

6.11 Checklist

The results of Environmental Impact Assessment are integrated and re-examined each road section by the Environmental Checklist as shown in Table 6-28 (1), (2) and (3). And then, over-all environmental evaluation by Environmental Checklist is shown in Table 6-29.

As a result of the examination using the Environmental Checklist, the minor influences of air quality, water quality, noise and vibration, land, soil, water, flora, social conditions (including wastes, relocation and safety) are evaluated. These results are mostly same as the results of Environmental Impact Assessment.

Table 6-28 Environmental Checklist

(1) Road Section - 1 between Managua and Masaya

Environmental items	: Condition *1 :	Problems
	: P *2 : E *3 :	and notes
I. Living environment		
1) Air quality	: 3 : 2 :	
- Heavy machine		- dust from bare ground by cutting and embankment
- Transportation		- no existing
- Dust		- emmission gas from automobiles
- Quarry		
- Traffic		
2) Water quality	: 2-3 : 2-3 :	
- Cutting		- SS from bare ground by cutting and embankment
- Embankment		- treatment of SS
- Discharge of water pumped		
- Quarry		- not existing
- Waste		
- Drainage		- drainage, innundation
3) Soil contamination	: 3 : 3 :	
- Waste		
4) Noise and vibration	: 2-3 : 2 :	
- Heavy machine		- traffic increase
- Transportation		- construction by heavy machine
- Traffic		
5) Land subsidence	: 3 : 3 :	
- Excavation		
- Pumping		
6) Odor	: 3 : 3 :	
- Waste		
- Asphalt plant		- not existing
II. Natural environment		
7) Land	: 2-3 : 2-3 :	
- Cutting		- slope failures
- Embanking		- falling stones
- Quarry		- waste soils
- Waste dump area		
- Soil dump area		
8) Soil	: 2-3 : 2-3 :	
- Soil erosion		- gutter, ditch
- Soil dump area		- drainage
- Drainage		- resedimentation
9) Water	: 2-3 : 2-3 :	
- Cutting		- drainage
- Embankment		
- Water course		water course

(Continued..)

Environmental items	: Condition	*1 :	Problems
	: P *2	: E *3	and notes
- Drainage			
10) Underground water	: 3	: 3	:- water well
- Cutting			
- Pumping			
- waste			
11) Meteorology	: 3	: 3	:
12) Sea and seashore	: 3	: 3	:- not existing
- Filling			
- Water course			
- Drainage			
13) Flora and fauna	: 3	: 2-3	:
- Cleaning			- cutting
- Cutting			- domestic animals
- Embankment			
- Parking area			
- Greening			
14) Landscape	: 3	: 2-3	:- planting
- Cutting			
- Embankment			
- Greening			
III. Social environment			
15) Waste	: 3	: 2-3	:- bus stop area
- Waste			- waste soils
- Worker's facilities			
16) Historical and cultural monuments	: 3	: 3	:- access road
17) Traffic	: 3	: 2	:- traffic safety
18) Sanitary	: 3	: 3	:
19) Hazards	: 2-3	: 2-3	:- innundation
- Flood			- water course
- Earthquake			
20) Relocation	: 3	: 2-3	:
21) Socio-economic condition	: 3	: 3	:
22) Cutting district	: 3	: 3	:
23) Safety	: 2	: 2	:- side walk in urban area
- Sidewalk			
- Domestic animals			- traffic increase
24) Community	: 3	: 3	:
25) Recreation facilities	: 3	: 3	:
26) Water right and right of common	: 3	: 3	:

- * 1 : 1 : Major influence
2 : Minor influence
3 : Very small or non influence
* 2 : Present environmental condition
* 3 : Environmental evaluation (Examination)

- (2) Road Section - 2 between Managua and Tipitapa and
 - 3 between Nandaime and San Benito

Environmental items	: Condition *1 :	Problems
	: P *2 : E *3 :	and notes
I. Living environment		
1) Air quality	: 3 : 3 :	
- Heavy machine		- dust from bare ground by cutting and embankment
- Transportation		- no existing
- Dust		- emmission gas from automobiles
- Quarry		
- Traffic		
2) Water quality	: 3 : 2-3 :-	SS from bare ground by cutting and embankment
- Cutting		- treatment of SS
- Embankment		
- Discharge of water pumped		- not existing
- Quarry		
- Waste		- drainage, innundation
- Drainage		
3) Soil contamination	: 3 : 3 :	
- Waste		
4) Noise and vibration	: 3 : 3 :-	traffic increase
- Heavy machine		- construction by heavy machine
- Transportation		
- Traffic		
5) Land subsidence	: 3 : 3 :	
- Excavation		
- Pumping		
6) Odor	: 3 : 3 :	
- Waste		
- Asphalt plant		- not existing
II. Natural environment		
7) Land	: 2-3 : 2-3 :	
- Cutting		- slope failures
- Embanking		- falling stones
- Quarry		- waste soils
- Waste dump area		
- Soil dump area		
8) Soil	: 2-3 : 2-3 :	
- Soil erosion		- gutter, ditch
- Soil dump area		- drainage
- Drainage		- resedimentation
9) Water	: 2-3 : 2-3 :-	drainage
- Cutting		
- Embankment		water course
- Water course		

(Continued..)

Environmental items	: Condition *1 :			Problems
	: P *2	: E *3	:	and notes
- Drainage				
10) Underground water	: 3	: 3	:	:- water well
- Cutting				
- Pumping				
- waste				
11) Meteorology	: 3	: 3	:	
12) Sea and seashore	: 3	: 3	:	:- not existing
- Filling				
- Water course				
- Drainage				
13) Flora and fauna	: 3	: 3	:	
- Cleaning				- cutting
- Cutting				- domestic animals
- Embankment				
- Parking area				
- Greening				
14) Landscape	: 3	: 3	:	:- planting
- Cutting				
- Embankment				
- Greening				
III. Social environment				
15) Waste	: 3	: 2-3	:	:- bus stop area
- Waste				- waste soils
- Worker's facilities				
16) Historical and cultural monuments	: 3	: 3	:	:- access road
17) Traffic	: 3	: 3	:	:- traffic safety
18) Sanitary	: 3	: 3	:	
19) Hazards	: 2-3	: 2-3	:	
- Flood				- water course
- Earthquake				
20) Relocation	: 3	: 3	:	
21) Socio-economic condition	: 3	: 3	:	
22) Cutting district	: 3	: 3	:	
23) Safety	: 2-3	: 2-3	:	:- side walk in urban area
- Sidewalk				- traffic increase
- Domestic animals				
24) Community	: 3	: 3	:	
25) Recreation facilities	: 3	: 3	:	
26) Water right and right of common	: 3	: 3	:	

- * 1 : 1 : Major influence
 2 : Minor influence
 3 : Very small or non influence
 * 2 : Present environmental condition
 * 3 : Environmental evaluation (Examination)

(3) Road Section - 4 between Tellica and San Isidro

Environmental items	: Condition *1 :	Problems
	: P *2 : E *3 :	and notes
I. Living environment		
1) Air quality	: 3 : 3 :	
- Heavy machine		- dust from bare ground by cutting and embankment
- Transportation		- no existing
- Dust		- emmition gas from automobiles
- Quarry		
- Traffic		
2) Water quality	: 2-3 : 2-3 :-	SS from bare ground by cutting and embankment
- Cutting		- treatment of SS
- Embankment		
- Discharge of water pumped		- not existing
- Quarry		
- Waste		
- Drainage		- drainage, innundation
3) Soil contamination	: 3 : 3 :	
- Waste		
4) Noise and vibration	: 3 : 3 :-	traffic increase
- Heavy machine		- construction by heavy machine
- Transportation		
- Traffic		
5) Land subsidence	: 3 : 3 :	
- Excavation		
- Pumping		
6) Odor	: 3 : 3 :	
- Waste		
- Asphalt plant		- not existing
II. Natural environment		
7) Land	: 2 : 2 :	
- Cutting		- slope failures
- Embanking		- falling stones
- Quarry		- waste soils
- Waste dump area		
- Soil dump area		
8) Soil	: 2-3 : 2-3 :	
- Soil erosion		- gutter, ditch
- Soil dump area		- drainage
- Drainage		- resedimentation
9) Water	: 2-3 : 2-3 :-	drainage
- Cutting		
- Embankment		water course
- Water course		

(Continued..)

Environmental items	: Condition	*1 :	Problems
	: P *2	: E *3 :	and notes
- Drainage			
10) Underground water	: 3	: 3	:- water well
- Cutting			
- Pumping			
- waste			
11) Meteorology	: 3	: 3	:
12) Sea and seashore	: 3	: 3	:- not existing
- Filling			
- Water course			
- Drainage			
13) Flora and fauna	: 3	: 2-3	:
- Cleaning			- cutting
- Cutting			- domestic animals
- Embankment			
- Parking area			
- Greening			
14) Landscape	: 3	: 2-3	:- planting
- Cutting			
- Embankment			
- Greening			
III. Social environment			
15) Waste	: 3	: 2-3	:- bus stop area
- Waste			- waste soils
- Worker's facilities			
16) Historical and cultural monuments	: 3	: 3	:- access road
17) Traffic	: 3	: 3	:- traffic safety
18) Sanitary	: 3	: 3	:
19) Hazards	: 2-3	: 2-3	:
- Flood			- water course
- Earthquake			- innundation
20) Relocation	: 3	: 3	:
21) Socio-economic condition	: 3	: 3	:
22) Cutting district	: 3	: 3	:
23) Safety	: 2-3	: 2-3	:- side walk in urban area
- Sidewalk			- traffic increase
- Domestic animals			
24) Community	: 3	: 3	:
25) Recreation facilities	: 3	: 3	:
26) Water right and right of common	: 3	: 3	:

- * 1 : 1 : Major influence
 2 : Minor influence
 3 : Very small or non influence
 * 2 : Present environmental condition
 * 3 : Environmental evaluation (Examination)

Table 6-29 Environmental Evaluation

Environmental items	Evaluation					E *2
	1*1:	2 :	3 :	4 :	Section	
1) Air quality	: 2	: 3	: 3	: 3	:	2-3
2) Water quality	: 2-3	: 2-3	: 2-3	: 2-3	:	2-3
3) Soil contamination	: 3	: 3	: 3	: 3	:	3
4) Noise and Vibration	: 2	: 3	: 3	: 2-3	:	2-3
5) Land subsidence	: 3	: 3	: 3	: 3	:	3
6) Odor	: 3	: 3	: 3	: 3	:	3
7) Land	: 2-3	: 2-3	: 2-3	: 2-3	:	2-3
8) Soil	: 2-3	: 2-3	: 2-3	: 2-3	:	2-3
9) Water	: 2-3	: 2-3	: 2-3	: 2-3	:	2-3
10) Underground water	: 3	: 3	: 3	: 3	:	3
11) Sea and seashore	: 3	: 3	: 3	: 3	:	3
12) Meteorology	: 3	: 3	: 3	: 3	:	3
13) Flora and fauna	: 2-3	: 3	: 3	: 2-3	:	2-3
14) Landscape	: 2-3	: 3	: 3	: 2-3	:	2-3
15) Waste	: 2-3	: 2-3	: 2-3	: 2-3	:	2-3
16) Historical and natural monument	: 3	: 3	: 3	: 3	:	3
17) Traffic	: 2	: 2-3	: 2-3	: 3	:	2-3
18) Sanitary	: 3	: 3	: 3	: 3	:	3
19) Hazards	: 2-3	: 3	: 3	: 2-3	:	2-3
20) Relocation	: 2-3	: 3	: 3	: 2-3	:	2-3
21) Socio-economic condition	: 3	: 3	: 3	: 3	:	3
22) Cutting district	: 3	: 3	: 3	: 3	:	3
23) Safety	: 2	: 2-3	: 2-3	: 2-3	:	2-3
24) Community	: 3	: 3	: 3	: 3	:	3
25) Recreation facilities	: 3	: 3	: 3	: 3	:	3
26) Water right and right of common	: 3	: 3	: 3	: 3	:	3

* 1 : 1 : Major influence
 2 : Minor influence
 3 : Very small or non influence
 * 2 : Over-all evaluation by item

7. ENVIRONMENTAL MANAGEMENT PLAN

The environmental management plan is based on the results of the prediction and evaluation concerning each environmental item. It is shown in Table 7-1.

7.1 Traffic Condition

The traffic safety of pedestrian and user of transportation system at the urban areas, villages and school zones will be influenced by increase of vehicles.

It will be necessary to ensure the safety of pedestrian by sidewalk, pedestrian crossing (including pedestrian crossing bridge at roundabout, if possible) and traffic sign and the safety of user of transportation system by bus stops, parking areas and traffic sign at the urban areas, villages and school zones.

(Countermeasurements)

Traffic safety	: Sidewalk, Pedestrian crossing, Bus stop, Parking area, Traffic sign	: Urban area, around village, school zone
----------------	---	---

7.2. Air Quality

Air quality is influenced by the exhausted gas and dust by the heavy machines and dust from bare ground at the stage of construction and by the exhausted gas and dust due to automobiles at the service stage.

The prediction results of NO_x and CO indicate that there will be little effect on the environment except Managua - Masaya. The predicted concentrations of NO_x and CO between Managua and Masaya will be closed to the values of environmental quality standard for air quality, although those are not beyond standard values. Therefore, it will be necessary to conduct a monitoring system for analysing air quality. And then, in case of serious condition of air pollution by emission gas from automobiles, it will be necessary to conduct the traffic control and emission control.

(Countermeasurements)

Air quality	: Traffic control	: Managua - Masaya
	Emmission control	
	: Monitoring	: Air pollution monitoring system

Table 7-1 Environmental Management Plan

Environmental items	Influences	Location	Countermeasurements
1. Traffic condition	:Traffic safety	:Urban area, village	:Sidewalk, bus stop, parking area
2. Air quality	:NOx, CO	:M-M*1	:Traffic control, emission control
3. Water quality	:SS	:Bare ground, asphalt p.*2	:Drainage, settling pond, plantation
4. Noise and vibration	:Noise, vibration	:M-M, M-T*3	:Vehicle restriction, speed restriction
5. Soil	:SS, erosion	:Bare ground, drainage, waste dump area	:Drainage, slope and bank protection, plantation
6. Land	:Slope failure, landslide, falling stone	:Cut, embankment	:Slope protection
7. Water	:Inundation,	:Drainage	:Drainage system, Bridge, culvert, ditch, gutter
8. Flora	: -	:Cut, Alignment	:Replantation
9. Landscape	: -	:Cut, bypass, Alignment	:Plantation, parking area
10. Social condition	:Waste, relocation, surplus soils, waste soils, safety	:Bus stop, Masaya	:Garbage can, relocation, communication, Sidewalk, bus stop

*1 : Road section between Managua - Masaya

*2 : Asphalt plant (temporary)

*3 : Road section between Managua - Tipitapa

7.3 Water Quality

The elements which will be influence Water Quality are suspended solid (SS) flowing from the bare ground of construction stage, namely soil dump area of surplus soils and wastes and other facilities, including temporary and/or permanent machinery stockyard, temporary asphalt plant area, temporary worker's facilities, etc. (if planning to set up).

The prediction results of SS indicate that the SS of 100~190 ppm will be generated from bare ground. The influence of the SS on the environment will be relatively small. However, it will be necessary to set up the drainage system and settling ponds for precipitation of SS.

In addition, in cases of permanent facilities accompanied with bare ground and the restoring areas of temporary facilities after completion of construction, replantation

In addition, in cases of permanent facilities accompanied with bare ground and the restoring areas of temporary facilities after completion of construction, replantation should be done. And then,

(Countermeasurements)

Soil : Drainage system : Ditch, bank protection
Settling : Settling pond
Replantation

7.6 Land

The slopes of the cuts and embankments will stabilize due to the standard slope gradient, drainage system and slope protection, including retaining walls, shotcrete, sodding, etc. The steep slopes will stabilize due to the retaining wall, shotcrete, etc.

In addition, there are eroded slopes (gully erosion) facing to the Masaya Lake at Nindiri, so that it is necessary to set up the slope protection.

(Countermeasurements)

Land : Cuts, embankments : Slope protection
retaining wall, shotcrete,
sodding
Drainage system
gutter, ditch

7.7 Water

The elements which is influenced Water are the volume of outflow of rivers and drainage of the roads. The examined results of outflow indicate that there will be little change from the present condition.

Concerning drainage of the roads, it will be necessary to set up the drainage facilities, including gutter, ditch, etc. and to drain smoothly until existing drainage and rivers.

(Countermeasurements)

Water : Drainage system : Gutter, ditch

7.8 Flora and Fauna

The minimized cut and embankment in several places are planed. Since most of the greenery in the project area will be preserved, it is assumed that the influences on the fauna are few.

In addition, the bare grounds of soil and waste dump areas, slopes, etc. will be planned for planting and sodding works as shown in Figure 7-1. The trees to be used for plantation will be selected from the existing species around the project area, including Acacia, Eucalipto, Chilamate, etc.

(Countermeasurements)

Flora and	:	Plantation	:	Selection of trees
Fauna		Replantation		
		Sodding		

7.9 Landscape

The viewing spheres where these topography will be changed by road improvement are limited along the existing roads, because minimized cutting and embanking areas are planned. Therefore, it is assumed that the influences of Landscape due to the improvement of road will be minimized.

In addition, there are several scenic places along the road sections, so that it is possible to set up a parking area such as Figure 7-2.

7.10 Social Condition

The surplus and waste soils occurred by the road construction will be treated at the soil dump area.

Concerning the bus stops and parking areas, it is necessary to set up the garbage cans and to treat the waste.

In the urban area of Masaya, the relocation of several temporary workshops and private lands due to the expansion of the road improvement will be existed. It is necessary to manage enough communication for understanding each other concerning the right of land.

Traffic safety was described at Section 7.1 (Traffic conditions).

(Countermeasurements)

Social condition	:	Wastes by construction	:	Soil dump area
		Waste	:	Waste disposal
		Relocation	:	Communication

7.11 Checklist

The integrated Environmental Checklist examined by the environmental management plan is shown in Table 7-2.

The influences of the environmental items except Air quality,

Noise and Vibration will be very small or minimized by the environmental management plan. However, Air quality, Noise and Vibration will be worse condition than the present in some places, therefore, it will be necessary to set up the monitoring systems for Air quality, Noise and Vibration and to control traffic condition depend on the result of the monitoring.

Table 7-2 Integrated Environmental Checklist

Environmental items	E v a l u a t i o n			
	E - 1	*2	E - 2	*3
1) Air quality	2-3	*1	3	
2) Water quality	2-3		3	
3) Soil contamination	3		-	*4
4) Noise and vibration	2-3		3	
5) Land subsidence	3		-	*4
6) Odor	3		-	*4
7) Land	2-3		3	
8) Soil	2-3		3	
9) Water	2-3		3	
10) Underground water	3		-	*4
11) Sea and seashore	3		-	*4
12) Meteorology	3		-	*4
13) Flora and fauna	2-3		3	
14) Landscape	3		3	
15) Waste	2-3		3	
16) Historical and natural monument	3		-	*4
17) Traffic	3		3	
18) Sanitary	3		-	*4
19) Hazards	2-3		3	
20) Relocation	2-3		3	
21) Socio-economic condition	3		-	*4
22) Cutting district	3		-	*4
23) Safety	2-3		3	
24) Community	3		-	*4
25) Recreation facilities	3		-	*4
26) Water right and right of common	3		-	*4

- * 1 : 1 : Major influence
- 2 : Minor influence
- 3 : Very small or non influence
- * 2 : Evaluation of the whole area
- * 3 : Integrated evaluation
- * 4 : Non environmental management plan

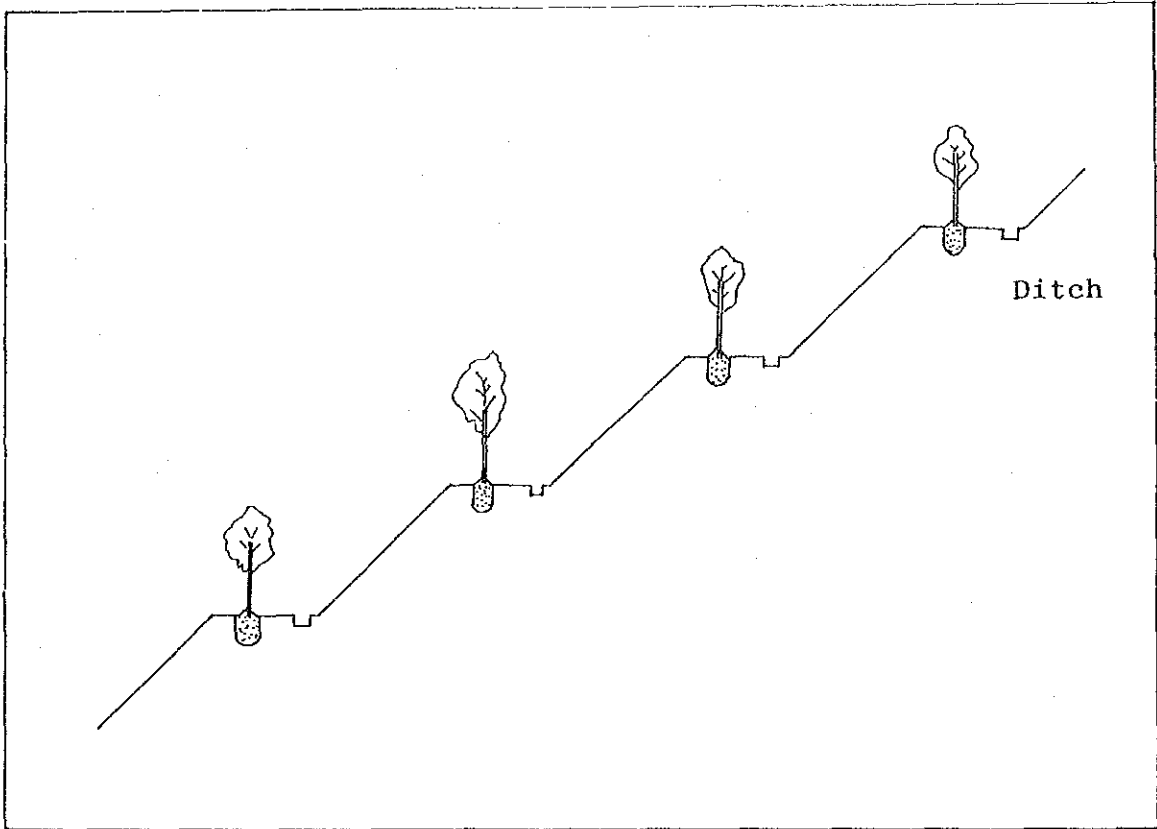


Figure 7-1 Planting



Figure 7-2 Parking Area

8. MONITORING PLAN

The monitoring is necessary to preserve the environment during construction and service of roads. The environmental items for monitoring consists of Air quality, Water quality, Noise and Vibration. The components of monitoring are shown in Table 8-1.

The Air quality, Noise and Vibration will be influenced to the environment of Managua and Masaya urban areas depending on the increasing of traffic volume. Therefore, it is necessary to set up the monitoring systems for Air quality, Noise and Vibration at Managua and Masaya as shown in Table 8-1 and to control traffic condition, including restriction of traffic volume and speed of vehicle.

Suspended solid (SS) of the Water quality will be influenced to the environment during road construction. The water containig much SS drained from bare ground should be treated SS by settling pond before discharge to the existing drainage systems or water courses. Therefore, it is necessary to enforce the monitoring of watching and analyzing suspended solid in the field.

Table 8-1 Monitoring

Environmental items	Components	Location	Remarks
Air quality	: NOx, CO, SPM, SOx, HC, O3	: Managua - Masaya	: Air pollution monitoring
Noise and Vibration	: dB(A), dB(B)	: Managua - Masaya	: Noise and vibration monitoring
Water quality	: SS	: Construction field	: SS measurement

9. CONCLUSION AND RECOMMENDATION

9.1 Conclusion

The Environmental Impact Assessment of the project area was carried out at the stage of the Feasibility Study. Ten environmental items, namely Traffic conditions, Air quality, Water quality, Noise and Vibration, Land, Soil, Water, Flora, Landscape and Social conditions were selected.

Concerning each environmental item, environmental investigations of the present condition were carried out and the examinations of prediction and evaluation in 2000 and 2010 were done. As results of the examinations, minor influences of the Traffic conditions, Air quality, Water quality, Noise and Vibration, Land, Soil, Flora, Landscape and Social conditions were extracted as shown Table 9-1.

The influences of the environmental items including Land, Soil, Flora, Landscape and Social condition will be very small or minimized by the environmental management plan. However, Air quality, Water quality, Noise and Vibration will be worse condition than the present in some places, therefore, it will be necessary to set up the monitoring systems for Air quality, Water quality, Noise and Vibration and to control traffic condition depend on the result of the monitoring.

9.2 Recommendation

The monitoring is recommended to be necessary in order to preserve the environment during construction and service of roads. The environmental items for monitoring consist of Air quality, Water quality, Noise and Vibration. The components of monitoring are shown in Table 9-2.

Table 9-1 Integrated Environmental Evaluation

Environmental items	: Evaluation : :E-1*2 :E-2*3 :	: Countermeasurements and monitoring
1. Traffic conditions	: 3 *1 : 3	: Sidewalk, bus stop, parking area, traffic sign
2. Air quality	: 2-3 : 3	: Traffic and speed control, : Monitoring system for air pollution
3. Water quality	: 2-3 : 3	: Drainage, settling pond for suspended solid : Monitoring for SS
4. Noise and Vibration	: 2-3 : 3	: Traffic and speed control, : Monitoring system for Noise and Vibration
5. Land	: 2-3 : 3	: Slope protection, planting, sodding, drainage
6. Soil	: 2-3 : 3	: Drainage, bank protection
7. Water	: 2-3 : 3	: Drainage
8. Flora	: 2-3 : 3	: Plantation
9. Landscape	: 3 : 3	: Plantation
10. Social conditions*4	: 2-3 : 3	: Waste disposal, communication, soil dump areas, sidewalk, bus stop

- * 1 : 1 : Major influence
- 2 : Minor influence
- 3 : Very small or non influence
- * 2 : Evaluation of the whole area
- * 3 : Integrated evaluation
- * 4 : Including wastes, relocation, traffic safety and hazards

Table 9-2 Monitoring

Environmental items	: Components	: Location	: Remarks
Air quality	: NOx, CO, SPM, SOx, HC, O3	: Managua - Masaya	: Air pollution monitoring
Noise and Vibration	: dB(A), dB(B)	: Managua - Masaya	: Noise and vibration monitoring
Water quality	: SS	: Construction field	: SS measurement

10. REFERENCES

- Arboles Forestal utiles Para su Propagacion, 1992: IRENA, Servicio Forestal Nacional.
- Areas Silvestres Legalmente Establecidas (1:1,000,000), 1992: No. 1 - No. 71, RDS, IRENA (Instituto Nicaraguense de Recursos Naturales y del Ambiente).
- Anuario Estadistico, 1987: INEC (Instituto Nacional de Estadisticos y Censos).
- Anuario Meteorologico, 1990, 1991: INETER.
- Boletin Sobre la Contaminacion del Aire Edicion, 1983: Trimestral Numero No. 1, 2, 3, 4, 5 and 6, INETER (Instituto Nicaraguense de Estudios Territoriales).
- Codificador de la Division Politico - Territorial de la Republica de Nicaragua, 1984: Instituto Nacional de Estadisticas y Censos.
- Comparacion Entre las Erupciones 1968, 1971 - 1992: INETER.
- Cronologia del Volcan Cerro Negro, 1993: INETER.
- Deslizamientos de Tierra (1:500,000), 1991: INETER.
- Distritos Mineros Activos de Nicaragua de Au y Ag, 1993: INMINE (Instituto Nicaraguense de las Minas).
- Division Politico - Administrativa, 1989: Republic de Nicaragua, INETER.
- Environmental Bulletin, 1992: World Bank, Vol. 15, No. 1.
- Especificaciones Generales Para Proyecto Geometrico de Caminos, 1978: Ministerio de Obras Publicas.
- Historica Volcanica, 1993: INETER.
- Hydrological Bulletin, Limology of lake Xolotlan, J. of Netherland Hydrobiological Society, Vol. 25 (2), pp 101- 180.
- Informe Anual, 1992: INETER.
- Intensidades de Precipitacion, 1993: INETER.
- Isotermas Medias Anuales Periodo 1972 - 1981, 1992: INETER.
- La Co-existencia de Pueblos Indigenas y el Ambiente Nacional en Centroamerica, 1992: A Scholarly Publication of the National Geographic Society.
- La Gasetta, 1979, 1980, 1983, 1984, 1988, 1990, 1991: Nicaragua.

- Lineamientos Estrategicos Para el Ordenamiento Territorial, 1992: INETER.
- Mapa de Amenaza Volcanica (1: 250,000), 1992: INETER.
- Mapa Geologico (1:50,000), 1974: Telica, etc. INETER.
- Mapa de Nicaragua (1:1,000,000), 1992: INETER, MCT.
- Mapa de Red Vial (1:1,000,000), 1985: INETER, MCT.
- Normas Tectonicas el Diseno y Construccion de Sistemas de Alcantarillado Sanitario: Instituto Nicaraguense de Acueductos y Alcantarillados (INAA).
- Ordenamiento Ambiental del Territorio - PAF -, 1992: IRENA.
- Precipitacion Total Anual Periodo, 1972 - 1985, 1992: INETER.
- Programa de Rehabilitacion y Mejoramiento de Caminos Rurales - Informa Ambiental -, 1992: Louis Berger International, Inc.
- Proyecto Santa Emilia-El Roblar, Tuma-Guapotal-La Washinton, - Informe Final, Evaluacion de Impacto Ambiental -, 1992: REMECAR, MCT.
- Recursos Basicos Hidrometeorologicos Nacional, 1992: INETER, Chinandega, Leon, A.C. Sandino, Rivas, Esteli.
- Red Vial de Nicaragua (1:1,000,000), 1989: MCT.
- Regulamentos del Sitema Vial y de Estacionamiento de Vehiculos, 1983: Ministerio de Vivienda y Asentamientos Humanos.
- Servicio Fosteral Nacional - Una Estrategia Para el Desarrollo Forestal, 1991: IRENA.
- Uso Actual del Suelo, 1983: INETER.
- Zonas Climaticos de Nicaragua Segun Koppen, 1993: INETER.

Appendix List of Flora in the Project Area

(a) Trees -1-

Nombre de Flora	F1	F2	F3	F4	F5	F6	F7	F8
Mamey	++	-	-	-	-	-	-	-
Nancite	+	+	+	+	-	-	-	-
Maranon	+	-	-	-	-	-	-	-
Limon	+	+	-	-	-	-	-	-
Aguacate	++	-	-	-	-	-	-	-
Cocos	++	-	-	-	-	-	-	+
Mango	+	+	-	+	-	-	-	+
Almendro	+	-	-	-	-	-	-	-
Guayabo	+	+	-	+	-	-	-	-
Palmeras	+	-	-	++	-	-	-	-
Chilamate	+	-	+	-	-	-	-	-
Jocote	-	+	-	-	-	-	-	+
Maiz y Frijoles	-	++++	-	-	-	-	-	-
Pitahaya	-	++++	-	-	-	-	-	-
Sardinillo	-	-	+	-	-	-	-	-
Laurel	-	-	-	+	+	+	-	-
Mamon	-	-	-	++	-	-	-	-
Madrono	-	-	-	+	-	-	-	-
Guacimo	-	-	-	+	-	-	-	-
Cesalpinea	-	-	-	+	-	-	-	-
Zapote	-	-	-	+	++	-	-	-
Guanacaste	-	-	-	-	+	-	+	-
Pochote	-	-	-	-	++	-	-	-
Madero negro	-	-	-	-	+	-	-	-
Cedros	-	-	-	+	++	+	+	++
Tiguilote	-	-	-	-	-	+	-	-
Ceiba	-	-	-	+	-	+	-	-
Guarumo	-	-	-	-	-	+	-	-
Acacia	-	-	-	-	-	-	-	+
Tamarindo	-	-	-	-	-	-	-	+
Aceituno	-	-	-	+	-	-	+	-
Frutillo	-	-	-	-	-	-	-	-
Roble	-	-	-	-	-	-	-	-
Conocuabo	-	-	-	-	-	-	-	-
Carao	-	-	-	-	-	-	-	-
Cortez	-	-	-	-	-	-	-	-
Bambu	-	-	-	-	-	+	-	-
Sorgo	-	-	-	-	-	-	-	-
Jobos	-	-	-	-	-	-	-	-
Genizaro	-	-	-	-	-	-	-	-

Number of plant : - : 0
 + : 1-3,
 ++ : 4-7
 +++ : 8-11
 ++++ : >11

(Continued..)

Nombre de Flora	F1	F2	F3	F4	F5	F6	F7	F8
Jinocuabo	-	-	-	-	-	-	-	-
Caoba	-	-	-	-	-	-	-	-
Gavilan	-	-	-	-	-	-	-	-
Malinche	-	-	-	-	-	-	-	-
Paraiso	-	-	-	-	-	-	-	-
Jicaro	-	-	-	-	-	-	-	-
Espino Bl	-	-	-	-	-	-	-	-
Espino de Playa	-	-	-	-	-	-	-	-
Jinote	-	-	-	-	-	-	-	-
Matapalo	-	-	-	-	-	-	-	-
Vainillo	-	-	-	-	-	-	-	-
Aguijote	-	-	-	-	-	-	-	-
Yuca	-	-	-	-	-	-	-	-
Aromo	-	-	-	-	-	-	-	-
Brasil	-	-	-	-	-	-	-	-
Cornizuelo	-	-	-	-	-	-	-	-
Panama	-	-	-	-	-	-	-	-
Palo Prieto	-	-	-	-	-	-	-	-
Palo Lapa	-	-	-	-	-	-	-	-
Quebracho	-	-	-	-	-	-	-	-
Chiquirin	-	-	-	-	-	-	-	-

Nombre de Flora	F9	F10	F11	F12	F13	F14	F15	F16	F17
Mamey	-	-	-	-	-	-	-	-	-
Nancite	-	-	-	-	-	-	-	-	-
Maranon	-	-	-	-	-	-	-	-	-
Limon	-	-	-	-	-	-	-	-	-
Aguacate	-	-	-	-	-	-	-	-	-
Cocos	-	-	-	-	-	-	-	-	-
Mango	-	-	-	-	-	-	-	-	-
Almendro	-	-	-	-	-	-	-	-	-
Guayabo	-	+	-	-	-	-	-	-	-
Palmeras	-	-	-	-	-	-	-	-	-
Chilamate	-	-	+++	-	-	-	-	-	-
Jocote	-	-	-	-	-	-	-	-	-
Maiz y Frijoles	-	-	-	-	-	-	-	++++	-
Pitahaya	-	-	-	-	-	-	-	-	-
Sardinillo	-	-	-	-	-	-	-	-	-
Laurel	+	-	-	-	+	-	-	++	+
Mamon	-	-	-	-	-	-	-	-	-
Madrono	-	-	-	-	-	-	-	-	-

(Continued..)

Nombre de Flora	F9	F10	F11	F12	F13	F14	F15	F16	F17
Guacimo	++	++	-	-	-	+	-	+	-
Cesalpinea:	-	-	-	-	-	-	-	-	-
Zapote	-	-	-	-	-	-	-	-	-
Guanacaste:	+	+	-	-	-	-	-	-	-
Pochote	-	-	-	-	-	-	-	-	-
Madero negro	-	-	-	-	-	-	-	-	-
Cedros	-	+	-	-	-	-	-	-	-
Tiguilote	++	-	-	+	+	-	-	-	++
Ceiba	-	+	-	-	-	-	-	+	-
Guarumo	-	-	-	-	-	-	-	-	-
Acacia	-	-	-	-	-	-	-	-	-
Tamarindo	-	-	-	-	-	-	-	-	-
Aceituno	-	-	++	+	-	+	-	-	-
Frutillo	-	-	-	-	-	-	+	-	-
Roble	-	-	-	-	-	-	+	-	-
Conocuabo	-	-	-	-	-	-	+	-	-
Carao	-	-	-	-	-	-	-	+	-
Cortez	-	-	-	-	-	-	-	+	-
Bambu	-	-	-	-	-	-	-	-	-
Sorgo	-	-	-	-	+	-	-	-	-
Jobos	+	-	-	-	-	-	-	-	-
Genizaro	+	+	+	-	-	+	+	-	-
Jinocuabo	+	-	-	-	-	-	-	-	-
Caoba	-	-	+	-	-	-	-	-	-
Gavilan	-	-	-	+	-	-	-	-	-
Malinche	-	-	-	++	-	-	-	-	-
Paraiso	-	-	-	+	-	-	-	-	-
Jicaro	-	-	-	-	+	-	-	-	++
Espino Bl	-	-	-	-	+	-	-	-	+
Espino de Playa	-	-	-	-	-	+	-	-	-
Jinote	-	+	-	-	-	-	-	-	-
Matapalo	-	+	-	-	-	-	-	-	-
Vainillo	-	-	-	+	-	-	-	-	-
Aguijote	-	-	-	+	-	-	-	-	-
Yuca	-	-	-	+	-	-	-	-	-
Aromo	-	-	-	-	-	-	-	-	++
Brasil	-	-	-	-	-	-	-	-	-
Cornizuelo:	-	-	-	-	-	-	-	-	-
Panama	-	-	-	-	-	-	-	-	-
Palo Prieto	-	-	-	-	-	-	-	-	-
Palo Lapa	-	-	-	-	-	-	-	-	-
Quebracho	-	-	-	-	-	-	-	-	-
Chiquirin	-	-	-	-	-	-	-	-	-

Nombre de Flora	F18	F19	F20	F21	F22	F23	F24	F25	F26
Mamey	-	-	-	-	-	-	-	-	-
Nancite	-	-	-	-	-	-	-	-	-
Maranon	-	-	-	-	-	-	-	-	-
Limon	-	-	-	-	-	-	-	-	-
Aguacate	-	-	-	-	-	-	-	-	-
Cocos	-	-	-	-	-	-	-	-	-
Mango	-	-	-	-	-	-	-	-	-
Almendro	-	-	-	-	-	-	-	-	-
Guayabo	-	-	-	-	-	-	-	-	-
Palmeras	-	-	-	-	-	-	-	-	-
Chilamate	-	+	-	-	-	-	-	-	-
Jocote	+	-	-	-	-	-	-	-	-
Maiz y									
Frijoles	-	-	-	-	-	-	-	-	-
Pitahaya	-	-	-	-	-	-	-	-	-
Sardinillo	-	-	-	-	-	-	-	-	-
Laurel	-	-	-	-	-	-	-	-	-
Mamon	-	-	-	-	-	-	-	-	-
Madrono	-	+	-	-	-	-	-	-	-
Guacimo	+	+	-	-	-	-	-	-	-
Cesalpinea	-	-	-	-	-	-	-	-	-
Zapote	-	-	-	-	-	-	-	-	-
Guanacaste	-	-	-	-	-	-	-	-	-
Pochote	+	-	-	-	-	-	-	-	-
Madero negro	-	+	-	-	-	-	-	-	+
Cedros	-	-	-	-	-	-	-	-	-
Tiguilote	++	-	-	-	-	-	-	-	+
Ceiba	-	-	-	-	-	-	-	-	-
Guarumo	-	-	-	-	-	-	-	-	-
Acacia	-	-	-	-	-	-	-	-	-
Tamarindo	-	-	-	-	-	-	-	-	-
Aceituno	-	-	-	-	-	-	-	-	-
Frutillo	-	-	-	-	-	-	-	-	-
Roble	-	-	-	-	-	-	-	-	-
Conocuabo	-	-	-	+	+	-	-	-	-
Carao	-	-	-	-	-	-	-	-	-
Cortez	-	-	-	-	-	-	-	-	-
Bambu	-	-	-	-	-	-	-	-	-
Sorgo	-	-	-	-	-	-	-	-	-
Jobs	-	-	-	-	-	-	-	-	-
Genizaro	-	-	-	-	+	-	-	-	-
Jinocuabo	-	-	+	-	-	-	-	-	-
Caoba	-	-	-	-	-	-	-	-	-
Gavilan	-	-	-	-	-	-	-	-	-
Malinche	-	-	-	-	-	-	-	-	-
Paraiso	-	-	-	-	-	-	-	-	-

(Continued..)

Nombre de Flora	F18	F19	F20	F21	F22	F23	F24	F25	F26
Jicaro	+	-	-	-	-	-	-	-	-
Espino Bl	-	-	-	-	-	-	-	-	-
Espino de Playa	-	-	-	-	-	-	-	-	-
Jinote	-	-	-	-	+	-	-	-	-
Matapalo	-	-	-	-	-	-	-	-	-
Vainillo	-	-	-	-	-	-	-	-	-
Aguijote	-	-	-	-	-	-	-	-	-
Yuca	-	-	-	-	-	-	-	-	-
Aromo	-	-	-	-	-	-	-	+	-
Brasil	+++	-	+	-	-	-	-	-	-
Cornizuelo	+	-	+	-	-	-	-	+	-
Panama	+	-	-	-	-	-	-	-	-
Palo Prieto	-	-	-	+	-	-	-	+	-
Palo Lapa	-	-	-	+	-	-	-	-	-
Quebracho	-	-	-	+	-	-	-	+	-
Chiquirin	-	-	-	-	+	-	-	-	-

Note : F23 and F24 are not existing tree.

(2) Bush - 1 -

Nombre de Flora	F1	F2	F3	F4	F5	F6	F7	F8
Hornamentales	+++	-	-	-	-	-	-	-
Platanos	++	-	-	+	+	+	-	-
Arboles de Color	+++	-	-	-	-	-	-	-
Limonarios	++++	-	-	-	-	-	-	-
Limon	-	+	-	-	-	-	-	-
Quelite	-	-	+	-	-	-	-	-
Tiguilote	-	-	-	+	-	-	-	-
Horticultura	-	-	-	+	-	-	-	-
Chaguite	-	-	-	+	-	-	-	-
Madero Negro	-	-	-	+	-	-	-	-
Cafe	-	-	-	-	+	-	+	-
Cacao	-	-	-	-	+	+	-	-
Guayaba	-	-	-	-	-	-	-	+

Nombre de Flora	F9	F10	F11	F12	F13	F14	F15	F16	17
Jicaro	-	-	-	-	-	-	-	-	++
Chopaste	-	-	-	-	-	-	-	-	++
Jocote	+	-	-	-	-	-	-	-	-
Tabacon	+	-	-	-	-	-	-	-	-
Guachipi- lin	-	+	-	-	-	-	-	-	-
Aceituno	-	+	-	-	-	-	-	-	-
Quelite	-	+	-	-	-	-	-	-	-
Caimito	-	+	-	-	-	-	-	-	-
Guayabo	-	+	-	-	-	-	-	-	-
Cornizuelo:	-	+	-	-	+	-	-	-	-
Cedro	-	+	-	-	-	-	-	-	-
Tiguilote	-	-	-	++++	-	-	-	-	+
Madero Negro	-	-	-	-	+	+	-	+	-
Sardinillo:	-	-	-	-	+	-	-	-	-
Nancite	-	-	-	-	+	-	-	-	-
Aromo	-	-	-	-	+	-	-	-	+++
Pico de Pato	-	-	-	-	-	+	-	-	-
Cachito	-	-	-	-	-	-	+	-	-
Espinos	-	-	-	-	-	-	+	-	+
Huevo de Yankee	-	-	-	-	-	-	-	+	+

Nombre de Flora	F18	F19	F20	F21	F22	F23	F24	25	26
Tiguilote	-	-	-	-	-	-	-	-	+
Espino	-	-	-	-	-	-	-	-	-
Aromo	-	-	-	-	-	+	-	+	-
Brasil	++	-	+	-	-	-	-	-	-
Cola de Garrobo	+	-	-	-	-	-	-	-	-
Cornizuelo	+	+	+	-	-	-	-	+	-
Madero Negro	-	+	-	-	-	-	-	+	+
Chiquirin	-	+	-	-	+	-	-	-	-
Conocuabo	-	+	-	+	-	-	+	-	-
Copal	-	-	+	-	-	-	-	-	-
Ron Ron	-	-	+	+	-	-	+	-	-
Palo Prieto	-	-	-	+	-	-	-	-	-
Chaparro	-	-	-	+	-	+	-	-	-
Guayabo	-	-	-	-	-	+	-	-	-

(Continued...)

Nombre de Flora	F18	F19	F20	F21	F22	F23	F24	25	26
Escobilla	-	-	-	-	-	-	+	-	-
Genizaro	-	-	-	-	-	-	-	-	-
Quebracho	-	-	-	+	-	-	-	-	-
Nacascolo	-	-	-	-	-	-	-	+	-

(3) Replanted trees - 1 -

Nombre de Flora	F1	F2	F7	F8	F10	F15	F16	F19
Aceituno	+	+	-	-	+	-	-	-
Cedro	+	+	+	+	-	-	-	-
Madero N.	-	++++	-	-	-	+	+	+
Caoba	-	+	-	-	-	-	-	-
Guachipilin	-	-	-	-	+++	-	-	+
Cornizuelo	-	-	-	-	+	-	-	+
Laurel	-	-	-	-	-	-	+	-
Cortez	-	-	-	-	-	-	+	-

Nombre de Flora	:	F23	:	F25	:
Quebracho	:	+	:	-	:
Cornizuelo	:	+	:	++++	:

Note : F3, F4, F5, F6, F9, F11, F12, F13, F14, F17,
F18, F20, F21, F22, F24 and F26 are not existing.

Number of plant :

- : 0
+ : 1~3
++ : 4~7
+++ : 8~11
++++ : >11

(4) Grass - 1 -

Nombre de Flora	:	F1	:	F2	:	F3	:	F4	:	F5	:	F6	:	F7	:	F8	:
Zacate	:	+	:	+	:	+	:	-	:	-	:	-	:	-	:	-	:
hoja ancha	:		:		:		:		:		:		:		:		:
Frijol	:	-	:	+	:	-	:	-	:	-	:	-	:	-	:	-	:
Leguminosa:	:	-	:	-	:	+	:	-	:	-	:	-	:	-	:	-	:
Escoba	:	-	:	-	:	+	:	+	:	-	:	-	:	-	:	-	:
Helechos	:	-	:	-	:	+	:	-	:	-	:	-	:	-	:	-	:
Hoja ancha:	:	-	:	-	:	-	:	+	:	+	:	+	:	-	:	-	:
Platanillo:	:	-	:	-	:	-	:	+	:	+	:	+	:	-	:	-	:
Zorillo	:	-	:	-	:	-	:	+	:	+	:	-	:	-	:	-	:
Enredadera:	:	-	:	-	:	-	:	+	:	-	:	-	:	-	:	-	:
Hierba	:	-	:	-	:	-	:	-	:	-	:	+	:	+	:	+	:

Nombre de Flora	F9	F10	F11	F12	F13	F14	F15	F16	F17
Hierba de hoja ancha	+	+	-	+	+	-	-	-	-
Maiz	-	+	-	-	-	-	-	-	-
Escoba de Flor A.	-	-	+	-	-	-	-	+	-
Dormilona Falsa	-	-	-	-	+	-	-	-	-
Zarza Cola: de Zorro	-	-	-	-	-	+	-	+	-
Chopaste Flor Amarilla	-	-	-	-	-	-	+	-	-
Rastrera	-	-	-	-	-	-	+	-	-
Campanita	-	-	-	-	-	-	+	-	-
Enredadera:	-	-	-	-	-	-	+	-	-
Madero N.	-	-	-	-	-	-	+	-	-
Zacate	-	-	-	-	-	-	-	-	+
Mozote	-	-	-	-	-	-	-	-	+
Escoba Negra	-	-	-	-	-	-	-	-	+

+ : existing
- : Non

Nombre de Flora	F18	F19	F20	F21	F22	F23	F24	F25	F26
Penca	+	-	-	-	-	-	-	+	-
Zarza	+	-	-	-	-	-	+	-	-
Zacate Ron Ron	+	-	+	+	-	+	+	+	-
Escoba	-	+	+	-	-	+	-	-	-
Pico de Pato	-	+	-	-	-	-	-	-	-
Campanita	-	+	-	-	-	-	+	-	+
Tuna	-	-	+	-	-	-	-	+	-
Chilillo	-	-	-	+	-	-	-	-	-
Flor Amarilla	-	-	-	-	+	-	-	-	-

JICA