

d.2 Education

Information of Population's General Censuses and Housing corresponding to the years of 1980 and of 1990 provides data population who has access to the facilities and available educational services in the municipality of Nezahualcoyotl. At the levels of basic education and specifically those of primary and secondary, a fact is revealed that in 1980 an equivalent to 24.90% of children of 6 to 14 years did not attend the school, while in 1990 the figure dropped down to 5.19%. In the 15 year-old or older population, the illiteracy decreased from 7.71% to 5.37% and those who do not complete primary education diminished from 25.19% to 15.10%.

The levels of these three indicators in 1990 reveal a better position of the municipality regarding the corresponding averages obtained at state level. However, although the averages of the municipality are satisfactory, there exists population who does not enjoy satisfactory education in the interior areas.

At state level it can be observed that, in spite of the good educational averages reported for the municipality, areas exist where the service coverage of the primary and secondary education is low.

d.3 Healthcare

Population's General Censuses and Housing does not provide enough information regarding the situation of health of the population at municipal level. However, referring to the State Information System, it is possible to obtain figures related to the coverage of public health services that operate in the municipality, both for the availability of attending as well as medical staff. The information below corresponds to 1989 and does not include the private sector.

Table 2-55: Health Services in Nezahualcoytl

	Total	Social Welfare Institutions			Social Assistance	
		IMMS	ISSSTE	ISSEMYM	ISEM	DIF
Population with access to Social Welfare Institutions	331 908	135 831	170 391	25 686	-	-
Medical units	38	5	1	1	21	10
Medical personnel	744	198	30	42	436	38

ISSEMYM: Instituto de Seguridad Social del Estado de México y Municipios

ISEM: Instituto de Salud del Estado de México

DIF: Desarrollo Integral de la Familia

e. Recreation

e.1 Architectural Monuments

Municipal palace, center of administrative services and the building of the Mexican Institute of the Public Health (IMSS) will be the ones to be mentioned.

e.2 Civil architecture

The examples most highlighted in the civil architecture are: the Municipal Palace, with a modernist and functional style, the municipal graveyard and all the Centers of

Social Service, such as the Center of Administrative Services, Secretary's of Health hospitals and of the Institute of the Public Health.

e.3 Religious

It has a modern style, since it was constructed recently.

e.3 Historical

Monument to the Heroes of the homeland.

e.4 Archaeological

El Tepalcate archaeological area .

e.5 Works of Art

The outstanding artistic demonstrations are those of the *Héroes de la Patria* (Homeland Heroes) made by Sanguino, and the Nezahualcoyotl mural in the Municipal Palace.

e.7 Music and Poetry

A thousand *estudiantinas* (groups of young people that play serenades) exist, such as the Bilbao, Jerusalem and Cielo Andaluz that have acted professionally inside and outside of the national territory; the folklore dances "Quetzalcoatl, Xocoyotli" and the folklore group of the Seguro Social that carries out activities and performances in different places of the republic. Concerning poetry, a work was carried out by the professor Gabriel Hernandez entitled "A city Nezahualcoyotl".

e.8 Libraries

In the whole municipal territory of Nezahualcoyotl 8 libraries exist, but it is not enough for the great demand of each library.

e.9 Traditions and Customs

Because Nezahualcoyotl is a center where people flowed from the most distinguished regions of the country, different and variable customs are held within strictly closed groups.

e.10 Crafts

Inside the municipality beautiful crafts such as embroideries, the production of baskets and typical tin works are carried out in the region.

e.11 Clothes

Because the municipality is constituted by population coming from diverse entities of the republic, there is no a typical attire to characterize their clothing.

e.12 Tourism

The attractive places of the municipality are the archaeological area of tepalcate without exploring and the mural of the municipal palace of Nezahualcoyotl.

e.13 Natural Areas

Due to the great demographic growth, there is a lack of natural areas in the municipality of Nezahualcoyotl.

f. Land Ownership

The distribution of the land use gives an account of the relative importance of the different economic activities in the municipality. The rounded absolute figures to the unit and the corresponding percentages are presented in the following table:

Table 2-56: Land Use Type

	Surface	Agriculture	Cattle	Forest	Urban	Others
ha	6,344	0	0	0	5 293	1 051
%	100.00%	0.00%	0.00%	0.00%	83.44%	16.56%

The figures and their percentage distribution reflect the eminently urban condition of the municipality. As can be seen, there is no land dedicated to agricultural or forest activities. The category "others" encompasses industrial use, water bodies and eroded soil. The latter item stands for 17% of the total surface, corresponding mainly to the Texcoco lake.

g. Productive activities

g.1 Agriculture

Due to the special conditions of the land, agricultural works of any species are not attempted and any type of agricultural products is not obtained in the whole municipal area.

g.2 Industry

The main industry in this municipality is the production of foods, drinks, and tobacco, as well as the industry of the metal, machinery and equipment.

Foods in general have 458 establishments, metal mechanics with 338 establishments, cloths in general with 128 establishments and wood in general with 141 establishments, making a total of 1065 industrial establishments in the municipality of Nezahualcoyotl.

g.3 Trade

There is a great activity in this matter ranging from traveling salespersons to established trade.

2.2.2.2 Results of the Sampling Study

In this section, a review of the human settlements of the municipalities near to the place proposed for the construction of the sanitary landfill is presented. In the case of the municipality of Nezahualcoyotl, a field work within the colonies near to the project was carried out.

The question of the urban settlements of the *colonia* Ampliación del Lago was formulated from an environmental view, analyzing the facts of historical

transformation processes - territorial global character. The environmental perspective, that has a certain reason for its purpose, allows to analyze in a non conventional way the emergence of the new problems represented by the settlements in the region, which are linked with the "informal city" boom.

The concept of settlement could be defined as a class or type of the habitat or natural base that was customized by a certain social group, that functions as a counterweight between society and nature. The idea to attribute a character stabilizer of exchanges to the concept of settlement is linked with the formation of a paradigm that governs these exchanges. If this society-nature counterweight is destroyed, it would help to acknowledge problems because an alteration to the habitat directly affects the nature and vice versa; this is due to the fact that because they are part of a nature-settlement unit.

It is not possible to establish types of the settlements only based on their material conditions of organization, land use, urban functions, etc. It often happens that the settlements are defined by historical processes of social organization and territorial appropriation many times for long duration or distant effects. An example of this condition inherent to the distant effects will be the consequence of reorganization of the territorial occupation in areas of colonies such as those on the periphery of the cities, due to the centralization of the industries and trade.

In demonstrating problems expressed in regard to the concept of settlements systems, there exist two big aspects that reflect the populational dynamics related with environmental problems.

First, a structural condition exists inside the capitalist development that provokes the urban concentration such as the emergence of populational displacements.

The phenomenon of external immigration and the internal migration in connection with the employment opportunities generate large demographic and continuous changes, a new social organization and those of territory among the groups.

Second, in regard to border settlements, it is meant that the process of migration of social groups toward places that possess high ecosystem fragility, where the social relationships and natural bases start to be transformed in particular in the environment and in the quality of life of the social groups. In this light, the *colonias* of Nezahualcoyotl adjacent to the Lake of Texcoco are very representative, since these people were relocated by the government with announcement clamoring for progress and technology, granting spaces at the outskirts of the city; space that is completely degraded since wastewater canals, open dumping sites, and noise pollution problems due to the proximity to Mexico city airport, converge. In this sense, it is important that the population know what are the steps to be followed, so as to allow the correct existence -side by side- of their habitat with the scarce natural resources available, thus preventing their over-exploitation. The advances of the environmental knowledge should encourage people to carry out a planning most thoughtful for the human *settlements* based on an environmental rationality, to manage the resources rationally and appropriately, for the improvement of the quality of social life and real options of *settlement* with the use of the technology and the effective participation of the communities.

Interviewed population

The population of the *colonia* Ampliación de Lago was surveyed where it was observed and corroborated that the male parents were in that time of study working and that the women were devoted to the household works, and therefore most of the questions were answered by the mothers (79%).

Economic Income

Of the field work, it was revealed that the person that contributes the economic income of the house is the father (65%), followed by both the mother and the father (15%), and the father and the children (10%). It can be supposed that local customs and social roles still exist, in that the male supports the economy of the house and the woman is devoted to the household works and the education of the children.

Occupation

In regard to working activities, trade is practiced by 50% of people, followed by workers (45%), and peasants (5%). In this sense a completely urbanized *colonia* is observed where the necessities are covered with precarious way because it was verified that in this *colonia* people are devoted to the handling of the solid wastes (i.e. as sweepers, pepenadores, and people that trade the solid wastes), upholsterers, bricklayers, and blacksmiths in which their economic income is merely one or two time as much as the minimum wages.

Time Used to Commune to the Work

The time that people use to go to work is on average one hour which shows the relative proximity from their works to their homes (85% of those interviewed), while 15 remaining percentage moves to farther places.

Transport Means

The means of transport most commonly used is the urban and collective transport (85%). Due to the economic shortage of the majority and the proximity of their works, 10% moves by walking and 5% by bicycle. It is necessary to highlight that those families do not possess their own cars, reflecting well the economic situation of their lives.

Mass Communication

It can be said that almost all people possess television sets (95%) and radios (50%) in their houses, which allow people to be informed and to spend time. However, the culture of reading is much less significant for them than the radio and the television, since the majority of people do not buy the newspaper to be kept informed mainly due to their economic condition and to an absence of a culture of reading.

Public Services

In regard to public services, it can be observed that all the housings possess potable water, public lighting, electric power and drainage; 85% have paved streets and 5% hire the telephone service.

In this sense it should be emphasized that the potable water is provided to the *colonia* only for certain hours in the very early morning and at very late night. The water

quality is too bad to be drunken, and people have to buy large bottles of water in particular companies. According to people's testimonies, although public lighting exists, it presents serious deficiencies, and the drainage lacks maintenance in rainy season, causing flooding and damaging some houses.

Literacy

80% of interviewed people know how to read and write and they have a school instruction that attended the primary school (40%), secondary (35%) and 5% higher school. Remaining 20% do not know how to read or write and they did not have any contact with school. In this sense it is supposed that people ceased attending schools at the early ages for the necessity to cooperate the economy of their houses.

Services of Healthcare

In an event of illness, 50% of the interviewed population go to the Center of Health, 30% to the particular doctors, other 10% not specified, 5% to the IMSS and the other 5% to the ISSSTE. In this sense, it can be deduced that because the labor occupation of people is not in the government which has its own health services, neither in particular companies that grant the right to the health service, people are devoted to what is called informal employment or under a honorarium contract.

Time of Residence

The time of residence in the place ranges from six to ten years with 35% of the people, 11 to 16 years with 25%, 16 years or more with 15% and one to five years with 15%.

Based on some testimonies, it was revealed that great part of the *colonia* was relocated by the government due to the construction of the *Central Camionera del Norte* (Northern Bus Station) located in San Lazaro, being reimbursed and paid for lands.

Material of the Housing

The material of the housings is concrete (70%), while remaining 30 % houses were constructed with concrete and sheet roof.

Land Use

80% of land is residential use, while remaining 20 % is used to build a room in its housing to use with commercial purposes (i.e. spreading groceries, butcher shops, poultry etc.) and in a same way they are proprietors of the housing.

Number of Household Members

The number of people in a house ranges from five to seven with 55%, 8 to 10 with 30% and two to four with 15%.

Number of Rooms

The number of rooms in a house ranges from four to six with 45%, one to three with 30% and four to six with 25%.

Recreation Area

Regarding recreation areas, cultural or sport centers do not exist in and near the area.

Observations

It is important to emphasize the fact that a great majority of the residents of this *colonia* are devoted to the commercialization of solid wastes, or to waste collection. Therefore, they may have a motivation to support and be involved in the project.

With regard to the affluence of waste collecting vehicles into the area, they did not present any complaint in this respect, implying that it does not affect their daily activities. Traffic for the proposed project will not affect them, either, because no major change in traffic mode is expected.

2.2.2.3 Socioeconomic Environment in Ecatepec

a. Historical Background

According to archaeologists, the future founders of Tenochtitlan arrived to Ecatepec in 1165; the latter was subordinated to Xaltocan until 1280, year in which it was subdued by the cuautitlanecas. By 1320 Ecatepec was dominated by Tenochtitlan. In 1507, the *tlatoani* (governor) of Ecatepec was Mr. Tolnahuac and in 1519 Huatzin or Panitzin governed.

After the fall of Tenochtitlan, Hernan Cortes became the ruler of Ecatepec. During the whole Colony period, Ecatepec was a Governorship with jurisdiction over the towns that currently belong to the municipality, such as San Pedro Xalostoc, Santa Clara Coatitla, Zumpango and Xaltocan.

Despite its category, Ecatepec was a sad town where viceroys rested. Prior to the Colony period, a dike was constructed, whose purpose was to prevent the waters of the Ecatepec lake to mix with those of Texcoco, since they flooded Tenochtitlan when this took place.

On December 13, 1877, the Legislature of the State of Mexico issued a decree by which the town of Ecatepec became a village and adding the name of Morelos to Ecatepec.

Finally, as for the meaning of Ecatepec, according to people that investigate the origin of the name of places, such as Orozco y Berra and Manuel de Olaguibel, it is "Windy Hill" or "Hill consecrated to Ehecatl (the Eagle God), a title that seems to be more appropriate.

The latter translation is supported by the symbol preserved by the *Códice Mendocino* (Mendocino Codex) which shows a hill with a figure of the God of Air on top of it.

The word Ecatepec comes from Nahuatl language: "*Ehecatl*" is the invocation of *Quetzalcoatl* as the Lord of the wind; "*tepetl*" stands for hill and "*C*" that means in. The complete meaning is "In the Hill Consecrated to the God of the Wind or Air."

b. Population

b.1 Trends

In 1990, the data of the General Censuses on Population and Housing for the municipality of Ecatepec registered a population of 1,218,135 inhabitants, with an

annual rate of growth of 4.50%; whereas in 1980, the number of inhabitants was 784,507 with an annual increase of 13.75 % during the previous decade. This reflective situation of a very drastic decrease in population growth rate has modified the demographic profile of the municipality, beginning to show a tendency of stabilization.

Table 2-57: Population in Ecatepec Municipality

	1970	1980	1990	%80/70	%90/80
Total	216,408	784,507	1,218,135	13.75%	4.50%
Men	110,300	389,499	600,410	13.45%	4.42%
Women	106,108	395,008	617,725	14.05%	4.57%

b.2 Total Population

The municipality of Ecatepec according to population's Count and Housing of 1995 carried out by the INEGI has a total population of 1 457 124 of which 720 752 are men and 736 372 women.

b.3 Rate of Annual Growth

The rate of annual growth from 1980 to 1990 was 4.50%. This is still high but much lower than annual growth rate during the 1970s. This reflective situation of a very drastic drop in population growth rate has altered the demographic profile of the municipality, giving a result of absolute population decline.

b.4 Pyramid of Age Groups

Table 2-58: Population by Age Group and by Sex in Ecatepec Municipality

Age Group	Total Population	Men	Women
0-4	161 583	81 991	79 592
5-9	164 595	83 860	80 735
10-14	163 642	82 708	80 934
15-19	161 732	80 779	80 953
20-24	165 488	80 950	84 538
25-29	134 925	65 352	69 573
30-34	119 411	56 982	62 429
35-39	107 650	51 949	55 701
40-44	81 851	40 578	41 273
45-49	61 349	30 931	30 418
50-54	44 424	22 611	21 813
55-59	29 128	14 449	14 679
60-64	22 208	10 416	11 792
65-69	14 885	6 655	8 230
70-74	9 725	4 342	5 383
75-79	5 540	2 426	3 114
80-84	3 030	1 199	1 831
85-89	1 738	669	1 069
90-94	693	243	450
95-99	343	122	221
100 and more	67	13	54
Not specified	3 117	1 527	1 590

b.5 Economically Active Population

Table 2-59: Economically Active Population of and over 12 year-old in Ecatepec Municipality

Activity condition	population of 12 year-old or over
Economically active population	44.80
Economically inactive population	53.46
Not specified	1.74

unit: %

b.6 Birthrate and Mortality

A significant fall is observed in the birthrate. Taking the alive born children by segment of the mother's age, the women of 50 to 54 years old had 5.8 children, while those of 25 at 29 had only 1.9.

Table 2-60: Age of Mothers and Average Number of Children

Age of Mothers	20-24	25-29	30-34	40-44	50-54
Number of Children	0.8	1.9	2.7	4.2	5.8

The decrease in the birthrate is reflected in the population pyramid of the municipality and explains the composition of its structure.

The birthrate and mortality recorded in the year of 1990 constitute important additional elements for the population analysis. In the following table, the comparison is presented with the resulting average for the State of Mexico, as well as the values of infantile mortality.

The behavior of these variables, both for their magnitude as well as for their comparison with state averages, does not only explain their population's growth but rather they also represent an indicator of the level of well-being in area in question.

Table 2-61: Birthrate and Mortality in Ecatepec and State of Mexico

	Birthrate	Mortality	Infantile mortality
Ecatepec	18.28	2.25	21.69
State of Mexico	24.52	3.84	35.32

As for the population of 1,000

b.7 Ethnic Groups

The Ecatepec municipality has a population of 19,472 that speaks indigenous language of which 10,025 are men and 9,447 women.

It can be said that the municipality of Ecatepec has a minimum population that speaks some indigenous language, however, the language Nahuatl is spoken by 5,668 people and followed by the Otomi with 3,915. It is necessary to mention that being a municipality which receives a great number of people, it is obvious that Ecatepec has a mixture of cultures and therefore it cannot be characterized by one specific cultural type.

b.8 Population Movement

The population inflow process has meant the incorporation of new residents. 64.87% of the residents of the municipality had been born outside the State of Mexico, and for those born before 1985, 17.19% of them did not live in the State of Mexico. However, these figures do not fully explain the sharp growth rate drop; therefore, it can be assumed that a considerable inter-municipal migration flow has taken place in the State, thus contributing to this result.

c. Employment

In accordance with the information census of 1990 for the population 12 year-old and over, the total population occupied in economic activities represents, in the case of the municipality, a larger proportion than that of the State, and occupational structures with large proportion of the women dedicated to the paid work. It also highlights a high proportion of students, implying the young population's larger permanency in the educational system.

Table 2-62: Level of Employment and Underemployment

	Ecatepec		State of Mexico
	Number	%	%
Occupied	367 801	43.32%	42.13%
Unoccupied	12 549	1.48%	1.28%
Home	240 959	28.38%	29.57%
Student	172 523	20.32%	19.53%
Others	55 125	6.49%	7.48%
Total	848 957	100.00%	100.00%

The work type that economically-active population carries out and the sector in which they perform these activities are remarkable. The following information is for 1990, without including unspecified activities:

Table 2-63: Distribution of Employed Population by Work Type and Sector

unit: persons

	Industry	Service	Agriculture	Total
Professionals and technicians	7 219	29 759	45	37 023
Officials and clerks	13 467	36 413	77	49 957
Merchants	8 400	53 902	113	62 415
Agricultural workers	64	157	1 207	1 428
Industrial workers	106 654	31 298	72	138 024
Public and personal services	1 654	18 766	68	20 488
Others	8 876	36 355	111	45 342
Total	146 334	206 650	1 693	354 677

The population distribution occupied by sectors of economic activity reveals a proportional structure different from that of the state average. In the municipality, the activities of services have greater importance.

In accordance with the information of the Economic Census of 1988, 16,807 economic units were found operating in the municipality; however, this information does not include the agricultural sectors nor financial and government services. The work force employed in the units taken in the census added up to 74,222 people, distributed in the activity sectors that are shown in the following table.

Table 2-64: Distribution of Employed Population by Sector

	Ecatepec		State of Mexico
	Number	%	%
Fisheries	0	0.00%	0.06%
Mining	181	0.24%	0.30%
Factories	41,702	56.19%	52.28%
Electricity	0	0.00%	1.22%
Construction	89	0.12%	1.62%
Trade	22,021	29.67%	27.14%
Services	10,229	13.78%	17.38%
Total	74,222	100.00%	100.00%

The information of fisheries is added to data of factory due to reasons of confidentiality.

The factories, for its importance, absorb 59.19% of the total occupation of the municipality. On the other hand, the primary sector is almost absent and the participation of the tertiary is smaller than the percentage obtained for the State. Besides, the detail of the subsectors in the factories is the following one.

Table 2-65: Distribution of Employment in Factories

	Total	Percentage
Ecatepec Total	41 702	100.00%
Foods, beverage and tobacco	6 102	14.63%
Textile and leather	3 491	8.37%
Wood and furniture	1 056	2.53%
Paper, printings and editorial	4 053	9.72%
Chemical and plastics	8 805	21.11%
Non metallic minerals	2 943	7.06%
Metallic basic	3 378	8.10%
Machinery and equipment	11 643	27.92%
Others	231	0.55%

d. Services

d.1 Media and Transport

In addition to the coverage of the basic services, information concerned to highways, postal and phone services and the electric power consumption will provide a global panorama of the infrastructure of the municipality. It is detailed in the following table, in which figures of transport are also included, basically of vehicles registered in the municipality.

Table 2-66: Highways in Ecatepec Municipality

Highways	km
Paved	71
Rural	6
Total	77

Table 2-67: Vehicles in Ecatepec Municipality

VEHICLES	Number
particular cars	109 126
public cars	5 916
Van and trucks	32 321
Others	1 224
Total	148 587

Table 2-68: Electric Power in Ecatepec Municipality

Electric power	Number
User	207 551
kWh per year	1 500 882

Table 2-69: Postal Services in Ecatepec Municipality

Postal Services	Number
Administrations	7
Branches	0
Agencies	2

Table 2-70: Telephone Services in Ecatepec Municipality

Telephone service	Number
Apparatuses	111 417
Lines	70 784

The previous information allows to obtain indicators that reflect the relative readiness of infrastructure in the municipality, facilitating the comparison with the prevailing global situation in the State.

Table 2-71: Comparison of Some Infrastructural Indicators with State of Mexico

	Ecatepec	State of Mexico
Inhabitant for it lines phone	17.2	21.7
Inhabitants for vehicle	8.2	8.1
kWh per inhabitant	1,232.1	908.1
km of highway for km ²	0.5	0.4

d.2 Education

The information of Population's General Censuses and Housing corresponding to the years of 1980 and of 1990 provides the population's figures of those who have access

to the facilities and available educational services in the municipality of Ecatepec. In the levels of basic education and specifically in those of primary and secondary, the fact is revealed that in 1980, 24.24% of children of 6 to 14 years did not attend the school, while in 1990, 5.55% was in such situation. In the population of 15 year-old or more, the illiteracy decreased from 6.92% to 5.23% and those that do not completely attend the primary education diminished from 23.83% to 15.25%.

These three indicators mean improvement in comparison with those that are obtained for the State.

d.3 Healthcare

Population's General Censuses and Housing provides scarce information regarding the situation of health of the population at municipal level. However, appealing to the State System of Information, it is possible to have figures related to the coverage of the public services of health operating in the municipality, both for the availability of these units as well as for the medical staff. The information that is presented below corresponds to the year 1989 and it does not include the private sector.

Table 2-72: Health Services in Ecatepec and State of Mexico

	Total	Social Welfare Institutions			Social Assistance	
		IMSS	ISSSTE	ISSEMYM	ISEM	DIF
Population with access to Social Welfare Institutions	544 899	436 613	86 367	21 919	-	-
Medical units	43	8	4	1	20	10
Medical personnel	1 082	674	76	29	271	32

ISSEMYM: Instituto de Seguridad Social del Estado de México y Municipios
ISEM: Instituto de Salud del Estado de México
DIF: Desarrollo Integral de la Familia

e. Recreation

e.1 Monuments

Architectural: the main objects are Santa María Chiconautla church; the church of Ecatepec; and the cultural house that had been used as convent until the year of 1908. Other churches are: Santo Tomás Chiconautla, Santa Ma. Tultepec, Santa Clara and San Pedro Xalostoc, as well as the convent that is in San Cristobal Ecatepec.

e.2 Works of Art

Sculptures: The statue of José Ma. Morelos y Pavón and the equinoctial monolith, which recorded the rotation of the sun.

e.3 Paintings

Paintings are conserved in Santa Clara church. There is a cave in the skirts of Ehecatl hill; it has a rupestrian paint that represents the wind as the snail, which is characteristic of the God Quetzalcoatl.

c.4 Libraries

In the municipality of Ecatepec five public municipal libraries exist to enlarge the student's educational culture which, in these times, is necessary. Those five libraries are: library "José Ma. Morelos y Pavón", municipal head of Municipal Library "Fraccionamiento de los Laureles", "Library 5 of May" in Santa Clara Coatilla; "Public Library ISSSTE-SEP" located in Santa Ma. Tuletlac; and the Public Municipal Library in Santo Tomas Chiconautla.

c.5 Sport Infrastructure

Table 2-73: Sport Infrastructure in Ecatepec

Sports	Number of Facilities
Soccer	17
Basketball	42
Volibol	19
Fronton	1
Sport Municipal	6
Sport modules	141

f. Land Ownership

The distribution of the land use of the municipality is presented in the following table:

Table 2-74: Land Use Type

	Surface	Agriculture	Cattle	Forest	Urban	Others
ha	15 549	1 702	117	1 890	8 612	3 228
%	100.00%	10.94%	0.75%	12.15%	55.38%	20.77%

The figures and their percentage distribution reflect the intensity experienced in the urbanization process of the municipality but not as intense as in Nezahualcoyotl because of the presence of agricultural and forest land. The category "other" contains industrial use, bodies of water and eroded land. They highlight the land dedicated to the industry and the bodies of water with 4% and 8% of the total surface.

g. Productive activities

g.1 Agriculture

The main crops in the municipality are alfalfa, corn, barley, beet and wheat.

Regarding the agricultural sector, in the spring - summer cycle of 1989, 1,622 out of the 1,702 available agricultural hectares were sowed, with the main cultivation of the corn with 873 hectares (54%), followed by the cultivation of forage corn, bean and beet, with 246, 199 and 123 hectares respectively. Of the 1,890 forest hectares, 71% corresponds to forests and the rest to bushy area.

g.2 Fruit Culture

The main tree fruits are: apple, pear, peach and *capulin* (fruit from the calabur tree).

g.3 Cattle Raising

The bovine, sheep, swinish, equine livestock and goats are raised.

The cattle activity of the municipality, as well as the relative participation regarding the state total, is presented in the following table. The figures correspond to the last cattle census conducted in the state, dated 1985.

Table 2-75: Types of Livestock

Type of Livestock	Total Number	% in the State
Bovine	7 320	1.11%
Swinish	13 268	2.04%
Ovino	6 143	0.78%
Caprino	1 596	0.89%
Equine	1 821	0.73%
Hens	843 132	6.82%
Guajolotes	10 268	1.58%
Other birds	40 300	4.69%
Beehives	6 512	5.50%
Rabbits	23 315	6.14%

g.4 Industry

Main industries in the municipality among those are: nutritious products, beverage and tobacco, textile, wood, paper, chemical substances, mineral products, metallic industries and other industries.

2.2.2.4 Results of the Sampling Study

In the case of the municipality of Ecatepec, a field work was carried out in the *colonias* Prizo I, Sagitario I and Media Luna, where the society-nature will be identified.

Interviewed Population

The population of the colonies Prizo I, Sagitario I and Media Luna was surveyed where it was observed and corroborated that the male parents were in that time of study working and that the women were devoted to the household works, and therefore most of the questions were answered by the mothers.

Economic Income

Of the field work, it was revealed that the person that contributes the economic income of the house is the father (70%), followed by both the father and the children (15%), the mother (10%) and the mother and father (5%). It can be supposed that social customs and roles still exist: the man is the one who supports the economy of the house and the woman is devoted to the household works and the education of the children.

Occupation

In regard to the occupation, the trade is denoted by 55% of people. This trade refers to that of sale and purchase of garbage in many occasions, because there are some centers of storing of garbage are located, followed by workers with 35%, and finally

10% correspond to drivers of *microbuses* (a collective transportation system); in this sense, a completely urbanized *colonia* is observed where the necessities are covered with precarious way because it was verified that their economic income is ranged from one to two times as much as the minimum wages.

Time Used to Commune to the work

The time that people spend to go to their work is between half and one hour (60 %), that reveals the relative proximity from their works to their houses; the remaining percentage (40%) goes to places that are farther away.

Transport Means

The means of transport most commonly used is the urban and collective transport (85%), due to the economic shortage of the majority and the proximity of their works. 10% moves by their own car and 5% by walking.

Mass Communication

It can be said that almost all people possess television sets and radios in their houses to spend time, but they do not use it to be informed of the important events.

Public Services

In regard to public services, it can be observed that all the housings possess potable water, public lighting, electric power and drainage; 85% of houses have paved streets and 5% hire the telephone service.

In this sense it should be emphasized that the potable water is provided to the *colonia* only for certain hours in the very early morning and at very late night. The water quality is too bad to be drunk, and people have to buy large bottles of water at particular companies, according to people's testimonies.

Literacy

90% of interviewed people know how to read and write and they have a school instruction that attended the primary school (40%), secondary (40%) and 10% higher school. Remaining 10% do not know how to read or write and they did not have any contact with the school. In this sense it is supposed that people ceased attending schools at the early ages for the necessity to cooperate the economy of their houses.

Services of health

In an event of illness, 55% of the interviewed population go to the Center of Health, 35% to the particular doctors, and the other 10% to the ISSSTE. In this sense, it can be deduced that because the labor occupation of people is not in the government which has its own health services, neither in particular companies that grant the right to the health service, people are devoted to what is called informal employment or under a honorarium contract.

Time of Residence

The time of residence in the place ranges from six to ten years with 40% of the people, 11 to 16 years with 30%, 16 years or more with 15% and one to five years with 15%.

Material of the Housing

The material of the housings is concrete (75%), while remaining 25 % of houses were constructed with concrete and sheet roof.

Land Use

80% of land is residential use, while remaining 20 % is used to build a room in its housing to use with commercial purposes and in a same way they are proprietors of the housing.

Number of Household Members

The number of people in a house ranges from five to seven with 55%, 8 to 10 with 30% and two at four with 15%.

Number of Rooms

The number of rooms in a house ranges from four to six with 55%, one to three with 40% and four at six with 5%.

Recreation Area

In regard to the recreation areas, 35% of the interviewed mentioned that they have small playground spaces for children of the *colonias* and sport courts.

It is necessary to mention that the area of the ex-Lake Texcoco, which is located at a little distance to the colonies, was not mentioned by the inhabitants. This indicates that they do not use it as an recreational place.

Observations

The interviewed population of this Municipality shows similarities with the interviewed population of Nezahualcoyotl. These *colonias* are marginal; the public services are not the most appropriate. Although the proposed project is to be implemented by the GDF which does not have responsibility of SWM in this municipality, it should be noted that they are forced to burn their residuals in secret waste dumps, since they are not offered satisfactory service of waste collection.

The inhabitants in these colonies enjoy only scarce resources, implying a lifestyle of low quality.

They will not be affected by the project, since many of them have not yet noticed that waste disposal activity is carried out in the ex-Lake Texcoco area. This implies that there has been no impact given by the landfill to affect by them.

1

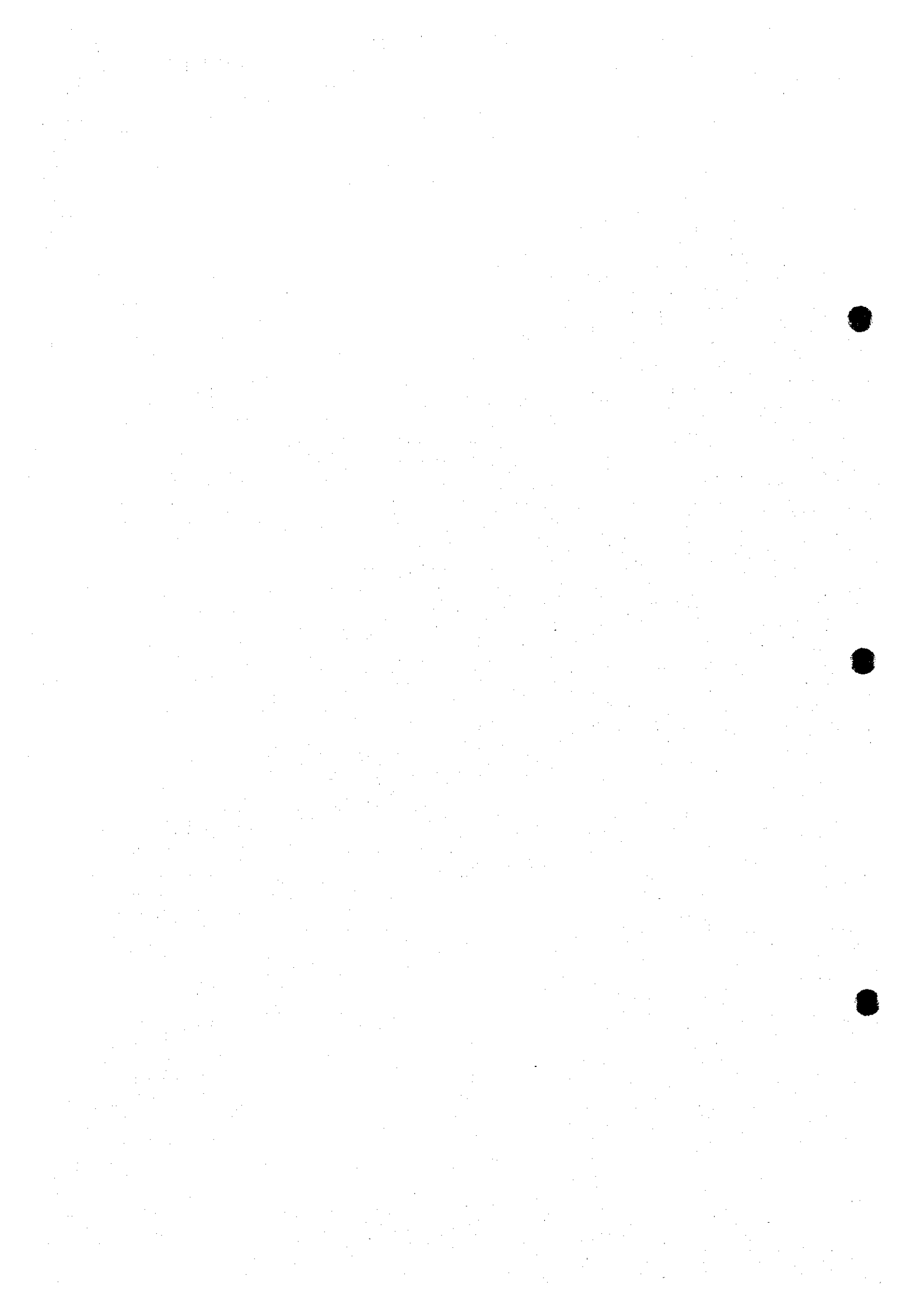
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Part A

Chapter 3

Verification of Land Use



3 Compliance with Norms and Regulations on Land Use

This chapter has an object to identify the applicable juridical regime in regard to land use of the portion of territory of the ex-Lake Texcoco in which the project is to be implemented.

The Mexican relevant laws stipulates the following in regard to the federal zone authorized by the CNA.

- Fraction XXIV, Article 32, of the Organic Law of the Federal Public Administration states that the role of the SEMARNAP is: "to administrate, control and regulate of the use of hydraulic basins, springs and waters of national property and the corresponding federal areas, ..."
- Fractions I and VII, Article 40, of the SEMARNAP's Interior Regulation state that the role of the General Subbureau of Administration of the Water of the CNA is: "to administrate and guard the national waters, as well as the goods that are linked to these, of conformity with the applicable juridical dispositions, except for those commended to the General Subbureau of Operation, as well as to watch over the execution of the Law of National Waters and their Regulations ..." and "to promote or carry out the necessary measures to avoid the superficial or the underground waters and the goods subject to protection from contaminated by garbage, waste, residue materials, toxic substances, sludge, and product of the treatments of residual waters, according to the applicable juridical dispositions".
- Fraction I, Article 50, of the SEMARNAP's Interior Regulation, states that the role of the Regional Management of the CNA is: "to exercise, inside the territorial environment that have been assigned, the attributions of the administrative units to which the articles 39 at 40 of this Regulation refer, ..."
- According to Fractions II, IV, V and VII, Article 113, of the Law of National Waters, national goods whose administration corresponds to the CNA are the following ones: the lands occupied by the lakes, lagoons, tidelands or natural deposits whose waters are of national property; the lands of riverbeds or federal zones adjacent to the flows and basins of national property; lands of natural deposits of lakes, lagoons, tidelands of national property, exposed by natural causes or for artificial works; the hydraulic infrastructure works financed by the federal government, such as dams, dikes, channels, drains, gutters, aqueducts, watering units and other built for the exploitation, use, and control of floods and handling of the national waters, together with the lands that occupy these and with the protection areas, in the extension that fixes the Commission in each case;
- According to Article 117, last paragraph of the Law of National Waters: "the Commission will agree with the state or municipal governments or individuals interested through assignation or a public bid, in case where the latter will be in charge of the custody, preservation and maintenance of such goods"

- According to Fraction VIII, Article 3, the riversides or federal areas are the strips of ten meters of contiguous width to the river beds or the deposits of national property, measured horizontally starting from the maximum level of waters”.
- Fraction IV, Article 119 of the Law of National Waters considers an administrative penalty “to occupy river beds, natural deposits, canals, federal zones, protected areas and other goods referred to in Article 113 without the license of the Commission”.

Under such legal background, the ex-Lake Texcoco area was put under the administration of the CNA, designated as the federal zone. Further, the CNA is appointed to do the following.

- According to the first paragraph, Article 118, of the Law of National Waters: “the national goods..., which the Commission is in charge of, could to be exploited or used, even as the construction materials located there, by any individuals or entities which are granted the concessions from the Commission grants for such an action”.

And:

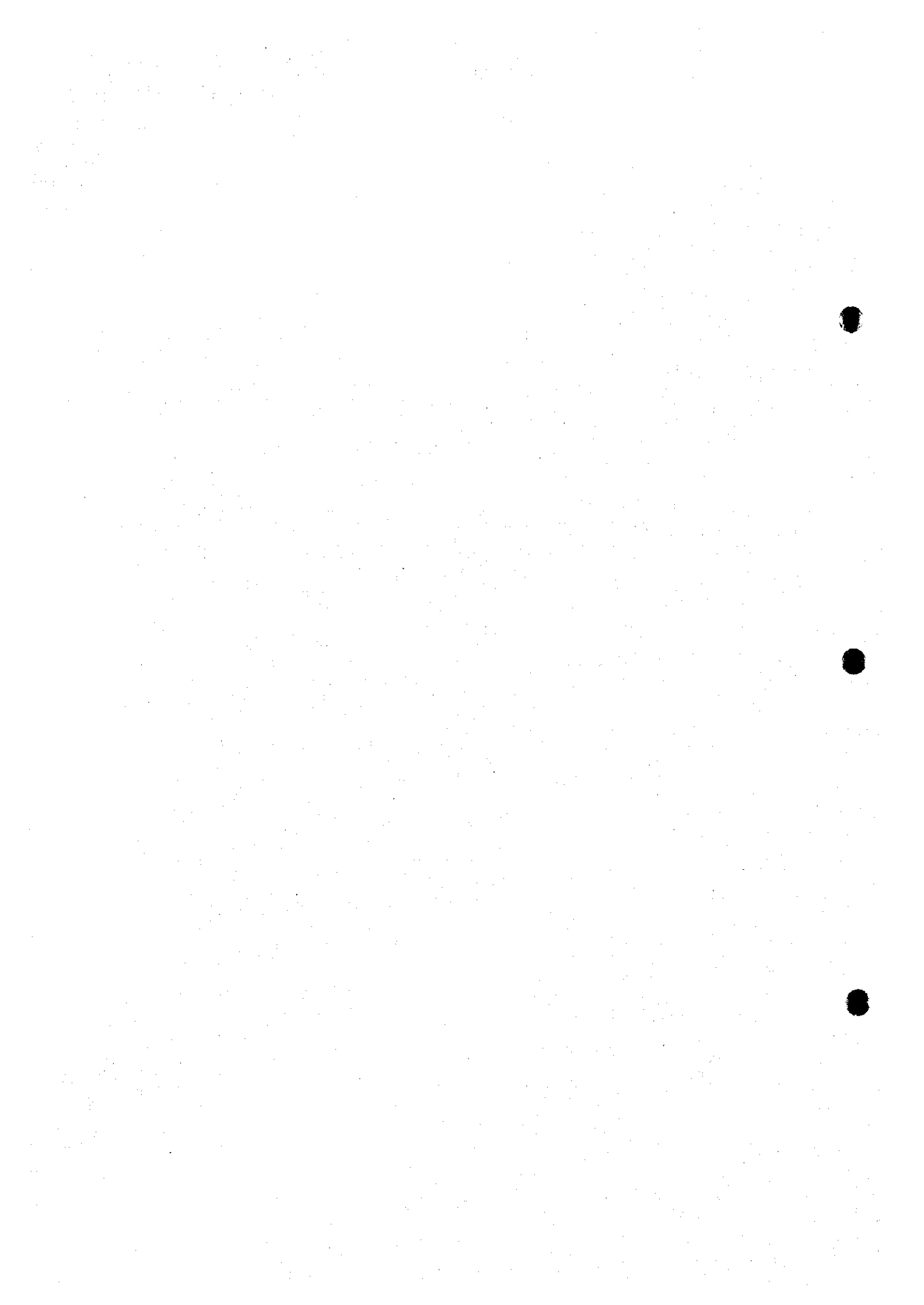
- According to Fractions VII and XV, Article 9, of the Law of National Waters, the role of the CNA is “to grant the titles of concession, assignment or permission as referred to in the present Law, ...” and “issue, in each case, regarding the goods of national property referred to by this Law, the corresponding declaration that will be published in the Official Federation Newspaper”.

Understanding that the project site was determined through the discussion between the CNA and the GDF, the use of land by the GDF for the said purpose is considered sufficiently verified.

Part A

Chapter 4

*Identification of
Environmental Impacts*



4 Identification of Environmental Impacts

Approach to be Used

An environmental impact is any alteration of the environmental conditions or the creation of a set of adverse or beneficial environmental conditions caused or induced by a new action or a group of new actions under consideration (BCIE (Banco Centroamericano de Integración Económica), 1988).

Understanding this, the evaluation of environmental impact is aiming to identify, predict and interpret the impacts of a project in the environmental parameters that have a significant implication to the natural and socioeconomic environment.

The development works, as we are concerned, could present diverse impacts to the natural and socioeconomic environment, in stages such as land preparation, construction and operation. In relation with the project type and the characteristics of the land and environment, the impacts can be of diverse magnitude and significance.

This fact brings multiple key issues and disciplines, interactions and complexity among them. Therefore, with a purpose to identify possible environmental impacts, a checkup list is prepared (Table 4-1).

The left end column shows the environmental aspects in which impacts could be observed. They are listed as to cover all possible impacts and not to omit any impact. It should be noted that the list has been elaborated for a SWM project in general, not specifically for the present project.

The table also shows the anticipated impacts, or results, of the activities of a solid waste management project during the construction and operation and after the closure of the project. In doing so, the causes and effects become explicit and impact identification is facilitated.

Following the list of environmental aspects, it is attempted to analyze the environmental impacts of the composting plant project in the following sections.

Table 4-1: Possible Impact by a SWM Project

Possible Impact (General guide for a SWM project)		
Evolution Aspects	During Construction	During Operation
Social Environment		
Resettlement	Resettlement of people living in the proposed land or on the access route.	Social instability of resettled people.
Economic Activities	Disturbance of economic activities.	Introduction of new activities introduced.
Transport	Increase in traffic and accidents.	Increase in traffic and accidents.
Public Facilities	Impacts on schools, hospitals, etc. by traffic and noise.	Impacts on schools, hospitals, etc. by traffic and noise.
Division of Community	Geographical separation of community or interruption of its communication.	Possible re-linkage of divided community.
Historical Heritage/Cultural Properties	Loss and/or devaluation of historical heritage or cultural properties such as churches, archeological remains and historical assets.	Restoration of their values to a certain extent.
Water Rights/Access Rights	Obstruction of fishing rights, water rights and rights of common access.	Restoration of previously abolished access rights.
Public Health		
Waste (from the project)	Degradation of public health due to wastes fallen from the trailers, the existence of a great amount of wastes in a limited area, and/or vermin/ pathogens proliferation there.	
Accidents/Risks	Prevention of threats to public health which could be brought by uncontrolled waste management (i.e. open dumping, no treatment or no-project option).	
Natural Environment	Generation of construction wastes and debris.	
Topography and Geology	Changes in valuable topography and geology due to excavation.	
Soil Erosion	Increase in soil erosion due to land preparation and/or deforestation.	
Groundwater		Changes in quality and level of groundwater due to leachate.
		CH ₄ explosion, intrusion of CO ₂ into residence, refuse fires, landslides, lateral pressure on land.

Possible Impact (General guide for a SWM project)			
Evaluation Aspects	During Construction	During Operation	After Closure
Hydrological Conditions	Changes in river discharge and riverbed condition.	Changes in river discharge and riverbed condition due to in-flow from the site.	Changes in river discharge and riverbed condition due to in-flow from the site.
Coastal Zone	Impacts on coastal environment.	Impacts on coastal environment.	Impacts on coastal environment.
Fauna and Flora	Obstruction of breeding of natural species and/or extinction of them due to interruption or loss of their habitats.	Obstruction of breeding of natural species and/or extinction of them due to interruption by traffic, noise and/or presence of humans.	Introduction of new habitat.
Meteorology	Changes in temperature, wind direction and/or intensity, etc.	Changes in temperature, wind direction and/or intensity, etc.	Changes in temperature, wind direction and/or intensity, etc.
Landscape/Aesthetics	Changes in landscape.	Changes in aesthetic values due to the existence of the facility.	Changes in aesthetic values due to the existence of the facility.
Pollution			
Air Pollution	Deterioration of air quality due to the increased traffic.	Deterioration of air quality due to the increased traffic and dust from wastes delivered by trucks, the landfill gases and/or smoke/dust from site operation.	
Water Pollution	Deterioration of water quality of surface water and/or groundwater due to the inflow of sand/silt from land preparation work.	Deterioration of water quality of surface water and/or groundwater due to the inflow of sand/silt and leachate from the site.	Deterioration of water quality of surface water and/or groundwater due to the inflow of leachate from the site.
Soil Contamination		Contamination of soil by leakage of leachate.	Contamination of soil by leakage of leachate.
Noise and Vibration	Noise and vibration caused by the construction operation and/or the construction tracks.	Noise and vibration caused by the waste trailers and/or landfill site equipment.	
Land Subsidence	Land subsidence due to land deformation.		
Offensive Odor		Odor caused by scattered wastes from waste trailers and/or wastes accumulated at the site.	

4.1 Socioeconomic Environment

4.1.1 Resettlement

Evaluation: No impact.

There is no need to resettle any residents, thus no impact caused by resettlement at all.

4.1.2 Economic Activities

Evaluation: Positive impact.

The project site is not currently used by any economic activities but there is a selection plant nearby where recyclable inorganic materials are sorted from the municipal waste. Since the composting plant deals with only organic waste generated and separated at source in the sub-system, there should not be a conflict between the two. Therefore no negative impact on economic activity is expected.

On the other hand, the establishment of the composting plant is the introduction of new activity to produce compost, which could be used to enrich the soils. The project will create new employment, besides probably provide new recognition of waste as resource to the general public. This will bring a positive impact on the DF's economy.

4.1.3 Transport

Evaluation: Slight negative impact is anticipated, which is temporal and could be minimized.

Only part of waste is diverted to the composting plant (approximately 431,000 ton/year, equivalent to 10% of the total waste generated in the DF), and the majority goes to the landfill at Etapas IV or V, which are close to the plant. Therefore, the overall change of the traffic mode is negligible.

However, in view of the fact that the Periferico is the major road with heavy traffic, traffic signs are provided near the entrance to the composting plant to urge both the drivers of waste trailers and the general drivers to pay particularly careful attention to the vehicle flow.

4.1.4 Public Facilities

Evaluation: No impact.

Since there is no public facilities in and around the project site which could be affected by the project, no impact is anticipated.

4.1.5 Division of Community

Evaluation: No impact.

The site is in the federal zone, where is no community. Therefore, there is no possibility to divide any community.

4.1.6 Historical Heritage/Cultural Properties

Evaluation: No impact.

There are no historical heritage or cultural properties in and around the project site which could be affected.

4.1.7 Water Rights/Access Rights

Evaluation: No impact.

The site is owned by the Federation, and neither water rights nor access rights are associated with the land. Therefore, there is no chance to affect them.

4.1.8 Public Health

Evaluation: Expected impacts are controllable and large benefits to the public health should be brought.

Public health can be adversely affected by the composting plant project for the following reasons.

1. Waste scattered from the waste trailers which deliver waste from its origins to the plant due to the mismanagement of waste delivery.
2. Offensive odor emitted from putrescible waste.
3. Proliferation of vermin and/or pathogens attracted to food waste.
4. Loud noise emitted by the use of machinery.
5. Dust caused in the turning process and machinery.

Items 1 and 3 are examined below, and the others will appear in the later sections.

a. Mismanagement of Waste Delivery

Careless delivery of waste may allow waste to be scattered along the transportation routes and around the composting plant, resulting into the degradation of city beauty and public health.

Meanwhile, the DGSU has been using tarpaulin to cover waste on the trailers in order to avoid waste scattering. It is observed that the tarpaulin has been achieving a satisfactory result to overcome this problem.

Since **this practice is continued**, waste will not be significantly scattered to degrade the city cleanness or public health. **It is ensured by regular monitoring that the tarpaulin does not have large holes or tears though which waste might escape from the trailers.**

b. Vermin/Pathogen Proliferation

Organic waste attracts wide range of pathogens (i.e. disease-causing bacteria) and vermin (or disease vectors such as fly, mosquitoes, rats, etc. which transmit pathogens) and hence can potentially increase the incidence of diseases in surrounding population and the plant workers.

It is intended that waste is first subject to aerobic decomposition in the proposed composting plant. In the aerobic decomposition process, easily biodegradable organic

matter, which is also the source attracting pathogens and vermin, is quickly decomposed. They are no longer readily available for those annoying fauna.

Aerobic decomposition will also raise the temperature of waste about 55 degrees centigrade. Since most pathogens are susceptible to heat, it is expected that the number of pathogens decreases significantly as aerobic decomposition proceeds, and vermin will not approach to such hot material.

Therefore, **aerobic decomposition, if successfully controlled**, will minimize the population of pathogens and disease vectors and limit the spread of diseases. Furthermore, residents live sufficiently far from the plant, thus they are unlikely to be affected by the annoying animals from the plant. Nevertheless, the newly delivered waste will attract pathogens and vermin, and there should be a certain amount of such young waste in the plant at any time. **Therefore, the plant workers working near the raw material are instructed to wear appropriate clothes and equipment to prevent from being exposed to disease vectors and pathogens.**

Finally, but by far the more importantly, it can not be too stressed that in spite of the issues pointed out above, *the proposed project of composting plant will reduce the public health hazard which would be caused under no-project option (i.e. all organic waste is disposed of at the landfill)*. This is because organic waste is decomposed and stabilized under the aerobic condition at the composting plant much faster than by the anaerobic condition at the landfill.

4.1.9 Waste (from the Project)

Evaluation: No impact.

No excavation work is planned, thus there is no construction waste generated. Therefore, the waste generation from the project can be ignored.

4.1.10 Accidents/Risks

Evaluation: No negative impact.

Methane is explosive when it accounts for 5% of air. Methane associated with waste management, however, originates in methanogenic decomposition taking place in an anaerobic process. In the windrows which operate aerobic decomposition, it is unlikely to produce methane. If it should be produced, it will be easily dispersed into the air. During curing, anaerobic decomposition may take place in the deep section, but decomposition process is very slow. Thus gas generation will not significant.

Carbon dioxide is formed as a result of aerobic decomposition of organic matter and hence the plant will produce it. Human being will be asphyxiated if exposed to high concentration of carbon dioxide for hours. At the composting plant, however, carbon dioxide is produced at the windrows in open air and immediately diffused.

Therefore, the said risks or accidents should be unlikely to happen.

4.2 Natural Environment

4.2.1 Topography and Geology

Evaluation: No impact.

The land is elevated not more than 2m in the center, thus change in topography is almost null.

4.2.2 Soil Erosion

Evaluation: No impact at the site; Positive impact in the mountainous areas.

Vegetation, which exists in the project site, may be removed before land preparation, but the construction of platform will prevent the occurrence of soil erosion.

On the other hand, producing compost will have an positive effect taking into account the large demand for organic soil conditioner. It is reported that¹ an illegal collection of nutritious manure (or called *tierrezos*) in mountains by those from the horticulture industry and individual gardeners who require soil conditioner has been causing serious soil erosion. Introduction of compost product into the current limited supply market may put a brake on such erosion problem.

4.2.3 Groundwater

Evaluation: Negative and long-term impacts could be anticipated, but they will be well controlled.

Groundwater contamination is anticipated to occur under a situation where leachate infiltrates into the soil and reaches to an aquifer.

Leachate intrusion into the aquifer, however, is only probable when there is enough leachate to fill all available pore space in the subsoil above the aquifer. In other words, leachate quantity matters. Although it is significantly difficult to numerically express the amount of leachate to be produced, the proposed composting plant will not yield much leachate for the following reasons².

- Meteorological data shows that precipitation is about 600 mm/year and evaporation is about 1,800 mm/year on average near the ex-Lake Texcoco area. The latter is by far greater than the former. Unlike a waste landfill which utilizes cover soil, waste in windrows is directly exposed to the air, hence waste is always prone to be dry.
- **Moisture content is strictly monitored and controlled to maintain the most favorable condition for decomposition, either by spraying water or encouraging evaporation using a turner.** It is noteworthy that turning was proved to be an exclusively effective countermeasure against flooded compost in the DGSU's existing composting plant during the rainy season of 1998, when abnormally much rainfall was recorded.

¹ Composting Organics in Mexico City, Christian Gonzalez del Carpio, BioCycle

² It is empirically known that a windrow composting plant produces little leachate and it commonly operates without being provided with impermeabilization.

Nevertheless, taking the very high water table in the site into account, once leachate, even small amount, seeps into soil, it will readily meet with superficial groundwater. Although the environmental impact given by this leachate may not be simply ignored, it is to be reminded that this groundwater is not used by people.

Generally speaking, the concerns of leachate are (i) its high concentration of organic matter (or high BOD or COD), (ii) its aggressiveness (i.e. low pH), and (iii) the contaminants carried by leachate.

Contaminants are those which are originally contained in inorganic waste and dissolved into acid leachate. Acidity is mainly a result of the dissolution of carbon dioxide and organic acids: the former is produced by aerobic decomposition and anaerobic fermentation, and the latter is produced by anaerobic fermentation.

In the case of the proposed composting plant, the following should be pointed out.

- The plant uses waste which is separated as "organic waste" by waste generators. Organic content is expected to be as high as 90%, while it is 38% in normal municipal waste in the DF. Therefore, there is **no or significantly few sources of noxious contaminants in waste**. Leachate contaminants in the composting plant are mostly food origin and should be highly biodegradable organic matter and nitrogen (either ammonia, nitrate or nitrite).
- The leachate will show low pH. Since groundwater contains high alkalinity, in other words it has high capacity to act as a buffer against the ingress of hydrogen ions, acid leachate will not lower the pH of groundwater.
- It is disputable whether there is a biomass which breaks up the organic matter in groundwater in the ex-Lake Texcoco area because of its atypically high salinity. It can not be considered, however, that biological activity is totally absent, and decomposable organics may be degraded into inorganics even at a limited rate.
- Since permeability of the clay subsoil is at the order of 10^{-5} cm/sec or could be lower (Chapter 2), the groundwater and contaminants, if any, move slowly.
- Groundwater in the shallow aquifer is not for human use because of the extreme salinity. Therefore, contamination with organics and nitrogen, if any, does not show any serious implication. Groundwater in the deep aquifer, which is used as potable water, is far below from the ground surface and slow flow of leachate within the shallow aquifer should by no means environmentally affect it.

In summary, it is considered that leachate seepage into the soil will probably be a small amount; it does not contain toxic substances but high concentrations of organic matter; it will only very slowly flow with groundwater which is not used by humans; and groundwater in the deeper aquifer unlikely will be polluted.

4.2.4 Hydrological Conditions

Evaluation: No impact.

The project is not such type of activity as causes the alteration of hydrological conditions (e.g. water flow volume, flow speed and river bed conditions). Further, there are no surface water bodies whose hydrological conditions is to be affected.

4.2.5 Coastal Zone

Evaluation: No impact.

This is not relevant since there is no coast near the site.

4.2.6 Flora and Fauna

Evaluation: No or possibly positive impact on flora; on fauna, negative impact in short and medium-term which will be minimized, and possibly positive impact in long-term.

a. Flora

The natural condition in the site where the project in question is to be established will be altered. The alteration will be in general observed by the reduction of the vegetable cover and change of the composition of flora species, which will be incurred at different stages by different activities.

The causal project activities and their effects will be as follows.

- i. Land preparation will eliminate the vegetable cover which may include ecologically valuable species.
- ii. Land preparation will eliminate the vegetable cover which was placed with a purpose to prevent a storm dust, and re-introduce that problem.

As for the first issue, there was no biotic population observed in the project site referring to the list of flora defined in the NOM-059-ECOL-1994. Thus, no impact on ecologically valuable species is predicted.

Regarding the second, the site is overlaid with a platform consisting of layers of construction material, gravel and sand. The site does not turn into the source of storm dust.

On the other hand, the project is aiming to produce compost which will be used as soil conditioner in areas where the vegetation has to be fostered including the ex-Lake Texcoco area. Such application should have a highly positive impact on the regional environment.

b. Fauna

The implementation of the project will inevitably occupy and disturb part of habitat of wildlife by land occupation and employment of heavy machinery and trailers.

Contrary to flora, and in spite of human intervention for decades, or in fact centuries, in the area, the field reconnaissance revealed the presence of a variety of birds. Among them, three species namely *Anas acuta*, *Anas discors*, and *Buteo jamaicensis* were designated as species which need special protection according to the NOM-059-ECOL-1994. **The site works are to be carried out not to give them direct harm but to allow them to escape from the site.** Through the fauna survey conducted in another area within the ex-Lake Texcoco zone for the EIA of the new landfill Etapa V, there are also these species. This suggests that they could find their new habitat outside the composting plant site.

Not by the field survey but by the bibliographic or personal consultation, three reptiles (*Guerrhonotus liocephalus*, *Thamnophis scaltiger*, and *Pituophis deppei*) and one mammal (*Peromiscus maniculatus*) were thought to be in the area and listed in the NOM-059-ECOL-1994, the first one being as threatened and the latter three being as rare. Each definition indicated by the norm is as follows.

Rare: Those species whose population is biologically viable, but very scarce in a natural way, which could be restricted to an area of reduced distribution, or of very specific habitats.

Threatened: Those species whose population could end up in extinction if factors which cause the deterioration or modification of the habitat or that reduce their population persist.

Therefore, prior to the establishment of the platform, the presence of them (or any other ecologically valuable species) is studied, and in the occasion of their identification, they are gently transferred to the area outside the influence of the project. Since they were found during the fauna study carried out in the area surrounding the Etapa V, new habitats for them will be available in the ex-Lake Texcoco area.

It should be noted, however, the compost product will be used to develop green areas. The enriched vegetation by doing so should bring a great benefit to the fauna.

4.2.7 Meteorology

Evaluation: No impact.

The scale of the project is not large enough to cause any change in meteorology.

4.2.7 Landscape/Aesthetics

Evaluation: No impact.

Since the platform has a height not more than 2m surrounded by 2.5m high embankments, the plant is not readily visible. Even if it is visible, so is it from the existing access road to the Etapa IV, the Periferico and the Autopista, where almost exclusively only vehicles pass by. In short, the change in landscape is small, and there are few people who might be affected by that change.

Moreover, trees are planted on the outer slope of the embankments, significantly lessening the visibility of the plant and even improving the aesthetics of the area.

4.3 Pollution

4.3.1 Air Pollution

Evaluation: Negative local impacts anticipated, but prevented by control.

Air is anticipated to be polluted by traffic of waste trailers, dust raised from windrows when the shredder and the turner are used, and biogas generation. The latter was already discussed in Section 4.1.10 Pollution due to the first two would increase the incidents of respiratory diseases and eyes irritation.

Regarding the traffic of waste trailers, the proposed project does not largely change the current traffic mode, thus the increase in pollutants emission attributable to the project should be minimum. At present, it is well known that the road traffic is the major cause of the air pollution in the DF, but the contribution of waste trailers traffic is negligible.

As for dust from windrows, the problem is highly local and the recipients are exclusively the plant workers. **To minimize the dust effect, the workers are urged to use appropriate clothes, masks and eye protectors and the site managers take care of their health condition.**

4.3.2 Water Pollution

Evaluation: Negative impact insignificant and controlled.

Water pollution could be found in groundwater and surface water, and the groundwater issue has already been discussed.

The adjacent surface water is *Brazo Izquierdo Río Churubusco*. The effect on it by leachate is to be considered in terms of quantity and quality, as shown in the section of groundwater.

The migration of leachate to the canal will be through groundwater or via ground surface. Regarding the first route, groundwater contamination with leachate will not be significant as discussed earlier, therefore groundwater will not contaminate the canal.

On the other hand, surface runoff which might contain organic matter and probably surface soil and compost particles may flow into the River Churubusco when it rains hard. However, the problem will be insignificant since this will be an occasional event when the runoff exceeds the water absorption capacity of the platform. Moreover, the runoff is intercepted at the embankment along the river and eventually evaporated.

4.3.3 Soil Contamination

Evaluation: Insignificant negative impact.

Soil contamination is a concern because it may cause groundwater pollution, degrade ecosystem within the soil, and restrict the future land use resulting in land devaluation.

The first issue has already been discussed under the title of groundwater.

As for the ecosystem, there are three items to be considered. One is that the **leachate infiltration occurs only when the control of moisture content is not successful**. Another is an effect by toxic material. Leachate produced at the proposed composting plant should not contain toxic substances that may impact the ecosystem, since **waste handled at the plant should contain few sources of toxicity**. The other is an effect by organic matter. Leachate containing high concentrations of organic matter may change the living environment for microorganisms in the subsoil and, in turn, change the structure of ecosystem. This change, if any, should not be negative.

In regard to the restriction of future land use, there are two key issues to be taken into account. Firstly, the land use in the project site is already restricted by its high salt content. Secondly, soil will be contaminated not by hazardous substances but by organics, which will be decomposed slowly but partly accumulated in soil for years little by little.

Generally speaking, soil containing excessive organic matter may fall in short of oxygen, then produce gases such as methane and hydrogen sulfide. Thus, excavation before construction works could be risky. But it is only the case where exist commonly expected biological activities. In the present case of the composting plant site, however, **leachate seepage is limited in volume, and organic matter will be degraded only in a slow manner.** Therefore, soil contamination with organic leachate would not restrict the land use options. Even if it should do so, the extent of restriction should be by far smaller than that due to salinity.

4.3.4 Noise

Evaluation: Insignificant negative impact anticipated, but controlled.

The plant will use a shredder to shred waste and a turner to turn waste in windrows to supply oxygen. These equipment can be a source of loud noise which might disturb the daily life of adjacent residents and/or have an adverse health effect on the plant workers.

Regulations in Mexico in regard to noise stipulate the following.

- Noise in the environment should not be louder than 68dB giving care to the surrounding residents and fauna (NOM-081-ECOL-1994).
- Noise in the working areas to protect the health of workers is defined by NOM-011-STPS-1994 which establishes the permissible maximum time of exposure to noise expressed by Continuous Sound Level Equivalent (NSCE)³ as follows.

Table 4-1: Permissible Maximum Time of Exposure to NSCE

Time (Hours)	NSCE (dB)
8	90
4	93
2	96
1	99
0.5	102
0.25	105

Both the shredder and the turner produce noise of 85dB from 1m away at the 1.5m height according to the technical specification. Background noise level is assumed to be at 50dB.

The following equation is given.

$$L_p = L_w - 20 \log_{10} r - 8 \dots \dots \dots (i)$$

³ NOM-011-STPS-1994 gives a guide to obtain Continuous Sound Level Equivalent (NSCE: Nivel Sonoro Continuo Equivalente) in case where the workers are exposed to noises with different intensity for different period in their work day.

where L_w = Noise level at source (dB).
 r = Distance between noise source and receiving point (m).
 L_p = Noise level at receiving point r meters away from the source (dB).

In case where several noise sources exist, the following equation is to be used.

$$P = 10 \log_{10} \sum 10^{P_i/10} \dots \dots \dots (ii)$$

where P = Resulting noise level (dB) from plural noise sources.
 P_i = Noise level from noise source i .

If the shredder and the turner are working very closely, the noise level from the two will be 88.01 dB by using equation (ii). Since the buffer area has 100m width, the noise level at the periphery of the plant will be 50 dB using equation (i). Combining this and background noise, the resulted noise level is 53dB.⁴ It is sufficiently below the permissible limit of 68dB.

As regards the second standard, the noise level of machinery, i.e. 85dB, combined with the background noise level, can be assumed to be the NSCE for the machine operators who work near the turner or shredder for eight hours. The synthetic noise still remains 85dB⁵ and exposure to 85dB noise for eight hours is within the permissible limit set by the norm, thus no health hazard is anticipated. Even when the shredder and the turner come close each other, the combined noise level will be 88dB, which should not be a serious problem.

Nevertheless, some plant workers may be vulnerable to noise less louder than the permissible level. They are instructed to put appropriate clothes and protectors.

4.3.5 Offensive Odor

Evaluation: Negative impact on limited recipients (site workers) and to be minimized with care.

Offensive odor is nearly unavoidable in solid waste management. It will be a minor issue for the majority, but can be extremely serious for limited population.

Culprits of offensive odor emitted from waste are gases such as ammonia (NH₄), hydrogen sulfide (H₂S) and methyl mercaptan (CH₃SH) which are mostly generated as the end products of the anaerobic decomposition of readily decomposable organic matter.

On the other hand, the plant is planned to operate a windrow system of aerobic decomposition. Waste will be mixed with air by periodical turning to maintain oxygen in waste. Therefore, well managed aerobic decomposition minimizes the production of malodorous gases.

However, anaerobic decomposition can not be totally eliminated particularly during the first week of the whole process. This is because the waste younger than about one week is biochemically active due to the high proportion of easily decomposable

⁴ Letting two noise levels A(dB) and B(dB) (A>B), and when the disparity A-B is given, the value d=C-A is empirically known, where C(dB) is the compound noise level of A and B. In this case, A-B=0(dB) and d=3(dB).

⁵ Following the above, A-B=35(dB) and d=0(dB).

matter, and oxygen is quickly consumed inside the waste. Therefore, odor will be the most problematic at the stages of unloading, shredding and first turning of the raw material.

In the curing section, although oxygen is not deliberately provided, natural oxygen diffusion into the young compost can be expected because it is porous. Furthermore, organics contained in the young compost are those which are difficult to be degraded such as cellulose and lignin, and undergo a decomposition process only at a very slow rate. Thus gas production is not significant.

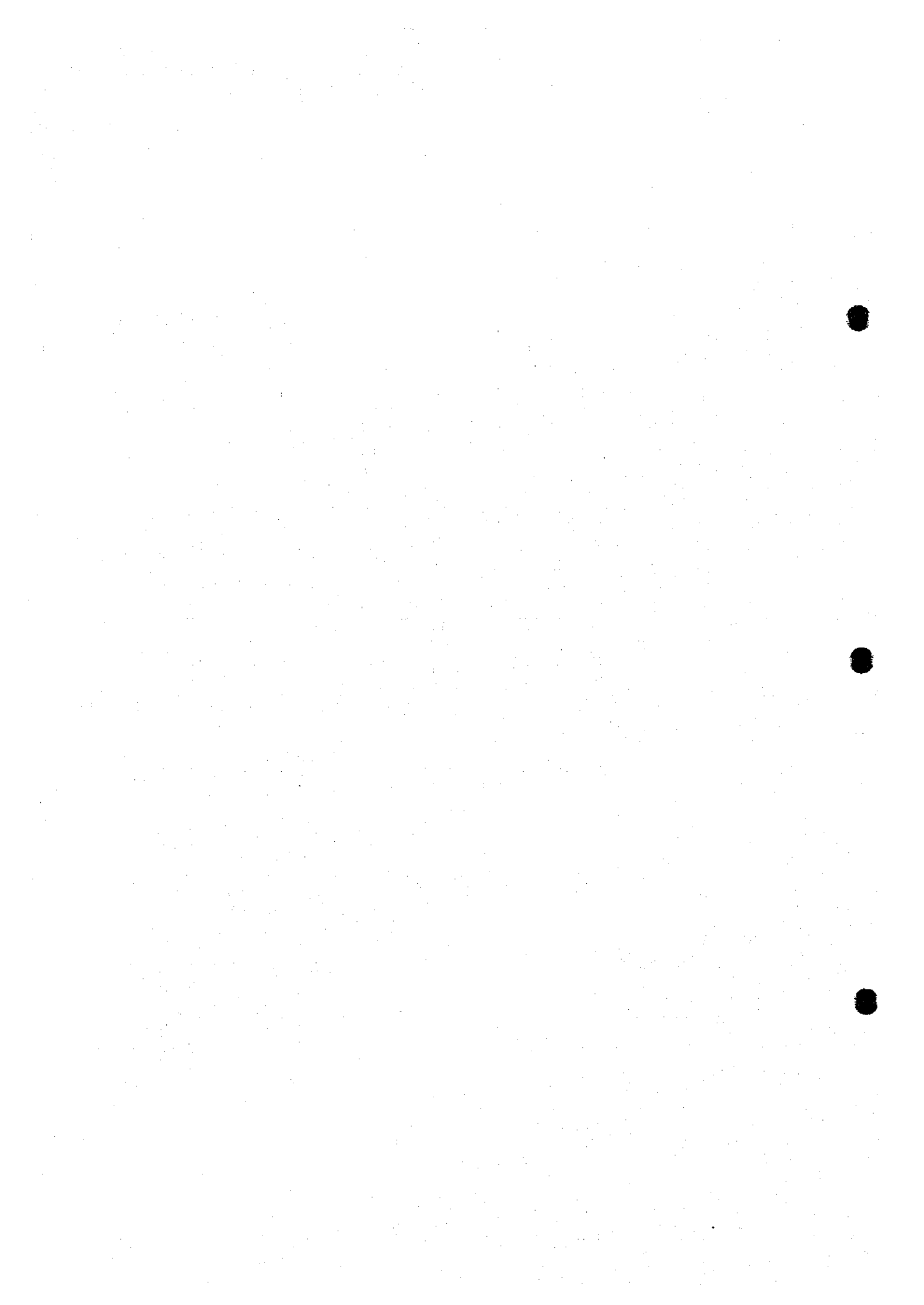
A worry might be release of malodorous gases when the compost products after curing are turned when they are transported, because of the possibility of oxygen depletion in the deep portion of the mature compost. However, anaerobic process will cease due to the drop in moisture content within the shorter period than the planned curing period. Therefore, sufficient time is allowed for slowly produced odor to be dispersed into the air, probably not remaining within the compost at the end of the curing.

In conclusion, odor produced in the early stage of composting is the most significant. Since the plant design shows that a curing area with much less odor is laid out in a portion closest to the residential area, odor will not affect the adjacent residents. The plant workers are instructed to wear appropriate clothes and masks.

Part A

Chapter 5

Countermeasures of Prevention and Mitigation of the Anticipated Impacts



5 Measures of Prevention and Mitigation of the Anticipated Impacts

The previous chapter described the possible causes and effects on the environment given by the compost plant development and the extent of the problems. Figure 5-1 is a diagram to show the discussion on negative environmental impacts schematically.

Besides cause and effect relations, the figure includes arguments against the anticipated environmental effects. These effects would be brought about under the generally presumed circumstances, but in the specific case of the composting plant project proposed here, it is unlikely that they will occur.

The figure also shows countermeasures (typed in bold letters in Chapter 4) which are incorporated in the design of the project in order to prevent or mitigate the negative effects. Assuming that these countermeasures are satisfactorily implemented, any significant environmental negative impacts are not envisaged, as set forth in Chapter 4.

Recognizing the importance in this light, the countermeasures are presented in depth in this chapter, together with approaches to ensure their performance.

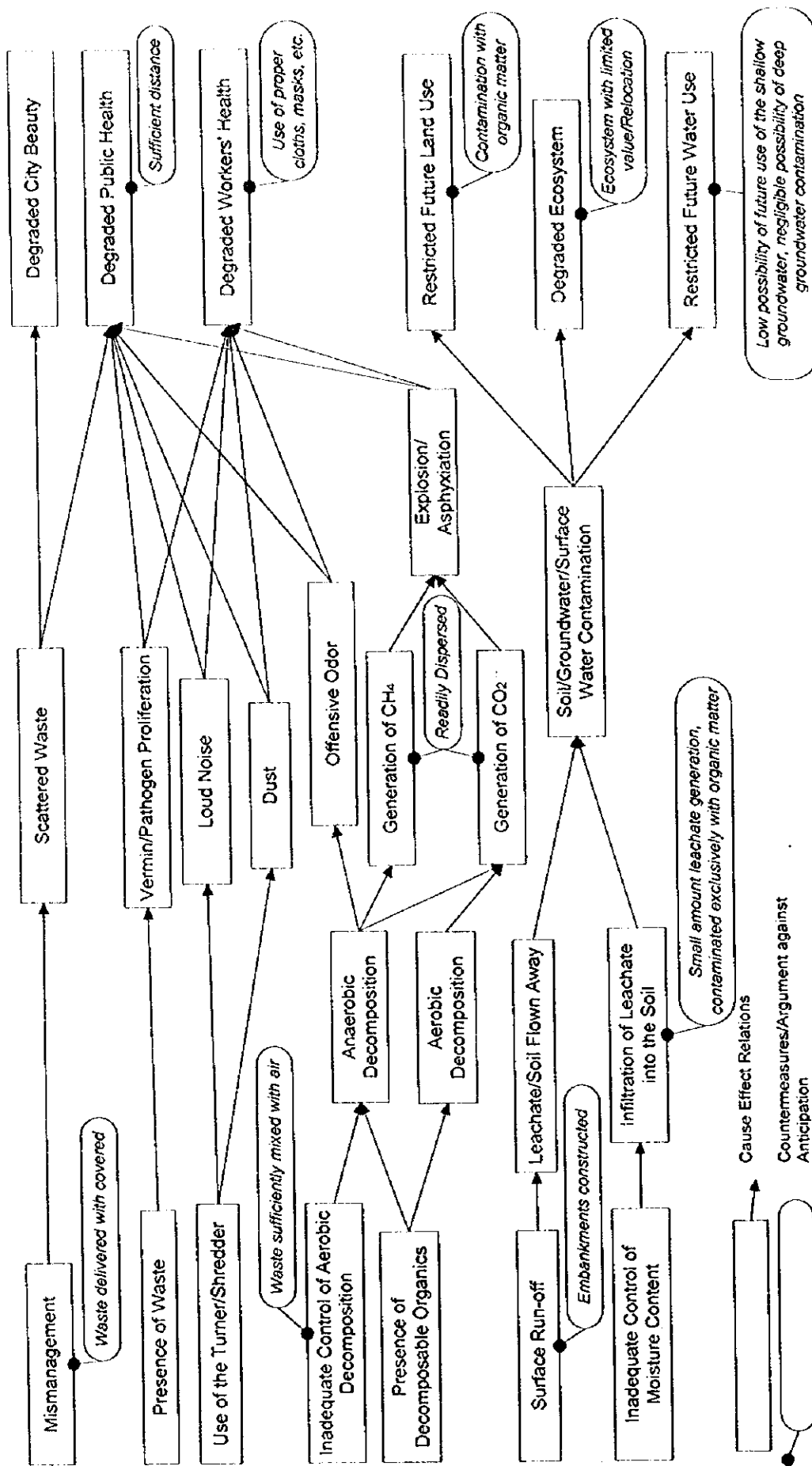


Figure 5-1: Cause Effect Relations (Composting Plant Project)

5.1 Countermeasures

5.1.1 Use of Tarpaulin over the Delivered Waste

Effect: Sanitary waste delivery

Ensured by: Supervision of operation and instruction to the workers.

As the DGSU has been practicing so far, use of tarpaulin over the waste on the trailer during its delivery is continued. Experience of the DGSU suggests that this method works satisfactorily to prevent waste from scattering.

The execution of this practice is routinely checked and the tarpaulins are inspected to see if there are holes or tears. The workers are encouraged to follow this rule all the time of waste delivery.

5.1.2 Distance from Anticipated Impact Receptors

Effect: Prevention of impacts on adjacent residents, and protection of public facilities.

Ensured by: Supervision of qualified engineers over the design and implementation procedure.

The location of the landfill allows a distance from three groups of receptors of anticipated impacts: residents, passers-by and public facilities.

The most adjacent population is found in Ecatepec municipality at a distance of about 0.5 km from the site. This distance will reduce possible impacts on their health, including offensive odor and noxious fauna, to an acceptable level.

The design also leaves a distance of at least 60m from the public facilities, i.e. wastewater conducting canal Brazo Izquierdo Río Churubusco, which otherwise could be distorted by the weight stress by the load of waste and platform.

5.1.3 Organic Waste Separation

Effect: Prevention of pollution of water and soil with contaminants.

Ensured by: Instruction to the waste generators and monitoring of impurities in compost.

Organic waste is separately collected within the sub-system and delivered to the plant, with contribution of waste generators who are instructed to discharge organic waste separately from other waste. As a result of the agreement between the GDF and the Section I, the collection of organic waste in the sub-system is totally under the control of the GDF.

The compost product is subject to a regular quality test, by which the presence of unintended impurities (e.g. heavy metals) is checked. When the product quality is unsatisfactory and if it is attributed to the insufficient separate collection, the instruction to the waste generators is reiteratively conducted.

5.1.4 Control of Vehicle Flow

Effect: Avoiding traffic accidents.

Ensured by: Monitoring of the vehicle flow.

Road signs along the Periferico to call attention of the general drivers to the movement of the waste trailers will facilitate the lane crossing by the trailers and minimize the possibility of traffic accidents.

The waste trailers drivers are instructed and provided with signboards to carefully drive to enter and leave the plant. Within the plant, they will be guided not only by signboards but also by the site managers to move to the positions appropriate for the specific occasions.

Site managers keep attention to the vehicle flow to detect the possibility of traffic accidents.

5.1.5 Operation Control

Effect: Vermin/pathogens control, less odor, and prevention of water pollution.

Ensured by: Moisture and temperature monitoring (monitoring of CO₂ as an option).

To confirm whether aerobic decomposition is maintained, temperature and moisture content are measured regularly. As described in Chapter 4, problems of vermin/pathogens proliferation, offensive odor, and leachate-derived pollution are avoided by keeping aerobic decomposition.

Monitoring of moisture and temperature can be enough to verify aerobic decomposition, but a certain level of experience may be needed. During the pilot project, it will be decided whether the periodic measurement of O₂ within the windrows is carried out as complement.¹

5.1.6 Protection of Fauna

Effect: Protection of ecologically valued fauna species.

Ensured by: Supervision of experienced personnel over the design and implementation of fauna protection plan.

Birds listed in the NOM-059-ECOL-1994 are allowed to escape from the project site. If the other animal species of the list which were not yet directly observed but found in the site prior to the implementation, they are trapped and escaped to the outside of the project site and its influencing area.

During the operation, instructions will be given to the personnel that works in the sanitary landfill not to bother, mistreat, kill or perturb the wildlife in the property or along the access road.

¹ In practice, the concentration of CO₂ is measured for the convenience. As the concentration of O₂ in the air is about 21%, that in the windrow is assumed by subtracting the concentration of CO₂ from 21%. As a rule, O₂ should not be less than 10%.

Such protection plan should be directed by experienced personnel to ensure its efficiency.

5.1.7 Embankments

Effect: Protection of the plant, and aesthetic improvement.

Ensured by: Supervision of experienced engineers over the design and implementation of embankments construction and performance.

Embankments are constructed so that the plant is protected from inundation, runoff ingress into the canal is prevented, and also the visibility of the plant is lessened.

Construction works are managed by an experienced engineer following the design for the said purpose.

5.1.8 Reforestation

Effect: Avoidance of loss of soil on embankments, and beautification of the area.

Ensured by: Supervision of experienced personnel over reforestation planning and implementation.

Trees are planted on the outer slopes of the embankments. Accordingly, the visibility of the plant is further lessened, noise and odor are cut off, and the aesthetics of the area is improved.

The reforestation plan is executed under the supervision of experienced personnel.

5.1.9 Access Control

Effect: Avoidance of accidents.

Ensured by: Instruction to the guards and inspection of the signboards.

Entrance of the general public is restricted by control of the guards and signboards at the entrance of the access road to avoid hazards on them.

The duty is instructed to the guards and the signboards are inspected regularly to make sure that they are visible by people.

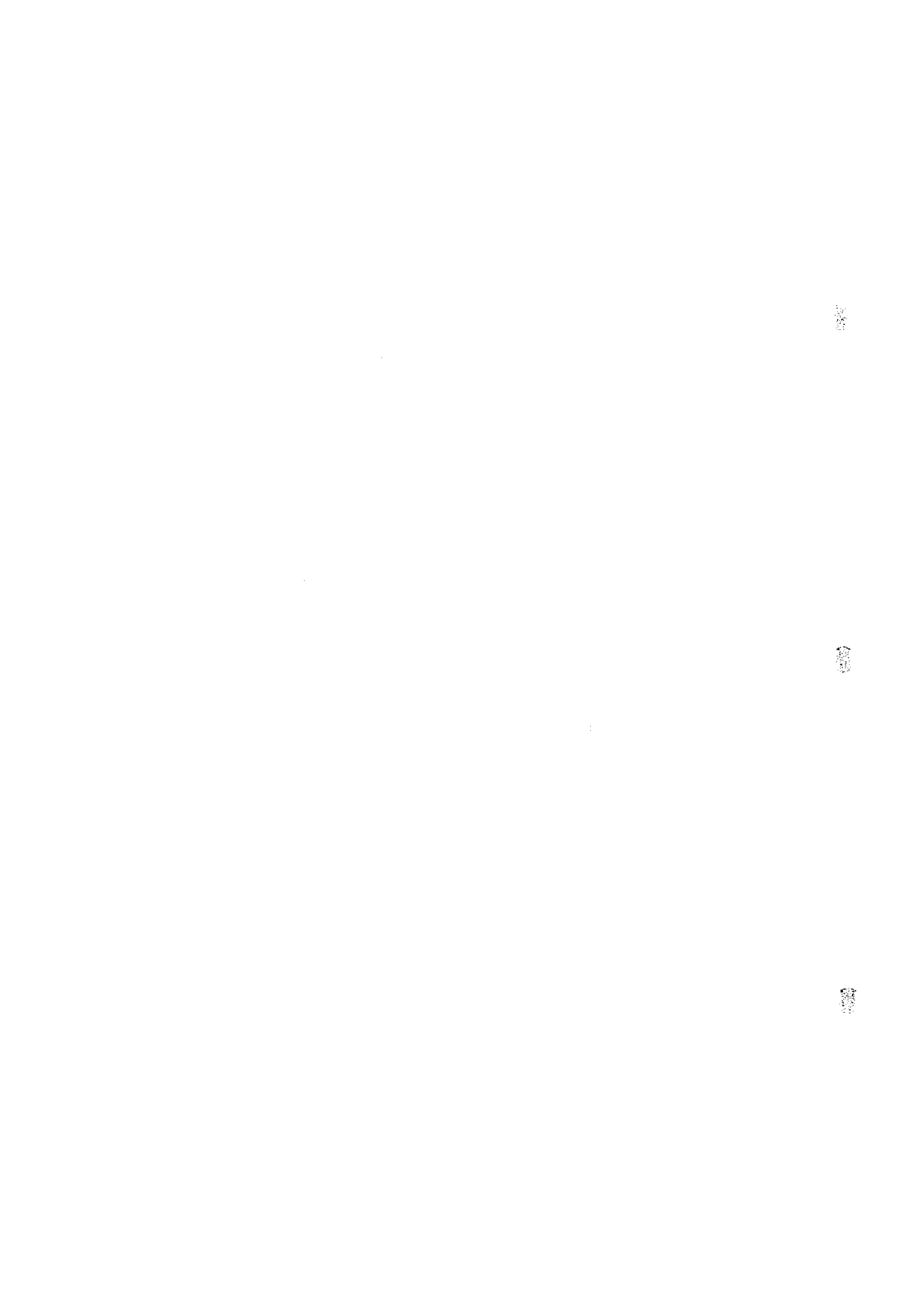
5.1.10 Safety Surveillance

Effect: Prevention of risk for the workers.

Ensured by: Instruction to the workers and site supervisors.

The system of plant operation is instructed to the workers with particular attention to machinery movement and operation.

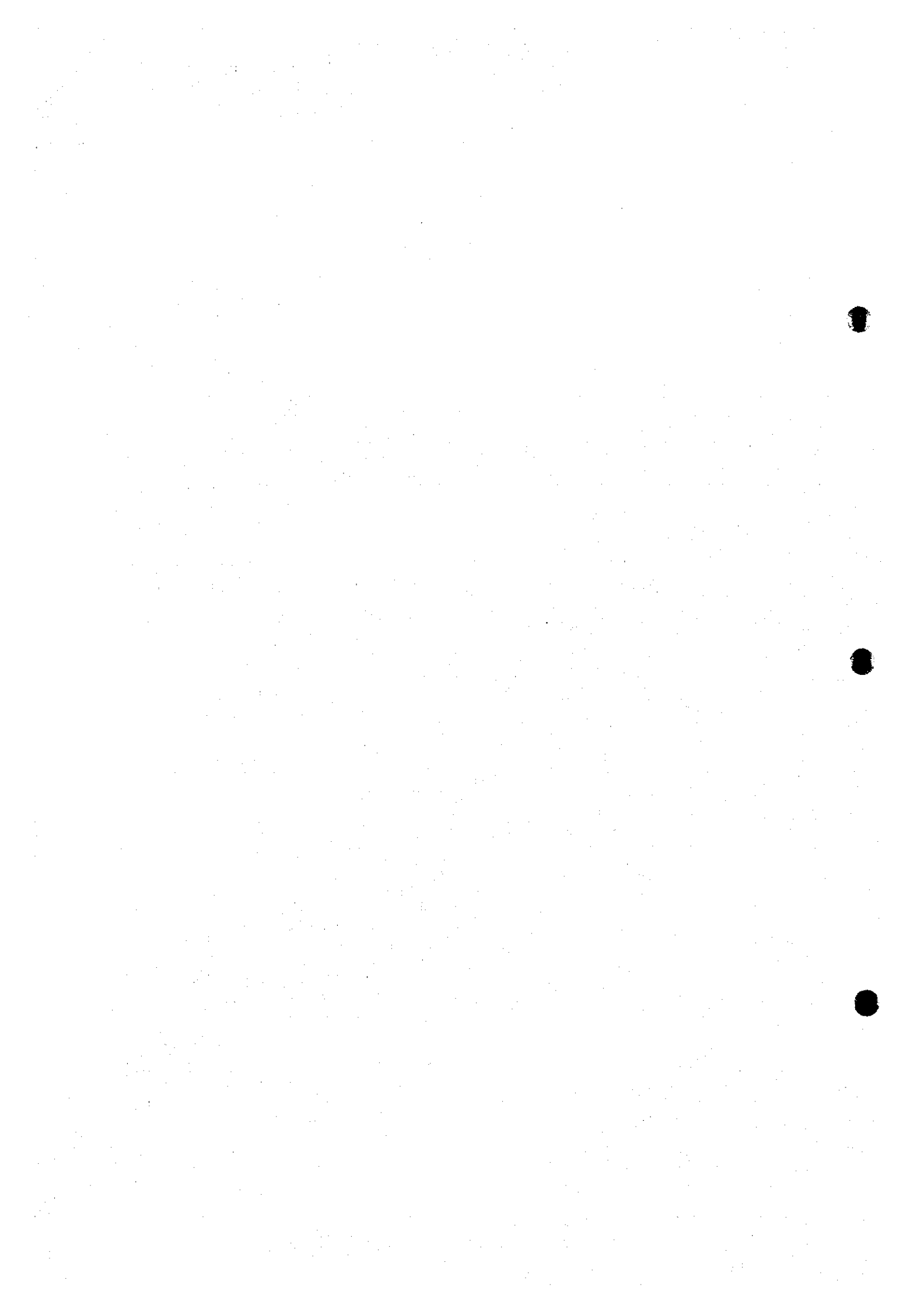
The workers are also urged to use appropriate clothes to protect themselves from injure, dust, offensive odor, vermin/pathogens and any other health danger raised at the landfill. Such clothes will include gloves, masks, and boots.



Part A

Chapter 6

Conclusion



6 Conclusions

The previous chapters discussed the benefits brought by the project, its importance in the urban society, and the anticipated influences of the modification of the natural and socioeconomic environment.

In concluding impact assessment, it should be emphasized that **the impact is a function of the character of recipients and the type of activities**. If the recipients are vulnerable or sensible, they can be affected however small the intended activities are, and vice versa. Therefore, impacts can not be assessed by looking at only one side: both the character of recipients and the type of activities have to be taken into account.

The recipients will be, in the present case, the environment, people, and the metropolitan society. The vulnerability or resistance of the environment at the site was reflected by the description of the current environmental status. It was inferred that the site is not particularly susceptible to the human interventions. Recipient people are at a distance from the site, which reduces their vulnerability together with the effect of the embankments and planted trees. Since all members of the metropolitan society produce wastes, it will be directly influenced by the project.

On the other hand, in regard to the activities at the site, the extent of its negative influence is considered low, involving a number of preventive actions against negative impacts, such as the establishment of a buffer area with embankments and trees around the plant, site management measures, as well as the implementation of operation control to minimize threats on the human health and the risks of environmental contamination in the site and its influence area. Thus, the negative influence for the environment and people is largely suppressed. Besides, through the use of compost, the environment can be enhanced, resulting overall in positive influence. On the other hand, for the society, the principle achievement of the plant, i.e. reduction of organic waste, should be absolutely fit for the society's needs.

In conclusion, the impact as a result of the character of recipients and the type of activities is, therefore, not negative but could be even beneficial for the environment and people, and highly positive for the society.

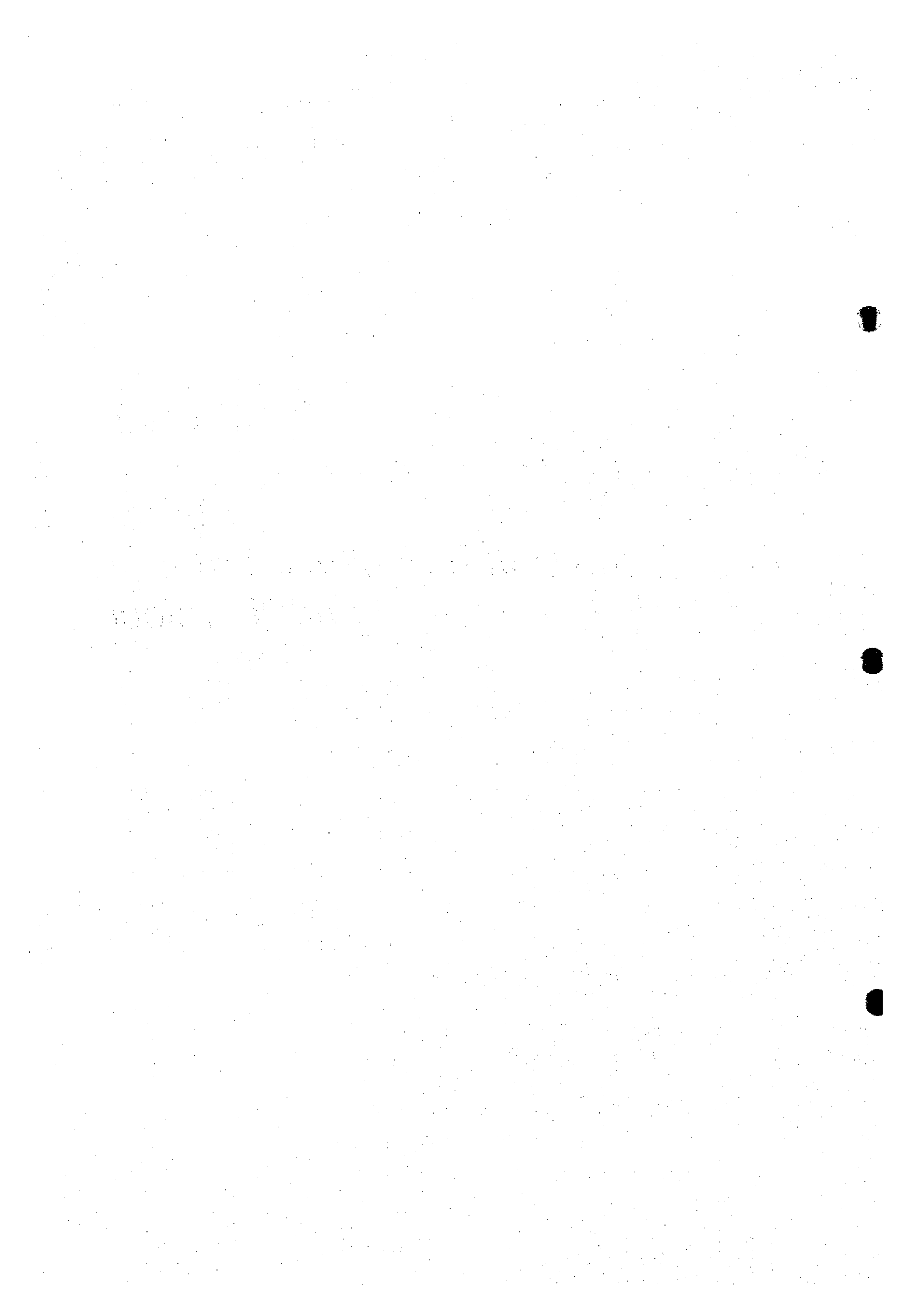
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Part B

*EIA for
the Bordo Poniente Etapa V
Landfill Project*



Contents

	Page :
1 Description of the Proposed Project	B-1-1
1.1 Background.....	B-1-1
1.2 Objectives of the Project.....	B-1-3
1.3 Justification of the project.....	B-1-3
1.3.1 Legal Justification	B-1-4
1.3.2 Social Justification	B-1-6
1.4 Site Selection	B-1-7
1.5 Preliminary Studies of Field	B-1-9
1.5.1 Bibliographical Studies	B-1-9
1.5.2 Visit to the Area in and near to the Site.....	B-1-9
1.6 Current Land Use.....	B-1-9
1.7 Description of the Work	B-1-10
1.7.1 Project Outline.....	B-1-10
1.7.2 Location and Land Area	B-1-11
1.7.3 Types of Waste to be Disposed of.....	B-1-13
1.7.4 Key Design Data.....	B-1-13
1.7.5 Landfill Capacity	B-1-13
1.7.6 Site Preparation	B-1-15
1.7.7 Access.....	B-1-15
1.7.8 Landfill Layout	B-1-15
1.7.9 Leachate Management	B-1-19
1.7.10 Landfill Gas Management	B-1-19
1.7.11 Surface Water Management	B-1-19
1.7.12 Aesthetic Design Consideration	B-1-19
1.7.13 Closure and Post-closure Care.....	B-1-20
1.7.14 Landfill Equipment.....	B-1-20
1.7.15 Operation	B-1-20
1.8 Sequence of BP-V Construction	B-1-20
2 Natural and Socioeconomic Environment	B-2-1
2.1 Natural Environment.....	B-2-1
2.1.1 Introduction	B-2-1
2.1.2 Area of Influence.....	B-2-1
2.1.3 Climatology.....	B-2-1
2.1.4 Air.....	B-2-18
2.1.5 Geological and Geomorphologic Traits	B-2-20
2.1.6 Biological features.....	B-2-56
2.2 Socioeconomic Environment.....	B-2-78

2.2.1 Socioeconomic Environment in the Beneficiaries Area.....	B-2-79
2.2.2 Socioeconomic Environment in Neighboring Communities.....	B-2-88

3 Compliance with Norms and Regulations on Land Use B-3-1

4 Identification of Environmental Impacts B-4-1

4.1 Socioeconomic Environment.....	B-4-4
4.1.1 Resettlement.....	B-4-4
4.1.2 Economic Activities.....	B-4-4
4.1.3 Transport.....	B-4-4
4.1.4 Public Facilities.....	B-4-5
4.1.5 Division of Community.....	B-4-5
4.1.6 Historical Heritage/Cultural Properties.....	B-4-6
4.1.7 Water Rights/Access Rights.....	B-4-6
4.1.8 Public Health.....	B-4-6
4.1.9 Waste (from the Project).....	B-4-7
4.1.10 Accidents/Risks.....	B-4-7
4.2 Natural Environment.....	B-4-11
4.2.1 Topography and Geology.....	B-4-11
4.2.2 Soil Erosion.....	B-4-11
4.2.3 Groundwater.....	B-4-11
4.2.4 Hydrological Conditions.....	B-4-12
4.2.5 Coastal Zone.....	B-4-12
4.2.6 Flora and Fauna.....	B-4-12
4.2.7 Meteorology.....	B-4-14
4.2.8 Landscape/Aesthetics.....	B-4-14
4.3 Pollution.....	B-4-14
4.3.1 Air Pollution.....	B-4-14
4.3.2 Water Pollution.....	B-4-15
4.3.3 Soil Contamination.....	B-4-16
4.3.4 Noise and Vibration.....	B-4-16
4.3.5 Land Subsidence.....	B-4-16
4.3.6 Offensive Odor.....	B-4-16

5 Measures of Prevention and Mitigation of the Anticipated Impacts and Monitoring Program B-5-1

5.1 Countermeasures.....	B-5-3
5.1.1 Use of Tarpaulin over the Delivered Waste.....	B-5-3
5.1.2 Distance from Anticipated Impact Receptors.....	B-5-3
5.1.3 Control of Waste Access.....	B-5-3
5.1.4 Control of Vehicle Flow.....	B-5-4
5.1.5 Signboards.....	B-5-4
5.1.6 Daily Soil Cover.....	B-5-5
5.1.7 Impermeabilization.....	B-5-5
5.1.8 Treatment of Leachate.....	B-5-6
5.1.9 Landfill Gas Control.....	B-5-6
5.1.10 Protection of Fauna.....	B-5-6

5.1.11 Reforestation	B-5-7
5.1.12 Access Control	B-5-7
5.1.13 Safety Surveillance	B-5-7
5.2 Monitoring Programs	B-5-8
6 Conclusions	B-6-1

List of Tables

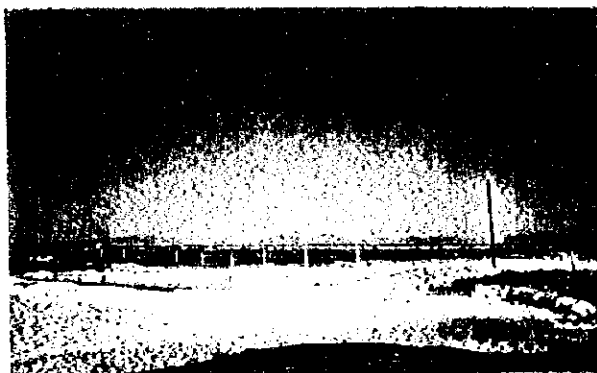
	Page :
Table 1-1: Outline of the M/P	B-1-1
Table 1-2: Compliance with NOM-083-ECOL-1996	B-1-7
Table 1-3: Outline of the Conceptual Design for A New Landfill Development	B-1-10
Table 1-4: Waste Disposal Amount in Etapa V	B-1-13
Table 1-5: Landfill Capacity of Etapa V	B-1-14
Table 2-1: Average Temperature	B-2-3
Table 2-2: Maximum Temperature	B-2-5
Table 2-3: Minimum Temperature (°C) (1994-1997)	B-2-7
Table 2-4: Total Precipitation (mm)	B-2-9
Table 2-5: Maximum Rainfall in 24 Hours	B-2-12
Table 2-6: Total Evaporation (mm)	B-2-13
Table 2-7: Monthly Frequencies of Elements and Special Phenomena (1)	B-2-14
Table 2-8: Monthly Frequencies of Elements and Special Phenomena (2)	B-2-14
Table 2-9: Dominant Directions and Average Velocity of Winds	B-2-15
Table 2-10: Daily Average Dominant Direction and Velocity of Winds in July and August	B-2-16
Table 2-11: Maximum Velocity and Direction of Winds	B-2-17
Table 2-12: Mantles and Refractors Determined at the Base Line	B-2-33
Table 2-13: Seismic Refraction Conducted by CFE in 1987	B-2-34
Table 2-14: Integration of Geophysical Study Conducted by CFE (1987) and LESSER y Asociados, S.A. (1988)	B-2-37
Table 2-15: Features of Geoelectrical Units	B-2-38
Table 2-16: Soil Characteristics	B-2-40
Table 2-17: Physical and Chemical Features of the Soil	B-2-40
Table 2-18: Soil Characteristics in Etapa V	B-2-42
Table 2-19: Results of Sampling Analysis of Surface Soil	B-2-44
Table 2-20: Results of Sampling Analysis of Surface Water	B-2-48
Table 2-21: Hydraulic Parameters by Rudolph	B-2-49
Table 2-22: Hydraulic Parameters by Zacuala and Arias	B-2-50
Table 2-23: Information on Wells from Lake Texcoco Commission	B-2-52
Table 2-24: Information on Wells from Mexico Valley Water Management Office	B-2-52
Table 2-25: Information on Wells from Water and Cleaning State Commission ..	B-2-53
Table 2-26: Ion Concentrations	B-2-55
Table 2-27: Water Analysis	B-2-55
Table 2-28: Results of Sampling Analysis of Groundwater	B-2-55
Table 2-29: Coverage for Respective Species Registered on Canfield Lines	B-2-58

Table 2-30: List of Flora in the Study Area.....	B-2-63
Table 2-31: Location of Vegetation Species in Different Areas of the Study	B-2-65
Table 2-32: List of Species of Terrestrial Vertebrates Registered.....	B-2-69
Table 2-33: List of Species of Terrestrial Vertebrates Based on the Field Work and Bibliographical Study	B-2-72
Table 2-34: Registered Species in the State of Mexico and in the Study Area ...	B-2-75
Table 2-35: Birds Listed in the Schedule.....	B-2-75
Table 2-36: Species of Interest Cynegetic Present in the Area.....	B-2-76
Table 2-37: Species Threatened and/or in Danger of Extinction.....	B-2-77
Table 2-38: Number of Species by Category.....	B-2-77
Table 2-39: Species Detected in the Project Site under the Categories Settled Down in NOM-059-ECOL-1994.....	B-2-78
Table 2-40: Population Forecast in the DF.....	B-2-81
Table 2-41: Population Density in the DF.....	B-2-82
Table 2-42: Transport System by Ownership Types.....	B-2-83
Table 2-43: The Number of Pupils Registered, Teachers, Number of Schools and Classrooms in the DF (1995-96).....	B-2-84
Table 2-44: National Parks in the Metropolitan Area of Mexico City	B-2-85
Table 2-45: Rate of GRP of the ZMVM to the GDP of the Country.....	B-2-86
Table 2-46: PEA by Sector	B-2-88
Table 2-47: Socioeconomic Indicators in Neighboring Municipalities (1995) ...	B-2-89
Table 2-48: Population in Nezahualcoyotl Municipality.....	B-2-89
Table 2-49: Population by Age Group and by Sex in Nezahualcoyotl Municipality.....	B-2-90
Table 2-50: Economically Active Population of and over 12 year-old in Nezahualcoyotl Municipality.....	B-2-90
Table 2-51: Birthrate and Mortality in Nezahualcoyotl and State of Mexico.....	B-2-91
Table 2-52: Age of Mothers and the Average Number of Children	B-2-91
Table 2-53: Level of Employment and Underemployment	B-2-92
Table 2-54: Distribution of Employed Population by Work Type and Sector.....	B-2-92
Table 2-55: Highways in Nezahualcoyotl Municipality	B-2-93
Table 2-56: Vehicles in Nezahualcoyotl Municipality	B-2-93
Table 2-57: Electric Power in Nezahualcoyotl Municipality.....	B-2-93
Table 2-58: Postal Services in Nezahualcoyotl Municipality	B-2-93
Table 2-59: Telephone Services in Nezahualcoyotl Municipality.....	B-2-93
Table 2-60: Comparison of Some Infrastructural Indicators with State of Mexico	B-2-93
Table 2-61: Health Services in Nezahualcoyotl.....	B-2-94
Table 2-62: Land Use Type.....	B-2-96
Table 2-63: Population in Ecatepec Municipality.....	B-2-101
Table 2-64: Population by Age Group and by Sex in Ecatepec Municipality ...	B-2-101
Table 2-65: Economically Active Population of and over 12 year-old in Ecatepec Municipality.....	B-2-102
Table 2-66: Age of Mothers and Average Number of Children.....	B-2-102
Table 2-67: Birthrate and Mortality in Ecatepec and State of Mexico	B-2-102
Table 2-68: Level of Employment and Underemployment	B-2-103
Table 2-69: Distribution of Employed Population by Work Type and Sector...	B-2-103
Table 2-70: Distribution of Employed Population by Sector	B-2-104
Table 2-71: Distribution of Employment in Factories.....	B-2-104

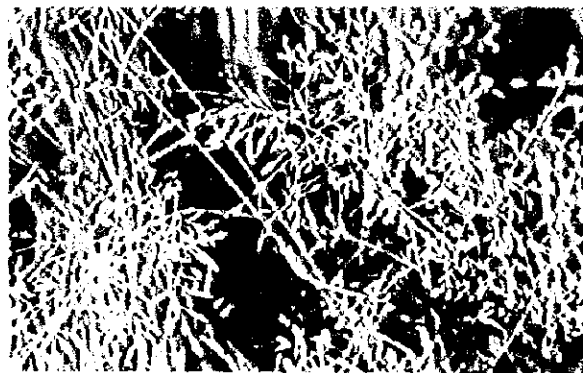
Table 2-72: Highways in Ecatepec Municipality.....	B-2-105
Table 2-73: Vehicles in Ecatepec Municipality.....	B-2-105
Table 2-74: Electric Power in Ecatepec Municipality.....	B-2-105
Table 2-75: Postal Services in Ecatepec Municipality.....	B-2-105
Table 2-76: Telephone Services in Ecatepec Municipality.....	B-2-105
Table 2-77: Comparison of Some Infrastructural Indicators with State of Mexico.....	B-2-105
Table 2-78: Health Services in Ecatepec and State of Mexico.....	B-2-106
Table 2-79: Sport Infrastructure in Ecatepec.....	B-2-107
Table 2-80: Land Use Type.....	B-2-107
Table 2-81: Types of Livestock.....	B-2-108
Table 4-1: Possible Impact by a SWM Project.....	B-4-2
Table 4-2: Subsoil Conditions.....	B-4-8
Table 4-3: Duration of Settlement.....	B-4-9
Table 5-1: Monitoring Program.....	B-5-8

List of Figures

	Page :
Figure 1-1: Location of Project.....	B-1-12
Figure 1-2: Height - Volume Curve (Etapa V).....	B-1-14
Figure 1-3: Landfill Layout of Etapa V.....	B-1-17
Figure 1-4: Plan of Waste Transport Control Facilities.....	B-1-18
Figure 1-5: Plan of First Lift (0m elevation).....	B-1-26
Figure 1-6: Plan of Second Lift (8m elevation).....	B-1-27
Figure 1-7: Plan of Third Lift (16m elevation).....	B-1-28
Figure 1-8: Plan of Finished Landfill.....	B-1-29
Figure 1-9: Cross Section of A-A'.....	B-1-30
Figure 1-10: Cross Section of Roads.....	B-1-31
Figure 2-1: Average Temperature (°C) (1994-1997).....	B-2-4
Figure 2-2: Maximum Temperature (°C) (1994-1997).....	B-2-6
Figure 2-3: Relative Humidity (1994-1997).....	B-2-8
Figure 2-4: Monthly Rainfall (1994-1997).....	B-2-10
Figure 2-5: Number of Event of Thermal Inversion.....	B-2-19
Figure 2-6: General View of Mexico Valley Basin.....	B-2-22
Figure 2-7: Location of Seismic Lines.....	B-2-31
Figure 2-8: Profiles of the Seismic Exploration Lines of Refraction.....	B-2-32
Figure 2-9: Electric Geophisics.....	B-2-35
Figure 2-10: Location of Vertical Electric Soundings.....	B-2-36
Figure 2-11: Location of Boring Points.....	B-2-43
Figure 2-12: Location of Rivers.....	B-2-46
Figure 2-13: Surface Water Sampling Points.....	B-2-48
Figure 2-14: Stratigraphic Section of Aquifer System of ex-Lake Texcoco.....	B-2-50
Figure 2-15: Location of the Wells.....	B-2-54
Figure 2-16: Location of Flora and Fauna Study.....	B-2-60
Figure 2-17: Composition of Flora by Stratum.....	B-2-65
Figure 4-1: Subsoil Settlement.....	B-4-9
Figure 5-1: Cause Effect Relations (Etapa V Landfill Project).....	B-5-2



Bordo Poniente Etapa V
Present View/Vista Actual



Gramínea
Sporobolus pyramidatus



Tamarix juniperina
Reforested area/Area Reforestada



Melilotus albus, Baccharis glutinosa,
Tamarix juniperina



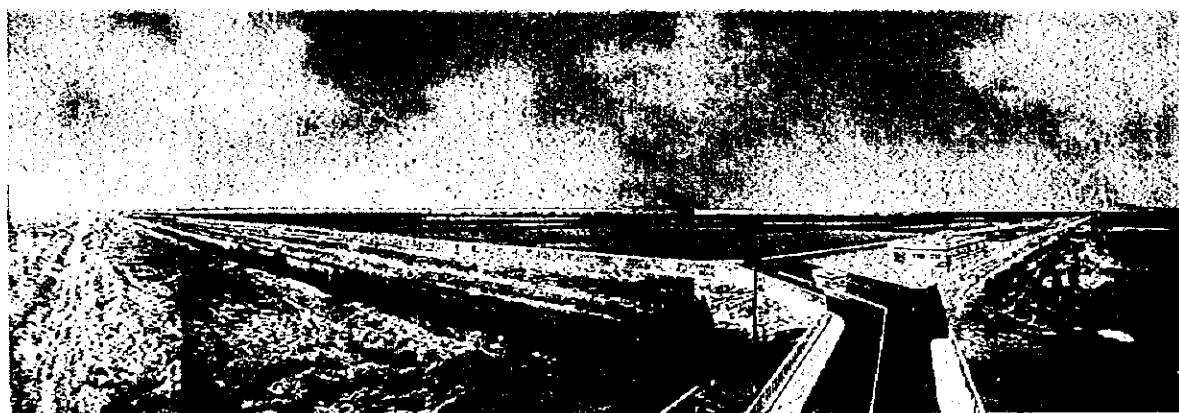
Garza/Heron
Egretta thula



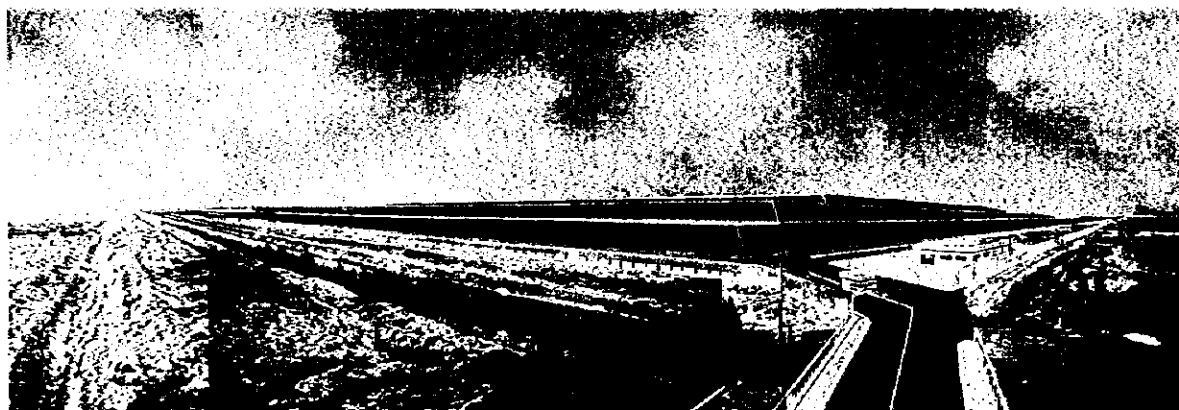
Pato/Duck
Anas clypeata



New Landfill (Etapa V) present landscape.



New landfill (Epata V) landscape expected in 2002.



New landfill (Etapa V) landscape after closure.

Part B

Chapter 1

Description of the Proposed Project

1 Description of the Proposed Project

In accordance with the effective legislative document published by the SEMARNAP, "the sanitary landfill is the engineering method recommended for the final disposal of the municipal solid wastes, which are deposited of in or on the land previously waterproofed, spread and compacted and covered with a tepetate layer to finish the operations of the day". The project proposed here is aiming to establish the sanitary landfill as such.

In the Federal District, more than 11,000 tons of waste are generated daily, and most of them are eventually disposed of in effect at only one place dedicated to the confinement of municipal wastes. That is the Bordo Poniente Etapa IV sanitary landfill located in the Federal Area of the ex-Lake of Texcoco.

The necessity to develop a new landfill, denominated as Bordo Poniente Etapa V, is derived from a fact that the current disposal site of Bordo Poniente Etapa IV will only work until the beginning of the year of 2001. Although it is proposed to vertically expand the Etapa IV to prolong its service life about 5 years more, this plan is not sufficient to sustain the SWM service, which can never cease. Further, due to the compressible land character of Bordo Poniente, the alternate use of two landfills is highly preferable for sound waste landfilling.

The landfill at Etapa V will employ a sanitary landfill method with best available and practical engineering to securely confine municipal solid waste.

1.1 Background

The project of Etapa V is to be implemented within the scope of the M/P targeting the year of 2010. Since the waste disposal is merely one component of the whole SWM system, its requisites and conditions are directly subject to the M/P. Consequently, the outline of the M/P is presented in Table 1-1.

Table 1-1: Outline of the M/P

		Data of 1997	Phase 1 (1999 - 2001)	Phase 2 (2002 - 2004)	Phase 3 (2005 - 2010)
Population		8,610,000	8,651,000-8,747,000	8,796,000-8,896,000	8,946,000-9,206,000
Waste generation amount (ton/year)					
Household		1,926,000	1,946,000-1,965,000	1,976,000-1,998,000	2,009,000-2,072,000
Commercial		1,210,000	1,217,000-1,223,000	1,229,000-1,236,000	1,244,000-1,267,000
Service		636,000	642,000-649,000	652,000-657,000	659,000-669,000
Special		130,000	131,000-134,000	134,000-136,000	136,000-140,000
Others		267,000	268,000-270,000	271,000-275,000	276,000-282,000
Total		4,169,000	4,204,000-4,241,000	4,262,000-4,302,000	4,324,000-4,430,000
Discharge/Storage					
	Sub System	-	Introduction of source separation	Introduction of source separation	Maintaining source separation
	Delegation	Mixed	Mixed	Introduction of source separation	Introduction of source separation
Collection					
Amount (ton/year)	Sub System	-	853,000-858,000	861,000-867,000	870,000-881,000
	Delegation	4,169,000	3,293,000-3,325,000	3,342,000-3,376,000	3,395,000-3,485,000
Method	Sub System	-	Introduction of separate collection	Introduction of separate collection	Maintaining separate collection

		Data of 1997	Phase 1 (1999 - 2001)	Phase 2 (2002 - 2004)	Phase 3 (2005 - 2010)
Delegation		Mixed	Mixed	Introduction of separate collection	Introduction of separate collection
Transfer Station and Transport					
Transfer Station and Transport			<ul style="list-style-type: none"> Installation of weighbridges for every station. Utilization of a single common format for data compilation 	<ul style="list-style-type: none"> Utilization of the transport monitoring and control system (for 5 flows¹) based on the accurate incoming/outgoing weight measuring Efficient transport allocation by the monitoring and control system 	
Transfer amount (ton/year)		3,123,000	3,725,000-3,757,000	3,776,000-3,812,000	3,830,000-3,922,000
O&M cost(US/year)		43,547,000	51,941,000- 52,387,000	52,652,000- 53,154,000	53,405,000-54,688,000
Intermediate Treatment					
Selection plant			<ul style="list-style-type: none"> Experiment of operation modification to incorporate an objective of quantity oriented picking. Experiment of "storage system" for recovered materials to cope with market prices fluctuation. 	<ul style="list-style-type: none"> Implementation of operation control with 2 objectives of: <ul style="list-style-type: none"> - revenue oriented picking; - quantitative picking, Establishment of "storage system" for recovered materials to cope with market prices fluctuation, in view of experiment results. 	<ul style="list-style-type: none"> Implementation of operation control with the major objective of "quantity oriented picking". Utilization of the optimum "storage system" for recovered materials to cope with market prices fluctuation.
Input amount (ton/year)	Mixed	1,794,000	1,650,000-1,546,000	1,288,000- 725,000	567,000 - 0
	Recyclable	-	0 - 98,000	210,000-438,000	504,000-844,000
Recycle amount(t/y)		182,000	166,000-224,000	277,000-380,000	409,000-591,000
Recovery rate (%)		10.0	10.0-13.6	18.5-32.7	38.2-70.0
O&M cost (US\$ 1,000)		11,232	10,565 - 10,537	9,857 - 8,296	7,867 - 6,809
Composting plant		-	Design and construction	Starting operation	Operation and maintenance
Input amount (ton/year)		-	-	253,000 - 424,000	425,000 - 431,000
Compost production amount (ton/year)		-	-	34,000 - 57,000	57,000 - 58,000
Investment (US\$)		-	3,959,000	1,345,000	1,334,000
O&M cost(US\$/year)		-	0 - 33,000	1,185,000 - 1,343,000	1,343,000 - 1,343,000
Final Disposal					
Final Disposal Site		BP "Etapa IV" Santa Catarina	BP "Etapa IV" vertical expansion Design & construction of BP "Etapa V"	Operation of BP "Etapa V"	Operation of BP "Etapa IV" & "Etapa V"
Disposal amount (ton/year)	GDF	3,489,000	3,619,000 - 3,592,000	3,325,000 - 3,101,000	3,089,000 - 2,994,000
	Edo. Mexico	262,000	284,000	284,000	284,000
	Total	3,751,000	3,903,000-3,876,000	3,609,000-3,385,000	3,373,000-3,278,000
Investment (US\$)		-	12,708,000	-	-
O&M cost (US\$/year)	Bordo Poniente	9,925,694	8,570,000 (2001)	9,400,000 (2003)	4,072,000 (2005)
	Santa Catarina	?	-	-	-
Others					
Street sweeping	Length (km/day)	1,273.4	1,285-1,296	1,303-1,316	1,323-1,357
	O&M cost (US\$/y)	3,293,000	3,323,000-3,352,000	3,369,000-3,403,000	3,421,000-3,509,000

¹ 5 flows refer to current waste flows (from the transfer stations to the S/Ps, from the transfer stations to the final disposal sites, and from the S/Ps to the final disposal site) and additional flows from the transfer stations to the NIT and the NIT to the final disposal site.

In regard to the final disposal, the following points have to be reminded.

- Separated collection is to be implemented for the waste generated within the Sub-system so that effective waste recycling and production of compost from the organic waste are promoted.
- Consequently, the disposal amount at the landfill is expected to be reduced.
- Landfill at Etapa V (proposed in this report) and that at Etapa IV, which is to be vertically expanded, are to be used alternately for every two or three years, so that the soil is allowed to be compacted and stable.

1.2 Objectives of the Project

The prime objective of the project is to dispose of waste, which requires great effort to reduce and which never goes out of the sight, in the most appropriate method which can be realized by the GDF within their competence in terms of engineering, finance and management without causing any unacceptable environmental impacts.

It should be emphasized that this project is one of the essential components of the Master Plan (M/P) of the solid waste management (SWM) in the DF which was prepared by the JICA team for the DGSU. The objectives of the M/P, which consequently the landfill project is supposed to aim at, are as follows.

- The improvement of public health and the reduction of health hazards in and around the city, in order to promote the well-being of citizens.
- The implementation of the sustainable and cost-effective SWM services required as the duty and mandate of the GDF through technical, institutional, legislative improvement and appropriate administration.
- The achievement of the environmental conservation through SWM by encouraging the public acknowledgment on the waste matter, promoting "reduction", "recycling" and "recovery" of waste and, with particular importance for the present project, operating disposal facilities which do not degrade the environment.

In order to achieve those objectives, the contribution by the landfill project is expected to be the following.

- Continuation of the reception of wastes generated in the DF, as well as of some municipalities of the State of Mexico, until the year 2012.
- Improvement of the final disposal method employed by the DGSU to avoid any unacceptable impact to the environment by the operation of the sanitary landfill.
- Accomplishment by the GDF, as the responsibility of the governmental body as established by the National Program of Urban Development 1995-2000, to provide infrastructure necessary for the sound urbanization.

1.3 Justification of the project

In Mexico City, more than 11,000 tons of wastes are daily generated (or 4.169 million tones per year in 1997), which have to be collected, stored, transported, and disposed

of in the most appropriate way in order to avoid possible negative impacts on the social and natural environment.

As well known, solid wastes are the result of the human activities. Its generation is largely influenced by the socioeconomic level, the consumption habits and the season of the year. The JICA team estimates the waste generation amount in the DF to be 4.430 million tons in the year 2010. Therefore, for the period from 1997 to 2010, the annual waste generation rate is on average worked out to be about 0.5%. To manage such large volume of wastes represents a great challenge for the GDF.

1.3.1 Legal Justification

Starting with the effective legal framework, the Public Administration of the DF is responsible for the service of urban sanitation, in which the final disposal of the solid wastes is included. In regards to environmental protection, the General Law of the Ecological Balance and Protection of the Environment (LGEEPA) specifies in the Art. 9 that preservation of the ecological balance and protection to the environment are to be looked after by the GDF, pursuant to the legal provisions issued by the Legislative Assembly of the DF and the powers referred to in articles 7 and 8 of this Law.

Art. 7 fraction VI stipulates that the DF has the following authority: "regulation of the systems of collection, transport, storage, handling, treatment and final disposal of the solid wastes and non-hazardous industrial waste in conformity with that prepared for the article 137 of the present law".

Article 8 stipulates that the GDF will have the following authority: "application of the relative juridical dispositions for the prevention and control of the effects on the environment caused by the generation, transport, storage, handling, treatment and final disposal of the solid wastes and non-hazardous industrial waste in conformity with article 137 of the LGEEPA.

Also, article 137 states that the operation of the systems of collection, storage, transport, lodging, reuse, treatment and final disposal of the municipal solid wastes is subject to the authorization of the municipalities or the DF, according to their applicable local laws the Mexican official norms.

In the Environmental Law of the DF published in the Federal Official Newspaper of 9 July of 1996, regarding the handling of municipal solid wastes and the benefit of services, the following is settled down:

Art. 15 for the Secretary of the environment of the DF concerning:

- XIV. In coordination with the DGSU, to prevent and to control the contamination of the soil, as well as the contamination originated from the generation and handling of wastes in the area not reserved to the Federation.
- XV. In coordination with the DGSU, to settle down or to authorize the establishment of the places dedicated to the management of waste which is out of the control of the Federation, as well as to propose the promotion of the arrangements that regulate their handling, observing the official norms.

- XXIII In coordination with the other competent authorities, to observe and to fulfill the official norms in the benefit of the public services, including those related with the supply of water, drainage and sewer system, treatment and reuse of residual waters, conservation of pluvial waters, cleansing, markets and central market, vaults, slaughterhouses and local transports.
- XXVIII. To regulate, to prevent and to control environmentally risky activities outside of the mandate or the Federation.
- XXX. To participate with the Federation in the analysis, approval and application of the programs of prevention and control of derived accidents of the realization of highly risky activities for the environment in the DF.
- XXXI. To participate, in the environment of their attributions, in the regulation and application of the urgent measures that are required to safeguard the integrity of the environment, in the event of accidents, escapes or spills of materials or wastes.

Art. 16 The DF will participate in the terms settled down by the Political Constitution of the Mexican United States and the Statute of GDF, in the planning and execution of actions coordinated with the Federation, States and Municipalities in the areas of co-urbanized with Mexico City, in matters of protection of the environment, and preservation and restoration of the ecological balance. For these purposes, they will subscribe agreements for the creation of the corresponding Commission where they will attend and participate according to their own laws.

Art. 18. Through this Commission, the following will be established:

- I. The bases for the celebration of agreements, in the headquarters of the Commission, according to what was agreed about the territorial environments and functions regarding the execution and operation of works, benefit of services or realization of actions in the matters indicated in Art. 16.

Art. 57. Those who cause contamination or deterioration are forced to restore the soil, underground, aquifer and the other affected natural resources in accordance with the present Law and the official norms.

Art. 93. Regarding the wastes and in the terms of the official norms, people are forced:

- I. To prevent waste generation;
- II. To minimize the generation of wastes that cannot be prevented;
- III. To recycle or to reuse wastes that are generated;
- IV. To treat them prior to their disposal final, when they cannot be recycled or to be reused, in order to eliminate or to minimize their danger and volume, and
- V. To dispose of the treated wastes finally.

Art. 94. It is assumed, unless otherwise verified, that the owners or possessors of wastes are responsible for their damages and injuries, according to the case. Those who manage residuals are considered as possessors during the time when they have

the waste under their custody or responsibility. The responsibility of the non dangerous waste will correspond to the Public Administration the DF once they are collected by its cleansing service.

The Ordinance by means of which the Internal Code for the Public Administration of the DF was reformed, and issued in the Official Gazette of the Federation on December 1st, states in its Art. 33 that the attributions are pointed out for the DGSU as regards to the municipal waste management as follows.

- In coordination with the competent authorities, to settle down approaches and technical norms for the activities of minimization, collection, transfer, treatment and final disposal of solid waste, to restore contaminated places, as well as to establish the systems of recycling and treatment of waste.
- To carry out the studies, projects and the construction, conservation and maintenance of infrastructure works for SWM, transfer stations, selection plants and utilization, as well as final disposal sites;
- To organize and to carry out the treatment and final disposal of solid waste, as well as the operation of the transfer stations;
- To receive the new works that require urban services and executed by other DF agencies, administrative units and decentralized bodies.

In realizing this project, the entity responsible for SWM, i.e. DGSU, will fulfill their responsibility which is established in the Political Constitution of the Mexican United States, the LGEEPA, as well as the Environmental Law of the DF.

1.3.2 Social Justification

Secondly, it is possible to point out the justification of the project from the view point of social needs, since the projected work seeks to give countermeasure to a demand generated by the necessity to grant a public service appropriate to the inhabitants of the DF and of some co-urbanized municipalities of the State of Mexico.

It has already been mentioned that at present more than 11,000 tons of wastes have been generated everyday in the DF, and that nearly 10,000 tons are deposited in Bordo Poniente Etapa IV. These municipal solid wastes include the domestic waste, those from trade, public spaces, and markets and some special wastes (such as disinfected medical waste). The population enjoying benefits from the operation of this work will be enormous, considering the population in the DF (8.5 million) and population inflow into the DF from outside during the day time.

In this connection, this figure at the beginning of operations in the landfill shows the satisfaction of the demand of the service required by the population. However, the quantity of waste that is necessary to be disposed of will increase in the same manner as the population growth, unless satisfactory efforts are made.

The sanitary landfills have been used as a system of waste final disposal in the DF for already approximately seventeen years and the present project at Etapa V will allow to apply the experience of the previous landfill sites (Etapa I to IV) of Bordo Poniente.

At present, two places of final disposal sites receive the solid wastes generated in the DF. One of them is the sanitary landfill Etapa IV, with a one year old useful life left, and the second is that of Santa Catarina, which arrives at the end of its useful life and is closed shortly, although precisely speaking, no waste is disposed of in the latter for the recent time.

Accordingly, although the M/P also proposes the vertical expansion of Etapa IV to increase its capacity, there is a strong need for sustainable SWM in the DF's society to obtain another new landfill site.

1.4 Site Selection

The development of a final disposal site is land-intensive work because of its scale and possible risk associated with its operation, and could impose severe "hardship" on the recipient environment, either natural or socioeconomic. Although technical countermeasures are available for certain problems and uncertainties, they could be unacceptably costly for the society and can not be perfect. Considering that an environmental effect is a result of the interaction of the causal activities and the recipient's characters, it is worth considering first the latter, or in other words, to what extent the recipient environment is susceptible or resistant to impacts presumably caused by the proposed project. It should be emphasized here that the term, environment, refers to natural, social, and economic environment. It also should be reminded that the mitigation of negative effects always must be pursued, the ultimate mitigation measure is the avoidance of the effects, and rational site selection is one of the most practical and effective tools toward avoidance.

For this reason, the NOM-083-ECOL-1996 was issued which establishes the conditions that should be satisfied by the sites to be dedicated to the final disposal of the municipal solid wastes. Therefore, the analysis of the proposed site of Etapa V in regard to the compliance with this norm is attempted as shown in the following table.

Table 1-2: Compliance with NOM-083-ECOL-1996

Issues stated in the norm	Site conditions	Necessity of counter-measures	Consideration/ countermeasures
General aspects			
The minimum distance of 3,000m should be secured from an airport where turbine engine airplanes are operated.	The distance to the nearest airport is about 10km.	No need.	Countermeasures are unnecessary.
The minimum distance of 1,500m should be secured from an airport where reciprocating engine airplanes are operated.	The distance to the nearest airport is about 10km.	No need.	Countermeasures are unnecessary.
The right of way of highways, railroads, main and secondary roads must be respected.	Autopista to Texcoco runs about 1.0km south of the site. It will be used for waste transportation.	Necessary.	U-turn part is to be widened to avoid adverse influence on traffic on the autopista, when waste transportation trucks come into and go out of the access road.

Issues stated in the norm	Site conditions	Necessity of counter-measures	Consideration/ counter-measures
Sites should not be located in natural protected areas.	The site is not in a natural protected area.	No need.	Countermeasures are unnecessary.
The right of way of federal public works should be respected, such as oil and gas pipelines, electric power pylons, water pipes, etc.	An gas pipe line is laid in the ground at the south-west of the site. However, it is out of the site.	No need.	There is a sufficient distance from the pipeline.
The minimum distance of 1,500m should be secured from an edge of a residential area.	The nearest residential area is 2.2km away from the west border of the site.	No need.	Countermeasures are unnecessary.
Hydrological aspects			
The site must be outside of a flood plain with return periods of 100 years.	The site is not located in such a flood plain.	No need.	Countermeasures are unnecessary.
The municipal solid waste final disposal site will not be located at swamps, salty marshes and similar places.	The groundwater level is about 0.7m from the surface, and the water has salinity. But the site is not swamp/marsh.	No need.	Countermeasures are unnecessary.
The minimum distance of 1,000m should be secured from surface water bodies which have capacities for the 10 year return period rainfall.	The site is next to 'Dren Texcoco Norte' which is a sewer of municipal waste water. So this is not surface water body.	No need.	Countermeasures are unnecessary.
Geological aspects			
The site must be located at a minimum distance of 60 meters away form active faults.	No fault is observed in the site and with in 60 from the site.	No need.	Countermeasures are unnecessary.
The site must be located outside of areas with unstable banks where soil movements may happen.	The site's subsoil is highly compressible clay as Etapa IV.	Necessary.	Landfill slope is to be inclined properly to avoid failure.
The zones, where serious settlements may happen, which lead to land fractures and increase risk of water-bearing strata pollution, must be avoided.		Necessary.	Impermeable liner is to be installed to avoid water-bearing strata pollution.
Hydrogeological aspects			
Infiltration rate to a water-bearing stratum must be less than $3 \times 10^{-10} \text{ sec}^{-1}$.	The groundwater level is about 0.7m under the surface, but the water can not be used for potable water due to its high salinity.	Necessary.	Landfill bottom (impermeable) liner will be installed to avoid seepage of leachate to the surroundings.
The minimum distance, from the site to water extraction wells for domestic, industrial, irrigation and livestock	There are about 30 wells which were used for salt making in the site.	Necessary.	Well casings are needed to be removed, then sealed properly.

Issues stated in the norm	Site conditions	Necessity of counter-measures	Consideration/ countermeasures
farming use that are still operating or abandoned, must be 500m.			

As a conclusion, the project generally complies with the norm except a few items, for which practical countermeasures are taken to prevent anticipated unfavorable consequences.

1.5 Preliminary Studies of Field

The field studies developed for the elaboration of the present environmental impact assessment, consists the following. Through these studies, it was possible to obtain the necessary elements for the development of Chapter 3, which describes the natural and socioeconomic environment.

1.5.1 Bibliographical Studies

Particularly due to its unique foundation history and the environment, the area of the ex-Lake Texcoco has been extensively studied in terms of geography, hydrogeography, ecology and other wide range of scientific view. Therefore, available bibliography was utilized as many as possible.

1.5.2 Visit to the Area in and near to the Site

In order to obtain updated, and/or site specific information, the following research activities were carried out to make up for bibliography.

- Visits and interviews to the population that inhabits the municipalities of Ecatepec and Nezahualcoyotl, adjacent colonies to the federal area of the ex-Lake Texcoco in order to determine socioeconomic aspects and the population's possible reception of impacts by the operation of the sanitary landfill.
- The study of the flora and fauna present in the site and its influence area, to determine the possible impacts by the operation of the sanitary landfill
- Analysis of underground and superficial water, to know the current state of the quality of the water before the development of the sanitary landfill.
- Analysis of soils, to determine the quality of the same ones, before the construction and operation of the sanitary landfill.

1.6 Current Land Use

The site is located in the ex-Lake Texcoco area administered by the CNA to the east of Mexico City.

The land has approximately 250 hectares that are adjacent to the south with the highway Mexico-Texcoco; the north, west and east limits are surrounded with lands without specific use of the project ex-Lake Texcoco. There are already gravel-paved road on the four limits, and canals run along these limits. The canal along the south

limit, called Dren Texcoco Norte, is the largest, and only the canal along the west limit is inside the adjacent road.

Regarding the conditions of the land, as briefly mentioned before, it is a plain of lacustrian soil with scarce vegetation except the pasture grass. The high groundwater level about 0.50 to 1.5m is one of the outstanding characteristics of the site.

The project site and also its adjacent area are under the similar conditions, without any specific use of the Project Lake Texcoco belonging to the CNA.

1.7 Description of the Work

1.7.1 Project Outline

Outline of the conceptual design for A New Landfill Development is presented in Table 1-3.

Table 1-3: Outline of the Conceptual Design for A New Landfill Development

Items	Facilities
Area	Site area: 256ha Filling area: 194 ha
Landfill capacity	29,032,000m ³ (23,226,000ton) is available for waste disposal.
Access	Access road: 605m Ring road: 5,950m at 0m elevation outer road: 5,950m inner road: 19,155m at 8m elevation outer road: 4,878m inner road: 11,743m at 16m elevation outer road: 3,854m inner road: 3,991m
Waste transport control facilities	gate: 1 (existing) weighbridge: 2 tire washing pit: 1 site office: 1 garage: 1 car park: 1 parking area for heavy equipment and/or storage yard: 1
Leachate management	Leachate extraction wells concrete pipes with 600mm diameter: 15 nos. Leachate extraction pumps: 15 nos. Leachate collection lines at 0m elevation: 25,105m at 8m elevation: 16,621m at 16m elevation: 7,845m
Landfill gas management	Gas extraction wells concrete pipes with 600mm diameter: 116nos. Gas extraction pipes - PVC200 at 0m elevation: 118 nos. at 8m elevation: 91 nos. at 16m elevation: 55 nos.
Surface water management	Daily/intermediate soil cover: 30cm (Compost is also usable.)

Monitoring	<p>Monitoring items:</p> <ul style="list-style-type: none"> -settlement of the landfill -leachate quality -landfill gas quality -groundwater -surface water <p>Monitoring facilities</p> <ul style="list-style-type: none"> -monitoring wells: 4 nos.
Aesthetic design	<p>Mobile screen</p> <p>Daily/intermediate soil cover: 30cm (Compost is also usable.)</p>
Closure and post-closure	<p>Final soil cover: 60cm</p> <p>Greening by seeding the final cover with grass</p>
Landfill equipment	<p>Bulldozers (300hp class): 4 nos.</p> <p>Sprinkler trucks (15,000liter class): 2 nos.</p> <p>Excavators (85hp class): 2 nos.</p>

1.7.2 Location and Land Area

The site for Etapa V is located in the ex-Texcoco lake as well as Etapa IV, the latter being about 6km south-west of the former. The site has an area of 256 ha and its coordinates are 19°29'N (latitude 19 degrees 29 minutes north) and 98°58'W (longitude 98 degrees 58 minutes west). The nearest residential area is located at 2.2km away from the west border of the site. The Mexico City International Airport is situated about 9.5 km south-west of the site. The location is shown in Figure I-1.

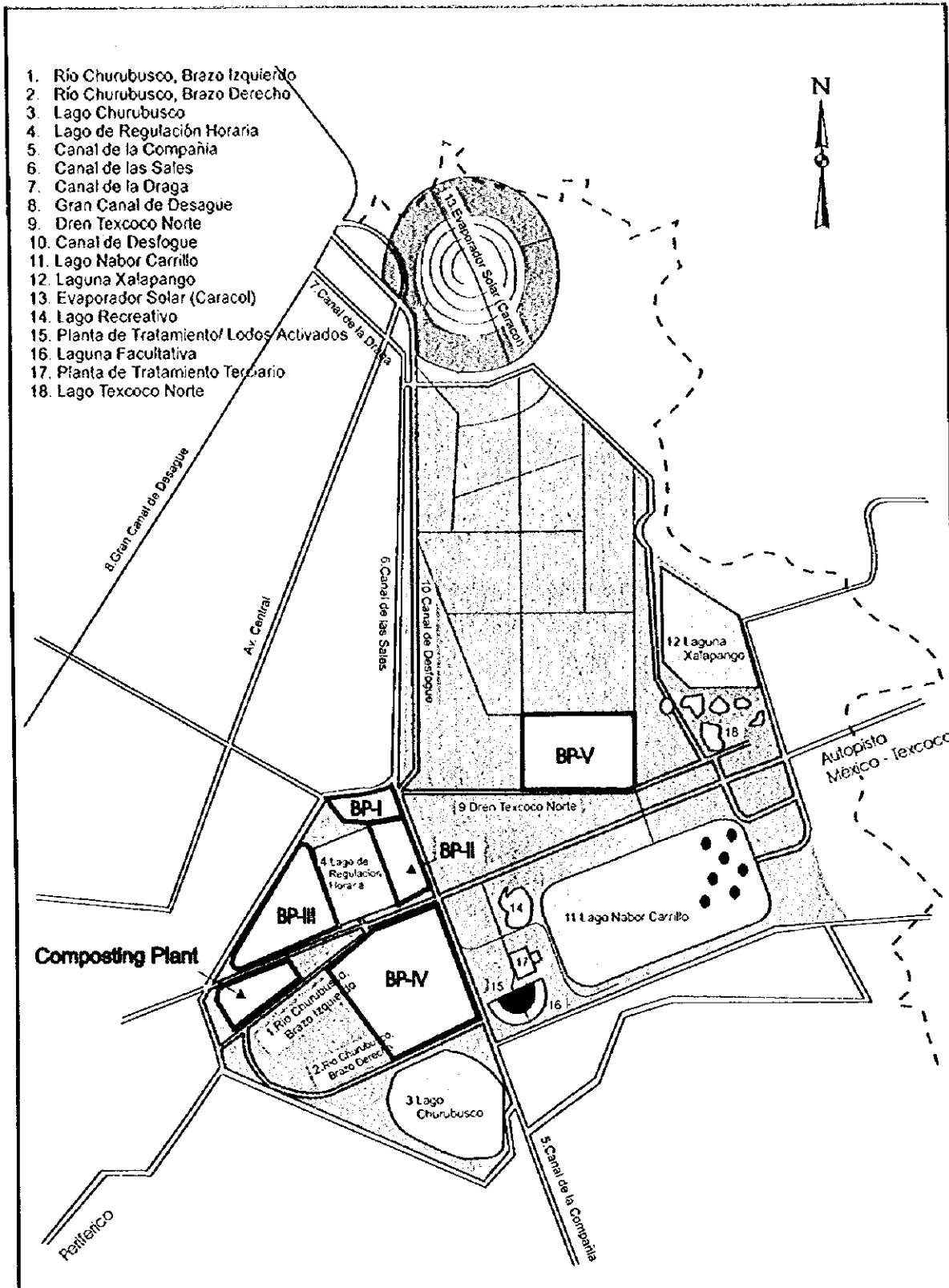


Figure 1-1:
Location of Priority Projects

KOKUSAI KOGYO Co., Ltd.