Government of Rajasthan
Asian Development Bank

Technical Assistance

Project Number: 40031

India: Rajasthan Urban Sector Development Investment Program (RUSDIP)

INITIAL ENVIRONMENTAL EXAMINATION (DRAFT)

JAISALMER: SEWERAGE AND SANITATION SUBPROJECT

September 2008

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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 will be implemented over a five year period beginning in late 2007, 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. Alwar, Jaisalmer and Jhalawar/Jhalrapatan are the towns chosen to benefit from the first tranche of RUSDIP investment.

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, 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 for the first tranche of funding were assessed by 13 Initial Environmental Examination (IEE) Reports and 3 Environmental Reviews, prepared according to ADB Environment Policy (2002) and Environmental Assessment Guidelines (2003). This document is the IEE report for the Alwar Sewerage and Sanitation Subproject.

B. Extent of IEE 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 that 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 classed this program as Category B and following normal procedure for MFF loans has determined that one IEE 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. Category A projects require EC 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 the sewerage and sanitation sub-project that is the subject of this IEE.

3. Review and Approval Procedure

12. For Category B projects the Draft IEE 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 for the Jaisalmer Sewerage and Sanitation subproject. It discusses the environmental impacts and mitigation measures relating to the location, design, construction and operation of all physical works proposed under this subproject. It is one of 18 documents describing the environmental impacts and mitigation of all subprojects proposed in Tranche 1. These documents were prepared in January and February 2007 by one International and one Domestic Environmental Specialist via inputs of two and three months respectively.

II. DESCRIPTION OF THE PROJECT

A. Type, Category and Need

14. This is a sewerage 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 the present sewerage system is inadequate for the needs of the growing population. Sewers are present only inside the fort (serving 2 % of the population), and leaks and overflows damage buildings and detract from the appearance of the area, and as there is no treatment, raw sewage collects on low lying land Gadisar Gate, creating a public health risk. Elsewhere people utilise septic tanks and pit latrines, discharge sewage into drains via illegal connections, or defecate on open ground. This is one of a series of subprojects designed by the RUSDIP that are intended to raise the standards of the municipal infrastructure and services of Jaisalmer and the other urban centres to those expected of modern Asian towns.

B. Location, Size and Implementation Schedule

15. The sub-project is located in Jaisalmer, the headquarters town of Jaisalmer District, in the west of Rajasthan in north-western India (Figure 1). The infrastructure will extend throughout

[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 (February 2007)

many parts of the town, where pipes for new secondary and tertiary sewer networks will be buried within or alongside roadways (Figure 2). A 7 km trunk sewer will follow a roughly circular course alongside roads in the periphery of the town, and a branch will extend north-east along the edge of the Jodhpur road to a new Sewage Treatment Plant (STP), to be built on 8 ha of government land outside Kishangad Village (Figure 3).

16. Detailed design will begin in the middle of 2007 and should be completed by the end of the year. Construction of all elements will begin in early 2008, and the treatment works will be built in around 6 months. Construction of the trunk sewer and networks will take up to 1½ years, so all work should be completed by the middle of 2009.

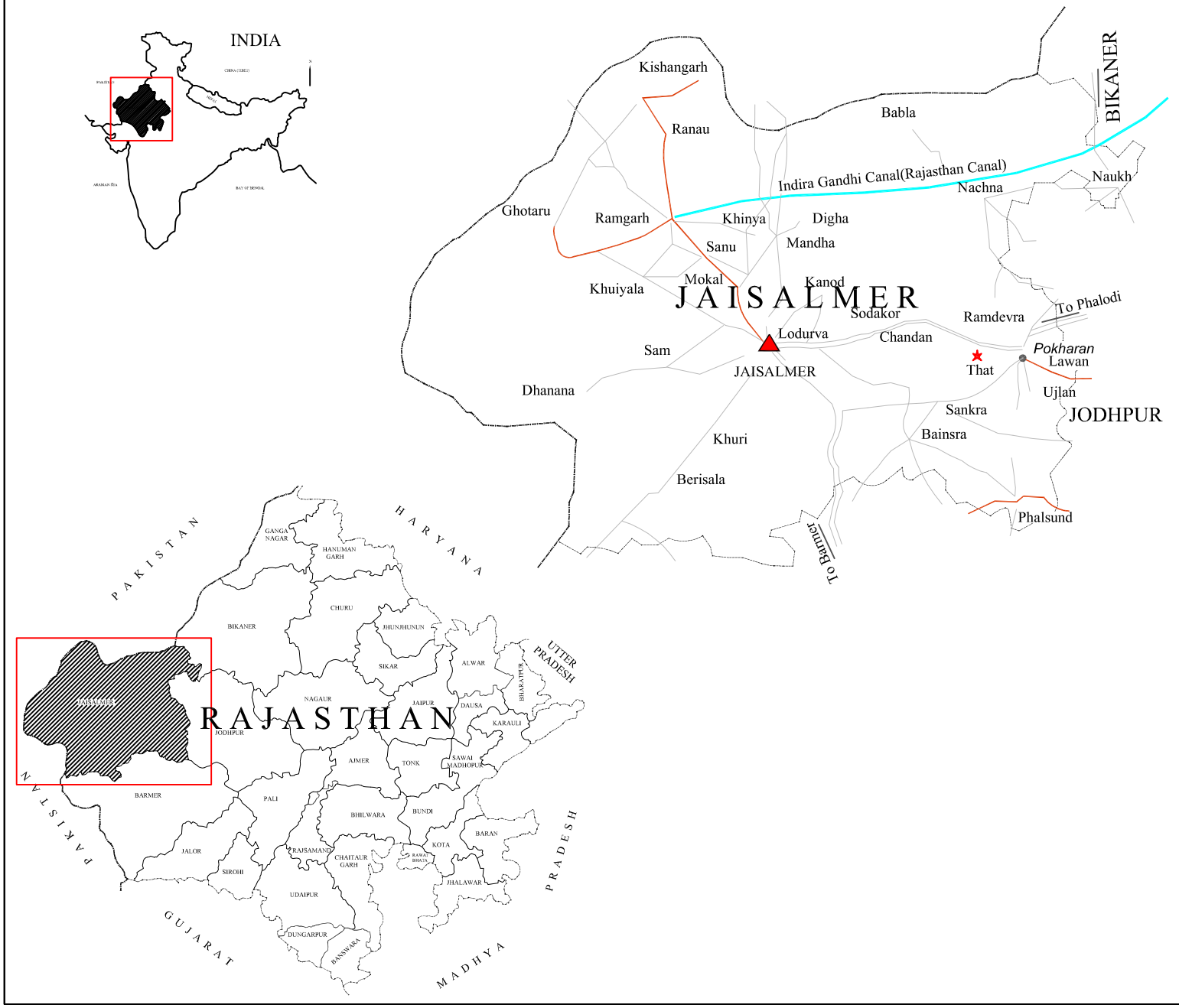
C. Description of the Sub-project

17. Table 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 individual houses; a trunk sewer encircling the town to transport waste to the STP; and a new STP to treat sewage to Indian legal standards. The descriptions shown in Table 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, particularly in the detailed design stage. It should also be noted that at this stage the infrastructure has been designed in outline only, to determine overall feasibility and budget costs, so certain aspects (such as the numbers and sizes of individual treatment ponds) have not yet been finalised.

18. The network pipes will be of Reinforced Cement Concrete (RCC), and will be located alongside roads and streets, in the government-owned Right of Way (RoW). The 14,000 domestic connections will collect sewage from individual houses via 150 mm diameter pipes. These will connect to a 25 km tertiary network of 150-250 mm RCC pipes buried in trenches of around 1.5 m. The 10.2 km secondary network (lateral sewers) will transport sewage into the trunk main, and pipes will be larger (400-600 mm in diameter), located in deeper trenches (ca 2 m).

19. The 7 km trunk sewer will also be of RCC (Photo 1), and will convey sewage from the secondary network to the STP at Kishangad Village. These pipes will be 900 mm in diameter, located in 2.3 m trenches alongside roads in the outskirts of the town. The trunk sewer will form a ring around the town (Figure 2), from which a branch will run alongside the main Jodhpur road to the STP.

20. The STP will be built on 31.78 ha of unused Government land at Kishangad Village (Figure 3; Photo 2), and will consist of two rows of equally sized ponds (approximately 50 x 100 m and 2-3 m in depth) dug into the soil, each with slightly sloping sides and a flat bed (Figure 4; Photo 3). RCC pipe-work and one or two pumping stations will also be built on the site, which will be surrounded by a security fence when completed. Initially STP site planned nearby the defence area (restricted land) but later it is shifted to adjacent government land.



Rajasthan Urban Sector
Development Investment Program
ADB TA 4814-IND

Jalsalmer
Regional Map

LEGEND:-

- International Boundary
- State Boundary
- District Boundary
- Railway
- District Headquarter \ Program Town
- Canal

OVERLAY LEGEND:-

GOVT. OF RAJASTHAN

ASIAN DEVELOPMENT BANK

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Figure :-

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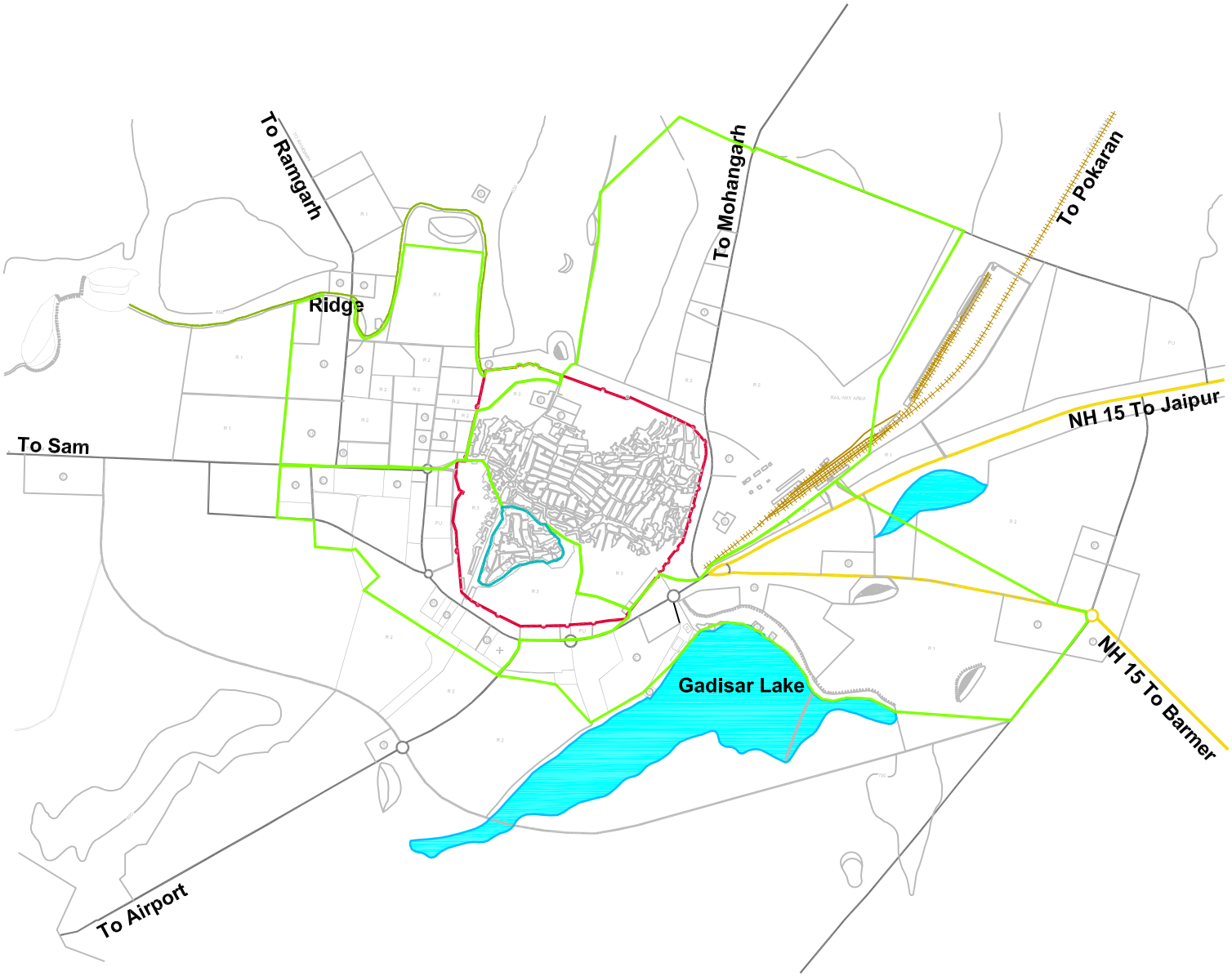

RAJASTHAN URBAN SECTOR DEVELOPMENT INVESTMENT PROGRAM

(ADB TA 4814 - IND)

JAISALMER

Sewerage System

LEGEND:

- Walled City, Jaisalmer
- Water Bodies
- National Highway
- Major Roads
- Railway Track
- Ridge

OVERLAY LEGEND:

- Existing Sewerage network
- Proposed Sewerage network

GOVT. OF RAJASTHAN

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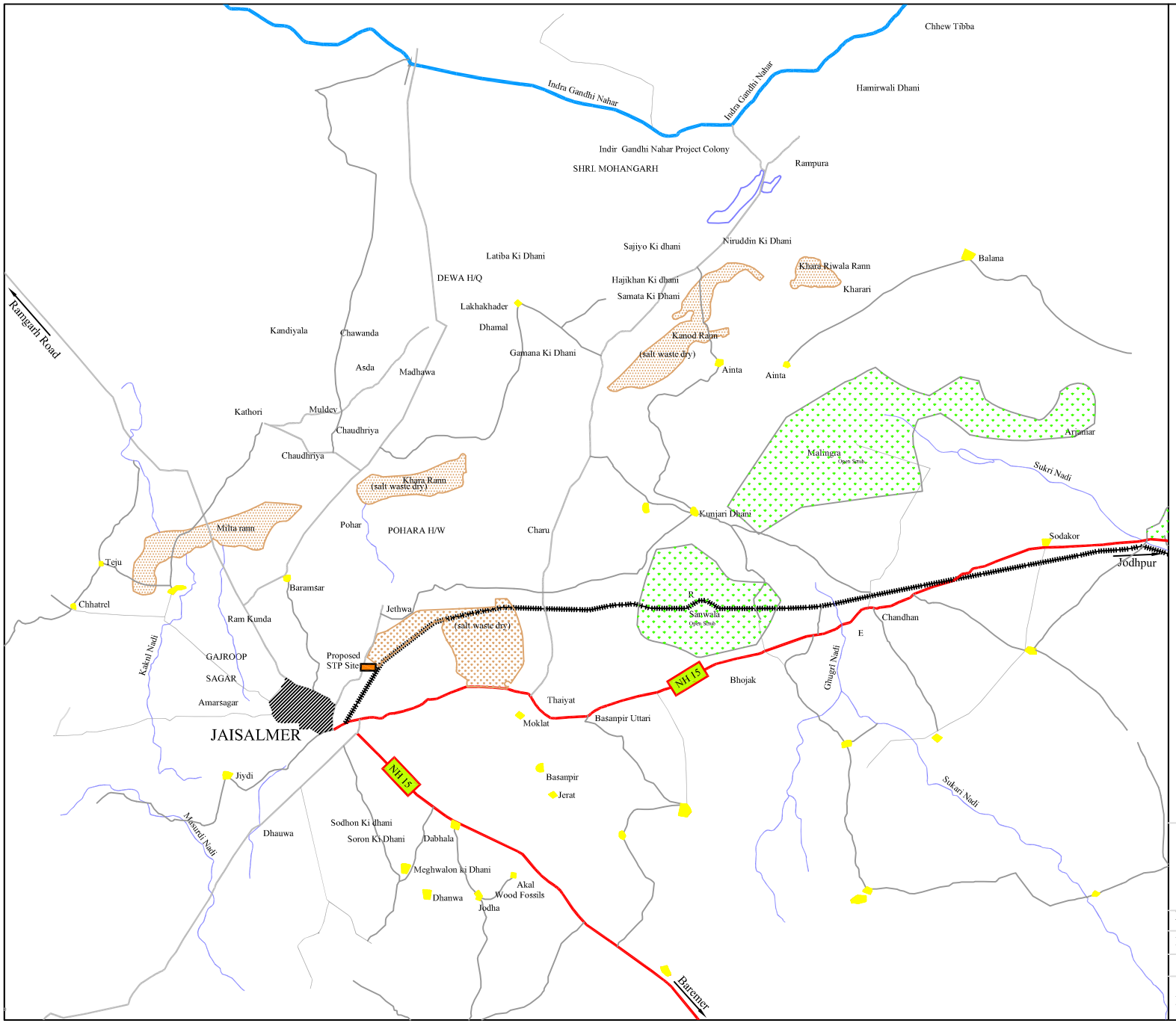


Rajasthan Urban Sector
Development Investment Program
ADB TA 4814-IND

Jaisalmer
Proposed STP Site Location

LEGEND:-

- Road
- Othes Road
- National Highway
- Open Scrub
- River
- Railway Track
- Small Towns

OVERLAY LEGEND:-

- Proposed STP Site

GOVT. OF RAJASTHAN

ASIAN DEVELOPMENT BANK

DRAWN :-	CHECKED :-
DATE :-	APPROVED :-
SCALE :-	

Figure :-

Table 1: Improvements in sewerage infrastructure proposed in Jaisalmer (After change in location)

Infrastructure	Function	Description	Change in location
Sewage Treatment Plant (STP)	Aerobic treatment of sewage according to Indian wastewater discharge standards	A series of oxidation ponds and waste stabilisation ponds, 2-3 m in depth, built in stages, to reach a capacity of 5 MLD in Phase 1 and 10 MLD in total	On 31.78 ha of unused government-owned land, outside Kishangad Village, 1 km north-east of Jaisalmer Initial identified land partly falling buffer zone of defence area of government of India, where no building is allowed Later in designing stage site identified nearby the government land (no acquisition of land needed for approach road- added advantage)
Trunk Sewer	Transport sewage from the town to the STP	7 km of 900 mm diameter Reinforced Cement Concrete (RCC) pipe	Buried in trenches in the Right of Way (ROW) alongside existing roads. Will follow a roughly circular route around the outskirts of the town, with a branch running to the STP
Lateral (Secondary) Sewers	Convey sewage from tertiary sewers into the trunk sewer	10.2 km of RCC pipes, 400-600 mm in diameter	Buried in trenches in the ROW alongside main roads in the town
Tertiary Sewer Network and house connections	Collect sewage from houses and transfer it into secondary sewers	14,000 house connections and 25 km of RCC pipe, 150-250 mm in diameter	Tertiary sewers are buried in trenches alongside lanes and roads, and house connections run in shallow trenches to individual dwellings

III. DESCRIPTION OF THE ENVIRONMENT

A. Physical Resources

1. Location

21. Jaisalmer District is located in the extreme west of both Rajasthan and India, and shares western and northern borders with Pakistan. It lies between the longitudes of 69° 29' to 72° 20' East, and latitudes of 26° 01' 20" to 28° 02' North (Figure 1), is at an average altitude of 242 m above MSL, and forms the major part of the Great Indian Desert (Thar Desert). Jaisalmer Town is the district headquarters and lies roughly in the centre, 550 km west of the State capital Jaipur and 300 km northwest of Jodhpur. The municipal area covers 126.27 km^2 in total, in which there is a population of only 57,537 according to the 2001 census. Most of the area consists of rocky hillsides and uninhabited areas of sand.

2. Topography, soil and geology

22. Although Jaisalmer Town is situated in the heart of the Thar Desert with its characteristic large and mobile sand dunes (Photo 4), the town and its environs present a different physiography. The town is located in an area of elevated rocky ridges extending from the Barmer District Hills in the south-west, and separated by undulating alluvial and sandy valleys. This area is around 15-20 km wide and stretches for over 60 km to the north of the town, and generally slopes from the north-west to the south-east. Soils are stony, sandy, and relatively infertile.

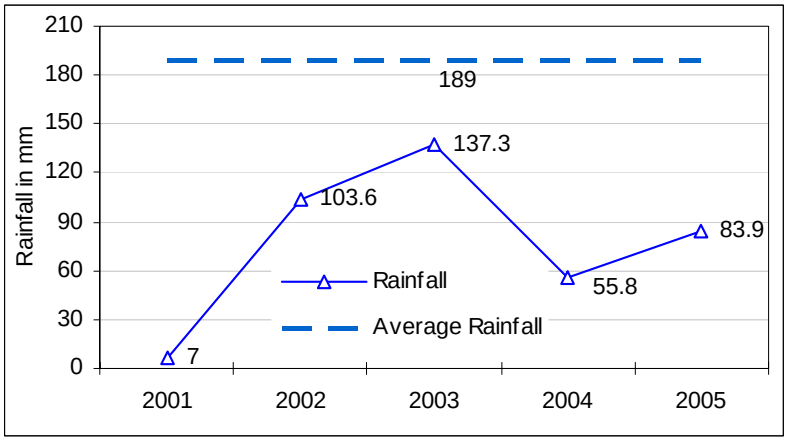
23. One of the most notable physical features of the town is Jaisalmer Fort (Photo 5), constructed in the 12th century, 75 m above ground level on a *trikuta* or triple-peaked hill. Two valleys run around the fort and meet in the south-east, and the surrounding land (on which the town subsequently developed) slopes towards the valleys, forming an overall bowl-like topography. There is little natural drainage and no permanent surface water, because of the very limited rainfall (see below).

24. According to the Vulnerability Atlas of India, most of Jaisalmer District, including Jaisalmer Town, is in an area of medium earthquake risk (Zone III). Although Rajasthan has not experienced a major earthquake in the recent past, there have been 37 events with a magnitude of 5-7 since 1720, with the most recent occurring in 2001. This measured 6.9 on the Richter Scale, but because the epicentre was in neighbouring Gujarat, there was only limited damage Jaisalmer, although "Salim Singh ki Haveli" and "Hawa Pol" in the fort were affected.

3. Climate

25. The climate is typical of a desert region, being hot and arid, with large day-night temperature extremes and sporadic and erratic rainfall. Winter extends from November to March, and the coolest period occurs in January when daytime temperatures average below 20 °C and often fall to freezing at night. Temperatures begin to rise in March and peak in May-June, when daytime values sometimes reach 48 °C. Wind speeds may also increase at this time, and dust storms are common. The south-west monsoon arrives in July, causing a sudden drop in temperature, although the air remains dry as rain only falls on an average of six days per year. The long-term average rainfall is just 189 mm, and annual figures have been well below average on each of the past few years (Figure 5). The monsoon ends in mid-September and air temperatures rise, only to fall again a few weeks later with the onset of winter. Winds are

generally light in winter and moderate to strong in the monsoon, and blow mainly from the north-west and south-west, and from the south and south west in the monsoon.



Source: Agriculture Dept 2007

Figure 5: Average Annual Rainfall in Jaisalmer 2001-2005

4. Air Quality

26. There are no data on ambient air quality in Jaisalmer Town, which is not subject to monitoring by the Rajasthan State Pollution Control Board (RPCB) as there are no major industries. Located in the Thar Desert, particulate matter is likely to be high, particularly during summer dust storms driven by relatively strong north-west to south-west winds. Traffic is the only significant pollutant, so levels of oxides of sulphur and nitrogen are likely to be well within the National Ambient Air Quality Standards (NAAQS). This is illustrated by data from Jodhpur (Table 2), which is larger and has more industry than Jaisalmer, but is less exposed to particulate matter.

Table 2: Ambient Air Quality in Jodhpur (Annual Average, 2004; units in μg/m^3)

Monitoring Station	Land use	SOx	NOx	RSPM	SPM
Sojati Gate	Residential	7	19	121	336
Maha Mandir Police Thana	Residential	6	19	96	310
NAAQ Standard	*Residential*	*60*	*60*	*60*	*140*
RIICO Office	Industrial	6	20	115	341
NAAQ Standard	*Industrial*	*80*	*80*	*120*	*360*

RSPM: Respirable Suspended Particulate Matter; SPM: Suspended Particulate Matter
Source: Central Pollution Control Board (CPCB) 2004

5. Surface Water

27. There are no perennial rivers in Jaisalmer District, and no natural lakes or ponds, which is not surprising given the low rainfall. A few ephemeral streams appear on land outside the town during rainfall, and water accumulates in certain low lying areas, but the water is shallow and drains into the sand very quickly. A few manmade reservoirs have been created by constructing simple bunds, such as Gadi Sagar Lake (Photo 6), which was built in the 14th century and was for some time the main source of water for the town.

6. Groundwater

28. Because of the sandy soils and lack of rainfall, the water table is very deep around Jaisalmer Town, ranging from 38-46 m below ground level. The main aquifer lies below this depth, comprising Lathi formations from the Lower Jurassic Age, composed of mainly sandstones and some lime stones in the upper levels. The aquifer is tapped by a number of wells, but the yield is reported to be low. Jaisalmer Municipal Board (JMB) has developed a well field at Dabla Village 12.5 km from the town, where the aquifer is around 85 m below the surface. There are 12 tubewells of 200 m depth providing an average yield of 18,000 l/h, producing a total of around 3 million litres per day.

29. The Public Health Engineering Department (PHED) regularly monitors the quality of water from the Dabla field, and the most recent data (Table 3) shows that fluoride concentration is slightly above the acceptable level according to national quality standards, and Total Dissolved Solids are above the desirable level but below the acceptable level.

Table 3: Quality of groundwater from the Dabla field (2005)

Parameter	Units	Monitored	Drinking Water BIS Standard	
		Value	Desirable Level	Acceptable Level
pH	-	7.6	6.5-9.0	NR
Chloride (Cl)	mg/l	190	250	1000
Total Dissolved Solids (TDS)	mg/l	980	500	2000
Nitrate (NO_3)	mg/l	4	45	100
Fluoride (F)	mg/l	1.6	1.0	1.5

Source: CDP Jaisalmer; BIS = Bureau of Indian Standards

B. Ecological Resources

30. Jaisalmer Town is an urban area located on a hard rocky substratum, 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 (Photo 7). 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*).

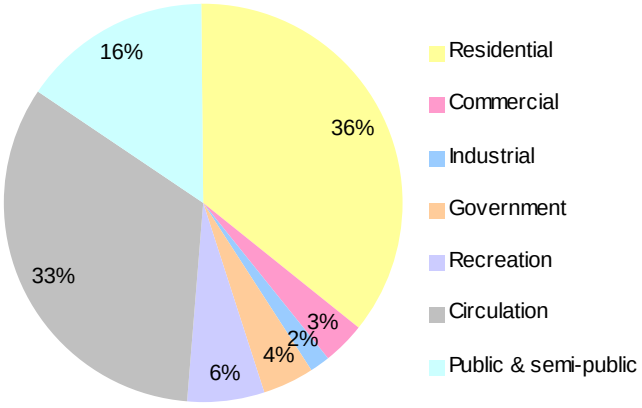
31. There are no forests in Jaisalmer District, mainly because of the climatic conditions. The nearest protected area is the Desert National Park 40 km away, which is designated as an excellent example of the Thar Desert ecosystem. This area includes a wide range of desert environments, including sand dunes, craggy rocks, salt lake bottoms, intermediate areas and fixed dunes, and the fauna is more diverse than found around Jaisalmer. It includes blackbuck, wolf, Indian fox, hare and desert cat, in addition to those species noted above. Small numbers of the great Indian Bustard are also found, which is an endangered bird species that is close to extinction.

C. Economic Development

1. Land use

32. Located in the Thar Desert in the extreme north-west of India, Jaisalmer is an important urban centre for its vast desert hinterland, and is also of strategic importance because of its proximity to Pakistan. Traditionally a services and administrative town, it was not until the late 1970's that trade and commerce began to increase, mainly through growth in the tourism sector.

33. Jaisalmer however offers little potential for further development, mainly because of the harsh and inhospitable landscape and the remoteness of the town. Only around 10 % (1,247 ha) of the total municipal area is developed, mainly because the remainder of the land is rocky and hilly and unsuitable for inhabitation, industry or infrastructure. Figure 6 shows the current land use in the developed area, from recently conducted surveys, which indicates that the major uses are for residential areas, roads/transportation and public and semi-public land. There is also a significant military presence, with a number of defence installations both inside and outside the town.



Source: Jaisalmer Urban Improvement Trust

Figure 6: Current land use in Jaisalmer (developed area)

2. Industry and Agriculture

34. There is very little industrial development in Jaisalmer and the town is in fact classified as a "No Industries District" in State planning terms. Economic activities are growing steadily however, stimulated by development in the tourism sector, as increasing mobility and affluence means that people are able to visit more remote regions, to benefit from the dual attractions of beautiful scenery and a rich historical and cultural heritage.

35. Rajasthan Industrial Infrastructure Corporation (RIICO) has developed a small scale industrial area on 25 ha of land in the town, which currently houses 136 units, specialising mainly in light industry, such as manufacturing farm equipment, repairing automobiles and machinery, and furniture-making. There are also a number of stone polishing workshops, located here because of the vast amount of building material and decorative stone available from quarries in the surrounding hillsides. There are a number of small cottage industries in the town, manufacturing *khadi*, cotton and woollen garments and handicrafts (Photo 8), and this is

one sector that has particularly benefited from the increase in tourism. There are also a number of hotels and restaurants, to serve the growing numbers of visitors.

36. Agriculture is restricted by both climate and physiography, as the limited rainfall and desert soils mean that there are very few areas that are suitable for agriculture, and yields are limited to a maximum of one crop per year. The main product is the fodder crop *jowar*, which is grown to feed the herds of camels, cattle, sheep and goats that are a feature of areas outside the town. Although the Indira Gandhi Nahar Project (IGNP) brings water for irrigation and domestic use into Rajasthan (including Jaisalmer District) from the Ravi and Bias rivers, this does not reach Jaisalmer Town where agriculture remains limited.

3. Infrastructure

37. PHED provides a piped municipal water supply in Jasailmer, which is sourced from the Dalba groundwater field (3 MLD) and from the Dewa Minor canal of the IGNP, 34 km away (5 MLD). The system supplies 80% of the population, but water is available for only 1-2 hours per day, mainly because of leakage losses (estimated at 40%) and low and unequal network pressure. The provision is also unequal, with un-served areas being mainly the slums and fringe or newly-developed areas. Profuse leaking from the network in the fort area is causing severe degradation of buildings and the fort walls and foundations.

38. There is a piped sewerage system only inside the fort, which serves 2% of the population. Developed in 1994, the system does not function well because of the undulating topography and blockages caused by solid waste, so leakages and overflows are very frequent. This contributes to the deterioration of the fort structures as well as detracting from the appearance of the fort (which is a major tourist attraction) and creating a public health hazard. There is no sewage treatment, and wastewater collected by the system accumulates in a low lying area near Gadisar Gate, which has become a major mosquito breeding ground. Most other households utilise pit latrines or septic tanks, and there are illegal connections through which sewage is deposited into open storm water drains. Because of the availability of large areas of vacant land, open disposal and open defecation are also prevalent.

39. There is also no proper system for storm water drainage in the town, and although this is not a major problem because of the limited rainfall, sudden storms (including one in 2006) can cause quite widespread flooding, damaging property and possessions. There are roadside drains in certain areas, but these are poorly designed with inadequate gradients, and are frequently clogged with solid waste and polluted by sewage.

40. The solid waste management system is also ineffective, and refuse is mainly discarded in the streets and drains, and dumped on vacant plots of land. Jaisalmer generates an estimated 21 tons of solid waste per day and the Municipal Board (JMB) collects around 12 tons from its manual street sweeping operation (conducted inside the fort), and removes other waste from vacant plots irregularly. Collected waste is transported on open vehicles to the outskirts of the town and dumped on open ground. The Municipality has recently acquired a 76 ha plot of land with the intention of constructing a sanitary landfill, but at present waste is simply dumped on a part of this area.

41. Thermal power is the main source of energy in Rajasthan, contributing 89% of the electricity, compared to hydropower, which produces the remainder. State-level companies (Rajya Vidyut Utpadan Nigam Ltd, RVUN; and Rajya Vidyut Prasaran Nigam Ltd, RVPN) are responsible for power generation and transmission respectively, and distribution is provided by

a regional company, the Jaipur Vidyut Vitran Nigyam Ltd (JVVNL). Power is supplied from the central grid by overhead cables carried on metal and concrete poles, mainly located in public areas alongside roads. The power supply is erratic and there are frequent outages in warmer months, and large fluctuations in voltage.

4. Transportation

42. The fort area and the walled old city are characterised by very narrow roads that are frequently congested with traffic and pedestrians (Photo 9). In contrast the remainder of the town has a relatively good road system, particularly in the outer areas, where streets are wide and not heavily used by traffic (Photo 10). The total road length in the town is 157 km, of which 70% are surfaced with bitumen/tar, 15% are stone paved and 15% are WBM (Water-borne Macadam). Most of the roads are maintained by JMB and around 15% by the Public Works Department (PWD), and the condition is generally poor, with many roads in need of repairs and resurfacing. This plus the absence of parking spaces and pedestrian walkways leads to slow traffic and congestion.

43. Transport in the city is mainly by personal vehicles (motorcycles and bicycles) and auto- and bicycle-rickshaws. The Rajasthan State Road Transport Corporation (RSRTC) runs public buses to neighbouring villages and towns and to larger towns farther afield, such as Jodhpur, Bikaner, Barmer and Jaipur, with which there are good road connections. Jaisalmer is also connected to Jodhpur, Jaipur and Delhi by the national railway. The nearest airport is 300 km away at Jodhpur, although there is a military air strip in Jaisalmer, which is also used for civilian purposes.

D. Social and Cultural Resources

1. Demography

44. According to the national census the population of Jaisalmer was 38,735 in 1991 and 57,537 in 2001, which shows an annual increase of 4.9 % over the decade. Gross population density is very low (457 persons/km), but because so much of the municipal area is undeveloped there are locations of very high density, particularly in the fort and walled city.

45. Overall literacy is 74.9%, reported at 85.5% for males and 60.7% for females, which is considerably better than literacy in the state as a whole, which is 60.4% overall, and 75.7% for males and 44.0% for females. The sex ratio is however significantly below the natural 1:1 ratio, being 764 females per 1000 males, lower than both the state and national averages (879 and 929 respectively).

46. According to the census, in 2001 only 32% of the population was in paid employment, significantly lower than both the state and national averages (42.1 and 39.1% respectively). This indicates that most of the townspeople are engaged in the informal sector, earning a living where they can, from small trading, casual labour, etc. Of those that are employed, almost all (96%) are involved in the service and industrial sectors, with the remainder being engaged in agricultural activities and household and cottage industries (around 2% each).

47. Around 75% of the people are Hindus, 20% are Muslim, and the remainder are mainly Sikhs and Janis. The majority of the inhabitants are Yadav Bhatti Rajputs, who take their name from a common ancestor named Bhatti. The main language is Marwari/Rajasthani, the principal dialect of the state. Most people speak the national language of Hindi and a few also speak

English. Other languages spoken include Khariboli, Godvari and Urdu (because Rajasthan borders Pakistan). About 4% of the population are from Scheduled Tribes (ST), but these are part of the mainstream population, and around 10% of the population belong to scheduled castes (SC).

2. Health and educational facilities

48. There are good educational facilities in Jaisalmer, which serve both townspeople and inhabitants of surrounding villages and towns in the hinterland. There are 41 primary schools, 27 secondary schools and 7 higher secondary schools, plus two general degree colleges and an industrial training institute (ITI).

49. As the district headquarters town, Jaisalmer is the main centre for health facilities in the area and there is a district general hospital with 150 bed capacity, 4 dispensaries, a mother and child welfare centre and a government-run homeopathic hospital. There is also a private hospital of 25 bed capacity, and a number of private clinics.

3. History, culture and tourism

50. Founded with the construction of the fort in 1156, the Golden City of Jaisalmer originally became wealthy from trade because of its position on the camel-train routes between India and Central Asia, and the merchants and townspeople built magnificent houses and mansions, intricately carved from wood and sandstone. Variously occupied by Rajputs, Mughals and maharajas, the city rose again to prominence in the 17th century because of its links to Delhi, and this heralded another period of building, featuring many grand palaces and *havelis* (decorated residences). The city declined with the rise of shipping and the port of Bombay, but since partition and the conflicts with Pakistan, its strategic importance has once again become important, as well as more recently, its attraction to tourists.

51. Tourism has risen in importance in Jaisalmer over the past 20 years, and in 2005 there were 280,000 tourists, almost double the number that visited in 2001 (150,000). The most important features of the town in terms of both culture and tourism are:

- Jaisalmer Fort, built in 1156 by the Rajput ruler Jaisala, rises over the city and provides magnificent views over the surrounding desert. Carved from sandstone and featuring 99 bastions, hundreds of narrow streets, a palace and many beautiful *havelis* and temples, this is the second oldest fort in Rajasthan. It is however suffering greatly from tourism pressure and damage from the leaking water system and ineffective drainage, and is on the World Monuments Watch list of100 endangered sites worldwide;

- Salem Singh, Patwon and Nathmal are the three most visited *havelis* (Photo 11) and are examples of merchants' houses from the 19th century grand architecture period;

- Temples abound both inside and outside the fort, and the most notable are the seven interconnected yellow sandstone Jain temples dating from the 12th to 16th centuries and the Laxminath Hindu temple with its brightly decorated dome;

- Gadi Sagar south of the city walls was excavated in 1367 by Rawal Gadsi Singh. Once the water supply for the city it is now a picturesque lake, with clusters of small temples, a museum, and flocks of visiting waterbirds, particularly during the winter months.

IV. ENVIRONMENTAL IMPACTS AND MITIGATION: INFRASTRUCTURE CONSTRUCTION

A. Screening out areas of no significant impact

52. 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.

53. 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 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 years.

54. 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 4, with an explanation of the reasoning in each case.

Table 4: 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	Jaisalmer is not located in a coastal area
Population and communities	Construction will not affect population numbers, location or composition

55. These environmental factors have thus been screened out and will not be mentioned further in assessing the impacts of the construction process.

B. Sewage Treatment Plant

1. Construction method

56. As explained above, provision of a Sewage Treatment Plant will involve construction of the following structures on 31.78 ha of land outside Kishangad Village:

- A series of oxygenation and waste stabilisation 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.

57. 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.

58. 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.

59. 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

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

61. Ponds will be dug on around 80% of the site, and if these are excavated to a depth of 2.5 m, around 160,000 m^3 of waste soil and stone will be generated. There will therefore be quite large physical changes at the construction site, and this quantity of waste could not be dumped without causing further physical impacts (on air quality, topography, soil quality, etc) at the point of disposal. The work will probably be conducted in the dry season, so there is also a lot of potential for the creation of dust, during excavation and when the waste is removed.

62. Action will therefore be needed to reduce physical impacts at both the construction and disposal sites, by controlling dust and reducing the amount of material to be dumped. The Contractor should therefore be required to:

- Contact the town authorities to find beneficial uses for as much waste material as 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;

- Prevent 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.

63. Another physical impact that is often associated with large-scale excavation is the effect on drainage and the local water table if groundwater and surface water collect in the voids. However, this should not be a problem in this case, given the low rainfall and deep water table (>40 m) in this area, and the fact that the Contractor will almost certainly plan excavation work to avoid the monsoon season.

3. Ecological Resources

64. The site proposed for the STP is characterised by sandy soil and a sparse desert-type of vegetation of halophytic bushes and small trees (Photo 12), which is of no special ecological interest. Construction should therefore have no adverse ecological impacts.

4. Economic Development

65. 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 not farmed or used for any other purpose and there is no industry, housing or infrastructure in the vicinity so there should be no impact on income-generating activities.

66. 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 on the Jodhpur road, and particularly in Jaisalmer 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 Jaisalmer 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

67. 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 recognised 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 to ensure its removal or protection in situ.

68. 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.

69. 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

70. Provision of a sewerage system in the town will involve construction of:

- A tertiary network comprising 14,000 house connections and 25 km of 150-250 mm diameter RCC pipe, to collect and transport sewage from individual dwellings;
- A 10.2 km secondary network of 400-600 mm RCC pipes to transfer waste into the trunk main.

71. The trunk sewer will follow a roughly circular route around the periphery of the town with an additional branch alongside the Jodhpur Road to the STP, and will consist of:

- 7 km of 900 mm diameter RCC pipe.

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

73. 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 (Photo 13). 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 to avoid damage to property some trenches may dug into the edge of the road.

74. Trenches will be dug by backhoe digger (Photo 14), supplemented by manual digging where necessary (Photo 15). 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 (Photos 15 and 16). After the pipes are joined, loose soil will be shovelled back into the trench, and the surface layer will be compacted by hand-operated vibrating compressor. Where trenches are dug into an existing roadway, the bitumen or concrete surface will be broken by hand-held pneumatic drills (Photo 17), after which the trench will be excavated by backhoe, and the appropriate surface will be reapplied on completion.

75. 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 2.2 m deep and 1.1 m wide for the trunk main, and a minimum of 1.4 m deep and 0.4 m wide for the tertiary network.

76. 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.

2. Physical Resources

77. 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. If average trench dimensions are 2.2 x 1.1 m for the 7 km trunk main, 1.8 x 0.7 m for the 10.2 km lateral sewer, and 1.5 x 0.4 m for the 25 km tertiary network, then construction of the trenches will require the excavation of almost 50,000 m^3 of material. After construction, approximately 50% of the trench will be occupied by the pipe, so there will be around 25,000 m^3 of waste soil left over. This is a relatively small quantity, particularly in comparison to the amount produced at the STP site. However the material will still need to be handled responsibly, and there are other considerations because this work will be conducted in the town where piles of soil could impede traffic and other activities (see below) and dust could affect inhabitants. These impacts should therefore 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.

78. The other important physical impact associated with large-scale excavation (effects on surface and groundwater drainage) should again be negated by the low rainfall and very low water table in this area, and the fact that the Contractor will almost certainly conduct the excavation work in the dry season.

79. 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 of network construction on the physical environment are not expected to be of major significance.

3. Ecological Resources

80. 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. 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 two new trees (of the same species) for each one that is removed.

4. Economic Development

81. Most of the network and trunk sewer pipelines will be constructed within the RoW of existing roads where there is no need to acquire land, so there should be no direct effect on the income or assets of landowners, or the livelihoods of tenants.

82. Some land may need to be acquired however along the final 500 m of the trunk sewer route, where the pipeline runs at right angles to the Jodhpur road to enter the STP (Figure 3). Some of this land is owned by the government, but some is in private ownership, and is farmed when there is sufficient rainfall. Private land will be obtained through the Land Acquisition Act (1894) by which the government purchases the land compulsorily at a rate established on the basis of recent transactions. ADB policy on Involuntary Resettlement requires that owners and users of acquired land do not suffer economically as a result of the project, and a separate Resettlement Plan and Resettlement Framework have been prepared to examine these and related issues. This establishes that no more than 10% of the land of any owner or occupant should be acquired, and that in addition to the price of the land, farmers should be compensated for any standing crops or trees they lose.

83. Although most of the work will not require land acquisition it could still have economic impacts, if the presence of trenches, excavated material, workers and machinery discourage customers from visiting shops and businesses, which 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:

- Compensating shopkeepers and other affected businesses for lost income;
- 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.

84. Excavation could damage existing infrastructure, in particular water pipes, which are mainly located alongside roads, storm drains where present, and the sewer network inside the fort area. 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 citizens (see below). It will be important therefore to avoid these impacts by:

- Obtaining details of the nature and location of all infrastructure from the municipal authorities and planning the sewer network to avoid any conflict;
- Integrating construction of the various Jaisalmer subprojects (in particular water supply, sewerage and drainage) so that:
    - Different infrastructure is located on opposite sides of the road wherever feasible;
    - Roads and inhabitants are not subject to repeated disturbance by construction in the same area at different times for different purposes.

85. 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.

86. It is inevitable that there will be an increase in the number of heavy vehicles in the town (particularly trucks removing waste material for disposal), 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

87. As was the case with the STP site, there is a significant risk that sewer construction, which involves further extensive disturbance of the ground surface, could damage undiscovered archaeological and/or historical remains, or even unknown sites. The risks are in fact very much higher in this case, as most of the work will be conducted in Jaisalmer town, which has been inhabited for a long period, and where there is therefore a greater risk of artefacts being discovered. The preventative measures described in Section IV.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 or sites 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 excavation, to recognise, protect and conserve any chance finds (see Section IV.B.5 for details).

88. Sewer construction will also disturb some more modern-day social and cultural resources, such as schools, hospitals, temples, and also sites that are of tourism importance.

Impacts could include noise, dust, interrupted access for pedestrians and vehicles, and if pneumatic drills are used to break the surface of roads, there could be a risk of damage from vibration. Given the historical importance of Jaisalmer and particularly the fort and walled city, any such damage or disruption could be highly significant, so very careful mitigation will 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.

89. 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.

90. 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 infrastructure will be planned to avoid locations of existing AC pipes so AC pipes should not be discovered accidentally.

91. Given the dangerous nature of this material for both workers and citizens, 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.

92. 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 IV.B.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.

[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

V. ENVIRONMENTAL IMPACTS AND MITIGATION: OPERATION AND MAINTENANCE

A. Screening out areas of no significant impact

93. 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 sectors which should be unaffected once the system begins to function. These are identified in Table 5 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.

Table 5: 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	No water bodies will be affected by operation of the sewerage system
Wildlife, forests, rare species, protected areas	There are none of these features in or outside the town
Coastal resources	Jaisalmer is not located in a coastal area

B. Operation and maintenance of the improved sewerage system

94. The new sewerage system will collect and treat surface water, domestic wastewater and sewage produced in most of the town. Although treatment will not be to the standards of more developed countries, the technology is approved by the Public Health Engineering Department, and the discharge after treatment will comply with Indian wastewater standards.

95. 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.

96. 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.

97. 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

98. The provision of an effective sewerage system should improve the physical appearance and condition of the town because raw sewage will no longer be discharged onto open ground, and there will be far fewer sewer leaks and blockages than occur at present. This, and the fact that there will also be fewer septic tanks, pit latrines and discharges of sewage to municipal drains, means that the quality of the town environment and its surface and groundwater should improve significantly.

99. 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.

100. 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.

101. 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 (Figure 3), 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).

2. Ecological Resources

102. 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 would 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.

3. Economic Development

103. 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.

104. 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

105. 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.

106. Repair work could cause some temporary disruption of activities at sites of social and cultural importance such as schools, hospitals, temples, tourist sites, etc, so at these locations the same type of 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.

107. 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 IV.C.5) to protect workers and the public. This should include application of the asbestos protocol if any AC pipes are encountered.

108. 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.

109. 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 the town, 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.

110. There should also be significant benefits for the cultural resources of the town, because the improvements in water and sewerage infrastructure will remove the leaks that are proving so damaging to the fabric of the fort and other historical buildings at present.

VI. ENVIRONMENTAL IMPACTS AND MITIGATION: LOCATION AND DESIGN

111. 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 IV and V above and no other impacts are expected.

112. 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. For example, if a STP produces an effluent that does not meet legally established standards, then this is an impact of the design as it would not occur if a more rigorous treatment technology had been adopted.

113. In the case of this subproject there are few impacts that can clearly be said to result from either the design or location. This is mainly because:

- The project is relatively small in scale and involves straightforward construction and low-maintenance operation, 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 is invasive, involving trenching and other ground disturbance. However the routine nature of the impacts means that most can be easily mitigated;
- In one of the major fields in which there could be significant impacts (archaeology), those impacts are clearly a result of the construction process rather than the project

design or location, as they would not occur if this did not involve trenching or other ground disturbance.

114. There are however two impacts that could be said to be related to the location and design of the project, which are:

- The effect on landowners and farmers from the acquisition of land for the trunk sewer, as this would not occur if the STP was located where the trunk main would cross only government land;
- The pollution of surface and groundwater from the release of treated wastewater into the adjacent *nallah*, which would not occur if the STP was located elsewhere, or if a treatment technology to remove nitrate and phosphate was adopted.

VII. INSTITUTIONAL REQUIREMENTS AND ENVIRONMENTAL MONITORING PLAN

A. Summary of environmental impacts and mitigation measures

115. Table 6 lists the potential adverse impacts of the Jaisalmer 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

116. 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.

Table 6: Environmental impacts and mitigation for the Jaisalmer Sewerage Subproject (Black = continuous activity; Grey = intermittent)

Potential Negative Impacts	Sig	Dur	Mitigation Activities and Method	Respon sibility	Location	07	2008				2009			[3]
Construction: Sewage Treatment Plant						D	1	2	3	4	1	2	Op	
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	All sites									0
Traffic may be disrupted by lorries carrying waste soil	M	T	Plan routes to avoid Jaisalmer Town & 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										+
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									+
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	Only remove trees if it cannot be avoided	Contractor	Network sites									0
			Plant and maintain two trees for every one removed											0
Shops may lose income if customers' access is impeded	M	T	*Compensate businesses for lost income	LSGD	Network sites									0
			Leave spaces for access between mounds of soil	Contractor										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
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											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	M	T	Consult authorities – work in light traffic periods	Contractor	Network									0

Sig = Significance of Impact (NS = Not Significant; S = Significant; HS = Highly 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

soil has to be placed on the road, and/or sewers have to be located in the road itself			Ensure police provide traffic diversions when necessary		sites									0
			As above: increase workforce to finish this work quickly											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 & 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
			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, tourism sites) may be disturbed by noise, dust, vibration and impeded access	M	T	Identify buildings at risk from vibration damage and avoid using pneumatic drills or heavy vehicles 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 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 contaminate soil and groundwater	M	T	Detect and repair sewer leaks rapidly and effectively	GA	Network sites									0
Sludge is removed from treatment ponds every 5 years	NS	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	NS	T	As before: inform shopkeepers of repair work in advance	GA	Network sites									0
			As before: provide walkways/bridges for people/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	NS	T	As before: avoid using drills/trucks near fragile buildings	OMC	Network sites									0
			As before: finish work quickly in sensitive areas											0
			As before: provide walkways/bridges for people/vehicles											0
			As before: consult authorities and communities, inform them of work in advance, avoid sensitive periods											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									+
Location and Design														
Some land may need to be acquired where main sewer runs between Jodhpur road and STP	M	P	*Purchase land as described in Resettlement Framework	LSGD	Near STP site									0
			*Avoid taking >10% of the land of any owner or occupant	DSC										0
			*Compensate farmers in cash for loss of crops and trees	LSGD										0
Discharge of treated effluent to *nallah* could pollute surface & groundwater with nitrate, phosphate, etc	M	P	Conduct bacteriological tests to ensure safety of effluent	GA	STP									0
			Sell treated wastewater to farmers for irrigation											+

117. 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.

118. Environmental issues will be coordinated by an Environmental Specialist within the IPMU, 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

119. Table 6 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.

120. 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].

121. Table 6 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 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.

[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)

122. Table 7 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 6 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.

123. Given the scale of the investment in providing the infrastructure, LSGD will 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 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.

124. 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.

Table 7: Environmental Monitoring Plan

Mitigation Activities and Method	Location	Responsible for Mitigation	Monitoring Method	Monitoring Frequency	Responsible for Monitoring
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	Observations on and off site	Weekly	EMS
Plan truck routes to avoid Jaisalmer Town, narrow or congested roads, important of fragile buildings, religious and tourist sites	All sites	Contractor	Observations off site; CC record	Weekly	EMS
Plan transport of waste soil to avoid peak traffic and tourist season	All sites	Contractor	Observations on and off site	Weekly	EMS
Cover or damp down stockpiled soil in dry weather	Inhabited areas	Contractor	Site observations	Weekly	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 observation; resident survey	Weekly	EMS
Only remove trees if it cannot be avoided	Network sites	Contractor	Site observations	Weekly	EMS
Plant and maintain two trees for every one removed	Network sites	Contractor	Observations on/off site; CC records	Monthly	EMS
*Compensate businesses for lost income	Where required	LSGD	Shopkeeper survey; LSGD recordS	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	All 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
Plan work with town authorities – work 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

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

Avoid using drills and heavy vehicles near fragile buildings	All 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 (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 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	STP	GA	Site observation; farmer survey	Monthly	
Inform shopkeepers and residents of repair work in advance	Network sites	GA	Resident surveys	Monthly	
Provide walkways and bridges for pedestrians and 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 and heavy vehicles near fragile buildings	Network sites	OM Contractor	Site observations	Monthly	
Complete work quickly in sensitive areas	Network sites	OM Contractor	Site observations; OMC records	Monthly	
Consult communities, avoid working during sensitive periods	Network sites	OM Contractor	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	

LOCATION AND DESIGN					
*Acquire land as described in Resettlement Framework	Near STP	LSGD	Landowner surveys; LSGD records	As needed	IMA
*Avoid taking >10% of the land of any owner or occupant	Near STP	DSC	Owner/tenant surveys; DSC records	As needed	IMA
*Compensate farmers in cash for loss of crops and trees	Near STP	LSGD	Farmer surveys; records	As needed	IMA
Sell treated wastewater to farmers for irrigation	STP	GA	Site observation; farmer 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	Jaisalmer Town	GA	Hospital records; resident surveys	Annual for 6 years	Social studies consultant

D. Environmental management and monitoring costs

125. 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 acquiring land and compensation shopkeepers and farmers for loss of income (Table 6) are calculated separately in the budgets for the Resettlement Framework and Resettlement Plans so are also excluded from this analysis.

126. 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.

These have not been budgeted elsewhere, and their costs are shown in Table 8, 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 1.7 million, ie US$ 37,000.

Table 8: 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	100,000[7]	300,000	
Survey Expenses	Sum	100,000	100,000	400,000
2. Survey of STP sludge and effluent (5 years)				
Domestic Consultant	5 x ½ month	100,000	250,000	
Sample Analysis	5 x 20	3,000[8]	300,000	
Other Expenses	Sum	200,000	200,000	750,000
3. Survey of public health (6 years)				
Domestic Consultant	6 x ½ month	100,000	300,000	
Expenses	Sum	200,000	200,000	500,000
TOTAL				1,650,000

[7] Unit costs of domestic consultants are based on current CTA rates. Costs include airfares, local transport and subsistence
[8] Cost of a standard bacteriological analysis (total and faecal coliforms, E.coli, enterococci, etc) is $65 (INR 3,000) per sample

VIII. PUBLIC CONSULTATION AND INFORMATION DISCLOSURE

A. Project stakeholders

127. Most of the main stakeholders have already been identified and consulted during preparation of this IEE, and any others that are identified during project implementation will be brought into the process in the future. Primary stakeholders are:

- Residents, shopkeepers and businesspeople who live and work alongside the roads in which new sewers will be provided and in the vicinity of the STP site;
- Owners and users of any land that is acquired along the final 500 m of the trunk sewer;
- 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.

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, 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

128. Two forms of public consultation have been used during preparation of the IEE, to discuss the project and involve the community in planning the mitigation measures and develop the Environmental Monitoring Plan. These are:

- A public meeting was held in Jaisalmer Town in March 2007, to which representatives of primary and secondary stakeholders were invited. Attendees were informed about the aim of the various subprojects and the benefits they would bring, together with their likely impacts and the ways in which they would be mitigated. Participants were invited to discuss their views and concerns, which were then incorporated into the IEE. Appendix 1 contains a summary of the meeting;
- *Ad hoc* discussions were also held on site with people and communities who could be affected by the subprojects, so that views could be expressed in a less formal setting. These were also considered in preparing the IEE.

This IEE will be disclosed to the public by making it available on the ADB website, together with the IEEs prepared for the other subprojects and the summary IEE (SIEE) describing the impacts and mitigation of all subprojects.

C. Future consultation and disclosure

129. 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

130. The process described in this document has assessed the environmental impacts of all elements of the infrastructure proposed under the Jaisalmer Sewerage and Sanitation Subproject. Potential negative impacts were identified in relation to construction and operation of the improved infrastructure, and the location and design of the project. 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.

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

131. 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 sewer branch that runs to the STP in the ROW of the main Jodhpur Road as far as possible, to reduce the acquisition of agricultural land and impacts on the livelihoods of farmers and workers.

132. 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 an ancient town where there are densely populated areas and sites of historical and tourism interest; and because Rajasthan is an area with a rich history, so 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, tourism, and the cultural heritage.

133. 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 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.

134. There could also be a need to acquire small amounts of farm land along the final 500 m of the trunk sewer route, between the Jodhpur Road and the STP. Such impacts are also frequently encountered and are dealt with by a combination of the legal process and additional measures required by ADB policy on Involuntary Resettlement. Actions are discussed in a separate Resettlement Plan and Resettlement Framework, and include:

- Acquiring land through the GOI Land Acquisition Act, through which the market value is paid, based on an analysis of recent transactions;
- Ensuring that no more than 10% of the land of a single owner or occupant is acquired;
- Providing additional compensation for loss of standing crops and productive trees.

135. 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.

136. Special measures were also developed to protect workers and the public from exposure to carcinogenic asbestos fibres in the event that Asbestos Cement pipes used in the existing water supply system are uncovered 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).

137. 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.

138. These and the other mitigation and enhancement measures are summarised in Table 6, which also shows the location of the impact, the body responsible for the mitigation, and the programme for its implementation.

139. 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*.

140. 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.

141. 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.

142. 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. The cultural heritage of the town should also benefit because improvements in sewerage and water supply infrastructure will remove the leaks that are proving so damaging to the fabric of the fort and other buildings at present.

143. Table 6 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).

144. 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 PIU. 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.

145. Finally, stakeholders were involved in developing the IEE through both face-to-face discussions on site and a large public meeting held in the town, after which views expressed were incorporated into the IEE and the planning and development of the project. The IEE will be made available at public locations in the town and will be disclosed to a wider audience via the ADB website. The consultation process will be continued and expanded during project implementation, when a nationally-recognised NGO will be appointed to handle this key element to ensure that stakeholders are fully engaged in the project and have the opportunity to participate in its development and implementation.

B. Recommendations

146. 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 IEE report (Table 6) and in the Resettlement Framework for the RUSDIP are implemented in full, as described in these two documents;
- The Environmental Monitoring Plan proposed in Section VI.C of this report and the internal and external monitoring proposed in the Resettlement Framework are also implemented in full.

X. CONCLUSIONS

147. The environmental impacts of the proposed improvements in sewerage infrastructure in Jaisalmer Town have been assessed by the Initial Environmental Examination reported in this document, conducted according to ADB guidelines. 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. These measures were integrated into the IEE and are summarised in this report.

148. 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.

149. There are no uncertainties in the analysis, and no additional work is required to comply with ADB procedure or national law. There is thus no need for further study or Environmental Assessment.

Photo 1: RCC Sewers

Photo 2: Proposed STP site at Kishanghat

Photo 3: Typical STP Pond

Photo 4: Sand dunes around Jaisalmer

Photo 5: Jaisalmer Fort

Photo 6: Gadi Sagar Lake in Jaisalmer

Photo 7: Natural vegetation around Jaisalmer

Photo 10: Roads in the outskirts of Jaisalmer

Photo 8: Jaisalmer handicrafts

Photo 11: A *haveli* in Jaisalmer

Photo 9: Narrow streets in the Fort area

Photo 12: Sparse vegetation in STP site

Photo 13: Enough space along roads for sewers

Photo 16: laying of pipeline using crane

Photo 14: Back hoe trenching

Photo 17: Hand-held pneumatic drill

Photo 15: Digging a trench by hand

Appendix IV- A

RAPID ENVIRONMENTAL ASSESSMENT (REA) CHECKLIST

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

Sub-Project: Construction of Trunk sewer, Lateral sewer, and Tertiary sewers and sewage treatment plant in Jaisalmer.

SCREENING QUESTIONS	Yes	No	REMARKS
A. Project Siting Is The Project Area…			There is no protected/environmental sensitive area along the sewerage line.
▪ Densely Populated?		No	
▪ Heavy with Development Activities?		No	
▪ Adjacent to or Within Any Environmentally Sensitive Areas?		No	
• Cultural Heritage Site		No	
• Protected Area		No	
• Wetland		No	
• Mangrove		No	
• Estuarine		No	
• Buffer Zone of Protected Area		No	
• Special Area for Protecting Biodiversity		No	
• Bay		No	
B. Potential Environmental Impacts Will The Project Cause…		No	
▪ Impairment of historical/cultural monuments/areas and loss/damage to these sites ?		No	No such impact is anticipated as sewerage line will pass under the existing road

SCREENING QUESTIONS	Yes	No	REMARKS
▪ Interferance with other utilities and blocking of access to buildings; nuisance to neighbouring areas due to noise, smell, and influx of insects, rodents, etc.?		No	Not applicable.
▪ Dislocation or involuntary resettlement of people		No	Not applicable. There is no R&R required for this project.
▪ Impairment of downstream water quality due to inadequate sewage treatment or release of untreated sewage ?		No	Not applicable.
▪ Overflows and flooding of neighboring properties with raw sewage ?		No	Not applicable.
▪ Environmenal pollution due to inadequate sludge disposal or industrial waste discharges illegally disposed in sewers?		No	Not applicable. This area is totally devoid of industries.
▪ Noise and vibration due to blasting and other civil works ?	Yes		During construction phase there will be some noise pollution.
▪ Discharge of hazardous materials into seweres,resulting in damage to sewer system and danger to workers		No	Not applicable. This is a new sewerage system project.
▪ Inadequate buffer zone around pumping and treatment plants to alleviate noise and other possible nuisnces, and protect facilities ?		No	There is no facility to alleviate noise and other nuisances. New buffer zone around Ps and treatment plan will be considered.
▪ Social conflicts between construction workers from other areas and community workers ?		No	Mostly local labour shall be employed during construction. Therefore, no conflict situation is expected.
▪ Road blocking and temporary flooding due to land excavation during the rainy season ?	Yes		There will be temporary road blocking due to excavation.
▪ Noise and dust from construction activities?	Yes		Little increase in noise levels and dust emission is anticipated from construction activities and shall be contained by taking proper mitigation measures as and when required.
▪ Traffic disturbances due to construction material transport and wastes?		No	No such impact is anticipated.
▪ Temporary silt runoff due to construction?		No	Not applicable.

SCREENING QUESTIONS	Yes	No	REMARKS
▪ Hazards to public health due to overflow flooding, and groundwater pollution due to failure of sewerage system?		No	Not applicable.
▪ Deterioration of water quality due to inadequate sludge disposal or direct discharge of untreated water ?		No	Not applicable.
▪ Contamination of surface and ground water due to sludge disposal on land ?		No	Not applicable. There is no ground and surface water resources in this area.
▪ Health and safety hazards to workers from toxic gases and hazards materials which may be contained in sewage flow and exposure to pathogens in sewage and sludge?		No	There is no existing sewerage system on site.