before EAC for the consideration of quantity of production for mining of Bajri/River Sand on yearly basis, as the rivers in Rajasthan are seasonal and not perennial.

In view of the above requirement, Bajri Lease/LoI Holder's Welfare Samiti, Jaipur approached CMPDI for undertaking the scientific replenishment study of their various mines spread across the State of Rajasthan. CMPDI has already submitted the first phase of the study report consisting of 19 leases. The report has been considered in the Special meeting of the Reconstituted Expert Appraisal Committee for Environmental Appraisal of Mining Projects (Non-Coal) of the Ministry of Environment, Forest and Climate Change was held on January 08, 2018. The 2nd phase of the report covering 41 mine leases, has been prepared in February, 2018 and submitted.

CHAPTER-II
Project Description

2. General

The scientific replenishment study of the mines of Bajri Lease/LoI Holder's Welfare Samiti, Jaipur in being undertaken in phases. In the 3rd phase of the study, the following mines have been considered:

Table-2.1: List of the mines to be taken up for study in 3rd Phase

Sl. No.	Name of leaseholder	Name of Lease Area	District	Area (in Ha)
1	Shri Pankaj Singh Jadaun	Nasirabad	Ajmer	120.31
2	Shri Abhishek Chaudhary	Kishan garh	Ajmer	1219.03
3	Shri Arjun Singh	Pisangan	Ajmer	163.45
4	Shri Paras Sethi	Chohatan	Barmer	54.68
5	Shri Abhimanyu Chaudhary	Sahada	Bhilwara	287.00
6	Shri Ashu Singh Bhati	Sahpura	Bhilwara	624.39
7	Shri Abhishek Chaudhary	Raipur	Bhilwara	836.13
8	M/s Rajasthan Fort & Pal.	Begau	Chittorgarh	286.43
9	Shri Ashu Singh Bhati	Gangrar	Chitt rgarh	77.50
10	M/s Shiva Corporation (I) Ltd.	Chittorgarh	Chittorgarh	450.89
11	M/s Satya Swaroop Jadaun	Mahua	Dausa	755.02
12	Shri Narottam Singh Jadaun	Dausa	Dausa	2031.98
13	Shri Nawal Kishore Gupta	Bari Baseri	Dholpur	232.92
14	Shri Kishore Gupta	Dholpur	Dholpur	391.75
15	Shri Arjun Singh	Shahpura	Jaipur	113.77
16	Shri Himmat Singh Shekhwat	Osion	Dholpur	668.96

A brief description of the above mines isprovided hereunder:

2.1 Shri Pankaj Singh Jadaun

Name of the Mine: Bajri (Minor Mineral) Mine of M/s Shri Pankaj Singh Jadaun
Lease area: 120.312 ha
Name of the river: River Dai Nadi
Length of the river under lease: Approx. 18 Kms Dai Nadi
Tehsil: Nasirabad **District:** Ajmer **State:** Rajasthan
Capacity of Production: 1.5 million tonnes per year

Location: This area is approached from National Highway of Nasirabad-Bhilwara NH-79 via State Highway road SH-26 passing through this area joining Nasirabad, Sarwar, Kekri then Deoli and

Kota. Link roads or village roads from this State Highway-26 joins the river villages. This area is suitable for supply of river sand for demand of Bhilwara, Ajmer and Jaipur.

Nasirabad Town falls on National Highway NH-79 road linking Nasirabad-Bhilwara and District headquarter Ajmer is about 18 Kms in North of Nasirabad. State Highway SH-26 links Nasirabad to Kekri via Sarwar and then to Kotavia Deoli. Motorable roads bifuricates towards villages joining riverside villages Hanutiya, Loharwada, Rampura, Chat near Dai river. Lease area falls in toposheet 45J/11, 45J/12, 45J/15, 45J/16. Area is located between following Latitude and Longitudes:

Latitude – 26° 11'27.90"N to 26°15'38.55"N
Longitude - 74° 43'59.09"E to 74°48'34.27"E

Physiography & Drainage

The lease area forms part of G.T. Sheet No. 45J/11, 45J/12, 45J/15, 45J/16. This is a river sand mining project granted for mining in Govt. allotted area. River is on the eastern slopes of Aravalli range, near Nasirabad Tehsil of Ajmer District and it flows in Tehsil for distance of about 15 Kms flowing from East to West direction. Location of villages granted for river sand mining are Hanutiya, Loharwada, Rampura, Chat in Tehsil-Nasirabad in District-Ajmer. These are located alongside of Dai River. The area is having flat topography in river zone and surrounding 10 Kms zone. Aravalli hill range slopes forms drainage of surrounding and connects to this river. River R.L. is varying higher side near village Chat about 414 mRL and decreasing in downstream direction of river towards Hanutiya 378 mRL which is end point of Tehsil Nasirabad. The Dai River is measuring length about 15 Kms from initial point starting from village Chat to end point at Hanutiya. There are surrounding agriculture farms with seasonal crops.

Rainfall and Climate

Dai river of Nasirabad is part of Ajmer District in Rajasthan, India. It goes through a semi-arid climate that features a hot summer, a short monsoon season and a mildly cold winter. District Ajmer experiences a very hot temperature during the summer months. Throughout the season, the average temperatrure fluctuates between 28° and 40°C while the low hardly drops to mid twenties. The monsoon season that comes in late August and lasts till October brings around 600 mm of rainfall for the city. However, winter arrives with much enjoyable climate. During this time temperature drops dramatically and stands at low teens. The low, on the other hand, drops below double digits as January, the coldest month of the year, gets 7°C of average low temperature.

Estimated Reserve and Production Envisaged:

A) PROVED RESERVES AS PER UNFC CODE (111)

Total Reserves = 6332764 m^3

B) BLOCKED RESERVES AS PER UNFC CODE (211 & 222)

Total Blocked Reserves = 633276 m^3
Mineable Reserves = 6332764 m^3 – 633276 m^3
= 5.69 million m^3

C) TARGETED PRODUCTION

During the 5 year period of lease total extraction proposed is @ 15Lac TPA
Total reserves to be extracted are 4.36 million m^3
Balance reserves are: 1.33 million m^3

Details of Production & Dispatches of Five Years

This is a new lease area being allotted to the applicant. Future production programme has been planned as per the details given below:

Production Programme

Proposed lease will be allotted for a period of 5 years only. Proposed lease consist of 120.312 ha area in 5 villages falling along the Dai River.

Daily production planned: 5454 tonnes per day
Yearly production planned: 15,00,000 tonnes
Working days have been taken as 275 days per annum which can be increased depending on the conditions prevailing at the time of execution.

Projected Production Per Year = 275 x 5454.54 = 15,00,000 tonnes
Specific Density = 1.72 tonne/ cu.m
Volumetric Production = 0.87 million m^3

2.2 Shri Abhishek Chaudhary

Name of the Mine: Bajri (Minor Mineral) Mine of M/s Abhishek
Lease area: 1219.03 ha
Name of the river: Rupangarh River
Length of the river under lease: Approx. 34 km
Tehsil: Kishangarh **District:** Ajmer **State:** Rajasthan
Targetted Capacity of Production: 3.0 million tonnes per year

Location

The lease area is located in Rupangarh River, Tehsil-Kishangarh of district Ajmer, covering an area of 1219.03 ha in the 4 villages falling along the Rupangarh River and is approached from metalled road via Kishangarh. The nearest railway station is Parbatsar Railway station at distance of 13.5 kms in west direction. Villages near river side are Palri Bhopatan, Sinodiya, Bakrawaliya, Bhadun. Lease area of river sand is located on toposheet 45J /13, 45N/1, 45 J/14. Area is located between following Latitude and Longitudes:

Latitude – 26°51'11.03"N to 26°55'56.22"N
Longitude - 74°47'22.14"E to 74°58'0.65"E

Physiography & Drainage

Lease and adjoining area is by and large undulating plain covered under river sand and windblown

sand respectively, concealing the subsurface geology. However, North-East and South–West trending ridge located west of village Palri and hillocks located east of Kotri and few other relief mounts are the only topographic features in the vast plain area.

Ridge is located west of village Palri is the prominent watershed feature of the area. Nallas originating from ridge flows towards west and east respectively and merges into river Roopangarh Nadi and contributes to the run off the Roopangarh Nadi. Roopangarh Nadi flows from SW to NNE and joins Sambhar Lake about 3.5 km NNE of village Sinodiya.

Rainfall and Climate

Rupangarh river of Kishangarh is part of district Ajmer, in Rajasthan, India, goes through a semi-arid climate that features a hot summer, a short monsoon season and a mildly cold winter. Ajmer district experiences a very hot temperature during the summer months. Throughout the season the average temperature fluctuates between 28° and 40°C while the low hardly drops to mid twenties. The monsoon season that comes in late August and lasts till October brings around 600 mm of rainfall for the district. However, winter arrives with much enjoyable climate. During this time temperature drops dramatically and stands at low teens. The low, on the other hand, drops below double digits as January, the coldest month of the year, gets 7°C of average low temperature.

Estimated Reserve and Production Envisaged

A) PROVED RESERVES AS PER UNFC CODE (111)

Total Reserves = 14130466 m3

B) BLOCKED RESERVES AS PER UNFC CODE (211 & 222)

Total Blocked Reserves = 14130466 m^3
Mineable Reserves = 14130466 m^3 – 1413046.6 m^3
= 12.71 million m^3

C) TARGETED PRODUCTION

During the 5 year period of lease total extraction proposed is @ 30LacTPA = 9.61 million m^3
Balance reserves are: 3.1 million m^3

Details of Production & Dispatches of Five Years

This is a new lease area being allotted to the applicant. Future production programme has been planned as per the details given below:

Production Programme

Proposed lease will be allotted for a period of 5 years only. Proposed lease consist of 1219.03 ha area in 4 villages falling along the Rupangarh River. It is proposed to work as per the details given earlier.

Daily production planned: 10909 tonnes Yearly production planned: 30,00,000 tonnes
Working days have been taken as 275 days per annum which can be increased depending on the

conditions prevailing at the time of execution.

Projected production per year = 275 x 10909 = 30,00,000 tonnes
Specific Density = 1.56 tonne/ cu.m
Volumetric Production = 1.92 million m^3

2.3 Shri Arjun Singh

Name of the Mine: River bed minning project Bajri (minor mineral) of Shri Arjun Singh
Lease area: 163.4503 ha
Name of the river: Saraswati & Sagarmati River
Tehsil: Pisangan, **District:** Ajmer, **State:** Rajasthan
Capacity of Production: 11,20,000 tonnes per annum

Table-2.2: Length & Width of the applied lease area

Name of River	Length (m)	Width (m)	
		Max.	Min.
Saraswati River	2796.0	670	171
Sagarmati River	3529.0	584	62

Location

The proposed project is river bed mining of Bajri in Saraswati & Sagarmati Rivers and is situated near village Govindgarh, Akhepura, Jaswantpura, Pisangan, Budhwada, Nuriawas in Tehsil–Pisangan & District–Ajmer of State of Rajasthan. Saraswati River (Block No.–I), is about 6.5 kms in NE direction & Sagarmati River (Block No. II) is about 5.5 km in NNW direction from the Pisangan Tehsil Headquarters.

The nearest District HQ is Ajmer which is 49 Kms from Pisangan. Lease area forms a part of Survey of India topo-sheet no. 45J/6, 7 & 11.

Table-2.3: Location of the Mine Lease

Block No.	Latitude	Longitude
Saraswati Nadi Block-I of 51.3618 Ha.	$26^0$27’23.63” to $26^0$27’36.75”N	$74^0$23’42.90” to $74^0$25’14.18’’ E
Sagarmati Nadi Block-II of 112.0885 Ha	$26^0$22’16.96” to $26^0$21’57.32”N	$74^0$26’01.10”E to $74^0$28’03.70’’ E

Physiography & Drainage

The topography of the applied area is mainly plain land marked with shallow nallah and undulations. In Block-I *i.e.* in Saraswati River the higher elevation is 397 mRL near village Akhepura and lower elevation point is 390 mRL near village Govindgarh in the applied area. In Block-II *i.e.* Sagarmati River, the higher elevation point is 418 mRL near village Nuriyawas and lower elevation point is 411 mRL near village Budhwara. The drainage of this area in general flowing from east towards west. Drainage pattern of the area is dendritic. The applied lease area is

part of the Saraswati & Sagarmati Rivers.The drainage of this area, in general, is flowing from east towards west.

Rainfall and Climate

Mean annual rainfall (1987-2006) of the district is 453.2 mm whereas normal rainfall (1901-70) is lower than average rainfall and placed at 433.8. Almost 95% of the total annual rainfall is received during the southwest monsoon, which enters the district in the last week of June and withdraws in the middle of September. Probability of average annual rainfall exceeding 300 mm is only 90%, except at Mangliawas. However, there is 10% probability that the average rainfall exceed 600 mm. Drought analysis based on agriculture criteria indicates that the district is prone to mild and normal type of droughts. Severe and very severe type of drought is very rare and occurred only twice during 1987 & 2002 (Srinagar); 1977 & 1987 (Todgarh); & 1991 & 1993 (Vijaynagar).

January is the coldest month with mean maximum and minimum temperatures being lowest at 22.7^0 C & 7.6^0 C. Temperature in summer month, June, reaches up to 39.5^0 C. There is drop in temperature due to onset of monsoon and rises again in the month of September. Atmosphere is generally dry except during the monsoon period. The humidity is highest in August with mean daily relative humidity 80%. The annual potential evapotranspiration in the district is 1565.6 mm and is the highest in the month of May (243 mm).

Estimated Reserve and Production Envisaged

Table-2.4: Estimated Reserve

Measured Category – 331 ***Bulk density – 1.4 tonne/m^3***

Name of River	Length (m)	Width (m)	Thickness (m)	Volume (cum)	MT=(Vol. * Bulk density)
Saraswati River Block-I	2796	341	3.0	2860308	4576492.8
Sagarmati River Block-II	3529	294	3.0	3112478	4980124.8
Total				**5972886**	**9556617.6**

Measured Reserves (331) : 9556617.6 MT
Losses along Statutory Barrier zone (211) : 392976 MT
Losses due to Public Road (211) : 292896 MT
Total **: 685872 MT**
Remaining Reserves (111) : 8870745.6 MT

Proved resources are 8870745.6 MT and indicated resources are calculated as 685872 MT.

Mineable reserve

Table-2.5: Estimation of Reserves out of Measured & Indicated Mineral Resources

Sr. No.	Resource Type (Intrinsically Economic)	UNFC Code	Reserve (in metric Tonnes)
1	Proved Mineral resources	(111)	8870745.60
2	Indicated Mineral resources	(211)	685872.00
Total Resources			**9556617.60**

Life of Mine

Life of mine is estimated at 8870745.6 tonnes/1120000 tonnes per annum = 7.92 years.

Details of Production & Dispatches of Five Years

This is a new lease area being allotted to the applicant. Future production programme has been planned as per the details given below:

Production Programme

Proposed lease will be allotted for a period of 5 years only. Proposed lease consist of 163.4503 ha area in various villages falling along the Saraswati River & Sagarmati River. It is proposed to work as per the details given earlier.

Daily production planned:

4,000 tonnes yearly production planned: 11,20,000 tonnes
Working days have been taken as 280 days per annum which can be increased depending on the conditions prevailing at the time of execution.
Projected production per year = 280 x 4,000 = 11,20,000 tonnes
Specific Density = 1.40 tonne/ cu.m
Volumetric Production = 0.8 million m^3

2.4 Shri Paras Sethi

Name of the Mine: Bajri (Minor Mineral) Mine of M/s Paras Sethi
Leasearea: 54.68 Ha
Name of the river: Shivpura River
Length of the river under lease: Approx. 5.00 kms
Tehsil: Chohtan, District: Barmer, State: Rajasthan
Capacity of Production: 2.24 LTPA Say 0.224 million tonnes per year

Location

The lease area is located in Shivpura River, Tehsil-Chohtan of district Barmer, covering an area of 54.68 ha in the Shivpura village falling along the Shivpura River and is approached from metalled road. The nearest railway station is Barmer station about 27 kms.The key plan is prepared on toposheet No.40/O/2, 40/O/3, 40/O/6, and 40/O/7 on a scale of 1:50,000. Area is located between following Latitude and Longitudes:

Latitude – 25°31'47.6"N to 25°32'56.8" N
Longitude - 71°13'43.9" E to 71°14'38.9" E

Physiography Drainage

The area is marked by flat topography of igneous formation, which is showing presence of weathered and fragmented particles of rocks of fine to medium size called Bajri deposite. The elevation level of 198 mRL is lowest and 221 mRL is the highest RL in the River Shivpura in Tehsil-Chohtan. The Shivpura River flows from NW to SE direction in the Tehsil Chohtan. Shivpura River is non-perennial and runs only in during rainy season and almostdry in summer.

Rainfall and Climate

The district experiences arid dry type of climate except during short rainy season. On an average, the district recorded 277 mm of rainfall. Almost 90% of the total rainfall is received during the southwest monsoon, which enters the district in the first week of July and withdraws in the mid of September. The district lies in the desert area and extreme heat recorded during summer and cold during winter season which is the characteristic of the desert. The winter extends from December to March and summer from March end to June third week, followed by rainy season which lasts up to third week of September. The temperature varies between 46°C to 48 °C in summer and lowest up to -01 °C in winter season. The maximum humidity recorded in the month of August with mean daily relativehumidity value of 43%.

Estimated Reserve and Production Envisaged:

A) PROVED RESERVES AS PER UNFC CODE (111)

Total Reserves = 2296560 Tonne or 1640400 m^3

B) BLOCKED RESERVES AS PER UNFC CODE (211&222)

Road (1 No.) = 1522.5 Tonnes
Total Blocked Reserves = 1087.50 m^3
Mineable Reserves = A-B
= 1640400 – 1087.50 = 1639312 m^3 Say 1.639 million m^3

C) TARGETED PRODUCTION

During the 5 year period of lease total extraction is = 11.2 LT Say 0.8 million m^3

D) Balance reserves will be = 1.639 – 0.8 = 1175037.5 Tonnes

Details of Production & Dispatches of Five Years

This is a new lease area being allotted to the applicant. Future production programme hasbeen planned as per the details given below:

Production Programme

Proposed lease will be allotted for a period of 5 years only. Proposed lease consist of 54.68 ha area in 1 village falling along the Shivpura River. It is proposed to work as per the detailsgiven earlier.

Daily production planned: 800.0 tonnes
Yearly production planned: 224000 Tonnes
Working days have been taken as 275 days per annum which can be increased depending on the conditions prevailing at the time of execution.
Projected production per year = 275 x 800 = 224000 Tonnes
Specific Density = 1.40 Tonne/ m^3
Volumetric Production = 0.16 million m^3

2.5 Shri Abhimanyu Chaudhary

Name of the Mine: Bajri (Minor Mineral) Mine of Abhimanyu Choudhary
Lease area: 287.58 ha
Name of the river: Chandrabhaga
Tehsil & District: Sahada, Bhilwara, **State:** Rajasthan
Capacity of Production: 0.56 million MT per year

Name & Length of the river under lease is as per Table-2.6.

Table-2.6: River Characteristics under lease

Name of River	Length traversed by the river in Tehsil (km)	River bed elevation		Total fall (head loss) in river bed with in tehsil	Average bed slope (m / km)
		At the start point in tehsil	At the exit point in tehsil		
Chandrabhaga	0-1.5	520	516	4	2.66
	1.5-11	516	500	16	1.68
	11-20.5	500	480	20	2.10
	20.5-26	480	470	10	1.82

Location

The mine lease area is linearly stretched under 85 revenue villages of tehsil Sahada in district Bhilwara. The geographical location is covered under SOI Toposheet no. 45 K/3, 45 K/4, K/7 and 45 K/8. The lease area lies on South of Gangapur town which is tehsil headquarters. The site is approachable from Bhilwara through NH-76B and also from SH- 61 via Karera through Gangapur–Karera MDR. Area is located between following Latitude and Longitudes:

Latitude – $25^0$11’00” N to $25^0$03’00” N
Longitude - $74^0$04’00” E to $74^0$14’00” E

Physiography & Drainage

The proposed mine lease area falls under Tehsil Asind, District Bhilwara of Rajasthan. Physio-graphically the area is one of the four major divisions of Great Plain of Northern India and constitutes its south-eastern extremity. The area lies to the east of Aravallies and is known as eastern plains characterized by hills, level rocky structural plains, rock cut pediments, gravel pavements, shallow colluvium plains and other sandy plains with thick alluvium underneath. The district is drained by ephemeral rivers like Khari, Mansi, Nekhadi, Kothari and Chandrabhaga which flow from west to east and south from the eastern part of Aravalli range. All these rivers are left bank tributaries of the Banas River which is left bank tributary of the Chambal.

The district with spatial extent of 10474 sq. kms. which is 3.06% of the area of the state, has geographic location as Latitude 25^0 01' to 25^0 58' North and Longitude 74^0 01' to 75^0 28' East. It shares its border with Ajmer and Tonk in the North and North-East respectively, Part of Ajmer and Rajsamand in west, Chittaurgarh in its South, Bundi on its east respectively. The district has 7 subdivisions namely Bhilwara, Shahpura, Gangapur, Gulabpura, Asind, Mandalgarh and Jahazpur. Tehsil Sahada has Raipur and Mandal Tehsil on its North, Bhilwara on its north-east, district Rajsamand on its west and south-west and district Chittorgarh on its south-east direction respectively.

From the eastern aspect of the Aravalli range numerous rivers emanate. The prominent rivers are Khari and its tributaries, Mansi and Nekhadi, Kothari and its tributaries and Chandrabhaga. All these rivers are ephemeral rivers and flow during monsoon and are part of Banas basin. Major part of Khari, Dai and Mashi drainage catchment (18814 sq. kms) of the Banas basin covered under Bhilwara, Ajmer, Tonk and Jaipur is occupied by alluvial plains having good recharge prospect, flood plain and channel fill areas having excellent recharge potential. The Khari, Mansi and Nekhadi River are 5^{th} order, 4^{th} order and 4^{th} order streams respectively while the Banas is 6^{th} order stream. The general drainage pattern is dendritic. Most of the rivers are influent except Banas which shows effluent nature at many places for which reason it has some flow in it throughout the year. The description of rivers flowing through Bhilwara district in Banas Catchment is presented in Table-2.7.

Table-2.7: Description of Rivers Flowing through Bhilwara District in Banas Catchment

S. No.	Name of River	Origin	Length km)	Catchment Area (sq.m)	Tributaries
1	Banas	Khamnor Hills of Aravalli Range 5 km from Kumalgarh, district Rajsamband	512	45833	Berach, Menali, Kothari, Chandrabhaga, Khari, Dai, Dheel, Sohadra, Mashi and Bandi
2	Berach	Hills North–east of Udaipur	157	7502	Ayar, Wagli, Gandhari and Orai
3	Kothari	Aravalli range near Horera village in district Bhilwara	151	2341	Bahamani
4	Khari	Hills near Devgarh in Rajsamband District	192	6268	Nekhadi, Bara and Mansi

The study area is mainly drained by Chandrabhaga River, which originates from district Rajsamand, enters tehsil Sahada at Phunkiya where an earthen dam was constructed in 1954.

Topography

The district has different landforms. Mountainous topography is presented in the form of local hills, having altitude varying from 600 m amsl (above mean sea level) to 800 m amsl, towering on the west direction of the district and dividing the state into east and west. The undulating and rolling topography is witnessed in the landmass below the hill extending upto plain topography where the ground elevation varies from 300 to 550 m amsl. The regional ground slope of the area has been dissected into 3 terrains comprising of highland of Aravalli Range, middle land pediments and low-land alluvial tracks. The general ground slope follows the direction of the drainage and is from west to south east as well as from north to south. Isolated hillocks and chain of hill range of elevation between 350 to 500 m amsl at many places suddenly break the more or less plain topography towards south-east near Jahajpur.

The study area covered within Sahada Tehsil has more or less peneplain topography with ground elevation varying from 470 to 520 m amsl. Hillocks in isolation as well as in continuous chain with top elevation varying from 546 to 690 m amsl are interspersed towards south-eastern bounds of the Tehsil. The highest elevation of 690 m amsl exists at hillock near Bharak, followed by hillocks at Kabra R.F. (581 m amsl) and Tiroli (546 m amsl). The lowest elevation of 467 m amsl exists near Bikrai in south-eastern direction. The study area has numerous shallow depressions which have been converted as tanks and reservoirs by creating suitable civil engineering structures like embankment and sluices. The general ground slope of the area is 1.92 m/km in north-south direction and 1.67 m/km in west-east direction.

Proposed Schedule for Implementation

The target production of sand/bajri mining during 5 year lease period from the mine is 2.0 MCM (2.8 MMT). The mine will be worked during the day shift only. The average number of working days in a year would be 280. It is revealed that the maximum proposed production in any block is 0.14 million metric tonne.

Table-2.8: Planned Production (In million Metric Tonnes)

S.No.	Year	Block –A	Block –B	Block –C	Block –D	Block –E	Total (in million Metric Tonnes)
1	I	0.08	0.11	0.14	0.08	0.14	0.56
2	II	0.14	0.11	0.08	0.14	0.08	0.56
3	III	0.11	0.08	0.08	0.14	0.14	0.56
4	IV	0.14	0.08	0.11	0.08	0.14	0.56
5	V	0.08	0.14	0.08	0.11	0.14	0.56
Total		**0.56**	**0.56**	**0.53**	**0.50**	**0.56**	**2.8**

The annual production is 0.40 million m^3 per year.

2.6 M/s Ashu Singh Bhati

Name of the Mine: Bajri (Minor Mineral) Mine of M/s Ashu Singh Bhati
Lease area: 624.39 ha
Name of the river: Khari River

Length of the river under lease: Approx. 42.20 kms
Tehsil: Shahpura District: Bhilwara
Capacity of Production: 0.84 million tonnes per year **State:** Rajasthan

Location

The lease area is Zone I can be approached from north side via SH-12 near Kadera on North side of the lease. Zone II (A) can be approached via SH-39 near village Barla and Pranotia on both sides. Zone II (B) is approachable via SH-12 starting from Shahpura. Lease area forms part of G. T. Sheet No's – 45K/13, 45K/14, 45O/1 and 45O/2 on a scale of 1:50,000. Area is located between following Latitude and Longitudes:

(Zone-I)
Latitude – 25°52'42.86" N to 25°46'05.84" N
Longitude - 74°52'03.21" E to 74°06'46.70"E

(Zone-II)
Latitude – 25°48'15.32" N to 25°46'05.84" N
Longitude - 74°45'31.08" E to 74°06'46.70" E

(Zone-III)
Latitude – 25°40'06.02" N to 25°44'00.95" N
Longitude - 74°47'09.75" E to 74°57'11.6"E

Physiography & Drainage

The area is marked by flat topography of igneous formation, which is surrounded by fine to coarse grained sandy soil overlying the river sand deposit. The elevation level of 342.50 mRL is lowest and 374.21 RL is the highest RL in the River Khari, Tehsil- Shahpura of dist. Bhilwara. The Khari River flows from SW to NE direction in the Tehsil Shahpura. Khari River is non-perennial and runs only in during rainy season and almost dry in summer. In some parts of the river boulder and exposure of basement rock is also available.

Rainfall and Climate

The district has a dry climate except during rainy season. The winter extends from December to March and summer from March end to June last week, followed by rainy season which lasts up to mid of September. The mean annual rainfall in the district is 633.9 mm. January is the coldest month with mean maximum and minimum temperatures being lowest at 22.2º C & 7.3º C. Temperature in summer month, June, reaches up to 46º C.

Estimated Reserve and Production Envisaged

A) PROVED RESERVES AS PER UNFC CODE (111)

Total Reserves = 5656200 m^3

B) BLOCKED RESERVES AS PER UNFC CODE (211 & 222)

Total Blocked Reserves = 52,70,778 m^3

Mineable Reserves = D-E
= 165,83,075 – 52,70,778 = 113,12,297 cu.m = 11.31 million m^3

C) TARGETED PRODUCTION

During the 5 year period of lease total extraction is = 3.0 million m^3
a) Safety zone for bridge b) Roads (21 nos) c) Wells (106 nos) d) Offset against bank and lease boundary (40.0 m) e) Bridge (09) = 52,70,778 m^3

D) Balance reserves will be = 11.31 – 3.0 = 8.31 million m^3

Details of Production & Dispatches of Five Years

This is a new lease area being allotted to the applicant. Future production programme has been planned as per the details given below:

Production Programme

Proposed lease will be allotted for a period of 5 years only. Proposed lease consist of 624.39ha area in 17 villages falling along the Khari River. It is proposed to work as per the details given earlier.

Daily production planned: 3,000 tonnes Yearly production planned: 8,40,000 tonnes
Working days have been taken as 280 days per annum which can be increased depending on the conditions prevailing at the time of execution.

Projected Production Per Year = 280 x 3,000 = 8,40,000 tonnes
Specific Density = 1.40 tonne/ cu.m
Volumetric Production = 0.6 million m^3 per year

2.7 M/s Abhishek Chaudhary

Name of the Mine: Bajri (Minor Mineral) Mine of M/s Abhishek Chaudhary
Lease area: 836.13 ha
Name of the river: Kothari River
Length of the river under lease: Approx. 58.9 kms
Tehsil: Raipur **District:** Bhilwara
Capacity of Production: 1.12 million tonnes per year
State: Rajasthan

Location

The lease area can be approached via Amet road on the west side near village Jhalamali, Bhindar to Ramgarh road near Patiyon ka Khera and Gangapur-Karera road near Kheri Mata. Lease area forms a part of G. T. Sheet No's – 45K/2, 45K/3, 45K/6, 45K/7. on a scale of 1:50,000. Area is located between following Latitude and Longitudes:

Latitude – 25°23'32.61"N to 25°20'41.03" N
Longitude - 74°01'7.64" E to 74°18'52.35" E

Physiography & Drainage

Lease area is gently dipping towards East side indicating the flow direction of river. The elevation level of 477.302 mRL is lowest and 582.223 mRL is the highest RL in the River.

Rainfall and Climate

The district has a dry climate except during rainy season. The winter extends from December to March and summer from March end to June last week, followed by rainy season which lasts up to mid of September. The mean annual rainfall in the district is 633.9 mm. January is the coldest month with mean maximum and minimum temperatures being lowest at 22.2^0C & 7.3^0 C. Temperature in summer month, June, reaches up to 46^0 C. (*Source: District Groundwater Brochure*).

Estimated Reserve and Production Envisaged

A) PROVED RESERVES AS PER UNFC CODE (111)

Total Reserves = 10,06,684 m^3

B) BLOCKED RESERVES AS PER UNFC CODE (211 & 222)

Total Blocked Reserves = 33,31,128 m^3

C) MINEABLE RESERVES = A-B-C

= 2,04,30,675 + 8,91,514.56 + 10,06,684 = 2,23,28,873.56 = 22.33 million m^3

C) TARGETED PRODUCTION

During the 5 year period of lease total extraction is = 4.0 million m^3
a) Safety zone for bridge b) Roads (7 nos) c) Wells (22 nos) d) Offset against bank and lease boundary (40.0 m) e) Bridge (10 no.)= 33,31,128 m3

D) Balance reserves will be = 19.0 – 4.0 = 15.0 million m^3

Details of Production & Dispatches of Five Years

This is a new lease area being allotted to the applicant. Future production programme has been planned as per the details given below:

Production Programme

Proposed lease will be allotted for a period of 5 years only. Proposed lease consist of 836.13 ha area in 28 villages (Khasra) in a total stretch of 58.9 km. It is proposed to work as per the details given earlier.

Daily production planned: 4,000 tonnes
Yearly production planned: 11,20,000 tonnes

Working days have been taken as 280 days per annum which can be increased depending on the conditions prevailing at the time of execution.

Projected Production Per Year = 280 x 4,000 = 11,20,000 tonnes
Specific Density = 1.40 tonne/ cu.m
Volumetric Production = 0.8 million m^3

2.8 M/s Rajasthan Fort and Palace Pvt. Ltd.

Name of the Mine: Bajri (Minor Mineral) Mine of M/s Rajasthan Fort and Palace Pvt. Ltd.
Lease area: 286.43ha
Name of the river: Berach & Ruparel
Length of the river under lease: Approx. 22 km
Tehsil: Begun, **District:** Chittorgarh, **State:** Rajasthan
Capacity of Production: 1.68 LTPA Say 0.168 million Tonnes per year

Location:

The lease covers an area of 286.43 ha in the 17 revenue villages of Tehsil Begun in district Chittorgarh falling along the Berach & Ruparel Rivers and is approached from metalled road. The nearest railway station is Chittorgarh station about 33 kms. The key plan of the mine is prepared on toposheet 45K/12, 45 K/16 on a scale of 1:50,000. Area is located between following Latitude and Longitudes:

Latitude – 25°10’20”N to 25°5‟55”N
Longitude - 74°46‟57”E to 74°51‟40” E

Physiography & Drainage

The area is marked by flat topography of igneous formation, which are surrounded by fine to coarse grained sandy soil overlying the river sand deposit. The elevation level of 368 mRL is lowest and 384 m RL is the highest in the River Berach & Ruparel of Tehsil Begun in district Chittorgarh. The Rivers flows from South to North East direction in this Tehsil Begun. Berach & Ruparel is non-perennial and runs only in during rainy season and almost dry in summer. In some parts of the river, boulder and exposure of basement rock is also available.

Rainfall and Climate

The district experiences arid dry type of climate except during short rainy season. On an average, the district recorded 760 mm of rainfall. Almost 95% of the total rainfall is received during the southwest monsoon, which enters the district in the first week of July and withdraws in the mid of September. The district lies in the desert area and extreme heat recorded during summer and cold during winter season which is the characteristic of the desert. The winter extends from December to March and summer from March end to June third week, followed by rainy season which lasts up to third week of September. The temperature varies between 41.5°C and during winters it is 25°C. The maximum humidity recorded in the month of August with mean daily relative humidity value of 70%.

Estimated Reserve and Production Envisaged

A) PROVED RESERVES AS PER UNFC CODE (111)

Total Reserves = 12030060 Tonnesor 8592900 M3

B) BLOCKED RESERVES AS PER UNFC CODE (211 & 222)

Table-2.9: Blocked Mineral Reserve in mine lease area

Description	Area
Water bodies	4.0 Ha
Roads (8 in Nos.)	6.30 Ha
Anicut	3.70 Ha
Mined out Area	75.0 Ha
Electric line	11.75 Ha
Total Blocked Area	**100.75 Ha**

Total blocked reserves = 4231500 Tones or 3022500 m^3
Mineable Reserves = A-B
= 8592900 - 3022500= 5570400 m^3 =5.57 million m^3

C) TARGETED PRODUCTION

During the 5 year period of lease total extraction is = 840000 Tonne Say 0.6 million m^3

D) Balance reserves = 5.57- 0.6 = 6958560 Tones or 4.97 million m^3

Details of Production & Dispatches of Five Years

This is a new lease area being allotted to the applicant. Future production programme has been planned as per the details given below:

Production Programme

Proposed lease will be allotted for a period of 5 years only. Proposed lease consist of 286.43 Haarea in 17 revenue villages falling along the Berach & Ruparel. It is proposed to work as per the details given earlier.

Daily production planned: 600 tonnes
Yearly production planned: 1, 68,000 tonnes
Working days have been taken as 280 days per annum which can be increased depending on the conditions prevailing at the time of execution.
Projected Production per Year = 280 x 600 = 1,68,000 tonnes
Specific Density = 1.40 tonne/ cu.m
Volumetric Production= 0.12 million m^3

2.9 Shri Ashu Singh Bhati

Name of the Mine: Bajri (Minor Mineral) Mine of Ashu Singh Bhati
Lease area: 77.50 ha
Name of the river: Berach River
Length of the river under lease: 10 kms
Tehsil – Gangrar, **District:** Chittorgarh, **State:** Rajasthan
Capacity of Production: 3.92 LTPA or 0.392 million tonnes per year

Location

The lease area is located in Berach River, Tehsil-Gangrar & District: Chittorgarh, covering an area of 77.50 ha in the 3 revenue villages falling along the Berach River. The nearest railway station is Chittorgarh Railway station about 15 kms from the mine site. The key plan is prepared on toposheet No. 45K/12, 45K/16, 45L/9, 45L/13 on a scale of 1:50,000. Area is located between 24°59'17.3" N to 25°03'39.6" N Latitude &74°41'02" E to 74°44'30.9" E Longitudes.

Physiography & Drainage

The area is marked by flat topography of igneous formation, which is surrounded by fine-grained loamy soil overlying the river sand deposit. The 401 mRL is the highest and 391 mRL is the lowest point in the River Berach of Tehsil: Gangrar, in District: Chittorgarh.

The Berach River flows from South to North direction. The alluvial ground surface area overlying river sand, some distance away from the river bed is under cultivation. River is non-perennial river and it runs only in rainy season and almost dry in summer. Some water bodies of very less dimension and shallow in depth may be visible in the river bed due to construction of some small check dams in some part of river. Big size boulders and exposure of basement rock is also visible.

Rainfall and Climate

The climate of study area is generally dry being hilly terrain. The maximum average temperature during summer is 41.5ºC and during winters it is 25ºC. The average rainfall is 760 mm. About 95% of the annual rains is experienced during southwest monsoon (June to September). The average rainy days in a year is about 33 days. The humidity is generally at 20% or below and it is only during southwest monsoon that humidity goes up to 70%. The wind blows at low velocity except during summer and monsoon when hard and turbulent winds are experienced. As per the long term climatological observations, the wind direction is southwest to northeast in summer and winter experience northern and northwest winds.

Estimated Reserve and Production Envisaged

A) PROVED RESERVES AS PER UNFC CODE (111)

Total Reserves = 3255000 Tones or 2.325 million m^3

B) BLOCKED RESERVES AS PER UNFC CODE (211 & 222)

Table-2.10: Details of blocked Mineral Reserves

Description	Area
Water bodies (5 Places)	4.27 Ha
Roads (2 Nos.)	3.11 Ha
Bridge	2.00 Ha
Anicut	4.83 Ha
Electric line	2.10 Ha
Total Blocked Area	**16.31 GHa**

Total blocked reserves = 685020 Tonnes Say 0.489 million m^3
Mineable reserves = A-B
= 2.325 - 0.489 = 1.836 million M3

C) TARGETED PRODUCTION

During the 5 year period of lease total extraction is = 1960000.0 Tones Say 1.40 million m^3

D) Balance reserves will be = 1.836 - 1.40= 0.436 million m^3

Details of Production & Dispatches of Five Years

This is a new lease area being allotted to the applicant. Future production programme has been planned as per the details given below:

Production Programme

Proposed lease will be allotted for a period of 5 years only. Proposed lease consist of 77.50 ha area in 3 revenue villages falling along the Berach River. It is proposed to work as per the details given earlier.

Daily production planned: 1400 tonnes
Yearly production planned: 3,92,000 tonnes
Working days have been taken as 280 days per annum which can be increased depending on the conditions prevailing at the time of execution.
Projected Production per Year = 280 x 1400 = 3,92,000 tones
Sp. Gravity = 1.4 tonne/m^3
Volumetric Production = 0.28 million m^3

2.10 M/s Shiva Corporation (I) Ltd.

Name of the Mine: Bajri (Minor Mineral) Mine of M/s Shiva Corporation (I) Ltd.
Lease area: 450.89 ha
Name of the river: Berach & Gambhir River
Length of the river under lease: App 50.0 Kms
Tehsil & District: Chittorgarh, **State:** Rajasthan
Capacity of Production: 2,26,000 TPA or 0.226 million tonnes per year

Location

The lease area is located in Berach & Gambhiri Rivers in Tehsil & District Chittorgarh, covering an area of 450.89 ha in the 18 revenue villages falling along the Berach & Gambhiri Rivers. The nearest railway station is Chittorgarh Railway station about 2 kms. The key plan of the mine lease is prepared on toposheet No. 45K/12, 45K/16, 45L/5, 45L/9, 45L/10, 45L/13 on a scale of 1:50,000. The mine lease area is located between 25°46'25" N to 25°11'9" N Latitude & 74°32'07" E to 74°57'13" E Longitudes.

Physiography & Drainage

The area is marked by flat topography of igneous formation, which is surrounded by fine-grained loamy soil overlying the river sand deposit. The 360 amsl is the lowest and 428 amsl is the highest point in the River. The Berach & Gambiri River originates in Udaipur district and enters Chittaurgarh through Rashmi tehsil. It passes through Somi, Sankhli, Pahunia and Unchkia villages. The Berach River flows from South to North-East direction in this Tehsil Rashmi. The alluvial ground surface area overlying river sand, some distance away from the river bed is under cultivation. River is non-perennial river and it runs only in rainy season and almost dry in summer. Water bodies of very less dimension and shallow in depth may be visible in the river bed due to construction of some small check dams. In some part of rivers, boulders and exposure of basement rock is also visible.

Rainfall and Climate

The climate of Chittorgarh is generally dry being hilly terrain. The average temperature during summer is 41.5°C and during winters it is 25°C. The average rainfall is 760 mm. About 95% of the annual rains are experienced during southwest monsoon (June to September). The average rainy days in a year is about 33 days. The humidity is generally at 20% or low and it is only during South-West monsoon that humidity goes up to 70%. The wind blows at low velocity except during summer and monsoon when hard and turbulent winds are experienced. As per the long term climatologically observations the wind direction is South-West to North-East in summer and winter experience Northern and North-West winds.

Estimated Reserve and Production Envisaged

A) PROVED RESERVES AS PER UNFC CODE (111)

Total Reserves = 18934020 Tonnes or 13524300 M3

B) BLOCKED RESERVES AS PER UNFC CODE (211 & 222)

Area covered under water bodies, Anicuts, bridge - 180 Ha.
Basement rock-120 Ha, Prohibited area first five years = 7.50 Ha
Total block reserves: 9024300 m^3
River sand (Bajri) deposit-150 Ha
Mineral reserve -150x3x1.4=6300000 tonnes or 4.5 million m^3

C) TARGETED PRODUCTION

During the 5 year period of lease total extraction is = 0.81 million m^3

D) Balance reserves will be = 4.5- 0.81 = 3.69 million m^3

Details of Production & Dispatches of Five Years

This is a new lease area being allotted to the applicant. Future production programme has been planned as per the details given below:

Production Programme

Proposed lease will be allotted for a period of 5 years only. Proposed lease consist of 450.89 ha area in 18 revenue villages falling along the Berach & Gambhir River. It is proposed to work as per the details given earlier.

Daily production planned: 800.0 Tones per Day
Yearly production planned: 2, 26,000 tones
Working days have been taken as 280 days which can be increased depending on the conditions prevailing at the time of execution.
Projected production per year = 280 x 807.14 = 2,26,000 tonnes
Sp. Gravity= 1.40 tonnes/m^3
Volumetric production per year = 0.16 million m^3

2.11 Shri Satya Swaroop Singh Jadaun

Name of the Mine: Bajri (Minor Mineral) Mine of Shri Satya Swaroop Singh Jadaun
Lease area: 755.02 ha
Name of the river: Banganga
Length of the river under lease: Approx. 21 Kms
Tehsil: Mahwa, District**:** Dausa **State:** Rajasthan
Capacity of Production: 1.5 million tonnes per year

Location

The mining lease area (755.02 Ha) for River Sand (Bajri) covers villages–Akbarpur, Aund Goojar, Bahar khoh, Bandanpura, Beerasna, Berkhera, Bhopur Shahpur, Bhopur Tappa, Chak Vishala, Dhand, Dhol Khera, Doolhapura, Gohandi Goojar, Gohandi Meena, Hasilpur, Jaitpura, Kamalpur, Khanpur, Kherli Narayan Singh, Khoh Kalan, Khohra, Khohra Nandsingh, Kondla, Ladanpur, Langripura, Mahwa, Mandawar, Maujpur, Mohanpur, Moondphori, Motooka, Nadna, Nahida, Naugaon, Naya Gaon, Norangwara, Pahari, Palan Hera, Pali, Paloda, Paota, Patti Kayampur, Peepal Khera, Peeplipara, Raipur, Rajpur, Raseedpur, Sahida, Salempur, Salimpur, Samaspur, Samleti, Sarangpur, Sarawali, Saypur, Seet, Shahadpur, Sheeshwara, Sinduki, Teekri Jafaran, Tekra, Todra, Valeen, Vishala, Wara Bujurg, Amolak Nagar, Veerpur, Saypur-2 in Tehsil-Mahwa, District-Dausa (Rajasthan). The lease area forms part of G.T. sheets covered under SOI Toposheet no. 54 A/16, 54 B/13, 54E/4 and 54 F/1 is linearly stretched under 68 revenue villages. Area is located between following Latitude and Longitudes:

Latitude – 27° 00' 49.4714"N to 27°05' 6.2470"N
Longitude - 76° 46' 26.8109"E to 76°59' 0.3644 "E

Physiography & Drainage

Lease and adjoining area is gently sloping plain. The highest RL in the Western part of the area is 249 m and the lowest RL is 226 m in the extreme Eastern part. From 3 to 8 kms south of the lease area *i.e.* River Banganga is seen chain of narrow elongated ridges from Delonda to Thekra over a strike length of about 6 kms. These ridges are the only topographic feature in the area. On the extreme Eastern and Western side network of rainy streams are seen along the borders of the Tehsil flowing North to South and ultimately merging into Banganga River to which lease area under consideration is confined.

Rainfall and Climate

The climatic conditions of district Dausa is semi arid climate. Winters are very cold when temperature goes down to 3°C and summers are very hot. During summer season, temperature rises up to 45°C. Winter season prevails from mid October to mid February, and from mid February to mid June, summer season prevails. Rainy season prevails from July and August. The annual rainfall of the Dausa district is 643.7 mm and Mahwah Tehsil is 601.9 mm.

Estimated Reserve and Production Envisaged:

A) PROVED RESERVES AS PER UNFC CODE (111)

Total Reserves = 22650600 m^3

B) BLOCKED RESERVES AS PER UNFC CODE (211 & 222)

Total blocked reserves = 4530120 m^3
Mineable reserves = 22650600 m^3 – 4530120 m^3
= 18.12 million m^3

C) TARGETED PRODUCTION

During the 5 year period of lease total extraction proposed is @ 15 LacTPA = Total reserves to be extracted are 4.545 million m^3
Balance reserves are : 13.575 million m^3

Details of Production & Dispatches of Five Years

This is a new lease area being allotted to the applicant. Future production programme has been planned as per the details given below:

Production Programme

Proposed lease will be allotted for a period of 5 years only. Proposed lease consist of 755.02 ha area in 68 villages falling along the Banganga River. It is proposed to work as per the details given earlier.

Daily production planned: 4545 tonnes per day or Yearly production planned: 1500,000 tonnes
Working days have been taken as 330 days per annum which can be increased depending on the conditions prevailing at the time of execution.

Projected Production Per Year = 330 x 4545 = tonnes
Specific Density = 1.65 tonne/ cu.m
Volumetric Production per year= 0.909 million m^3

2.12 Shri Narottam Singh Jadaun

Name of the Mine: Bajri (Minor Mineral) Mine of Shri Narottam Singh Jadaun
Lease area: 2031.98 ha
Name of the river: Ban Ganga River and its connected nallahs
Tehsil & District: Dausa
Capacity of Production: 16.80 Lakh tonnes per year **State:** Rajasthan

Location

The proposed project is River Bed mining of sand (Bajri) in Ban Ganga River & its connected nallahs, at near village-Kharana, Chandrana, Borai, Jherawas, Dhai, Bapi, Chandrama ki Dhani, Lalu ki Bas, Mangabhata ka Bas, Topara, Bhajwara, Nayagoan and Bane ka Barkhera. Approach roads to villages and towns are cutting across the Banganga River at 16 places in the stretch of 28 kms of the applied area. The nearest District HQ *i.e.* Dausa is about 10 kms, which is in South side of the river. The nearest railway station is at Dausa, which is about 10 kms away from the applied area. The applied mine area forms a part of Survey of India topo-sheet no. 54 B/1, 54 B/5, 54 B/9, 54 A/4 & 54 A/8. The location of the lease is as under:

Latitude: $26^0$55’00” to $27^0$00’00” N
Longitude: $76^0$13’00” to $76^0$28’00’’ E

Table-2.11 Length and Width of the Applied Lease Area

Name of River	Length (m)	Width (m)
Ban Ganga River and its connected nalla	28712.0	1443.0

Physiography & Drainage

The topography of the applied area is mainly plain land marked with shallow nalah and undulations. The higher elevation point is 451 mRL and lower elevation point is 290 mRL. Drainage pattern of the area is dendritic. The applied area is part of the Ban Ganga River & its connected flow nallahs. The River is seasonal in nature &flows through the district in NW- SE direction.

Rainfall and Climate

The climate of the district is dry semi-arid and usually has south- western monsoon. The minimum and maximum temperatures recorded in the district vary from 4 to 5 degree Celsius to 47.00 degree Celsius on the higher end. The average rainfall of the district is 604.03 mm. The region experiences tropical climate.

Estimated Reserve and Production Envisaged

Table-2.12: Estimation of Reserves

Sl. No.	Category	Area	Average depth (m)	Sp. Gravity	Recovery factor	Reserve (metric tonnes)
1	Proved Reserve	2031.98 x 10000	3.0	1.4	0.90	7,68,08,844
2	Probable Reserve	2031.98 x 10000	3.0	1.4	0.90	7,68,08,844

Mineable Reserves & Life of Mine

Life of mine is calculated on the basis of proved reserves. Mineable reserves are worked out after considering a recovery of 90% and losses along various statutory barriers @ 10%.

Table-2.13: Mineable Reserves & Life of Mine

Proved Reserves	7,68,08,844 tonnes
Losses along various statutory barriers	76,80,884 tonnes
Mineable Reserves available	6,91,27,960 tonnes
Recovery @ 90% (Pebbles & cobbles)	6,22,15,164 tonnes
Proposed rate of production	16,80,000 TPA
Life of Mine	6,22,15,1645 / 16,80,000 = 37 yrs

C) TARGETED PRODUCTION

Table-2.14: Year-wise Production of Bajri/sand

Year	Bajri
1st Year	16,79,937
2nd Year	16,80, 000
3rd Year	16,80, 000
4th Year	16,80, 000
5th Year	16,80, 000

Recovery of Bajri is considered as 90% of total reserve. About 10% of the total reserve is considered as not mineable because of statutory barrier (River bank), Bridge, Wells, Roads, and Railway Line *etc.*

Details of production & dispatch of five years

This is a new lease area being allotted to the applicant. Future production programme has been planned as per the details given below:

Production Programme

Proposed lease will be allotted for a period of 5 years only. Proposed lease consist of 2031.98 ha

area in various villages falling along the Banganga River. It is proposed to work as per the details given earlier.

Daily production planned: 6,000 tonnes
Yearly production planned: 16,80,000 tonnes
Working days have been taken as 280 days per annum which can be increased depending on the conditions prevailing at the time of execution.
Projected Production per year = 280 x 6,000 = 16,80,000 tonnes
Specific Density = 1.40 tonne/ cu.m
Volumetric Production per year= 1.2 million m^3

2.13 Shri Naval Kishore Gupta

Name of the Mine: Bajri (Minor Mineral) Mine of Shri Naval Kishore Gupta
Lease area: 232.92 ha
Name of the river: Parvati
Tehsil: Baseri & Bari, District: Dholpur (Raj.)
Capacity of Production: 12,00,000 MTPA **State:** Rajasthan

Location

The mining lease area under reference is situated in Tehsil-Baseri & Bari in District Dholpur (Rajasthan).The area is approachable by tar road *via* Dholpur-Bari-Sarmathura at one end & at the last end of lease area in NNW direction. The area lies at a distance of 4.0 Km from Bari Town. The Baseri Town can be approached by tar road from Dholpur (district H.Q.) at a distance of 1.0 km. The nearest railway station is at Baseri at a Distance 5 Kms. The nearest national highway (NH-3A) is at a distance of 8.0 kms & (SH-42) at a distance of 13.0 Kms. The nearest airport is Kheria Airport, Agra at a Distance of 50.0 kms.The key plan is prepared on toposheet 54 F/5, 54 F/9, 54 F/10 & 54 F/6 on a scale of 1:50,000. Area is located between following Latitude and Longitudes:

Table-2.15: The location of the Mining lease

Sl. No.	Latitude	Longitude
1.	26°38'45.10"N to 26°45'46.25"N	77°29'17.65"E to 77°38'27.07"E

Physiography & Drainage

The Dholpur district can be divided into four morphological divisions as follows:

i. Western hilly areas
ii. Central undulating plains
iii. The eastern plains (east of Dholpur-Maiwa alignment)
iv. About 3 to 10 kms wide strip of plateau along the southern boundary demarcated by Chambal River. Ravines are very common and prominent physiographic feature in the district.

The highest peak (the Gurjar Pahar) in the district is the highest peak about 357 m amsl and is located in the south west of the district. The eastern 12 plains lies at altitude between 163 and 171 m amsl. The central part of the district lies between the altitude of 232 and 177 m amsl. The drainage system of the district is quite well developed and is represented by Chambal, Gambhiri and Parbati

rivers and their various tributaries. The entire district falls under theYamuna basin as both Chambal and Gambhiri rivers are tributary of Yamuna River. Major part of the district comes under the Gambhiri and Parbati sub-basins and a narrow strip of the Soupur part of the district running NE-SW direction falls under Chambal sub-basin. The details are given below:

Table-2.16: Details of the Watershed

Basin	Area sq. km %	% of district	% of Basin
Parbati	1950.70	64.50	81.70
Gambhir	203.50	17.80	4.90
Chambal	869.40	28.80	2.80

Rainfall and Climate

Climate of the district can be classified as semi-arid type. The summers are very hot and dry and the winters are very cold. The summer season prevails from March to mid June after the rainy season starts with the onset of monsoon; rains lasting till the end of September. During the May to June months, the mean daily temperature is about 40°C. The potential evapotranspiration is 1780.0 mm annually. The mean annual rainfall of the district is 598.00 mm (1977-1906). The long term normal annual rainfall (1901-1970) is 717.5 mm. This indicates that annual rainfall of the district has decreased. The co-efficient of variation varies from 28.2% at Bari to 41.6% at Rajakhera indicating that rain fall is slightly unreliable. The occurrences of mild droughts are highest in the district. Normal drought occurs sometimes where as severe type of drought occurs rarely.

Estimated Reserve and Production Envisaged:

I. Proved Reserve:

Reserve = Area x A vg. Depth x sp. Gravity x Recovery factor
= 232.92xl0000X3xl.4 x 0.90
= 88,04,376 MT

II. Probable reserve

Reserve=Area x A vg. Depth x Sp. Gravity x Recovery factor
= 232.92xl0000X3xl.4 x 0.90
= 88,04,376 MT

BLOCKED RESERVES AS PER UNFC CODE (211 & 222)

Recovery of Bajri is considered as 90 % of total reserve as 10% of the total reserve is considered as not mineable because of statutory barrier (River bank), Bridge, Wells, Roads, Railway Line *etc*.

C) TARGETED PRODUCTION

River sand mining will be worked for 300 days. Assuming Per day targeted production would be @ 4000 TPD. Targeted production@ 12,00,000 tonnes per annum.

Details of Production & Dispatches of Five Years

This is a new lease area being allotted to the applicant. Future production programme has been planned as per the details given below:

Production Programme

Table-2.17: Proposed Production Programme

Years	Proposed Production in Metric Tons
First	12,00,000
Second	12,00,000
Third	12,00,000
Fourth	12,00,000
Fifth	12,00,000
Total	**60,00 ,000**

Working days have been taken as 300 days per annum.
Projected production per year = 300 x 4000 = 12,00,000 tonnes
Specific Density = 1.40 tonne/ cu.m
Volumetric Production = 0.857 million m^3

2.14 Shri Kishore Gupta

Name of the Mine: Bajri (Minor Mineral) Mine of M/s Kishor Gupta
Lease area: 391.75 ha
Name of the river: Parvati
Tehsil: Sepau & Dholpur **District:** Dholpur
Capacity of Production: 12.00 Lakhs MTPA **State:** Rajasthan

Location

The lease area is located on river Parvati in Tehsil- Sepau & Dholpur of district Dholpur, covering an area of 391.75 ha in the 30 villages falling along the Parvati River and is approached from metalled road. The nearest railway station is Sapau which is about 15-20 km. The key plan is prepared on toposheet 54 F/9, 54 F/13, 54 F/10, 54 F/14 on a scale of 1:50,000. Area is located between following Latitude and Longitudes:

LATITUDE	26°44'37.6"N to 26°53'6.1"N
LONGITUDE	77°37'39.1."E to 77°53’17.1”E

Physiography & Drainage
The Dholpur district can be divided into four main morphological divisions as follows:

i. Western hilly areas
ii. Central undulating plains
iii. The eastern plains (east of Dholpur- Maiwa alignment)

iv. About 3 to 10 km wide strip of plateau along the southern boundary demarcated by Chambal River. Ravines are very common and prominent physiographic feature in the district.

The highest peak (the Gurjar Pahar) in the district is the highest peak about 357 m amsl and is located in the south west of the district. The eastern 12 plain lies at altitude between 163 and 171 m amsl. The central part of the district lies between the altitude of 232 and 177 m amsl.

The drainage system of the district is quite well developed and is represented by Chambal, Gambhir and Parbati rivers and their various tributaries. The entire district falls under the Yamuna basin as both Chambal and Gambhir rivers are tributary of Yamuna River. Major part of the district comes under the Gambhir and Parbati sub basins and a narrow strip of the Soupur part of the district running NE-SW direction falls under Chambal sub-basin. The details are given below:-

Table-2.18: Details of rivers

Basin	Area Sq. km	% of district	% of Basin
Parbati	1950.70	64.50	81.70
Gambhir	203.50	17.50	4.90
Chambal	869.40	28.80	2.80

Rainfall and Climate

Climate of the district can be classified as semi-arid type. The summers are very hot and dry and the winters are very cold. The summer season prevails from March to mid June after which the rainy season starts with the onset of monsoon rains lasting till the end of September. During the May / June month the mean daily temperature is about 40°C. The potential evapotranspiration is 1780.0 mm annually. The mean annual rainfall of the district is 598.00 mm (1977-1906). The long term normal annual rainfall (1901-1970) is 717.5. This indicates that annual rainfall of the district has decreased. The co-efficient of variation varies from 28.2% at Bari to 41.6% at Rajakhera indicating that rain fall is slightly unreliable. The occurrences of mild droughts are highest in the district. Normal drought occurs sometimes where as severe type of drought occurs rarely.

Estimated Reserve and Production Envisaged

A) PROVED RESERVES AS PER UNFC CODE (111)

Total Reserves = 1,48,08,150 MT = 62,19,423 m^3

B) BLOCKED RESERVES AS PER UNFC CODE (211 & 222)

10% of the total reserve is considered as not mineable because of statutory barrier (River bank), Bridge, Wells, Roads, Railway Line *etc.*

C) TARGETED PRODUCTION

River Bajri mining will be worked for 300 days. Assuming Per day targeted production would be @ 4000.00 TPD. Targeted production@12,00,000 Tons per annum. Production schedule during 1st to 5 year is shown as below. The production from 1st to V year will be @ 12,00,000 TPA.

Details of Production & Dispatches of Five Years

This is a new lease area being allotted to the applicant. Future production programme has been planned as per the details given below:

Production Programme

Table-2.19: Production Programme

Years	Proposed Production in Metric Tons
First	12,00,000
Second	12,00,000
Third	12,00,000
Fourth	12,00,000
Fifth	12,00,000
Total	**60,00,000**

Working days have been taken as 300 days per annum.
Projected Production Per Year = 300 x 4000 = 12,00,000 tonnes
Specific Density = 1.40 tonne/cu.m
Volumetric Production = 0.86 million m^3

2.15 Shri Arjun Singh

Name of the Mine: River bed minning project of Bajri (minor mineral) of Shri Arjun Singh
Lease area: 113.77 ha
Name of the river: Gair mumkin nadi, nallahs and Rivers of revenue villages in Tehsil – Shahpura, **State:** Rajasthan
Capacity of Production: 5,60,000 tonnes per annum

Table-2.20: Length and width of the Mining lease

Name of Village	Length (m)	Width (m)	
Charsa, village Kumbhawas	1171.0	873.0 over all	
Kareri village	1061.0	734.0 over all	
Saivad, village Badijodi	3151.0	Max	Min
		236	132
Manoharpur village	2326.0	Max	Min
		444	15
Nawalpura, Mamtori village	944.0	808.0 over all	

Location

The proposed project is of River Bed mining of Bajri in Gair mumkin nadi, Nallahs and Rivers of revenue villages in Tehsil–Shahpura in G.T. sheet no. 45 M/15. The applied lease area is about 8 kms from the Tehsil Headquarter Shahpura. District Headquarter is Jaipur, which is about 50 kms from the Shahpura. The nearest railway station is at Chomu, which is about 44 kms SW from Shahpura.

Table-2.21: Location of the Mining Lease

Village	Latitude	Longitude
Manoharpura	270 17’ 39.78” N	750 58’ 23.58’’ E
Mamtori	270 16’ 38.46” N	750 56’ 35.46’’ E
Kareri	270 23’ 27.06” N	750 45’ 27.02’’ E
Bari Jhori	270 26’ 45.60” N	750 53’ 59.58’’ E
Charasa	270 16’ 25.08” N	760 00’ 23.04’’ E

Physiography & Drainage

The topography of the applied area is mainly plain land marked with shallow nalla and undulations.

Table-2.22: Highest and Lowest Elevation of the Area

S. No.	Village	Elevation (mRL)	
		Highest	Lowest
1.	Charsa, village Kumbhawas	455	444
2.	Kareri village	513	502
3.	Saivad, village Badijodi	460	451
4.	Manoharpur village	459	445
5.	Nawalpura, Mamtori village	508	498

Drainage pattern of the area is dendritic.The lease area is part of the gair mumkin nadi, nallahs and rivers of revenue villages. The drainage of this area in general flowing from west to east.

Rainfall and Climate

The semi-arid district receives normal annual rainfall of 527 mm (1901-71) while average annual rainfall for the last 30 years (1977-2006) is 565 mm. Over 90% of total annual rainfall is received during monsoon. Total annual potential evapotranspiration is 1744.7 mm. The coefficient of variation is moderate at 32.6% indicating slightly unreliable pattern of rainfall. Though, Jaipur city has experienced floods in 1981, the district area is prone to drought spells as witnessed during 1984 to 1989 and 1999 to 2002.

Estimated Reserve and Production Envisaged

Table-2.23: Estimation of Resources

Particulars	Area	Average depth (m)	Sp. Gr.	Recovery (%)	Reserve (MT)
Proved reserve	113.77 x 10000	3	1.4	90%	43,00,506
Probable reserve	113.77 x 10000	3	1.4	90%	43,00,506

Table-2.24: Planned Annual Production (in Metric Tonnes)

Year	Bajri	Mineral Rejects
First Year	5,60,000	Nil
Second Year	5,60,000	Nil
Third Year	5,60,000	Nil
Fourth Year	5,60,000	Nil
Fifth Year	5,60,000	Nil

Details of Production & Dispatches of Five Years

This is a new lease area being allotted to the applicant. Future production programme has been planned as per the details given below:

Production Programme

Proposed lease will be allotted for a period of 5 years only. Proposed lease consist of 113.77 ha area in Gair mumkin nadi, Nallahs and Rivers of revenue Villages in Tehsil – Shahpura. It is proposed to work as per the details given earlier.

Daily production planned

2,000 tonnes Yearly production planned: 5,60,000 tonnes
Working days have been taken as 280 days per annum which can be increased depending on the conditions prevailing at the time of execution.
Projected Production Per Year = 280 x 2,000 = 5,60,000 tonnes
Specific Density = 1.40 tonne/ cu.m
Volumetric Production per year = 0.4 million m^3

2.16 M/s Himmat Singh

Name of the Mine: Bajri (Minor Mineral) Mine of M/s Himmat Singh
Lease area: 668.96 ha
Name of the river: Luni River
Tehsil: Osian, **District:** Jodhpur
Capacity of Production: 1 million tonnes per year **State:** Rajasthan

Location: The lease area is located in Luni River, in Tehsil- Osian of district Jodhpur, covering an area of 668.96 ha in the 37 villages falling along the Luni River and is approached from metalled road. The nearest railway station is Osian is at about 6.06 kms from the site. Area is located between following Latitude and Longitudes:

Table-2.25: Location of the Mining Lease

Latitude	Block 1	26° 22' 20" to 26° 29' 14" N
	Block 2	26° 29' 44" to 26° 25' 40" N
	Block 3	26° 29' 47" to 26° 28' 53" N
	Block 4	26°36' 47" to 26°41' 27" N
	Block 5	26°40' 20" to 26°42' 34" N
	Block 6	26°47' 00" to 26°48' 07" N
	Block 7	26°44' 07" to 26°49' 47" N

Longitude	Block 1	72° 47' 39" to 72° 50' 43" E
	Block 2	72° 58' 10" to 73° 05' 10" E
	Block 3	73° 03' 04" to 73°05' 17" E
	Block 4	73° 02' 28" to 73° 03' 27" E
	Block 5	73° 08' 14" to 73°10' 49" E
	Block 6	72°56' 34" to 72° 57' 18" E
	Block 7	73°15' 30" to 73°13' 02" E

Physiography & Drainage

Jodhpur district forms part of desert in this arid region; there are sand dunes, alluvial areas dotted with few hillocks and hill chains scattered in the area. In the eastern part of the district, the area between Bilara and Jodhpur is covered by alluvium deposited due to fluvial action of Luni river system. The eastern part of the district exhibits gentle undulating topography interrupted by small ridges of hard rocks. The general elevation of plains varies from 300 m amsl in north to 150 m amsl in south. Regional slope is from north-east towards south-west direction. Orientation of alluvial plain area follows the Luni River and its tributaries.

Jodhpur district falls in the Luni & Barmer Basins. Major River of the district is Luni, which flows in ENE to WSW direction. It enters in Jodhpur district near village Jhak in Bilara tehsil and leaves the district near village Dhundhara. Total length of the Luni River is 125 kms in Jodhpur district. Channel pattern of Luni is dendritic to sub-parallel. However in major part of the district, the drainage is essentially ephemeral and internal. Important tributaries to the Luni River are Mithri and Bandi. Other streams in the district are Jojri, Golasmi, Guniamata and Bastua, which are all ephemeral.

Rainfall and Climate

The district experiences arid to semi-arid type of climate. Mean annual rainfall (1971-2005) of the district is 326.8 mm whereas normal rainfall (1901-1970) is lower than average rainfall and placed at 296.1 mm. The rainy days are limited to maximum 15 in a year. Almost 80% of the total annual rainfall is received during the southwest monsoon, which enters the district in the first week of July and withdraws in the mid of September. Probability of annual rainfall exceeding 650 mm is only 10%. However, there is 90% probability that the annual rainfall will be more than 190 mm. The probability of occurrence of mean annual rainfall is 45%. Drought analysis based on agriculture criteria indicates that the district is prone to mild and normal type of droughts. Occurrence of severe and very severe type of drought is very rare. As the district lies in the desert area, extreme of heat in summer and cold in winter is the characteristic of the desert.

Estimated Reserve and Production Envisaged

Table-2.26: Estimated Reserve

Sr. No.	Resource Type	UNFC Code	Reserves of Sand (Bajri) in lakh tonnes
1.	PROVED RESERVES	111	57.96
2.	PROBABLE RESERVES	222	120.75
3.	POSSIBLE RESERVES	333	120.75

C) TARGETED PRODUCTION

During the 5 year period of lease total extraction is = 50,00,000 Tonnes

Details of Production & Dispatches of Five Years

This is a new lease area being allotted to the applicant. Future production programme has been planned as per the details given below:

Production Programme

Proposed lease will be allotted for a period of 5 years only. Proposed lease consist of 668.96 ha area in 37 villages falling along the Luni Nadi. It is proposed to work as per the details given earlier.

Daily production planned: 3571 tonnes Yearly production planned: 10,00,000 tonnes
Volumentric production per year: 0.71 million m^3
Working days have been taken as 280 days per annum which can be increased depending on the conditions prevailing at the time of execution.

CHAPTER-III
Literature Survey & Methodology

3.1 Estimation of Surface Runoff / River Flow

The importance of estimating the water availability from the available hydrological data for estimating the runoff is quite important for determination of replenishment. Many engineers in the past has developed empirical run off estimation formulae. These formulae are essentially rainfall-runoff relations with additional third or fourth parameters to account for climatic or catchment characteristics. Some of the empirical formulae used in various parts of India are as under:

Binnie's Percentages

Sir Alexander Binnie measures the runoff from a small catchment near Nagpur (area of 16 km^2) during 1869 and 1872 and developed curves of cumulative runoff against cumulative rainfall. The two curves are found to be similar. From these, he established percentage of runoff from the rainfall data. These percentages have been used in Madhya Pradesh and Vidarbha Region of Maharashtra for the estimation of yield.

Barlows Tables

Barlow, the first Chief Engineer of the Hydro-electric Survey of India (1915), on the basis of his study in small catchments (area–130 km^2) in Uttar Pradesh expressed runoff R as:

$$R = K_b P$$

Where K_b is the runoff coefficient which depends upon the type of catchment and nature of monsoon rainfall.

Table-3.1: Barlow's Runoff coefficient Kb in percentage (Developed for use in UP)

Class	Description of catchment	Value of K_b (Percentage)		
		Season I	Season II	Season III
A	Flat, cultivated and absorbent soils	7	10	15
B	Flat, partly cultivated and stiff soils	12	15	18
C	Average catchment	16	20	32
D	Hills and plains with little cultivation	28	35	60
E	Very hilly, steep and hardly any cultivation	36	45	81

Season I: Light rain, no heavy downpour
Season II: Average or varying rainfall, no continuous downpour
Season III: Continuous downpour

Strange's Tables

Strange (1928) studies the available data on rainfall and runoff on the border areas of present day Maharashtra and Karnataka and obtained the values of runoff coefficient as,

$$Ks = R/P$$

as a function of the catchment character. For purpose of calculating the yield from the total monsoon rainfall, the catchments were characterized as "good", "average" and "bad". Value of the Ks for these catchments is shown in Table-3.2. Strange also gave a table for calculating the daily runoff from daily rainfall. In this, the run-off coefficient depends not only on the amount of rainfall but also on the state of the ground. Three categories of the original ground state as "dry", "damp" and "wet" are used by him.

Table-3.2: Extract of Strange's table of Run-off Co-efficient Ks in percent

Total monsoon rainfall (cm)	Run-off Co-efficient Ks in percent		
	Good catchment	Average catchment	Bad catchment
25	4.3	3.2	2.1
50	15.0	11.3	7.5
75	26.3	19.7	13.1
100	37.5	28.0	18.7
125	47.6	35.7	23.8
150	58.9	44.1	29.4

Inglis and De'Souza Formula

As a result of careful stream gauging in 53 sites in Western India, Inglis and De'Souza (1929) evolved two regional formulae between annual runoff R in cm and annual rainfall P in cm as follows:

i. For Ghat regions of western India, $R= 0.85 P – 30.5$
ii. For Deccan plateau, $R = (1/254) P (P-17.8)$

Khosla formula

Khosla (1960) analyzed the rainfall, runoff and temperature data for various catchment in India and USA to arrive at an empirical relationship between runoff and rainfall. The time period is taken as a month. His relationship for monthly runoff is

$$R_m = P_m - L_m$$

and $L_m= 0.48T_m$ for $T_m>4.5^oC$
where R_m= monthly runoff in cm and $R_m \geq 0$
P_m= monthly rainfall in cm
L_m= monthly losses in cm
T_m= Mean monthly temperature of the catchment in ^oC

For $T_m \leq 4.5^oC$, the loss L_m may provisionally be assumed as:

T °C	4.5	-1	-6.5
L_m (cm)	2.17	1.78	1.52

Annual run-off = $\sum R_m$

Khosla's formula is indirectly based on the water balance concept and the mean monthly catchment temperature is used to reflect the losses due to evapotranspiration. The formula has been tested on a number of catchments in India and is found to give fairly god results for the annual yield for use in preliminary studies. This formula can also be used to generate synthetic run-off data from historical rainfall and temperature data.

All of the above empirical formulae have been developed for a particular region of India and have their own limitations. For the present study, the area of the watershed for the river has been estimated using remote sensing satellite data. This estimation has also helped in determining the river parameters and soil erosion from the catchment area.

Computing Run-off by using Run-off Coefficient

The volume of run-off can be directly computed approximately, by using an equation of the form;

$$Q = K.P$$

Where Q = Run-off
P = Precipitation, and
K = is a constant, depending upon imperviousness of the drainage area.

Various values of K, which are commonly used, are shown in Table-3.3 below.

Table-3.3: Values of Run-off Coefficient K

Sl. No.	Type of Area	Value of K		
		Flat land 0-5% slope	Rolling land 5-10% slope	Hilly land 10-30% slope
1. (a)	**Urban areas**			
	30% area impervious (paved)	0.40	0.50	--
	50% area impervious (paved)	0.55	0.65	--
	70% area impervious (paved)	0.65	0.80	--
(b)	**Single family residence in urban areas**	0.30		
2.	**Cultivated areas**			
	Open sandy loam	0.30	0.40	0.52
	Clay and silt loam	0.50	0.60	0.72
	Tight clay	0.60	0.70	0.82
3.	**Pastures**			
	Open sandy loam	0.10	0.16	0.22
	Clay and silt loam	0.30	0.36	0.42
	Tight clay	0.40	0.55	0.60
4.	**Wooded land or Forested Areas**			
	Open sandy loam	0.10	0.25	0.30
	Clay and silt loam	0.30	0.35	0.50
	Tight clay	0.40	0.55	0.60

(Source: Irrigation Engineering & Hydraulic Structures by S.K. Garg)

3.2 Estimation of Bed Load

The transport of sediment by rivers has been studied extensively by engineers and earth scientists for more than a century. The use of Bed load transport is a famous one for this analytical type of approach. The first bed load equation was developed by Du Boys in 1879. Since then several equations have been proposed for the prediction of bed load transport. One of the major models among them was Mayer- Peters and Muller model (1948) which is still being hold good for the prediction of bed load transport. The other models include schoklitsch model (1962),Chang model (1939) and Shamove (1962). Each model fit into different scenario. Bagnold (1980), Parker et.al. (1982) were the major works carried out for the Mayer- Peter equations giving an empirical correlation of bed loadtransport rates in flumes and natural rivers. There were different reported studies which use the same model indifferent types of rivers. Dietrich and Smith (1984) studied the behaviour of bed load transport in meandering river.

Another scientist Bathurst and Graf (1987) developed a bed load discharge equation for steep mountain rivers which are appropriate for course sediment. Carson and Griffiths (1987) had given a review on the behaviour of the bed load transport in gravel channels. Meade *et.al.*(1990) has made a detailed study on movement and storage of sediment of the rivers of United States and Canada. Parker (1990) made a study of bed load transport of Gravel Rivers. The study indicates that the bed load transport rate of mixtures should be based on the availability of the each size range in the surface layer. Parker (1991) put forward a theory on selective sorting and abrasion of river gravel.

Recent studies on bed load transport incorporated the stochastic nature of the river sand inflow. Habibi *et.al.* (1994) developed a new formulation for estimation of bed load transport. Zhilin Sun and Donahue (2000) developed astatistical based bed load formula for non-uniform sediment. Maarten Klienhans and Rijn (2002) introducedanother stochastic model for bed load transport prediction. Nian-Sheng Cheng (2002) developed another exponential formula for the bed load transport which does not involve the concept of critical shear stress. Jaber Almedeij and Diplas (2003) worked on bed load transport in gravel bed streams with uni-model sediment. Strom et.al (2004) studied about the cluster formation and evolution by tackling the aspects associated with micro- topography and the bed load transport. Yantao and Parker (2005) presented a new numerical model for the simulation of gravel bed load transport and pulse evolution in Mountain Rivers.

The study of Darren *et al.*(2005) is an important one in the model study of bed load transport, which gave moreattention and increases the applicability of Meyer–Peter‘s equation. Hyung et.al (2008) reported a study onsediment transport processes over a sand bank in macro tidal Garolim Bay, West coast of Korea. In India there areonly a few studies on sand mining. Chandrakanth *et.al* (2005) studied the effect of sand mining on ground waterdepletion in Karnataka by investigating the field data and comparing it with a non-sand bearing area. Rajendra *et.al.*(2008) reported a detailed study on sand extraction from agricultural fields around Bangalore. Several such studiesrelated to river sand mining have been reported for the rivers of Kerala also.

For a cleardirection for the local bodies, for the limit for safe sandmining from different stretches, an analytical study basedon bed load transport model combined with actual sandflow measurement is necessary. This study develops a reach wiseassessment of actual sand inflow and the optimal removalfrom rivers.

3.3 Methodology for Estimation of Sediment Load

The scientific solution for the crisis of sand mining needs an optimization of sand removal. Knowledge of sand inflow is the key part of determination of optimal sand removal. To determine this sand inflow an analytical study is carried out by using bed load transport model. The bed load transport can be estimated using different analytical model such as Meyer-Peter's, Einstein's Model, Shield's Formula, Du-Boy's Formula etc. However, in the present study, the most scientifically accepted Meyer-Peter's equation for estimation of bed load transport was used.

The monsoon in the state of Rajasthan is not regular. Thus, the actual observation of flow and silt which is essential for determination of replenishment is difficult. With this situation in mind, a three stage sand replenishment study, described hereunder, was undertaken.

***In stage one**, preliminary study with field data collection was done. During the field visit, the installation of marked observation rods was undertaken in every leasehold area in the pre-monsoon period. The rise of river bed level in the post monsoon season was then ascertained. While installing the marked observation rods, it was also kept in mind that depending upon the rainfall intensity and duration, there may not be actual discharge in this particular year of 2017 and therefore data from secondary sources might be required. In view of this, CMPDI has approached Central Water Commission (CWC), Ministry of Water Resources, Government of India, for getting the hydrological data from the observation stations CWC has in the study area of the State of Rajasthan. In addition to this CMPDI has also approached state agencies in Jaipur for getting the hydrological data for those rivers that are not covered by CWC.*

***The second stage** includes, **use of remote sensing technology**for identification of watershed area relevant to eachmine lease.In addition to this, the grain size analysis i.e. d_{10}, d_{30}, d_{50} and d_{60}, uniformity coefficient and coefficient of curvature was also determined as an input for estimation of bajri/sand replenishment of rivers under study. Use of **Universal Soil Erosion Equation** was also done to have an idea of the soil erosion from the river catchment area.*

***The final stage** of this study comprises of use of analytical study of bed load transport from the non-perennial rivers flowing through the mining lease areas. The data for this study was taken from field survey, Central Water Commission and approved mine plans of leases. The real time data of major rivers flowing in the state of Rajasthan is collected by CWC periodically through its well established hydrological network stations at critical observation points. This data along with field data was used in the **Meyer Peter's equation** for calculation of bed load transport.*

Meyer – Peter's equation:

The present study used the Meyer-Peterson's model for the estimation of bed load transport because of its wide acceptance and simplicity in computation. Other models give reliable estimates for manmade channels like canals. But the present study considered with river body, in which the former equation is relevant.

Meyer-Peter's equation is based on experimental workcarried out at Federal Institute of Technology, Zurich.Mayer-Peter gave a dimensionless equation based, for thefirst time, on rational laws. The simplified Meyer Peter's equation (*Source: Irrigation Engineering & Hydraulic Structures by S.K. Garg)* is as follows:

$$g_b = 0.417[\tau_0 (\eta'/ \eta)^{1.5} - \tau_c]^{1.5}$$

where,

g_b = 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.* $\eta' = (1/24) \times d^{1/6}$ 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.

τ_c = Critical shear stress required to move the grain in N/m^2 and given by equation $\tau_c = 0.687 d_a$, where d_a 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}.

τ_0= Unit tractive force produced by flowing water *i.e.* $\gamma_w RS$. Truly speaking, its value should be taken as the unit tractive force produced by the flowing water on bed = $0.97\gamma_w RS$. R is the hydraulic mean depth of the channel (depth of flow for wider channel) and S is the bed slope

The value of Manning's coefficient (η) depends upon channel condition and also upon discharges. The recommended values are provided in Table-3.3 and Table-3.4.

Table-3.4: Recommended values of Manning's coefficient (η) for unlined channels

Sl. No.	Condition of Channel	Value of η
1	Very good	0.0225
2	Good	0.025
3	Indifferent	0.0275
4	Poor	0.030

Central Board of Irrigation has recommended the following values of η for different discharges:

Table-3.5: Recommended values of Manning's coefficient (η) for Different Discharges

Sl. No.	Discharge in Cumecs	Value of η
1	14 to 140	0.025
2	140 to 280	0.0225
3	280 and above	0.020

Figure 3.1: Field Survey in the Mine leases

Figure 3.2: Installation of Observation Points in Mine leases

Figure 3.3: A view of the Sand Mining Lease

Figure 3.4: Field Survey and Installation of Observation Points in Mine leases

Figure 3.5: Field Survey and Installation of Observation Points in Mine leases

Figure 3.6: Field Survey and Installation of Observation Points in Mine leases

Figure 3.7: Field Survey and Installation of Observation Points in Mine leases

Universal Soil Erosion Equation:

Soil Erosion Equation is defined as, A = KR(LS)C

Where,

A = Estimate of soil loss rate in tons/hectare/year
K = Soil erodibility factor
R = Rainfall factor
LS = Slope factor
C = Crop management factor

This will help us to determine the soil loss from the catchment area that finds place in the rivers.

CHAPTER-IV
Data Collection, Analyses and Estimation of Replenishment

4. General

As described in Chapter-II, there are following 16 mining leases that has been considered for replenishment study in the 3rd phase of this assignment. The list of concerned rivers for each of the mining leases is provided in Table-4.1.

Table-4.1: List of the mines to be taken up for study in 3rd Phase and concerned rivers

Sl. No.	Name of leaseholder	District	Name of the Rivers
1	Shri Pankaj Singh Jadaun	Ajmer	Daee
2	Shri Abhishek Chaudhary	Ajmer	Rupangarh
3	Shri Arjun Singh	Ajmer	Luni
4	Shri Paras Sethi	Barmer	Shivpura
5	Shri Abhimanyu Chaudhary	Bhilwara	Banas
6	Shri Ashu Singh Bhati	Bhilwara	Manasi & Khari
7	Shri Abhishek Chaudhary	Bhilwara	Banas & Kothari
8	M/s Rajasthan Fort & Pal. Ltd.	Chittorgarh	Minali & Bamani
9	Shri Ashu Singh Bhati	Chittorgarh	Beduch
10	M/s Shiva Corporation (I) Ltd.	Chittorgarh	Beduch, Gambhiri & Orai
11	M/s Satya Swaroop Jadaun	Dausa	Banganga
12	Shri Narottam Singh Jadaun	Dausa	Banganga
13	Shri Nawal Kishore Gupta	Dholpur	Parvati & Gambhiri
14	Shri Kishore Gupta	Dholpur	Parvati
15	Shri Arjun Singh	Jaipur	Kantali
16	Shri Himmat Singh Shekhwat	Dholpur	Nale

The size of the leasehold including their average length and width is provided in Table-4.2 below:

Table-4.2: Dimensional Parameters of the mines to be taken up for study in 3rd Phase

Sl. No.	Name of leaseholder	Area (in Ha)	Dimension of the Lease		
			Average length (in kms)	Average Effective width (in km)	Bed slope
1	Shri Pankaj Singh Jadaun	120.31	18.00	0.067	1:500
2	Shri Abhishek Chaudhary	1219.03	15.00	0.813	1:938
3	Shri Arjun Singh	163.45	6.80	0.240	1:523
4	Shri Paras Sethi	54.68	5.00	0.052	1:280

Sl. No.	Name of leaseholder	Area (in Ha)	Dimension of the Lease		
			Average length (in kms)	Average Effective width (in km)	Bed slope
5	Shri Abhimanyu Chaudhary	287.00	35.00	0.082	1:700
6	Shri Ashu Singh Bhati	624.39	42.00	0.149	1:1312
7	Shri Abhishek Chaudhary	836.13	58.90	0.142	1:561
8	M/s Rajasthan Fort & Pal. Ltd.	286.43	22.00	0.130	1:1375
9	Shri Ashu Singh Bhati	77.50	10.00	0.078	1:1000
10	M/s Shiva Corporation (I) Ltd.	450.89	50.00	0.090	1:1316
11	M/s Satya Swaroop Jadaun	755.02	25.00	0.302	1:1087
12	Shri Narottam Singh Jadaun	2031.98	28.00	0.532	1:459
13	Shri Nawal Kishore Gupta	232.92	25.00	0.093	1:675
14	Shri Kishore Gupta	391.75	45.00	0.087	1:818
15	Shri Arjun Singh	113.77	21.00	0.055	1:233
16	Shri Himmat Singh Shekhwat	668.96	30.00	0.223	1:857

From the above, it may be seen that major rivers for the above mining leases are Khari, Luni, Sukri, Lilari and Bangarnga. These rivers have been considered for replenishment study in the 3rd phase.

4.1 Banas River

The Banas is a river of Rajasthan state in western India. It is a tributary of the Chambal River, which in turn flows into the Yamuna, a tributary of the Ganges. The Banas is approximately 512 kilometres in length. It is also known as 'Van Ki Asha' (Hope of forest).

The Banas originates in the Veron ka Math situated in Khamnor Hills of the Aravalli Range, about 5 kms from Kumbhalgarh in Rajsamand district. It flows northeast through the Mewar region of Rajasthan, and meets the Chambal near the village of Rameshwar in Sawai Madhopur District. The cities of Nathdwara, Jahazpur, and Tonk lie on the river. Major tributaries include the right bank tributaries of Berach and Menali and the left bank tributaries of Kothari, Khari, Dai, Dheel River, Sohadara, Morel and Kalisil.

The Banas drains a basin of 45,833 km², and lies entirely within Rajasthan. It is a seasonal river that dries up during the summer, but it is nonetheless used for irrigation. The Bisalpur-Jaipur project completed by the Government of Rajasthan in 2009 provides drinking water from the Banas to Jaipur city. Banas drains the east slope of the central portion of the Aravalli Range, and the basin includes all or part of Ajmer, Bhilwara, Bundi, Chittorgarh, Dausa, Jaipur, Pali, Rajsamand, Sawai Madhopur, Sirohi, Tonk, and Udaipur districts.

Tributaries: Berach and Menali on the right, and Kothari, Khari, Dai, Dheel, Sohadara, Morel and Kalisil onthe left.

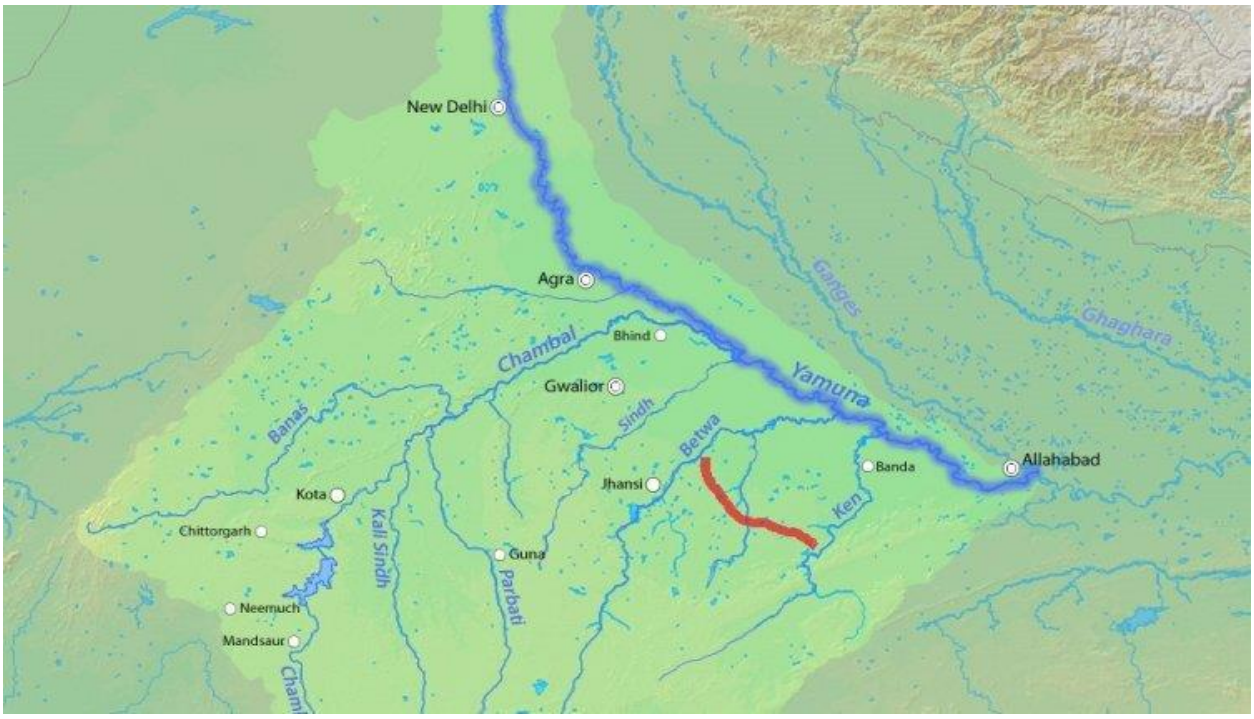

Figure-4.1: Drainage map of study area showing Banas River

Khari: Kahri River rises from Palanpur (B.K.district) and drains into the Banas River through Mehsana district at 80 km downstream of Dantiwada dam.It flows northeast forabout 192 km through Rajsamand, Bhilwara and Ajmer Districts before joining the Banas River near Chosalavillage in Ajmer District. The entry point of the river in the district is village Dhuwala, tehsil Karera and existpoint village Gulabpura, tehsil Hurda with the travel length of 62 kms. The catchment area of the river around6,268 km^2.

Tributaries: Nekhadi and Bara rivers on the left and Mansi River on the right.

Luni: The Luni is the only river basin of any significance in Western Rajasthan which forms the bulk of arid zone. Luni originates from Western slopes of the Aravalli ranges at an elevation of 772 m above m.s.1. near Ajmer flowing in South West direction and traversing a course of 511 kms. In Rajasthan, it finally flows into the Rann of Kutchh. Its total catchment area falls in Rajasthan. Luni basin is situated in between 240 11' to 260 43' North latitude and 700 37' to 740 39' East longitude approximately. The peculiarity of this river is that it tends to increase its width rather than deepening the bed because the banks are of soils which are easily erodable whereas beds are of sand. The floods develop and disappear so rapidly that they have no time to scour the bed. The Aravalli ranges form its East boundary whereas main course of river in Barmer district itself forms North boundary andmostly Banas and initial reach of Chambal River form its Southern boundary.

Tributaries: Luni receives all the main tributaries on its left bank except one *i.e.* Jojari (Mithri) on the right bank. Luni receives ten tributaries namely Lilari, Guhiya, Bandi (Hemawas), Sukri (Hemawas), Sukri, Mithri, Jawai, Khari Bandi, Sukri Bandi and Sugi. Hence the drainage on the left bank of Luniis, therefore, more extensive than on Right Bank. The Luni drains an area of 32,879 sq Kms. In Rajasthan state only.

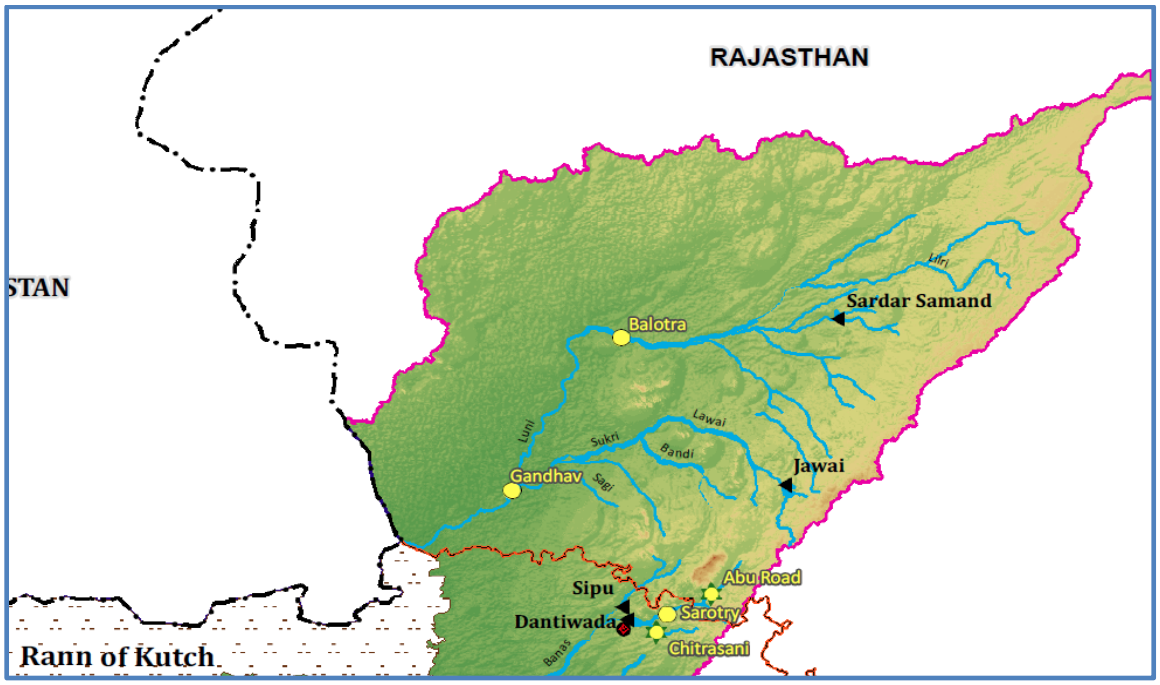

Figure-4.2: Drainage map of study area showing Luni River

Kothari River: Kothari River, another tributary of Banas, originate in the eastern slopes of Aravali ranges, near Horera village in Bhilwara District. The catchment area of the river is 2341 km^2 lying between 73^{0}47'30" and 75^{0}03'30" East longitudes and 73^{0}47'30" & 75^{0}03'30" North latitudes. The river flows through Rajsamand and Bhilwara districts for about 51 kms in hilly region and 100 kms through plains before joining the Banas River near Nandrai village in Bhilwara district.

Tributaries: Bahamani

Banganga: Banganga River is a prominent river in the Bharatpur district of Rajasthan.Banganga River Basin is located in the northeastern part of Rajasthan, between latitudes 26°40' and 27°37' and longitudes 75°49' and 77°39'. It lies between the Gambhir and Banas Basins to its south-southwest, Ruparail and Sabi to its north, and the Shekhawati Basin to its west. Its eastern edge borders the Yamuna River Basin in Uttar Pradesh. Banganga River Basin extends over parts of Alwar, Jaipur, Dausa, Sawai Madhopur and Bharatpur Districts.The total catchment area of the Basin is 8,878 km^2 according to 1:250,000 scale topographical maps published by the Survey of India.

Orographically, the western part of the Basin is marked by hilly terrain belonging to the Aravali chain, with fairly flat valleys along the Banganga River and its tributaries. East of the Todabhim -Mandawar chain of hills lies an extensive alluvial plain which gently slopes eastwards, towards the Yamuna River in Uttar Pradesh. The northeastern part of the area is also rather flat, interspersed with moderately elevated hills.The main urban agglomeration in Banganga River Basin is Bharatpur city situated at the eastern edge of the Basin. The second largest urban centre is Dausa.

Drainage

River Banganga originates in the Aravali hills, near Arnasar and Bairath in Jaipur District. It flows towards the south up to the village of Ghat, then east through partly hilly and partly plain terrain. The total length of the river is 240 kms. The main tributaries are Gumti Nalla and Suri River, joining the river on its right bank, and Sanwan and Palasan Rivers, meeting the river on its left bank.

Figure-4.3: River Banas, Tonk

River Manshi: River Manshi originates near village Karera in Bhilwara District. It flows from south west to north east and then merges in Khari River. The entry point of the river in the district is village Kaserpura, tehsil Karera and exist point is village Sangriya, tehsil Phuliakala with the travel length of 68 kms in the district. The total catchment area of the river is around 1500 km^2.

Figure-4.4: Bajri/sand deposition in River Banas, Tonk

4.2 Estimation of Watershed Area through Remote Sensing data

The watershed area of each lease has been worked out based on the topo-sheet and remote sensing data. The data estimated for each of the lease is provided in Table-4.3.

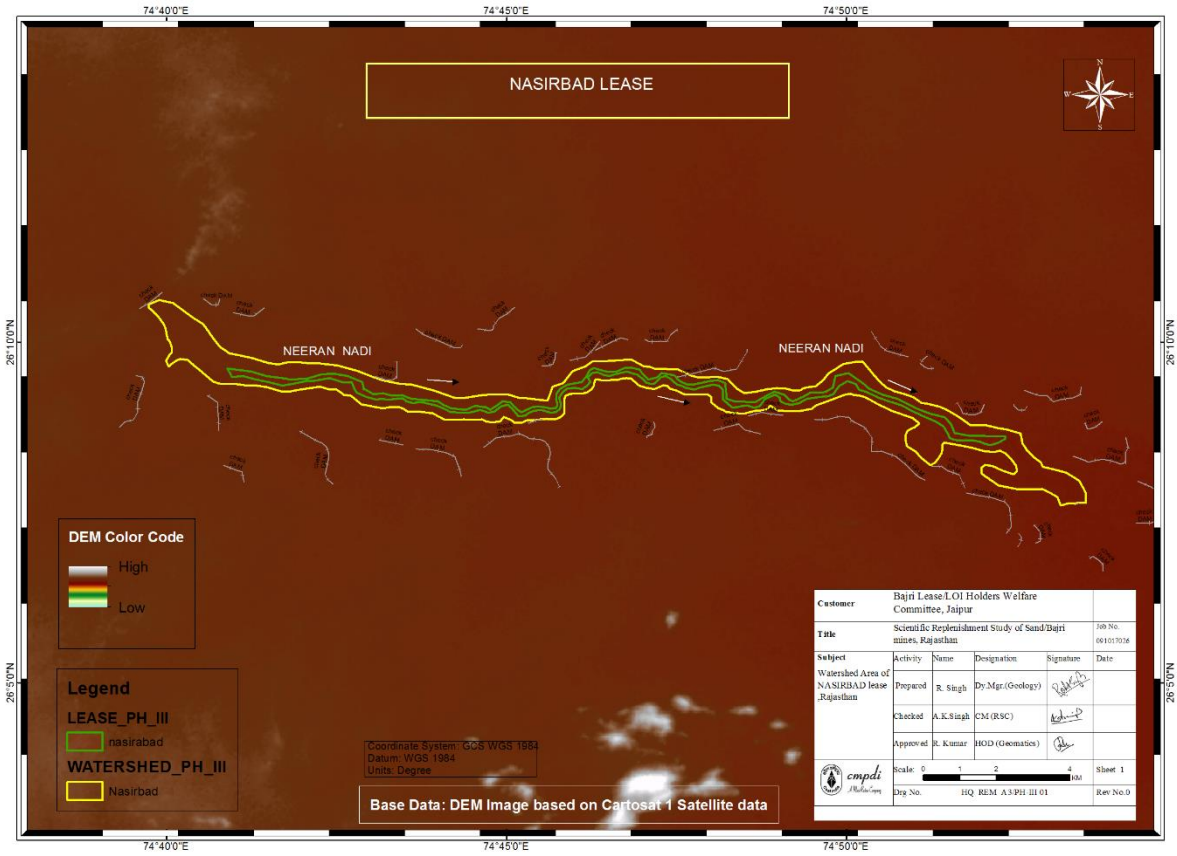

Figure-4.5: Watershed Area determination of Nasirabad Lease through Remote Sensing

Table-4.3: Watershed Parameters of Mine Leases

Sl. No.	Name of leaseholder	Area (in Ha)	Name of Rivers	Watershed Perimeter in Kms	Watershed Area in Sq. Kms.
1	Shri Pankaj Singh Jadaun	120.31	Daee	17.25	57.74
2	Shri Abhishek Chaudhary	1219.03	Rupangarh	16.91	39.87
3	Shri Arjun Singh	163.45	Luni	20.57	59.84
4	Shri Paras Sethi	54.68	Shivpura	2.30	17.15
5	Shri Abhimanyu Chaudhary	287.00	Banas	28.30	101.56
6	Shri Ashu Singh Bhati	624.39	Manasi & Khari	8.82	51.57
7	Shri Abhishek Chaudhary	836.13	Banas & Kothari	36.71	130.31
8	M/s Rajasthan Fort & Pal.	286.43	Minali & Bamani	17.58	70.52
9	Shri Ashu Singh Bhati	77.50	Beduch	10.54	43.91
10	M/s Shiva Corporation (I) Ltd.	450.89	Beduch, Gambhiri & Orai	44.79	115.10
11	M/s Satya Swaroop Jadaun	755.02	Banganga	56.41	78.30
12	Shri Narottam Singh Jadaun	2031.98	Banganga	174.51	246.89
13	Shri Nawal Kishore Gupta	232.92	Parvati & Gambhiri	23.06	70.90
14	Shri Kishore Gupta	391.75	Parvati	20.33	102.79
15	Shri Arjun Singh	113.77	Kantali	63.04	82.15

Sl. No.	Name of leaseholder	Area (in Ha)	Name of Rivers	Watershed Perimeter in Kms	Watershed Area in Sq. Kms.
16	Shri Himmat Singh Shekhwat	668.96	Nale	16.37	52.07

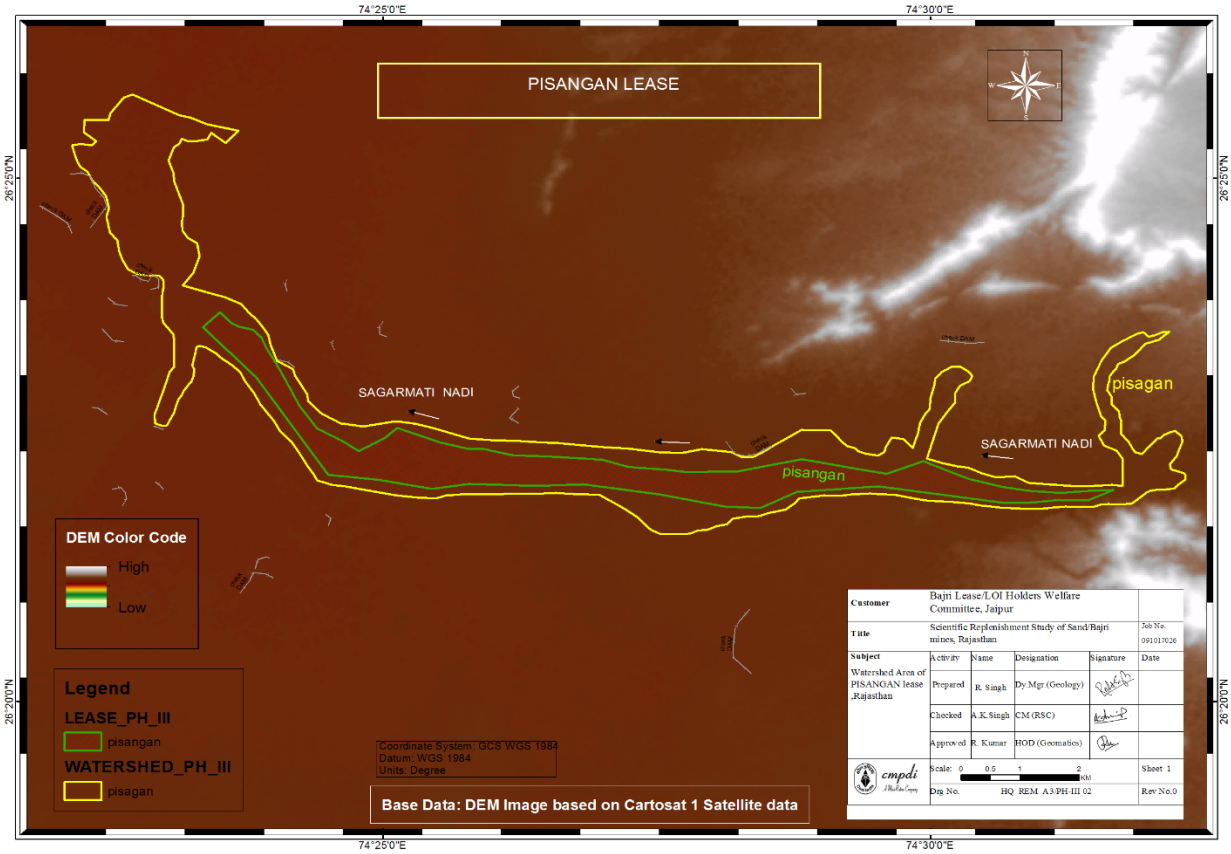

Figure-4.6: Watershed Area determination of Pisangan Lease through Remote Sensing

4.3 Data obtained from Central Water Commission

The data obtained from Central Water Commission from some of their observation stations located in the study area is provided in Table-4.4. This data has been utilized for estimation of replenishment of sand mining projects. For determination of the grain size distribution of the Bajri/sand, the sample from each of the mine lease was collected and analyzed. The grain size distribution *i.e.* d_{10}, d_{30}, d_{50}, d_{60}, uniformity coefficient and coefficient of curvature was determined in the laboratory. The analysis result is presented in Table-4.7. From the analysis, it is evident that the sand is well graded.

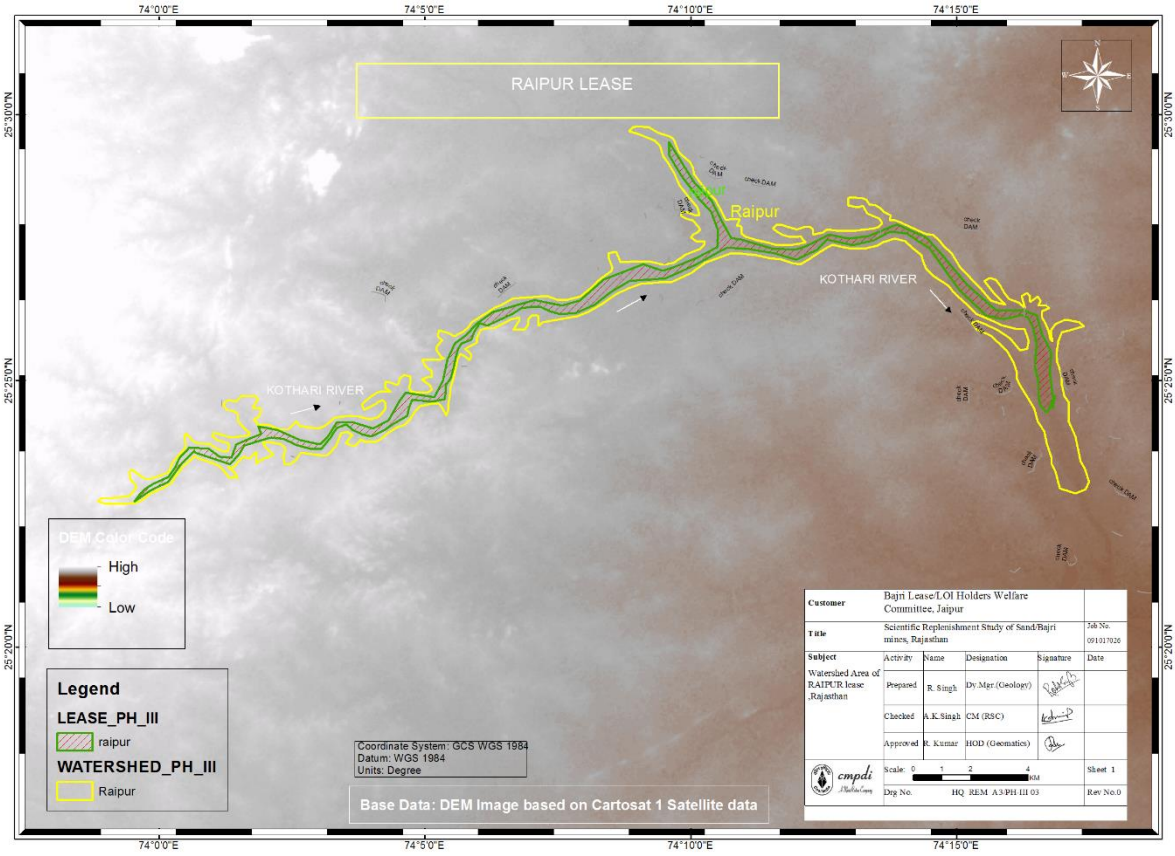

Figure-4.7: Watershed Area determination of Raipur mine lease area through Remote Sensing

For estimation of bed load transport, Peyer-Peter's equation was used. The data collected from field, the real time flow data from CWC and grain size distribution was used. For all the tributaries of Banas River, a depth of flow 0.75 m as observed from the field was assumed for estimation of sand replenishment.

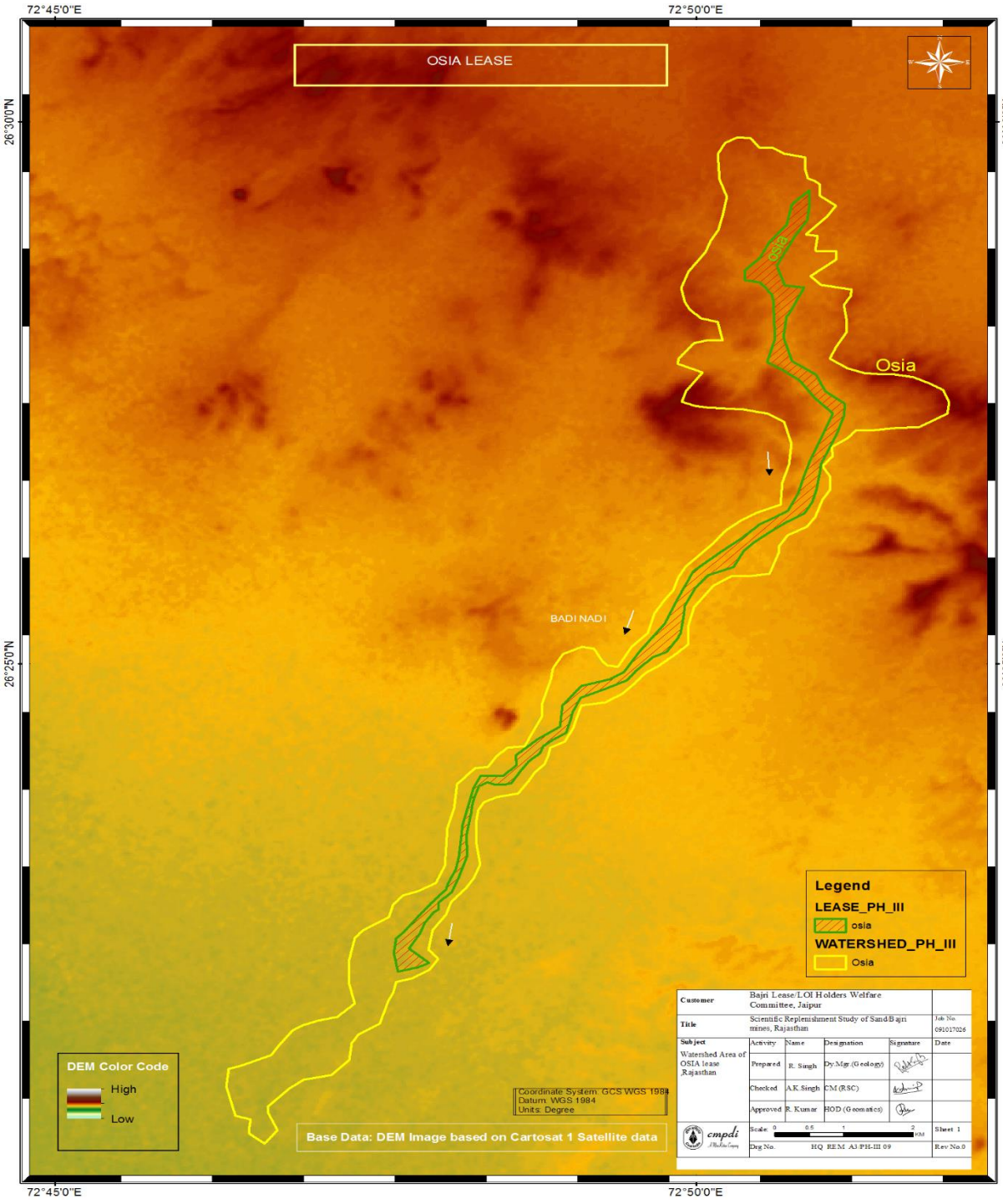

Figure-4.8: Watershed Area determination of Osian Lease through Remote Sensing

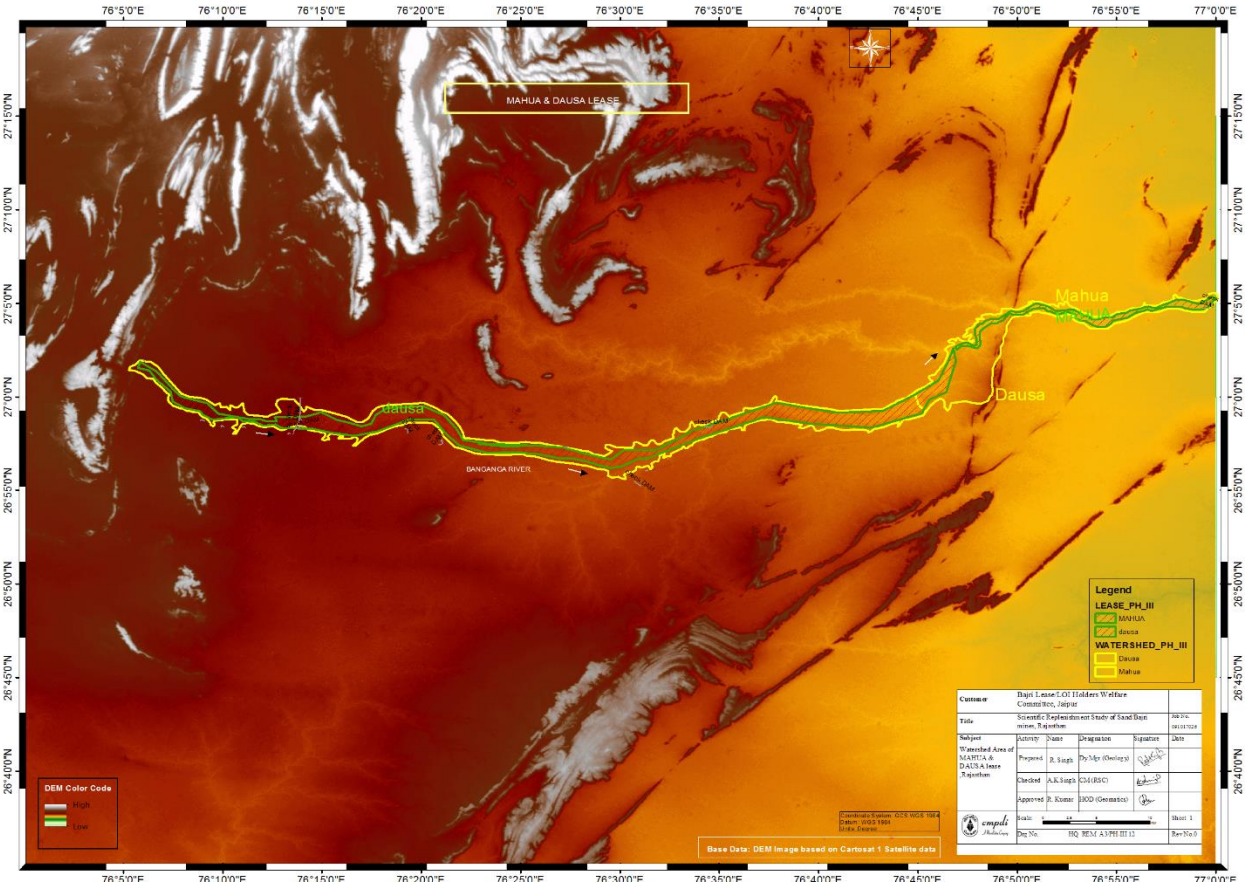

Figure-4.9: Watershed Area determination of Mahua-Dausa Lease through Remote Sensing

Table-4.4: Hydrological data of the Luni River (Year 2016-17)

Name of the CWC Observation Stations	Hydrological Data											
	Gauge (in m)		Discharge (cumecs)		Wetted perimeter (in m)		Hydraulic radius (in m)		Average velicity (m/sec)		Max velocity (m/sec)	
	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
Balotra	0.13	2.53	21.08	611.23	137.05	484.10	0.46	2.23	0.31	0.71	0.49	0.90
Gandhav	0.92	4.85	6.87	2049.38	333.17	367.45	0.66	1.25	0.01	0.36	0.33	1.18

(Source: Central Water Commission)

Table-4.5: Hydrological data of the Study Area (Year 2016)

Name of the CWC Observation Stations	Hydrological Data									
	Annual runoff (in MCM)	Annual runoff (in mm)	Peak Observed Discharge (Cumecs)	Corresponding Water Level (in m)	Peak computed Discharge (Cumecs)	Corresponding Water Level (in m)	Lowest Observed Discharge (Cumecs)	Corresponding Water Level (in m)	Lowest Computed Discharge (Cumecs)	Corresponding Water Level (in m)
Baranwada	2809	56	2750	197.70	1650	196.6	0.00	191.0	0.00	191.9
Bigod	2911	203	832.9	423.89	5140	428.20	0.00	420.00	0.70	420.96
Chittorgarh	208	144	183.7	402.71	124.4	402.15	0.00	398.89	0.00	398.89
Khatoli	11112	734	9839	197.38	14400	200.1	0.00	189.61	3.00	189.76
Tonk	495	12	242.9	257.21	587.00	260.06	0.00	253.00	9.00	254.30

(Source: Central Water Commission)

Table-4.6: Annual rainfall data for 2016

Name of the CWC Observation Stations	Rainfall (in mm)						Total Rainfall (in mm)	Total Rainy Days
	May	June	July	August	September	October		
Baranwada	0.00	69.20	415.80	260.00	15.20	18.80	779.00	40
Bigod	Data Not Available							
Chittorgarh	11.00	36.40	283.00	1108.00	36.60	78.00	1553.00	53
Khatoli	0.00	60.00	162.50	463.00	74.80	4.20	764.50	41
Tonk	0.00	5.00	263.00	332.20	8.00	0.00	608.20	34

(Source: Central Water Commission)

Table-4.7: Grain size distribution of the River Sand of mine leases

Sl. No.	Name of leaseholder	Lease Area (in Ha)	Sand Characteristics							Classification as per Is:1498
			D_{10}(µ)	D_{30}(µ)	D_{50}(µ)	D_{60}(µ)	C_u	C_{cr}	Bulk Density (g/cc)	
1	Shri Pankaj Singh Jadaun	120.31	35	250	690	1000	28.57	1.79	1.58	Well graded sand
2	Shri Abhishek Chaudhary	1219.03	38	260	680	1040	27.37	1.71	1.62	Well graded sand
3	Shri Arjun Singh	163.45	36	250	700	1040	28.89	1.67	1.58	Well graded sand
4	Shri Paras Sethi	54.68	40	260	690	960	24.00	1.76	1.56	Well graded sand
5	Shri Abhimanyu Chaudhary	287.00	42	280	670	970	23.10	1.92	1.54	Well graded sand
6	Shri Ashu Singh Bhati	624.39	38	270	680	1000	26.32	1.92	1.58	Well graded sand
7	Shri Abhishek Chaudhary	836.13	40	300	660	960	24.00	2.34	1.54	Well graded sand
8	M/s Rajasthan Fort & Pal.	286.43	35	280	700	1020	29.14	2.20	1.62	Well graded sand
9	Shri Ashu Singh Bhati	77.50	38	260	690	1000	26.32	1.78	1.61	Well graded sand
10	M/s Shiva Corporation (I) Ltd.	450.89	36	300	670	1020	28.33	2.45	1.54	Well graded sand
11	M/s Satya Swaroop Jadaun	755.02	35	320	670	980	28.00	2.99	1.56	Well graded sand
12	Shri Narottam Singh Jadaun	2031.98	28	290	690	960	34.29	3.13	1.58	Well graded sand
13	Shri Nawal Kishore Gupta	232.92	30	260	710	960	32.00	2.35	1.62	Well graded sand
14	Shri Kishore Gupta	391.75	32	300	700	980	30.63	2.87	1.58	Well graded sand
15	Shri Arjun Singh	113.77	34	260	720	980	28.82	2.03	1.62	Well graded sand
16	Shri Himmat Singh Shekhwat	668.96	36	270	730	1020	28.33	1.99	1.63	Well graded sand

C_u= Uniformity Coefficient, C_{cr}= Coefficient of Curvature

Table-4.8: Estimation of Sand Replenishment

Sl. No.	Name of leaseholder	Lease Area (in Ha)	Estimated Bed Load (Tonnes/day)	Estimated deposition or replenishment (Tonnes/day)	Sediment Load Deposition per month (in Tonnes)	Annual Replenishment (in Tonnes)	Estimated Annual Replenishment (in million m^3)*
1	Shri Pankaj Singh Jadaun	120.31	4162.22	3329.78	99893.36	299680.08	0.21
2	Shri Abhishek Chaudhary	1219.03	17230.50	13784.40	413531.89	1240595.68	0.89
3	Shri Arjun Singh	163.45	15424.31	12339.45	370183.38	1110550.15	0.79
4	Shri Paras Sethi	54.68	12526.19	10020.95	300628.49	901885.48	0.64
5	Shri Abhimanyu Chaudhary	287.00	27988.46	22390.77	671723.13	2015169.39	1.44
6	Shri Ashu Singh Bhati	624.39	1719.72	1375.78	41273.26	123819.77	0.09
7	Shri Abhishek Chaudhary	836.13	67743.75	54195.00	1625850.09	4877550.28	3.48
8	M/s Rajasthan Fort & Pal.	286.43	1376.75	1101.40	33042.00	99126.00	0.07
9	Shri Ashu Singh Bhati	77.50	1491.89	1193.51	35805.41	107416.24	0.08
10	M/s Shiva Corporation (I) Ltd.	450.89	1023.01	818.40	24552.14	73656.43	0.05
11	M/s Satya Swaroop Jadaun	755.02	4940.38	3952.31	118569.18	355707.54	0.25
12	Shri Narottam Singh Jadaun	2031.98	38091.03	30472.83	914184.81	2742554.42	1.96
13	Shri Nawal Kishore Gupta	232.92	3602.79	2882.24	86467.07	259401.20	0.19
14	Shri Kishore Gupta	391.75	2386.86	1909.49	57284.67	171854.02	0.12
15	Shri Arjun Singh	113.77	12522.57	10018.05	300541.58	901624.73	0.64
16	Shri Himmat Singh Shekhwat	668.96	5691.09	4552.87	136586.18	409758.54	0.29

**Specific gravity of sand = 1.4 tonne per m^3*

Table-4.9: Status of Sand Replenishment vis-à-vis annual planned production

Sl. No.	Name of the Lessee	*Estimated Mineable Reserve (in million m^3)	*Annual Production Capacity envisaged (as per mining plan in million m^3)	Estimated Annual replenishment (in million m^3)	Replenishment Status vis-à-vis planned production
1	Shri Pankaj Singh Jadaun	3.68	0.87	0.21	Replenishment less than planned annual production
2	Shri Abhishek Chaudhary	9.06	1.92	0.89	Replenishment less than planned annual production
3	Shri Arjun Singh	6.29	0.80	0.79	Replenishment less than planned annual production
4	Shri Paras Sethi	1.64	0.16	0.64	Replenishment more than planned annual production
5	Shri Abhimanyu Chaudhary	4.90	0.40	1.44	Replenishment more than planned annual production
6	Shri Ashu Singh Bhati	11.31	0.60	0.09	Replenishment less than planned annual production
7	Shri Abhishek Chaudhary	19.00	0.80	3.48	Replenishment more than planned annual production
8	M/s Rajasthan Fort & Pal.	5.56	0.12	0.07	Replenishment less than planned annual production
9	Shri Ashu Singh Bhati	1.83	0.28	0.08	Replenishment less than planned annual production
10	M/s Shiva Corporation (I) Ltd.	4.50	0.16	0.05	Replenishment less than planned annual production
11	M/s Satya Swaroop Jadaun	18.12	0.90	0.25	Replenishment less than planned annual production
12	Shri Narottam Singh Jadaun	44.73	1.20	1.96	Replenishment more than planned annual production
13	Shri Nawal Kishore Gupta	6.29	0.86	0.19	Replenishment less than planned annual production
14	Shri Kishore Gupta	10.58	0.86	0.12	Replenishment less than planned annual production
15	Shri Arjun Singh	3.07	0.40	0.64	Replenishment more than planned annual production
16	Shri Himmat Singh Shekhwat	4.14	0.71	0.29	Replenishment less than planned annual production

**** As per Mining Plan approved by Department of Mines and Geology, Government of Rajasthan***

4.4 Summary of the Estimation of Sand Replenishment

The annual Bajri/ sand replacement in mine lease area has been calculated using the Meyer-Peter's equation. It is found that the annual replenishment rate varies from 0.05 million m^3 to 3.58 million m^3 depending on bed load transport rate of rivers. In 31% of the total 41 leases considered for the study, the replenishment rate was found to be more than the planned annual production. In rest of the leases *i.e.* in 69% of the leases, the replenishment rate is less than the planned annual production. The variation in annual replenishment rate is due to variation in the catchment area size, river slope, annual rainfall, catchment and soil characteristics. It may be mentioned that occurrence of rain in the state of Rajasthan is erratic, unpredictable and comparatively of shorter period. The estimated annual replenishment of mine leases has been provided in the Table-4.8. A comparative analysis of estimated sand replenishment in each lease has been made with the annual planned production of the mine leases in Table 4.9.

CHAPTER-V
Conclusion & Recommendations

i. The EAC, MoEFCC while deliberating the proposal of sand mining in 11th Meeting held at October 24-25, 2016 rightly opined that "*the proposals of sand mining from Rajasthan are not in perennial rivers. These are, in effect, paleo sand deposits and are not replenished annually during monsoon season.*Therefore, the study for replenishment of rivers in the State of Rajasthan have been conducted after giving due consideration to the observations of MoEFCC.

ii. The rivers of Rajasthan are ephemeral in nature and therefore there is need to look at the issue of replenishment of these rivers from different perspective. The rivers are not replenished annually as is the case of perennial rivers and therefore the concept of ***annual replenishmentbased mine capacity*** does not apply for the rivers of Rajasthan. There is need to consider appropriately for change of the policy applicable for annual replenishment of rivers*vis-à-vis* mine capacity permits in case of Rajasthan.

iii. There may be appreciable variation in the amount of replenishment of the rivers in the State of Rajasthan. This is primarily due to erratic and uncertainty in the occurrence of rainfall in the State. Thus, the replenishment achieved at one point of time may be utilized over more than a year depending upon requirement. This factor needs to be considered while planning for the capacity of mines in the State. Linking to annual production with annual replenishment of the rivers in the State of Rajasthan may not be a practical approach.

iv. In our considered opinion, there is need to consider the concept of ***resource accounting*** of bajri/sand in the rivers of Rajasthan and take the replenishment as a measure for resource augmentation. The permissible level of bajri/sand in each stretch need to be identified and each year, the resource augmentation based on the replenishment of the river need to be added into it for updating the bajri/sand. Based on this estimation, quantum of further permits may be decided by Government.

The system of *Environmental Accounting* has also been propagated by United Nations (UN). UN has come up with the *System of Environmental-Economic Accounting 2012-Central Framework (SEEA-Central Framework)*which is a statistical framework consisting of a comprehensive set of tables and accounts, which guides the compilation of consistent and comparable statistics and indicators for policy making *etc.*It is a tool that helps in tackling natural resource depletion and environmental degradation. For sand mining projects of Rajasthan, physical supply use tables (PSUT) as provided in SEEA-Central Framework of UN may be utilized for sustainable use of sand mining and grant of mining permits. The mining leases in Rajasthan occur in paleo sand deposits and use of PSUT will be appropriate in this case.

v. The installation of observation pointsmay be appropriately considered for determination of replenishment level in each tract of river under consideration. The observation points may be installed at strategic locations and rise in the level of Bajri/sand may be monitored.

vi. The Special meeting of the Reconstituted Expert Appraisal Committee for Environmental Appraisal of Mining Projects (Non-Coal) of the Ministry of Environment, Forest and Climate Change was held on January 08, 2018 for consideration of Nineteen (19) proposals of River Sand/ Bajri Mining in the State of Rajasthan in pursuance of Hon'ble Supreme Court Judgment dated 16.11.2017. As noted by Reconstituted Expert Appraisal Committee for Environmental Appraisal of Mining Projects (Non-Coal) of the Ministry of Environment, Forest and Climate Change, the following is recommended to be taken up by the leaseholders in future;

- → *Demarcate the stretch of land (lease) in consultation with State Irrigation Department on which it wants to permit river/ sand mining,*
- → *Based on such area identification, identify the cross-section benchmarks on which the replenishment study shall be undertaken for calculation of replenishment amount/ rate, as the case may be;*
- → *The areas for 'carrying out mining' and cross-sections for 'monitoring replenishment' are required to be demarcated through latitudes and longitudes along with the Original Ground Level (OGL) of the cross-section and shall be duly authenticated by DMG, Govt. of Rajasthan and State Irrigation Department respectively. The future replenishment assessment may be undertaken based on OGL duly authenticated by State Irrigation Department.*

vii. It is suggested that fixation of cross-section for estimation of annual replenishment in future should *interalia* be based on critical river characteristics like abrupt change in gradient, occurrence of meandering stretches, existing water storage or other such structures in the river, distance of observation points from the upper stretch of the river in the lease and other such parameters that are likely to affect the rate of replenishment. In normal stretches, the cross-section at an interval of 1.0 km along the course of the river may be sufficient for estimation of surface run-off and replenishment. For smaller leases, this interval may be kept at around 500 m or so along the river course. The observation points for estimation in rise of bed level should be installed/fixed at an interval of 100 m across the width of the river and monitored both pre-monsoon and post-monsoon. However, for rivers having width lesser than 100 m, at least two observations points evenly distributed along the width may be considered.

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