Environmental Assessment Report

Initial Environmental Examination: Barmer Sewerage and Sanitation Sub Project

Project Number: 40031

September 2008

India: Rajasthan Urban Sector Development Investment Program

Prepared by Local Self Government Department

For the Government of Rajasthan
Rajasthan Urban Infrastructure Development Project

WEIGHTS AND MEASURES

lakh	–	100 thousand = 100,000
crore	–	100 lakhs = 10,000,000
$\mu g/m^3$	–	micrograms per cubic meter
km	–	kilometer
lpd	–	liters per day
m	–	meter
mg/l	–	milligrams per liter
mm	–	millimeter
ppm	–	parts per million

NOTE{S}

(i) In this report, "$" refers to US dollars.
(ii) “INR” and “Rs” refer to Indian rupees

Contents

I. INTRODUCTION

A. Purpose of the Report

1. Rajasthan Urban Sector Development Investment Program (RUSDIP) is intended to optimize social and economic development in 15 selected towns in the State, particularly district headquarters and towns with significant tourism potential. This will be achieved through investments in urban infrastructure (water supply; sewerage and sanitation; solid waste management; urban drainage; urban transport and roads), urban community upgrading (community infrastructure; livelihood promotion) and civic infrastructure (art, culture, heritage and tourism; medical services and health; fire services; and other services). RUSDIP will also provide policy reforms to strengthen urban governance, management, and support for urban infrastructure and services. The assistance will be based on the State-level framework for urban reforms, and institutional and governance reforms recommended by the Government of India (GoI) through the Jawaharlal Nehru National Urban Renewal Mission (JNNURM) and Urban Infrastructure Development Scheme for Small and Medium Towns (UIDSSMT).

2. RUSDIP Phase II to be implemented over a seven year period beginning in 2008, and will be funded by a loan via the Multitranche Financing Facility (MFF) of the ADB. The Executing Agency (EA) is the Local Self-Government Department (LSGD) of the Government of Rajasthan (GoR); and the Implementing Agency (IA) is the Project Management Unit (PMU) of the Rajasthan Urban Infrastructure Development Project (RUIDP), which is currently in the construction stage.

3. RUSDIP will improve infrastructure through the design and implementation of a series of subprojects, each providing improvements in a particular sector (water supply, sewerage, solid waste etc) in one town. RUSDIP has been classified by ADB as environmental assessment category B (some negative impacts but less significant than category A). The impacts of subprojects prepared according to ADB Environment Policy (2002) and Environmental Assessment Guidelines (2003).

B. Extent of the Study

4. Indian law and ADB policy require that the environmental impacts of development projects are identified and assessed as part of the planning and design process, and that action is taken to reduce those impacts to acceptable levels. This is done through the environmental assessment process, which has become an integral part of lending operations and project development and implementation worldwide.

1 ADB Policy

5. ADB's Environment Policy requires the consideration of environmental issues in all aspects of the Bank's operations, and the requirements for Environmental Assessment are described in Operations Manual (OM) 20: Environmental Considerations in ADB Operations. This states that ADB requires environmental assessment of all project loans, programme loans, sector loans, sector development programme loans, financial intermediation loans and private sector investment operations.

6. The nature of the assessment required for a project depends on the significance of its environmental impacts, which are related to the type and location of the project, the sensitivity, scale, nature and magnitude of its potential impacts, and the availability of cost-effective

mitigation measures. Projects are screened for their expected environmental impacts and are assigned to one of the following categories:

Category A: Projects that could have significant environmental impacts. An Environmental Impact Assessment (EIA) is required.

Category B: Projects that could have some adverse environmental impacts, but of less significance than those for category A. An Initial Environmental Examination (IEE) is required to determine whether significant impacts warranting an EIA are likely. If an EIA is not needed, the IEE is regarded as the final environmental assessment report.

Category C: Projects those are unlikely to have adverse environmental impacts. No EIA or IEE is required, although environmental implications are reviewed.

Category FI: Projects that involve a credit line through a financial intermediary (FI) or an equity investment in a FI. The FI must apply an environmental management system, unless all subprojects will result in insignificant impacts.

7. The Bank has categorised this program as Category B and following normal procedure for MFF loans has determined that one Environmental Examination will be conducted for each subproject, with a subproject being the infrastructure improvements in a particular sector (water supply, sewerage, etc) in one town.

2 National Law

8. The GoI EIA Notification of 2006 (replacing the EIA Notification of 1994), sets out the requirement for Environmental Assessment in India. This states that Environmental Clearance (EC) is required for specified activities/projects, and this must be obtained before any construction work or land preparation (except land acquisition) may commence. Projects are categorised as A or B depending on the scale of the project and the nature of its impacts.

9. Categories A projects require Environmental Clearance from the National Ministry of Environment and Forests (MoEF). The proponent is required to provide preliminary details of the project in the form of a Notification, after which an Expert Appraisal Committee (EAC) of the MoEF prepares comprehensive Terms of Reference (ToR) for the EIA study, which are finalized within 60 days. On completion of the study and review of the report by the EAC, MoEF considers the recommendation of the EAC and provides the EC if appropriate.

10. Category B projects require environmental clearance from the State Environment Impact Assessment Authority (SEIAA). The State level EAC categorises the project as either B1 (requiring EIA study) or B2 (no EIA study), and prepares TOR for B1 projects within 60 days. On completion of the study and review of the report by the EAC, the SEIAA issues the EC based on the EAC recommendation. The Notification also provides that any project or activity classified as category B will be treated as category A if it is located in whole or in part within 10 km from the boundary of protected areas, notified areas or inter-state or international boundaries.

11. The only type of infrastructure provided by the RUSDIP that is specified in the EIA Notification is solid waste management, where EC is required for all Common Municipal Solid Waste Management Facilities (facilities that are shared by more than one town) 1. EC is thus not required for sewerage sanitation sub-project that is the subject of this Environmental Examination.

3 Review and Approval Procedure

12. For Category B projects the Draft Environmental Status report and its summary (SIEE) are reviewed by ADB's Regional Department sector division and Environment and Social Safeguards Division, and by the Executing Agency, and additional comments may be sought from project affected people and other stakeholders. All comments are incorporated in preparing the final documents, which are reviewed by the Executing Agency and the national environmental protection agency (MoEF in this case). The EA then officially submits the IEE and SIEE reports to ADB for consideration by the Board of Directors. Completed reports are made available worldwide by ADB, via the depository library system and the ADB website.

4 Scope of Study

13. This is the IEE report for the Barmer sewerage sanitation subproject. It discusses the generic environmental impacts and mitigation measures relating to the location, design, construction and operation of physical works proposed under this sewerage and sanitation subproject.

II. DESCRIPTION OF THE PROJECT

A. Type, Category and Need

14. This is a sewerage and sanitation sub-project, and as explained above it has been classified by ADB as Category B, because it is not expected to have major negative environmental impacts. Under ADB procedures such projects require an IEE to identify and mitigate the impacts, and to determine whether further study or a more detailed EIA may be required. The sub-project is needed because there is no underground sewage system in Barmer City at present. Only few households have covered individual septic tanks. The disposal of waste and effluent of septic tank is through the open drains. Presently the open drains, which have been constructed by Municipal Board, convey the sludge and sewage which is leading to unhygienic and unsanitary conditions.

15. From the demand gap analysis it is to be concluding that there is comprehensive need of ULB scheme for proper collection and treatment and disposal of sewage in the town. It is also to be seen from demand gap assessment that significant area of land will be required for installation of sewage treatment facilities.

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[1] According to the Rajasthan State Pollution Control Board, the MoEF intends to issue a clarification to the EIA Notification in due course, which will add all landfill facilities and Sewage Treatment Plants to the list of projects specified as requiring EC under the Notification. This has not yet been issued, so the text above indicates the correct legal position at the time of writing

B. Location, Size and Implementation Schedule

16. The sub-project is located in Barmer, the headquarters town of Barmer District, in the western part of Rajasthan **(Figure 2.1).** The infrastructure will extend throughout many parts of the town, where pipes for new secondary and tertiary sewer networks will be buried within or alongside roadways. A new trunk sewer will be buried alongside the Road. There will be a new Sewage Treatment Plant (STP) of 8 MLD to be built on 181.16 Bigha under Khasra no. 395 at village Kundla, Tehsil Barmer **Figure 2.2** shows proposed sewer network and **Figure 2.3** depicts STP location. Environmental features around the STP shows in Survey of India District Map **(Figure 2.4).**

17. Detailed design will begin in the second quarter of 2008 and should be completed by the end of the year. Construction of all elements will begin in early 2009, and the treatment works will be built in around 6 months. Construction of the trunk sewer and networks will take up to 1½ - 2 years, so all work should be completed by the middle of 2010. Photographs of the project area are attached as **Appendix II - A**

C. Present Situation and Description of the Sub-Project

1 Present Situation

18. Through continued endeavor by Urban Local Body and the State Government, about 60% dry latrines of the town Barmer has already been converted into sanitary flushed latrines connected to septic tank. The general drainage of town is through open drains in the town Barmer. Some soak pits of shallow depth and inadequate size are also in existence. These soak pits do not function properly and after some time is overflowing. Effluent from septic tank also flows directly in the road side drains.

19. The town is fairly densely populated. Out of 35 municipal wards, population density is more than 100 persons per hectare in at least 16 wards. Under the subproject, it is proposed to cover a population a 2001 population of 56873 as of 2001 in an area of 1147 hectares encompassing 31 municipal wards. However, all these wards are not proposed to be covered by total collection system including branches and laterals and will be provided with trunk and interceptor sewers. Branch and lateral sewers will be provided in 12 of the above 31 wards, where necessary facilities for house connections will also be provided under the subproject. These 12 wards are ward nos. 1, 2, 21to 24 and 31, 33 to 35. Out of these 12 wards, ward 25 and ward 32 will be partially covered and all the other 10 wards will be fully covered in an area of 711 hectares with 2001 population of 23, 378. In the other 19 wards the downstream works, including house connections, are expected to be completed gradually by ULB either from their own fund or through other funding. However, under the Subproject the drains carrying sullage and even partially treated sewage will be intercepted and connected to trunk/ interceptor sewers and will be conveyed to the STP proposed.

2 Description of Sub-project Including Details Scope

20. Barmer town is located in south western part of Rajasthan in the Thar Desert at the junction of 25°45’ north latitude and 71°22’ East longitude at an altitude of 250 meters above mean sea level. It is the border town of Western India and is located on National High-way No. 15, which connects it with Ahmedabad in the south & Jaisalmer, Bikaner and GangaNagar in the North. It is about 209 Kms. from Jodhpur and 550 Kms from Jaipur. It has got a rail connection from Jodhpur via Samdari, State Highway No. 16 Connects this town with

Jodhpur.The site on which the town stands is of great significance in its natural setting. The old town was established on the eastern side of a hillock, which provided natural protection against the westerly sand storms. Its has a gradual slope towards south and the old town was located in a river valley namely 'khagal'. This locational advantage made this town to grow and prosper throughout its history.

21. The town Barmer of 19.64 sq.km (1964 hectare) area comprises 35 wards having a population of 83,591 as per 2001 census and present (2008) estimated population of 95,408. the town is expected to have a per capita net water supply of 135 litres per day from the present supply of 60 lpcd.

22. Twelve wards (1,2,21 to 24,31,33,34,35 fully covered and 25 & 32 partially covered),comprising areas such as Khagai mohalla, Mahaveer Pura, Subhash Chock, Gandhi circle, area around Agarwal Bhawan, Ram Dev Satsang Bhawan, Fadiya Chock, Dak Ghar, Panch Murthy Temple, Major Veer Singh Marg, Joshiyon Ka Samshan, Market area, Rabriyon Ka Bas, Lakshmi Nagar and Vivekanand Circle have been considered as priority area to be fully covered under sewerage system. The balance 19 wards shall be provided with trunks and Interceptors as earlier discussed.

23. The sewer network now proposed will comprise construction of 8 MLD sewage treatment plant (with waste stabilization pond process), laying of Trunk main sewer line dia varying from 700mm to 900mm, 5.9 km and laterals sewers dia varying from 200-mm to 600mm, 32.49 km. For house service connection it has been proposed 110&160mm OD uPVC pipes (4 to 6 per manholes). The house service connection is normally to the manholes. However, provisions for required numbers. of road side chambers are also made which, if required, shall be used in wide roads for ease in construction and maintenance where 2 or 3 House service connections (HSC) shall be to Road side Chamber (RSC) and RSCs will be in turn connected with manholes. Also provision has been made in the cost estimate for dismantling cum refilling the septic tank / soak pit utilities for those who do not find space for effecting a separate connection.

24. The collection system is designed for waste water volume to be generated for the projected population of 2041. Per capita waste water generation is considered as 80% of the net water supply of 135 lpcd. Peak factor has been considered to design the sewer lines. Minimum velocity of 0.6 m/ sec to achieve self cleansing and maximum velocity of 2.5 m/ sec to avoid possible scouring have been considered for design purposes. For all the component designs standard design criteria and practices have been adopted. Minimum cover is 0.9 m. Provision of manholes at suitable intervals is also considered.

25. **Table 2.1** shows the nature and size of the various components of the subproject. As indicated above there are three main elements: provision of a network to collect sewage from different city part; a trunk sewer to transport waste to the STP; and a new STP to treat sewage to Indian urban standards. The descriptions shown in **Table 2.1** are based on the present proposals, which are expected to be substantially correct, although certain details may change as development of the subproject progresses.

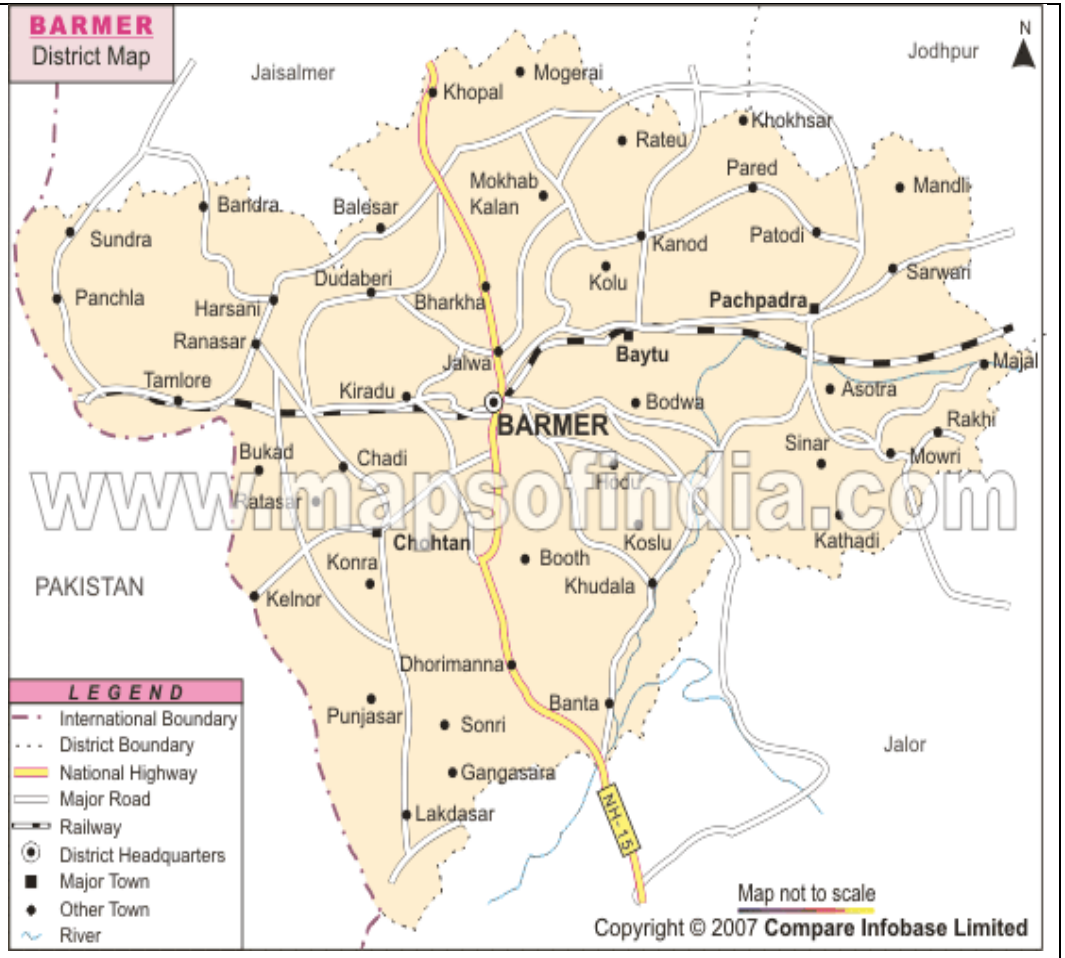
26. Under Tranche-II, works of the STP (which will be of approx.8.0 MLD capacity in 1st phase and can be increased in phase manner) will be constructed comprising of secondary treatment by Conventional WSP and Sewerage Network of pipe line in the main old town including out fall and Trunk sewer, Laterals and house connection. Under Tranche-II, the work for sewerage network for the city including laying of Laterals and sewer lines in surrounding

developed areas of the town and house connections to be considered. Land identified for STP to an extent of 181 bigha and in the process of acquisition by PHED, Barmer

27. The network pipes (32.49 km) will be of Reinforced Cement Concrete (RCC), and will be located alongside roads and streets, in the government-owned Right of Way (ROW). The secondary and tertiary network will collect sewage from individual houses have a sufficient water supply, These pipes will be of small diameter (200 to 600 mm) and will be located in shallow trenches (ca 1.5 m in depth).

28. The trunk/outfall sewer of 5.9 km will also be of RCC pipes and will convey sewage from the secondary network to the STP. These pipes will be 700 and 900 mm in diameter has been finalised.

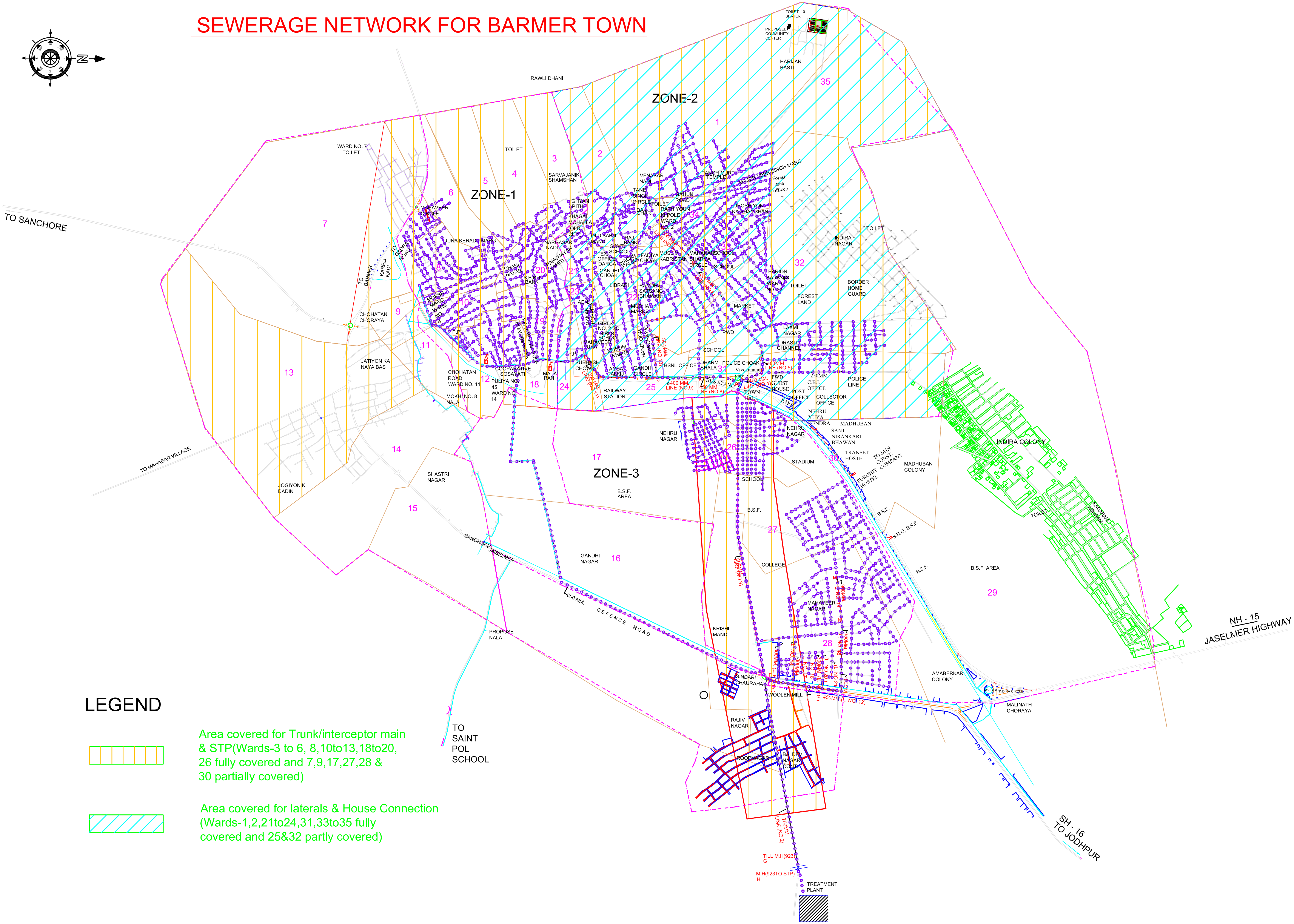
Figure 2.1: Location of Project Area



Rajasthan Urban Sector Development Investment Program ADB TA 4814-IND	**Govt of Rajasthan Asian Development Bank**
Barmer Regional Map	

Figure 2.2: Proposed Sewerage System - Sewer Layout and Trunk Main Routing

SEWERAGE NETWORK FOR BARMER TOWN

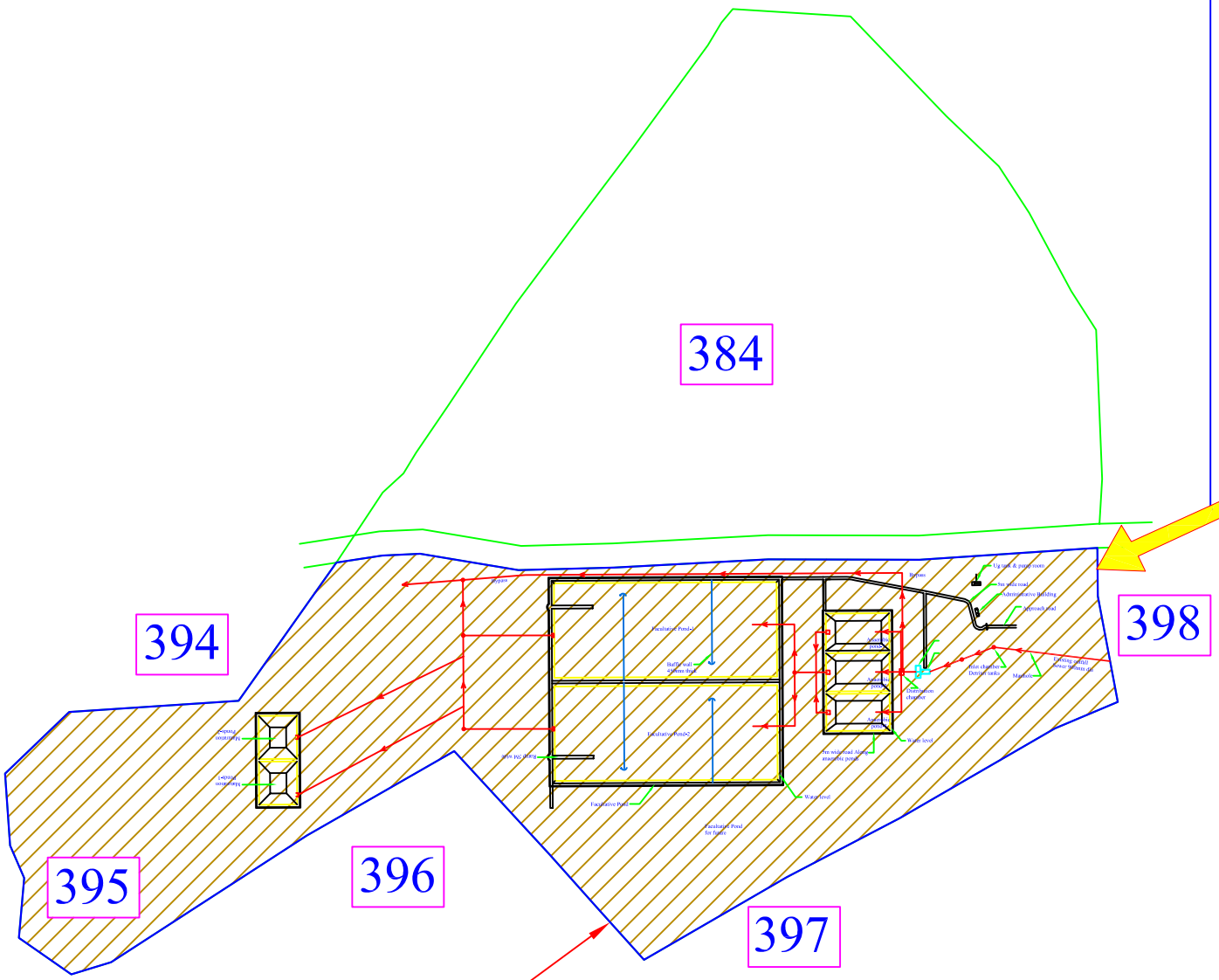


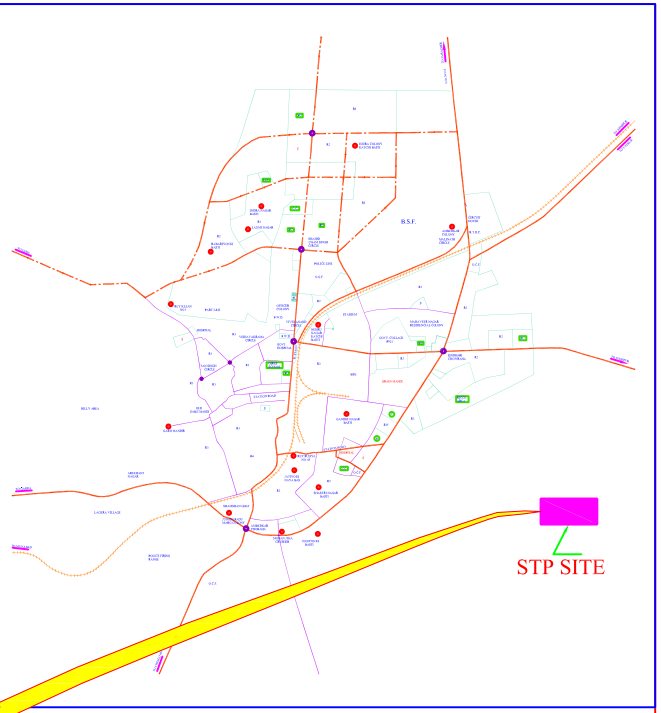
LEGEND

Area covered for Trunk/interceptor main & STP(Wards-3 to 6, 8,10to13,18to20, 26 fully covered and 7,9,17,27,28 & 30 partially covered)

Area covered for laterals & House Connection (Wards-1,2,21to24,31,33to35 fully covered and 25&32 partly covered)

Figure 2.3: Location of Sewage Treatment Plant Site





LEGEND:-

- RAILWAY STATION AND YARD
- NATIONAL HIGHWAY
- STATE HIGHWAY AND OTHER ARTERIAL ROADS
- SUB ARTERIAL ROAD
- MAJOR ROAD
- OTHER IMPORTANT ROAD
- ROAD JUNCTIONS
- SLUMS(KATCHI BASTI)
- STP SITE

RUSDIP(BARMER)	RAJASTHAN URBAN SECTOR DEVELOPMENT INVESTMENT PROGRAM	
SECTOR:-	TITLE:- PROPOSED STP SITE	
CONTENT:- CLIP DRAWING	DRAWING NO. RUSDIP/BAR/01	R0
	DRAWN BY:- R.KRISHNA	APPROVED BY:-
	DATE:- MAR-2008	SCALE:- NOT TO SCALE

Figure 2.4: Sewage Treatment Plant shown in District Map

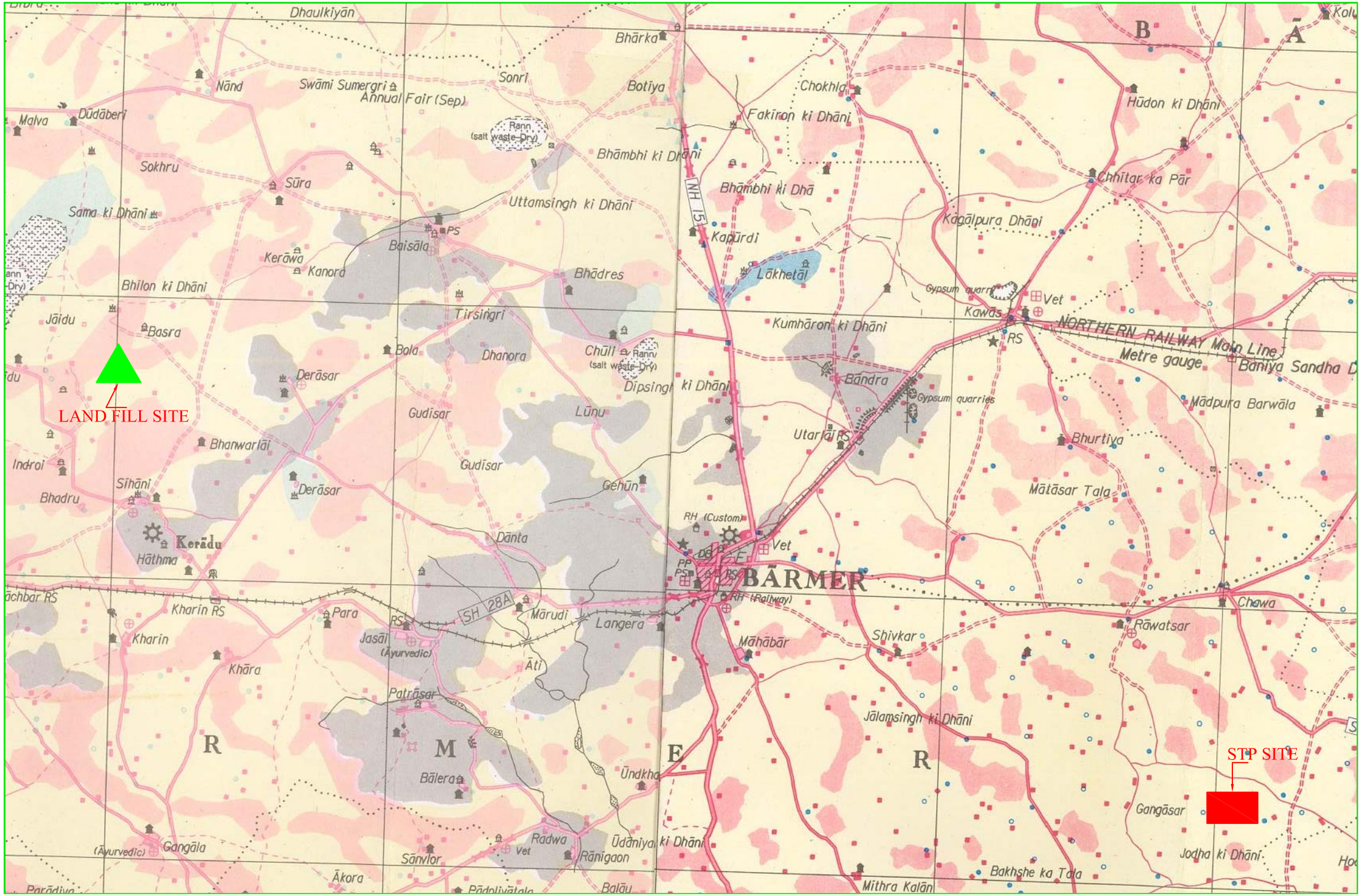

LAND FILL SITE
STP SITE
BĀRMER
Dhaulkiyān
Bhārka
Nānd
Swāmi Sumergri
Annual Fair (Sep)
Sonri
Botīya
Malva
Dūdāberi
Rann
(salt waste-Dry)
Sokhru
Sūra
Bhāmbhi ki Dhāni
Sama ki Dhāni
Uttamsingh ki Dhāni
PS
Baisāla
Kerāwa
Kanora
Bhādres
Bhilon ki Dhāni
Jāidu
Basra
Tirsingri
Bola
Dhanora
Chūll
Rann
(salt waste-Dry)
Derāsar
Dipsingh ki Dhāni
Gudisar
Lūnu
Bhanwarlāi
Indroi
Sihāni
Bhadru
Derāsar
Gehūn
Kerādu
Hāthma
Dānta
RH (Custom)
Vet
PP
PS
RS
RH (Railway)
Kharin RS
Kharin
Para
RS
SH 28A
Jasāi
(Āyurvedic)
Mārudi
Langera
Khāra
Āti
Patrāsar
R
M
Bālera
Ūndkha
Gangāla
(Āyurvedic)
Sānvlor
Radwa
Vet
Rānigaon
Ūdāniya ki Dhāni
Ākora
Pādaliyātala
Balāu
Parādiya
Fakiron ki Dhāni
Bhāmbhi ki Dhā
NH 15
Kapūrdi
Lākhetāl
Chokhla
Hūdon ki Dhāni
Chhītar ka Pār
Kagālpura Dhāni
Gypsum quarry
Vet
Kawās
RS
NORTHERN RAILWAY Main Line
Metre gauge
Baniya Sandha D
Kumhāron ki Dhāni
Bāndra
Gypsum quarries
Utarlai RS
Mādpura Barwāla
Bhurtiya
Mātāsar Tala
Chawa
Rāwatsar
Shivkar
Māhābār
Jālamsingh ki Dhāni
E
R
Gangāsar
Jodha ki Dhāni
Bakhshe ka Tala
Mithra Kalān
B
Ā

Table 2.1: Improvements in Sewerage Infrastructure Proposed in Barmer

Infrastructure	Function	Description	Location
Sewage Treatment Plant (STP)	For treatment of Raw Sewage.	8 MLD STP waste stabilization pond type proposed for short term assessment and capacity could be increased in Phase manner WSP includes 2 numbers (nos.) of anaerobic ponds, 2 nos. facultative stabilization ponds, 1 pump sump , 1 no. inlet chamber, 1 no. screen chamber, 1 grit chamber, 1 no. sump, 1 no. measurement channel, 3 nos. distribution box, 4 nos. outlet chamber	Land identified of total 181.16 Bigha under Khasra no. 395 at village Kundla, Tehsil Barmer.
Trunk Sewer	To connect collection network with STP	Trunk main sewer line dia. varying from 700mm to 900mm, 5.9 km	From village Kundla
Lateral (Secondary) Sewers and tertiary network and house connection	Different dia. of sewer network and to connect with outfall sewer.	Approx. 32.49 km. length of 200 to 600 dia. Sewer line.	Different locations

III. DESCRIPTION OF THE ENVIRONMENT

A. Physical Resources

1. Location

29. The Urban Agglomeration (UA) of Barmer district is located about 565 km from Jaipur. Barmer district is situated in the western part of Rajasthan and forms part of the Thar desert. It is surrounded by Jaisalmer in the north, Jalore in the south, Pali and Jodhpur in the east and Pakistan in the west. It is about 887 kms from Delhi, 565 kms from Jaipur. The nearest Airport is at Jodhpur.

30. The total area of the city is 10.29 sq. km. Barmer city is the administrative headquarter of the district. The district is divided into two sub-divisions viz., Barmer and Balotra. The district has 3 municipalities, 8 panchayat samitis, 225 gram panchayats, 1,640 revenue villages and 853 inhabited villages. District map of Barmer is shown in **Figure 3.1**.

2. Topography, Natural Hazard and Drought

31. **Topography** Barmer is the district headquarter. It is located at 25°45' North latitude and longitude 71°22' East longitude, at a height of about 250 meters above the mean sea level.

32. **Natural Hazards-** Earthquake: Barmer town lies in medium to high risk zone (III and IV). The area is prone to earthquakes as it is located on comparatively unstable geological plains based on evaluation of the available earthquake zone information. Figure 3.2 depicts the earthquake zones of Rajasthan. Figure 3.3 shows natural hazard zones of the Barmer district.

33. **Drought:** Low rainfall coupled with erratic behaviour of the monsoon in the State makes Rajasthan the most vulnerable to drought. Based upon the discussion with PHED officials the water table in the City continuously decreases by 4-5 meter on an annual basis combined with significant drawdown conditions.

Figure 3.1: District Map of Barmer

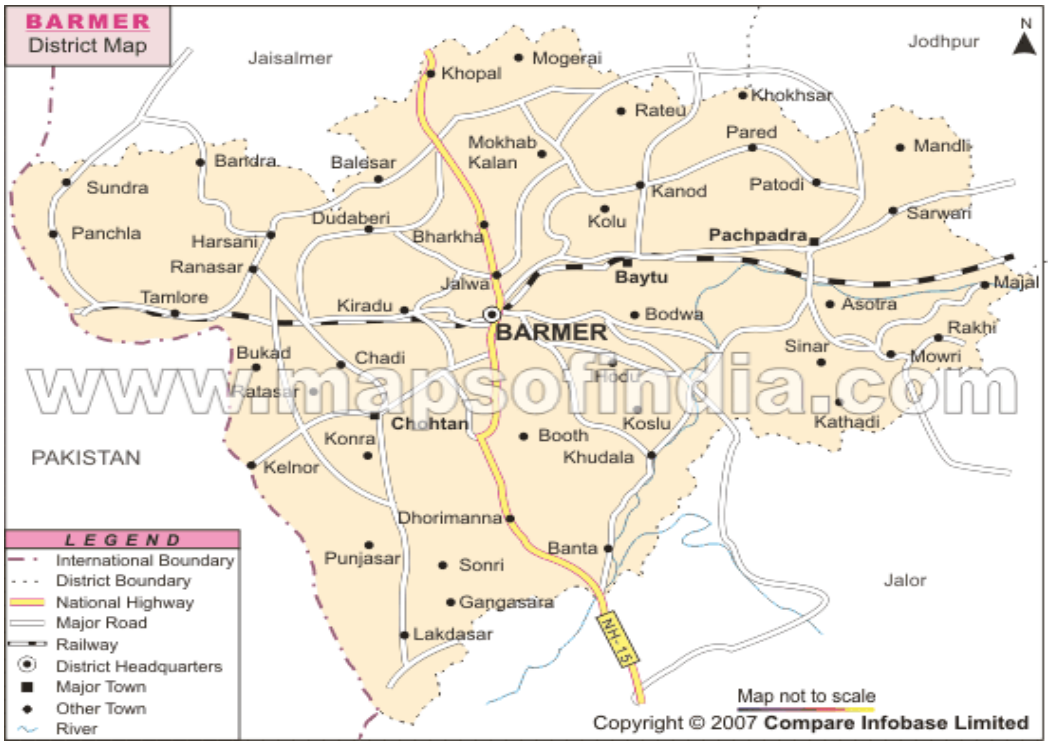


Figure 3.2: Earthquake Zones of Rajasthan

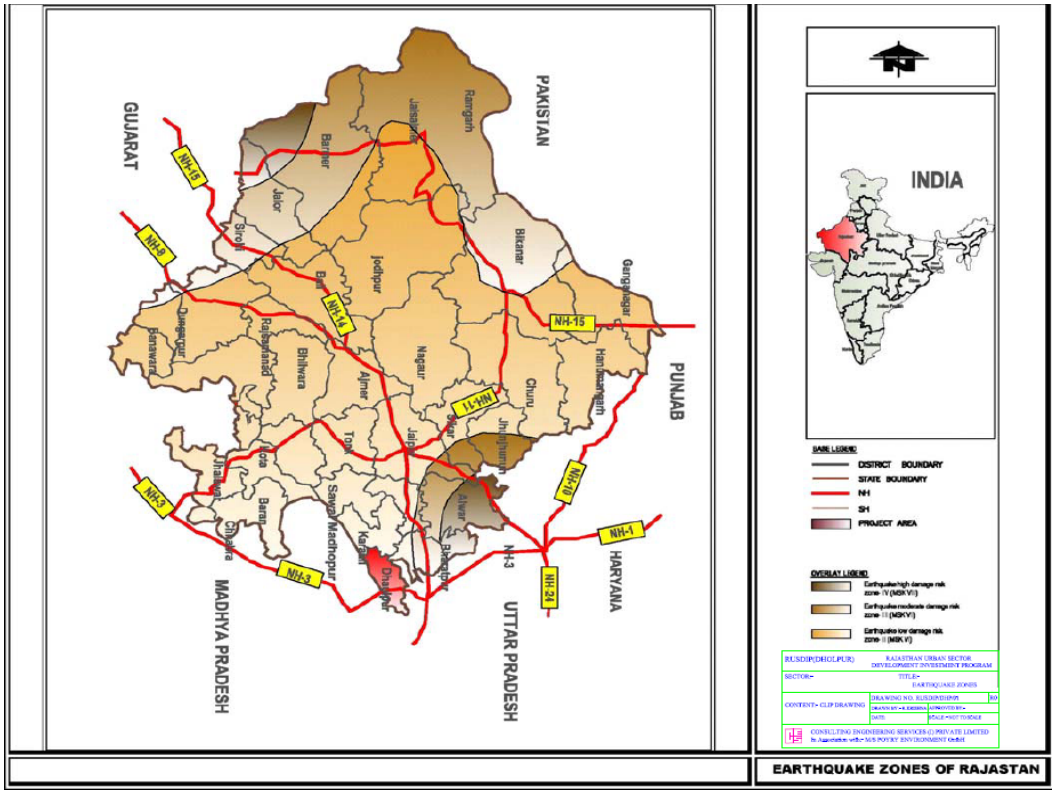
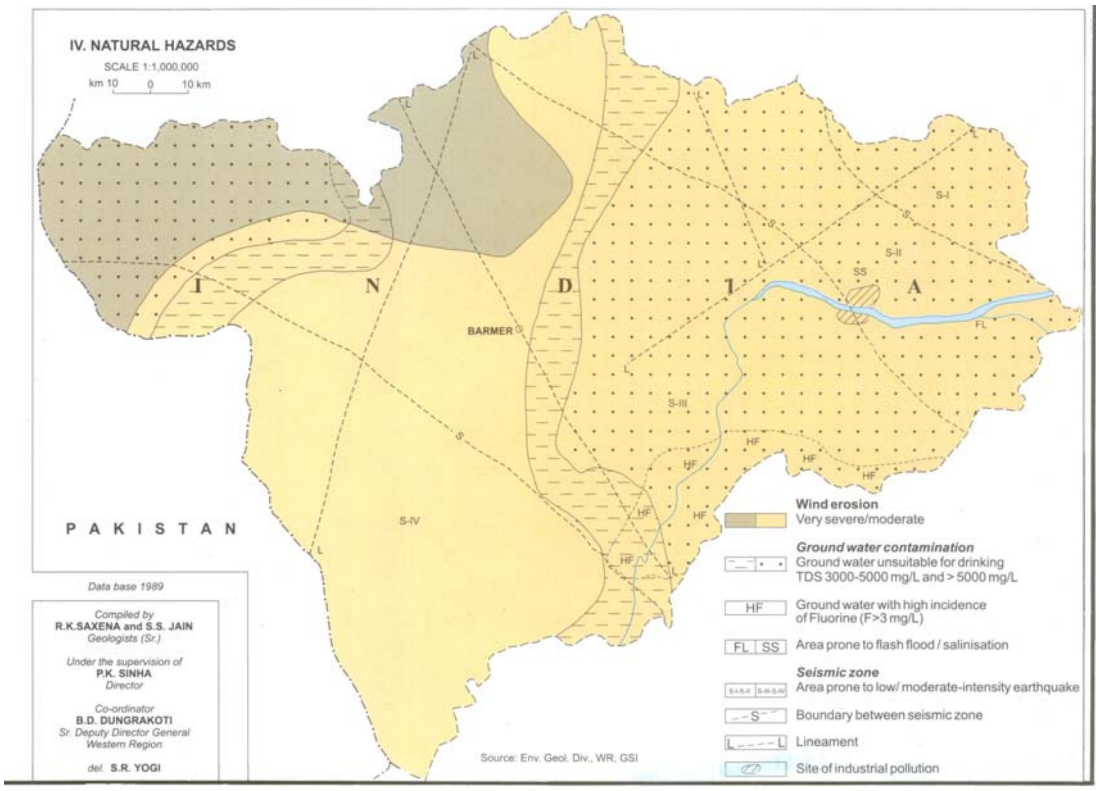


Figure 3.3: Natural Hazard Map of Barmer (GSI Resource Map)



3. Geology, Geomorphology, Mineral Resources and Soil

34. Barmer district is situated in the western part of the state, bordering Pakistan. It occupies the area of 28,287 km^2. Shiv, Baytu, Pachpadra, Barmer, Chauhtan, Siwana and Gudha Malani are the seven Tehsil in the district. The ephemeral Luni and Sukri rivers drains the eastern and southern part of the district. The district is having arid climate with average annual rainfall in the district is 27cm.

35. The district forming the part of the 'Thar desert' is mostly covered by Aeolian sand. The area however exposes a variety of rock types ranging in age from upper Proterozoic to Quaternary. The pre- Malani ligneous Suit comprise volcanic phase (rhyolite, agglomerate tuff), plutonic phase (granite) and dyke phase rhyolite, felsites, prophyrite,basalt). The Malani volcanic are dominated by acid volcanic flows. Three phases of acid volcanism, seprated from each other by pyroclastic material, have been identified. The Birmania formation comprising limestone, chert, shale, sandstone, (Upper Proterzoic) overlite the Malani rocks the overlying Lathi formation (Jurassic) is represented by sandstone, siltstone, conglomerate and pockets of clay. Over most part of the area they are covered by Quaternary sediments and could be seen in dug well section. The Fategarh formation uncomfortably overlying the Lathi sandstone comprises sequences of conglomerate, gritty sandstone. phosphalic sandstone, siltstone and bentonite Outliers of the Fategarh Formation are also seen around Sarnu. The emplacement of

alkaline suite of rocks (alkali olivine basalt, hawaiite, trachyte, trachyandesite. syenite) within the Malanis. in the area around Sarnu and Dandali marks another magnetic phase The Tertiary sequence, overlying the Fatehgarh Formation is represented by ihe Akli the Mandai and the Kapurdi Formations. The Akli Formation consisting of argrillaceous sandstone, lignite, bentonic clay grades upward into the arenaceous Mandai Formation which includes conglomerate, sandstone, etc. The Kapurdi Formation (Eocene) consists mainly of Fuller's earth, variegated clay and ferruginous and gypseous concretions. The Bandah Formation consisting of friable and variegated sandstone and clay, seen in the western part of the district, is considered time equivalent of the Kapurdi Formation.

36. The Phalsund and Shumar Formation (Pleistocene age) comprising grit, conglomerate, iron stone, pebble spread etc occur in isolated patches at several places. Quaternary sediments of aeolian and fiuvial phases conceal the older formations and cover large part of the district.

37. Geomorphologically, the district is classified into seven geomorphic units, namely, alluvial plain, obstacle dune, complex / composite dune, parabolic dune, sand sheet, rocky desert and denudational hill Geohydrologically, the district is classified into three hydrological domains (unconsolidated alluvium and pebble; semi consolidated formations; and consolidated fissured formations) with ground water potential ranging from <10 to 100 LPS. Natural hazards include mainly wind erosion which is moderate to very severe.

38. Mineral resources: The district abounds in mineral resources of bentonite, China clay, fuller’s earth, glass sand, lignite phosphorus, salt, vermiculite and Kankar. Benotonitic clay deposits swelling and non – swelling type are reported from Akli, Amba Bari, Bisu Kalan, Gunga, Narguida, Khoral, Shiv, Thumbli, Sonri, Bhadres, Jalipa, and Mahabar, with the total of 7.15 million tones of proved reserves. China clay beds, up to 2.4 m in thickness occur near Gunga, Nimla and Botiya. Fuller’s earth deposits are located around Bharka, Kaprudi, Botiya. Gypsum occurrences are reported from. Talsar, mith ka Tala, Binjkasar, Mithrau, Uttarlai, Kawas and Shivkar. Glass sand are suitable for glass industries are reported from Shiv. Lignite occurrences (from Mandai Formation) are reported from Kapurdi, Jalipa, Thumbli and Bharka areas. Mineral Exploration Corporation Limited estimated reserves of about 200 million tones form Kapurdi – Jalipa area. Phosphorite horizon, 1 to 4 m thick, Comprising oolite, pellet, replaced fossil shell, is traceable from Bhiyar to Dharavi Khurd with 5.25 % P_2O_5 contents. Salt deposit are found around Pachpadra. Vermiculite has been reported from (west of) Simaliya. Kankar occurrences are reported from Saro – ki – Dhani, Kashmir, Redwali, salariya etc. where they are locally used as road material. Malani granite and rhyolite are extensively quarried for use as construction material near Mokalsar, Pataudi, Dharimanna, etc. They also possess vast reserves of road metal and railway ballast.

39. Geology and mineral map of the district is shown in **Figure 3.4** and geomorpholigal map of the district is depicted in **Figure 3.5.**

Figure 3.4: Geology and Mineral Map of Barmer District (Source: GSI Resource Map)

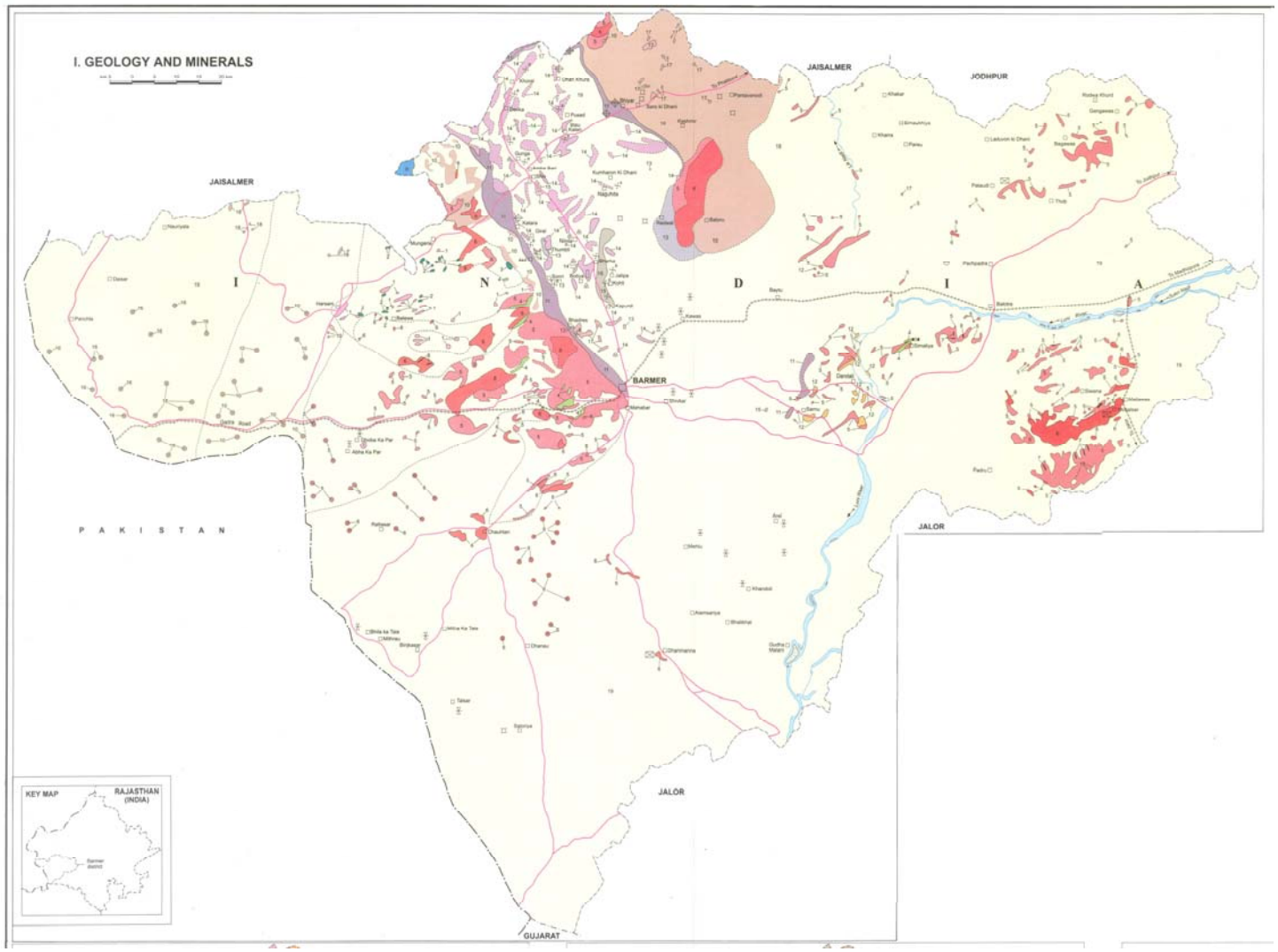
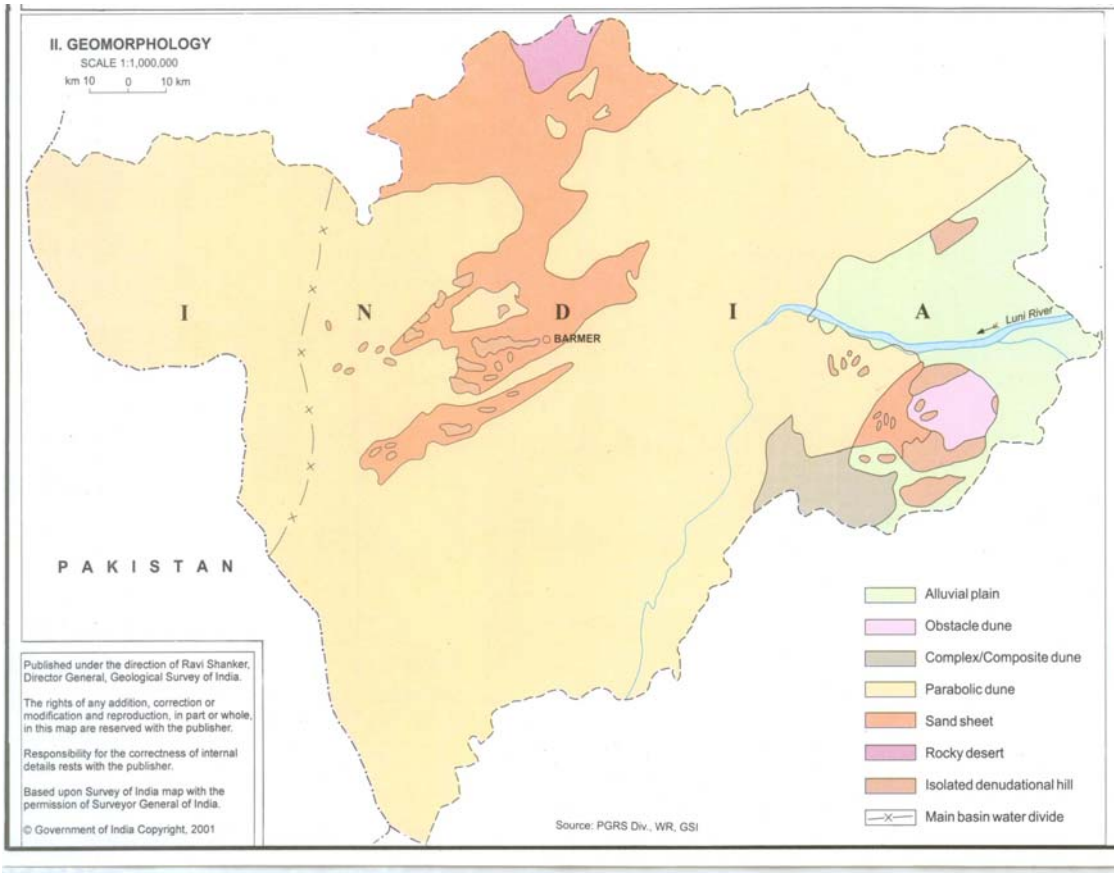


Figure 3.5: Geomorphology of Barmer District (Source: GSI Resource Map)



40. Soil characteristics: Soil of the region falls within low rainfall zone of 200- 400 mm. The soil is generally desert type and sand dunes. Specifically soil is aeolian, coarse sand in texture and some places calcareous. Table 3.1 shows nutrient level in the Barmer soil including area coverage of sodic soil. The nutrient status of the Barmer soil is graded as very low to medium level.

Table 3.1: Fertility Status – Major Nutrients and Problematic Soils of Barmer district

Item	Nutrient			Saline Soil(Ha)	Sodic or Alkali(Ha)
	N	P	K		
Status	VL	M	M	-	1989

(Source: Vital Agricultural Statistics 2004-05, Directorate of Agriculture, Rajasthan)

4. Climate

41. The temperature of Barmer varies between minimum of 9 degrees celsius to the maximum of 45 degrees celsius. The normal rainfall is 27.75 cms. .

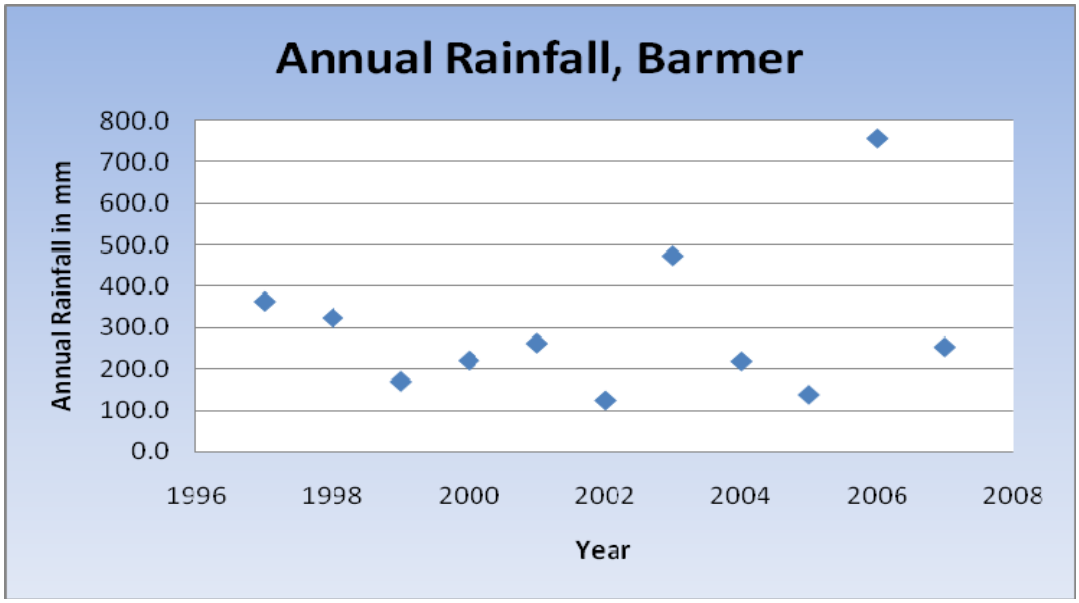
42. The rainfall over Barmer is scanty and is concentrated over four month i.e. from June to September. The rains are erratic and so is the distribution of the rainfall. However agriculture and the animal wealth are dependent on rains to large extent. Seasonal Rainfall data for the recent year (2005-2006) is shown in **Table 3.2. Figure 3.6** shows yearly variation (1997-2007) of rainfall at Barmer.

Table 3.2: Rainfall at Barmer in Recent Years (2005-06)

S.No.	Months	Rainfall (mm)
1	June	12
2	July	20
3	August	42
4	September	38
5	October	0
6	November	0
7	December	0
8	January	0
9	February	0
10	March	44
11	April	1
12	May	0
13	**Monsoon Rainfall**	**112**
14	**Non monsoon rainfall**	**45**
15	**Annual Rainfall**	**157**

(Source: Irrigation Department, Govt. of Rajasthan)

Figure 3.6: Rainfall at Barmer During 1997 to 2007



Source: Deputy Director hydrology water resources ID and R, Jaipur

5. Air Quality

43. There are no data on ambient air quality of Barmer Town, which is not subject to monitoring by the Rajasthan State Pollution Control Board (RPCB) as there are no major industries. The nearest station is located at Jodhpur (222 km from Jodhpur). Traffic is the only significant pollutant in Barmer, so levels of oxides of sulphur and nitrogen are likely to be well within the National Ambient Air Quality Standards (NAAQS). The ambient air quality data is depicted in **Table 3.3.**

Table 3.3: Ambient Air Quality in Jodhpur (Annual Average, 2004; units in µG/M^3)

Monitoring Station	Land use	SOx	NOx	RSPM	SPM
Jodhpur Residential, Rural and others area	Residential	8.05	19.58	118	357
NAAQ Standard	Residential	60	60	60	140
Jodhpur Industrial area	Industrial	7.98	19.68	111	340
NAAQ Standard	Industrial	80	80	120	360

RSPM: Respirable Suspended Particulate Matter; SPM: Suspended Particulate Matter
Source: Annual Report 2005-2006 Rajasthan State Pollution Control Board

6. Surface Water

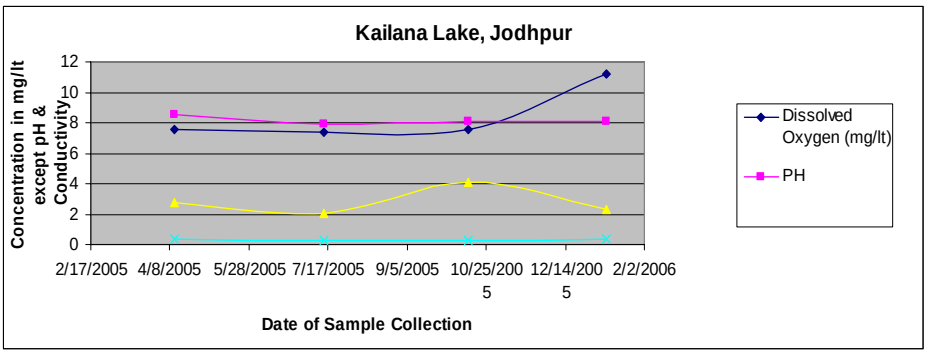
44. There is no water quality monitoring station at Barmer. The Kailana lake is located at Jodhpur district, 222 km from Barmer. The monitoring has been carried out by Rajasthan Pollution Control Board at Kailana lake. The data on DO, pH, BOD and Electrical conductivity is given in **Table 3.4.** During 2005 to 2006 DO, pH and BOD ranged from7.4– 11.2 mg/l, 7.88 – 8.56 and 2.02 – 4.09 mg/l respectively.

Table 3.4: Kailana Lake Water Quality, Jodhpur

Date of Sample Collection	Dissolved Oxygen (mg/lt)	P^H	BOD (mg/lt) (3 days at 27^o C)	Conductivity at 25^o C (m-MHO)
4/11/2005	7.6	8.56	2.75	0.4
7/14/2005	7.4	7.88	2.02	0.26
10/14/2005	7.6	8.05	4.09	0.29
1/9/2006	11.2	8.05	2.3	0.33

Source: Annual Report 2005-2006 Rajasthan State Pollution Control Board

Figure 3.7: Variation of Water Quality Parameters



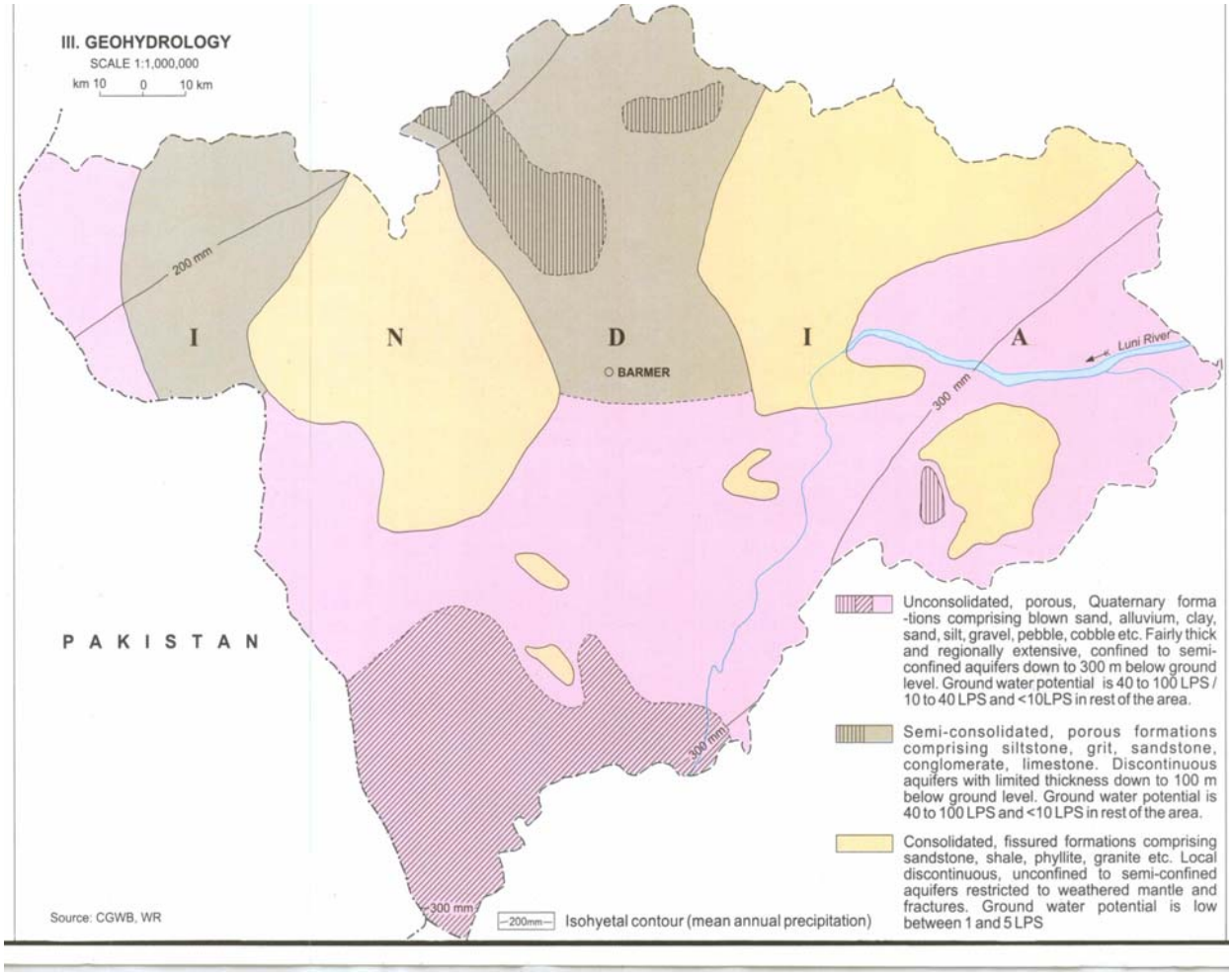
7. Geohydrology and Groundwater

45. Geohydrological map of the Barmer district is shown in **Figure 3.8.** For broadly grouping geological formations from ground water occurrence and movement considerations, the various lithological units have been classified into three groups on the basis of their degree of consolidation and related parameters. These are,

- Unconsolidated porous, quaternary formation
- Semi consolidated porous formation
- Fissured formations – consolidated sedimentary rocks.

46. On an average 60-70 % of the district area (mostly south and eastern part of the district) covered with unconsolidated porous formations.

Figure 3.8: Geohydrological Map of Barmer (Source: GSI Resource map)



47. There are number of National Hydrographic monitoring stations of Central Ground Water Board in and around Barmer. Fluctuation of ground water level is shown in **Table 3.5.** In most of the cases ground water table ranged between 20-60 m bgl.

Table 3.5: Number and Percentage of National Hydograph Network Station (Barmer) with Water Fluctuation Range

Period	No of wells analyzed	Range		0-2 m		2-5 m		5-10m		10-20m		20-60m		>60 m	
		Min	Max	No	%	No	%	No	%	No	%	No	%	No	%
Jan-06	58	5.13	76.55	0	0	0	0	9	15.52	11	18.97	31	53.45	7	12.07
Nov-05	58	5.49	76.5	0	0	0	0	9	15.52	11	18.97	31	53.45	7	12.07
Aug-05	58	5.45	101.24	0	0	0	0	10	17.24	11	18.97	33	56.9	6	10.34
May-05	59	5.67	76.5	0	0	0	0	9	15.25	10	16.95	34	57.63	6	10.34

Source: Ground water year book 2005-06 Rajasthan, Central Ground Water Board, Jaipur (2007)

48. The Central Ground Water Board carried out chemical testing of tube well water seasonally. The average concentrations of major constituents are shown in **Table 3.6**.

Table 3.6: Ground Water Quality In and Around Barmer

Parameters	Maximum Level	Minimum Level	Standard of Drinking water (IS: 10500: 1991)	
			Desirable limit (mg/l)	Maximum Permissible limit (mg/l)
pH	8.7	7.45		
EC (micro-mhos/cm at 25 °C)	17520	835		
Cl (mg/l)	8130	50	250	1000
SO_4(mg/l)	1825	20	200	400 (if Mg does not exceeds 30 ppm)
NO_3(mg/l)	745	0	-	100
PO_4(mg/l)	0.44	0		
Total Hardness(mg/l)	3060	70	300	600
Ca(mg/l)	412	4	75	200
Mg(mg/l)	554	5	30	100
Na(mg/l)	4750	4	-	-
K(mg/l)	125	1	-	-
F(mg/l)	5.34	0.36	1.0	1.5
Fe(mg/l)	3.18	0	0.3	1.0
SiO_2(mg/l)	56	12		
TDS (mg/l)	11388	543	500	2000

Note: Total – 18 nos. samples

Source: Ground water year book 2005-06 Rajasthan, Central Ground Water Board, Jaipur (2007)

49. As per PHED TDS level is more than 2020 mg/l and Fluoride between 1.4 to 1.7 mg/l. Groundwater quality of Barmer city is not in conformity with the set norms of Government of Rajasthan. Consumption of this high fluoride content has resulted in bone deformity and joint pains (as evident from Public perception).

Table 3.7: Present Supply Water Quality at Barmer

Total supply per day (lac liter)	Type of Sources Surface / Ground	Ground	Surface	No. of CWR	No. of SR	F^- Min	F^- Max	TDS Min	TDS Max	NO_3^- Min	NO_3^- Max
16	**Ground**	**100**	**0**	**9**	**7**	**1.9**	**2.2**	**2020**	**2460**	**10**	**10**

B. Ecological Resources

50. Barmer Town is, surrounded by a harsh desert environment of wind-blown sand and dunes. The municipal area includes large swathes of uninhabited rocky hills and sand dunes, with alluvial soil and sand in the intervening valleys, which are cultivated where there is enough rain. Natural vegetation is very limited, and consists of mainly sparse, scattered shrubs and grasses The fauna of the town comprises mainly domesticated animals (camels, cows, goats, pigs and chickens), plus other species able to live close to man (urban birds, rodents and some insects). In the desert away from the inhabited area there is a more natural fauna, which includes hyaenas (*Hyaena hyaena*), desert fox (*Vulpes pusilla*), jackal (*Conis aures*) and chinkara gazelle (*Gazella gazella pallas*).

51. There is no forest area nearby the city. Therefore no endangered floral and faunal species are expected.

C. Economic Development

52. Barmer being a desert district generally faces famines & drought. The bulk of population depends upon agriculture & animal husbandry. Being district headquarter, Barmer town is the main regional centre for the entire district and is working as service centre for providing services like trade and commerce, transport, commercial and other higher level public facilities for the entire district.

53. The economic condition of people in Barmer is not satisfactory. As per information in 1998 about 28% population comprised of families below poverty line. These people are mostly labour class working in industries, shops, restaurant, construction, transport and certain other. This aspect has to be given due consideration while designing the housing projects.

54. Work force: In 1991 the total working force was 17,943, which was 26.15% of total population. In 2001 the total workers were 24,360, which was about 29.14% of total population. Out of the total workers 21,871 were main workers and 2560 marginal workers. The male workers participation rate was 48.41% while in the case of females 6.5% were workers.

55. The occupational structure as per 2001 census is assessed as follows:

Table 3.8: Distribution of Work Force 2001

Category		Numbers	% of Total
Main Workers	Male	20,419	93.67
	Female	1,381	6.33
	Total	**21,800**	**100.00**
Marginal Workers	Male	1452	56.72
	Female	1108	43.28
	Total	**2,560**	**100.00**
Total Workers	Male	21,871	89.78
	Female	2,489	10.22
	Total	**24,360**	**100.00**

56. The occupational structure data for 2001 census has not been given in category wise details. Therefore, 2001 occupational data are based on estimates of data for 1971 to 1991 census. The economic structure of the town is associated with the regional character. Being the seat of district administration, about 31% of the total workers are employed in other services

category. Trade and commerce is the next important function where 28.5% workers are engaged. Barmer is also a centre of household and small industries like furniture making and dying and printing. About 21% workers are employed in various industrial units. It is also a transport terminus and 7.5% workers are engaged in this activity. The agriculture and allied activities also provide employment to about 4.5% workers. The following table and figure shows the occupational structure of the total population in 1981 to 2001.

Table 3.9: Occupational Structure of Barmer Town

S. No.	Occupation	1981		1991		2001	
		Persons	% of Total Workers	Persons	% of Total Workers	Persons	% of Total Workers
1.	Agriculture and allied activities	1238	7.85	981	5.47	609	2.50
2.	Industry	2998	19.02	3734	20.81	5480	22.50
3.	Trade and Commerce	3348	21.24	4909	27.36	6943	28.50
4.	Construction	726	4.61	1424	7.94	1949	8.00
5.	Transport and Communication	1108	7.03	1276	7.11	1827	7.50
6.	Other service	6343	40.25	5619	31.32	7552	31.00
	Total	**15761**	**100.00**	**17943**	**100.00**	**24360**	**100.00**

Source: Census of India and estimates

57. **Power status of the area:** There is no power generation unit at Barmer. The consumption of electricity by different sectors is shown in Table below.

Table 3.10: Consumption of Electricity in Million Kwh (2003-04)

District	Domestic	Non- Domestic (Commercial)	Industrial	Public Lighting	Public Water Works	District	Domestic
			Small	Medium	Large		
Barmer	39.833	15.172	8.41	22.326	3.20	1.566	44.137

(Source: District Statistics Book)

1. Land use

58. The municipal limits of Barmer encompass an area of about 3290 acres, out of which about 2100 acres can be called urban area. The remaining is undeveloped vacant land, forest and hilly. About 130 acres of land contiguous to the municipal limit in the east is also developed urban area. Thus total urban area of Barmer town is 2230 acres. Out of the total urban area, about 1540 acres is developed area, the remaining land is either government land, reserved or vacant land. Residential use is the most dominant urban component, which constitutes about 57.80% of the developed area, which is high in comparison to other towns. This is due to lack of industrial areas, parks and open spaces and other community facilities in the town. The area under public and semi public use comprising educational, medical facilities, public utilities etc. is about 11.36% of developed area. Circulation covers about 18.84% of the total developed area. Table shows the existing land use analysis of Barmer town based on survey conducted in 1985.

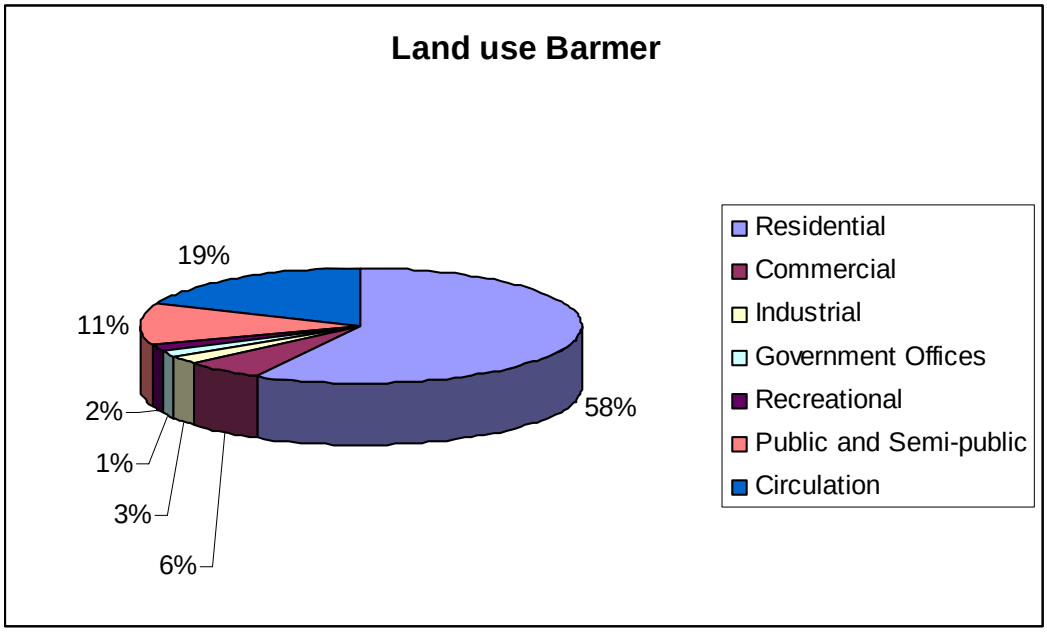
Table 3.11: Land Use of Barmer City – 1985

S.No.	Land use	Area in acres	%
1.	Residential	890	57.79
2.	Commercial	90	5.84
3.	Industrial	40	2.60
4.	Government Offices	20	1.30

S.No.	Land use	Area in acres	%
5.	Recreational	35	2.27
6.	Public and Semi-public	175	11.36
7.	Circulation	290	18.83
	Total Developed Area	**1540**	**100.00**
8.	Government Reserved	370	
9.	Other vacant un-developed land	320	

Source: Town Planning Department

Figure 3.9: Land Use Proportion for Barmer Developed area



59. As per survey it is noted that sewerage network will be passing through residential areas. Therefore impact on sensitive objects is the minimum. Details are discussed in social impact assessment report.

2. Commerce, Industry and Agriculture

60. Most of the business activities are carried out along roads namely station road, Chohtan road, Panghat road, Dhani Bazar, Laxmi Bazar, Sadar Bazar, Ratan Singh Bazar, Subhash Chowk, Gandhi Chowk, Hanumanji Ka Chowk and Pratapji Ki Pole. The business in cloth is generally carried out in Laxmi bazaar. Station road and Ahinsa Chowk constitute the main markets of the town where retail business in cloth, watches, books and stationary and general merchandise is carried out. A small shopping centre has been developed in Mahaveer Nagar residential scheme. Except this scheme new developments generally lack in organised shopping facilities. There is no shopping centre for the localities in the north. Due to this unauthorised construction of shops have taken place in scattered manner, mostly along main roads like NH-15, Defence road and Jodhpur road. A wholesale grain market covering an area of 63 acres has been developed along Defence road. FCI godowns have been built along Jodhpur road. Some warehouses have also been constructed near industrial area.

61. The desertic climatic conditions and lack of infrastructure such as water supply and electricity, industrial development in Barmer town is not very much. As per 1991 census, there were 3734 industrial workers which was about 21% of total workers. There has been increase in workers percentage from 16.7% in 1971 to about 22.5% by 2001. Household industries play a significant role in Barmer and out of the total industrial employments 50% are engaged in household industries. The household industries mostly consist of dying and printing of textile. shoe making, iron goods, black smithy, woollen carpet etc.

62. In RIICO industrial area, out of 271 plots in 240 plots industrial units are functioning mostly dealing with guar gum, gypsum, bentonite powder, iron and steel utensils, dying and printing of cotton textile. The industrial prospects of the town are brighter in view of availability of water from IGNP and power supply from recent petroleum / gas investigations.

63. In and around the Barmer city area there are about 80% of lands used for agricultural purpose. Crop production statistics as depicted in **Table 3.12** indicates more crop production at Kharif season in compared to Rabi season.

Table 3.12: Crop Production in Around Barmer

Type of Crops	Under Rabi Crops 2003-04 (Prod in Tonnes)	Under Kharif Crops 2003-04 (Prod in Tonnes)
Cereals	20199	564907
Pulses	602	251777
Food Grains	20801	816684
Oilseeds	13679	14343
Others	69769	146805
Total	**104249**	**977832**

(Source: Vital Agricultural Statistics 2004-05, Directorate of Agriculture, Rajasthan)

3. Infrastructure

64. Water supply: In Barmer town water is available from underground source. The water is drawn from 28 tube wells near NH-15 at Bhadka situated 38 Km. from Barmer city and is boosted through 300 mm AC / 200 mm CI conveyance mains to Barmer city with intermediate boosting at Harsani Phanta and Jalipa Head Works. The total production is 9 MLD and per capita supply is about 100 liters. Out of the 9 MLD available from current sources, PHED supplies around 0.22 MLD to Commercial Consumers, 0.88 MLD to Industrial consumers and 7.90 MLD to Domestic consumers. The city is divided into 11 water supply zones covering 35 municipal wards. The approximate total length of the existing water supply distribution network is 144 km and includes all localized distribution networks.

65. Sewerage System: As is the case with all medium towns in Rajasthan, Barmer too does not have any sewerage system. Water Closets (WC) are connected to septic tanks in most of the houses, while some houses, due to lack of space, discharge WC effluent directly in to open drains. In some households, especially in slum areas, open defecation is still a common practice. Sullage generated from houses is directly discharged in to open drains, forming pools. The open drains carrying wastewater and the resultant pools are causing unsanitary conditions, which are threat to public health.

66. Scarcity of water, undulated topography and above all the lack of financial resources restrained planning of underground sewerage system. At present, there is no plan for a sewerage system. It is necessary that feasibility and detailed project reports be prepared by experienced consulting agencies for the comprehensive scheme covering topographic survey, designing of conveyance system, treatment and disposal of treated effluent and its reuse. The city lies on both sides of railway track. The natural slope is from west to east. According to natural slope at present the sewerage of Northern Zone is flowing near Jodhpur road causing nuisance and ugly appearance. For southern zone outfall of sewer is likely to be behind Saint Paul's school at Shivkar road.

67. Sanitation: Only 50-60 % of the households reportedly has septic tanks and soaks well as the system of sewerage disposal. The remaining accounted for cases of open defecation which is an unacceptable and unhygienic practice. The raw settled sewage from septic tank is periodically flushed out by sanitary workers of the Municipal Board and discharge to open spaces, agricultural lands in an indiscriminate manner. Slum areas were also not equipped with requisite sanitation (LCS etc.) resulting in open defecation.

68. Drainage: The topography of Barmer city is cup shaped, the town being surrounded by sand dunes. Due to scanty rains in the region, natural drainage system has not been so far evolved. In fact there is no river/rivulet in the entire Barmer district. In Barmer town itself no natural drainage system exists to drain away the rainwater or wastewater from the town. Presently there exists a minimal network of storm water drains in the city. The existing network of (roadside) storm water drains in Barmer has been identified under three broad categories as follows: (i) open pucca and (ii) closed pucca. (iii) Kutchha

69. Industrial Effluents. Small industries exists in under RIICO, which is out side the city area and small amount of effluent disposed scattered in local nallahs. As reported by the local MC, the responsibility of effluent disposal is under RIICO's own and could not be connected to the proposed sewer network. The individual industry should treat their effluent to bring it to the required standard before final disposal.

70. Solid Waste: MBB's jurisdiction is spread over an area of 10.29 sq.km, which includes core old city area and some rural parts at the fringes. 30 tons of solid waste is collected daily. In addition to household (domestic) solid waste, the main waste generation sources in the town are vegetable and fruit markets, commercial and institutional establishments including hotels and eateries, construction activities, and other tourism related activities. MBB jurisdiction includes core old city area and slum area at fringes. The entire area is divided in to 35 wards.

71. Waste Collection - The MSW generated in the Barmer city (including slum area) mainly consist of domestic refuses, waste from Commercial Area, Vegetable-Fruit market, bio-medical waste, waste from Hotels and Restaurants, Industries etc. The waste collection system being followed is quite primitive, individual households/units throw the garbage on road side/open drains close to their houses and the sweepers collect the garbage in the form of small heaps on road sides. Similarly the open drains are also cleaned periodically and the sludge is heaped adjacent to the drain where it is left for 2-3 days to get dried and lifted. Tractor trolleys then lift these dumps the heaped garbage once or twice a day. In the process part of the garbage gets dispersed on the road or finds it way into to the open drains or open low lying pits (Ginanis).

72. The Municipality owns five tractors, 3 taxis for door to door collection of solid waste. Capacity of five tractors is approximately 7 cum. The waste material is lifted by a loader and placed on trolleys for transportation to disposal site. Details of quantity of garbage collected and

disposed off are not available. However based on the information gathered from the concerned engineer an approximate quantity of MSW generated has been assessed as 25 tonnes / day. Estimated quantities of MSW generated from different sections of the town is given in the following table:

Table 3.13.Waste Generation in 2006

Type of waste generation	Quantity of waste in TPD
Residential Area (Domestic)	17
Commercial Area	4
Industrial	2
Bio-medical and Hospital	2
Total	**25**

73. This gives per capita generation of MSW as 300 gms/day, which is in line with garbage generated in similar towns, e.g. Pushkar, in Rajasthan.

74. As regards quality of MSW, there is no data available. Physical inspection carried out during the visits indicates very little presence of organic matter. Presence of plastic bags and wrappers of pan masala / tobacco pouches are source of nuisance around the points of garbage collection and along the roads and disposal sites. The garbage as such cannot be used for composting and is primarily being disposed off as landfill at a site near Somayon Ki Dhani.

4. Transportation

75. Road Transport: The district is linked by road with Jaisalmer, Jodhpur, Pali, Jalore, Jaipur, Ajmer and Ahmedabad. The total length of roads in the district was 5,109 kms as on 31 March 2000.

76. Rail Transport: The district is linked with neighbouring districts of Jodhpur, Jalore and Jaipur in the State and with Agra in UP and Munawa in Pakistan, by railway line. The total length of rail line in the district is 254 kms with 30 railway stations.

77. Important roads of the town are NH-15, State Highway No.-16 (Jodhpur road). The NH-15 runs in north-south direction making the eastern boundary of the town and is known as defence road. A number of developments have taken place on other side of the road such as RIICO area, dairy as well as katchi basties. These are creating problems on free movement of traffic on this important road. The station road, which is important road is narrow with shops on both sides. Being important road connecting old town with railway station it is subject to mixed traffic. All streets of old town are narrow ranging from 5' to 30'. The town does not have organised bus stand or truck stand. The bus stand is located near railway crossing, but it does not have adequate land for proper functioning. Trucks are parked by the side of the road on carriage way creating traffic congestion.

78. The **Table 3.14** provides a breakdown of road surface composition in physical growth of the city has resulted in a corresponding increase in vehicular traffic greater than that of the city's population growth due to improving economic status of the city.

Table 3.14: Jurisdiction of Authorities Responsible for the Road of the City

Type	Maintaining Authority	Length in km	%
Bitumen road	MBB	170	70.10
Cement-concrete road	MBB	12.5	5.15
WBM (Metalled)	MBB	10	4.13
NH & State Highway	PWD	50	20.62
Total		**242.50**	

Source: PWD Barmer

D. Social and Cultural Resources

1. Demography

79. Barmer city has nearly 58% of total urban population of the district. In 2001 its population was 83591 persons. Growth rate has not been significant during last two decades because of lack of economic factor. During last decade (1991-2001) the growth rate was 21.8% only which was even less then the national population growth rate. Thus migration is negligible. Scheduled caste and Scheduled Tribe population is 10.10% and 0.5% respectively. **Table 3.15** gives the features of the city. Projected population growth of the city is shown in **Table 3.16.**

Table 3.15: Demographic Features of Barmer

Details	Barmer City	District
Total Population	83,591	1,964,835
Urban Population	83,591	1,45,404
Urban Area (sq.km.)	10.29	59.29
Population Density (persons / sq. km.)	8123	2107
SC	12,009 (10.10%)	3,08,996 (15.70%)
ST	1,298 (0.50%)	1,18,688 (6.00%)
Sex Ratio (Females per 1000 Males)	851	892
Literacy Rate (%)	76.90	59.00
Female Literacy Rate (%)	61.20	43.40

Source: Compiled from Primary Census Abstract Data 2001

Table 3.16: Population and Growth Rate

Year	Population
1901	6,064
1911	6,380
1921	7,184
1931	9,240
1941	12,051
1951	20,812
1961	27,600
1971	38,630
1981	55,554
1991	68,625

Year	Population
2001	83,591
2011	104,113
2021	129,253
2031	160,230
2041	198,640

Source: District Census Handbook Data 2001

2. Health and educational facilities

80. There are good educational facilities in Barmer district, which serve both townspeople and inhabitants of surrounding villages and towns in the hinterland. There are 2,714 primary schools, 130 secondary and higher secondary schools, plus 2 general degree colleges and 2 industrial training institutes (ITI).

Table 3.17: Educational Facility of Barmer District

Facility	No.
Primary Schools	2,714
Middle Schools	451
Higher Secondary and Secondary Schools	130
Colleges	2
Polytechnics	1
ITI	2
STC	1

(Source: Official website of District)

81. In Barmer district, number of private and government hospital and health centers are recorded.

3. History, Culture and Tourism

82. Barmer has moderate tourist inflows with main attractions being Juna Barmer is important from heritage point of view. There are number of festivals held in Barmer, the most famous of which is cattle fair held every year at Talwara village situated on the banks of the Luni river. The fair goes on for a fortnight in the months of March-April. The other predominant festival is the Barmer Thar Festival, started as a practice to enhance the tourism potential of the town. During the annual Barmer Festival in March, the town is at its colourful best and that is the best time to visit Barmer. 'Safed Akra Mahadev Mela' is celebrated on Mahashivratri.

83. Projects in Line for development of tourism in Barmer: Municipal Board Barmer have framed following schemes to promote tourism.

- **Development of Son Nadi:** Development of Son Nadi is proposed to promote tourism. This will include construction of CC road near protection wall, development of park, providing and furnishing play ground equipments, installation of fountains and development of Ghats.

- **Development of Vensa Nadi:** The area of Vensa Nadi has also been included in Tourist Development Plan. This includes development of park, providing and furnishing play ground equipment.

- **Construction of Cement Concrete road** from Peepla Devi Temple to Tourist Point: A cement concrete road is proposed from Peepla Devi Temple to Venasar and tourist point. This will facilitate easy transportation of tourist.

- **Development of Kareli Nadi:** Kareli Nadi area is proposed to be developed for tourists.

IV. ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES: LOCATION AND DESIGN

84. ADB Environmental Assessment Guidelines require that an IEE should evaluate impacts due to the location, design, construction and operation of the project. Construction and operation are the two activities in which the project interacts physically with the environment, so they are the two activities during which the environmental impacts occur. In assessing the effects of these processes therefore, all potential impacts of the project are identified, and mitigation is devised for any negative impacts. This has been done in Sections V and VI below and no other impacts are expected.

85. In many environmental assessments there are certain effects that, although they will occur during either the construction or operation stage, should be considered as impacts primarily of the location or design of the project, as they would not occur if an alternative location or design was chosen.

86. However in the case of this subproject, it is not considered that there are any impacts that are a result of the design or location. This is because:

- The project will be built at a single relatively small location and involves straightforward construction and low-maintenance operation, in an environment that is not especially sensitive, so it is unlikely that there will be major impacts;

- Most of the predicted impacts are associated with the construction process, and are produced because that process involves quite extensive groundwork. However, these are more routine in nature, and the impacts that can be most easily mitigated.

V. POTENTIAL ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES: INFRASTRUCTURE CONSTRUCTION

A. Screening out Areas of No Significant Impact

87. From the descriptions given in Section III.C it is clear that implementation of the project will affect a significant proportion of the town as branches of the new sewerage network will be built alongside many roads and streets. Areas outside the town will also be affected, by construction of the trunk sewer and STP.

88. However it is not expected that the construction work will cause major negative impacts, mainly because:

- Most of the network and the trunk sewer will be built on unused ground alongside existing roads and can be constructed without causing major disruption to road users and any adjacent houses, shops and other businesses;
- The STP will be located on government-owned land that is not occupied or used for any other purpose;
- Most network construction will be conducted by small teams working on short lengths at a time so most impacts will be localised and short in duration;
- The overall construction programme will be relatively short for a project of this nature, and is expected to be completed in 1.5 -2 years.

89. As a result there are several aspects of the environment that are not expected to be affected by the construction process and these can be screened out of the assessment at this stage as required by ADB procedure. These are shown in **Table 5.1**, with an explanation of the reasoning in each case.

90. These environmental factors have thus been screened out presently but will be assessed again before implementation of the project**.**

Table 5.1: Fields in Which Construction Is Not Expected To Have Significant Impacts

Field	Rationale
Climate	Short-term production of dust is the only effect on atmosphere
Geology and seismology	Excavation will not be large enough to affect these features
Fisheries & aquatic biology	No rivers or lakes will be affected by the construction work
Wildlife and rare or endangered species	There is no wildlife or rare or endangered species in the town or on the government owned areas outside the town on which facilities will be built
Coastal resources	Barmer is not located in a coastal area
Population and communities	Construction will not affect population numbers, location or composition But after finalisation of alignment the actual impact can be assessed

B. Sewage Treatment Plant

1. Construction method

91. Work components of STP involve

- A series of oxygenation and waste stabilization ponds, each approximately 50 x 100 m and 2-3 m in depth;
- Pump stations and pipes with valves to transfer material between ponds;
- An outfall to discharge the treated wastewater.

92. Although the site is fairly large, the construction will be straightforward, involving mainly simple excavation. The ponds will be dug by backhoe diggers and bulldozers, and soil will be transferred into trucks for offsite disposal. Clay will then be applied to the floor and sloping sides of each pond and after watering will be covered with low density poly-ethylene (LDPE) sheeting. A thin layer of cement mortar is then added, and concrete tiles are embedded into the surface by hand, with more cement grouting applied to seal joints between tiles.

93. Trenches for the pipe-work will also be dug by backhoe, and pipes will be brought to site on trucks, offloaded and placed into each trench by small cranes or pipe-rigs, after which soil will be replaced by hand to cover the trench.

94. Foundations for the small pump houses will be dug by backhoe, and concrete and aggregate will be tipped in to create the foundations and floor. The brick sides will then be built by hand by masons and pumps will be brought in on trucks and placed inside the pump house by crane. The roof material will then be attached by hand.

2. Physical Resources

95. Although the impacts of constructing the STP will be confined to a single site, because of its size and the invasive nature of the excavation work, physical impacts could be significant, so mitigation measures will be needed.

96. Ponds will be dug on around 80% of the site, and if these are excavated to a depth of 2.5 m, and substantial waste soil will be generated. This is a very large amount of waste, which could not be dumped without causing further physical impacts on air quality (dust), topography, soil quality, etc. It will be important therefore to reduce the amount of dumping by finding beneficial uses for as much waste soil as possible. This will require:

- Contacting the town authorities to arrange for the use of this material where possible in construction projects, to raise the level of land prior to construction of roads or buildings, or to fill previously excavated areas, such as brickworks;

- Preventing the generation of dust (which could affect surrounding agricultural land and crops) by removing waste material as soon as it is excavated, by loading directly onto trucks, and covering with tarpaulins to prevent dust during transportation.

97. Another physical impact associated with large-scale excavation is the effect on drainage and the local water table if groundwater and/or surface water collect in the voids. Given the difficulties of working in wet conditions the Contractor will almost certainly conduct all excavation in the dry season, so this should avoid any impacts on surface water drainage. If water collects in any quantity it will need to be pumped out, and it should then be donated to neighbouring farmers to provide a beneficial use to the communities most affected by this aspect of the work, and improve public perceptions of the project.

3. Ecological Resources

98. At proposed site one pond is located therefore some ecological interest at the site, so construction will cause moderate ecological impacts. There are some trees that will need to be removed, and given global concerns regarding the loss of trees, the project should make a small positive ecological contribution by planting three native trees at a nearby site for every one that is removed.

4. Economic Development

99. The site of the proposed STP is owned by the government so there should be no need to acquire land from private owners, which might affect the income and assets of owners and tenants. The land is also not used for any purpose except for the unauthorized grazing of goats,

and there is other suitable grazing nearby, so this activity should not be affected. The land is not farmed and there are no industries or housing in the vicinity so there should be no impact on income-generating activities.

100. The only aspect of the work that has any economic implications is the transportation of waste material from the site to locations where it can be put to beneficial use as recommended above. This will require a large number of lorry movements, which could disrupt traffic near the site and particularly in Barmer if such vehicles were to enter the town. The transportation of waste will be implemented by the Construction Contractor in liaison with the town authorities, and the following additional precautions should be adopted to avoid effects on traffic:

- Planning transportation routes so that heavy vehicles do not enter Barmer town and do not use narrow local roads, except in the immediate vicinity of delivery sites;
- Scheduling transportation activities to avoid peak traffic periods.

5. Social and Cultural Resources

101. Although the STP will be built on an uninhabited and un-used site, with no residential areas nearby, there is a risk that the work could damage social and cultural resources, so careful mitigation and strict adherence by the EA and Contractor will be necessary.

102. Rajasthan is an area with a rich and varied cultural heritage that includes many forts and palaces from the Rajput and Mughal periods, and large numbers of temples and other religious sites, so there is a risk that any work involving ground disturbance could uncover and damage archaeological and historical remains. Given that this particular location is uninhabited and shows no sign of having been used to any extent in the past, then it could be that there is a low risk of such impacts. Nevertheless this should be ascertained by consulting the appropriate authorities, and appropriate steps should be taken according to the nature of the risk. This should involve:

- Consulting historical and archaeological authorities at both national and state level to obtain an expert assessment of the archaeological potential of the site;
- Selecting an alternative location if the site is considered to be of medium or high risk;
- Including state and local archaeological, cultural and historical authorities and interest groups in consultation forums as project stakeholders so that their expertise can be made available to the project;
- Developing a protocol for use by the Contractor in conducting any excavation work, to ensure that any chance finds are recognized and measures are taken to ensure they are protected and conserved. This should involve:
  - Having excavation observed by a person with archaeological field training;
  - Stopping work immediately to allow further investigation if any finds are suspected;

- Calling in the state archaeological authority if a find is suspected, and taking any action they require ensuring its removal or protection in situ.

103. There are no modern-day social and cultural resources (such as schools and hospitals) near the site, and no areas that are used for religious or other purposes, so there is no risk of other impacts on such community assets.

104. Finally, there could be some short-term socio-economic benefits from the construction work if local people are able to gain employment in the construction workforce. To ensure that such gains are directed towards communities most directly affected by this part of the scheme, the Contractor should be required to employ at least 50% of the STP labour force from communities within a radius of say 2 km from the site, if sufficient people are available.

C. Sewerage Network and Trunk Sewer

1. Construction method

105. Provision of a sewerage system in part of the town during the second phase of investment (Tranche 2) will involve construction of:

- The secondary and tertiary network will collect sewage from individual houses have a sufficient water supply, These pipes will be of small diameter (200 to 600 mm) and will be located in shallow trenches (ca 1.5 m in depth).

- The trunk sewer will also be of RCC pipes and will convey sewage from the secondary network to the STP These pipes will be 700 - 900 mm in diameter

106. These two elements of the project involve the same kinds of construction and will produce similar effects on the environment, so their impacts are considered together.

107. Most pipes will be buried in trenches immediately adjacent to roads, in the un-used area within the ROW, alongside the edge of the tarmac. The trunk main and secondary network will be located alongside main roads, where there is generally more than enough free space to accommodate the pipeline. However in parts of the tertiary network where roads are narrow, this area is occupied by drains or the edges of shops and houses etc., so the trenches may have to be dug into the edge of the road.

108. Trenches will be dug by backhoe digger, supplemented by manual digging where necessary. Excavated soil will be placed nearby, and the pipes (brought to site on trucks and stored on unused land nearby) will be placed in the trench by crane or using a small rig. After the pipes are joined, loose soil will be shovelled back into the trench, and the surface layer will be compacted by hand-operated compressor.

109. Pipes are normally covered by 1.2 m of soil, and a clearance of 100 mm is left between the pipe and each side of the trench to allow backfilling. Trenches will therefore be quite large, a maximum of 2.3 m deep and 1.2 m wide for the trunk main, and a minimum of 1.5 m deep and 0.4 m wide for the tertiary network.

110. At intervals, small chambers (ca 1-2 m^3) will be created to allow inspection and clearance of blockages and sediment during operation. These will be excavated by backhoe, and hardcore and concrete (mixed on site) will be tipped in to form the base. Brick sides will

then be added by masons by hand, and the top will be sealed at ground level by a metal manhole cover.

111. As noted above, some of the narrower roads are constructed of concrete and have no available space at the edge because of the presence of drains, or shop- and house-fronts encroaching into the ROW. In these places it may be necessary to break open the surface of the road using hand-held pneumatic drills, after which the trench and pipeline will be constructed as described above. On completion a concrete layer will be re-applied to the surface to repair the road.

2. Physical Resources

112. Construction of trenches will have similar physical impacts to the excavation work at the STP, although their extent and significance will be different because trenches are linear structures and the network is located in the town. Since length of the trunk main is not much the generation of waste will be less. Although this is <10% of the quantity produced at the STP it is still a significant amount of waste, and in this case there are additional considerations because piles of soil could impede traffic and other activities in the town (see below) and dust could affect inhabitants during dry weather. These impacts should be mitigated by applying the same measures as at the STP site to minimise waste and dust, and there will need to be some additional precautions to control dust. The Contractor should:

- Contact the town authorities to find beneficial uses for the waste material, in construction projects, to raise the level of land prior to construction of roads or buildings, or to fill previously excavated areas, such as brickworks;
- Remove waste material as soon as it is excavated (by loading directly into trucks), to reduce the amount stockpiled on site;
- Use tarpaulins to cover loose material when transported from the site by truck;
- Cover or water stockpiled soil to reduce dust during windy weather.

113. The other important physical impact associated with large-scale excavation (effects on surface and groundwater drainage) should not be an issue in this case because of the very low rainfall in this area and the very low water table. In addition the Contractor will almost certainly conduct all excavation in the dry season, to avoid the difficult working conditions during the monsoon.

114. The physical impacts of trenching will also be reduced by the method of working, whereby the network and trunk sewer will probably be constructed by small teams working on short lengths at a time, so that impacts will be mainly localised and short in duration. Physical impacts are also mainly temporary as trenches will be refilled and compacted after pipes are installed, and any disturbed road surfaces will be repaired. Because of these factors and the mitigation measures proposed above, impacts on the physical environment are not expected to be of major significance.

3. Ecological Resources

115. There are no significant ecological resources in or outside the town (protected areas or rare or important species or habitats), so construction of the network and trunk sewer should

have no ecological impacts. However roadside trees should not be removed unnecessarily to build the trenches, and to mitigate any such losses the Contractor should be required to plant and maintain three new trees (of the same species) for each one that is removed.

4. Economic Development

116. As the network and trunk sewer pipelines will all be conducted within the ROW of existing roads (either adjacent to the road, or beneath the road surface in narrower streets) there will be no need to acquire land, so there should be no direct effect on the income or assets of landowners, or the livelihoods of tenants.

117. There could be some economic impacts however, if the presence of trenches, excavated material, workers and machinery discourage customers from visiting shops and businesses adjacent to network construction sites, and the businesses lose income as a result. These losses will be short in duration as work at any one site should be completed in a week or less. However the loss of income could be significant for small traders and other businesses that exist on low profit margins. These impacts should therefore be mitigated by:

- Leaving spaces for access between mounds of excavated soil, and providing footbridges so that pedestrians can cross open trenches;
- Increasing the workforce in these areas to ensure that work is completed quickly;
- Consulting affected businesspeople to inform them in advance when work will occur.

118. ADB policy on Involuntary Resettlement requires that no-one should be worse off as a result of an ADB-funded project, and a separate Resettlement Plan and Resettlement Framework have been prepared to examine these issues and provide appropriate mitigation. This establishes that, in addition to the above practical measures to reduce the economic impact of the construction work, owners and tenants of affected businesses will also be compensated in cash for any income they lose.

119. Excavation could also damage existing infrastructure, in particular storm drains and water supply pipes, both of which are located alongside roads in the town. It will be particularly important to avoid damaging existing water pipes as these are mainly manufactured from Asbestos Cement (AC), which can be carcinogenic if inhaled, so there are serious health risks for both workers and the public (see below). It will be important therefore to avoid these impacts by:

- Obtaining details from the Municipal Council of the nature and location of all infrastructure, and planning the sewer networks so that all such sites are avoided;
- Integrating the construction of the various Barmer subprojects (in particular water supply and sewerage) so that:
  - Different pipelines are located on opposite sides of the road wherever feasible;

- Roads and inhabitants are not subject to repeated disturbance by trenching in the same area for different purposes.

120. Transport is another type of infrastructure that will be affected by some of the work, as in the narrower streets there is not enough space for excavated soil to be piled off the road. As noted above the road itself may also be excavated in places where there is no available land alongside. Traffic will therefore be disrupted, and in some very narrow streets the whole road may need to be closed for short periods. The Contractor should therefore plan this work in conjunction with the town authorities and the police force, so that work can be carried out during periods when traffic is known to be lighter, and alternative routes and diversions can be provided where necessary. The Contractor should also increase the workforce in areas such as this, so that the work is completed in the shortest possible time.

121. It is inevitable that there will be an increase in the number of heavy vehicles in the town (particularly trucks removing waste and delivering pipes and other materials to site), and this could disrupt traffic and other activities, as well as damage fragile buildings if vibration is excessive. These impacts will therefore need to be mitigated by:

- Careful planning of transportation routes with the municipal authorities to avoid sensitive areas as far as possible, including narrow streets, congested roads, important or fragile buildings and key sites of religious, cultural or tourism importance;

- Scheduling the transportation of waste to avoid peak traffic periods, the main tourism season, and other important times.

5. Social and Cultural Resources

122. As was the case with the STP site, there is a risk that sewer construction, which involves extensive disturbance of the ground surface, could damage undiscovered archaeological and/or historical remains, or even unknown sites. The risks are in fact considerably higher in this case, because such artefacts are more likely to occur in areas that have been inhabited for a long period. The preventative measures described in Section V.B.5 will thus need to be employed and strictly enforced. These are:

- Consulting national and state historical and archaeological authorities to assess the archaeological potential of all construction sites;

- Selecting alternative routes to avoid any areas of medium or high risk;

- Including state and local archaeological, cultural and historical authorities and interest groups as project stakeholders to benefit from their expertise;

- Developing a protocol for use in conducting all trenching, to recognise, protect and conserve any chance finds (see Section V.B.5 for details).

123. Sewer construction will also disturb some modern-day social and cultural resources, such as schools, hospitals, temples, and sites that are of interest to tourists. Impacts will include noise, dust, and interrupted access for pedestrians and vehicles, and in cases where pneumatic

drills are used to break the surface of concrete roads, there could be a risk of damage from vibration. Mitigation will therefore be needed to protect these resources and to enable usage by local people and visitors to continue throughout the construction work. This will be achieved through several of the measures recommended above, including:

- Consulting the town authorities to identify any buildings at risk from vibration damage and avoiding any use of pneumatic drills or heavy vehicles in the vicinity;
- Limiting dust by removing waste soil quickly, covering and watering stockpiles, and covering soil with tarpaulins when carried on trucks;
- Increasing the workforce in sensitive areas to complete the work quickly;
- Providing wooden bridges for pedestrians and metal sheets for vehicles to allow access across open trenches where required (including access to houses);
- Using modern vehicles and machinery with standard adaptations to reduce noise and exhaust emissions, and ensuring they are maintained to manufacturers' specifications.

In addition the Executing Agency and Contractor should:

- Consult municipal authorities, custodians of important buildings, cultural and tourism authorities, and affected communities in advance of the work to identify and address key issues, and avoid working at sensitive times, such as religious and cultural festivals.

124. There is invariably a safety risk when substantial construction such as this is conducted in an urban area, and precautions will thus be needed to ensure the safety of both workers and citizens. The Contractor will be required to produce and implement a site Health and Safety Plan, and this should include such measures as:

- Excluding the public from the site;
- Ensuring that all workers are provided with and use appropriate Personal Protective Equipment;
- Health and Safety Training for all site personnel;
- Documented procedures to be followed for all site activities;
- Accident reports and records; etc.

125. An additional, particularly acute health risk presented by this work derives from the fact that, as mentioned above, the existing water supply system comprises mainly AC pipes, so there is a risk of contact with carcinogenic material if these pipes are uncovered in the course of the work. Precautions have already been introduced into the design of the project to avoid this, of which the most important is that:

- The locations of all new infrastructures will be planned to avoid locations of existing AC pipes so AC pipes should not be discovered accidentally.

126. Given the dangerous nature of this material for both workers and the public, additional precautions should be taken to protect the health of all parties in the event (however unlikely) that AC pipes are encountered. The design consultant should therefore develop a protocol to be applied in any instance that AC pipes are found, to ensure that appropriate action is taken. This should be based on the approach recommended by the United States Environmental Protection Agency (USEPA)[2], and amongst other things, should involve:

- Training of all personnel (including manual labourers) to enable them to understand the dangers of AC pipes and to be able to recognise them in situ;
- Reporting procedures to inform management immediately if AC pipes are encountered;
- Development and application of a detailed H&S procedure to protect both workers and citizens. This should comply with national and international standards for dealing with asbestos, and should include:
  - Removal of all persons to a safe distance;
  - Usage of appropriate breathing apparatus and protective equipment by persons delegated to deal with the AC material;
  - Procedures for the safe removal and long-term disposal of all asbestos-containing material encountered.

127. There could again be some short-term socio-economic benefits from the construction work if local people gain employment in the workforce. To ensure that these benefits are directed to communities that are affected by the work, as suggested in Section VB.5, the Contractor should be required to employ at least 50% of his labour force from communities in the vicinity of construction sites. Creating a workforce from mainly local people will bring additional benefits by avoiding problems that can occur if workers are imported; including social difficulties in the host community and issues of health and sanitation in poorly serviced temporary camps.

VI. POTENTIAL ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES: OPERATION AND MAINTENANCE

A. Screening out Areas of No Significant Impact

128. Although the sewerage system will need regular maintenance when it is operating, with a few simple precautions this can be conducted without major environmental impacts (see below). There are therefore several environmental factors which should be unaffected once the system begins to function. These are identified in **Table 6.1** below, with an explanation of the reasoning in each case. These factors are thus screened out of the impact assessment and will not be mentioned further. The specific impact can only be assessed after development of detail design.

[2] In the USA, standards and approaches for handling asbestos are prescribed by the Occupational Health and Safety Administration (OHSA) and the Environmental Protection Agency (EPA) and can be found at http://www.osha.gov/SLTC/asbestos

Table 6.1: Fields in Which Operation and Maintenance of the Completed Sewerage System Is Not Expected To Have Significant Impacts

Field	Rationale
Climate, topography, geology, seismology	There are no known instances where the operation of a relatively small sewerage system has affected these factors
Fisheries & aquatic biology	The only local fishery is in local pond, which will not be affected
Wildlife, forests, rare species, protected areas	There are none of these features in or outside the town
Coastal resources	Barmer is not located in a coastal area

129. These environmental factors have thus been screened out presently but will be assessed again before implementation of the sub-project.

B. Operation and Maintenance of the Improved Sewerage System

130. The new sewerage system will collect and treat all surface water, domestic wastewater and sewage produced by 50% of the town, and the remainder of the inhabited area and future expansion will be served by additional sewers provided via subsequent tranches of funds. Although treatment will not be to the standards of more developed countries, the technology is approved by the Central Public Health and Environmental Engineering Organization (CPHEEO) and Pollution Control Board attached as **Appendix VI-A** and the discharge after treatment will comply with Indian wastewater standards (**Table 6.2**).

Table 6.2: Waste Water Quality Discharge Standards

SL.no	Parameter	Standards			
		Inland surface water	Public sewers	Land irrigation	Marine/coastal areas
(a)		(b)	(c)		(d)
1.	Colour and odour	remove as far as practicable			
2.	Suspended solids mg/l. max.	100	600	200	(a) For process waste water100 (b) For cooling water effluent 10% above total suspended matter of influent.
3.	Particle size of suspended solids	shall pass 850 micron IS Sieve			(a)Floatable solids, max. 3mm. (b)Settable solids (max 850 micron)
4.	pH value	5.5. to 9.0	5.5 to 9.0	5.5 to 9.0	5.5 to 9.0
5.	Temperature	shall not exceed 5^0C above the receiving water temperature			shall not exceed 5^0C above the receiving water temperature
6.	Oil and grease, mg./l, max.	10	20	10	20
7.	Total residual chlorine, mg/l. max.	1.0			1.0
8.	Ammoniacal nitrogen (as N.) mg/l max	50	50		50
9.	Total Kjeldahl Nitrogen (as NH_3)	100			100

SL.no	Parameter	Standards			
		Inland surface water	Public sewers	Land irrigation	Marine/coastal areas
	mg/l. max				
10.	Free ammonia (as NH_3), mg/l.max	5.0			5.0
11.	Biochemical oxygen demand (3 days at 27^0C), mg/l. max.	30	350	100	100
12.	Chemical oxygen demand, mg/l, max.	250			250
13.	Arsenic (as As) mg/l, max.	0.2	0.2	0.2	0.2
14.	Mercury (As Hg), mg/l, max.	0.01	0.01		0.01
15.	Lead (as Pb) mg/l, max	0.1	1.0		2.0
16.	Cadmium (as Cd) mg/l. max	2.0	1.0		2.0
17.	Hexavalent chro- mium (as Cr. +6). mg/l, max	0.1	2.0		1.0
18.	Total Chromium (as Cr) mg/l, max	2.0	2.0		2.0
19.	Copper (as Cu) mg/l, max	3.0	3.0		3.0
20.	Zinc (as Zn) mg/l, max	5.0	15		15
21.	Selenium (as Se) mg/l, max	0.05	0.05		0.05
22.	Nickel (as Ni) mg/l, max	3.0	3.0		5.0
23.	Cyanide (as CN) mg/l, max	0.2	2.0	0.2	0.2
24.	Fluoride (as F) mg/l, max	2.0	15		15
25.	Dissolved phosphates (as P) mg/l, max	5.0			
26.	Sulfide (as S) mg/l, max	2.0			5.0
27.	Phenolic compounds (as C_6H_5OH) mg/l, max	1.0	5.0		5.0

131. The sewer pipes will not function without maintenance, as silt inevitably collects in areas of low flow over time. The project will therefore provide equipment for cleaning the sewers, including buckets and winches to remove silt via the inspection manholes, diesel-fuelled pumps to remove blockages, and tankers to transport the waste hygienically to the STP.

132. Piped sewers are not 100% watertight and leaks can occur at joints. Any repairs will be conducted by sealing off the affected sewer and pumping the contents into tankers, after which the faulty section will be exposed and repaired following the same basic procedure as when the sewer was built. Trenches will be dug around the faulty section and the leaking joint will be re-sealed, or the pipe will be removed and replaced.

133. At the STP sewage sludge will need to be removed from the active treatment ponds every four or five years. This is a simple process that does not require a Sludge Management Plan. Ponds are allowed to dry out naturally and the solid sludge is removed by manual digging. The treatment and drying processes kill enteric bacteria and pathogens, and because of its high content of nitrates, phosphates and other plant nutrients the sludge is an excellent organic fertilizer and farmers are normally allowed to remove the dry material for application to their land.

C. Environmental Impacts and Benefits of the Operating System

1. Physical Resources

134. The provision of an effective sewerage system in 50% of the town should improve the physical appearance and condition of the city area that will no longer be discharged to the

nallahs. This measure and the fact that there will be fewer septic tanks and less sewage discharged to drains, should also improve the appearance of the town and the quality of surface water drainage and groundwater. Clearly there will be further significant improvements once the whole town is connected to sewer via the future funding.

135. There could also be small-scale physical benefits from the operating STP if the sewage sludge that is removed periodically from the treatment ponds is provided to farmers and applied to fields, as it will improve soil structure and fertility. There could be a useful cost-recovery element if a system was established to sell this material to farmers, so this should be considered by the EA.

136. There are also certain environmental risks from the operating system, most notably from leaking sewer pipes as untreated faecal material can damage human health and contaminate both soil and groundwater. It will be imperative therefore that the Government Agency (GA) responsible for operating the sewerage system establishes a procedure to routinely check the operation and integrity of the sewers, and to implement rapid and effective repairs where necessary. If trenches are dug to locate and repair leaks or remove and replace lengths of pipe, the work will follow the same procedure as occurred when the infrastructure was provided. However the impacts should be much less significant as the work will be infrequent, and will affect individual small locations for short periods only. Work will not be conducted during rainfall so there will be no effect on drainage, and the excavated soil will be replaced in the trench so there will be no waste. Physical impacts should thus be negligible.

137. Treated effluent from an STP is often discharged to a nearby water body, which may then become contaminated by the high levels of nitrate, phosphate and organic matter in the effluent. As there is a *nallah* (natural or man-made drainage channel) in the vicinity of the proposed STP site, effluent may be discharged into this channel, which may then pollute surface and groundwater and present a risk to the health of humans and animals if it is consumed via well water. This can be avoided by developing a system to sell the treated wastewater to farmers (delivered by tanker) to irrigate their fields. This would provide water and plant nutrients and thus improve agricultural productivity and farm incomes, as well as allowing further cost-recovery by the EA. This should be operated in conjunction with a scheme to sell inert sewage sludge as a farm fertilizer as recommended above, and some of the capacity building and training provided by the project should focus on providing the GA with the skills to operate these measures. This should be preceded by rigorous bacteriological tests to confirm that the treatment methods render all dried sludge and effluent free from enteric bacteria and pathogens, so that it is safe to humans, animals and crops (see Section VII.C below). This water can also be discharged into ponding system developed specifically for aqua-culture if the potential exists.

2. Ecological Resources

138. Although the new sewerage system will improve the environment of the town, there are unlikely to be significant ecological benefits as there are no natural habitats or rare or important species. If effluent from the STP was discharged into the nearby *nallah* there could be some small ecological benefits as marsh plants and animals will colonise the small wetland that is likely to be formed. However the risks of contaminating groundwater are more significant, so it would be more appropriate to forego this ecological gain in favour of the better disposal method suggested above, whereby the effluent is supplied to farmers to irrigate and fertilize their fields or the treated water is discharged into water ponding system which can be developed by the project.

3. Economic Development

139. Although repairs to the sewer network could result in shops losing some business if access is difficult for customers whilst the work is carried out, any losses will be small and short-lived and will probably be at the level of normal business fluctuations. It should therefore not be necessary to compensate for such losses. Nevertheless simple steps should be taken to reduce the inconvenience of the works, including:

- Informing all residents and businesses about the nature and duration of any repair work well in advance so that they can make preparations if necessary;
- Requiring contractors employed to conduct these works to provide wooden walkways across trenches for pedestrians and metal sheets where vehicle access is required;
- Consulting the local police regarding any such work so that it can be planned to avoid traffic disruption as far as possible, and road diversions can be organised if necessary.

140. As noted above, a by-product of the scheme could be to provide economic improvements in the agricultural sector if sewage sludge and treated wastewater provide farmers with a safe and affordable source of organic fertilizer, and crop yields increase as a result. The completed scheme should also contribute to improvements in environmental and community health in the town (discussed below), which could provide some knock-on benefits to business from healthier workers and consumers.

4. Social and Cultural Resources

141. Although there is a high risk of excavation in the town discovering material of historical or archaeological importance, there will be no need to take precautions to protect such material when areas are excavated to repair leaks in the sewer network, as all work will be conducted in trenches that have already been disturbed when the infrastructure was installed.

142. Repair work could cause some temporary disruption of activities at sites of social and cultural importance such as schools, hospitals, temples, etc, so at these locations the same precautions as employed during the construction period should be adopted. These include:

- Consulting the town authorities to identify any buildings at risk from vibration damage and avoiding any use of pneumatic drills or heavy vehicles in the vicinity;
- Completing work in these areas quickly;
- Providing wooden bridges for pedestrians and metal sheets for vehicles to allow access across open trenches where required;
- Consulting municipal authorities, custodians of important buildings, cultural and tourism authorities, and local communities to inform them of the work in advance, and avoid sensitive times, such as religious and cultural festivals.

143. The responsible authorities will employ local contractors to conduct repairs of the sewer network, and contractors should be required to operate the same kinds of Health and Safety procedures as used in the construction phase (see Section V.C.5) to protect workers and the public. This should include application of the asbestos protocol if any AC pipes are encountered.

144. The use of local contractors will provide economic benefits to the companies and the workers they employ. There is however little prospect of directing these benefits to persons affected by any maintenance or repair works as contractors will utilise their existing workforce. To provide at least some economic benefits to affected communities, unskilled persons employed to maintain and operate the STP should be residents of the neighbouring area.

145. The citizens of the town will be the major beneficiaries of the new sewerage system, as human waste from those areas served by the new network will be removed rapidly and treated to an acceptable standard. This should improve the environment of these areas, and in conjunction with the development of other infrastructure (in particular water supply), should deliver major improvements in individual and community health and well-being. Diseases of poor sanitation, such as diarrhoea and dysentery, should be reduced, so people should spend less on healthcare and lose fewer working days due to illness, so their economic status should also improve, as well as their overall health.

VII. INSTITUTIONAL REQUIREMENTS AND ENVIRONMENTAL MONITORING PLAN

A. Summary of Environmental Impacts and Mitigation Measures

146. **Table 7.1** lists the potential adverse impacts of the Barmer sewerage subproject as identified and discussed in Sections IV, V and VI, and the mitigation proposed to reduce these impacts to acceptable levels. The table also shows how the mitigation will be implemented, who will be responsible, and where and when the mitigation activities will take place. The mitigation programme is shown as the quarter of each year in which each activity will occur, which relates to the project programme described in Section II.B. The final column assesses whether the proposed action will successfully mitigate the impact (shown as 0), and indicates that some of the measures will provide an additional benefit (shown as +).

B. Institutional Arrangements for Project Implementation

147. The main agencies involved in managing and implementing the subproject are:

- LSGD is the Executing Agency (EA) responsible for management, coordination and execution of all activities funded under the loan.
- The Implementing Agency (IA) is the Project Management Unit of the ongoing RUIDP, which will be expanded to include a broader range of skills and representation from the Urban Local Bodies (ULB, the local government in each town). Assigned as the RUSDIP Investment Program Management Unit (IPMU), this body will coordinate construction of subprojects across all towns, and ensure consistency of approach and performance.
- The IPMU will be assisted by Investment Program Management Consultants (IPMC) who will manage the program and assure technical quality of design and construction; and Design and Supervision Consultants (DSC), who will design the infrastructure, manage tendering of Contractors and supervise the construction process.
- Investment Program Implementation Units (IPIU) will be established in seven zones across the State to manage implementation of subprojects in their area. IPIUs will be staffed by professionals seconded from government departments (PHED, PWD), ULBs, and other agencies, and will be assisted by consultants from the IPMC and DSC as necessary.
- The IPMU will appoint Construction Contractors (CC) to build elements of the infrastructure in a particular town. The CCs will be managed by the IPIU, and construction will be supervised by the DSC.
- LSGD will be assisted by an inter-ministerial Empowered Committee (EC), to provide policy guidance and coordination across all towns and subprojects. The EC will be chaired by the Minister of Urban Development and LSG, and members will include Ministers, Directors and/or representatives of other relevant Government Ministries and Departments.

- City Level Committees (CLCs) have also been established in each town, chaired by the District Collector, with members including officials of the ULB, local representatives of state government agencies, the IPIU, and local NGOs and CBOs. The CLCs will monitor project implementation in the town and provide recommendations to the IPIU where necessary.

148. **Figure 7.1** shows institutional responsibility for implementation of environmental safeguard at different level.

Figure 7.1: Institutional Responsibly- RUSDIP

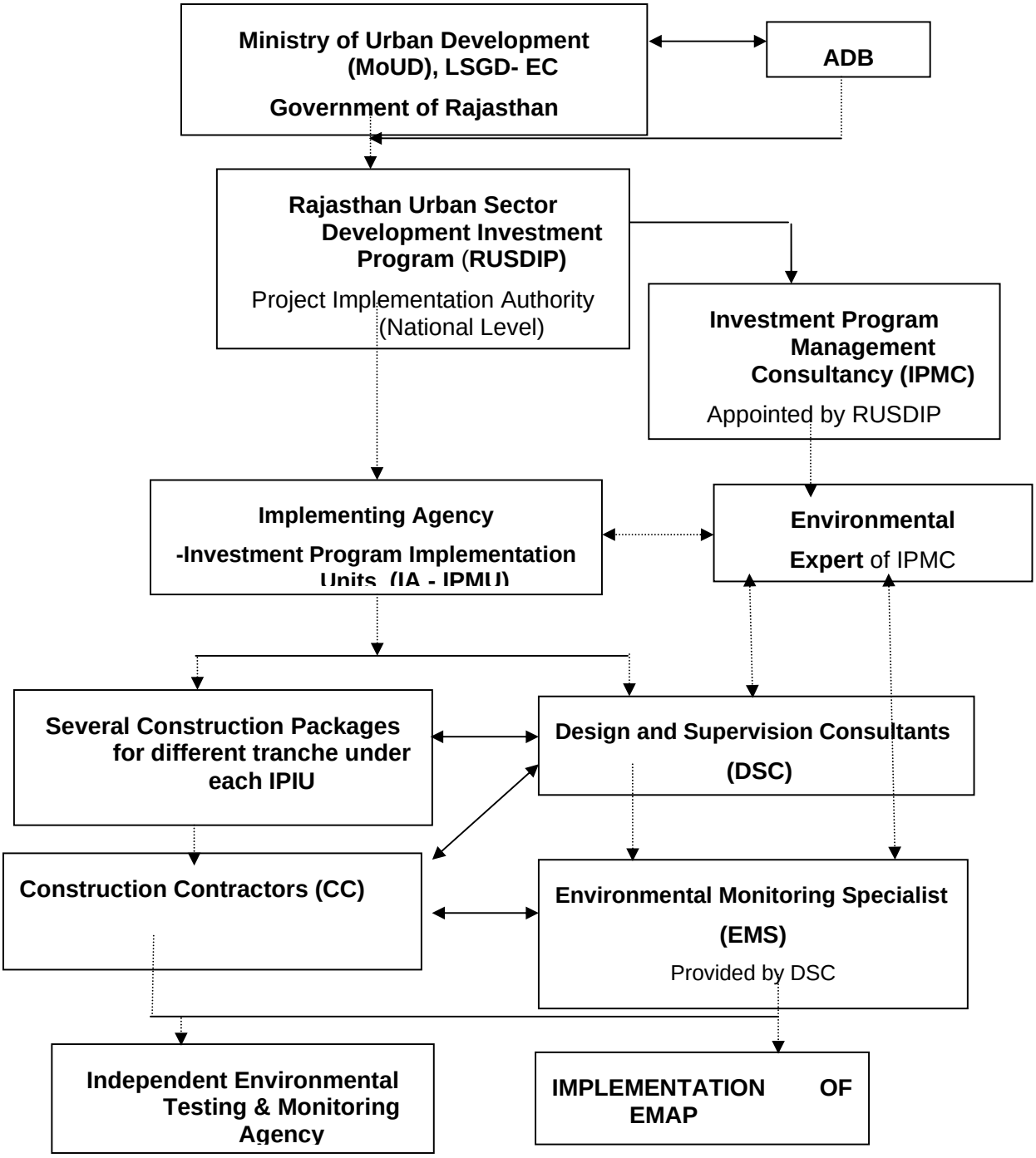


Table 7.1: Environmental Impacts and Mitigation for the Barmer Sewerage Subproject (Black = continuous activity; Grey = intermittent)

Potential Negative Impacts	Sig	Dur	Mitigation Activities and Method	Responsibility	Location	2008				2009				[3]
						D	D	3	4	1	2	3	Op	
Location and Design														
Discharge of treated effluent to *nallah* could pollute surface & groundwater with nitrate, phosphate, etc. Water ponding systems for aquaculture can be introduced for treated water	M	P	Conduct bacteriological tests to ensure safety of effluent	GA	STP									0
			Sell treated wastewater to farmers for irrigation Aquaculture can be introduced on a small scale.											+
Construction: Sewage Treatment Plant														
Excavation will produce large amounts of waste soil	M	P	Find beneficial uses for waste soil in construction, land raising and infilling of excavated areas	Contractor	All sites									+
Stockpiled soil could create dust in windy weather	M	T	Remove soil as soon as it is excavated	Contractor	All sites									0
Dust could also be produced when soil is transported	M	T	Use tarpaulins to cover dry soil when carried on trucks	Contractor										0
Rain and ground water could collect in excavated areas	M	T	Conduct all excavation in the dry season	Contractor	All sites									0
			Pump out groundwater & provide to farmers for irrigation	Contractor	STP site									+
Some trees will need to be removed from the site	M	P	Only remove trees if it cannot be avoided	Contractor	All sites									0
			Plant and maintain two trees for every one removed											0
Traffic may be disrupted by lorries carrying waste soil	M	T	Plan routes to avoid Barmer Town and narrow local roads	Contractor	From STP site									0
			Schedule transportation to avoid peak traffic periods											0
Ground disturbance could damage archaeological and historical remains	S	P	Request state and local archaeological authorities to assess archaeological potential of proposed STP site	DSC	All sites									0
			Select alternative if site has medium-high potential	DSC										0
			Include state and town historical authorities as project stakeholders to benefit from their expertise	LSGD										0
			Develop and apply protocol to protect chance finds (excavation observed by archaeologist; stop work if finds are suspected; state authority to plan appropriate action)	DSC and Contractor										+

Sig = Significance of Impact (NS = Not Significant; M = Moderately Significant; S = Significant). Dur = Duration of Impact (T = Temporary; P = Permanent)
D = Detailed Design Period; Op = Period when infrastructure is operating
[3] This column shows impacts remaining after mitigation: 0 = zero impact (impact successfully mitigated); + = positive impact (mitigation provides a benefit)
* Mitigation of these impacts will be provided through a separate Resettlement Plan, see Section VII.B

Potential Negative Impacts	Sig	Dur	Mitigation Activities and Method	Responsibility	Location	2008				2009				
						D	D	3	4	1	2	3	Op	3
Economic benefits if local people are employed in Contractor's workforce	M	T	Contractor should employ at least 50% of workforce from communities in vicinity of STP site	Contractor	All sites									+
						2008/2009				2010/11				
						D	D	3	4	1	2	3	4	
Construction: Sewerage Network and Trunk Sewer														
Trenching will produce additional amounts of waste soil	M	P	As above: find beneficial uses in construction or infill	Contractor	All sites									+
Waste soil may create dust when stored or transported	M	T	As above: remove waste soil as soon as it is excavated	Contractor	All sites									0
			As above: cover soil with tarpaulins on trucks											0
			Cover or damp down stored soil in dry weather											0
Trees may be removed along pipeline routes	M	P	As above: avoid removing trees, plant 2 for every 1 cut	Contractor	All sites									0
Shops may lose income if customers' access is impeded	M	T	Leave spaces for access between mounds of soil	Contractor	Network sites									0
			Provide bridges to allow people/vehicles to cross trench	Contractor										0
			Increase workforce in these areas to finish work quickly	Contractor										0
			Inform shopkeepers of work in advance	LSGD										0
			*Compensate businesses for lost income	LSGD										0
Trenching could damage other infrastructure	S	P	Confirm location of infrastructure and avoid these sites	DSC	Network sites									0
			Locate water and sewer pipes on opposite sides of roads	DSC										0
Roads/people may be disturbed by repeated trenching	M	T	Integrate subprojects to conduct trenching at same time	DSC/LGD	Network									0
Traffic will be disrupted if lack of space means that dug soil has to be placed on the road, and/or sewers have to be located in the road itself	M	T	Consult authorities – work in light traffic periods	Contractor	Network sites									0
			Ensure police provide diversions when necessary	Contractor										0
			As above: increase workforce to finish this work quickly	Contractor										0
Traffic, people and activities could be disrupted by trucks carrying waste soil or delivering materials to site	M	T	Plan routes to avoid narrow streets, congested roads, important/fragile buildings, key religious and tourism sites	Contractor	Network sites									0
			Plan work to avoid peak traffic and main tourism season											0
Major risk that ground disturbance in town could damage archaeological and historical remains	S	P	As above: ask authorities to assess potential of all sites	DSC	All sites									0
			As above: alternative sites where risk is high/medium	DSC										0

Potential Negative Impacts	Sig	Dur	Mitigation Activities and Method	Responsibility	Location	2008				2009				
						D	D	3	4	1	2	3	Op	3
			As above: include state/local authorities as stakeholders	LSGD										0
			As above: apply protocol to protect chance finds	DSC/CC										+
Sites of social/cultural importance (schools, hospitals, temples) may be disturbed by noise, dust, vibration and impeded access	M	T	Identify buildings at risk from vibration damage and avoid using pneumatic drills nearby	Contractor	Network sites									0
			As above: remove waste quickly, cover/spray stockpiles, cover soil when carried on trucks											0
			As above: increase workforce to finish work quickly											0
			As above: use bridges to allow access (people/vehicles)											0
			Use modern vehicles/machinery & maintain as specified	Contractor	All sites									0
			Consult relevant authorities, custodians of buildings, local people to address issues & avoid work at sensitive times	Contractor	Network sites									0
Workers and the public are at risk from accidents on site	M	T	Prepare and implement a site Health and Safety Plan that includes measures to:	Contractor	All sites									0
			- Exclude the public from site;											0
			- Ensure that workers use Personal Protective Equipment											0
			- Provide Health & Safety Training (including process of transmission of HIV/AIDS) for all personnel;											0
			- Follow documented procedures for all site activities;											0
			- Keep accident reports and records.											0
Existing water supply system uses AC pipes, a material that can be carcinogenic if inhaled as dust particles	S	T	Design infrastructure to avoid locations of AC pipes	DSC	Network									0
			Train all construction personnel in dangers of AC pipes and how to recognise them in situ	Contractor	All sites									0
			Develop and apply protocol if AC pipes are encountered. This should include:	DSC and Contractor	Network sites									0
			- immediate reporting of any occurrence to management	Contractor	Network sites									0
			- removal of all persons to a safe distance											0
			- use of appropriate breathing apparatus and protective suits by workers delegated to deal with AC material											0
			- safe removal and long-term disposal of AC material											+
Economic benefits for people employed in workforce	M	T	As above: 50% of workforce from affected communities	Contractor	All sites									+
Operation and Maintenance														
Leaking sewers can damage human health and	M	T	Detect and repair sewer leaks rapidly and	GA	Network									0

Potential Negative Impacts	Sig	Dur	Mitigation Activities and Method	Responsibility	Location	2008				2009				
						D	D	3	4	1	2	3	Op	3
contaminate soil and groundwater			effectively		sites									
Sludge is removed from treatment ponds every 5 years	S	T	Dry sludge and test for absence of bacteria & pathogens	GA	STP									0
			Sell dried sludge to farmers to fertilize land											+
Shops may lose small amounts of income if customers' access is impeded by network repair works	S	T	As before: inform shopkeepers of work in advance	GA	Network sites									0
			As before: provide walkways and bridges for vehicles	OMC										0
			As before: request police to divert traffic if necessary	OMC										0
Sites of social/cultural importance may be disturbed by noise, dust, vibration, impeded access for short time during network repairs	S	T	As before: avoid using drills/trucks near fragile buildings	OMC	Network sites									0
			As before: finish work quickly in sensitive areas	OMC										0
			As before: provide walkways and bridges for vehicles	OMC										0
			As before: consult authorities and communities, inform them of work in advance, avoid sensitive periods	GA										0
Health and safety of workers & the public could be at risk from repair work and AC pipes of old water supply system	M	T	Prepare and operate H&S plan with same measures as used in construction phase	OMC	All sites									0
			Apply previously-developed protocol to protect all persons if AC pipes are encountered											0
Local people will benefit if employed by project	M	P	STP workers should be residents of neighbouring areas	GA	STP									+

149. Resettlement issues will be coordinated centrally by a Resettlement Specialist within the IPMU, who will ensure consistency of approach between towns. A local Resettlement Specialist will also be appointed to IPIUs of zones in which there are resettlement impacts and they will prepare and implement local Resettlement Plans following the framework established in Tranche 1.

150. Environmental issues will be coordinated by an Environmental Specialist within the IPMU/ IPMC, who will ensure that all subprojects comply with environmental safeguards. An Environmental Monitoring Specialist (EMS) who is part of the DSC team will implement the Environmental Monitoring Plan from each IEE (see below), to ensure that mitigation measures are provided and protect the environment as intended. Domestic Environmental Consultants (DEC) will be appointed by each IPIU to update the existing IEEs in the detailed design stage, and to prepare IEEs or EIAs for new subprojects, where required to comply with national law and/or ADB procedure.

C. Environmental Monitoring Plan

151. **Table 7.1** shows that most mitigation activities are the responsibility of the Construction Contractors[4] (CC) employed to build the infrastructure during the construction stage, or the O&M Contractors employed to conduct maintenance or repair work when the system is operating. Responsibility for the relevant measures will be assigned to the Contractors via the contracts through which they are appointed (prepared by the DSC during the detailed design stage), so they will be legally required to take the necessary action. There are also some actions that need to be taken by LSGD in their role as project proponent, and some actions related to the design that will be implemented by the DSC.

152. A program of monitoring will be conducted to ensure that all parties take the specified action to provide the required mitigation, to assess whether the action has adequately protected the environment, and to determine whether any additional measures may be necessary. This will be conducted by a qualified Environmental Monitoring Specialist (EMS) from the DSC. The EMS will be responsible for all monitoring activities and reporting the results and conclusions to the IPMU, and will recommend remedial action if measures are not being provided or are not protecting the environment effectively. The EMS may be assisted by environmental specialists in particular technical fields, and junior or medium-level engineers who can make many of the routine observations on site. Post-construction monitoring will be conducted by the relevant Government Agency (GA) to whom responsibility for the infrastructure will pass once it begins to operate[5].

153. **Table 7.1** shows that most of the mitigation measures are fairly standard methods of minimising disturbance from building in urban areas (maintaining access, planning work to avoid sensitive times, finding uses for waste material, etc), and experienced Contractors should be familiar with most of the requirements. Monitoring of such measures normally involves making observations in the course of site visits, although some require more formal checking of records

[4] During implementation the contractor will submit monthly progress reports, which includes a section on EMP implementation to the IPIU. The IPIU will submit reports to the IPMU for review. The IPMU will review progress reports to ensure that the all mitigation measures are properly implemented. The IPMU will consolidate monthly reports and submit quarterly reports to ADB for review

[5] In the operational period some infrastructure will be the responsibility of the Municipal Boards/Councils, whilst others will be the responsibility of the appropriate branch of the State government (such as PWD, PHED, etc)

and other aspects. There will also be some surveys of residents, as most of the measures are aimed at preventing impacts on people and the human environment.

154. **Table 7.2** shows the proposed Environmental Monitoring Plan (EMP) for this subproject, which specifies the various monitoring activities to be conducted during all phases. Some of the measures shown in **Table 7.1** have been consolidated to avoid repetition, and there has been some re-ordering to present together those measures that relate to the same activity or site. The EMP describes: (i) mitigation measures, (ii) location, (iii) measurement method, (iv) frequency of monitoring and (v) responsibility (for both mitigation and monitoring). It does not show specific parameters to be measured because as indicated above, most measures will be checked by simple observation, by checking of records, or by interviews with residents or workers.

155. Given the scale of the investment in providing the infrastructure, LSGD will also wish to conduct monitoring during the operational period to ensure the correct functioning of the STP and confirm the long-term benefits of the scheme. There will also be bacteriological surveys when the STP is operating, to ensure the safety of dried sludge and treated effluent before sale to farmers to fertilize and irrigate fields. **Table 7.2** shows that these long-term surveys will monitor:

- the chemical and bacteriological quality of treated STP effluent;
- the bacteriological content of dried sewage sludge;
- the health of the population and the prevalence of diseases of poor sanitation.

156. An accredited consulting laboratory will be appointed to collect and analyse samples of treated effluent and dried sludge once per month for the first five years of operation of the STP. A domestic social studies consultant will be appointed to monitor public health and the incidence of disease, once per year over the same five year period, after collecting baseline data during the construction period.

D. Environmental Management and Monitoring Costs

157. Most of the mitigation measures require the contractors to adopt good site practice, which should be part of their normal procedures already, so there are unlikely to be major costs associated with compliance. Regardless of this, any costs of mitigation by the contractors (those employed to construct the infrastructure or the local companies employed to conduct O&M when the system is operating) are included in the budgets for the civil works and do not need to be estimated separately here. Mitigation that is the responsibility of LSGD will be provided as part of their management of the project, so this also does not need to be duplicated here. Costs of compensating shopkeepers for loss of business income during the construction period (**Table 7.1**) are calculated separately in the budgets for the Resettlement Framework and Resettlement Plans so are also excluded from this analysis.

158. The remaining actions in the Environmental Management Plan are:

- The environmental monitoring during construction, conducted by the EMS;
- The long-term post-construction surveys that will be commissioned by LSGD.

159. These have not been budgeted elsewhere, and their costs are shown in **Table 7.3,** with details of the calculations shown in footnotes beneath the table. The figures show that the total cost of environmental management and monitoring for the project as a whole (covering design, 1 ½ years of construction and the first five years of operation) is INR 2.25 million, ie US$ 52,442.

Table 7.2: Environmental Monitoring Plan

Mitigation Activities and Method	Location	Responsible for Mitigation	Monitoring Method	Monitoring Frequency	Responsible for Monitoring
LOCATION AND DESIGN					
Sell treated wastewater to farmers for irrigation, development of water ponding system	STP	GA	Site observation; farmer survey	Monthly	
CONSTRUCTION					
Find beneficial uses for waste soil (construction, land raising, infill)	All sites	Contractor	Site observations; CC records	Monthly	EMS
Remove waste soil as soon as it is excavated	All sites	Contractor	Site observations	Weekly	EMS
Use tarpaulins to cover soil when transported on trucks	All sites	Contractor	Site observations	Weekly	EMS
Avoid Barmer Town and narrow local roads when transporting soil	From STP	Contractor	Observations off site; CC record	Weekly	EMS
Avoid transporting soil during peak traffic periods	From STP	Contractor	Observations on and off site	Weekly	EMS
Cover or damp down stockpiled soil in dry weather	Inhabited areas	Contractor	Site observations	Weekly	EMS
Conduct all excavation work in the dry season	All sites	Contractor	Site observations	Monthly	EMS
Pump groundwater from excavated areas and provide to farmers	STP site	Contractor	Site observations; farmer survey	Monthly	EMS
Leave spaces for access between mounds of soil	Network sites	Contractor	Site observations	Weekly	EMS
Provide bridges to allow people & vehicles to cross open trenches	Network sites	Contractor	Site observations	Weekly	EMS
Only remove trees if it cannot be avoided	All sites	Contractor	Site observations	Weekly	EMS
Plant and maintain two trees for every one removed	All sites	Contractor	Observations on/off site; CC records	Monthly	EMS
*Compensate businesses for lost income	Where required	LSGD	Shopkeeper survey; LSGD record	As needed	IMA[6]
Increase workforce in inhabited areas to finish work quickly	Network sites	Contractor	Site observations; CC records	Monthly	EMS
Inform shopkeepers and residents of work in advance	Network sites	LSGD	Resident surveys; CC records	Monthly	EMS
Confirm location of infrastructure and avoid these sites	Network sites	DSC	Site observation; design reports	Monthly	EMS
Locate water and sewer pipes on opposite sides of roads	Network sites	DSC	Site observation; design reports	Monthly	EMS
Integrate subprojects to conduct trenching at same time	Network sites	DSC/LSGD	Site observation; design reports	Monthly	EMS
If work will affect traffic, conduct when traffic is light	Network sites	Contractor	Site observations; CC records	Monthly	EMS
Ensure police provide traffic diversions when required	Network sites	Contractor	Site observations; CC records	Monthly	EMS
Request archaeological authorities to assess potential of all sites	All sites	DSC	DSC records; design reports	As needed	EMS
Select alternatives if sites have medium or high potential	All sites	DSC	DSC records; design reports	As needed	EMS
Include state and town historical authorities as stakeholders	All sites	LSGD	CC records; observations at meetings	As needed	EMS
Develop and apply archaeological protocol to protect chance finds	All sites	DSC and CC	DSC and CC records; site observations	Weekly	EMS
Plan transport routes to avoid narrow streets, important or fragile buildings, religious and tourism sites	Network sites	Contractor	Observations off site: CC record	Weekly	EMS
Plan work to avoid peak traffic and main tourism season	Network sites	Contractor	Site observations; CC records	Monthly	EMS

[6] Resettlement issues (asterisked) will be monitored by an Independent Monitoring Agency (IMA) established under the Resettlement Framework

Mitigation Activities and Method	Location	Responsible for Mitigation	Monitoring Method	Monitoring Frequency	Responsible for Monitoring
Avoid using pneumatic drills near buildings at risk from vibration	Network sites	Contractor	Site observations; CC records	Weekly	EMS
Use modern vehicles and machinery and maintain as specified	All sites	Contractor	Site observations; CC records	Monthly	EMS
Consult authorities, custodians of buildings, communities: address key issues, avoid working at sensitive times	Network sites	Contractor	Site observations; CC records; resident surveys	Monthly	EMS
Prepare and implement a site H&S Plan including personal protection from transmission of HIV/AIDS (safety of workers/public)	All sites	Contractor	Site observations; CC records	Monthly	EMS
Exclude public from the site	All sites	Contractor	Site observations; CC records	Monthly	EMS
Ensure that workers wear Personal Protective Equipment	All sites	Contractor	Site observations; CC records	Monthly	EMS
Provide Health and Safety training including process of transmission of HIV/AIDS for all personnel	All sites	Contractor	CC records; worker interviews	Monthly	EMS
Follow documented procedures for all site activities	All sites	Contractor	Site observations; CC records	Monthly	EMS
Keep accident reports and records	All sites	Contractor	CC records	Monthly	EMS
Design infrastructure to avoid known locations of AC pipes	Network sites	DSC	DSC records; design reports	As needed	EMS
Train all personnel in dangers and recognition of AC pipes	All sites	Contractor	Site observations; CC records	Monthly	EMS
Develop and apply protocol if AC pipes are encountered	All sites	DSC/CC	DSC & CC records; site observations	Weekly	EMS
If AC pipes are encountered, report to management immediately	All sites	Contractor	Site observations; CC records	Weekly	EMS
Remove all persons to safe distance	All sites	Contractor	Site observations; CC records	Weekly	EMS
Workers handling AC: wear breathing apparatus; protective suits	All sites	Contractor	Site observations; CC records	Weekly	EMS
All AC material must be removed and disposed of safely	All sites	Contractor	Observations on and off site; CC records	As needed	EMS
Employ at least 50% of workforce from communities near sites	All sites	Contractor	CC records; worker interviews	Monthly	EMS
OPERATION AND MAINTENANCE					
Detect and repair sewer leaks rapidly and effectively	Network sites	GA	Site observation; resident survey	Monthly	
Sell dried inert sludge to farmers to fertilize land, ponding of water to introduce aquaculture	STP	GA	Site observation; farmer survey	Monthly	
Inform shopkeepers and residents of work in advance	Network sites	GA	Resident surveys	Monthly	
Provide walkways and bridges for vehicles	Network sites	OM Contractor	Site observation; resident survey	Monthly	
Request police to divert traffic if necessary	Network sites	OM Contractor	Site observations	Monthly	
Avoid using drills or heavy vehicles near fragile buildings	Network sites	OM Contractor	Site observations	Monthly	
Finish work quickly in sensitive areas	Network sites	OM Contractor	Site observations; OMC records	Monthly	
Consult communities, avoid working during sensitive periods	Network sites	GA	Site observation; resident survey	Monthly	
Prepare and operate H&S plan to protect workers and citizens	All sites	OM Contractor	Site observations; OMC records	Monthly	
Apply AC protocol to protect all persons if AC pipes encountered	All sites	OM Contractor	Site observations; OMC records	Monthly	
STP workers should be residents of neighbouring areas	STP	GA	Employer record; worker survey	Monthly	
LONG-TERM SURVEYS					
Survey of chemical and bacteriological quality of STP effluent	STP	GA	Water quality sampling/analysis	Monthly for 5 years	Consulting lab
Bacteriological surveys of dried STP sludge	STP	GA	Bacterial sampling/analysis		Consulting lab
Survey of public health and incidence of water borne disease	Barmer Town	GA	Hospital records; resident surveys	Annual for 6 years	Social studies consultant

Table 7.3: Environmental Management and Monitoring Costs (INR)

Item	Quantity	Unit Cost	Total Cost	Sub-total
1. Implementation of EMP (2 years)				
Domestic Environmental Monitoring Specialist	1 x 3 month	130,000[7]	390,000	
Survey Expenses	Lumpsum	100,000	100,000	490,000
2. Survey of STP sludge and effluent (5 years)				
Domestic Consultant	5 x ½ month	130,000	325,000	
Sample Analysis	5 x 20	3,500[8]	350,000	
Other Expenses	Lumpsum	200,000	200,000	875,000
3. Survey of public health (6 years)				
Domestic Consultant	6 x ½ month	130,000	390,000	
Expenses	Lumpsum	200,000	200,000	590,000
4. Environmental mitigation measures including greenery development	Lumpsum	300,000	300,000	300,000
TOTAL				**2,255,000**

E. Associated Facilities

160. There are no upstream associated facilities in this subproject; however, the downstream users of treated water can be considered associated to the facility.

161. If the Sewage Treatment Plant's (STP's) treated waste water is drained into a *nallah* or discharged into boreholes, care must be taken to properly treat it before it is discharged otherwise the infusion of contaminated waters in the ground aquifers can render the water permanently unfit for human consumption.

162. Inappropriate waste water disposal pollutes the receiving waters such as rivers, *nallahs*, water ponding systems for aquaculture and may render them unfit for abstraction and treatment if toxic in nature. These *nallahs*, rivers or farmers which "take away/use" this waste water are deemed to be endusers of the wastewater from the STP. Therefore before disposal, all Indian wastewater discharge standards must be met in full and proper records must be maintained.

VIII. PUBLIC CONSULTATION AND INFORMATION DISCLOSURE

A. Project Stakeholders

163. Most of the main stakeholders have already been identified preliminary. If any other stakeholders that are identified during project implementation will be brought into the process in the future. Primary stakeholders are:

- Residents, shopkeepers and business people who live and work alongside the roads in which network improvements will be provided and near sites where facilities will be built

[7] Unit costs of domestic consultants include fee, travel, accommodation and subsistence
[8] Cost of a standard bacteriological analysis (total and faecal coliforms, E.coli, enterococci, etc) is $90 (INR 3,500) per sample

- Owners and users of any land that is acquired along the trunk/ outfall main route;
- Custodians and users of socially and culturally important buildings in affected areas;
- State and local authorities responsible for the protection and conservation of archaeological relics, historical sites and artefacts;
- State and local tourism authorities.

164. Secondary stakeholders are:

- LSGD as the Executing Agency;
- Other government institutions whose remit includes areas or issues affected by the project (state and local planning authorities, Department of Public Health Engineering, Local Government Dept, Ministry of Environment and Forests, Roads and Highways Division, etc);
- NGOs and CBOs working in the affected communities;
- Other community representatives (prominent citizens, religious leaders, elders, women's groups);
- The beneficiary community in general; and
- The ADB.

B. Consultation and Disclosure to Date

165. Some informal discussion was held with the local people during site visit Issues discussed are

- Awareness and extent of the project and development components
- Benefits of Project for the economic and social Upliftment of Community
- Labour availability in the Project area or requirement of outside labour involvement
- Local disturbances due to Project Construction Work
- Necessity of tree felling etc. at project sites
- Water logging and drainage problem if any
- Drinking water problem
- Forest and sensitive area nearby the project site
- Movement of wild animal around the project site

166. Local populations are very much interested on the project and they will help project authorities in all aspects. Public consultation results specifically on environmental issues are shown in **Appendix – VIII-A**

167. Major concerns were made on the necessity of adequate access road during the laying of sewer lines and the possible dust and noise problems during construction phase. Also some concerns made on the necessity of proper safety arrangements. Hence necessary provisions shall be provided to avoid the traffic snarl during the construction.

168. The public Consultation and group discussion meeting were conduct by RUIDP on Date 7 June, 2008 after advertising in Local NEWS papers. The objective of the meeting was to appraise the stakeholders about the environmental and social impacts of the proposed program and the safeguards provided in the program to mitigate the same. In the specific context of Barmer, the environmental and social impacts of the proposed subprojects under Tranche 2 in Barmer were discussed.

169. Meetings and individual interviews were held at potentially temporarily affected areas; and local informal interviews were conducted to determine the potential impacts of sub-project construction to prepare the sample Environmental Framework. A town-wise stakeholder consultation workshop was conducted which provided an overview of the Program and sub-projects to be undertaken in Barmer; and discussed the Government and ADB's Environment policies acts and potential environment impacts of the sub-projects in Barmer. During the workshop, Hindi versions of the Environmental Framework were provided to ensure participants understood the objectives, policy principles and procedures related to Environment, English and Hindi versions of the Environmental Framework have been placed in the Urban Local Body (ULB) office and Environmental Framework will be provided later on. The NGO to be engaged to implement the Mitigation Measures will continue consultations, information dissemination, and disclosure. The Environmental Framework will be made available in the ULB office, Investment Program Project Management Unit and Implementation Unit (IPMU and IPIU) offices, and the town library. The finalized IEE containing Mitigation Measures will also be disclosed in ADB's website, the State Government website, the local government website, and the IPMU and IPIU websites. ADB review and approval of the RP is required prior to award of civil works contracts.

C Major Issues Discussed During Public Consultation Are

(i) Proposed waste water management project should ensure proper hygienic disposal of sewerage water in all wards of city.

(ii) Executive agency should give preference to engage internationally reputed contractor like Gammon, HCC, etc as people do not faith about the local contractors in respect of quality of works as well as timely completion of work;

(iii) Livelihood affected households should be given assistance in the mode of cash compensation;

(iv) Local people should be employed by the contractor during construction work;

(v) Adequate safety measures should be taken during construction work;

(vi) Mobile kiosks/vendors/hawkers have shown willingness to shift in nearby places without taking any compensation and assistance from the Executing Agency;

(vii) Local people have appreciated the waste water management proposal of the government and they have ensured that they will cooperate with the Executing Agency during project implementation.

D. Future Consultation and Disclosure

170. LSGD will extend and expand the consultation and disclosure process significantly during implementation of RUSDIP. They will appoint an experienced NGO to handle this key aspect of the programme, who will conduct a wide range of activities in relation to all subprojects in each town, to ensure that the needs and concerns of stakeholders are registered, and are addressed in project design, construction or operation where appropriate. The programme of activities will be developed during the detailed design stage, and is likely to include the following:

- Consultation during detailed design:
  - Focus-group discussions with affected persons and other stakeholders (including women's groups, NGOs and CBOs) to hear their views and concerns, so that these can be addressed in subproject design where necessary;
  - Structured consultation meetings with the institutional stakeholders (government bodies and NGOs) to discuss and approve key aspects of the project.
- Consultation during construction:
  - Public meetings with affected communities to discuss and plan work programmes and allow issues to be raised and addressed once construction has started;
  - Smaller-scale meetings to discuss and plan construction work with individual communities to reduce disturbance and other impacts, and provide a mechanism through which stakeholders can participate in subproject monitoring and evaluation;
- Project disclosure:
  - Public information campaigns (via newspaper, TV and radio) to explain the project to the wider city population and prepare them for disruption they may experience once the construction programme is underway;
  - Public disclosure meetings at key project stages to inform the public of progress and future plans, and to provide copies of summary documents in Hindi;
  - Formal disclosure of completed project reports by making copies available at convenient locations in the study towns, informing the public

of their availability, and providing a mechanism through which comments can be made.

IX. FINDINGS AND RECOMMENDATIONS

A. Findings

171. The Project is designed to improve the quality of life of small town residents and enhance the small towns' roles as market, services, and manufacturing centers. . It has a strong community development focus reinforced by integrated poverty reduction, health and hygiene improvement investment projects. The towns' economies will benefit from enhanced productivity as a result of health improvement, time savings in collecting water, as well as from increased urban efficiency arising from improved roads, bridges, drainage, drinking water and sanitation. Residents in towns will also benefit from savings in health care costs.

172. During project design, community meetings were held with beneficiaries to discuss sanitation, poverty, resettlement, affordability issues, and environmental concerns. Socioeconomic surveys obtained information and individual views on current situations and future preferences. Potential environmental impacts of urban infrastructure improvements are mainly short-term during the construction period and can be minimized by the proposed mitigating measures and environmentally sound engineering and construction practices.

173. The process described in this document has assessed the environmental impacts of all elements of the infrastructure proposed under the Barmer Sewerage and Sanitation Subproject. Potential negative impacts were identified in relation to construction and operation of the improved infrastructure, and the design and location of the subproject. Mitigation measures have been developed to reduce all negative impacts to acceptable levels. These were discussed with specialists responsible for the engineering aspects, and as a result some measures have already been included in the outline designs for the infrastructure. These include:

- Locating the trunk main and sewerage networks within the ROW of existing roads, to avoid the need to acquire land or relocate people;
- Locating sewers on unused land adjacent to roads wherever possible, to avoid damaging roads and disrupting traffic and other activities.

174. This means that the number of impacts and their significance has already been reduced by amending the design.

175. Changes have also been made to the location of elements of the project to further reduce impacts. These include:

- Locating the STP on government-owned land to avoid the need for land acquisition and relocation of people;
- Locating the trunk main in the ROW alongside the Road, to avoid acquiring agricultural land and affecting the livelihoods of farmers and farm workers.

176. Regardless of these and various other actions taken during the IEE process and in developing the subproject, there will still be impacts on the environment when the infrastructure

is built and when it is operating. This is mainly because of the invasive nature of trenching work and the excavation of ponds at the STP site; because the sewer network is located in a town, some parts of which are densely populated; and because Rajasthan is an area with a rich history, in which there is a high risk that ground disturbance may uncover important remains. Because of these factors the most significant impacts are on the physical environment, the human environment, and the cultural heritage.

177. During the construction phase, impacts mainly arise from the need to dispose of large quantities of waste soil; and from the disturbance of residents, businesses, traffic and important buildings by the construction work. These are common impacts of construction in urban areas, and there are well developed methods for their mitigation. These include:

- Finding beneficial uses for waste material;
- Covering soil and sand during transportation and when stored on site;
- Planning work to minimise disruption of traffic and communities;
- Providing temporary structures to maintain access across trenches where required.

178. Although there will be no need to acquire land or relocate people, roadside businesses will lose some income as access will be difficult for customers when work is in their vicinity. ADB policy requires that no-one should be worse off as a result of an ADB-funded project, so these losses will be compensated through a Resettlement Plan and Framework prepared to comply with Bank policy on Involuntary Resettlement.

179. One field in which impacts are much less routine is archaeology, and here a series of specific measures have been developed to avoid damaging important remains. These include:

- Assessing the archaeological potential of all proposed construction sites, and selecting alternative locations to avoid any areas of medium or high risk;
- Including archaeological, cultural and historical authorities and interest groups as project stakeholders to benefit from their expertise;
- Developing a protocol for use in conducting all excavation to ensure that any chance finds are recognised, protected and conserved.

180. Special measures were also developed to protect workers and the public from exposure to carcinogenic asbestos fibers in the event that Asbestos Cement pipes used in the existing water supply system are encountered accidentally during excavation work. These are to:

- Avoid all known sites of AC pipes when the locations of new infrastructure are planned in the detailed design stage;
- Train all construction personnel to raise awareness of the dangers of AC and enable early recognition of such pipes if encountered;

- Develop and apply a protocol to protect workers and the public if AC pipes are encountered (including evacuation of the immediate area, use of protective equipment by workers, and safe removal and disposal of AC material).

181. There were limited opportunities to provide environmental enhancements, but certain measures were included. For example it is proposed that the project will:

- Employ in the workforce people who live in the vicinity of construction sites to provide them with a short-term economic gain;

- Ensure that people employed in the longer term to maintain and operate the new STP are residents of nearby communities.

182. These and the other mitigation and enhancement measures are summarised in **Table 7.1,** which also shows the location of the impact, the body responsible for the mitigation, and the programme for its implementation.

183. On completion the sewerage system should operate with routine maintenance, which should not significantly affect the environment, providing certain pre-conditions are met. These are that:

- The operation and integrity of sewers are checked regularly and any leaks are repaired rapidly and effectively to avoid public health risks and contamination of land and water;

- Treated effluent from the STP is sold to farmers to fertilize and irrigate fields instead of being discharged into a nearby nallah. Water ponding system could also be established for development of acqua-culture in treated water.

184. The repair of sewers will have fewer environmental impacts than the original sewer construction as the work will be infrequent and will affect small areas only. It will also be conducted in areas that have already been excavated, so there will be no need to protect archaeological material.

185. The regular removal of sludge from the treatment ponds should also have no environmental impacts, and if tests show that the drying procedure removes bacterial contamination the material should be sold to farmers to fertilize soil, as this will provide an environmental gain and some cost recovery.

186. The main impacts of the operating sewerage system will be beneficial as human waste from those areas served by the new network will be removed rapidly and treated to an acceptable standard. This will improve the environment and appearance of these areas, and the health and quality of life of the citizens. Diseases of poor sanitation should be reduced, which should lead to economic gains as people will be away from work less and will spend less on healthcare, so their incomes should increase.

187. **Table 7.1** also assesses the effectiveness of each mitigation measure in reducing each impact to an acceptable level. This is shown as the level of significance of the residual impact (remaining after the mitigation is applied). This shows that all impacts will be rendered at least neutral (successfully mitigated), and that certain measures will produce a benefit (in addition to the major benefits provided by the operating scheme).

188. Mitigation will be assured by a program of environmental monitoring conducted during both construction and operation to ensure that all measures are provided as intended, and to determine whether the environment is protected as envisaged. This will include observations on and off site, document checks, and interviews with workers and beneficiaries, and any requirements for remedial action will be reported to the IPMU. There will also be longer-term surveys to ensure the safety of sewage sludge and treated effluent for use in agriculture, and to monitor the expected improvements in the health of the population.

B. Recommendations

189. There are two straightforward but essential recommendations that need to be followed to ensure that the environmental impacts of the project are successfully mitigated. These are that LSGD should ensure that:

- All mitigation, compensation and enhancement measures proposed in this environmental status report (**Table 7.1**) are implemented in full, as described in the text above;
- The Environmental Monitoring Plan proposed in Section VII.C of this report is also implemented in full.

X. CONCLUSIONS

190. The environmental status of the proposed improvements in sewerage and sanitation in Barmer Town has been assessed. Issues related to Involuntary Resettlement were assessed by a parallel process of resettlement planning and will be compensated by measures set out in detail in the Resettlement Framework for the subproject.

191. The overall conclusion of both processes is that providing the mitigation, compensation and enhancement measures are implemented in full, there should be no significant negative environmental impacts as a result of location, design, construction or operation of the subproject. There should in fact be some small benefits from recommended mitigation and enhancement measures, and major improvements in quality of life and individual and public health once the scheme is in operation.

192. There are no uncertainties in the analysis, and no further studies are required to comply with ADB procedure or national law.

APPENDIX – II-A

PHOTOGRAPHS

Annexure II A Photo Gallery

	
STP Site Barmer	STP Site Barmer
	
Way to STP Site	Shrubs on STP Site
	
Alignment for Sewer Pipelines	

APPENDIX – V-A: REA CHECKLIST

RAPID ENVIRONMENTAL ASSESSMENT (REA) CHECKLIST

Country/Project Title: India/Rajasthan (Barmer) Urban Sector Development Investment Programme (Tranche-II).

Sub-Project: **Design and Construction of Sewage Treatment Plant**

Including Supply, Laying, Jointing, Testing of Sewer – Barmer town

Item	Screening Questions	Yes/No	Remarks
A	Is the project area …		
	• Densely populated	No	The proposed STP is 7 km away from the human settlement zone and no residential colony comes under 500 m area from STP site. Village Kundla in the vicinity of STP site (More than 500 m away)
	• Heavy with development activities	No	Land around STP site is either open land or agricultural land.
	• Adjacent to or within to any environmentally sensitive area		
	▪ Cultural heritage site	No	There is no cultural heritage nearby our STP site. Some heritage temples and small religious places like Rani Bhatyani Mandir, Durga Mata Mandir, Hanuman Mandir are comes under main trunk line area but there will be no influence of project on these cultural & heritage sites because our work will be done after proper safeguard to these sites. We will make a proper Environmental Management System (EMS).
	▪ Protected area	No	No forest land is there nearby our STP site
	▪ Wetland	No	There is no wetland area nearby our project site
	▪ Mangrove	No	There is no mangrove nearby our project site
	▪ Estuarine	No	There is no estuarine nearby our project site
	▪ Buffer zone of protected area	No	There is no buffer zone of protected area nearby our project site
	▪ Special area of protecting biodiversity	No	There is no special area of protecting biodiversity nearby our project site, so there is no harm to our biodiversity.
	▪ Bay	No	Not applicable
B	B. Potential Environmental Impacts Will The Project Cause…		
	• Impairment of	No	There is no harm to historical/cultural monuments,

Item	Screening Questions	Yes/No	Remarks
	historical/cultural monuments/areas and loss/damage to these sites?		because no such area comes nearby our STP Site. Some heritage temples and small religious places like Rani Bhatyani Mata Mandir, Durga Mata Mandir, Hanuman Mandir are comes under main trunk line area but there will be no influence of project on these cultural & heritage sites because project work will be done after proper safeguard to these sites. Proper Environmental Management System (EMS) will be applied
	• Interference with other utilities and blocking of access to buildings; nuisance to neighboring areas due to noise, smell, and influx of insects, rodents, etc.?	Yes	There is no interference with other utilities nearby. There is a village Kundla in the vicinity of STP site (More than 500 m away) which may be slightly impacted due to noise, smell and influx of insects. Mitigation measures like development of buffer zone around the STP will be required
	• Dislocation of involuntary resettlement of people	No	Our STP site is 7 km away from the residential areas. This has been done to avoid the problem of involuntary resettlement of people. The land issued for STP is govt. land and no residential colonies nearby our project site.
	• Impairment of downstream water quality due to inadequate sewage treatment or release of untreated sewage?	No	Wastewater after treatment will be discharged to the open land by achieving the norms for open land discharge as specified by the RPCB, This treated wastewater will be used for irrigation purposes and also for small scale business like fish production.
	• Overflows and flooding of neighboring properties with raw sewage?	No	Sewer line project is designed for the year 2041 by keeping in mind all the necessary factors for designing of sewerage line project for small town like peak factor & d/D ratio. There will be no chances of overflow / flooding.
	• Environmental pollution due to inadequate sludge disposal or industrial waste discharges illegally disposed in sewers	No	Sewerage line project is designed for treatment of domestic wastewater only, proper checking will be done if any industry will discharge its effluent with the domestic sewer then strict action will be taken against industry. It will be monitored regularly to avoid this problem.
	• Noise and vibration due to blasting and other civil works?	Yes	Noise during construction activity is natural, but contractor will ensure that the noise level in construction area should in prescribed norms of RPCB. They should check the noise level at every location of construction site, and submit the reports regularly.
	• Discharge of hazardous materials into sewers, resulting in damage to sewer system and danger to works?	No	There will be no chances of discharge of hazardous materials into the sewer. Monitoring will be done at regular interval to avoid this problem.
	• Inadequate buffer zone around pumping and treatment plants to	Yes	Adequate buffer zone will be provided as per guidelines.

Item	Screening Questions	Yes/No	Remarks
	alleviate noise and other possible nuisances and protect facilities?		
	• Social conflicts between construction workers from other areas and community workers?	No	Only temporary settlement will be there, because project completion time is around 3 years. So there are no chances of any conflicts between construction workers and community workers.
	• Road blocking and temporary flooding due to land excavation during the rainy season?	Yes	Alternate routes will be provided to avoid road blockage.
	• Noise and dust from construction activities	Yes	All preventive measures will be taken to control noise and dust at construction site. Sampling will be done at regular interval.
	• Traffic disturbances due to construction material transport and wastes?	Yes	Traffic disturbance would be there during construction work. To control this we will provide diversion road.
	• Temporary silt runoff due to construction	No	There will be no silt runoff during construction
	• Hazards to public health due to overflow flooding, and groundwater pollution due to failure of sewerage system?	No	Hydro testing will be done for sewer lines and manholes are designed as per CPHEEO manual.
	• Deterioration of water quality due to inadequate sludge disposal or direct discharge of untreated sewage water?	No	Sewerage will be discharged after achieving the prescribed norms of RPCB & norms of CPHEEO
	• Contamination of surface and ground waters due to sludge disposal on land?	No	The generated sludge will be disposed off to the secure land fill site after taking prior permission from the RPCB or it will be used as manure.
	• Health and safety hazards to workers from toxic gases and hazardous materials which may be contained in sewage flow and exposure to pathogens in sewage and sludge	No	Contractor will appoint an Environment Health & Safety officer. He will take care of all safety measures during construction phase.

APPENDIX – VI-A

STP- WSP Technology (Approved by CPHEEO)

Waste Stabilization Pond:

Stabilization ponds are open, flow through earthen basins retaining the sewage comparatively long detention periods extending from a few to several days, during which period putrescible matter in the waste is stabilized in the pond through a symbiotic relation between bacteria and algae. They do not require skilled operational staff & their performance do not fluctuate from day to day.

The facultative pond functions aerobically at the surface while an aerobic condition prevails at the bottom. The aerobic layer act as a good check against odor evolution from the pond. The treatment effected by this type of pond is comparable to that of conventional secondary treatment process. The facultative pond is hence best suited and most commonly used for the treatment of sewage.

Process Description:

Waste stabilization pond is a process that will give desired results i.e. deliver a treated effluent' suitable for irrigation purpose (with nutrients and hygienically- safe). The process involves minimal mechanical and electrical equipment for screen, grit removal, flow measurement and minimal operation and maintenance. The routine maintenance will involve removal and disposal of screenings and grit; measurement of flow. Consumption of energy is minimal & O& M will only involve cutting of weeds, removing floating matter, repair of any damage to the embankments.

The waste stabilization pond system will include screen, grit chamber, flow Measuring arrangement, anaerobic pond and facultative pond will considerably reduce the area required. The effluent from the waste stabilization pond will contain algae which is a rich source of nutrients viz. Nitrogen (N), Phosphorous (P) and Potassium (K). The algae deposited on soil are used as organic manures enriching the soil with N, P, . K liberated from algal cells from bacterial action. A certain amount of nutrients in raw sewage, which have not been used for producing algal cells will also, be available in the treated sewage.

In properly designed, operated and maintained ponds, there will be no problem of odour, mosquito and fly nuisance. The percentage. removal of indicator bacteria and pathogens is higher in case of waste stabilization ponds than in case of conventional treatment processes.

No sludge treatment is required to be provided as the sludge collected in the pond is well stabilized. The sludge can be withdrawn after sufficiently long intervals.

THE TREATMENT PLANT SHALL CONSIST OF FOLLOWING UNITS

- Main inlet chamber with distribution chamber
- Bar screen chamber with coarse screen with clear openings of 50mm width and bar screen with 15 mm width
- Grit Chambers The grit chambers shall be able to remove grit particles of size 0.15 mm
- Anaerobic ponds
- Facultative ponds
- Office Building cum laboratory

APPENDIX - VIII-A: PUBLIC CONSULTATION- ENVIRONMENT

PUBLIC CONSULTATION- ENVIRONMENT

STP Site Barmer

Issues discussed

- Awareness and extent of the project and development components
- Benefits of Project for the economic and social Upliftment of Community
- Labour availability in the Project area or requirement of outside labour involvement
- Local disturbances due to Project Construction Work
- Necessity of tree felling etc. at project sites
- Water logging and drainage problem if any
- Drinking water problem
- Forest and sensitive area nearby the project site
- Movement of wild animal within the project area

1. Date & time of Consultation 10:00 AM on 20/06/08
2. Location Kundla Village

.**Table: Issues of the Public Consultation- Design phase**

Sr. No.	Key Issues/Demands	Perception of community
1	Awareness of the project – including coverage area	Few people are aware about this project and coverage area.
2	In what way they may associate with the project	People wants job during construction phase of project
3	Presence of any forest, wild life or any sensitive / unique environmental components nearby the project area	No forest land in the nearby area of project. Some wild animals are found in this area**.**
4	Presence of historical/ cultural/ religious sites nearby	No historical sites nearby. One well and one rainy pond exists in this site.
5	Un favorable climatic condition	No unfavourable climatic condition
6	Occurrence of flood	Flood occurred in 1991
7	Drainage and sewerage problem facing	No sewerage and drainage problem. Individual septic tanks are in use.
8	Present drinking water problem – quantity and quality	Drinking Water is available. There is no problem of quality.
9	Present solid waste collection and disposal problem	No designated site for solid waste disposal. People use nearby land for waste disposal.
10	Availability of labour during construction time	Surplus labour available.
11	Access road to project site	Good accessability at project site

Sr. No.	Key Issues/Demands	Perception of community
12	Perception on tree felling and afforestation	No tree felling involved in this project.
13	Dust and noise pollution and disturbances during construction work	Dust and noise pollution is not a problem in this area.
14	Setting up worker camp site within the village/ project locality	People agreed to cooperate project authority for setting up worker camp within the village
15	Safety of residents during construction phase and plying of vehicle for construction activities	As per local people safety of resident is not an issue, but smell and mosquito may be problem for villager
16	Conflict among beneficiaries down stream users – water supply project using of river water	Not applicable.
17	Requirement of enhancement of other facilities	One pond, one closed well exists in the project – those would be rehabilitate
18	Whether local people agreed to sacrifice their lands (cultivable or not) for beneficial project after getting proper compensation	People do not want to sacrifice their land for this project.

NAME AND POSITION OF PERSONS CONSULTED

1. Mr. Mev Singh	Farmer
2. Mr. Narpat Singh	Farmer
3. Mr. Gaje Singh	Farmer
4. Mr. Mev Singh	Farmer
5. Mr. Devi Singh	Farmer
6. Mr. Nakhta Ram	Farmer
7. Mr. Fateh singh	Farmer
8. Mr. Narayan Singh	Farmer
9. Mr. Parveen Singh	Shopkeeper
10. Mr. Bhopal Singh	Farmer
11. Mr. Prem Singh	Farmer
12. Mr. Madho Singh	Farmer