Environmental Assessment Document

Initial Environmental Examination: Jaisalmer Solid Waste Management Subproject
Project Number: 40031

April 2007

India: Rajasthan Urban Sector Development Investment Program

Prepared by Local Self Government Department.

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I. INTRODUCTION

A. Purpose of the Report

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

2. RUSDIP 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 11 Initial Environmental Examination (IEE) Reports, prepared according to ADB Environment Policy (2002) and Environmental Assessment Guidelines (2003). This document is the IEE report for the Jaisalmer Solid Waste Management 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 project 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 proposed 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. Solid waste management is the only type of infrastructure provided by the RUSDIP that is specified in the EIA Notification, which indicates that EC is required for all Common Municipal Solid Waste Management Facilities (facilities that are shared by more than one town)[1]. This subproject proposes a single landfill that would only be used by Jaisalmer town, so EC should therefore not be required.

3. Review and Approval Procedure

12. For Category B projects the IEE report is 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 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 Solid Waste Management 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 11 IEEs 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 solid waste management 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 solid waste infrastructure in Jaisalmer is inadequate for the needs of the growing population. There are no collection points and people deposit their refuse on open ground in the town, from where the municipality collect the waste irregularly. Collected waste is then dumped on open ground outside the town, or more recently at a site acquired for future landfill development, where it is unsightly and presents an environmental hazard. 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 main infrastructure will be a new

[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)

engineered landfill to be built on 5.5 ha of government land outside the town, construction of a waste transfer station on 0.2 ha of land at the outskirts of the town, and new metal collection bins at various locations in the urban area (Figures 2 and 3). Other components include the provision of vehicles and equipment, plus training and support to the municipality in the operation of a solid waste management system.

16. Detailed design will begin in the middle of 2007 and should be completed by the end of the year, after which construction of the infrastructure and procurement of equipment will be completed in around six months. The solid waste management system should therefore begin to operate in the middle of 2008.

C. Description of the Sub-project

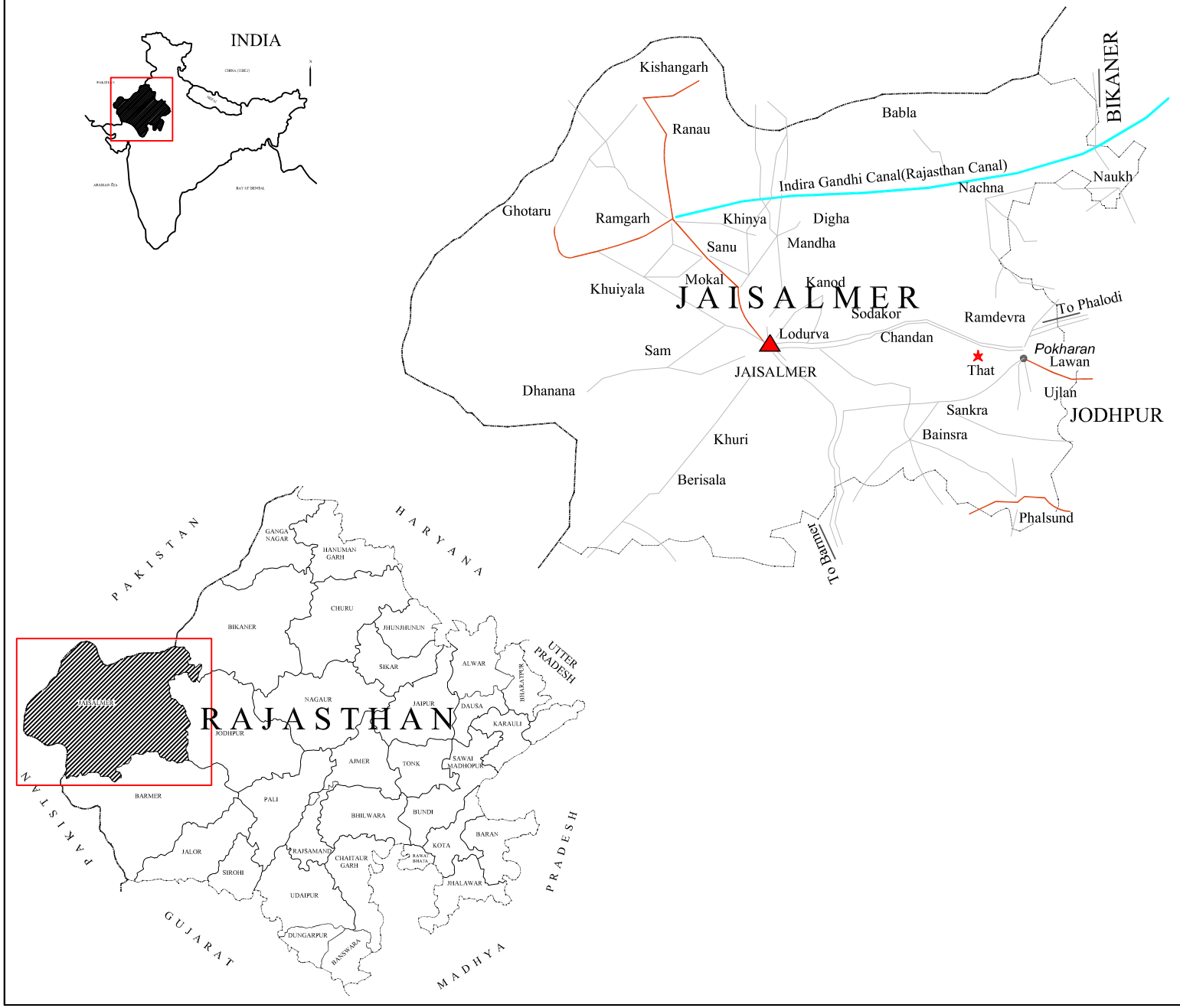
17. Table 1 shows the nature and size of the various components of the subproject. There are three main elements: construction of a landfill, composting plant and access road; construction of storage bins in the town and a transfer station at the outskirts; and provision of vehicles and equipment. The 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 location and dimensions of the transfer station) have not yet been finalised.

18. The landfill and composting plant will be built on 5.5 ha of government land along the Ramgarh Road (Figure 2 and Photo 1), where the landfill will occupy 5 ha and the composting facility 0.5 ha. The landfill will be 2 m deep and extend 8 m above ground level when full, and the floor will be sealed with amended clay and provided with drains to collect leachate, which will be transferred into small evaporation ponds. The working area will be divided into 25 cells, one for each year of operation (Figure 3). The composting area will be paved with concrete slabs, and the whole site will be enclosed by a 2 m high brick wall. A 100 m access road will be built to the landfill from the main Ramgarh Road, and this will be 5.5 m wide, constructed from concrete, with a 1 m earth shoulder on either side.

19. The transfer station will be located on approximately 0.2 ha of government land near the present outskirts of the town. The area will be paved and surrounded by a brick wall, and a concrete ramp and platform will be built to allow the vehicles carrying waste from the town to unload their contents into larger transfer vehicles parked below the platform. The waste collection/storage bins will be of metal, 3 m^3 in capacity (Photo 2), located on small concrete plinths at various points in the town, mainly on waste ground adjacent to roads. Two bins will be provided at each location to allow the segregation of biodegradable waste.

20. Equipment to be provided includes:

- Almost 30,000 household waste bins and 500 roadside litter bins (Photo 3);
- Vehicles and push carts to collect household waste and deposit it in the storage bins (Photo 4);
- Dump trucks to transport full storage bins to the transfer stations (Photo 5);
- Transfer trucks to carry waste to the landfill (Photo 6);
- A backhoe digger/bulldozer, compactor and two dump trucks to handle waste at the landfill (Photo 7).



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

DRAWN :-	CHECKED :-
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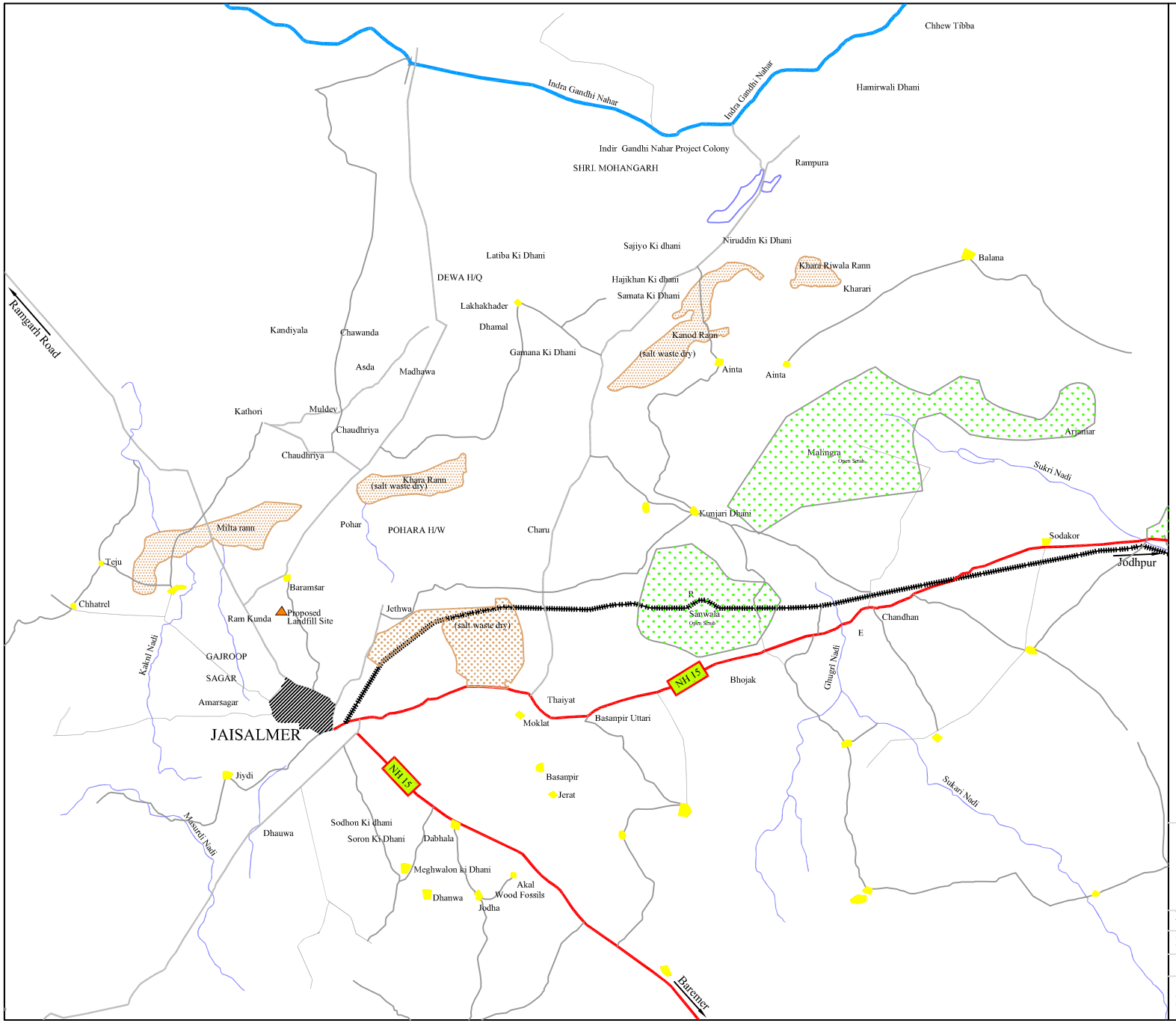

Rajasthan Urban Sector
Development Investment Program
ADB TA 4814-IND

Jaisalmer
Proposed Landfill Site Location

LEGEND:-

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

OVERLAY LEGEND:-

- Proposed Landfill Site

GOVT. OF RAJASTHAN

ASIAN DEVELOPMENT BANK

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Figure :-

Table 1: Improvements in Solid Waste Management Proposed in Jaisalmer

Infrastructure	Function	Description	Location
1. Physical Infrastructure			
Sanitary Landfill	Provide a safe repository for non-biodegradable waste (and rejected material from the composting plant) to serve the town population for 25 years.	A 5 ha clay-lined engineered landfill, a maximum of 8 m high when cells are full, with drains and ponds to collect and treat leachate.	On 5.5 ha within a 75 ha plot of government land along the Ramgarh Road, approximately 12 km north-west of Jaisalmer town
Composting Facility	Convert biodegradable domestic waste to marketable agricultural manure compost	A 0.5 ha paved area on which piles of biodegradable waste are allowed to decompose naturally in the open air.	At the landfill site, adjacent to the landfill area.
Access Road	Provide access to the landfill from the main road	100 m concrete road, 5.5 m in width, with an additional 1 m shoulder on either side	The access road will connect the landfill with Ramgarh Road
Transfer Station	Allow transfer of waste into larger vehicles for transportation to the landfill.	A 0.2 ha paved and walled area with a ramp up which the secondary collection vehicles drive to deposit waste through a hopper into transfer vehicles below	On unused government owned land at the outskirts of the town.
Waste Storage Bins	Provide a location where householders can deposit and segregate their waste, from where the municipality can collect the material regularly and transport to landfill.	145 closed metal containers of 3 m^3 capacity, located on small concrete platforms, with two bins per site to allow segregation of biodegradable waste	At appropriate locations in the town, on waste ground adjacent to roads.
2. Equipment			
Landfill vehicles	Relocate waste after deposition at the landfill and cover with soil at the end of each day, and on closure of each cell	1 backhoe digger/bulldozer; 1 compactor; 1 tipper truck	Landfill site
Transfer vehicles	Transport waste from the transfer station to the landfill	5 or 6 large capacity (5 ton) tipper trucks	Town
Secondary collection vehicles	Collect waste from the town by emptying the waste storage bins, and carry the waste to the transfer station.	14 twin-container dump trucks	Town
Primary collection vehicles	Collect waste from households	19 three-wheeled vehicles; 142 push carts	Town
Litter bins	Deposition of waste by people in town	500 street litter bins	Town
Household waste baskets	Storage and segregation of waste by householders	29,588 household waste baskets	Individual households

Rajasthan Urban Sector
Development Investment Program
ADB TA 4814-IND

Jalsalmer

Conceptual Layout of Compost & Landfill

LENGEND:-

1. Security Room
2. Weight Bridge
3. Office & Staff Amenities
4. Compost Storage & Selling Area
5. Workshop
6. Leachate Collection Sump

(71) Khasra No.

OVERLAY LENGEND:-

NOTE:-

Arrangement of facilities shown are indicative only. The actual location shall be finalised by engineering survey.

GOVT. OF RAJASTHAN
ASIAN DEVELOPMENT BANK

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

Figure :-

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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 8), 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.

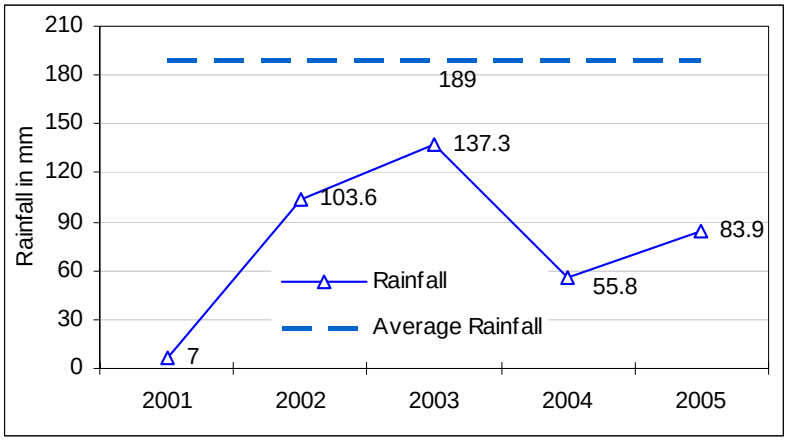
23. One of the most notable physical features of the town is Jaisalmer Fort (Photo 9), constructed in the 12th century, 75 m above ground level on a *trikuta* or triple-peaked hill. Two valleys run around the fort and meet in the south-east, and the surrounding land (on which the town subsequently developed) 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 4). 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 4: 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 10), 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 11). The fauna of the town comprises mainly domesticated animals (camels, cows, goats, pigs and chickens), plus other species able to live close to humans (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*).

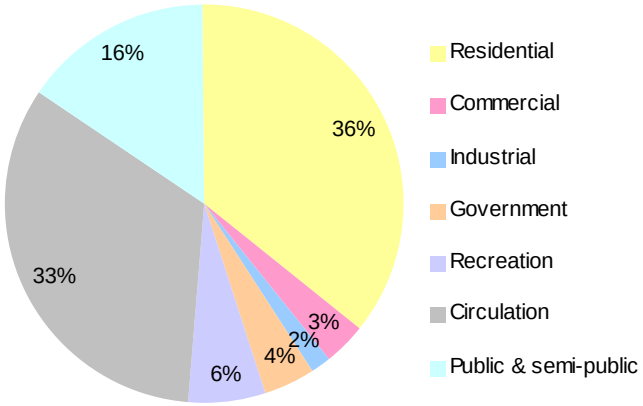
31. There are no forests in Jaisalmer District, mainly because of the climatic conditions. The nearest protected area is the Desert National Park 40 km away, which is designated as an excellent example of the Thar Desert ecosystem. This area includes a wide range of desert environments, including sand 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 5 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 5: 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 12), 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 13). 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 14). 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 (Photo 9). 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 15) and are examples of rich merchants' houses from the grand architecture period of the 19th century;

- 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 should not have major environmental impacts because most of the construction work is relatively small scale and straightforward, and work in the town will affect a series of very small sites only.

53. Because of this 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 land outside the town where the landfill 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

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

B. Landfill and Composting Plant

1. Construction Method

55. Construction of the landfill will begin with excavation to reduce the floor of the site to 2 m below the present ground level. This will be done by backhoe diggers and bulldozers, and waste soil and rock will be loaded onto trucks and taken off site for disposal. Once the floor is level and the sloping sides have been formed, a clay layer will be created, by watering and compacting the existing soil if it is of the required composition, or by importing a clay and Bentonite mixture, which will be applied from trucks and smoothed and finished by hand. This will be covered with a geo-textile membrane to improve the retention capacity, and perforated plastic pipes will be laid on the surface to collect leachate, which will drain into small shallow evaporation ponds dug in an adjacent part of the site. Finally a 20 cm depth of gravel will be added above the geo-textile to allow leachate to drain into the pipes.

56. A 0.5 ha portion of the site will be left at the original ground level for the composting plant, and after minimal earth removal to render it flat, the surface will be sealed with concrete pavement, brought in on trucks.

57. A small trench (ca 0.5 x 0.5 m) will be dug around the perimeter of the site by backhoe, and hard-core and concrete will be inserted to form foundations. A double-skin brick wall (ca 2m high) will then be built by hand by masons. Other facilities, including a small building for workers and a shed for vehicles, will be constructed in a similar manner. Foundations will be dug by backhoe and hardcore and concrete will be tipped in to form foundations, after which bricks will be applied by hand by masons to form the structures.

58. The access road will run from the main Ramgarh Road to the landfill, approximately 100 m away (Figure 2). Vegetation will first be cleared from the route, after which the ground will be levelled by a small bulldozer, with waste material being taken offsite on trucks for disposal. The 5.5 m width of the road will then be delimited by small shuttering boards pegged into the ground, after which aggregate will be tipped in, followed by concrete (mixed on site) to form a thickness of around 200 mm. The surface will be flattened by hand using smoothing boards, and after drying the edge-boards will be removed.

2. Physical Resources

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

60. 5 ha of land will be excavated to a depth of 2 m, so around 100,000 m^3 of waste soil and rock will be generated. There will therefore be quite large physical changes at the site, and this quantity of waste could not be dumped without causing further physical impacts on air quality (dust), topography, soil quality, etc at the disposal site. The work will almost certainly be conducted in the dry season, so there is also a lot of potential for the creation of dust, and this will need to be controlled regardless of the remote location, to avoid effects on site workers and adjacent roads and farmland.

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

- Contact the town authorities to arrange for the use of this material where possible in construction projects, to raise the level of land prior to construction of roads or buildings, or to fill previously excavated areas, such as brickworks;
- Reduce dust by removing waste material by truck as soon as it is excavated;
- Use tarpaulins to cover soil and other loose material during transportation;
- Stockpile suitable topsoil and subsoil for use in the daily covering of refuse once the landfill is operating, in which case stockpiles will need to be sprayed with water when necessary to avoid the production of dust during dry windy conditions.

62. Another physical impact 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.

63. The other construction work at the landfill site (levelling and paving the composting area and construction of the perimeter wall and small buildings for workers and vehicles) will all have physical impacts, but they will be very small in scale compared to those of the landfill excavation, and will thus be of little significance in themselves.

64. Constructing the access road should also not be greatly significant in physical terms as it will be built on the existing ground surface on unused government land. The work will require minor ground clearing and levelling and should not involve excavation or infill, so physical changes should be minor. The work involves concreting so it will be conducted in the dry season, when there should be no problems from the runoff of water containing silt, sand or cement. If dust is generated from exposed soil during windy weather this should be controlled by lightly spraying with water when necessary.

3. Ecological Resources

65. The site proposed for the landfill is within a larger area of government land that is already partially degraded by the uncontrolled dumping of municipal waste (Photo 16). The soil is mainly loose and sandy and supports a sparse desert-type vegetation of halophytic bushes and small trees, which is of no special ecological interest. Construction should therefore have no adverse ecological impacts.

4. Economic Development

66. The landfill and access road will be located within a 75 ha site that is owned by the government, so there will be no need to acquire land from private owners, which might affect the income and assets of owners and tenants. There is also no industry, housing or infrastructure, and the only activity on the overall site is the open dumping of refuse by Jaisalmer Municipal Board, which will cease once the new landfill begins to operate.

67. The land surrounding the site is not suitable for agriculture, but there is one economic activity, as there is a small tourist hotel 200 m from the western boundary (Figure 3). Clearly this would be less attractive to visitors if there was a construction site nearby, and in time an operating waste management facility. The landfill should therefore be located as far from the hotel as is practicable, and at least a distance of 500 m. This should provide a sufficient buffer to avoid economic, visual or other impacts on the hotel during both construction and operation of the site.

68. One other aspect of the work that has economic implications is the transportation of waste soil and stone 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 Ramgarh 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

69. 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 the proposed landfill site 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 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.

70. 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.

71. There are safety risks associated with any construction work, even in a remote location, and the Contractor will be required to produce and implement a site Health and Safety Plan, to protect the safety of both workers and the general public. This should include such measures as:

- Excluding the public from each site (including storage bin sites);
- 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.

72. 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 direct these benefits to the communities directly affected by this part of the scheme, the Contractor should be required to employ at least 50% of the landfill labour force from communities within a radius

of say 2 km from the site, if sufficient people are available. This will have the added benefit of avoiding social problems that sometimes occur when workers are imported into host communities, and avoiding environmental and social problems from workers housed in poorly serviced camp accommodation.

C. Storage Bins and Transfer Station

1. Construction Method

73. Waste storage bins will be provided at approximately 70 locations in the town, from where waste will be collected daily by the municipality. The sites will be on open ground adjacent to roads, and at each a small concrete plinth (approximately 3 x 2 m and 0.25 m above ground level) will be built. This will require the excavation of soil down to around 0.25 m by backhoe, after which the sides above- and below- ground will be encased in wooden shuttering. Concrete will be inserted and allowed to dry, after which the shuttering will be removed. The closable metal storage bins will be manufactured locally and brought to each site on trucks and placed on the plinths by means of a small crane.

74. The transfer station will be located on 0.2 ha of unused land at the outskirts of the town. The area will be levelled by bulldozer and waste soil will be taken offsite on trucks for disposal, after which concrete paving slabs, brought in on trucks, will be affixed to the surface. A Reinforced Cement Concrete (RCC) ramp (approximately 8 m wide, 30 m long and 4 m tall, with a 15 m long platform) will then be built. Foundations will be dug by backhoe and wooden shuttering will be applied to the sides. Heavy-duty metal reinforcing rods will then be inserted, and hardcore and concrete will be added to form the foundations. The shape of the above-ground structure will then be formed from further shuttering and reinforcing rods, after which concrete will again be applied.

2. Physical Resources

75. These facilities will involve simple construction at relatively small sites, and as a result there should not be major environmental impacts.

76. Excavation of foundations for the storage bin plinths will produce around 1.5 m^3 of waste at each site (around 100 m^3 in total), which the Contractor will probably spread across any adjoining waste ground. Ground levelling and excavation at the transfer station will produce around two or three truck loads of soil, which will be taken away for disposal. The work will affect the surface of each area only and will be conducted in the dry, so there is no risk of surface or groundwater collecting in dug areas. There should also be no need for precautions against dust as the excavation in the town will be very small in scale and the transfer station will be located at the outskirts, in an uninhabited area.

77. Creation of the ramp will gradually alter the appearance and topography of the transfer station site, but there should be no need to erect fences to mask the structure from view as there will be no houses in the vicinity and thus few people to observe the site.

3. Ecological Resources

78. There are no significant ecological resources in or around the town, so this work should also have no impacts on ecology. The sites for the storage bins and transfer stations should however be selected to avoid the need to remove any trees.

4. Economic Development

79. These facilities will all be located on government land, so there will be no need to acquire land, and thus there should be no impacts on the assets or income of landowners or tenants. The storage bin sites are so small that construction should not impede the access of customers to nearby shops, and the site of the transfer station will be selected to avoid the presence of any shops or other business activities, so there should be no economic impacts.

80. Excavation could however damage existing infrastructure located alongside roads, in particular water supply pipes and sewer lines, either existing systems or new infrastructure installed by RUSDIP or other programs. It will be particularly important to avoid damaging existing water pipes as these are mainly manufactured from Asbestos Cement (AC), which can be carcinogenic if inhaled, so there are serious health risks for both workers and the public (see below). It will be important therefore to avoid these impacts by:

- Obtaining details from the Municipal Council of the nature and location of all infrastructure, and selecting waste bin sites to avoid any conflict or damage;
- Integrating the construction of the various Alwar subprojects so that:
  - Different infrastructure is located on opposite sides of the road wherever feasible;
  - Roads and inhabitants are not subject to repeated disturbance by excavation in the same area for different purposes.

81. Precautions will also be needed to avoid impeding traffic, particularly where storage bins are to be located in the centre of the town and inside the fort where roads are narrow and easily congested. This will require the Contractor to:

- Place all excavated soil off the road wherever possible; and
- Where this cannot be achieved, conduct the work during periods of low traffic volume (for example on a Sunday).

5. Social and Cultural Resources

82. As was the case for the landfill, there is a risk that the excavation work related to these facilities could damage undiscovered historical remains. The risks could be more significant in this case because such artefacts are more likely in areas that have been inhabited for a long period as Jaisalmer town has, although this could be counterbalanced by the fact that in this case the excavation will be of superficial layers only. Regardless of this the preventative measures described in Section IV.B.5 will need to be employed. These are:

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

83. Construction of these facilities should not be large enough to significantly disturb any nearby modern-day social and cultural resources, such as schools, hospitals, temples and sites

of tourism importance. However it would not be desirable to have operating waste handling facilities in the vicinity of these resources, so such locations should be avoided during the detailed design stage.

84. The storage bins will be located in both residential and commercial areas, and although people should not be significantly disturbed by the construction, they should nevertheless be informed about the work and the operation of the facilities in advance so that they will utilise them when available. This should involve:

- Consultation with the local community to inform them of the nature, duration and minimal impacts of the construction work;
- A public education campaign to inform residents of the new waste management system and their role in its successful implementation.

85. Safety risks are probably greater at these sites than at the much larger landfills, because they are located in the towns, where there will be large numbers of people, vehicles and activities. The Contractor will thus be required to produce and implement the Health and Safety Plan outlined in Section IV.B.5.

86. An additional, particularly acute health risk 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.

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

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

[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

88. Finally, 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.

V. ENVIRONMENTAL IMPACTS AND MITIGATION: OPERATION AND MAINTENANCE

A. Screening Out Areas of No Significant Impact

89. Because the waste storage sites in the town are relatively small and self-contained, and the landfall is located outside the town in an uninhabited and unused area, providing the waste management system is managed effectively, it should operate without major environmental impacts (see below). As a result there are several environmental sectors that 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 Solid Waste Management System is Not Expected to Have Significant Impacts

Field	Rationale
Climate	Odour from decaying waste is the only impact on air quality
Fisheries & aquatic biology	There are no rivers or lakes close to any of the waste management sites
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
Infrastructure, health and education facilities, physical or cultural heritage, historical or archaeological resources	Locations of waste management facilities (bins, transfer station and landfill) will be selected in the detailed design stage to avoid municipal infrastructure and sites and facilities of social or cultural importance

B. Operation and Maintenance of the Improved Waste Management System

90. Jaisalmer Municipal Board (JMB) will be responsible for management and implementation of the waste management system, and will distribute almost 30,000 bins to households in the town (two per household) for temporary waste storage. This will be supported by a public education campaign, through which citizens will be requested to segregate their biodegradable and general domestic waste into separate bins, and will be informed about the waste collection and management system.

91. JMB will introduce door-to-door primary waste collection throughout the city by its own staff or through private sector participation (PSP) by a local contractor or NGO. Three-wheeled auto trolleys (in 30% of the town) and hand-operated pushcarts (remaining 70%) will collect waste from each household on a regular cycle every day or every two or three days, and the segregated waste will be deposited into separate storage bins in the locality. Waste will also be removed from litter bins in the streets, and debris from street sweeping and drain de-silting will

also be deposited into the municipal storage bins. These will be removed daily by purpose-made vehicles, and two empty bins will be replaced at each site.

92. Full containers will be transported to the transfer station where the vehicles will empty the waste from each container into a large truck located beneath the ramp platform, with separate vehicles being used for biodegradable material and mixed waste. When full, each vehicle will drive to the landfill and deposit the waste in the landfill area or at the composting plant.

93. Waste for landfilling will be moved into position in the currently-used cell by backhoe/bulldozer, and reduced in volume by a compactor vehicle. All waste will be covered by soil at the end of each day, and by a thicker layer of topsoil at the end of each year, when one cell will be closed and another will begin.

94. Waste at the composting plant will be sorted manually and via conveyors, and any unsuitable material will be transferred to the landfill. Biodegradable waste will be left to rot in piles in the open air, with material being turned and mixed manually as required. Once the compost has been formed it will be loaded into bags and taken away on a truck for sale to retailers.

C. Environmental Impacts and Benefits of the Operating System

1. Physical Resources

95. Clearly it is imperative that JMB maintains the individual facilities and the waste management system as a whole in proper working order, because if the system begins to fall into disrepair then waste will rapidly accumulate in streets and on open ground and there will be consequent impacts on many elements of the environment. Capacity building, public education campaigns and other support provided by this sub-project and future tranches of investment will be aimed at ensuring the continuation of the operating system.

96. If waste is collected regularly from houses, litter bins and elsewhere and the storage bins are emptied daily as intended, there should be no direct impacts on the physical environment. Even air quality should not deteriorate from increased odour in the vicinity of the bins, providing they are emptied and replaced each day. As an additional safeguard, contractors should be required to hose out each bin once it is emptied at the transfer station to ensure that residual waste is not left in replaced bins to decompose over the long term. A rudimentary drainage system should also be provided at the station to collect the waste and wastewater so that it does not pollute the surroundings.

97. The greatest physical impacts from the operating system will occur at the landfill, where decomposing waste will rise to an eventual height of up to 8 m above ground level, which will greatly alter the appearance and topography of the site. Although these impacts would be significant at certain locations this should not be the case at the proposed site, which is partially screened by surrounding hills (Photo 17), and where there are no inhabited areas nearby from which people would be able to see the site. The only exception is the hotel to the west mentioned in Section IV.B.4 above, so tall trees with dense foliage should be planted along the western edge of the landfill to screen the site from this direction.

98. The landfill design includes measures to collect leachate and prevent pollution of surface and groundwater, and because there is very low rainfall in the area, the collected liquid will be

allowed to evaporate in simple lined ponds. The design also includes measures to maintain an orderly appearance at the site and to prevent the liberation of excessive odours, as deposited waste will be covered with soil after compaction at the end of each day; and when a cell is closed at the end of each year, a thicker layer of topsoil will be applied to effectively seal the completed area. Simple tubed vents will be inserted into the material to allow the escape of methane and other gases produced by the decomposition process, and equipment will be provided for automatic monitoring of such gases, so that additional measures such as controlled flaring can be adopted if necessary.

2. Ecological Resources

99. As there are no significant ecological resources in or around the town, or near the transfer station and landfill site, operation of the solid waste management system should have no ecological impacts.

100. Poorly-managed landfills can cause negative ecological impacts by allowing the development of colonies of scavenging birds, rodents and other vermin, which can then be a nuisance and a health hazard in surrounding areas. This should not be a problem given the remoteness of this site, and these animals will be discouraged anyway by the daily covering of deposited waste. Nevertheless the Municipality should routinely monitor the incidence of pests at the site and take further controlling action if necessary.

101. There will be a small ecological gain from the planting of trees to screen the site from view from the nearby hotel as recommended above, and this should be augmented by planting trees on and around closed waste cells as has been done successfully at landfills elsewhere. Given the sandy soil and low rainfall of the area such planting may need to be supported by the application of fertiliser from the composting plant and the use of an artificial watering regime.

3. Economic Development

102. Business and small industry in the town should operate more efficiently if their waste is removed speedily and efficiently, so there should be small economic gains once the system is in place. The main economic benefit will be obtained by the companies that are involved in operating the waste management system, either in partnership with the Municipality via PSP schemes or through direct employment.

103. There should also be a significant economic benefit in the long term from the commercial sale of agricultural compost produced at the composting plant, although given the low level of agriculture in this part of Rajasthan the product may need to be sold farther afield. Farms that do utilise the compost should show increased yields, providing further economic gains.

104. The only negative economic impact from the operating waste management system is on traffic and transportation as there will be more heavy vehicles on the roads in and around the town, collecting and transporting the storage bins and transferring waste to the landfill. This should be mitigated by conducting these collections early in the day (when traffic is light) as much as possible, after which any remaining impacts should be counterbalanced by the economic and other benefits of the scheme.

4. Social and Cultural Resources

105. The main beneficiaries of the improved system of waste management will be the citizens of the town, whose general environment, and in some cases living conditions, will be improved considerably. The unsightly mounds of garbage should no longer be evident in the town, and the attendant appearance, smell and public health risk should be removed. This should also enhance the cultural resources of the town and make the various sites more appealing to visitors, which could then bring economic benefits.

106. There will also be socio-economic benefits for people who are able to gain employment with companies involved in operating the system, or with the Municipality, who will need to increase their manpower. Farmers who benefit from fertilizer produced at the composting plant should also experience increases in their income.

107. One group who will suffer economically are the “rag-pickers” who currently scavenge the piles of refuse in the town for materials that they can sell for re-use (textiles, bottles, etc). These activities will be prohibited at the new landfill, so this poor and vulnerable group of people will lose their means of livelihood. This has been recognised by JMB, who plan to mitigate this impact by employing rag pickers at the composting plant to sort through the material to remove any non-biodegradable constituents.

VI. ENVIRONMENTAL IMPACTS AND MITIGATION: LOCATION AND DESIGN

108. 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.

109. 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 leachate from an unsealed landfill drains into an exploited aquifer and pollutes water sources this would be an impact of both location and design as it would not have occurred with a sealed landfill located in an area with no groundwater resources.

110. However in the case of this subproject it is not considered that there are any impacts that can clearly be said to result from the design or location. This is because:

- Most elements of the subproject are relatively small in scale and involve straightforward construction and 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 involves excavation and other ground disturbance. However the routine nature of the impacts means that most can be easily mitigated.

VII. INSTITUTIONAL REQUIREMENTS AND ENVIRONMENTAL MONITORING PLAN

A. Summary of Environmental Impacts and Mitigation Measures

111. Table 6 lists the potential adverse impacts of the Jaisalmer solid waste management 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

112. 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 Solid Waste Subproject (Black = continuous activity; Grey = intermittent)

Potential Negative Impacts	Sig	Dur	Mitigation Activities and Method	Respon sibility	Location	07	2008			[3]
Construction: Landfill and Composting Plant						D	1	2	Op	
Excavation of landfill will produce a large amount of waste soil	S2	P	Find beneficial uses for waste soil in construction, land raising and infilling of excavated areas	Contractor	Landfill site					+
			Retain topsoil and subsoil to cover waste when landfill is in operation							0
Dust could be produced when soil is transported and stockpiled	S2	T	Remove waste soil as soon as it is excavated	Contractor	Landfill site					0
			Use tarpaulins to cover dry soil when carried on trucks	Contractor	All sites					0
			Spray soil stockpiles with water in dry weather	Contractor	Landfill site					0
Road construction could produce dust in dry weather	S2	T	Damp down exposed soil to reduce dust when necessary	Contractor	Access road					0
Construction site could reduce visitors at nearby hotel	S2	T	Locate landfill as far from hotel as possible: at least 500m	DSC	Landfill site					0
Traffic may be disrupted by lorries carrying waste soil	S2	T	Plan routes to avoid Jaisalmer Town & narrow local roads	Contractor	From landfill					0
			Schedule transportation to avoid peak traffic periods							0
Ground disturbance could damage archaeological and historical remains	S1	P	Request state and local archaeological authorities to assess archaeological potential of landfill 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						+
Workers and the public are at risk from accidents on site	S2	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
Economic benefits if local people are employed in Contractor's workforce	S2	T	Contractor should employ at least 50% of workforce from communities in vicinity of landfill site	Contractor	All sites					+
Construction: Storage Bins and Transfer Station										
Excavation for foundations could damage infrastructure	S1	P	Determine location of infrastructure and avoid these sites	DSC	Both sites					0

Sig = Significance of Impact (S3 = Not Significant, negligible impacts; S2 = Moderate, reversible impacts which are site specific and simple to contain and mitigate; S1 = Significant, potentially irreversible impacts requiring complex mitigation). Dur = Duration of Impact (T = Temporary; P = Permanent)
D = Detailed Design period; Op = Period when infrastructure is operating
*This column shows impacts remaining after mitigation: 0 = zero impact (impact successfully mitigated); + = positive impact (mitigation provides a benefit)

			Locate different infrastructure on opposite sides of roads	DSC	Storage Bins					0
Roads/people may be disturbed by repeated excavation	S2	T	Integrate subprojects to conduct excavation at same time	DSC/LGD	Storage Bins					0
Work could impede traffic in narrow roads	S2	T	Place excavated soil off road wherever possible	Contractor	Storage Bins					0
			Conduct this work during light traffic periods (eg Sunday)							0
Ground disturbance could damage archaeological and historical remains	S1	P	As above: ask authorities to assess potential of all sites	DSC	All sites					0
			As above: choose alternative sites if 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						+
Facilities may disturb schools, hospitals, tourist sites	S2	P	Choose sites that are not near sensitive buildings/areas	DSC	Both sites					0
Community should be informed about work in advance			Consult community; conduct public information campaign	LSGD	Town					0
Workers and the public are at risk from accidents on site	S2	T	As above: prepare and implement H&S plan (exclude public, use safety equipment, training, accident record)	Contractor	All sites					0
Existing water supply system uses AC pipes, a material that can be carcinogenic if inhaled as dust particles	S1	T	Design all infrastructure to avoid locations of AC pipes	DSC	All sites					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	All sites					0
			- immediate reporting of any occurrence to management;	Contractor	Bins and Transfer Stn					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	S2	T	As above: 50% of workforce from affected communities	Contractor	All sites					+
Operation and Maintenance										
Town environment will deteriorate if system malfunctions	S1	P	Maintain facilities and system in full working order	GA	All sites					0
Unclean waste bins could produce foul odour	S2	T	Hose out bins after emptying at Transfer Station	OMC	Transfer Stn					0
			Provide hoses and drains at Transfer Station	DSC	Transfer Stn					0
Landfill could detract from views from nearby hotel	S2	P	Screen site by planting tall trees along western boundary	DSC	Landfill					0
Landfills can attract birds, rodents and other pests	S2	P	Monitor pest incidence & reduce numbers if necessary	GA	Landfill site					0
Small ecological gains if closed landfills planted with trees	S2	P	Plant trees on closed cells; apply compost if necessary	OMC	Landfill site					+
Traffic may be impeded by heavy waste vehicles	S2	P	Collect waste early in the day as much as possible	OMC	Town					0
Rag-pickers will lose their means of livelihood	S1	P	Employ rag-pickers to sort waste at compost plant	GA	Landfill site					+

113. 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.

114. 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.[4]

C. Environmental Monitoring Plan

115. Table 6 shows that most mitigation activities are the responsibility of the Construction Contractors (CC) employed to build the infrastructure during the construction stage, or the O&M Contractors employed to operate the new waste management system in the future. 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.

116. 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].

117. 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)

118. 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

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)	Landfill site	Contractor	Site observations; CC records	Monthly	EMS
Retain topsoil and subsoil to cover waste when landfill is operating	Landfill site	Contractor	Site observations	Monthly	EMS
Remove waste soil as soon as it is excavated	Landfill site	Contractor	Site observations	Weekly	EMS
Use tarpaulins to cover dry soil when carried on trucks	All sites	Contractor	Observations on and off site	Weekly	EMS
Spray soil stockpiles with water in dry weather	Landfill site	Contractor	Site observations	Weekly	EMS
Damp down exposed soil to reduce dust when necessary	Access road	Contractor	Site observation; resident survey	Weekly	EMS
Locate landfill as far from hotel as possible: at least 500 m	Landfill site	DSC	Site observation; design reports	As needed	EMS
Plan truck routes to avoid Jaisalmer Town and narrow local roads	From landfill	Contractor	Observations off site; CC record	Weekly	EMS
Schedule transportation of waste to avoid peak traffic periods	From landfill	Contractor	Observations on and off site	Weekly	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	LSGD 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
Employ at least 50% of workforce from communities near sites	All sites	Contractor	CC records; worker interviews	Monthly	EMS
Determine location of infrastructure and avoid these sites	Bins + Trans St	DSC	DSC records; design reports	As needed	EMS
Locate different infrastructure on opposite sides of roads	Storage Bins	DSC	Site observation; design reports	Monthly	EMS
Integrate subprojects to conduct trenching at same time	Storage Bins	DSC/LSGD	Site observation; design reports	Monthly	EMS
Place excavated soil off road wherever possible	Storage Bins	Contractor	Site observations	Weekly	EMS
Conduct work near narrow roads during light traffic (eg Sunday)	Storage Bins	Contractor	Site observations	Weekly	EMS
Choose sites that are not near sensitive buildings/areas	Bins + Trans St	DSC	Design reports; site observation	As needed	EMS
Consult community; conduct public information campaign	Town	LSGD	LSGD 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 the public from site	All sites	Contractor	Site observations; CC records	Monthly	EMS
Ensure that workers use Personal Protective Equipment	All sites	Contractor	Site observations; CC records	Monthly	EMS
Provide Health & 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	All 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
OPERATION AND MAINTENANCE					
Maintain facilities and system in full working order	All sites	GA	Site observation; resident survey	Monthly	
Hose out bins after emptying at Transfer Station	Transfer Stn	OM Contractor	Site observation	Monthly	
Provide hoses and drains at Transfer Station	Transfer Stn	DSC	Design reports; site observation	Monthly	EMS
Screen landfill by planting tall trees along western boundary	Landfill site	DSC	Design reports; site observation	As needed	EMS
Monitor pest incidence & reduce numbers if necessary	Landfill site	GA	Site observation; GA records	Monthly	
Plant trees on closed cells; apply compost if necessary	Landfill site	OM Contractor	Site observations	Monthly	
Collect waste early in the day as much as possible	Town	OM Contractor	Site observation; resident survey	Monthly	
Employ current rag-pickers to sort waste at compost plant	Landfill sites	GA	GA records; worker survey	As needed	
LONG-TERM SURVEYS					
Township litter and garbage survey	Town	GA	Systematic observation; resident survey	Annual for 5 years	Specialist consultant

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.

119. Given the scale of the investment in providing the infrastructure, LSGD will also wish to conduct monitoring during the operational period to confirm the long-term benefits of the scheme. Table 6 shows that a specialist consultant will be appointed to conduct a survey of the amount of litter and garbage in the town, during the construction period (baseline), and annually for the first five years of operation of the improved waste management system.

D. Environmental Management and Monitoring Costs

120. 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 operate the waste management system) 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.

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

- The environmental monitoring during construction, conducted by the EMS; and
- The long-term garbage survey 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 the one year of design and construction, and the first five years of operation) is INR 0.9 million, ie US$ 20,000.

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[6]	300,000	
Survey Expenses	Sum	100,000	100,000	400,000
2. Survey of litter and garbage (6 years)				
Domestic Consultant	6 x ½ month	100,000	300,000	
Expenses	Sum	200,000	200,000	500,000
TOTAL				900,000

[6] Unit costs of domestic consultants include fee, travel, accommodation and subsistence

VIII. PUBLIC CONSULTATION AND INFORMATION DISCLOSURE

A. Project Stakeholders

122. 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:

- People who live and work near the sites of storage bins, transfer station and the landfill;
- State and local authorities responsible for the protection and conservation of archaeological relics, historical sites and artefacts.

Secondary stakeholders are:

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

B. Consultation and Disclosure to Date

123. 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 April 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

124. 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

125. The process described in this document has assessed the environmental impacts of all elements of the infrastructure proposed under the Jaisalmer Solid Waste Management Subproject. Potential negative impacts were identified in relation to construction and operation of the improved infrastructure, but no impacts were identified as being due to either the subproject design or location. 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:

- Using natural or amended clay to seal the landfill and incorporating a drainage system to collect leachate, to prevent the pollution of groundwater;

- Including a composting plant to provide a beneficial use for biodegradable waste.

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

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

- Locating the storage bins, transfer station and landfill on government-owned land to avoid the need for land acquisition and relocation of people;
- Locating the landfill at a site with natural screening, and positioning the facility at least 500 m from the one inhabited building in the vicinity to provide an effective buffer.

127. Regardless of these and various other actions taken during the IEE process and in developing the project, 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 excavation work, because the secondary storage facilities (waste bins) are located in the town, some parts of which are densely populated, and because Rajasthan is an area with a rich history, in which there is a high risk that ground disturbance may uncover important remains. Because of these factors the most significant impacts are on the physical environment, the human environment, and the cultural heritage.

128. During the construction phase, impacts mainly arise from the need to dispose of large quantities of waste soil produced by excavation at the landfill site. Such impacts are commonly encountered during construction in and around urban areas, and there are well developed methods for their mitigation. These include:

- Finding beneficial uses for waste material;
- Covering soil to prevent dust during transportation on trucks;
- Damping down exposed soil and stockpiled material to reduce dust during dry weather.

129. 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.

130. 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 encountered accidentally during excavation work. These are to:

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

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

131. 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;
- Plant trees on completed parts of the landfill site once it is operating, to improve the appearance and provide a small ecological gain.

132. 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.

133. Once the system is operating, it will be important that Jaisalmer Municipal Board maintains the facilities and the waste management system as a whole in proper working order, because the town environment will deteriorate rapidly from waste accumulation if the system begins to fail. The project will provide capacity building, public education and financial support to ensure continuation of the operating system.

134. If waste is collected regularly from houses and municipal storage bins, transferred to the landfill and treated as intended, then there should be no significant negative impacts. Even the accumulation of waste to a design height of 8 m at the landfill should not be significant as waste will be compacted and covered with soil daily and when each waste cell is completed, thus limiting pests, odours and visual impacts. Trees will also be planted to screen the site from the one building in the vicinity.

135. The main impacts of the operating waste management system will be beneficial as the general environment of the town will improve considerably as mounds of garbage are no longer evident and the appearance, smell and public health of the area improves as a result. This should enhance the cultural resources of the town and make the various historical and tourism sites more appealing to visitors. Some people will gain socio-economically from being employed in companies engaged to operate the system, or in the expanded Municipality manpower. Farmers should also benefit from increased yields from the use of fertilizer produced in the composting plant.

136. 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).

137. Mitigation will be assured by a programme 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 a longer-

term survey to monitor the expected improvements in the town environment from the improved solid waste management.

138. 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

139. 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) are implemented in full, as described in the text above;
- The Environmental Monitoring Plan proposed in Section VI.C of this report is also implemented in full.

X. CONCLUSIONS

140. The environmental impacts of the proposed improvements in solid waste management infrastructure in Jaisalmer Town have been assessed by the Initial Environmental Examination reported in this document, conducted according to ADB guidelines. The overall conclusion 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 the town environment once the scheme is in operation.

141. 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: Proposed landfill and compost site

Photo 2: Solid waste container

Photo 3: Household waste storage bin

Photo 4: Auto trolley for collection

Photo 5: Dumper placer with container

Photo 6: Transfer truck

Photo 7a: Excavator cum loader

Photo 7b: Compactor

Photo 8: Sand dunes around Jaisalmer

Photo 9: Jaisalmer Fort

Photo 10: Gadi Sagar Lake in Jaisalmer

Photo 11: Natural vegetation in Jaisalmer

Photo 12: Jaisalmer handicrafts

Photo 15: Jaisalmer Fort

Photo 13: Narrow streets in the Fort area

Photo 16: Open dumping at the site

Photo 14: Roads in the outskirts of Jaisalmer

Photo 17: Hilly topography around the site