13.4.2 Selection of Items for Environmental Impact Assessment

According to the Environmental Impact Assessment Regulation of the Republic of Turkey, an Initial Environmental Assessment/Evaluation (IEE) should be carried out prior to the construction of a disposal site for general wastes to determine whether there is a need for environmental impact assessment. However, because this project involves infectious and hazardous medical wastes the direct implementation of environmental impact assessment is required. The items to be subject to the environmental impact assessment were selected by JICA Study Team based on the JICA guidelines for environmental considerations for the conduct of development studies as shown in Table 13-10. In consideration of the guidelines, the selected items pertain to the site topography, surrounding land use conditions, location of residential areas, and natural conditions .

The environmental impact assessment for this project will cover the following items:

- Economic activities
- Public health
- Hazards/risks
- Topography and geology
- Groundwater
- Hydrological situation
- Fauna and flora
- Landscape/aesthetics
- Air pollution
- Water pollution
- Soil contamination
- Noise and vibration
- Offensive odour

Table 13-10: Scoping of Environmental Impacts for Proposed Site

No	Environmental Item	Description	Evaluation	Reason
Social Environment				
1	Resettlement	Resettlement due to land acquirement for project(s) (transfer of rights of land ownership/residence).	D	No houses/residents in area for proposed site.
2	Economic Activities	Loss of bases for economic activities (e.g., land) and effects on these activities.	C	Loss of agricultural land; effect on recycling/scavenging activities; production and sale of compost
3	Traffic and Public Facilities	Impacts on schools, hospitals, etc. and traffic conditions (e.g., increased traffic congestion/accidents).	D	Almost no increase of traffic congestion/accidents because traffic volume will not change since the proposed disposal site is located neighbouring the present disposal site
4	Division of Community	Division of Community geographically due to project location, interruption of area traffic, etc.	D	No community in proposed area.
5	Cultural Property	Damage to or loss of value of churches, temples, archaeological remains or other cultural assets.	D	No cultural property in area around landfill site.
6	Water Rights/ Access Rights	Obstruction of fishing rights, water rights and rights of common access.	D	No water/fishing rights affected.
7	Public Health	Deterioration of public health and sanitary conditions due to refuse generation and increase in pathogens/vermin.	B	Impact will be significant near landfill site due to refuse disposal; deterioration in air and water quality will also affect public health.

No	Environmental Item	Description	Evaluation	Reason
8	Waste	Generation of construction wastes/debris.	D	Almost no construction wastes/debris.
9	Hazards/Risks	Increase in natural disasters (e.g., landslides) and man-made hazards (e.g., landfill gas explosions, refuse fires).	C	Possibility of natural disasters (landslides, flooding) is unlikely to increase; possibility of gas explosions.
		Natural Environment		
10	Topography and Geology	Changes of valuable topography and geology due to excavation, construction and/or filling works.	C	No valuable topography and geology; changes of topography
11	Soil Erosion	Topsoil erosion by rainfall after earthfilling and deforestation.	D	No forest removed under construction on the proposed site and little possibility of erosion.
12	Groundwater	Changes in groundwater level due to infiltration of leachate and run-off from disposal site.	C	Impact on groundwater level is likely to be small but should be considered.
13	Hydrological Situation	Changes in river discharge and riverbed condition due to inflow of run-off and landfill.	C	Small Impact on surface water resources in vicinity of landfill.
14	Coastal Zone	Coastal erosion and changes in vegetation due to coastal reclamation and changes.	D	Project will not impact on coastal zone.
15	Fauna and Flora	Obstruction of breeding and extinction of species due to changes in habitat conditions.	C	Increase in vermin may threaten flora and fauna.
16	Meteorology	Changes in temperature, rainfall, wind, etc. due to large scale land changes and building construction.	D	None; scale of landfill is too small to produce such changes.
17	Landscape/ Aesthetics	Changes in topography and vegetation due to earthworks; deterioration in environmental aesthetics.	B	The proposed site can be seen from some villages; affects the view from the villages unless sanitary management is conducted.
		Pollution		
18	Air Pollution	Pollution caused by exhaust/toxic gases, dust, smoke, fumes, etc. from refuse collection vehicles and the landfill site.	C	Landfill gases (e.g., methane) will be generated; smoke/dust may be problematic especially during dry season; impact of fumes/exhaust gases from refuse collection and landfill vehicles same as present (small).
19	Water Pollution	Pollution caused by inflow of sand, silt, leachate and run-off from disposal site into rivers, groundwater and sea near river discharges.	A	Due primarily to leachate.
20	Soil Contamination	Contamination of soil by leakage and diffusion of ash, leachate, etc.	B	Due primarily to leachate and hazardous/toxic substances in medical waste.
21	Noise and Vibration	Noise and vibration generated by refuse collection vehicles and landfill site equipment.	B	Due to refuse collection vehicles and heavy landfill site equipment (e.g., bulldozers).
22	Land Subsidence	Deformation of land and land subsidence due to decrease in groundwater table.	D	None
23	Offensive Odour	Generation of offensive odour from landfill site, associated treatment facilities and during waste transportation.	B	Odour due to landfill gases, refuse smell, leachate and compost will be generated at landfill site.

Note: Evaluation categories: A - serious impact expected; B - some impact expected; C - extent of impact unknown (examination needed; impacts may become clear as Study progresses); D - no impact expected; EIA not necessary

13.4.3 Characteristics of Socio-economic, Physical-biological Environment and Use of Natural Resources

13.4.3.1 Social Environment

a. Economic Activities

The aim of this study is to provide economic analysis for the Adana and Mersin waste management systems. More particularly, it is aimed to find economic value added, including employment, and beneficiaries and losers of the Project.

Data are taken from "Main Report". Price and quantity information were collected in October 1998. The price information is converted to June 1999 by the method developed below. The quantity data are used as given in the Report.

The first step was to convert prices to the US dollar values of October 1998 and June 1999. This provides a base for comparison of prices in October 1998 and June 1999. For simplicity, a calculated ratio, as "June 1999 US $/ October 1998 US $= 1.51" is used. October 1998 prices are multiplied by this ratio.

October 1998 prices were converted to June 1999 prices, using State Institute of Statistics' "private sector wholesale price index" as the second step. A ratio is calculated by "June 1999 Index/ October 1998 Index = 1.312". October 1998 prices are multiplied by this ratio.

The third step was a simple arithmetic average of step 1 and step 2.

There are mainly three stages in waste collection in Adana. The first stage is performed by "street waste pickers". Their numbers are estimated as 150. Pickers use only their labourforce and simple push carts and sack. The estimated amount of collection is 15 tonnes/day. Pickers sell waste to "middlemen". Their numbers are given 19 in Adana (for those who were interviewed). Middlemen sell waste to final users and to each other. Final users are listen in the Report. The final waste collection site is the last stage of waste collection. Scavengers recycle 9 tonnes/day in the Sofulu- Adana Site.

Street waste pickers' wage income and profit are considered together, while middlemen and final site scavengers enjoy from profit. It is assumed that none of these people pay any tax, rent, etc. to public authorities.

a.1 The Economic Analysis of the Adana Waste Management System

Table 13-11: Prices Calculated for Street Waste Pickers (as of June 1999, TL/Kg)

Material	Price
Metal	14,110
Tin can	14,110
Plastics	15,520
PET	15,520
Scrap copper	232,815
Aluminium can	232,815
Bottle and glass	17,638
Paper	12,699

The next step is to estimate daily and annual income of street waste pickers.

Table 13-12: Estimated Incomes of Street Waste Pickers (TL/day)

Material	Income
Metal	40,919,000
Plastics	74,496,000
Paper	78,733,800
Total	195,912,600

Although street waste pickers revealed that they work seven days a week, the annual income is calculated for 350 days: 195,912,600 X 350= 68,569,410,000. This is the total value added, created by street waste pickers. It is estimated that 150 pickers exist in Adana, making average annual income per picker 457,129,400. TL, and daily income 1.3 million TL.

Middlemen buy waste from pickers, and occasionally, from households, and sell to final users. They enjoy from a profit margin, as calculated below.

Table 13-13: Profit of Middlemen (as of June 1999, TL/Kg)

Material	Profit
Metal	3,175
Plastics	23,282
PET	31,748
Aluminium can	56,440
Bottle and glass	5,997
Paper	11,994
Cardboard	7,055

It is possible to calculate daily and annual total profit of middlemen:

Table 13-14: Profit of Middlemen (TL/day)

Material	Profit
Metal	19,050,000
Plastics	93,128,000
PET	31,748,000
Aluminium can	113,280,000
Bottle and glass	5,997,000
Paper	143,131,000
Total	407,131,000

The total annual profit of middlemen is calculated for 350 days:

407,131,000 x 350= 142,495,850,000 TL.

The same procedure is employed for the Sofulu Site.

Table 13-15: Prices at the Sofulu Site (as of June 1999, TL/Kg)

Material	Prices
Metal	11,288
Plastics	45,858
PET	49,385
Aluminium can	112,880
Glass	7,761
Cardboard	16,932
Bone	21,165

Monthly and annual income at the Sofulu Site is calculated as follows:

Table 13-16: Monthly Income at the Sofulu Site (TL/month)

Material	Income
Metal	903,040,000
Plastics	1,834,320,000
PET	987,700,000
Aluminium can	1,128,800,000
Glass	620,880,000
Cardboard	507,960,000
Bone	211,650,000
Total	6,194,350,000

The annual income at the Sofulu Site is calculated as :

6,194,350,000 x 12= 74,332,200,000 TL.

This is gross income. There are 60-70 workers who work regularly at the Site. Each one receives a wage of 3 million TL/day, and works 6 days a week. Therefore, annual work period for a worker is 313 days. Total wage bill reaches to:

3,000,000 x 313 x 70= 65,730,000,000 TL.

The “big five scavengers” enjoy total profit of 8.6 billion TL/year. It turns out an average of 1.7 billion TL/year for each. This amount would be assumed a “low” profit, assuming, “five big scavengers” do have alternative source(s) of income, e.g., middlemen.

The total value added of all waste management operation is;

Street waste pickers	68.5 billion TL/year,
Middlemen	142.5 billion TL/year,
At Sofulu Site	8.6 billion TL/year,
Total	219.6 billion TL/year.

Adding 65.7 billion TL/year wage of Sofulu, the grand total would have been 285.3 billion TL/year. Finally, approximately 150 street waste pickers, a number of middlemen, and permanently employed 60-70 workers of Sofulu Site are the total employment of waste management in Adana.

The total amount of waste collected in Adana would be calculated as shown at Table 13-17.

Table 13-17: Total Waste Collected in Adana (Ton/year)

Material	Amount
Metal	3,120
Aluminium can	840
Plastics	1,920
PET	600
Glass and bottle	1,320
Paper and cardboard	4,680
Total	12,480

3,240 tonnes/year of the total is collected at the Sofulu Site while the remaining part is from the city. It is calculated that street waste pickers collect 15 tonnes/day, middlemen collect 26 tonnes/day, and scavengers collect 9 tonnes/day at Sofulu. The total daily waste collection is 35 tonnes and it makes 12 500 tonnes/year. Since Table 13-17 gives very close conclusion, it could be accepted as equal.

The breakthrough of waste and Turkish average values are as follows:

Material	**Adana**	**Turkey**
Metal	25%	9%
Plastics and PET	21%	20%
Bottle and glass	11%	16%
Paper and cardboard	35%	46%
Aluminium can	8%	N/A

Should the Sofulu project were completed, it would be assumed that street waste pickers and middlemen would not be effected. According to Table 13-18, waste-user firms demand 9,960 tonnes/year paper, 4,400 tonnes/year PET, and 2,280 tonnes/year plastics. Supply of waste by street waste pickers and middlemen is significantly below these amounts: 4,680 tonnes/year paper, 600 tonnes/year PET, 1,920 tonnes/year plastics. It is possible to conclude that there are enough capacities for waste utilisation in Adana, but, supply from Adana is not sufficient.

a.2 An Economic Evaluation of The Sofulu Site

There are several villages in the vicinity of the Sofulu Site. The existing waste dumping site covers 22 ha. The nearby area is suitable for agriculture, and, some parts are also opened to housing construction. As far as housing construction is concerned, these villages are very close to the Adana Metropolitan Area, and therefore, the value of land is high. It is as low as 1 million TL per square meter (approximately $2,5) in the neighbourhood of the dumping site, but as high as 20 million TL per square meter

(approximately $ 50) in the distant places away from the dumping site. However, it is impossible to use the land for housing construction because of smoke of landfill fires and offensive odour from the dumping site.

The common agricultural products are wheat and barley, along with some animal husbandry and orchards. The proposed project is going to cover approximately 73 ha. Should the existing dumping site and proposed project are considered together, the total site would be 95 ha. Most farmers grow wheat and barley. The following calculation is wheat-equivalent. Wheat production per hectare is approximately 4 tonnes. Farmgate price of wheat per ton is 50 million TL. The grain field accounts for 50% of the area. Therefore, farmgate value is :

4 tonnes X 50,000,000 TL X 73 ha X 0.5 = 7.3 billion TL
(approximately $ 18,250)

b. Public Health

A public health survey has been conducted to assess the occurrence and incidence of diseases among the residents in the vicinity of the disposal site to provide some baseline health data.

The source for these data are case reports regarding to diseases with or without obligation of reporting, reported not only by all local health institutions like primary health centres and hospitals serving the area, but also by distant health institutions in case they have received patients among the residents living in the specified area.

Table 13-18: Population Distribution of the Area according to the Years
(Mid-annual Population in the Service Area of Sofulu Primary Health Centre)

Years	Males	Females	Total
1997	7,183	6,820	14,003
1998	7,939	7,750	15,689

The data regarding disease cases observed in the Sofulu Primary Health centre Area should be filtered for the diseases that can be related to the presence of a disposal site such as enteritis, salmonellosis, hepatitis A, hepatis B, amoebic dysentery and suspicious bites. The first 5 diseases can be related to the contamination of water sources or water distribution system by specific causative agents, but should be supported and verified by biological and microbiological analysis proving the presence of infecting agents in the water.

Table 13-19: Reported Diseases Distribution in the Service Area of Sofulu Primary Health Centre

Years	Diseases	Case numbers
1996	Amoebic dysentery	1
	Enteritis	5
1997	Enteritis	15
	Salmonellosis	2
	Suspicious bites	1
	Acute upper respiratory tract infections	1239
	Acute sinusitis	109
	Acute laryngitis	98
	Acute tonsillitis	457
	Acute bronchitis-brochiolitis	346
	Acute laryngitis	10
	Diabetes	38
1998	Enteritis	23
	Salmonellosis	1
	Suspicious bites	27
	Acute upper respiratory tract infections	3314
	Acute sinusitis	140
	Acute laryngitis	65
	Acute tonsillitis	667
	Acute bronchitis-brochiolitis	677
	Amoebic dysentery	8
	Hepatitis B	4
	Tuberculosis	1
	Cutancous Leishmaniosis	2
	Hepatitis A	3
1999	Hepatitis A	1
	Suspicious bites	6
	Acute upper respiratory tract infections	1252
	Acute sinusitis	26
	Acute laryngitis	33
	Acute tonsillitis	205
	Acute bronchitis-brochiolitis	460
	Measles	3
	Diabetes	58

When we calculate the morbidities of the infection cases (i.e., the standardised frequencies of the diseases according to the population in the area) , it is observed that the morbidities of enteritis, hepatitis A and amoebic dysentery resulted an increase. As we do not have systematic results -yearly or seasonal- of biological and microbiological analysis of the water sources or distribution system, we cannot directly relate these rises to the presence of a disposal site in the area. Only the rise of morbidity regarding suspicious bites, with arise of 24.5 times of morbidity between the years 1997 and 1998 can be related to the presence of the disposal site, as such places are very adequate for survival and reproduction of dogs and cats that feed on waste material abundantly present in such disposal sites (Table 13-20).

Table 13-20: The Morbidity Distribution of some Infections at Sofulu Primary Health Centre Area (figures in parentheses are case counts)

Morbidity Distribution of Diseases (Per thousand)							
Years	Enteritis	Salmonellosis	Hepatitis A	Hepatitis B	Amoebic Dysentery	Suspicious Bites	Population
1997	1.07 (15)	0.14 (2)	0.00 (0)	0.00 (0)	0.00 (0)	0.07 (1)	14003
1998	1.47 (23)	0.06 (1)	0.19 (3)	0.25 (4)	0.25 (4)	1.72 (2.7)	15689

c. Hazards/ Risks

Judging from the result of existing situation survey, it is considered that topographic and geological condition is stable, and there is no probability of landslide in the proposed site because the topographical features are gentle.

There is an existing dumping site in the disposal site. Presently the waste is not covered with soil and the landfill fires have been occurring all the year round. There may be possibility of gas explosion.

13.4.3.2 Natural Environment

a. Topography and Geology

The proposed area is situated in the Mediterranean Sea Region, southern Turkey. It is about 25 km north-east of Adana city, adjacent to the old Kozan Road, known as "Sofulu Waste Damping Area" (Figure 13-19). The area is fairly flat. The elevation, generally decreases from north to south in accordance with geological features. The area consists entirely of the Cenozoic formations. In the area, the Miocene-Pliocene sequence consisting mainly of sandstone-claystone and sandstone alternations named as Handere formation widely underlie, and the Quaternary Terrace Conglomerate partially and unconformably overlies these formations. The formations dip towards the Adana basin which is filled with alluvium, involving many of Adana's drinking water aquifers.

a.1 Formations of Miocene-Pliocene Age

Handere Formation (Th)

Schmidt (1961) defined the upper unit of the Late Miocene- Pliocene aged Adana Groups as Handere formation (Figure 13-20). The formation crops out to the north of Adana. It displays a flysh like character with alternating claystone and sandstone in many locations. According to Gokcen and Gurbuz (1985) Handere formation is characterised by fluvial cross-bedded polygenetic continental conglomerates, gravely sandstone, siltstone and mudstone. Its age is estimated as Pliocene based on the Ostracods and Foraminifera fossils it contains.

Handere formation crops are bounded by terrace conglomerates of plain towards east from Balcali and Menekse villages. At the south of this boundary the unit crops out in stream beds around Cinarli, Akkuyu, Sofulu, Beyceli, and Buruk towns.

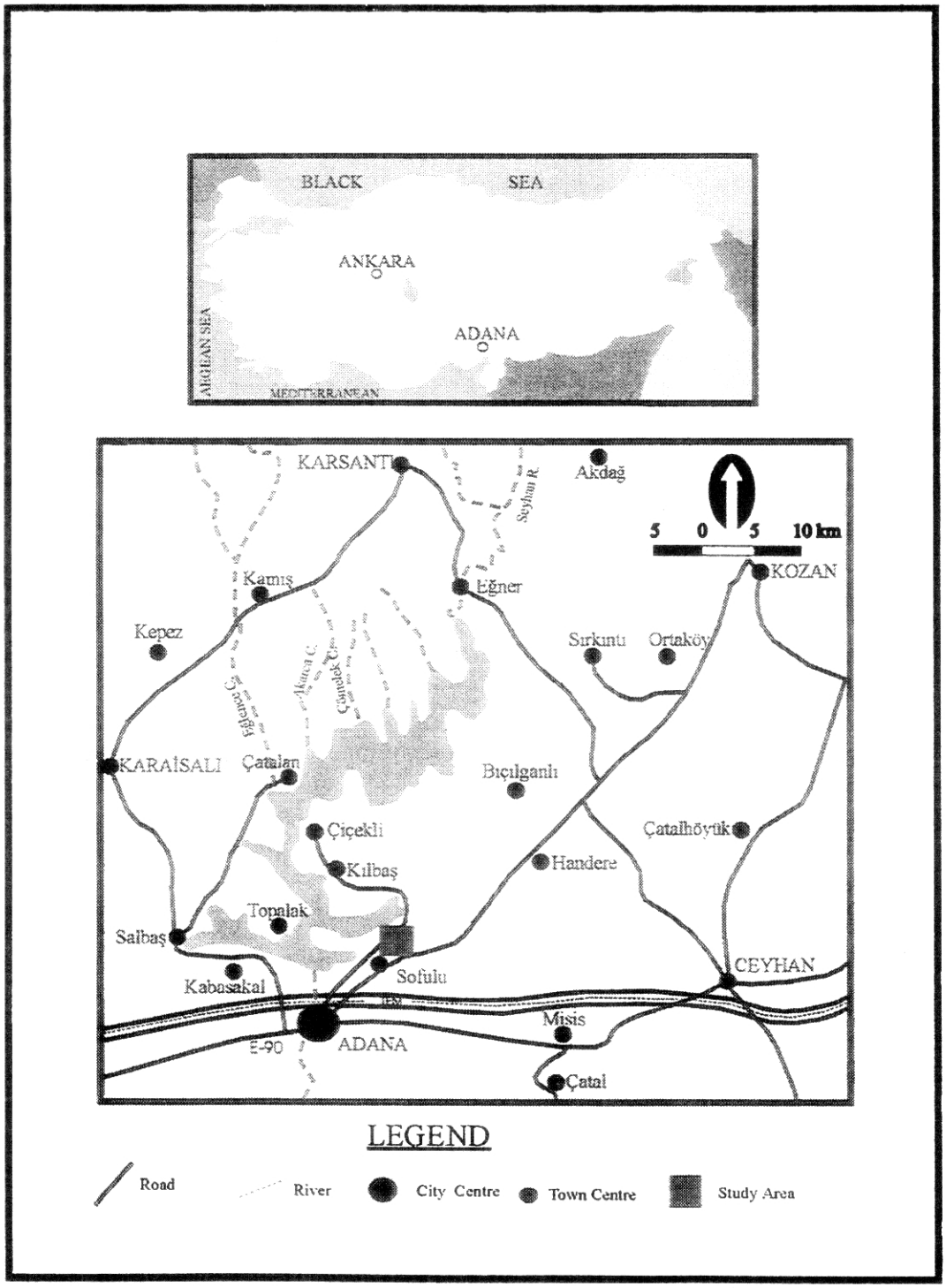


Figure 13-19: Location Map of the Proposed Area

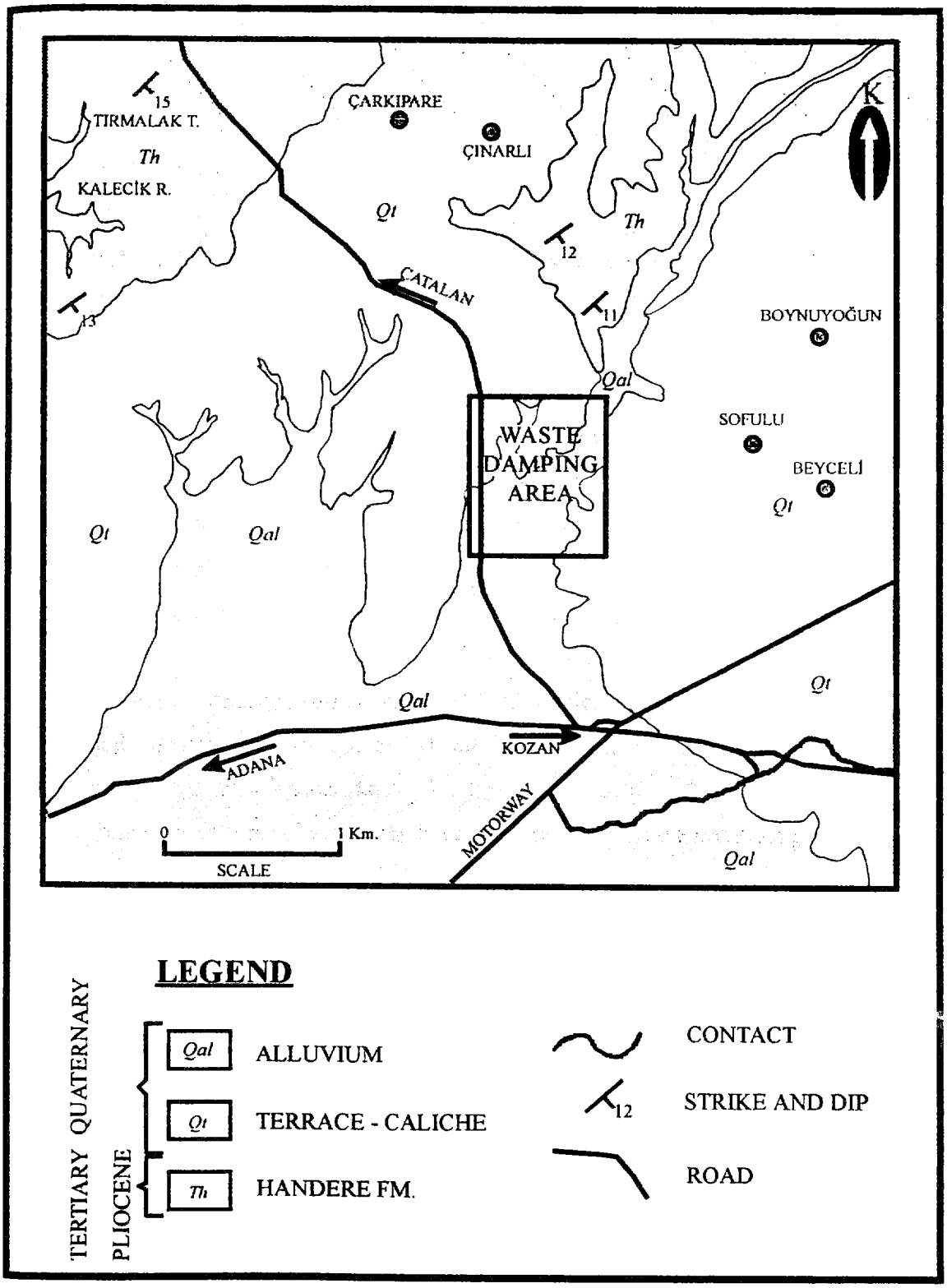


Figure 13-20: Geological Map of the Proposed Area

It is made up of conglomerate, gravely sandstone, siltstone, mudstone, lenses and layers of gypsum and anhydrite are also encountered in Handere formation around west of the Seyhan Dam Lake. West of the study area, the sequence starts with grey coloured, lens-like geometry, cross bedded coarse sized conglomerate and gravely sandstone. Below that, the Memisli members of the Kuzgun formation is observed.

Around the northwest of the University campus, the Handere formation starts with siltstone-mudstone alternations, from the water level of Dam lake and passes to mudstone upwards. It is followed by siltstone consisting of thin sandstone bands. Towards upper part of the sequence, the formation continues with conglomerate whose gravels comprise limestone, ophiolite, quarts and radiolarite. The conglomerate cemented by sand matrix is medium-bad sorted and is cross bedded. Coarse sandstone, siltstone-mudstone alternations lie on the conglomerate (Karakas, 1997). Mudstone comprises very fine layers of siltstone, and has parallel laminations.

Handere formation comprises several lithological units of shallow marine, fluvial and lacustrine environments, from the bottom to the top of the sequence respectively. In Adana Basin, the formation which is observed on the Memisli formation as transitional at the base is overlain by terrace conglomerates. Alluvium deposits are also observed in some places.

a.2 Rocks of Quaternary Age

In the study area, Quaternary is represented by terrace conglomerates, caliche, old and young alluvium (Figure 13-20).

Terrace Conglomerates (Qt)

Two terrace materials in Adana basin are observed at the base. Among these, the first one rests on the Handere formation in the south of the basin and is covered by the old-young alluvium towards the south. They display caliche-like character in some places, so they cannot be distinguished as different depositions. The areas of terrace-caliche alternations are shown as Qt symbols in the map (Figure 13-20).

The other crops out along the river bed (Cakit, Eglence, Seyhan) from west to east. They are situated at the Seyhan river bed downstream from the dam. They are composed of carbonate cemented conglomerates whose gravels are made up of limestone, quartzite and serpantinite. Gravels are transported by Seyhan river.

Around Balcali, the unit is coarse grained, brownish- greyish coloured, cross-bedded and bad sorted. It has sandstone layers and gravely sandstone lenses.

Caliche

It crops out at the north of Adana Plain, along a belt extending east-west between the Neogene Formations and the alluvium. Occurrence of caliche has taken place at the contact of Handere formation and alluvium. It partially covers the Pliocene-Miocene series.

The caliche is highly calcareous and is made up of alluvium cemented by carbonates. Locally, they comprise gravels and clay; they are fed by surface flow. It is a continental formation and covers the Pleistocene terraces.

Deposition of caliche is originated by the emergence of the ground water of high bi-carbonate concentrations through fractures and joints in formations.

Alluvium (Qal)

Alluvium is observed in the south of the Seyhan Diversion Dam. It covers wide areas in the south of study area. It is composed of coarse sand, silt and clay in the area between the Seyhan river and Incirlik village. However, it comprises common layers of gravels. In Adana Basin, there are old and young alluvium. Old alluvium is covered by organic soils. Young alluvium is formed by bad-sorted gravel, sand, silt and clay, and it is situated in river beds.

b. Ground Water

b.1 Water Bearing Formation (Aquifers)

In the region, the ground water occurs within the formation of conglomerates. Conglomerate outcrops appear in layers of varying thicknesses interbedded with clay, sand and gravel. The depositions are generally fissured thus acquiring aquifer characteristics, but the degree of fissuring decreases in the proposed area. The drinking water supply of the Adana city is provided by boreholes in this part of the aquifer.

In the proposed area there is no good aquifer utilised for domestic purposes. However, this region is a catchment area for alluvium which includes many aquifers in Adana Plain.

The ground water is observed in some existing wells, but they are probably being recharged by the landfill and by surface flow. Ground water levels in both existing wells and piezometric wells are measured once a month. The values are shown in Table 13-21.

Table 13-21: Ground Water Level in Existing Wells and Boreholes

Well number	Watertable Depth From Surface (m)	Watertable Height From Datum (m)
Exis. Well 1(Sofulu Village)	30.35	69.65
Exis. Well 2 (Crop Field)	3. 06	91.94
Exis. Well 3 (Farm entrance)	7.10	92.9
Borehole 1(Leachate pond)	8.90	91.1
Borehole 2 (Landfill)	2.60	97.4
Borehole 3 (Landfill, Hill)	1.20	123.4

The depth to the ground water table increases toward south due to topographic elevation and to the presence of clay layers and ground water flows from north-east to south-west.

The transmissibility values range between 500-2000 m^3/day/m in the proposed area. The conglomerates has the highest transmissibility values. The highest storage coefficient values are reached in the area on both sides of Seyhan river (Kurttas, 1988).

Hydraulic conductivity (permeability) values are 0.1-10 m/day. These formations, conglomerate, are permeable for ground water. However, according to the geoelectrical studies, clay and marl layers in the area which is observed after 1 m below the surface, have low hydraulic conductivity values such as 10^{-4} m/day.

b.2 Boreholes

A total number of three boreholes were drilled at the construction site. Borehole logs are presented in Figure 13-21. Information about borehole logs are presented below:

Borehole No: B1

Aim:	Research
Depth:	15.45m
Static Level:	8.90m
Lithology:	0.00-2.20 m Cover soil
	2.20-2.40 m Clay with gravel
	4.40-8.70 m Clay
	8.70-15.45 m Marl

Borehole No: B2

Aim:	Research
Depth:	15.45m
Static Level:	2.00 m
Lithology:	0.00-1.43 m Clay with gravel
	1.43-5.70 m Clay with some silt
	5.70-8.90 m Clay
	8.90-15.45 m Marl

Borehole No: B3

Aim:	Research
Depth:	20.15m
Static Level:	2.15m
Lithology:	0.00-6.00 m Solid, brown, white yellow silty clay
	6.00-8.90 m Clay with fine gravel and sand
	8.90-12.00 m Very densified, brown, sandy gravel
	12.00-20.15 m Brown, fine gravel consistent sandy clay

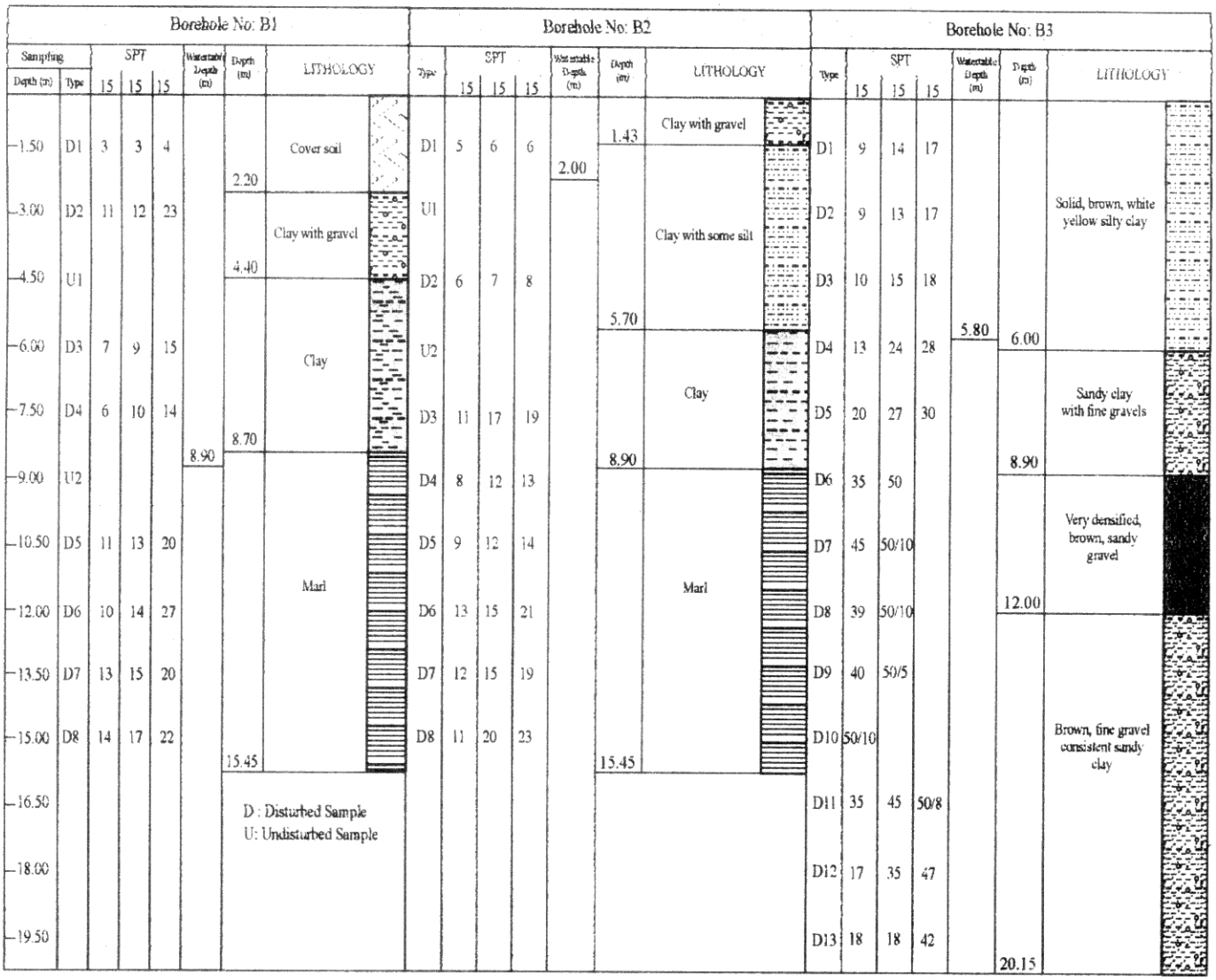


Figure 13-21: Borehole Logs

Extension of formation below the ground is shown in Figure 13-22 according to geoelectrical measurements and well logs. The lithologic and some engineering properties of soil have been determined from visual inspection and standard penetration tests (SPT) done in the boreholes. Soil samples were collected for laboratory testing from the borings and fill material nearby soil pits to the site. The samples were subjected to necessary tests in the soil mechanics laboratory. The laboratory test results are given in Table 13-22. The values of hydraulic coefficient (permeability) were determined and given in Table 13-23.

Table 13-22: The Laboratory Test Results

Laboratory Test		Boreholes	Fill material
Moisture content	Wn (%)	5-43	3.5-24.9
Bulk density	δ_n ton/m^3	1.70-1.98	1.62-1.87
Unit weights	δ_s ton/m^3	2.65-2.72	2.57-2.72
Consistency limits	W_l (%)	48 - 55	-
	W_p (%)	24-27	-

Table 13-23: The Values of Hydraulic Coefficient (permeability)-k (cm/sec)

Borehole No	B1	B1	B2	B2
Depth (m)	7.50-7.95	13.50-13.95	4.50-6.0	13.50-13.95
K (cm/sec)	3.51×10^{-7}	8.20×10^{-8}	6.22×10^{-7}	1.60×10^{-7}

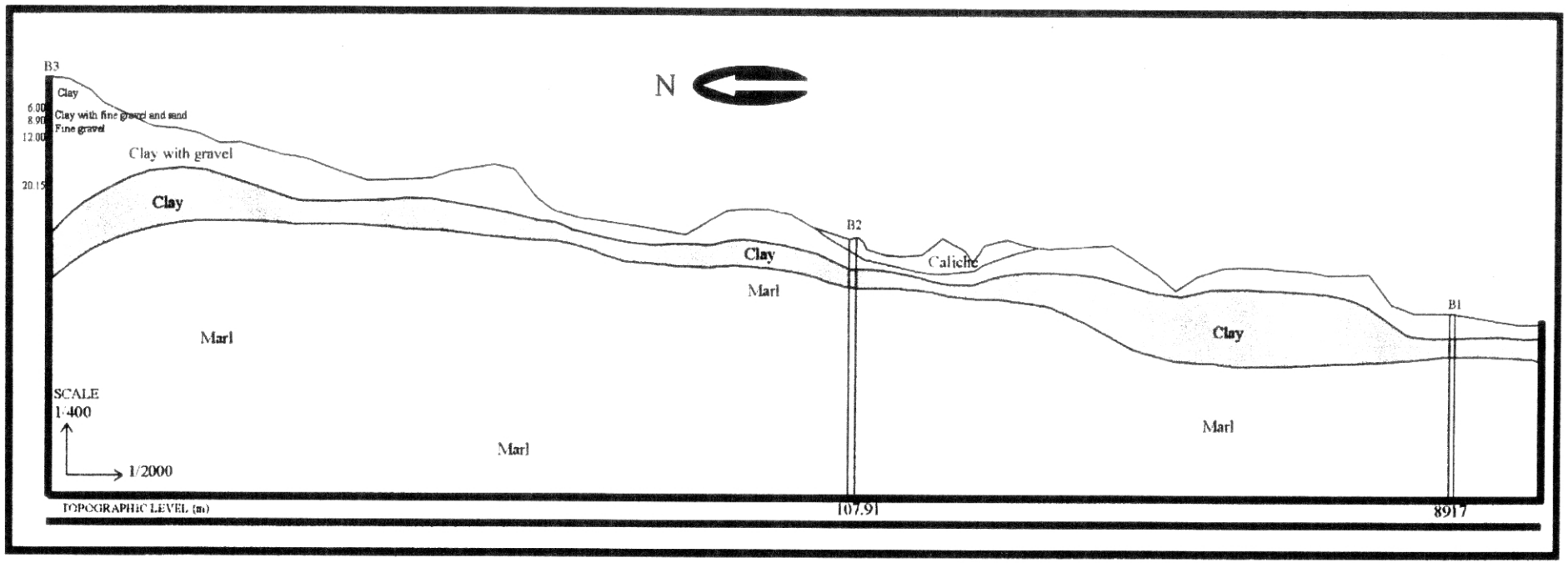


Figure 13-22: The Section Showing Extension of Formation Under Ground

Hydraulic conductivity coefficient of clayey soil were found in the order of $1x10^{-7}$ cm/sec according to the compaction test. As seen from the Table 13-23, the value of hydraulic conductivity (permeability) is small enough.

From the sieve and hydrometer analyses it has been found that the borehole soil samples (from borehole1, borehole2) consist of mainly clay and silt size fine materials (over 95%) and gravel-sand size coarse materials are less than about 3%. But the soil sample taken form borehole 3 between 10.50m-10.95m appeared to be different from other results since it consists mainly coarse materials (about 100%).

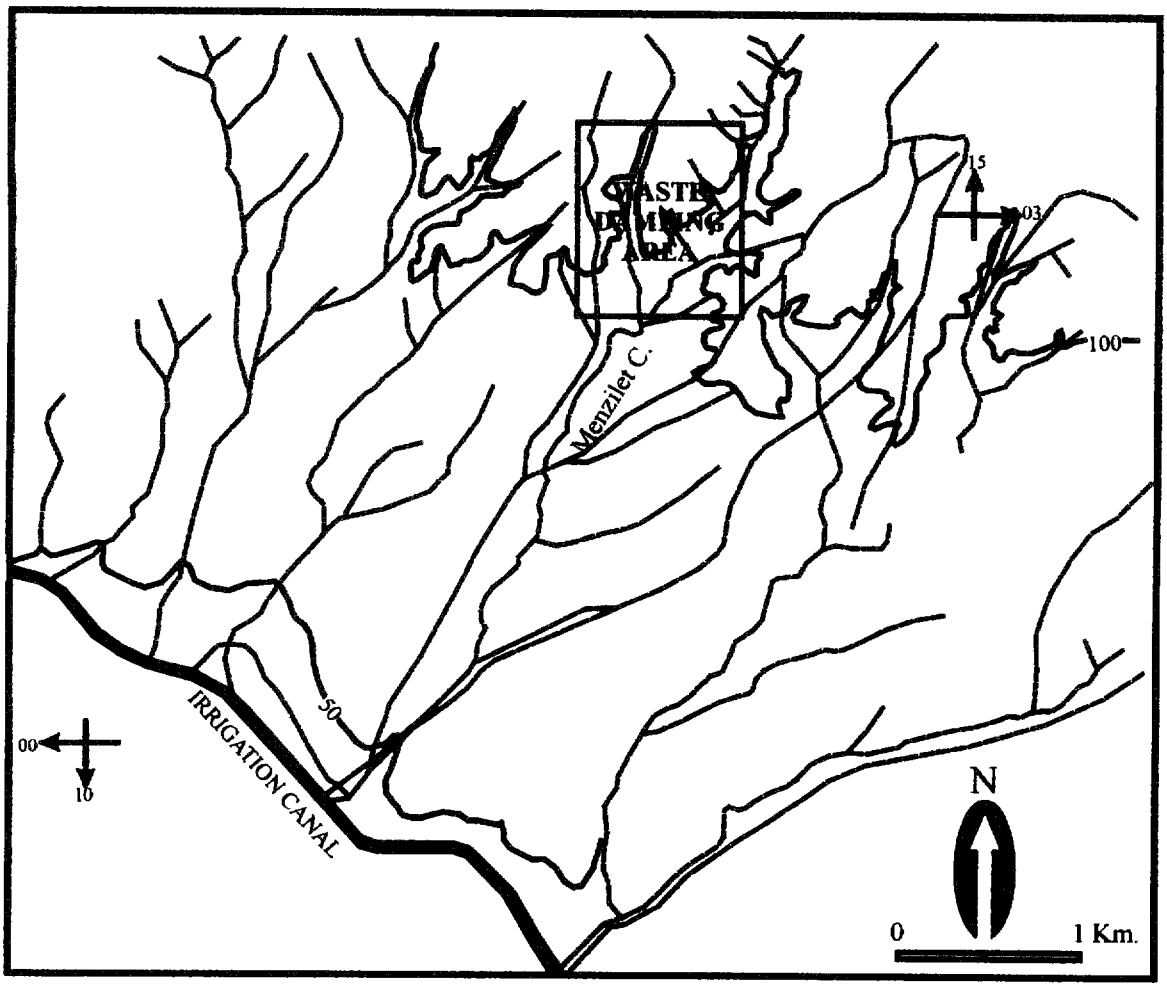
The soil type at the site , except granular soil layer (borehole3); was "medium to low plasticity inorganic silty clay (with the group symbol CL-CH). Clay and cemented clay stone layer with calcareous are observed below these soils. It is known that the permeability of these type of soils are very low.

c. Hydrological Situation

In the proposed area, there are no significant surface waters like lake, river, wetlands which are wet every season.

c.1 Streams

Surface water is observed as small flows in bed of the creeks in the study area (Figure 13-23). Creeks mainly flow in the north-south direction according to the topographic elevations. Surface water flows are measured in the area and the results are shown in Table 13-24. Firstly, there is one small creek, possibly, recharged by the landfill and its flow rate is measured as 3 L/sec. In the south, this creek meets with a fresh water stream, flows around the dumping site. This stream has 10 L/sec measured flow rate. In downstream, after meeting point, flow rate is measured as 13 L/sec. All creeks meet together in the south and flow into Seyhan River through Saricam River.



LEGEND

Seasonal Stream

Topographic Contour

Irrigation Canal

Figure 13-23: Hydrographic Map of the Proposed Area (Karakas, 1997)

Table 13-24: Flow Rate Values Measured in Surface Flows

Location	Flow rate (l/s)
Leachate Creek	3
Fresh Water Creek	10
Meeting point (down stream)	13

c.2 Springs

There is no spring in the area, but some water leakage takes place in some districts around the dumping site.

c.3 Lakes

There is no significant natural lake. Only very shallow waters like small lakes which are formed by leakage water from sandy and gravely layers are observed. This leakage water accumulates on impermeable clay layers. It is thought that these lakes form only in winter time. It dries in late spring if it is not recharged by dumping site.

d. Fauna and Flora

d.1 Fauna

Fauna of the area was classified in five groups (mammals, birds, reptiles, amphibians and insects) and investigation took place in and around waste dumping site. Fauna elements divided into two groups as site dependent species and species which inhabit in the site but are not strictly dependent. According to this research 8 mammal, 29 bird, 9 reptile and 3 amphibian species were identified in the proposed area.

d.1 Mammals

Macchie thickets limited in the marginal sites are abound in mammals. This habitat helps to enrich the biological diversity in the area. According to the field observations and interview performed in the site, following list was formed. Among these species, *Rhinolophus euryale, Pipistrellus nathusii* and *Crocidura leucodon* are dependent on the waste dumping site in terms of feeding habit. In addition, many domestic animals as stray cats and dogs feed on organic waste.

English Name	Latin Name
Common Fox	*Vulpes vulpes flavescens*
Rabbit	*Lepus europeus*
Horseshoe Bat	*Rhinolophus euryale*
Pipistrelle	*Pipistrellus nathusii*
Shrew	*Crocidura leucodon*
Mole	*Talpa levantis*
Porcupine	*Erinaceus europeus*
Indian Crested Porcupine	*Hystrix indica*
Wild Boar	*Sus scrofa*

d.2 Birds

A significant number of birds, including natives and migratory species, enrich the wild life potential of the proposed site. 29 bird species were recorded in the site. 16 are migratory and 13 are native among these species which are shown in Table 13-25. The colonies of three crow species, *Corvus corax, Corvus corone cornix* and *Corvus monedula* are dependent on waste disposal site due to their feeding habits. *Falco tinnunculus* and *Hurindo rustica* feed in the site as well as mentioned crow colonies. *Francolinus francolinus*, an endangered species, also inhabit in the proposed site (Figure 13-24). Some bird species recorded in the site, are illustrated in Figure 13-24 to Figure 13-29.

Table 13-25: Bird Species Recorded in and around Sofulu Waste Disposal Site

English Name	Latin Name	Migratory	Native	Summer Visitor	Winter Visitor	Breeding
Yellow-vented Bulbul	*Pycnonotus barbatus*		*			*
Black Bird	*Turdus merula*	*			*	
Tree Sparrow	*Passer montanus*		*			*
Green finch	*Carduelis chloris*	*			*	
Little Owl	*Athena noctua*		*			*
Crested Lark	*Gallerida cristata*		*			*
Great Tit	*Parus major*	*		*		*
Chaffinch	*Fringilla coelebs*	*			*	
Kestrel	*Falco tinnunculus*		*			*
Swallow	*Hirundo rustica*	*		*		*
Goldfinch	*Carduelis carduelis*		*			*
House Sparrow	*Parus domesticus*		*			*
Wood pigeon	*Columba palumbus*	*			*	
Bee-eater	*Merops apiaster*	*		*		*
Sparrow hawk	*Accipiter nisus*		*			*
Common Quail	*Coturnix coturnix*	*		*		*
Roller	*Coracias garrulus*	*		*		*
Swift	*Apus apus*	*		*		
Black-headed Bunting	*Emberiza melanocephala*	*		*		
Collared Dove	*Streptopelia decaocto*		*			*
Northern Weather	*Oenanthe oenanthe*	*		*		*
Raven	*Corvus corax*		*			*
White Stork	*Ciconia ciconia*	*		*		
Jackdaw	*Corvus monedula*		*			*
Carrion Crow	*Corvus corone cornix*		*			*
Mistle Thrush	*Turdus viscivorus*	*			*	
Corn Bunting	*Miliaria calandra*	*		*		
White Wagtail	*Motacilla alba*	*			*	
Herring Gull	*Larus argentatus*		*			*