

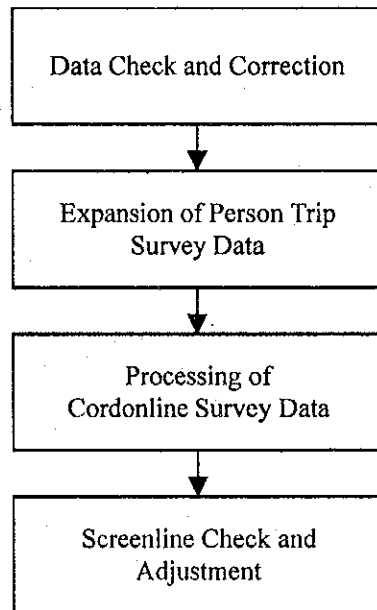
APPENDIX 3 DATA PROCESSING FOR PERSON TRIP MASTER DATABASE

In order to analyze the present situation of transportation systems and travel behavior of the citizen of Managua, the Study Team conducted a series of surveys. The most large-scale survey is the person trip survey, having a sample size of 9,000 households. The purpose of the Person Trip Survey is to know quantitatively the characteristics of personal trip behavior. Present 'Origin and Destination' matrices (hereinafter called OD matrix) can be estimated based on the information obtained by this survey through data processing. In this section, the data processing methodology, i.e. how to create database and how to estimate OD matrices, is discussed.

1. Outline

The data processing for creation of Person Trip master database can be roughly divided into four major steps: data correction, expansion of Person Trip Survey data, processing of cordonline survey data and screenline adjustment as shown in Figure 1.1.

Figure 1.1
Major Steps of Data Processing



(a) Data check and correction

After the field survey being completed, the raw data of the Person Trip Survey was coded and inputted into database by a number of coders. Thus, the database usually includes wrong information due to various types of mistakes. Therefore, the database must be checked thoroughly through the following three steps: order check, validity check and logical check.

(b) Expansion of Person Trip Survey Data

A Person Trip Survey is a sample survey and needs expansion in order to represent the characteristics of the whole population. The expansion is, in general, closely related to the methodology of sampling. The target households were selected by the manner called "Area Sampling" in this project.

(c) Processing of Cordonline Survey data

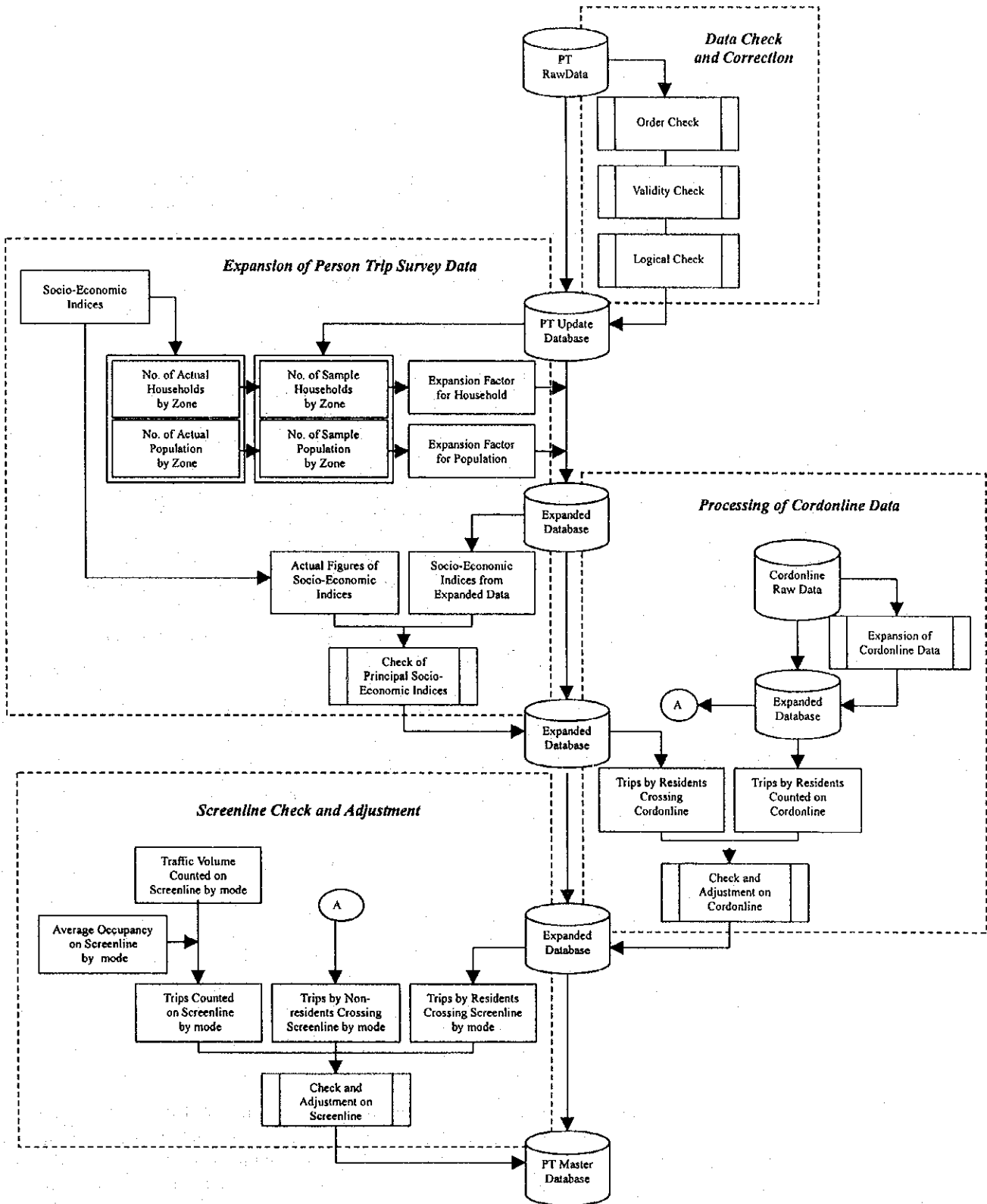
The purpose of processing of Cordonline Survey data is two-fold; creation of OD matrices of non-residents and adjustment of expansion factors for the trips of residents crossing the cordonline.

(d) Screenline check and adjustment

The traffic volume by vehicle type, crossing the screenline is estimated from the expanded person trip survey results, and then compared with the actually counted traffic volume on the screenline. The initially calculated expansion factors are then adjusted based on this comparison. Although the details are explained hereafter, the traffic by non-residents and average occupancy by vehicle type are the major factors to be taken into account.

A detailed flow chart of the master database creation is shown in Figure 1.2.

Figure 1.2
Flow Chart for Creation of Person Trip Master Database



2. Data check and Correction

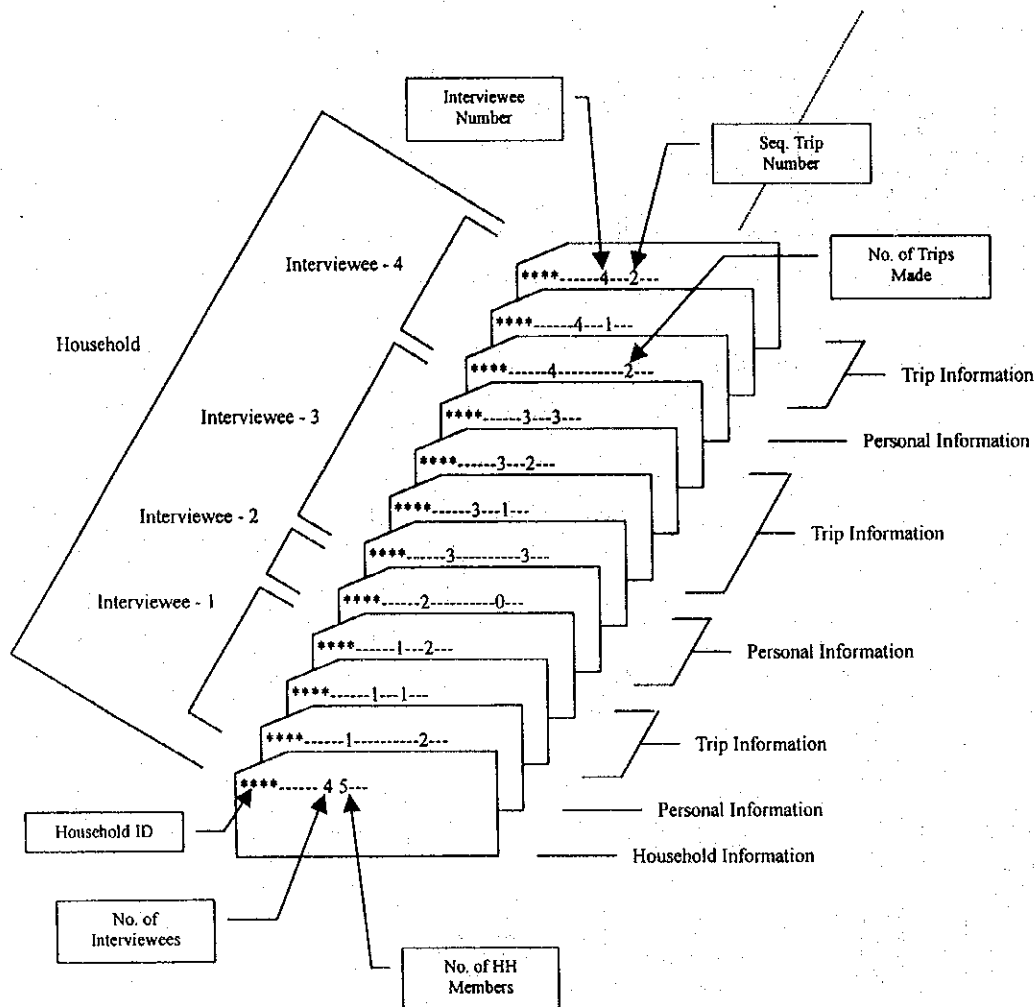
The Person Trip data were examined through the following methods:

- (a) Order check
- (b) Validity check
- (c) Logical Check

(1) Order Check

The database has three types of record, i.e household information, personal information and trip information. These records should be inputted in the following order shown in Figure 2.1.

Figure 2.1
Data Order in Database



The first record of a data set for one household is for household information, on which the number of interviewees in the household is recorded, followed by personal information. For this personal information, the same number of records as the number of interviewees should be inputted. If an interviewee made trips, records for trip information should be inputted according to the number of trips he or she made. If he or she did not make a trip, it is not necessary to input a record for trip information.

(2) Validity check

Validity of every numerical and categorized data should be checked according to its possible range. Some of the data had been automatically checked by data-input software when it was inputted.

(3) Logical Check

The last step is to check the consistency among the three sorts of information. Inconsistency to be checked can be divided into the following categories:

(a) Personal attributes:

Inconsistencies among sex, age, activity condition, occupation, industry and working/school place zone are checked.

(b) Between personal attribute and trip information:

Inconsistency between occupation and trip purpose is checked.

(c) Travel Time

Inconsistency of start/arrival time between trips.

Inconsistency of start time and trip purpose.

Inconsistency of travel time and travel mode.

3. Expansion of Person Trip Survey Data

The Person Trip Survey was undertaken to interview all the members that belong to a family selected by random sampling in each traffic zone. Moreover, there may be a member who refused to be interviewed. Therefore, the results of the survey should be expanded to provide the complete information reflecting the whole activities of all the population of the Study Area.

When sampled data is expanded, the following points should be examined.

- (a) Manner of random sampling.
- (b) Significant difference of distribution between sampled data and known population by attribute.
- (c) Regional differences of characteristics

In the process of expansion, the bias of the sampled data can be eliminated so that no statistically significant difference exists, if the expansion factor is properly set according to the distribution of known attributes. In the Person Trip Survey, households were selected by random sampling. If there is a bias in the household size and in some attribute structure of households, the expanded result will show a deviation from the actual attribute structure. Taking this into account, the expansion was done independently based on the number of households and on the population by sex and activity condition as follows:

- (a) Calculate population and number of households by zone.
- (b) Compare the total number of households and the effective number of interviewed households by planning zone to obtain the expansion factor for households.
- (c) Compare the total population and the effective number of interviewed persons by planning zone to obtain the expansion factor for population.
- (d) Compare the number of population and the expanded number of population by sex and activity condition group to obtain the adjustment figures for expansion factor by sex and activity condition group.

Figure 3.1
Expansion of Person Trip Survey Data

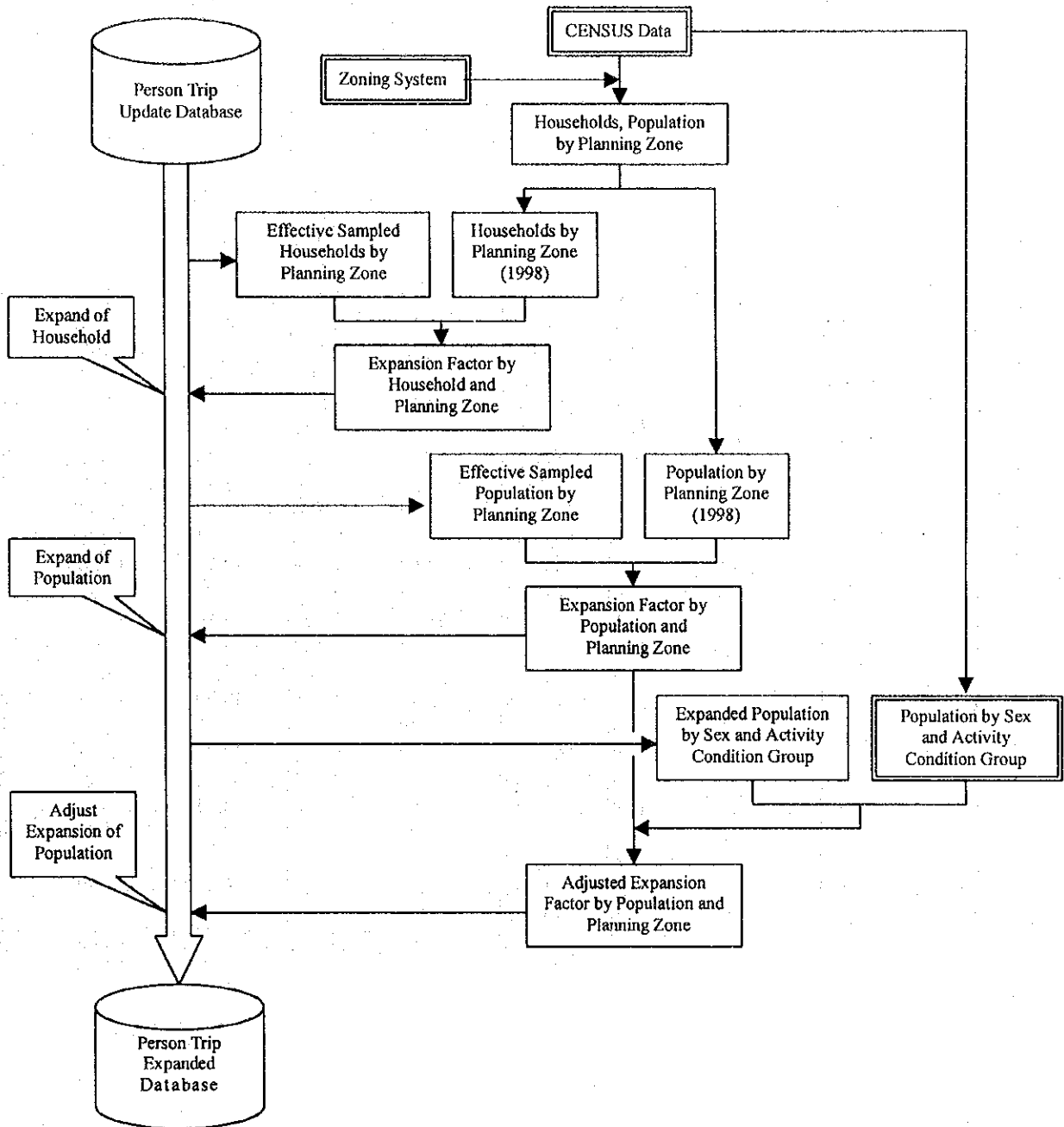


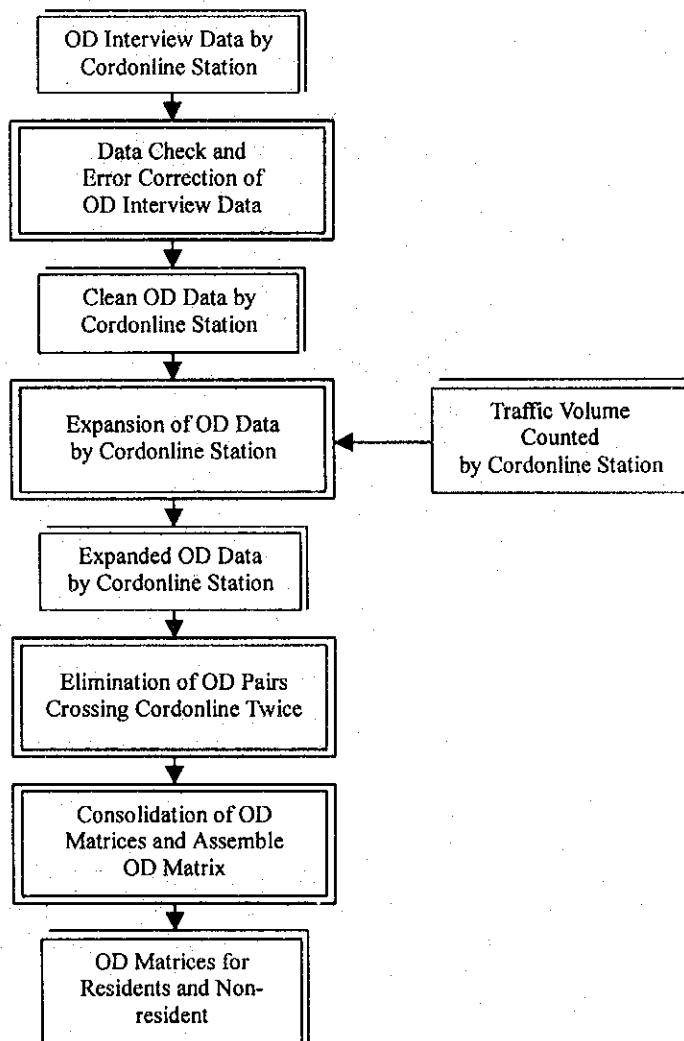
Table 3.1
Expansion Factor of Both Household and Population by Planning Zone
(Before Adjustment)

Planning Zone	Household			Population					
	Actual No. of HHs	Sampled HHs	Expansion Factor	Actual No. of Population	Sampled Population	Sampled 5 yrs more	Estimated 5 yrs more Population	Sampled Inter-viewees	Expansion Factor
1	3,040	150	20.3	20,634	789	634	16,580	622	26.7
2	7,937	397	20.0	51,809	2,218	1,901	44,404	1,851	24.0
3	801	10	80.1	4,560	49	46	4,281	45	95.1
4	4,608	233	19.8	27,850	1,192	953	22,266	936	23.8
5	11,001	644	17.1	73,075	3,084	2,608	61,796	2,562	24.1
6	6,825	264	25.9	36,738	1,238	1,110	32,940	1,066	30.9
7	11,237	582	19.3	69,534	2,916	2,520	60,091	2,479	24.2
8	519	25	20.8	3,153	126	101	2,527	100	25.3
9	8,305	360	23.1	49,537	1,845	1,592	42,744	1,582	27.0
10	2,401	199	12.1	12,675	982	812	10,481	798	13.1
11	1,908	22	86.7	10,772	93	82	9,498	96	98.9
12	6,609	354	18.7	39,881	1,911	1,595	33,286	1,587	21.0
13	4,715	120	39.3	28,218	688	596	24,445	569	43.0
14	7,176	286	25.1	41,194	1,419	1,196	34,720	1,165	29.8
15	19,469	808	24.1	126,496	3,734	3,384	114,639	3,296	34.8
16	5,798	283	20.5	35,374	1,458	1,267	30,740	1,228	25.0
17	15,056	578	26.0	97,183	2,724	2,435	86,872	2,390	36.3
18	16,014	664	24.1	98,412	3,342	2,926	86,162	2,824	30.5
19	1,072	23	46.6	6,410	123	103	5,368	101	53.1
20	3,822	174	22.0	22,010	816	704	18,989	691	27.5
21	7,160	371	19.3	46,025	2,044	1,776	39,990	1,754	22.8
22	121	15	8.1	605	60	51	514	50	10.3
23	25,199	1,153	21.9	160,523	6,220	5,395	139,232	5,203	26.8
24	10,587	644	16.4	71,052	3,378	2,921	61,440	2,859	21.5
25	714	17	42.0	4,378	85	76	3,914	75	52.2
26	4,957	110	45.1	32,638	527	465	28,798	452	63.7
27	1,059	15	70.6	5,295	79	73	4,893	72	68.0
28	1,697	64	26.5	11,254	336	291	9,747	280	34.8
29	2,167	70	31.0	13,000	445	380	11,101	365	30.4
Total	191,974	8,635	22.2	1,200,285	43,921	37,993	1,042,460	37,098	28.1

4. Processing of Cordonline Survey Data

In the Cordonline Survey, traffic volumes were counted by type of vehicle and sampled drivers were simultaneously interviewed to obtain detailed travel information, such as origin and destination of trips, and purpose. The OD information collected by cordonline survey station was expanded as against the counted traffic volume, and were compiled into OD matrices by survey station. In order to obtain OD matrices for both residents and non-residents separately, these station-wise OD matrices should be consolidated. The OD pairs crossing the cordonline only once were summed. The OD pairs crossing the cordonline twice were summed and their averages were taken for the OD. The matrix for residents was compared with the OD matrix calculated from the Person Trip Survey in order to adjust the number of person trips traveled by residents crossing the cordonline. The matrix for non-residents was then added to the OD matrix.

Figure 4.1
Data Processing of Cordonline Survey Data



5. Screenline Checking and Adjustment

The OD matrix obtained from the Person Trip Survey can be checked for accuracy by comparing it with the results of the screenline traffic count survey. If the traffic volume calculated from the OD matrix are significantly different from the present traffic flow, the OD matrix should be adjusted to represent the existing situation.

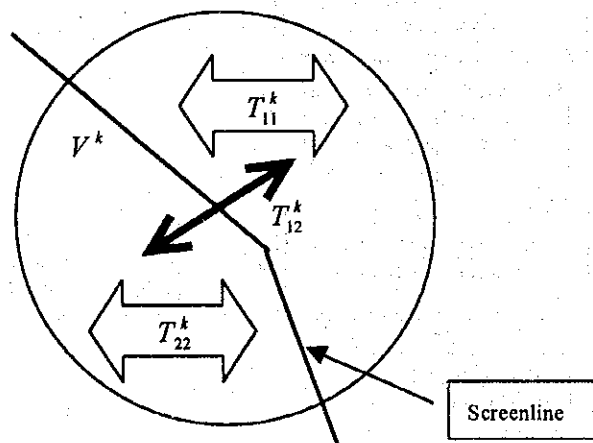
During the process of screenline adjustment, the following issues had to be discussed:

- (a) The Person Trip Survey deals with person trips while the screenline survey counts vehicular traffic.
- (b) The Person Trip Survey deals with the traffic of residents while the screenline count includes the traffic made by non-residents.

(1) Concept of Screenline Adjustment

The screenline adjustment aims to adjust the person trip data by multiplying the ratio between the screenline traffic and the person trip data (V_k / T_{12}^k) with all the person trip data ($T_{11}^k, T_{12}^k, T_{22}^k$), as shown in Figure 5.1.

Figure 5.1
Concept of Screenline Adjustment



- V^k : Screenline traffic of vehicle type k
 T_{12}^k : Person trip traffic crossing the screenline of vehicle type k
 T_{11}^k, T_{22}^k : Person trip traffic not crossing the screenline of vehicle type k

(2) Average Occupancy by Vehicle Type

In order to compare the counted vehicular traffic volume and the estimated number of person trips, the average occupancy or average number of persons per vehicle must be determined by vehicle type. The occupancy was surveyed by vehicle type on the screenline at the same time as the traffic counts. The result of occupancy survey is shown in Table 5.1.

Table 5.1
Average Occupancy by Vehicle Type

Mode Number	Vehicle Type	No. of Surveyed Samples	Average Occupancy Ratio
2	Car	15,418	1.963
3	Light Truck	2,723	1.706
4	Large Truck	2,448	1.667
5	Trailer	1,720	1.592
6	Taxi	16,153	1.830
7	Passenger Truck	-	-
8	Microbus	4,644	6.167
9	Bus	4,560	29.525
10	Motorcycle	8,035	1.286
11	Bicycle	2,484	1.004

(3) Screenline Traffic by Non-Residents

The traffic volume counted on the screenline includes that of non-residents. In order to exclude the non-resident traffic from the screenline traffic, the OD matrices of non-residents must be identified. These could be obtained from the cordonline survey, and its cross-screenline traffic was subtracted from the screenline traffic.

(4) Adjustment Value from Screenline Checking

Table 5.2 shows the result of traffic count survey on the screenline by type of vehicles and survey station. Table 5.3 shows the result of the screenline adjustment done according to the methodology explained previously. Consequently, the obtained adjustment value by type of vehicles is applied to adjust the expansion factor for trip information.

Table 5.2
Traffic Volume Counted on Screenline by Mode and Survey Station

Direction	Vehicle Type	Station							Total
		Palacio Nacional	Dupla Norte	Dupla Sur	Calle Colon	Paseo Tiscapa	Av. Bolivar	Juan Pablo II	
East -> West	Car + Taxi	1,525	12,787	3,736	10,727	16,192	8,710	18,695	72,372
	Buses	259	324	331	902	762	518	1,194	4,290
	Motorcycle	162	947	278	748	966	644	1,047	4,792
	Bicycle	84	151	83	331	168	113	118	1,048
	Trucks	135	1,243	167	468	454	307	854	3,628
	Total	2,165	15,452	4,595	13,176	18,542	10,292	21,908	86,130
West -> East	Car + Taxi	933	17,177	3,503	8,739	16,695	6,071	18,910	72,028
	Buses	141	576	307	1,195	929	467	1,158	4,773
	Motorcycle	106	825	317	780	1,125	368	1,018	4,539
	Bicycle	179	100	172	329	171	140	90	1,181
	Trucks	89	1,224	187	367	610	261	1,000	3,738
	Total	1,448	19,902	4,486	11,410	19,530	7,307	22,176	86,259
Total	Car + Taxi	2,458	29,964	7,239	19,466	32,887	14,781	37,605	144,400
	Buses	400	900	638	2,097	1,691	985	2,352	9,063
	Motorcycle	268	1,772	595	1,528	2,091	1,012	2,065	9,331
	Bicycle	263	251	255	660	339	253	208	2,229
	Trucks	224	2,467	354	835	1,064	568	1,854	7,366
	Total	3,613	35,354	9,081	24,586	38,072	17,599	44,084	172,389

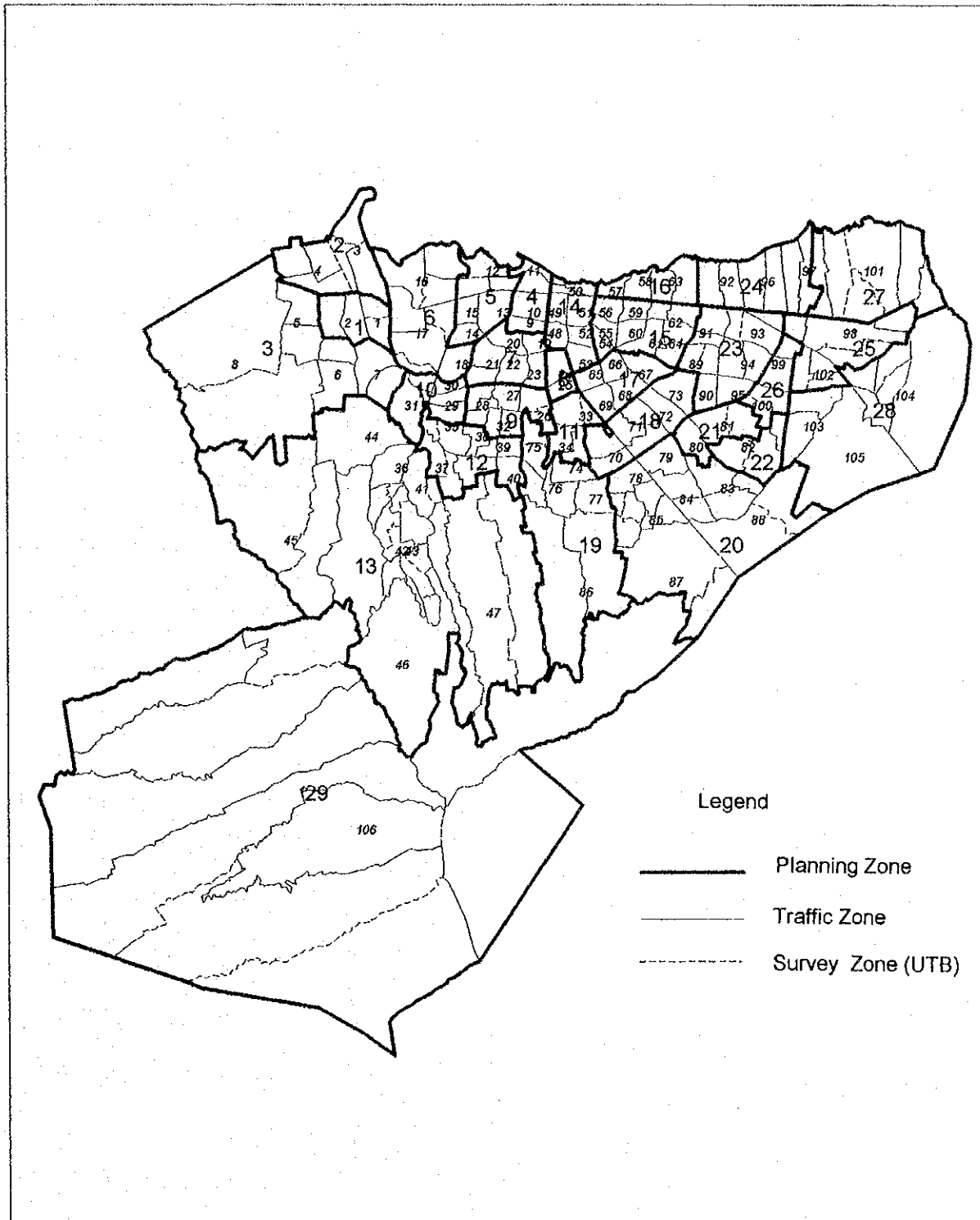
Table 5.3
Result of Screenline Check and Adjustment

Mode	No. of Trips by Residents			Trips By Non- residents	Grand Total	Average Occu- pancy	No. of Vehicle Trips	Integrated Mode	Traffic Volume Counted	Coverage (%)	Adjust- ment Factor
	E -> W	W -> E	Total								
Car	32,170	32,285	64,455	12,842	77,297	1.96	39,377	46,316	144,400	32.1	3.1177
Light Truck	1,640	1,920	3,560	2,006	5,566	1.71	3,263	5,482	7,366	74.4	1.3438
Large Truck	144	157	301	1,847	2,148	1.67	1,289				
Trailer	24	0	24	356	380	1.59	239				
Taxi	6,035	6,588	12,623	76	12,699	1.83	6,939				
Pass. Truck	613	567	1,180		1,180	1.71	692				
Micro-bus	2,185	2,049	4,234	323	4,557	6.17	739				
Bus	82,781	81,127	163,908	4,186	168,094	29.53	5,693	6,432	9,063	71.0	1.4090
Motorcycle	1,863	1,875	3,738	490	4,228	1.29	3,288	3,288	9,331	35.2	2.8381
Bicycle	684	602	1,286	89	1,375	1.00	1,370	1,370	2,229	61.4	1.6276
Total	128,139	127,170	255,309	22,215	277,524	4.41	62,887	62,887	172,389	36.5	2.7412

6. Zoning

Table 6.1 shows the relationship between various zoning systems adopted in the Study. Figure 6.1 illustrates "Survey Zones" (same as UTB zones), "Traffic Zones" and "Planning Zones".

Figure 6.1 Zoning



Zone Code Reference Table

Table 6.1

District No.	UTB No.	Principal Barrio Name	Survey Zone	District Zone	Traffic Zone	Screenline Zone	Planning Zone
1	01		101	1	1	1	1
1	02	LA GRUTA	102	1	1	1	1
1	03	EDUARDO CONTRERAS/SATELITE ASOSOSCA	103	1	2	1	1
1	12	BELLO AMANECEER	112	1	2	1	1
1	04	TANGARA	104	1	3	1	2
1	05	ORO VERDE	105	1	3	1	2
1	06	URB.VILLA DEMOCRACIA	106	1	4	1	2
1	07	BELLA CRUZ	107	1	4	1	2
1	08	CIUDAD SANDINO	108	1	4	1	2
1	09	ROBERTO CLEMENTE	109	1	4	1	2
1	10		110	1	5	1	3
1	11		111	1	5	1	3
1	13		113	1	6	1	3
1	14		114	1	6	1	3
1	15	LOTIFICACION KM 9.	115	1	7	1	3
1	16		116	1	7	1	3
1	81	LA TRINIDAD(LA TRINIDAD NORTE)	181	1	8	1	3
1	82	COMARCA CUAJICHILLO	182	1	8	1	3
2	01	MARTA QUEZADA	201	2	9	1	4
2	02	EL BOER	202	2	10	1	4
2	03	DETRAS DE JORGE NAVARRO	203	2	11	1	4
2	04	MANCHESTER	204	2	11	1	4
2	05	SANTA ANA	205	2	12	1	5
2	09	SHELILDA MIRANDA	209	2	12	1	5
2	10	AE. ACAHUALINCA BASURERO	210	2	12	1	5
2	06	MONSEÑOR LEZCANO	206	2	13	1	5
2	07	ANEXO EDGAR LANG	207	2	14	1	5
2	08	EL CORTIJO (DIGNIDAD 4 DE MAYO)	208	2	15	1	5
2	11	ACAHUALINCA BASURERO	211	2	16	1	6
2	12	VALLE DORADO	212	2	16	1	6
2	18	SIN VIVIENDA CONSIDERADA EN ESTA U.T.B.	218	2	16	1	6
2	13	LINDA VISTA SUR	213	2	17	1	6
2	15	MOTASTEPE	215	2	17	1	6
2	16	SIN VIVIENDA CONSIDERADA EN ESTA U.T.B.	216	2	17	1	6
2	17	SIN VIVIENDA CONSIDERADA EN ESTA U.T.B.	217	2	17	1	6
2	14	BATAHOLA SUR	214	2	18	1	6
3	01	BOLONIA Y BOSQUES DE BOLONIA(45%)	301	3	19	1	7
3	02	ALTAGRACIA(30%)	302	3	20	1	7
3	03	A VERDE Y COMUNAL DE NORA ASTORGA	303	3	21	1	7
3	04	ALTAGRACIA(15%)	304	3	21	1	7
3	05	EL RECREO NORTE	305	3	22	1	7
3	06	CARLOS NUNEZ	306	3	23	1	7
3	07	VILLA ARGENTINA	307	3	24	2	8
3	08	EDGAR MUNGUA(50%)	308	3	25	2	8
3	09	HIALEAH(60%)	309	3	26	2	9
3	20	LOMAS DE MONSERRAT	320	3	26	2	9
3	10	LA ESPERANZA	310	3	27	1	9
3	11	HEROES Y MARTIRES DEL BOCAY (INDEPENDENCIA)	311	3	28	1	9
3	17	SAN JUDAS(85%)	317	3	28	1	9
3	12	FRAWLEY	312	3	29	1	10
3	16	HERLINDA LOPEZ(20%)	316	3	29	1	10
3	13	BELMONTE	313	3	30	1	10
3	14	REISELL	314	3	31	1	10
3	15	LAS PIEDRECITAS 1 Y 2	315	3	31	1	10
3	26		326	3	31	1	10
3	18	SAN PABLO O EDUARDO FLORES	318	3	32	1	9
3	19	HIALEAH(30%)	319	3	32	1	9
3	21	LOS ROBLES	321	3	33	2	11
3	22	ALTAMIRA NO1	322	3	33	2	11
3	23	VILLA FONTANA	323	3	34	2	11
3	24	MIGUEL BONILLA	324	3	34	2	11
3	25	SAN PATRICIO	325	3	35	1	12
3	29	AE. ARGES SEQUEIRA	329	3	35	1	12
3	27	PENA DEL SUR	327	3	36	1	13
3	28	VILLA NUEVA(90%)	328	3	37	1	12
3	35	CAMILO ORTEGA	335	3	37	1	12
3	30	UP-LUIS ALFONSO VELASQUEZ 2	330	3	38	1	12
3	31	AE. LOS TREJOS	331	3	39	1	12
3	32	HIALEAH	332	3	39	1	12

Zone Code Reference Table

District No.	UTB No.	Principal Barrio Name	Survey Zone	District Zone	Traffic Zone	Screenline Zone	Planning Zone
3	33		333	3	40	1	12
3	34	VILLA ROMA	334	3	40	1	12
3	36	SIN VIVIENDAS CONSIDERADAS EN ESTA U.T.B.	336	3	41	1	13
3	37	SIN VIVIENDAS CONSIDERADAS EN ESTA U.T.B.	337	3	41	1	13
3	42	EL ROSAL	342	3	42	1	13
3	44	SANTA ISABEL	344	3	42	1	13
3	45		345	3	42	1	13
3	46		346	3	42	1	13
3	49		349	3	42	1	13
3	52		352	3	42	1	13
3	43	MARCELL PALLAIS	343	3	43	1	13
3	47	EL SOCIEGO	347	3	43	1	13
3	48	SANTA MARIA	348	3	43	1	13
3	50	ELCARMEN	350	3	43	1	13
3	51	MONTEFRESCO	351	3	43	1	13
3	80	COMARCA NEJAPA	380	3	44	1	13
3	81	COMARCA CHIQUILISTAGUA	381	3	45	1	13
3	82	COMARCA CEDRO GALAN	382	3	45	1	13
3	83	COMARCA SAN JOSE DE LAS CANADAS	383	3	45	1	13
3	84	COMARCA MONTE TABOR	384	3	46	1	13
3	85	COMARCA TICOMO	385	3	47	1	13
3	86	COMARCA POCHOCAUPE	386	3	47	1	13
3	87	COMARCA SAN ISIDRO	387	3	47	1	13
4	01	COLONIA MILITAR TISCAPA	401	4	48	2	14
4	02	SAJONIA	402	4	49	2	14
4	03	CANDELARIA	403	4	50	2	14
4	04	CARLOS REYNA(BARRIO LOS PESCADORES)	404	4	50	2	14
4	05	SANTO DOMINGO(95 %)	405	4	51	2	14
4	06	LARGAESPADA(80%)	406	4	52	2	14
4	07	REPARTO SERRANO	407	4	53	2	14
4	08	RIGOBERTO LOPEZ PEREZ (CAMPO BRUCE)	408	4	54	2	15
4	09	UP SAN JOSE ORIENTAL(60%)	409	4	55	2	15
4	10	LOS ANGELES	410	4	56	2	15
4	11	COSTADO N.E. DE BENEDICTO VALVERDE	411	4	57	2	16
4	12	LAS TORRES	412	4	58	2	16
4	13	SAN LUIS SUR	413	4	59	2	15
4	14	LATENDER(95%)	414	4	60	2	15
4	15	EL EDEN	415	4	61	2	15
4	16	COSTA RICA	416	4	62	2	15
4	19	BELLO HORIZONTE(20%)	419	4	62	2	15
4	17	PEDRO JOAQUIN CHAMORRO	417	4	63	2	16
4	18	JARDINES DE STA CLARA	418	4	63	2	16
4	20	BELLO HORIZONTE(80%)	420	4	64	2	15
4	21	VENEZUELA	421	4	64	2	15
5	01	14 DE JUNIO	501	5	65	2	17
5	02	RIGUERO	502	5	66	2	17
5	03	10 DE JUNIO	503	5	67	2	17
5	04	MEXICO	504	5	68	2	17
5	05	PANCASAN	505	5	69	2	17
5	06	VILLAS ITALIANAS	506	5	70	2	18
5	12	NO SE CONSIDERO VIVIENDA AL MOMENTO DEL ESTUDIO	512	5	70	2	18
5	07	CENTROAMERICA	507	5	71	2	18
5	08	ADOLFO REYES	508	5	71	2	18
5	11	22 DE ENERO O CASCADA(50%)	511	5	71	2	18
5	09	LA FUENTE O ARIEL DARCE	509	5	72	2	18
5	10	NICARAO	510	5	73	2	18
5	13	BOSQUES DEL RECREO	513	5	74	2	19
5	14	HIALEAH	514	5	75	2	19
5	15	NO SE CONSIDERO VIVIENDA AL MOMENTO DEL ESTUDIO	515	5	75	2	19
5	16	NO SE CONSIDERO VIVIENDA AL MOMENTO DEL ESTUDIO	516	5	76	2	19
5	17	NO SE CONSIDERO VIVIENDA AL MOMENTO DEL ESTUDIO	517	5	76	2	19
5	18	NO SE CONSIDERO VIVIENDA AL MOMENTO DEL ESTUDIO	518	5	77	2	19
5	19	LOMAS DE SANTO DOMINGO	519	5	78	2	20
5	20	LAS COLINAS(40%)	520	5	79	2	20
5	21	SCHICK No.2	521	5	80	2	21
5	22	28 DE MAYO	522	5	81	2	21
5	23	ANEXO VILLA LIBERTAD	523	5	81	2	21
5	24	CHE GUEVARA	524	5	82	2	22
5	36		536	5	82	2	22

Zone Code Reference Table

District No.	UTB No.	Principal Barrio Name	Survey Zone	District Zone	Traffic Zone	Screenline Zone	Planning Zone
5	37		537	5	82	2	22
5	25	NOSE COSIDERO VIVIENDA AL MOMENTO DEL ESTUDIO	525	5	83	2	20
5	34		534	5	83	2	20
5	35		535	5	83	2	20
5	26	LAS COLINAS	526	5	84	2	20
5	33	BOSQUES DE SANTA MARIA	533	5	84	2	20
5	27	MIRADOR	527	5	85	2	20
5	28	LOMAS DE SANTO DOMINGO	528	5	85	2	20
5	29	NO SE CONSIDERO VIVIENDA AL MOMENTO DEL ESTUDIO	529	5	85	2	20
5	30	ALTOS DE SANTO DOMINGO	530	5	85	2	20
5	31	ESTANCIA DE SANTO DOMINGO	531	5	85	2	20
5	32	LOS PALMARES	532	5	85	2	20
5	80	COMARCA JOCOTE DULCE	580	5	86	2	19
5	81	COMARCA SAN ISIDRO DE LA CRUZ VERDE	581	5	86	2	19
5	82	COMARCA SANTO DOMINGO	582	5	87	2	20
5	83	SANTO DOMINGO(SAN ANTONIO SUR)	583	5	87	2	20
5	84	COMARCA ESQUIPULAS	584	5	88	2	20
5	85	LAS JAGUITAS(LAS JAGUITAS)	585	5	88	2	20
6	01	GEORGINO ANDRADE	601	6	89	2	23
6	03	VILLA AUSTRIA	603	6	89	2	23
6	02	1o. DE MAYO	602	6	90	2	23
6	04	VILLA PROGRESO	604	6	91	2	23
6	05	MOMBACHO O FREDDY HERRERA	605	6	91	2	23
6	06	LA PRIMAVERA O CALOS SANCHEZ	606	6	92	2	24
6	07	JOSE DOLORES ESTRADA	607	6	92	2	24
6	08	WASPAN SUR (RPTO. ALINA)	608	6	93	2	23
6	12	UP. VILLA RECONCILIACION(50%)	612	6	93	2	23
6	13	NO SE CONSIDERARON VIVIENDAS EN ESTA U.T.B.	613	6	93	2	23
6	09	VILLA SAN JACINTO LIBRE	609	6	94	2	23
6	11	VILLA FRATERNIDAD(10%)	611	6	94	2	23
6	10	VILLA VENEZUELA(80%)	610	6	95	2	23
6	14	NUEVA ESPERANZA	614	6	96	2	24
6	15	CAMILO CHAMORRO	615	6	96	2	24
6	16	JOSE BENITO ESCOBAR(10%)	616	6	97	2	24
6	17	LAS MERCEDES	617	6	97	2	24
6	18	JORGE SALAZAR	618	6	98	2	25
6	24	NO SE CONSIDERARON VIVIENDAS EN ESTA U.T.B.	624	6	98	2	25
6	33	DE LA U.T.B. 25,SON CONSIDERADAS RURALES	633	6	98	2	25
6	34		634	6	98	2	25
6	19	CONCEPCION DE MARIA	619	6	99	2	26
6	20	BARRIO NUEVO	620	6	99	2	26
6	21	ARLEN SIU	621	6	100	2	26
6	22	VILLA LIBERTAD	622	6	100	2	26
6	23	NO SE CONSIDERARON VIVIENDAS EN ESTA U.T.B.	623	6	101	2	27
6	28	ESCUELA QUEMADA	628	6	101	2	27
6	29	EL RODEITO	629	6	101	2	27
6	30	DE LA U.T.B. 25,SON CONSIDERADAS RURALES	630	6	101	2	27
6	31	DE LA U.T.B. 25,SON CONSIDERADAS RURALES	631	6	101	2	27
6	32	ASENT. ESPONT. SAN CRISTORAL	632	6	101	2	27
6	25	PALESTINA	625	6	102	2	25
6	35		635	6	102	2	25
6	36		636	6	102	2	25
6	26	DE LA U.T.B. 25,SON CONSIDERADAS RURALES	626	6	103	2	28
6	27	CAMINO DEL RIO	627	6	103	2	28
6	37		637	6	104	2	28
6	38		638	6	104	2	28
6	39		639	6	104	2	28
6	40	SABANA GRANDE (1COMARCA)	640	6	104	2	28
6	81		681	6	104	2	28
6	80	SABANA GRANDE (+UTB)	680	6	105	2	28
7	80	COMARCA BERLIN	780	7	106	1	29
7	81	COMARCA LAS JAGUAS(LAS JAGUAS)	781	7	106	1	29
7	82	COMARCA LOS HIDALGOS	782	7	106	1	29
7	83	COMARA CHICHIHUALTEPE	783	7	106	1	29
7	84	COMARCA LAS PILAS	784	7	106	1	29
7	85	LAS PILAS(LAS PILAS No.2)	785	7	106	1	29
7	86	COMARCA LOS CHOCOYOS	786	7	106	1	29
7	87	LOS FIERROS	787	7	106	1	29
7	88	COMARCA SECTOR SN.RAMON(LAS CUILLAS SUR)	788	7	106	1	29

Zone Code Reference Table

District No.	UTB No.	Principal Barrio Name	Survey Zone	District Zone	Traffic Zone	Screenline Zone	Planning Zone
7	89	COMARCASECTOR CANDELARIA	789	7	106	1	29
8			811	8	107	1	30
8			812	8	108	1	30
8			813	9	109	1	31
8			814	10	110	2	32
8			815	11	111	2	33
8			816	11	111	2	33
8			821	12	112	1	34
8			827	12	112	1	34
8			822	14	113	2	36
8			828	14	113	2	36
8			829	14	113	2	36
8			830	14	113	2	36
8			831	14	113	2	36
8			832	14	113	2	36
8			823	14	114	2	36
8			824	13	115	2	35
8			825	13	116	2	35
8			826	13	117	1	35
8			833	14	118	2	36
8			834	14	118	2	36
8			835	14	118	2	36
8			836	13	119	2	35
8			840	12	120	2	34
8			841	13	121	2	35

APPENDIX 4 OD MATRICES (PLANNING ZONE)

(Walk, M/C and Others)

Person Trip OD Matrix by Travel Mode and Planning Zone in 1998

Travel Zone	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	Total		
1	3,646	912	2,063	0	0	0	0	0	0	0	0	0	0	0	0	77	0	0	0	0	0	0	0	0	0	0	0	0	0	63	8,678	
2	99	34,377	702	68	39	276	346	0	0	68	0	0	39	169	175	299	0	112	0	0	20	0	27	0	0	340	0	0	0	463	38,059	
3	2,063	197	2,063	0	0	0	0	0	0	0	0	0	40	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2,260		
4	0	68	0	6,244	1,764	0	838	123	123	0	24	0	22	1,640	372	163	111	156	0	0	0	0	145	38	0	0	0	0	0	74	11,861	
5	0	39	0	1,771	6,074	4,810	1,233	0	228	79	68	0	22	381	352	24	460	267	0	0	0	0	232	348	50	63	0	0	0	31	20,808	
6	0	276	0	5,188	14,212	451	0	115	25	105	34	0	64	64	141	0	36	114	0	74	0	0	269	82	0	0	0	0	0	0	117	21,987
7	27	156	0	747	1,908	439	3,839	143	2,783	974	463	217	22	747	541	114	862	189	0	0	100	0	138	120	71	200	0	0	0	31	85	51,747
8	0	0	0	178	0	31	77	33	713	313	192	0	127	0	65	116	0	0	0	0	0	0	0	0	0	0	0	0	0	0	14	1,642
9	64	0	0	95	201	55	2,821	617	1,692	567	742	2,334	0	138	207	0	208	209	0	25	0	0	127	23	83	0	82	0	0	2	26,611	
10	31	68	0	24	21	25	1,063	0	556	3,260	14	149	42	0	25	207	166	0	21	0	0	0	0	0	0	0	0	0	0	5	5,719	
11	0	0	0	0	166	28	463	131	713	14	2,639	294	0	0	420	0	1,096	112	0	69	46	0	29	19	0	0	0	0	0	31	6,619	
12	0	68	0	24	0	55	273	114	2,351	127	315	875	0	0	190	21	0	0	0	0	0	0	0	43	0	0	60	0	0	0	10,962	
13	29	39	0	0	22	0	48	0	0	42	0	0	0	0	0	0	201	0	0	33	0	0	0	0	0	0	0	0	0	0	0	16,377
14	0	149	0	1,098	323	64	507	83	73	46	0	22	0	0	0	1,386	1,157	461	0	85	0	0	0	188	0	264	0	0	0	27	251	33,643
15	0	185	46	426	321	141	336	46	186	46	420	131	0	754	2,384	4,716	4,191	1,162	556	81	211	0	3,339	238	0	21	0	0	0	99	25,876	
16	77	290	0	201	24	0	158	0	0	0	75	21	0	1,901	4,615	11,297	1,118	61	0	0	62	0	372	292	0	101	0	0	0	0	75	19,740
17	0	68	0	111	470	110	724	32	208	177	725	0	201	1,971	4,487	11,297	2,933	7,003	202	329	523	71	631	242	39	127	39	0	0	0	424	47,247
18	0	112	0	156	167	245	194	184	176	131	331	0	33	426	1,191	61	714	3,982	46	571	3,170	0	2,243	907	0	36	0	0	0	0	67	53,061
19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	354	0	0	0	0	0	254	0	0	0	0	0	0	0	0	0	4,616
20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	342	603	1,646	0	0	0	185	0	0	120	0	0	0	0	0	54	12,109
21	0	0	0	0	0	0	100	0	0	0	0	0	0	0	0	544	3,477	26	1,152	0	17	1,300	97	23	1,206	0	115	0	0	22	27,169	
22	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	77	0	0	39	0	0	0	0	0	239	
23	0	27	0	92	202	315	206	0	127	55	0	21	0	333	2,221	596	675	2,212	0	185	1,202	0	833	1,484	251	2,169	85	78	0	139	97,899	
24	0	0	0	21	366	82	142	0	23	0	39	43	0	146	394	401	242	908	0	22	97	77	1,770	20,200	693	378	43	94	0	29	25,998	
25	0	340	0	0	0	0	71	0	83	0	0	0	0	0	0	0	39	0	0	0	23	0	231	772	3,073	529	113	0	0	149	6,953	
26	0	0	0	0	0	0	200	0	0	0	0	0	0	264	51	101	68	62	0	120	1,106	39	2,211	258	488	1,106	0	292	0	128	18,617	
27	0	0	0	0	0	0	0	0	82	0	0	60	0	0	0	0	39	0	0	0	0	85	22	662	0	4,296	112	0	0	0	5,398	
28	0	0	0	0	0	0	27	0	0	0	0	0	0	0	0	0	57	0	0	0	133	0	78	94	78	292	11	0	0	5,374		
29	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9,023	
30	39	377	0	83	26	12	30	17	22	16	39	0	124	44	243	38	477	137	0	48	22	0	38	22	49	13	33	351	284	92	2,330	
Total	8,770	37,722	2,665	11,539	47,608	29,954	51,156	17,748	24,812	5,622	6,126	10,805	24,278	36,278	76,794	20,867	47,309	53,546	44,810	12,699	26,539	258	97,654	25,937	8,220	16,667	5,290	8,437	9,099	3,181	705,440	

(Car, Trucks and Taxi)

Person Trip OD Matrix by Travel Mode and Planning Zone in 1998

Travel Zone	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	Total		
1	3,600	474	372	0	315	78	346	0	76	173	112	0	91	181	310	76	0	127	0	0	0	0	176	85	330	199	0	0	0	0	369	4,243
2	638	23,967	795	488	354	692	434	221	268	331	66	0	76	738	494	0	0	0	0	76	237	0	249	144	714	303	0	0	0	0	1,766	
3	795	795	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2,591	
4	0	81	0	1,971	1,427	729	1,872	395	630	469	418	198	145	1,419	2,083	242	1,680	718	0	328	151	0	844	439	208	172	0	0	0	0	303	10,022
5	315	484	0	1,376	3,095	6,431	2,872	711	999	1,023	1,973	198	539	3,537	2,891	299	2,234	1,984	564	437	0	76	3,079	1,508	936	604	76	0	0	170	21,102	
6	243	550	296	694	6,182	3,939	4,337	958	1,780	1,353	4,024	306	2,109	2,457	2,860	292	1,963	2,260	0	1,113	69	0	1,374	833	464	734	0	0	0	2,149	44,259	
7	345	516	58	1,908	3,002	4,090	10,973	769	3,164	1,858	1,530	1,033	1,644	4,937	3,347	847	5,468	2,806	82	3,255	437	0	3,176	1,071	507	388	155	0	334	15,959		
8	0	169	0	395	277	1,044	782	243	437	44	91	264	132	604	1,236	0	1,389	814	0	564	72	0	1,223	208	0	0	0	79	180	504	7,043	
9	0	170	0	295	1,142	1,849	3,259	416	3,003	1,347	2,458	301	360	2,310	1,936	818	948	1,055	76	2,810	142	0	1,787	478	620	686	0	110	0	1,141	30,627	
10	28	237	0	556	883	952	2,071	211	1,075	1,041	390	306	529	616	1,742	0	1,370	772	104	214	79	0	1,160	273	246	208	0	225	389	683	16,395	
11	85	66	0	410	2,117	4,788	2,094	152	2,576	296	3,046	663	1,560	1,165	6,397	683	5,005	3,782	0	2,282	352	325	5,047	685	0	484	211	0	189	932	48,592	

(Microbus and Bus)

Person Trip OD Matrix by Travel Mode and Planning Zone in 1998

Traffic Zone	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	Total	
1	482	391	0	168	949	692	1,237	808	144	133	471	108	61	1,380	501	170	202	288	0	265	0	0	107	124	41	32	0	0	0	191	7,939	
2	463	1,351	0	746	1,323	1,972	1,238	37	638	855	399	61	34	4,811	1,698	173	756	304	102	211	67	0	330	288	206	147	34	0	37	1,601	22,437	
3	0	30	76	142	0	0	180	0	513	118	0	0	59	548	274	132	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2,028
4	131	837	142	1,531	1,969	756	731	169	836	373	128	481	139	2,649	1,884	774	1,271	614	0	39	365	0	1,323	441	37	229	36	97	45	22	17,210	
5	875	1,254	0	1,899	3,094	4,134	3,587	591	1,967	1,444	817	979	346	5,511	2,992	1,082	1,779	1,846	0	226	237	0	3,215	1,008	335	595	0	48	0	1,204	42,486	
6	652	1,803	0	762	3,893	3,874	3,478	636	1,635	721	303	607	484	1,623	2,295	659	1,793	2,584	0	184	617	0	2,894	714	241	172	0	138	0	1,278	32,025	
7	337	1,284	176	882	3,336	3,561	3,436	1,428	1,109	1,109	1,461	2,191	1,738	5,713	3,401	1,040	3,226	2,271	0	472	723	29	3,469	1,275	144	964	0	34	356	4,238	54,538	
8	144	71	0	221	563	477	1,463	1,147	968	109	44	598	109	1,377	2,531	393	1,403	1,404	0	38	147	0	1,729	831	65	399	0	49	0	604	13,069	
9	133	570	515	801	1,947	1,845	4,190	939	753	2,495	923	3,862	1,918	545	1,759	1,082	1,759	1,082	76	307	402	0	2,378	1,022	652	199	0	118	1,302	33,589		
10	241	751	118	386	1,237	974	1,377	73	934	334	237	327	307	1,165	1,142	366	687	392	73	21	174	0	978	366	18	138	0	110	1,743	14,264		
11	130	389	0	68	568	974	1,350	240	557	702	751	515	391	2,328	994	464	1,686	1,828	98	444	562	32	1,967	876	0	148	175	0	135	17	14,101	
12	71	61	0	350	1,000	833	2,450	598	2,674	347	653	334	391	2,328	994	464	1,686	1,828	98	444	562	32	1,967	876	0	148	175	0	135	17	14,101	
13	100	65	59	224	464	548	1,554	109	932	530	354	293	369	99	1,414	149	720	484	0	59	0	0	341	182	0	80	0	0	279	377	13,721	
14	1,508	4,319	548	2,442	4,972	1,701	3,684	239	3,651	919	363	2,730	118	2,246	3,015	2,925	6,051	5,237	149	629	2,862	66	10,571	5,627	1,876	2,260	372	274	87	8,163	87,338	
15	459	1,355	274	1,492	2,983	2,234	3,566	2,560	1,748	971	1,298	594	1,464	8,210	2,538	3,413	6,131	6,283	234	1,725	2,838	13	11,215	4,401	1,380	2,074	151	493	311	782	84,233	
16	115	208	132	796	577	698	872	528	542	431	161	434	149	3,111	3,084	2,264	1,943	2,505	0	119	679	0	3,183	2,640	514	603	0	41	0	1,028	27,196	
17	188	640	0	1,290	1,802	1,802	3,329	1,354	1,706	727	1,601	712	728	6,729	3,741	2,131	5,976	3,823	124	1,219	3,026	46	3,208	1,622	706	1,431	248	143	88	2,123	61,542	
18	249	304	0	704	1,604	1,698	1,984	1,338	1,311	451	1,599	245	428	5,266	6,089	1,604	8,984	3,183	384	2,564	2,282	64	5,851	1,477	919	1,064	597	48	42	3,968	64,292	
19	0	108	0	0	0	0	0	0	76	73	73	0	0	149	234	0	124	384	0	111	28	0	73	31	0	105	0	0	0	0	0	1,627
20	189	211	0	39	189	219	410	0	542	21	409	60	39	386	1,530	119	995	2,495	111	1,297	554	0	796	335	83	118	83	52	0	533	12,085	
21	0	67	0	370	316	613	526	115	392	205	635	0	0	3,034	2,964	645	3,076	2,144	28	618	1,223	0	1,972	400	394	456	194	52	0	648	21,487	
22	0	0	0	0	0	0	0	0	0	15	0	0	0	66	13	14	46	64	0	0	0	0	28	14	0	17	0	0	0	0	0	396
23	180	606	0	1,352	3,186	2,882	3,045	1,859	2,140	1,191	2,386	403	530	10,048	11,524	3,363	5,604	5,903	0	995	1,800	28	22,373	5,203	4,702	6,904	623	641	0	4,825	106,231	
24	124	260	0	441	809	835	1,779	764	1,049	429	961	142	182	3,007	4,530	1,931	1,783	1,520	31	250	454	14	5,172	5,631	3,505	1,544	608	271	0	1,794	42,467	
25	41	208	0	37	257	211	145	63	614	13	0	271	0	963	1,998	612	706	809	0	25	362	0	4,431	3,081	3,311	525	479	846	46	1,823	16,420	
26	32	75	0	293	463	172	815	436	418	77	96	57	80	2,275	1,911	613	1,512	1,090	103	64	631	0	7,047	1,339	765	1,121	0	350	0	473	25,515	
27	0	34	0	30	0	0	30	0	0	0	0	27	0	572	151	0	146	458	0	42	194	0	571	546	376	89	0	0	0	188	3,454	
28	0	0	0	97	48	138	0	40	0	0	0	30	0	246	496	51	143	48	0	52	0	0	653	315	893	394	0	813	0	48	4,572	
29	0	37	0	87	0	6	301	0	118	42	219	0	403	45	262	0	88	42	0	44	0	0	0	0	0	49	0	0	543	872	3,453	
30	174	266	0	288	736	962	3,613	692	331	1,269	103	208	364	3,205	857	415	2,333	1,859	73	463	432	0	2,674	972	1,968	3,341	168	0	685	3,919	32,855	
Total	7,387	20,325	1,864	17,046	41,029	33,020	53,397	18,678	34,843	14,453	18,589	13,763	13,174	85,513	83,682	24,999	64,247	59,280	1,546	13,081	20,724	292	101,353	48,614	19,453	23,321	3,988	4,427	2,885	42,442	879,974	

Estimated Person Trip OD Matrix by Travel Mode and Planning Zone in 2003

(Walk, M/C and Others)

Table showing estimated person trip OD matrix for walk, M/C and others. Includes Traffic Zone columns 1-30 and Total row. Values range from 0 to 6,770.

Estimated Person Trip OD Matrix by Travel Mode and Planning Zone in 2003

(Car, Trucks and Taxi)

Table showing estimated person trip OD matrix for car, trucks and taxi. Includes Traffic Zone columns 1-30 and Total row. Values range from 0 to 15,984.

(Microbus and Bus)

Estimated Person Trip OD Matrix by Travel Mode and Planning Zone in 2003

Traffic Zone	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	Total
1	359	1,463	72	37	873	673	1,048	174	64	406	347	562	374	875	1,038	253	696	565	116	273	265	11	738	296	166	276	33	47	45	74,155	
2	1,342	4,031	164	1195	2,164	1,575	2,298	397	1,872	918	779	1,377	832	1,584	2,464	609	1,816	1,314	274	647	638	28	1,763	717	366	652	76	116	109	2,697.3	
3	74	174	167	115	210	133	255	43	181	126	91	164	99	193	233	155	165	130	28	58	57	9	155	58	31	56	6	13	9	3,101	
4	520	1,283	124	114	2,035	1,448	2,765	356	1,725	587	694	1,690	742	2,191	3,341	856	2,179	2,020	419	931	1,063	38	2,915	1,131	273	820	90	198	113	210	35,649
5	901	2,282	221	2,400	3,781	3,028	4,780	659	2,957	1,301	1,244	2,647	1,364	3,461	4,667	1,174	3,131	2,684	991	1,280	1,382	51	3,735	1,472	509	1,185	139	232	191	1,443	56,838
6	664	1,643	161	1,250	2,930	2,747	2,873	408	1,915	854	742	1,796	996	3,114	2,573	699	1,776	1,579	268	743	853	29	2,170	851	233	672	73	159	133	15,279	
7	973	3,374	261	2,542	4,764	3,186	5,256	921	4,661	1,622	1,789	2,907	1,801	3,853	5,969	1,390	4,615	3,934	944	1,954	2,017	68	5,079	1,869	698	1,495	132	334	428	3,029	76,435
8	86	193	21	178	373	268	465	208	408	164	157	392	149	310	636	148	623	541	120	294	273	7	645	229	35	168	14	41	23	696	7,687
9	354	1,344	160	1,455	2,981	1,744	4,135	782	2,347	1,328	1,614	2,942	1,237	2,806	3,577	844	3,632	2,993	686	1,346	1,274	47	3,130	1,114	396	1,022	103	208	167	1,869	47,852
10	385	915	136	584	1,316	976	1,695	194	1,341	597	407	1,742	834	786	1,442	362	1,211	1,148	307	565	623	18	1,517	557	113	430	40	102	196	2,698	25,150
11	207	497	61	432	783	597	1,132	206	1,171	282	202	778	378	749	1,431	333	1,687	1,914	424	1,017	876	28	1,945	678	109	547	43	132	63	25	19,887
12	561	1,473	170	1,601	2,642	1,820	4,225	797	3,372	1,681	1,486	3,364	1,715	2,737	3,578	838	2,719	2,212	561	1,123	1,000	43	2,619	993	303	969	105	171	141	1,474	47,408
13	332	795	91	630	1,222	863	1,620	275	1,272	718	443	699	381	1,012	1,523	358	1,163	1,063	207	532	580	29	1,374	488	187	469	43	94	218	358	22,883
14	791	1,849	189	2,043	3,392	1,917	3,883	560	2,572	778	1,033	2,572	1,072	4,225	6,781	1,762	4,835	4,149	700	1,856	2,194	75	5,933	2,241	445	1,504	136	377	174	9,734	69,423
15	948	2,332	228	3,005	4,462	2,601	5,837	1,246	3,914	1,368	2,251	3,338	1,631	6,364	9,091	3,387	8,707	7,614	1,024	2,893	3,346	139	12,359	4,296	1,285	3,453	369	694	217	1,398	107,741
16	314	782	67	864	1,364	784	1,605	379	1,121	492	585	999	480	1,874	4,050	1,654	2,729	2,127	278	802	1,178	66	3,637	1,572	412	1,044	124	265	68	12,628	82,160
17	640	1,593	159	2,018	2,983	1,788	4,423	1,240	3,377	1,119	2,396	2,596	1,348	4,540	8,028	1,913	9,899	7,184	959	2,907	3,402	123	8,259	2,900	787	2,472	204	465	165	2,681	82,902
18	535	1,333	128	1,887	2,639	1,807	3,967	1,113	3,104	1,132	2,887	2,149	1,176	4,337	7,947	1,748	7,087	5,899	883	3,020	3,402	136	8,069	2,990	1,038	2,446	238	464	138	4,219	79,870
19	115	281	28	356	541	338	879	225	733	257	579	556	229	648	1,041	216	867	877	706	473	410	12	958	323	100	307	24	38	33	0	72,228
20	234	589	54	701	1,083	637	1,604	464	1,304	433	1,235	987	539	1,503	2,607	559	2,475	2,671	416	1,138	1,634	91	2,736	890	367	883	69	263	355	258	31,682
21	239	645	54	381	1,285	784	1,950	542	1,397	609	1,284	901	622	2,183	3,735	873	3,633	2,986	377	1,537	2,815	93	3,560	1,096	631	1,307	136	241	58	678	36,592
22	14	36	2	39	64	37	82	16	64	21	43	53	29	86	189	46	140	150	16	109	123	79	272	73	30	76	6	22	3	0	7,869.3
23	655	1,697	146	2,533	3,409	2,021	4,769	1,279	3,265	1,423	2,815	2,380	1,466	5,453	11,593	2,688	7,511	7,370	863	2,779	3,681	184	16,362	5,000	2,146	5,001	439	769	144	5,538	196,333
24	299	774	59	1,089	1,489	871	1,938	481	1,377	580	1,004	994	580	2,862	4,452	1,274	2,577	2,434	328	1,035	1,241	60	5,481	3,996	1,396	2,338	304	346	58	2,138	62,255
25	213	510	44	327	649	363	651	64	560	139	198	664	275	561	1,720	512	1,088	1,411	162	506	909	32	3,215	1,928	308	1,111	212	270	41	304	18,887
26	231	645	55	775	1,142	677	1,904	340	1,135	435	830	914	509	1,631	3,486	833	2,474	2,591	309	1,011	1,392	63	5,393	2,321	824	2,724	204	404	57	376	35,644
27	36	86	7	89	143	82	164	31	124	41	71	114	53	167	345	110	231	259	30	95	156	6	357	333	151	221	206	43	6	4	4,130
28	38	131	10	199	266	163	361	86	259	111	202	176	112	411	723	171	266	483	99	285	282	19	869	335	204	416	42	410	11	48	7,429
29	57	149	13	123	228	161	320	38	234	137	115	261	283	212	273	64	208	174	39	80	82	3	206	76	33	74	7	14	14	569	5,569
30	388	720	0	324	772	1,375	4,638	795	1,033	1,470	118	258	348	3,337	4,426	546	2,832	1,940	33	384	465	0	3,188	1,277	2,369	3,723	38	28	1,113	4,900	98,838
Total	13,295	32,613	3,615	31,299	54,728	35,069	75,178	14,273	51,547	21,891	28,733	45,308	23,894	63,419	107,552	24,216	81,523	74,036	12,833	34,723	38,232	1,530	199,679	41,086	15,953	38,181	3,797	6,953	4,773	58,863	1,138,747

Estimated Person Trip OD Matrix by Travel Mode and Planning Zone in 2008

(Walk, M/C and Others)

Traffic Zones	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	Total	
1	579	600	829	117	160	144	195	18	121	96	44	53	65	132	21	86	79	245	177	30	0	0	0	0	0	0	0	0	0	62	16,826	
2	575	32,443	678	304	462	422	325	38	336	235	129	326	117	308	336	87	63	67	267	173	0	0	68	25	0	0	0	0	0	602	8,576	
3	1,066	924	2,042	63	143	120	150	0	102	65	23	110	22	2189	1,476	335	928	684	181	383	255	17	791	259	42	167	0	12	0	238	37,407	
4	121	327	651	10,618	2,721	883	2,135	144	772	213	318	578	107	2,189	1,476	335	928	684	181	383	255	17	791	259	42	167	0	12	0	184	24,799	
5	161	489	201	20,272	3,133	2,807	1,609	1,004	584	262	724	121	1,235	1,077	233	720	337	512	302	192	116	0	324	100	76	0	0	0	0	95	58,536	
6	145	405	108	73	2,594	12,314	2,789	117	862	702	155	572	100	551	364	108	338	287	54	82	116	0	324	100	76	0	0	0	0	184	24,799	
7	172	519	126	1,386	2,819	3,220	3,021	1,664	3,423	1,294	641	1,888	338	2,070	2,066	322	1,205	1,290	593	684	408	20	1,106	377	54	256	0	13	0	95	58,536	
8	0	21	0	48	60	24	38	33	69	17	65	86	0	121	171	26	664	272	41	47	44	0	101	20	0	0	0	0	0	18	3,536	
9	96	303	82	606	879	802	3,072	544	20,669	1,201	1,258	1,882	234	716	989	166	1,282	1,184	479	693	316	24	777	184	40	171	0	0	0	54	38,497	
10	89	248	48	219	582	856	1,335	46	1,688	540	101	1,127	304	165	362	43	363	321	48	176	124	11	273	63	45	0	0	0	0	0	15,956	
11	25	81	0	131	153	88	399	87	898	49	627	251	0	147	346	66	783	1,374	774	543	231	15	506	112	11	111	0	0	0	41	12,159	
12	91	351	82	544	786	600	1,887	221	2,177	1,075	384	254	644	345	545	644	638	517	141	129	164	0	438	49	0	0	0	0	0	0	41,751	
13	0	136	0	0	85	77	260	10	214	216	23	591	15,968	40	0	0	0	0	0	0	0	33	0	0	10	0	0	0	0	0	66	15,648
14	91	292	65	1,999	1,240	593	2,057	301	755	171	270	494	52	3,393	4,634	741	2,030	1,237	169	452	414	29	1,295	416	55	231	0	11	0	268	35,706	
15	105	383	66	1,289	1,019	488	1,939	447	1,107	247	549	592	0	4,790	6,936	2,308	6,733	3,313	189	836	1,120	108	5,757	1,190	252	788	10	37	0	373	78,991	
16	35	108	16	363	289	139	394	72	229	50	102	156	0	860	2,822	954	930	679	49	163	269	24	1,396	557	78	212	12	15	0	97	19,075	
17	66	264	40	762	680	347	1,758	1,447	1,410	316	1,027	637	31	2,211	6,861	7,216	3,811	2,716	408	1,369	1,259	112	3,382	572	140	613	0	33	0	153	72,063	
18	26	193	46	623	530	295	1,206	533	1,338	316	2,184	501	83	1,284	3,327	556	2,386	3,858	669	1,822	2,084	164	4,591	588	219	746	21	46	0	137	64,682	
19	0	20	0	122	71	42	454	119	463	98	1,256	93	0	97	180	10	344	600	574	64	99	0	116	0	0	21	0	0	0	0	15,795	
20	0	0	0	221	120	36	474	155	468	85	659	100	55	281	670	88	1,097	1,550	57	13,576	954	3,343	0	774	92	53	205	0	10	0	87	32,875
21	0	0	0	233	183	112	400	119	533	105	321	150	44	403	1,014	188	1,130	1,817	98	869	1,480	217	1,260	194	109	280	10	25	0	41	26,280	
22	0	0	0	31	11	0	54	12	32	14	39	0	32	36	123	20	119	167	0	0	0	146	146	12	15	40	0	0	0	0	4,659	
23	0	73	0	666	498	287	1,014	253	775	239	634	375	0	1,191	3,334	583	3,020	4,088	94	771	1,315	121	3,066	627	2,540	54	116	0	368	86,105		
24	0	27	0	234	195	105	329	65	231	67	156	49	0	392	1,230	429	564	545	0	125	217	11	3,423	3,395	900	764	56	26	0	166	27,901	
25	0	0	0	0	48	69	38	70	0	83	10	26	0	68	350	93	196	273	0	90	148	18	832	678	2,974	333	76	57	0	202	6,781	
26	0	0	0	146	138	77	245	45	205	47	145	56	0	234	797	180	616	732	36	263	307	35	2,548	763	288	13,845	23	96	0	0	24,101	
27	0	0	0	0	0	0	0	0	0	0	0	0	0	11	10	10	10	23	0	0	12	0	86	62	49	36	2,399	0	0	0	102	2,760
28	0	0	0	13	0	0	15	0	0	0	11	0	0	22	39	11	35	48	0	11	28	0	133	26	51	99	0	0	0	0	3,625	
29	0	0	0	0	0	0	0	0	0	0	11	44	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4,074	
30	111	521	0	12	39	97	55	21	41	20	52	0	16	80	303	591	133	153	0	80	31	0	217	131	127	73	165	0	30	0	2,564	
Total	10,907	38,808	7,381	24,229	36,668	23,331	36,603	6,857	39,223	13,054	15,675	41,005	15,333	33,573	76,463	16,992	70,741	67,253	14,883	34,298	26,993	4,470	88,621	27,829	5,725	31,795	2,766	3,574	4,064	5,826	321,013	

Estimated Person Trip OD Matrix by Travel Mode and Planning Zone in 2008

(Car, Trucks and Taxi)

Traffic Zones	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	Total
1	956	790	461	825	882	612	1,408	333	1,949	619	606	958	611	1,046	1,025	399	1,116	1,084	360	556	480	79	1,346	605	478	618	122	106	125	447	20,934
2	770	37,479	1,654	1,912	1,384	2,850	474	2,325	1,274	1,242	1,274	1,545	2,043	3,514	869	2,288	2,400	2,707	2,883	1,183	1,228	228	2,302	1,483	979	1,384	266	378	376	2,091	48,958
3	312	653	208	554	660	459	951	163	769	407	375	796	466	696	1,175	299	818	865	306	788	456	82	1,202	588	310	495	95	104	154	525	15,698
4	1,005	1,868	718	2,189	2,299	1,646	2,696	342	2,245	788	1,131	1,115	1,817	3,868	3,423	2,847	3,273	3,049	1,503	4,710	1,906	327	4,199	1,945	882	1,563	288	359	462	2,278	60,618
5	975	2,099	818	1,945	2,925	2,081	3,412	522	2,635	1,188	1,393	3,160	2,170	2,257	4,799	1,053	3,273	3,049	1,503	4,710	1,906	327	4,199	1,945	882	1,563	288	359	462	2,278	60,618
6	686	1,554	581	1,340	1,035	1,247	2,556	393	1,968	965	1,003	2,226	1,520	1,584	2,994	727	2,256	2,114	995	3,042	1,042	225	2,897	1,328	610	1,087	195	243	317	2,641	42,592
7	1,050	1,044	1,224	2,251	3,739	2,363	6,717	702	4,667	1,524	2,024	5,401	3,692	2,983	6,481	1,547	5,682	5,070	2,830	9,333	2,561	684	6,930	3,166	1,082	2,391	405	614	743	2,254	94,574
8	161	488	111	292	307	247	416	259	411	118	209	549	355	355	655	147	672	551	317	1,080	272	68	720	328	81	253	36	59	75	683	9,879
9	1,663	2,237	874	1,875	2,479	1,904	3,830	651	4,583	1,471	1,798	3,990	2,500	2,346	4,791	1,126	3,981	3,639	1,869	5,826	1,743	402	4,790	2,158	966	1,775	312	414	518	1,416	67,199
10	769	1,346	548	785	1,396	1,241	1,800	197	1,857	1,088	778	2,633	1,843	916	2,499	598	2,510	2,124	1,305	4,293	1,118	289	2,992	1,986	366	1,001	157	270	334	241	38,659
11	533	1,076	412	889	1,173	879	1,671	279	1,676	599	1,539	1,816	1,179	1,099	2,366	551	2,185	2,159	1,131	3,305	941	226	2,605	1,155	419	912	144	222	250	1,809	34,781
12	986	2,577	983	2,589	2,929	2,077	4,714	874	3,859	2,074	2,022	5,266	2,492	3,259	5,988	1,341	4,919	3,731	1,446	4,110	1,722	356	4,755	2,164	1,468	2,042	395	405	554	755	71,409
13	637	1,654	614	1,624	1,925	1,569	2,992	536	2,386	1,356	1,254	2,892	1,644	1,644	2,983	6,481	2,477														

Estimated Person Trip OD Matrix by Travel Mode and Planning Zone in 2008

Travel Zone	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	Total		
1	1,072	1,500	643	661	854	646	1,137	170	773	518	543	763	401	764	1,013	232	615	618	220	377	283	43	737	282	165	270	31	48	322	15,884	
2	1,437	1,533	1,319	1,442	1,973	1,404	2,515	571	1,534	1,111	746	1,842	530	2,366	576	247	1,453	1,026	518	916	702	108	1,765	689	359	632	70	123	109	37,385	
3	735	639	396	337	866	630	978	125	754	413	254	973	444	608	973	547	2,649	703	272	440	387	62	914	370	132	298	29	68	64	15,414	
4	625	1,673	696	1,545	2,944	1,699	3,290	380	2,257	771	770	2,698	947	2,332	3,897	975	2,649	2,581	1,037	1,714	1,356	239	3,465	1,335	386	1,003	102	244	129	2,65	
5	813	2,032	745	2,086	3,176	2,724	4,678	606	3,089	1,473	1,138	3,076	1,371	2,872	4,161	1,631	2,768	2,593	1,064	1,714	1,286	219	3,304	1,270	535	1,062	117	240	163	1,647	
6	622	1,352	530	1,444	2,630	2,759	2,904	394	2,671	1,000	703	2,131	990	1,573	2,375	570	1,628	1,292	698	1,061	801	139	1,922	763	285	627	65	145	116	1,916	
7	1,028	2,434	897	3,066	4,673	3,213	5,093	889	5,466	1,929	1,687	5,630	2,101	3,366	6,007	1,378	4,709	4,462	2,151	2,037	374	5,279	1,903	607	1,555	149	365	431	6,180		
8	85	185	59	198	308	314	461	221	438	115	132	489	168	294	61	141	619	589	276	461	280	52	632	233	52	172	14	42	24	803	
9	618	1,533	579	1,953	2,728	1,927	4,894	860	3,378	1,761	1,638	4,362	1,571	2,402	3,998	919	3,483	3,504	1,669	2,365	1,666	238	3,634	1,245	511	1,167	112	260	185	2,825	
10	472	1,074	400	722	1,513	1,184	2,038	203	2,033	1,131	433	2,713	1,130	3,241	441	692	1,580	1,576	800	1,069	791	133	1,836	639	173	526	44	131	228	2,408	
11	264	476	155	489	747	508	1,150	203	1,385	310	223	1,231	441	692	1,513	338	1,692	2,194	1,018	1,044	920	164	1,948	622	157	563	41	141	60	34	
12	743	1,972	811	2,453	3,101	2,213	5,716	966	4,967	2,623	1,821	5,203	2,527	3,925	4,328	964	3,345	3,084	1,333	2,003	1,369	223	3,345	1,217	652	1,231	124	224	270	1,624	
13	349	840	328	807	1,195	831	1,863	296	1,955	902	380	2,253	3,201	938	1,570	355	1,197	1,196	470	814	620	104	1,410	482	219	480	43	100	214	593	
14	664	1,577	521	2,159	2,823	1,665	3,507	527	2,354	881	963	2,741	1,037	3,323	5,723	1,415	4,154	3,757	1,327	2,530	1,897	333	4,913	1,815	526	1,379	133	140	11,285		
15	880	2,192	778	3,429	3,953	2,399	5,792	1,161	4,310	1,665	2,114	4,018	1,698	5,973	3,523	3,125	8,189	7,716	1,980	4,577	3,996	697	11,797	3,930	1,384	3,303	321	697	196	1,615	
16	288	716	248	1,012	1,103	710	1,576	306	1,212	403	555	1,103	489	1,570	3,713	1,589	2,075	2,097	538	1,193	1,190	203	3,365	1,427	453	975	111	201	60	1,468	
17	396	1,488	515	2,304	2,628	1,640	4,419	1,183	3,785	2,229	3,133	3,300	3,923	8,289	3,284	3,333	7,304	1,791	1,982	4,577	3,996	519	7,708	2,276	859	2,336	191	475	146	3,105	
18	564	1,439	551	2,431	2,758	1,623	4,477	1,157	4,005	1,526	3,164	2,969	3,334	3,839	7,907	1,715	7,337	3,042	3,008	4,599	3,697	570	8,300	2,380	1,179	2,705	230	506	141	4,833	
19	197	500	182	831	932	635	1,811	438	1,674	645	1,313	1,246	483	1,156	1,856	389	1,580	1,760	2,048	1,232	698	116	1,649	548	233	563	47	105	54	24,928	
20	302	788	242	1,270	1,398	880	2,471	704	2,230	815	1,984	1,649	811	2,081	3,512	888	3,522	4,202	1,176	1,132	2,492	542	3,921	1,196	571	1,343	101	397	67	6,324	
21	248	686	277	1,259	1,203	739	2,182	586	1,729	790	1,982	1,233	643	1,894	3,769	830	3,023	3,264	663	2,346	3,044	354	3,666	1,071	676	1,317	125	240	57	8,920	
22	44	124	51	256	238	135	413	93	325	166	231	333	122	383	355	180	531	598	128	528	415	317	707	222	169	274	28	73	10	2,784	
23	626	1,637	655	3,023	3,010	1,839	4,924	1,209	3,892	1,710	2,669	2,598	1,462	4,038	11,029	2,493	7,038	7,486	1,614	4,045	3,749	622	16,921	4,671	2,269	4,782	418	779	194	69,116	
24	273	729	286	1,295	1,276	784	1,978	448	1,461	692	940	1,300	546	1,904	4,087	1,140	2,337	2,308	589	1,363	1,700	214	5,059	3,821	1,336	2,148	266	335	51	2,478	
25	201	481	146	420	656	390	743	100	676	195	256	808	316	634	1,769	349	1,142	1,513	382	931	921	189	3,136	1,700	889	1,194	207	294	38	354	
26	241	622	228	943	1,023	629	1,571	338	1,304	534	821	1,148	533	1,419	3,341	792	2,346	2,650	686	1,545	1,389	255	5,171	2,142	947	2,820	196	429	53	436	
27	30	77	27	98	121	72	158	36	132	47	68	178	53	145	335	97	209	249	61	144	164	26	492	300	158	204	311	40	5	4,018	
28	49	136	54	248	251	156	483	87	317	147	210	244	119	355	735	167	305	525	120	425	294	74	873	340	241	422	44	10	47	8,040	
29	55	145	50	147	198	146	323	52	259	160	107	327	291	171	252	38	192	181	75	106	83	123	197	166	33	69	6	14	182		
30	427	838	0	377	900	1,294	3,348	921	1,322	1,303	138	301	389	4,449	1,650	627	3,301	2,245	61	446	541	0	3,793	1,478	2,174	4,324	45	351	1,322	46,214	
Total	14,493	33,398	12,127	46,439	53,179	36,172	81,618	14,994	63,258	27,406	38,789	61,999	27,868	59,524	109,092	24,879	83,462	83,113	26,623	55,487	41,549	7,145	111,369	49,341	78,680	39,744	3,721	7,527	5,066	39,918	1,277,463

(Walk, M/C and Others)

Estimated Person Trip OD Matrix by Travel Mode and Planning Zone in 2018

Table with 30 columns (Traffic Zones 1-30) and 30 rows (Traffic Zones 1-30). Total values are 38,418 on the diagonal and 945,754 for the total.

(Car, Trucks and Taxi)

Estimated Person Trip OD Matrix by Travel Mode and Planning Zone in 2018

Table with 30 columns (Traffic Zones 1-30) and 30 rows (Traffic Zones 1-30). Total values are 38,418 on the diagonal and 4,987 for the total.

1) Evaluation of Existing Signalized Intersections

- Out of 26 signalized intersections surveyed of traffic volume and signal phases, 24 were analyzed (No. 16 Montoya and No. 34 Gonzalez Theatre in Dupla Norte were excluded due to the wide-spread geometrical configurations) by HCS (Highway Capacity Software).
- HCS was prepared based on the 1994 HCM (Highway Capacity Manual) by TRB (Transportation Research Board) and FHWA (Federal Highway Administration) of USA. This software first assumes unadjusted service volumes in terms of mixed vehicle per hour of green for Standard Conditions (5% left-turning vehicles, 10% right-turning vehicles and no local transit bus). Then adjustments are made on the cycle time and green time based on actual directional flows at the intersection. The level of service before and after the adjustment is the output of this software.
- The following table presents the result of HCS application to the 24 intersections in Managua. The following can be pointed out:
 1. Most of existing signalized intersections are already saturated or nearly saturated under the current phasing.
 2. After some adjustment, however, the level of service will be greatly improved for most intersections.
 3. There are four (4) intersections which need geometrical improvement.
 4. There are 32 other signalized intersections in Managua not surveyed in this study. It is likely that these intersections also require adjustment of phasing.

Results of Analysis on 24 Signalized Intersections in Managua

INTERSECTION No.	INTERSECTION'S NAME	TOTAL VOLUME PEAK HOUR	INTERSECTING ROADS	TOTAL FLOW RATE	CURRENT SERVICE LEVEL	LEVEL OF SERVICE BEFORE THE CYCLE ADJUSTMENT	NUMBER OF PHASES	NEEDS FOR GEOMETRICAL IMPROVEMENT
1	Pista Larraynaga and Pista Juan Pablo II	2544	Prim. Col. with Prim. Dist.	0.815	F	D	4	NO
2	Pista Juan Pablo II and 30 Ave. East	2717	Prim. Dist. with Local Street	0.681	B	B	2	NO
3	Pista Juan Pablo II and Bolivar Ave.	4160	Prim. Dist. with Prim. Col.	0.778	*	D	4	NO
4	Pista Juan Pablo II and Radial Country Club	3634	Prim. Dist. with Prim. Dist.	0.878	*	B	3	NO
5	Pista Juan Pablo II with South Road	1886	Prim. Dist. with Prim. Col.	0.574	B	B	3	NO
6	Suburban Highway and Road to Masaya	3679	Prim. Dist. with Prim. Dist.	0.811	D	D	4	NO
7	Suburban Highway and Pista El Dorado	2982	Prim. Dist. with Prim. Col.	0.795	*	D	4	NO
8	Paseo Las Brisas and 35 Ave. West	2388	Prim. Dis. with Prim. Col.	0.909	*	E	4	YES
9	Pista Sabana Grande and Suburban Highway	3269	Prim. Dist. with Prim. Dist.	0.892	E	D	4	NO
10	South Road and Pista Intermedia	2944	Prim. Dist. with Prim. Col.	0.903	*	E	4	YES
11	Suburban Highway and Entrance to La Fuente	3329	Prim. Distr. with Sec. Col.	0.879	*	D	4	YES
12	Calle Colon and Fifth Ave. East	2196	Prim. Dist. with Prim. Col.	0.786	*	C	3	NO
13	Calle Colon and Bolivar Ave.	3616	Prim. Dist. with Prim. Col.	0.735	D	C	4	NO
14	Dupla Sur and Bolivar Ave.	2145	Prim. Dist. with Prim. Col.	0.522	C	C	4	NO
15	North Road and Pista Juan Pablo II	3979	Prim. Dist. with Prim. Dist.	0.882	*	D	3	NO
17	North Road and Suburban Highway	3516	Prim. Dist. with Prim. Dist.	0.814	*	D	4	NO
18	North Road and Pista Rural Side Road	3456	Prim. Dist. with Prim. Dist.	0.943	*	D	4	NO
19	Calle a la Venada and Suburban Highway	1959	Local street with Prim. Dis.	0.707	*	D	4	NO
21	Pista Juan Pablo II and Radial Santo Domingo	3470	Prim. Dist. with Prim. Col.	0.805	*	C	3	NO
23	Suburban Highway and Radial Santo Domingo	2929	Prim. Dist. with Prim. Col.	0.804	*	C	3	NO
25	Suburban Highway and Mail Entrance	2865	Prim. Dist. with Local street	0.765	*	C	3	NO
29	Pista Sabana Grande and Pista Buenos Aires	2180	Prim. Dist. with Prim. Col.	0.895	*	E	3	YES
31	South Road and Calle el Seminario	1606	Prim. Dis. with Prim. Dist.	0.739	*	C	4	NO
36	Radial Santo Domingo and Calle Colon	1467	Prim. Col with Prim. Dist.	0.595	C	C	4	NO

Note: 1) Intersection No. Corresponds to the intersection traffic count survey conducted in February 1998.
2) Level of Service:

LEVEL OF SERVICE A: This is a condition of free flow, accompanied by low volumes and high speeds. Traffic density will be low, with uninterrupted flow speeds controlled by driver desires, speed limits and physical roadway conditions. There is little or no restrictions in maneuverability due to the presence of other vehicles, and drivers can maintain their desired speeds with little or no delay.

LEVEL OF SERVICE B: This occurs in the zone of stable flow, with operating speeds beginning to be restricted somewhat by traffic conditions. Drivers still have reasonable freedom to select their speed and lane of operation. Reductions in speed are not unreasonable, with a low probability of traffic flow being restricted. The lower limit (lower speed, highest volume) of this level of service has been used in the design of rural highways.

LEVEL OF SERVICE C: This is still in the zone of stable flow, but speeds and maneuverability are more closely controlled by the higher volumes. Most of the drivers are restricted in their freedom to select their own speed, change lanes, or pass. A relatively satisfactory operating speed is still obtained, with service volumes suitable for urban design practice.

LEVEL OF SERVICE D: This level of service approaches unstable flow, with tolerable operating speeds being maintained, though considerably affected by changes in operating conditions. Fluctuations in volume and temporary restrictions to flow may cause substantial drops in operating speeds. Drivers have little freedom to maneuver, and comfort and convenience are low. These conditions can be tolerated, however, for short periods of time.

LEVEL OF SERVICE E: This cannot be described by speed alone, but represents operations at lower operating speeds, with volumes at or near the capacity of the highway. Flow is unstable and there may be stoppages of momentary duration. This level of service is associated with operation of facility at capacity flows.

LEVEL OF SERVICE F: This describes a force-flow operation at low speeds, where volumes are below capacity. In the extreme, both speeds and volume can drop to zero. These conditions usually result from a restriction downstream. The section under study will be serving as a storage area during parts or all of the peak hour. Speeds are reduced substantially and stoppages may occur for short or long periods of time because of the downstream congestion.

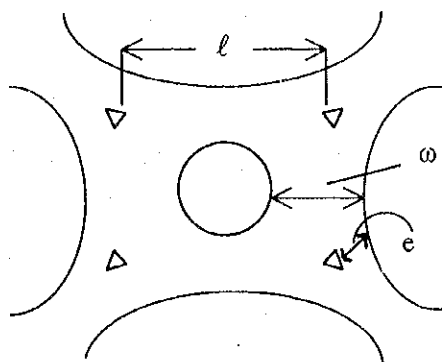
2) Capacity calculation of Existing Roundabouts

- At present, there are five (5) roundabouts in Managua. Based on the geometric design, their capacity has been calculated as shown below:

Capacity of Existing Roundabouts

Name	Dimension (m)			Capacity ³⁾ (veh./hr)
	e ¹⁾	ω ¹⁾	ℓ ¹⁾	
Metrocentro	9.00	14.00	57.70	2,960
Plaza España	13.25	14.00	48.25	3,380
Santo Domingo	15.50	16.22	54.75	3,920
Centro America ²⁾	12.50	14.00	48.00	3,280
Villa Progreso	16.00	18.00	71.25	4,340

Note 1)



- This roundabout is not conventional with flares. The calculated capacity may not be accurate.
- Formulae:

$$\text{Capacity } Q = \frac{160 (1 + e / \omega)}{1 + \omega / \ell}$$

(vehicle inflow: veh./hour)

- TRRL (Transport and Road Research Laboratory), UK

- Considering that all the legs of these roundabouts are 4-lane roads, the calculated capacity of 3,000 – 4,300 vehicles/hour seems to be smaller than that of signalized intersection (around 6,000 – 8,000 vehicles/hour).

3) **Comparison of Roundabout and Signalized Intersection**

- The following table compares the performance of signalized intersection and roundabout for the same traffic flows. The intersection is imaginary but typical in Managua. The analysis was done by SIDRA (Signalized and Unsignalized Intersection Design and Research Aid).
- The following can be pointed out:
 1. The total capacity is larger in signalized intersection than in roundabout. Although the degree of saturation does not differ much, signalized intersection has more room for adjustment of signal phases.
 2. Overall average delay time is similar. But in the case of roundabout, delay may be extremely large in some specific directions.

Comparison of Signalized Intersection and Roundabout

<SIGNALIZED INTERSECTIONS>

MOV No.	MOV Typ	Green Ratio	Time (g/C)	Total Flow (veh/h)	Total Cap. (veh/h)	Deg. Of Satn (v/c)	Prog. Factor	Ave. Delay (sec)	LOS
		1 st gm	2 nd gm						
SOUTH: South Approach									
1 L		.173		200	323	.620	.85	35.8	D
2 T		.173*		800	961	.832	.85	48.6	D
3 R		.173	.755	25	30	.834	.85	48.5	D
ALL MOVS:				1025	1314	.834		46.1	D
EAST: East Approach									
4 L		.209		300	395	.760	.85	38.2	D
5 T		.255		809	979	.826	.85	39.8	D
6 R		.673	.255	300	1626	.184	.85	.1	A
ALL MOVS:				1409	3000	.826		31.0	C
NORTH: North Approach									
7 L		.218		337	415	.811	.85	41.6	D
8 T		.218		400	1445	.277	.85	17.4	B
9 R		.218	.709	241	871	.277	.85	.2	A
ALL MOVS:				978	2731	.811		21.5	C
WEST: West Approach									
10 L		.209		300	373	.803	.85	42.1	D
11 T		.255		734	878	.836*	.85	41.8	D
12 R		.673	.255	74	1653	.045	.85	.1	A
ALL MOVS:				1108	2905	.836		39.1	D
INTERSECTION:				4520	9951	.836		34.4	D

Level of Service calculations are based on overall delay.
* Maximum v/c ratio, or critical green periods

<ROUNDBABOUT>

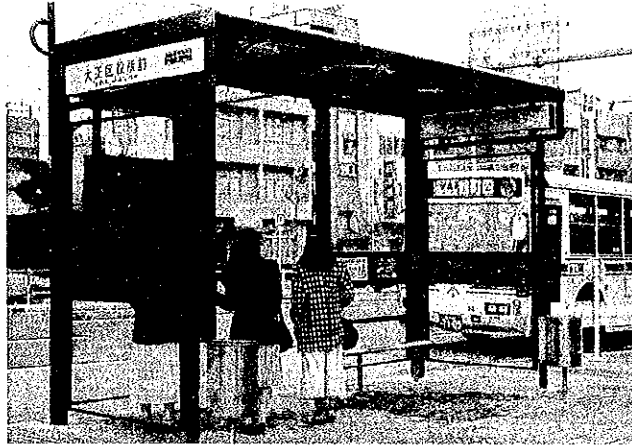
MOV No.	MOV Typ	Total Flow (veh/h)	Total Cap. (veh/h)	Deg. Of Satn (v/c)	Prog. Factor	Ave. Delay (sec)	LOS
SOUTH: South Approach							
1 L		200	274	.730	1.00	11.4	B
2 T		800	1095	.731	1.00	13.4	B
3 R		25	34	.735	1.00	15.2	B
ALL MOVS:		1025	1403	.735		13.1	B
EAST: East Approach							
4 L		300	299	1.003	1.00	79.2	F
5 T		809	805	1.005*	1.00	83.6	F
6 R		300	299	1.003	1.00	89.9	F
ALL MOVS:		1409	1403	1.005		84.0	F
NORTH: North Approach							
7 L		337	481	.701	1.00	9.9	B
8 T		400	571	.701	1.00	11.3	B
9 R		241	344	.701	1.00	13.2	B
ALL MOVS:		978	1396	.701		11.3	B
WEST: West Approach							
10 L		300	395	.759	1.00	10.0	B
11 T		734	966	.760	1.00	11.4	B
12 R		74	97	.763	1.00	12.4	B
ALL MOVS:		1108	1458	.763		11.1	B
INTERSECTION:		4520	5659	1.005		34.3	D

Level of Service calculations are based on overall delay.
* Maximum v/c ratio, or critical green periods

Urban New Bus System – Osaka (Japan)

City Population	2.6 million
Urban Public Transportation Services	Bus metro and elevated guided automated transport system operated by city authority, several commuter and interurban rail lines by private railway companies and JR, some privately operated buses.
Modal Share	Railways (61%), bus: (3%), taxi (4%), private car (32%)
New Bus System	Exclusive bus lane
Length of New Bus System	10.4 km (city bus total 446 km)
Fare	Flat ¥180 (=US\$ 1.20)
Start Year	April 1986
Purpose of New Bus System	<ul style="list-style-type: none"> • Reduce travel time • Provide comfort for passengers • Provide scheduled operation
System Features	<ul style="list-style-type: none"> • Bus priority lane (5:00 a.m. – 1:00 a.m.) • Bus priority signal • Special bus fleets (low floor, aircon, wide door) • Bus location system (with information display at stops) • Bus shelter (bus terrace)

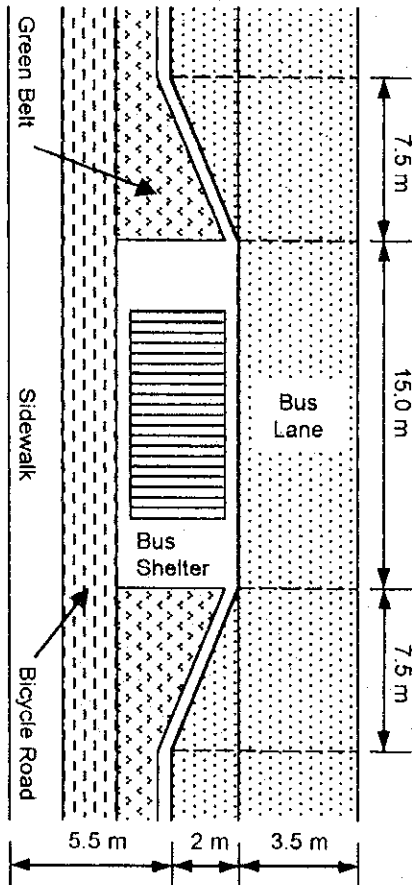
Bus Shelter



Bus Location System

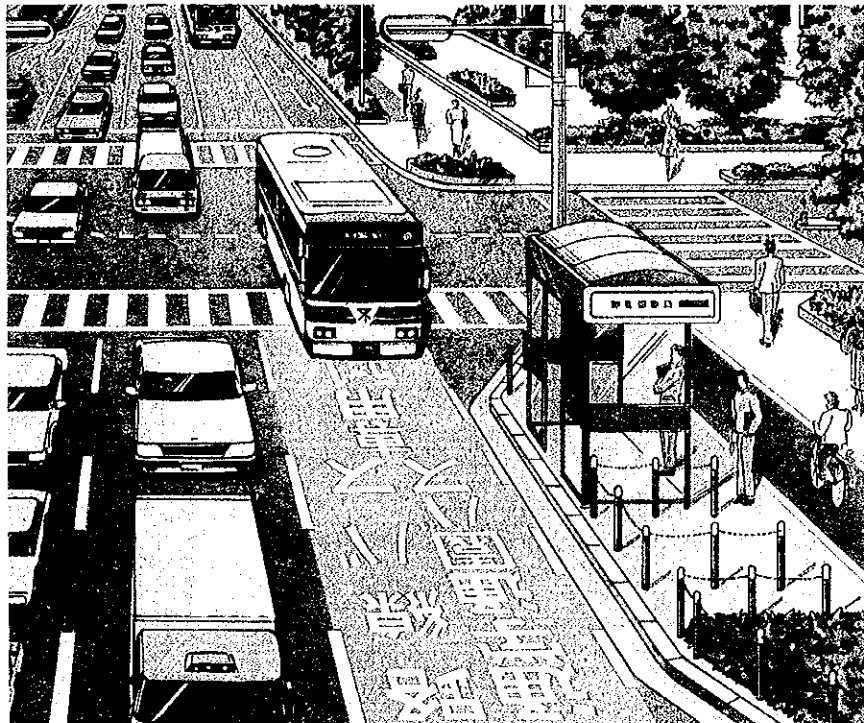


Section Plan at Bus Stop



Information Display

Concept of Urban New Bus System



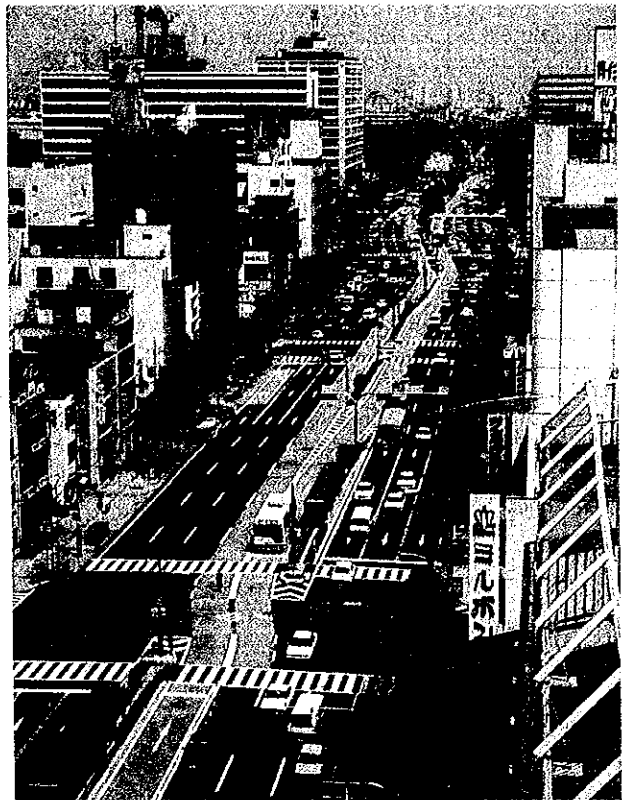
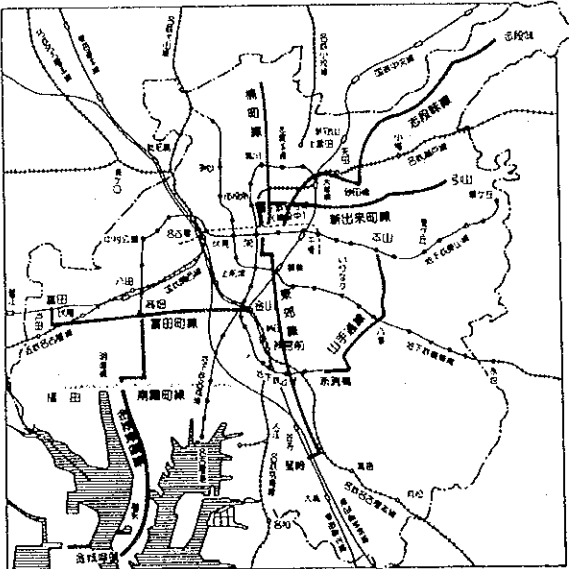
"Key Route" Bus System – Nagoya (Japan)

City Population	2.2 million
Urban Public Transportation Services	Bus and metro services operated by municipal undertaking, suburban/interurban services by private railway companies and JR, additional bus services operated by private railway companies.
New Bus System	Exclusive bus lane
Length of New Bus System	81 km (city bus total 666 km)
Fare	Flat
Start Year	1982-
Purpose of New Bus System	<ul style="list-style-type: none"> • Reduce travel time • Provide comfort for passengers • Provide scheduled operation
System Features	<ul style="list-style-type: none"> • Bus priority lane • Bus priority signal • Special bus fleets (low floor, aircon, wide door) • Bus location system (with information display at stops) • Distance bet. Stops : 800-1,000 m

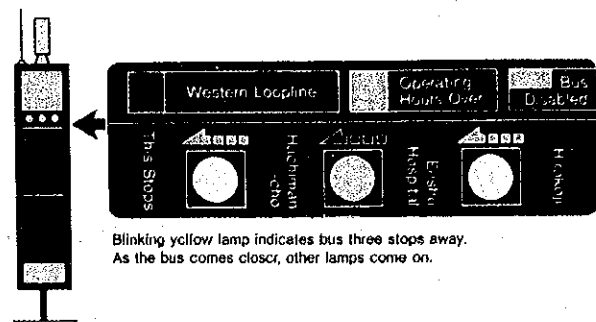
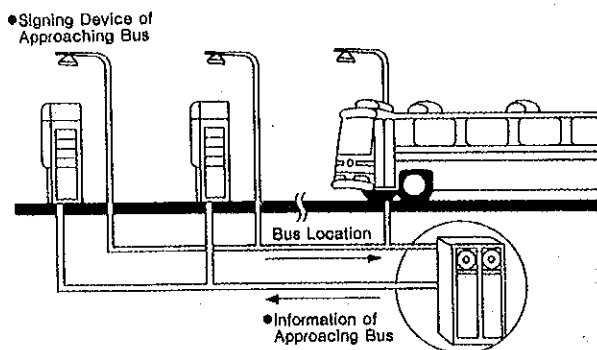
Shindekimachi line, with bus lanes in the center of roadway



"Key Route" network plan



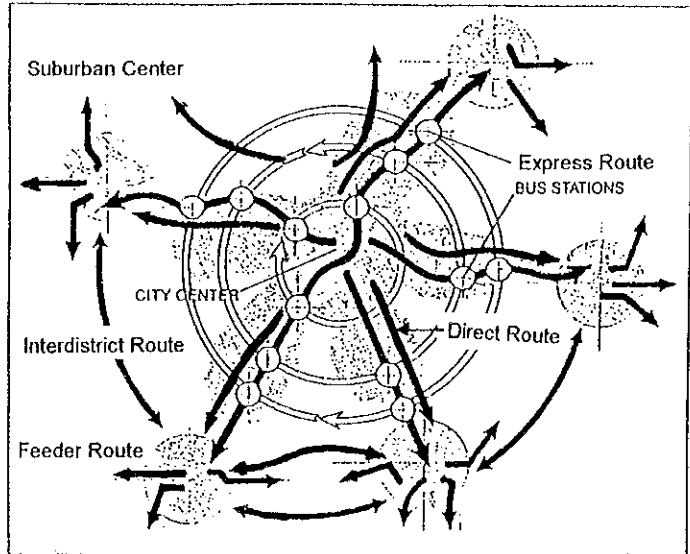
Concept and display of approaching bus information system



Integrated Transportation Network – Curitiba (Brazil)

City Population	1.6 million
Urban Public Transportation Services	Integrated bus service provided by 10 independent companies contracted by city authority.
New Bus System	Busway and bus lane
Length of New Bus System	56 km (city total 1,217 km)
Fare	Flat set by city, double for executive midibus service and lower for city center and neighborhood routes
Start Year	1974
Purpose of New Bus System	<ul style="list-style-type: none"> • Reduce travel time and stopping time at stops • Provide comfort for passengers • Provide scheduled operation
System Features	<ul style="list-style-type: none"> • Busway and bus lane • Bus priority signals at junctions by bus actuation or area traffic control • High capacity bus fleets (bi-articulated buses :270 pax) • Tube stations (every 400 m)

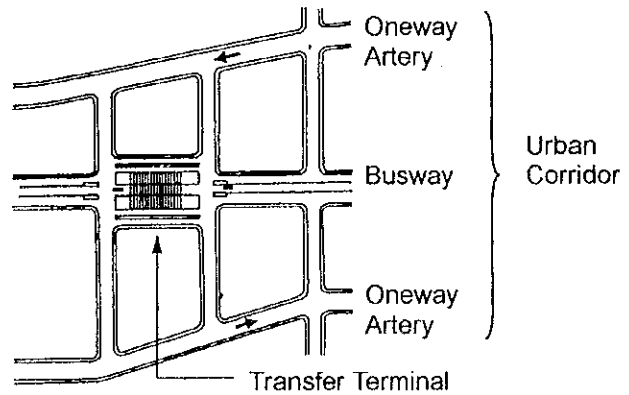
Curitiba Transportation System



Tube Station



Concept of Busway and Urban Corridor



Transfer Terminal



APPENDIX 7. COST INFORMATION

1. UNIT COST OF MATERIALS, 1998

MATERIALS	UNIT	COST WITHOUT TAX (C\$)
Asphalt	Gal.	6.90
Cement (Sn.Rafael)	Bag	34.65
Cement (Managua)	Bag	35.70
Gravel ½", 3/8"	m ³	132.85
Sand	m ³	16.30
Reinforced Steel bar 20' long		
¼"	qq	228.00
3/8"	qq	231.55
½"	qq	231.44
5/8"	qq	231.55
¾"	qq	231.55
1"	qq	236.00
Timber (pine)	Sq.in. yard	1.20
(cedar)	Sq.in. yard	3.00
Plywood 3/16"x4'x8'	Sheet	93.75
¼"x4'x8'	Sheet	128.40
Pre-mixed Concrete		
2000 psi ½", rev. 2"- 4"	m ³	643.10
2000 psi ¾", rev. 4"- 6"	m ³	673.10
3000 psi - ½", rev. 2" - 4"	m ³	708.50
3000 psi - ¾", rev. 4" - 6"	m ³	752.10
Mortar 1:3	m ³	775.00
.....1:4	m ³	612.00
.....1:2	m ³	517.00
Reinforced Concrete Tubes		
Bell type: 18"x 1m.	ea	314.92
.....21"x 1m.	ea	387.82
.....24" x 1m.	ea	488.68
Pin type: 30" x 1m.	ea	736.92
.....36" x 1m.	ea	1,016.18
.....42" x 1m.	ea	1,148.05
.....48" x 1m.	ea	1,504.96
Concrete Posts		
Post for fence 2.05 mts	ea	69.74
..... 2.55 mts	ea	87.57
..... 3.05 mts	ea	103.81
..... 3.55 mts	ea	113.20
..... 4.05 mts	ea	128.18
.....4.55 mts	ea	142.95
Twin-post for fence, 2.05 mts	ea	125.65
..... 2.55 mts	ea	145.80
..... 5.00 mts	ea	289.28
..... 6.00 mts	ea	343.30
..... 7.00 mts	ea	401.11

Construction post 3.00 mts	ea	196.23
.....3.50 mts	ea	228.94
.....4.00 mts	ea.	261.64
.....4.50 mts	ea.	294.45
.....5.00 mts	ea.	338.13
.....5.50 mts	ea.	359.76
.....6.00 mts	ea.	392.46
Slotted-post for stone slabs		
1R x 3.25 mts	ea.	188.42
2R x 3.25 mts x 90o	ea.	188.42
2R x 3.25 mts x 180o	ea.	188.42
3R x 3.15 mts	ea.	188.42
Slotted-post for stone slabs		
1R x 3.70 mts	ea.	202.98
2R x 3.70 mts x 90o	ea.	202.98
2R x 3.70 mts x 180o	ea.	202.98
3R x 3.70 mts	ea.	202.98

Note: To know the total unit cost apply 5% to cement and 15% to the rest of materials.

Source: Dirección de Ingeniería y Diseño Municipal. ALMA

2. LABOR UNIT COST, 1998

ITEM	NORM	COST PER DAY
Number of National Holidays	10 days at C\$84.50 / day	845.00
Holidays paid	2 days at C\$84.50 / day	422.50
Minimum wage	1,568.00	52.26
Bonus System	None	----
Employer Social Charges		
Driver wages	2,025.00	67.50
Janitor wages	1,568.00	52.26
Office clerk salary	2,535.00	84.50

Note: The office clerk salary was taken as parameter (C\$2,535 Córdoba) to calculate the cost per day of national (remunerated) holidays and of paid holidays.

• EMPLOYER SOCIAL CHARGES:

C\$ 2,535.00 (CHRISTMAS BONUS)
 C\$ 211.25 (VACATIONS - SALARY ÷ DAYS BY 2.50/ MONTH)
 C\$ 152.10 (SENIORITY - SALARY X 6% ESTIMATED 4 YEARS)

NOT ACCOUNTED FOR THESE ARE ESTIMATED FIGURES ONLY.

Source: Dirección de Recursos Humanos. ALMA

3. UNIT COST OF TYPICAL WORK ITEMS, 1998

1) Road Construction Unit Cost Estimation

			Unit Cost US\$	
Cleaning and Crubbing Pavement	Main Traffic Lane(Travesia)	m2	1.00	
	Main Traffic Lane(Distributor)	m2	15.00	
	Main Traffic Lane(others)	m2	14.00	
	Frontage Road	m2	13.00	
	Shoulder	m2	10.00	
Excavation Embankment Median/Divider		m2	9.00	
		m3	5.00	
		m3	11.00	
	1 m (Curb, and Tuff)	m	25.00	
	2 m (Curb and Planting)	m	30.00	
Divider (Frontage Road) Side Walk Pavement Side Walk Planting Drainage	3 m (Curb and Planting)	m	35.00	
	5 m (Curb and Planting and Drainage)	m	45.00	
	3 m (Curb, and Tuff)	m2	30.00	
		m2	7.50	
		m2	5.00	
Lane Marking and Sings	U type drainage (0.5 x 1.0)	m	14.00	
	U type drainage (0.3 x 0.5)	m	10.00	
	Pipe culvert(D=1.0m)	m	250.00	
	Pipe culvert(D=0.5m)	m	100.00	
	Single Carriageway	km	20,000.00	
Street Lighting	Dual Carriageway (6 lanes)	km	40,000.00	
	Dual Carriageway (4 lanes)	km	33,000.00	
	Frontage Road	km	10,000.00	
	Single Carriageway	km	48,000.00	Interval 50m, each US\$1200
	Dual Carriageway (4 lanes)	km	60,000.00	
Vehicle Guard Rail Bridge Box Culvert Interchange	Dual Carriageway (6 lanes)	km	75,000.00	Interval 40m, each US\$1500
		m	30.00	
	Concrete	m2	1,000.00	
	Concrete (2*2)	m	3,500.00	
	Diamond Type	ea	1,500,000.00	
Rotonda	Three-leg (Trumpet)	ea	1,800,000.00	
	Four-leg (Cloverleaf)	ea	3,000,000.00	
	Total No. of Approach Lanes (8 lanes)	ea	450,000.00	
	Total No. of Approach Lanes (12 lanes)	ea	650,000.00	
	Total No. of Approach Lanes (15 lanes)	ea	800,000.00	

2) Intersection Improvement

Signal System	Mast Arm	ea	3,500.00	
	Straight Pole	ea	900.00	
	Signal Lantern (Vehicle)	ea	900.00	
	Signal Lantern (Pedestrian)	ea	1,000.00	
	Local Controller	ea	21,000.00	
	Detector	ea	1,100.00	per lane
	Timing Prameter Set	ea	2,000.00	per intersection
	Interconnection Cable (Coordination)	m	15.00	
	Coordination Timing	ea	500.00	per coordinated intersections
	Marking and Sign	Pedestrian crossing (w=3)	m	12.00
lane marking and sings (per lane) (Additional lanes)		km	100.00	
Pavement Sidewalk		m2	14.00	
		m2	7.50	
Drainage		m2	5.00	
		m	10.00	

3) Public Transportation Corridor

Normal Section	Divider	m	25.00	w=1m
	Pavement	m2	13.00	
Station	Lane Marking and Signs	km	20,000.00	
	Vehicle Guard Rail	m	30.00	
	Plat form (3m x 30m)	m2	10.00	
	Guard rail	m	20.00	
	Shelter (w=1.5m)	ea	5,000.00	
	Kiosk (2m x 2m)	ea	2,000.00	
	Pedestrian Crossing (w=5m L=30)	m	15.00	
	Pedestrian Signal	ea	1,900.00	
	Elevated Station	m2	500.00	
	Intersection Bridge	Bus Signal (per Intersection)	ea	2,900.00
Pedestrian Bridge		m2	300.00	
	Fly-over Bridge	m2	800.00	

4. CONSTRUCTION COST OF ONE (1) KM OF ROAD, 1998

New Road Construction Cost Estimate per Unit Length

unit: US\$ per km

Road Classification	ROW (m)	Construction Cost	Cost including Land Acquisition and Compensation			
			within Former CBD	within Pista Juan Pabro	within Former Travesia	Other areas
1.Travesia						
a) 6 lanes	60	1,277,500	4,278,000	3,078,000	1,878,000	1,578,000
b) 4 lanes	50	1,031,250	3,531,000	2,531,000	1,531,000	1,281,000
2.Primary Distributor						
a) 6 lanes with Frontage Road	60	1,375,000	4,375,000	3,175,000	1,975,000	1,675,000
b) 6 lanes	45	1,140,625	3,391,000	2,491,000	1,591,000	1,366,000
c) 4 lanes with Frontage Road	50	1,138,750	3,639,000	2,639,000	1,639,000	1,389,000
d) 4 lanes	40	994,375	2,994,000	2,194,000	1,394,000	1,194,000
3.Primary Collector						
a) 4 lanes	30	837,500	2,338,000	1,738,000	1,138,000	988,000
4.Secondary Collector						
a) 2 lanes (commercial area)	20	577,500	1,578,000	1,178,000	778,000	678,000
b) 2 lanes (Residential area)	15	396,875	1,147,000	847,000	547,000	472,000
Land Acquisition and Compensation	US\$/sq.m	-	50.00	30.00	10.00	5.00

Interchange Construction Cost including Land Acquisition and Compensation

Interchange	unit	(6 lanes)	(4 lanes)
Diamond Type	ea	1,500,000	1,150,000
Three-leg (Trumpet)	ea	1,800,000	1,450,000
Four-leg (Cloverleaf)	ea	3,000,000	2,650,000

Breakdown of the New Road Construction Cost Estimate per Unit Length

1-a) Travesia (6 lanes)					1998 price	Remarks
Item	unit	unit Price (US\$)	Quantity (per KM)	Price (US\$)		
1 Cleaning and Crubbing	sq.m	1.00	60,000	60,000	w=60	
2 Common Excavation	cu.m	5.00	22,500	112,500	h=1.5, w=30	
3 Borrow Material	cu.m	11.00	22,500	247,500	h=1.5, w=30	
4 Pavement	sq.m	15.00	22,000	330,000	w=11, Dual	
5 Shoulder	sq.m	9.00	6,000	54,000	w=3	
6 Median	m	45.00	1,000	45,000	w=5	
7 Drainage	m	14.00	2,000	28,000		
8 Vehicle Guard Rail	m	30.00	1,000	30,000	Embankment	
9 Lane Marking and Sings	km	40,000.00	1	40,000		
10 Lighting Pole and Foundation	km	75,000.00	1	75,000		
Subtotal				1,022,000		
Miscellaneous 25% above				255,500		
Total				1,277,500		

1-b) Travesia (4 lanes)					Remarks
Item	unit	unit Price (US\$)	Quantity (per KM)	Price (US\$)	
1 Cleaning and Crubbing	sq.m	1.00	50,000	50,000	w=50
2 Common Excavation	cu.m	5.00	18,750	93,750	h=1.5, w=25
3 Borrow Material	cu.m	11.00	18,750	206,250	h=1.5, w=25
4 Pavement	sq.m	15.00	15,000	225,000	w=7.5, Dual
5 Shoulder	sq.m	9.00	6,000	54,000	w=3
6 Median	m	45.00	1,000	45,000	w=5
7 Drainage	m	14.00	2,000	28,000	
8 Vehicle Guard Rail	m	30.00	1,000	30,000	Embankment
9 Lane Marking and Sings	km	33,000.00	1	33,000	
10 Lighting Pole and Foundation	km	60,000.00	1	60,000	
Subtotal				825,000	
Miscellaneous 25% above				206,250	
Total				1,031,250	

2-a) Primary Distributor (6 lanes with Frontage Road)					Remarks
Item	unit	unit Price (US\$)	Quantity (per KM)	Price (US\$)	
1 Cleaning and Crubbing	sq.m	1.00	60,000	60,000	w=60
2 Common Excavation	cu.m	5.00	15,000	75,000	h=1.0, w=30
3 Borrow Material	cu.m	11.00	15,000	165,000	h=1.0, w=30
4 Pavement	sq.m	14.00	25,000	350,000	w=12.5, Dual
5 Frontage Road	sq.m	10.00	12,000	120,000	w=6
6 Median	m	45.00	1,000	45,000	w=5
7 Divider	m	35.00	1,000	35,000	w=3
8 Side walk (Pavement)	sq.m	7.50	6,000	45,000	w=3
9 Side walk (Planting)	sq.m	5.00	6,000	30,000	w=3
10 Drainage	m	10.00	4,000	40,000	
11 Vehicle Guard Rail	m	30.00	0	0	
12 Lane Marking and Sings	km	60,000.00	1	60,000	
13 Lighting Pole and Foundation	km	75,000.00	1	75,000	
Subtotal				1,100,000	
Miscellaneous 25% above				275,000	
Total				1,375,000	

2-b) Primary Distributor (6 lanes without Frontage Road)

Item	unit	unit Price (US\$)	Quantity (per KM)	Price (US\$)	Remarks
1 Cleaning and Crubbing	sq.m	1.00	45,000	45,000	w=45
2 Common Excavation	cu.m	5.00	11,250	56,250	h=1.0, w=22.5
3 Borrow Material	cu.m	11.00	11,250	123,750	h=1.0, w=22.5
4 Pavement	sq.m	14.00	25,000	350,000	w=12.5, Dual
5 Frontage Road	sq.m	10.00	0	0	
6 Median	m	45.00	1,000	45,000	
7 Divider	m	35.00	0	0	
8 Side walk (Pavement)	sq.m	7.50	9,000	67,500	w=4.5
9 Side walk (Planting)	sq.m	5.00	6,000	30,000	w=3
10 Drainage	m	10.00	2,000	20,000	
11 Vehicle Guard Rail	m	30.00	2,000	60,000	
12 Lane Marking and Sings	km	40,000.00	1	40,000	
13 Lighting Pole and Foundation	km	75,000.00	1	75,000	
Subtotal				912,500	
Miscellaneous 25% above				228,125	
Total				1,140,625	

2-c) Primary Distributor (4 lanes with Frontage Road)

Item	unit	unit Price (US\$)	Quantity (per KM)	Price (US\$)	Remarks
1 Cleaning and Crubbing	sq.m	1.00	50,000	50,000	w=50
2 Common Excavation	cu.m	5.00	12,500	62,500	h=1.0, w=25
3 Borrow Material	cu.m	11.00	12,500	137,500	h=1.0, w=25
4 Pavement	sq.m	14.00	17,000	238,000	w=8.5, Dual
5 Frontage Road	sq.m	10.00	12,000	120,000	w=6
6 Median	m	45.00	1,000	45,000	w=5
7 Divider	m	30.00	1,000	30,000	w=2
8 Side walk (Pavement)	sq.m	7.50	6,000	45,000	w=3
9 Side walk (Planting)	sq.m	5.00	6,000	30,000	w=3
10 Drainage	m	10.00	4,000	40,000	
11 Vehicle Guard Rail	m	30.00	0	0	
12 Lane Marking and Sings	km	53,000.00	1	53,000	
13 Lighting Pole and Foundation	km	60,000.00	1	60,000	
Subtotal				911,000	
Miscellaneous 25% above				227,750	
Total				1,138,750	

2-d) Primary Distributor (4 lanes without Frontage Road)

Item	unit	unit Price (US\$)	Quantity (per KM)	Price (US\$)	Remarks
1 Cleaning and Crubbing	sq.m	1.00	40,000	40,000	w=40
2 Common Excavation	cu.m	5.00	10,000	50,000	h=1.0, w=20
3 Borrow Material	cu.m	11.00	10,000	110,000	h=1.0, w=20
4 Pavement	sq.m	14.00	20,000	280,000	w=10, Dual
5 Frontage Road	sq.m	10.00	0	0	
6 Median	m	45.00	1,000	45,000	w=5
7 Divider	m	35.00	0	0	
8 Side walk (Pavement)	sq.m	7.50	9,000	67,500	w=4.5
9 Side walk (Planting)	sq.m	5.00	6,000	30,000	w=3
10 Drainage	m	10.00	2,000	20,000	
11 Vehicle Guard Rail	m	30.00	2,000	60,000	
12 Lane Marking and Sings	km	33,000.00	1	33,000	
13 Lighting Pole and Foundation	km	60,000.00	1	60,000	
Subtotal				795,500	
Miscellaneous 25% above				198,875	
Total				994,375	

3. Primary Collector (4 lanes)

Item	unit	unit Price (US\$)	Quantity (per KM)	Price (US\$)	Remarks
1 Cleaning and Crubbing	sq.m	1.00	30,000	30,000	w=30
2 Common Excavation	cu.m	5.00	7,500	37,500	h=1.0, w=15
3 Borrow Material	cu.m	11.00	7,500	82,500	h=1.0, w=15
4 Pavement	sq.m	14.00	18,000	252,000	w=9, Dual
5 Median	m	35.00	1,000	35,000	w=3
6 Side walk (Pavement)	sq.m	7.50	6,000	45,000	w=3
7 Side walk (Planting)	sq.m	5.00	3,000	15,000	w=1.5
8 Drainage	m	10.00	2,000	20,000	
9 Vehicle Guard Rail	m	30.00	2,000	60,000	
10 Lane Marking and Sings	km	33,000.00	1	33,000	
11 Lighting Pole and Foundation	km	60,000.00	1	60,000	
	Subtotal			670,000	
	Miscellaneous 25% above			167,500	
	Total			837,500	

4-a) Secondary Collector (2 lanes)

Item	unit	unit Price (US\$)	Quantity (per KM)	Price (US\$)	Remarks
1 Cleaning and Crubbing	sq.m	1.00	20,000	20,000	w=20
2 Common Excavation	cu.m	5.00	5,000	25,000	h=1.0, w=10
3 Borrow Material	cu.m	11.00	5,000	55,000	h=1.0, w=10
4 Pavement	sq.m	13.00	13,000	169,000	w=13
5 Median	m	35.00	0	0	
6 Side walk (Pavement)	sq.m	7.50	4,000	30,000	w=2
7 Side walk (Planting)	sq.m	5.00	3,000	15,000	w=1.5
8 Drainage	m	10.00	2,000	20,000	
9 Vehicle Guard Rail	m	30.00	2,000	60,000	
10 Lane Marking and Sings	km	20,000.00	1	20,000	
11 Lighting Pole and Foundation	km	48,000.00	1	48,000	
	Subtotal			462,000	
	Miscellaneous 25% above			115,500	
	Total			577,500	

4-b) Secondary Collector (2 lanes)

Item	unit	unit Price (US\$)	Quantity (per KM)	Price (US\$)	Remarks
1 Cleaning and Crubbing	sq.m	1.00	15,000	15,000	w=15
2 Common Excavation	cu.m	5.00	3,750	18,750	h=1.0, w=7.5
3 Borrow Material	cu.m	11.00	3,750	41,250	h=1.0, w=7.5
4 Pavement	sq.m	13.00	9,000	117,000	w=9
5 Median	m	35.00	0	0	
6 Side walk (Pavement)	sq.m	7.50	3,000	22,500	w=1.5
7 Side walk (Planting)	sq.m	5.00	3,000	15,000	w=1.5
8 Drainage	m	10.00	2,000	20,000	
9 Vehicle Guard Rail	m	30.00	0	0	
10 Lane Marking and Sings	km	20,000.00	1	20,000	
11 Lighting Pole and Foundation	km	48,000.00	1	48,000	
	Subtotal			317,500	
	Miscellaneous 25% above			79,375	
	Total			396,875	

Breakdown of the Road Improvement and Widening Cost Estimate per Unit Length

Type A	Type E	Type J	Type K	Type L
Item	Item	Item	Item	Item
unit	unit	unit	unit	unit
Quantity (per KM)	Quantity (per KM)	Quantity (per KM)	Quantity (per KM)	Quantity (per KM)
Price (US\$)	Price (US\$)	Price (US\$)	Price (US\$)	Price (US\$)
unit Price (US\$)	unit Price (US\$)	unit Price (US\$)	unit Price (US\$)	unit Price (US\$)
Remarks	Remarks	Remarks	Remarks	Remarks
1 Removal of Existing Pav.	1 Removal of Existing Pav.	1 Removal of Existing Pav.	1 Removal of Existing Pav.	1 Removal of Existing Pav.
sq.m	sq.m	sq.m	sq.m	sq.m
16,000	16,000	16,000	16,000	16,000
16,000	16,000	16,000	16,000	16,000
2 Pavement	2 Pavement	2 Pavement	2 Pavement	2 Pavement
sq.m	sq.m	sq.m	sq.m	sq.m
17,000	238,000	18,000	18,000	18,000
17,000	238,000	18,000	18,000	18,000
3 Frontage Road	3 Frontage Road	3 Frontage Road	3 Frontage Road	3 Frontage Road
sq.m	sq.m	sq.m	sq.m	sq.m
12,000	120,000	10,000	10,000	10,000
12,000	120,000	10,000	10,000	10,000
4 Median	4 Median	4 Median	4 Median	4 Median
m	m	m	m	m
1,000	45,000	1,000	1,000	1,000
1,000	45,000	1,000	1,000	1,000
5 Divider	5 Divider	5 Divider	5 Divider	5 Divider
m	m	m	m	m
2,000	60,000	2,000	2,000	2,000
2,000	60,000	2,000	2,000	2,000
6 Side walk (Pavement)	6 Side walk (Pavement)	6 Side walk (Pavement)	6 Side walk (Pavement)	6 Side walk (Pavement)
sq.m	sq.m	sq.m	sq.m	sq.m
6,000	45,000	6,000	6,000	6,000
6,000	45,000	6,000	6,000	6,000
7 Side walk (Planting)	7 Side walk (Planting)	7 Side walk (Planting)	7 Side walk (Planting)	7 Side walk (Planting)
sq.m	sq.m	sq.m	sq.m	sq.m
6,000	30,000	3,000	3,000	3,000
6,000	30,000	3,000	3,000	3,000
8 Drainage	8 Drainage	8 Drainage	8 Drainage	8 Drainage
m	m	m	m	m
4,000	40,000	2,000	2,000	2,000
4,000	40,000	2,000	2,000	2,000
9 Vehicle Guard Rail	9 Vehicle Guard Rail	9 Vehicle Guard Rail	9 Vehicle Guard Rail	9 Vehicle Guard Rail
m	m	m	m	m
30,000	30,000	30,000	30,000	30,000
30,000	30,000	30,000	30,000	30,000
10 Lane Marking and Signs	10 Lane Marking and Signs	10 Lane Marking and Signs	10 Lane Marking and Signs	10 Lane Marking and Signs
km	km	km	km	km
53,000.00	53,000.00	33,000.00	33,000.00	33,000.00
53,000.00	53,000.00	33,000.00	33,000.00	33,000.00
11 Lighting Pole and Foundation	11 Lighting Pole and Foundation	11 Lighting Pole and Foundation	11 Lighting Pole and Foundation	11 Lighting Pole and Foundation
km	km	km	km	km
60,000.00	60,000.00	60,000.00	60,000.00	60,000.00
60,000.00	60,000.00	60,000.00	60,000.00	60,000.00
Subtotal	Subtotal	Subtotal	Subtotal	Subtotal
707,000	707,000	203,000	203,000	203,000
707,000	707,000	203,000	203,000	203,000
Miscellaneous 25% above Total	Miscellaneous 25% above Total	Miscellaneous 25% above Total	Miscellaneous 25% above Total	Miscellaneous 25% above Total
176,750	176,750	75,750	75,750	75,750
883,750	883,750	378,750	378,750	378,750
883,750	883,750	378,750	378,750	378,750

Type B	Type F	Type G	Type H
Item	Item	Item	Item
unit	unit	unit	unit
Quantity (per KM)	Quantity (per KM)	Quantity (per KM)	Quantity (per KM)
Price (US\$)	Price (US\$)	Price (US\$)	Price (US\$)
unit Price (US\$)	unit Price (US\$)	unit Price (US\$)	unit Price (US\$)
Remarks	Remarks	Remarks	Remarks
1 Removal of Existing Pav.	1 Removal of Existing Pav.	1 Removal of Existing Pav.	1 Removal of Existing Pav.
sq.m	sq.m	sq.m	sq.m
16,000	16,000	16,000	16,000
16,000	16,000	16,000	16,000
2 Pavement	2 Pavement	2 Pavement	2 Pavement
sq.m	sq.m	sq.m	sq.m
12,000	120,000	20,000	20,000
12,000	120,000	20,000	20,000
3 Frontage Road	3 Frontage Road	3 Frontage Road	3 Frontage Road
sq.m	sq.m	sq.m	sq.m
10,000	100,000	10,000	10,000
10,000	100,000	10,000	10,000
4 Median	4 Median	4 Median	4 Median
m	m	m	m
45,000	45,000	45,000	45,000
45,000	45,000	45,000	45,000
5 Divider	5 Divider	5 Divider	5 Divider
m	m	m	m
30,000	30,000	30,000	30,000
30,000	30,000	30,000	30,000
6 Side walk (Pavement)	6 Side walk (Pavement)	6 Side walk (Pavement)	6 Side walk (Pavement)
sq.m	sq.m	sq.m	sq.m
6,000	45,000	6,000	6,000
6,000	45,000	6,000	6,000
7 Side walk (Planting)	7 Side walk (Planting)	7 Side walk (Planting)	7 Side walk (Planting)
sq.m	sq.m	sq.m	sq.m
6,000	30,000	6,000	6,000
6,000	30,000	6,000	6,000
8 Drainage	8 Drainage	8 Drainage	8 Drainage
m	m	m	m
4,000	40,000	4,000	4,000
4,000	40,000	4,000	4,000
9 Vehicle Guard Rail	9 Vehicle Guard Rail	9 Vehicle Guard Rail	9 Vehicle Guard Rail
m	m	m	m
30,000	30,000	30,000	30,000
30,000	30,000	30,000	30,000
10 Lane Marking and Signs	10 Lane Marking and Signs	10 Lane Marking and Signs	10 Lane Marking and Signs
km	km	km	km
53,000.00	53,000.00	33,000.00	33,000.00
53,000.00	53,000.00	33,000.00	33,000.00
11 Lighting Pole and Foundation	11 Lighting Pole and Foundation	11 Lighting Pole and Foundation	11 Lighting Pole and Foundation
km	km	km	km
60,000.00	60,000.00	60,000.00	60,000.00
60,000.00	60,000.00	60,000.00	60,000.00
Subtotal	Subtotal	Subtotal	Subtotal
295,000	295,000	683,375	683,375
295,000	295,000	683,375	683,375
Miscellaneous 25% above Total	Miscellaneous 25% above Total	Miscellaneous 25% above Total	Miscellaneous 25% above Total
73,750	73,750	171,875	171,875
368,750	368,750	855,250	855,250
368,750	368,750	855,250	855,250

Type C	Type I	Type M
Item	Item	Item
unit	unit	unit
Quantity (per KM)	Quantity (per KM)	Quantity (per KM)
Price (US\$)	Price (US\$)	Price (US\$)
unit Price (US\$)	unit Price (US\$)	unit Price (US\$)
Remarks	Remarks	Remarks
1 Removal of Existing Pav.	1 Removal of Existing Pav.	1 Removal of Existing Pav.
sq.m	sq.m	sq.m
16,000	16,000	16,000
16,000	16,000	16,000
2 Pavement	2 Pavement	2 Pavement
sq.m	sq.m	sq.m
20,000	20,000	20,000
20,000	20,000	20,000
3 Frontage Road	3 Frontage Road	3 Frontage Road
sq.m	sq.m	sq.m
10,000	100,000	10,000
10,000	100,000	10,000
4 Median	4 Median	4 Median
m	m	m
45,000	45,000	45,000
45,000	45,000	45,000
5 Divider	5 Divider	5 Divider
m	m	m
30,000	30,000	30,000
30,000	30,000	30,000
6 Side walk (Pavement)	6 Side walk (Pavement)	6 Side walk (Pavement)
sq.m	sq.m	sq.m
9,000	67,500	9,000
9,000	67,500	9,000
7 Side walk (Planting)	7 Side walk (Planting)	7 Side walk (Planting)
sq.m	sq.m	sq.m
6,000	30,000	6,000
6,000	30,000	6,000
8 Drainage	8 Drainage	8 Drainage
m	m	m
2,000	20,000	2,000
2,000	20,000	2,000
9 Vehicle Guard Rail	9 Vehicle Guard Rail	9 Vehicle Guard Rail
m	m	m
30,000	30,000	30,000
30,000	30,000	30,000
10 Lane Marking and Signs	10 Lane Marking and Signs	10 Lane Marking and Signs
km	km	km
33,000.00	33,000.00	33,000.00
33,000.00	33,000.00	33,000.00
11 Lighting Pole and Foundation	11 Lighting Pole and Foundation	11 Lighting Pole and Foundation
km	km	km
60,000.00	60,000.00	60,000.00
60,000.00	60,000.00	60,000.00
Subtotal	Subtotal	Subtotal
551,500	551,500	551,500
551,500	551,500	551,500
Miscellaneous 25% above Total	Miscellaneous 25% above Total	Miscellaneous 25% above Total
137,875	137,875	137,875
689,375	689,375	689,375
689,375	689,375	689,375

Type D	Type N	Type O
Item	Item	Item
unit	unit	unit
Quantity (per KM)	Quantity (per KM)	Quantity (per KM)
Price (US\$)	Price (US\$)	Price (US\$)
unit Price (US\$)	unit Price (US\$)	unit Price (US\$)
Remarks	Remarks	Remarks
1 Removal of Existing Pav.	1 Removal of Existing Pav.	1 Removal of Existing Pav.
sq.m	sq.m	sq.m
16,000	16,000	16,000
16,000	16,000	16,000
2 Pavement	2 Pavement	2 Pavement
sq.m	sq.m	sq.m
20,000	20,000	20,000
20,000	20,000	20,000
3 Frontage Road	3 Frontage Road	3 Frontage Road
sq.m	sq.m	sq.m
10,000	100,000	10,000
10,000	100,000	10,000
4 Median	4 Median	4 Median
m	m	m
45,000	45,000	45,000
45,000	45,000	45,000
5 Divider	5 Divider	5 Divider
m	m	m
30,000	30,000	30,000
30,000	30,000	30,000
6 Side walk (Pavement)	6 Side walk (Pavement)	6 Side walk (Pavement)
sq.m	sq.m	sq.m
6,000	45,000	6,000
6,000	45,000	6,000
7 Side walk (Planting)	7 Side walk (Planting)	7 Side walk (Planting)
sq.m	sq.m	sq.m
6,000	30,000	6,000
6,000	30,000	6,000
8 Drainage	8 Drainage	8 Drainage
m	m	m
2,000	20,000	2,000
2,000	20,000	2,000
9 Vehicle Guard Rail	9 Vehicle Guard Rail	9 Vehicle Guard Rail
m	m	m
30,000	30,000	30,000
30,000	30,000	30,000
10 Lane Marking and Signs	10 Lane Marking and Signs	10 Lane Marking and Signs
km	km	km
33,000.00	33,000.00	33,000.00
33,000.00	33,000.00	33,000.00
11 Lighting Pole and Foundation	11 Lighting Pole and Foundation	11 Lighting Pole and Foundation
km	km	km
60,000.00	60,000.00	60,000.00
60,000.00	60,000.00	60,000.00
Subtotal	Subtotal	Subtotal
349,000	349,000	349,000
349,000	349,000	349,000
Miscellaneous 25% above Total	Miscellaneous 25% above Total	Miscellaneous 25% above Total
87,250	87,250	87,250
436,250	436,250	436,250
436,250	436,250	436,250

Breakdown of the Road Improvement and Widening Cost Estimate per Unit Length

Type M	Item	unit	unit Price (US\$)	Quantity (per KM)	Price (US\$)	Remarks
	1 Removal of Existing Pavc.	sqm	1.00	0	0	w=10
	2 Pavement	sqm	14.00	15,000	210,000	w=12.5+2.5
	3 Frontage Road	sqm	10.00	12,000	120,000	w=6
	4 Median	m	45.00	1,000	45,000	w=5
	5 Divider	m	35.00	2,000	70,000	w=3
	6 Side walk (Pavement)	sqm	7.50	6,000	45,000	w=3
	7 Side walk (Planting)	sqm	5.00	6,000	30,000	w=3
	8 Drainage	m	10.00	4,000	40,000	
	9 Vehicle Guard Rail	m	30.00	0	0	
	10 Lane Marking and Signs	km	60,000.00	1	60,000	
	11 Lighting Pole and Foundation	km	75,000.00	1	75,000	
	Subtotal				695,000	
	Miscellaneous 25% above Total				173,750	
	Total				868,750	

Type N	Item	unit	unit Price (US\$)	Quantity (per KM)	Price (US\$)	Remarks
	1 Removal of Existing Pavc.	sqm	1.00	10,000	10,000	w=10
	2 Pavement	sqm	14.00	25,000	350,000	w=12.5, Dual
	3 Frontage Road	sqm	10.00	0	0	w=6
	4 Median	m	45.00	1,000	45,000	w=5
	5 Divider	m	35.00	0	0	w=3
	6 Side walk (Pavement)	sqm	7.50	9,000	67,500	w=4.5
	7 Side walk (Planting)	sqm	5.00	6,000	30,000	w=3
	8 Drainage	m	10.00	2,000	20,000	
	9 Vehicle Guard Rail	m	30.00	0	0	
	10 Lane Marking and Signs	km	40,000.00	1	40,000	
	11 Lighting Pole and Foundation	km	75,000.00	1	75,000	
	Subtotal				637,500	
	Miscellaneous 25% above Total				159,375	
	Total				796,875	

Type O	Item	unit	unit Price (US\$)	Quantity (per KM)	Price (US\$)	Remarks
	1 Removal of Existing Pavc.	sqm	1.00	0	0	w=10
	2 Pavement	sqm	14.00	15,000	210,000	w=12.5+2.5
	3 Frontage Road	sqm	10.00	0	0	w=6
	4 Median	m	45.00	1,000	45,000	w=5
	5 Divider	m	35.00	0	0	w=3
	6 Side walk (Pavement)	sqm	7.50	9,000	67,500	w=4.5
	7 Side walk (Planting)	sqm	5.00	6,000	30,000	w=3
	8 Drainage	m	10.00	2,000	20,000	
	9 Vehicle Guard Rail	m	30.00	0	0	
	10 Lane Marking and Signs	km	40,000.00	1	40,000	
	11 Lighting Pole and Foundation	km	75,000.00	1	75,000	
	Subtotal				487,500	
	Miscellaneous 25% above Total				121,875	
	Total				609,375	

Type P	Item	unit	unit Price (US\$)	Quantity (per KM)	Price (US\$)	Remarks
	1 Removal of Existing Pavc.	sqm	1.00	10,000	10,000	w=10
	2 Pavement	sqm	14.00	17,000	238,000	w=8.5, Dual
	3 Frontage Road	sqm	10.00	12,000	120,000	w=6
	4 Median	m	45.00	1,000	45,000	w=5
	5 Divider	m	30.00	2,000	60,000	w=2
	6 Side walk (Pavement)	sqm	7.50	6,000	45,000	w=3
	7 Side walk (Planting)	sqm	5.00	6,000	30,000	w=3
	8 Drainage	m	10.00	4,000	40,000	
	9 Vehicle Guard Rail	m	30.00	0	0	
	10 Lane Marking and Signs	km	53,000.00	1	53,000	
	11 Lighting Pole and Foundation	km	60,000.00	1	60,000	
	Subtotal				701,000	
	Miscellaneous 25% above Total				175,250	
	Total				876,250	

Type Q	Item	unit	unit Price (US\$)	Quantity (per KM)	Price (US\$)	Remarks
	1 Removal of Existing Pavc.	sqm	1.00	0	0	w=10
	2 Pavement	sqm	14.00	8,500	119,000	w=8.5
	3 Frontage Road	sqm	10.00	12,000	120,000	w=6
	4 Median	m	45.00	1,000	45,000	w=5
	5 Divider	m	30.00	2,000	60,000	w=2
	6 Side walk (Pavement)	sqm	7.50	6,000	45,000	w=3
	7 Side walk (Planting)	sqm	5.00	6,000	30,000	w=3
	8 Drainage	m	10.00	4,000	40,000	
	9 Vehicle Guard Rail	m	30.00	0	0	
	10 Lane Marking and Signs	km	53,000.00	1	53,000	
	11 Lighting Pole and Foundation	km	60,000.00	1	60,000	
	Subtotal				572,000	
	Miscellaneous 25% above Total				143,000	
	Total				715,000	

Type R	Item	unit	unit Price (US\$)	Quantity (per KM)	Price (US\$)	Remarks
	1 Removal of Existing Pavc.	sqm	1.00	10,000	10,000	w=10
	2 Pavement	sqm	14.00	20,000	280,000	w=10, Dual
	3 Frontage Road	sqm	10.00	0	0	w=6
	4 Median	m	45.00	1,000	45,000	w=5
	5 Divider	m	30.00	0	0	w=2
	6 Side walk (Pavement)	sqm	7.50	9,000	67,500	w=4.5
	7 Side walk (Planting)	sqm	5.00	6,000	30,000	w=3
	8 Drainage	m	10.00	2,000	20,000	
	9 Vehicle Guard Rail	m	30.00	0	0	
	10 Lane Marking and Signs	km	33,000.00	1	33,000	
	11 Lighting Pole and Foundation	km	60,000.00	1	60,000	
	Subtotal				545,500	
	Miscellaneous 25% above Total				136,375	
	Total				681,875	

Type S	Item	unit	unit Price (US\$)	Quantity (per KM)	Price (US\$)	Remarks
	1 Removal of Existing Pavc.	sqm	1.00	0	0	w=10
	2 Pavement	sqm	14.00	10,000	140,000	w=10
	3 Frontage Road	sqm	10.00	0	0	w=6
	4 Median	m	45.00	1,000	45,000	w=5
	5 Divider	m	35.00	0	0	w=2
	6 Side walk (Pavement)	sqm	7.50	9,000	67,500	w=4.5
	7 Side walk (Planting)	sqm	5.00	6,000	30,000	w=3
	8 Drainage	m	10.00	2,000	20,000	
	9 Vehicle Guard Rail	m	30.00	0	0	
	10 Lane Marking and Signs	km	33,000.00	1	33,000	
	11 Lighting Pole and Foundation	km	60,000.00	1	60,000	
	Subtotal				395,500	
	Miscellaneous 25% above Total				98,875	
	Total				494,375	

Type T	Item	unit	unit Price (US\$)	Quantity (per KM)	Price (US\$)	Remarks
	1 Removal of Existing Pavc.	sqm	1.00	10,000	10,000	w=10
	2 Pavement	sqm	13.00	18,000	234,000	w=9, Dual
	3 Frontage Road	sqm	10.00	0	0	w=6
	4 Median	m	35.00	1,000	35,000	w=3
	5 Divider	m	30.00	0	0	w=2
	6 Side walk (Pavement)	sqm	7.50	6,000	45,000	w=3
	7 Side walk (Planting)	sqm	5.00	3,000	15,000	w=1.5
	8 Drainage	m	10.00	2,000	20,000	
	9 Vehicle Guard Rail	m	30.00	0	0	
	10 Lane Marking and Signs	km	33,000.00	1	33,000	
	11 Lighting Pole and Foundation	km	60,000.00	1	60,000	
	Subtotal				452,000	
	Miscellaneous 25% above Total				113,000	
	Total				565,000	

Type U	Item	unit	unit Price (US\$)	Quantity (per KM)	Price (US\$)	Remarks
	1 Removal of Existing Pavc.	sqm	1.00	0	0	w=10
	2 Pavement	sqm	13.00	9,000	117,000	w=9
	3 Frontage Road	sqm	10.00	0	0	w=6
	4 Median	m	35.00	1,000	35,000	w=3
	5 Divider	m	35.00	0	0	w=2
	6 Side walk (Pavement)	sqm	7.50	6,000	45,000	w=3
	7 Side walk (Planting)	sqm	5.00	3,000	15,000	w=1.5
	8 Drainage	m	10.00	2,000	20,000	
	9 Vehicle Guard Rail	m	30.00	0	0	
	10 Lane Marking and Signs	km	33,000.00	1	33,000	
	11 Lighting Pole and Foundation	km	60,000.00	1	60,000	
	Subtotal				325,000	
	Miscellaneous 25% above Total				81,250	
	Total				406,250	

6. MAINTENANCE COST OF ONE (1) KM OF ROAD, 1998

A. ORDINARILY MAINTENANCE
PERIOD: EVERY YEAR

CONCEPT	UNIT	QUANTITY	UNIT PRICE (C\$)	TOTAL COST (C\$)
Road Cleaning	Ha.	1.60	600.00	960.00
Cleaning of the sediment material	m ³	40.00	24.00	960.00
Sewers Cleaning	ml	22.00	14.00	308.00
Sewers channels rectification	ml	20.00	16.00	320.00
Cement-covered gutters repairs	m ²	10.00	96.00	960.00
Cleaning and rectification of gutters	ml	30.00	7.40	222.00
Potholes repairs with asphalt mix	m ²	100.00	250.00	25,000.00
Replacement of posts	ea.	3.00	450.00	1,350.00
Replacement of vertical signs	ea	2.00	540.00	1,080.00
TOTAL				31,160.00

B. PERIODIC MAINTENANCE
PERIOD: EVERY THREE (3) YEARS

CONCEPT	UNIT	QUANTITY	UNIT PRICE (C\$)	TOTAL COST (C\$)
Road Cleaning	Ha	1.60	600.00	960.00
Drainage rubble-works	m ³	0.10	750.00	75.00
Paints for bridges	ml	50.00	45.70	2,285.00
Shoulders reinforcement	ml	22.00	14.00	308.00
Sewers cleaning	ml	10.00	14.00	140.00
Rectification of cement-cover gutters	m ²	10.00	96.00	960.00
Potholes repair with asphalt mix	m ²	100.00	250.00	25,000.00
Asphalt RC-250	Glns	2,500.00	20.80	52,000.00
"D" TRAR bituminous surf. Additive	m ³	125.00	272.40	34,050.00
Traffic paving marks and others	Global	1.00	1,200.00	1,200.00
Fence bridge repairs	Ml	7.00	1,000.00	7,000.00
Replacement of posts	Ea	3.00	450.00	1,350.00
Replacement of vertical signs	Ea	2.00	540.00	1,080.00
Miscellaneous works	Global	1.00	1,500.00	1,500.00
TOTAL		sub-total (every 3 years)		127,908.00

YEARLY MAINTENANCE COST	C\$	31,160.00 / KM (Routine)
PERIODIC MAINTENANCE COST	C\$	42,636.00 / KM (Periodic)
TOTAL YEARLY MAINTENANCE	C\$	73,796.00 / KM

Source: Dirección General de Seguimiento y Control. MTI

7. UNIT COST OF SIGNAL AND INTERSECTION IMPROVEMENT, 1998

Intersection Improvement Cost Estimate Including Geometric Improvement

	No. of Lanes		Pre-Timed	Semi-Actu.	Full-Actu.	Coordinate	Grade-Sepa.
	Main	Gross					
4 Legs	6	6	-	-	143,504	151,504	3,153,372
	6	4	-	-	140,784	148,784	3,140,428
	6	2	-	92,932	-	109,732	-
	4	4	-	-	138,064	146,064	2,180,428
	4	2	68,812	94,212	-	108,812	-
	2	2	40,024	65,224	-	75,424	-
3 Legs	6	6	-	-	96,712	104,712	3,109,228
	6	4	-	-	96,452	104,452	3,103,846
	6	2	-	75,276	-	92,076	-
	4	4	-	-	93,732	101,732	2,143,806
	4	2	49,812	75,012	-	88,512	-
	2	2	30,918	55,018	-	67,418	-

Type of Signal System Improvement

	No. of Lanes		Pre-Timed	Semi-Actu.	Full-Actu.	Coordinate	Grade-Sepa.
	Main	Gross					
4 Legs	6	6			○	○	○
	6	4			○	○	○
	6	2		○		○	○
	4	4			○	○	○
	4	2	○	○		○	○
	2	2	○	○		○	○
3 Legs	6	6			○	○	○
	6	4			○	○	○
	6	2		○		○	○
	4	4			○	○	○
	4	2	○	○		○	○
	2	2	○	○		○	○

Intersection Improvement Cost Estimate (Signal System Only)

	No. of Lanes		Pre-Timed	Semi-Actu.	Full-Actu.	Coordinate	Grade-Sepa.
	Main	Gross					
4 Legs	6	6	-	-	106,200	114,200	102,400
	6	4	-	-	104,000	112,000	100,200
	6	2	-	69,000	-	85,800	-
	4	4	-	-	101,800	109,800	100,200
	4	2	41,600	69,000	-	83,600	-
	2	2	29,200	54,400	-	64,600	-
3 Legs	6	6	-	-	73,900	81,900	70,100
	6	4	-	-	73,900	81,900	70,100
	6	2	-	56,600	-	73,400	-
	4	4	-	-	71,700	79,700	70,100
	4	2	31,600	56,800	-	70,300	-
	2	2	22,800	46,900	-	59,300	-

Project Cost for Rotonda

Total No. of Approach Lanes (8 lanes)	ea	450,000.00
Total No. of Approach Lanes (12 lanes)	ea	650,000.00
Total No. of Approach Lanes (15 lanes)	ea	800,000.00

Quantity Estimates for 4 Legs Intersection (per Intersection)

Signal System	6-6		6-4		6-2		4-4		4-2		2-2	
	Full-Actu.	Coordinates	Grade-Sep Full-Actu.	Coordinates	Grade-Sep Semi-Actu.	Coordinates	Full-Actu.	Coordinates	Grade-Sep.	Coordinates	Pre-Timed Semi-Actu.	Coordinates
Signal System	ca	3,500.00	ca	3,500.00	ca	3,500.00	ca	3,500.00	ca	3,500.00	ca	3,500.00
Street Arm	ca	500.00	ca	500.00	ca	500.00	ca	500.00	ca	500.00	ca	500.00
Straight Pole	ca	900.00	ca	900.00	ca	900.00	ca	900.00	ca	900.00	ca	900.00
Signal Lantern (Vehicle)	ca	1,000.00	ca	1,000.00	ca	1,000.00	ca	1,000.00	ca	1,000.00	ca	1,000.00
Signal Lantern (Pedestrian)	ca	21,000.00	ca	21,000.00	ca	21,000.00	ca	21,000.00	ca	21,000.00	ca	21,000.00
Local Controller	ca	1,100.00	ca	1,100.00	ca	1,100.00	ca	1,100.00	ca	1,100.00	ca	1,100.00
Detector	ca	2,000.00	ca	2,000.00	ca	2,000.00	ca	2,000.00	ca	2,000.00	ca	2,000.00
Timing Parameter Set	ca	15.00	ca	15.00	ca	15.00	ca	15.00	ca	15.00	ca	15.00
Interconnection Cable (Coordination)	ca	500.00	ca	500.00	ca	500.00	ca	500.00	ca	500.00	ca	500.00
Coordination Timing	ca	12.00	ca	12.00	ca	12.00	ca	12.00	ca	12.00	ca	12.00
Pedestrian crossing (w=3)	ca	100.00	ca	100.00	ca	100.00	ca	100.00	ca	100.00	ca	100.00
lane marking and signs (per lane)	ca	14.00	ca	14.00	ca	14.00	ca	14.00	ca	14.00	ca	14.00
Pavement	m2	7.50	m2	7.50	m2	7.50	m2	7.50	m2	7.50	m2	7.50
Sidewalk	m2	5.00	m2	5.00	m2	5.00	m2	5.00	m2	5.00	m2	5.00
Planting	m2	10.00	m2	10.00	m2	10.00	m2	10.00	m2	10.00	m2	10.00
Drainage	m2	1,000.00	m2	1,000.00	m2	1,000.00	m2	1,000.00	m2	1,000.00	m2	1,000.00
Grade Separation	ca	420,000.00	ca	420,000.00	ca	420,000.00	ca	420,000.00	ca	420,000.00	ca	420,000.00
Rotunda	ca		ca		ca		ca		ca		ca	

Marking and Sign
 Pedestrian crossing (w=3)
 Lane marking and signs (per lane)
 Pavement
 Sidewalk
 Planting

Drainage
 Grade Separation

L=30x4(L=5.5x4), L=5.5x4
 L=7x4(L=2x4)
 w=3.5 L=50x4(x8)
 w=3 L=50x8
 w=3 L=50x8
 L=100 m#8
 (w=12.5 L=120x2)

L=25x4(L=5.5x4), L=5.5x4
 L=5x4(L=1x4)
 w=3.5 L=50x2
 w=3 L=50x4
 w=3 L=50x4
 w=3 L=50x4
 L=100 m#8
 (w=8.5 L=120x2)

L=25x2 L=13x2
 L=5x2 L=2x2
 w=3.5 L=50x2
 A=3x50x4, A=2x30x4
 A=3x50x4, A=1.5x30x4
 L=100x4, L=50x4

L=13x4
 L=2x4
 A=2x30x8
 A=1.5x30x8
 L=50x8

* () Grade Separation

Quantity Estimates for 3 Legs Intersection (per Intersection)

Signal System	6-6		6-4		6-2		4-4		4-2		2-2	
	Full-Actu.	Coordinates	Grade-Sep Full-Actu.	Coordinates	Grade-Sep Semi-Actu.	Coordinates	Full-Actu.	Coordinates	Grade-Sep.	Coordinates	Pre-Timed Semi-Actu.	Coordinates
Signal System	ca	3,500.00	ca	3,500.00	ca	3,500.00	ca	3,500.00	ca	3,500.00	ca	3,500.00
Street Arm	ca	500.00	ca	500.00	ca	500.00	ca	500.00	ca	500.00	ca	500.00
Straight Pole	ca	900.00	ca	900.00	ca	900.00	ca	900.00	ca	900.00	ca	900.00
Signal Lantern (Vehicle)	ca	1,000.00	ca	1,000.00	ca	1,000.00	ca	1,000.00	ca	1,000.00	ca	1,000.00
Signal Lantern (Pedestrian)	ca	21,000.00	ca	21,000.00	ca	21,000.00	ca	21,000.00	ca	21,000.00	ca	21,000.00
Local Controller	ca	1,100.00	ca	1,100.00	ca	1,100.00	ca	1,100.00	ca	1,100.00	ca	1,100.00
Detector	ca	2,000.00	ca	2,000.00	ca	2,000.00	ca	2,000.00	ca	2,000.00	ca	2,000.00
Timing Parameter Set	ca	15.00	ca	15.00	ca	15.00	ca	15.00	ca	15.00	ca	15.00
Interconnection Cable (Coordination)	ca	500.00	ca	500.00	ca	500.00	ca	500.00	ca	500.00	ca	500.00
Coordination Timing	ca	12.00	ca	12.00	ca	12.00	ca	12.00	ca	12.00	ca	12.00
Pedestrian crossing (w=3)	ca	100.00	ca	100.00	ca	100.00	ca	100.00	ca	100.00	ca	100.00
lane marking and signs (per lane)	ca	14.00	ca	14.00	ca	14.00	ca	14.00	ca	14.00	ca	14.00
Pavement	m2	7.50	m2	7.50	m2	7.50	m2	7.50	m2	7.50	m2	7.50
Sidewalk	m2	5.00	m2	5.00	m2	5.00	m2	5.00	m2	5.00	m2	5.00
Planting	m2	10.00	m2	10.00	m2	10.00	m2	10.00	m2	10.00	m2	10.00
Drainage	m2	1,000.00	m2	1,000.00	m2	1,000.00	m2	1,000.00	m2	1,000.00	m2	1,000.00
Grade Separation	ca	420,000.00	ca	420,000.00	ca	420,000.00	ca	420,000.00	ca	420,000.00	ca	420,000.00
Rotunda	ca		ca		ca		ca		ca		ca	

Marking and Sign
 Pedestrian crossing (w=3)
 Lane marking and signs (per lane)
 Pavement
 Sidewalk
 Planting

Drainage
 Grade Separation

L=30x4(L=5.5x4), L=5.5x2
 L=7x4(L=2x4)
 w=3.5 L=50x1(x8)
 w=3 L=50x8
 w=3 L=50x8
 L=100 m#8
 (w=12.5 L=120x2)

L=25x3(L=5.5x2, 5x2, 5x2), L=5.5x2
 L=5x4(L=1x4)
 w=3.5 L=50x1
 w=3 L=50x4
 A=3x50x4, A=2x30x2
 A=3x50x4, A=1.5x30x2
 L=100x4, L=50x2
 (w=8.5 L=120x2)

L=25x2 L=13x1
 L=5x4(L=2x1)
 w=3.5 L=50x1
 A=3x50x4, A=2x30x2
 A=3x50x4, A=1.5x30x2
 L=100x4, L=50x2

L=13x3
 L=2x3
 A=2x30x8
 A=1.5x30x8
 L=50x8

* () Grade Separation

Cost Estimate for 4 Legs Intersection (per Intersection)

Signal System	6-6		6-4		6-2		4-4		4-2		2-2			
	Full-Actu.	Coordinates	Grade-Sep.	Full-Actu.	Coordinates	Grade-Sep.	Full-Actu.	Coordinates	Grade-Sep.	Full-Actu.	Coordinates	Pre-Timed	Semi-Actu.	Coordinates
Signal System	3,500.00	28,000	21,000	28,000	21,000	21,000	28,000	21,000	21,000	21,000	21,000	14,000	14,000	14,000
Mast Arm	900.00	10,800	14,400	10,800	14,400	14,400	10,800	10,800	14,400	14,400	10,800	5,400	5,400	3,800
Straight Pole	900.00	10,800	10,800	10,800	10,800	10,800	10,800	10,800	10,800	10,800	10,800	7,200	7,200	3,800
Signal Lantern (Vehicle)	900.00	10,800	10,800	10,800	10,800	10,800	10,800	10,800	10,800	10,800	10,800	7,200	7,200	3,800
Signal Lantern (Pedestrian)	1,000.00	18,000	18,000	18,000	18,000	20,000	18,000	18,000	18,000	18,000	18,000	8,000	8,000	8,000
Local Controller	21,000.00	21,000	21,000	21,000	21,000	21,000	21,000	21,000	21,000	21,000	21,000	0	21,000	21,000
Detector	11,000.00	17,800	17,800	13,200	15,400	11,000	13,200	13,200	11,000	11,000	11,000	0	2,000	4,400
Timing Parameter Set	2,000.00	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	0	2,000	2,000
Interconnection Cable (Coordination)	15.00	0	0	0	0	0	0	0	0	0	0	0	0	7,500
Coordination Timing	500.00	0	0	0	0	0	0	0	0	0	0	0	0	500
Pedestrian crossing (w=3)	12.00	1,704	1,704	1,272	1,584	1,128	1,464	1,464	1,128	1,128	912	912	824	824
Lane marking and sign (per lane)	100.00	2,800	2,800	2,400	2,400	1,400	2,000	2,000	1,400	1,400	1,400	1,400	800	800
Pavement (Additional lanes)	14.00	9,800	9,800	24,500	9,800	4,800	9,800	9,800	4,800	4,800	4,800	0	0	0
Pavement	7.50	9,000	9,000	9,000	9,000	6,300	9,000	9,000	6,300	6,300	6,300	3,900	3,900	3,800
Sidewalk	5.00	6,000	6,000	6,000	6,000	3,900	6,000	6,000	3,900	3,900	3,900	1,800	1,800	1,800
Planing	10.00	8,000	8,000	8,000	8,000	8,000	8,000	8,000	8,000	8,000	8,000	7,800	7,800	4,000
Drainage	1,000.00	0	0	0	0	0	0	0	0	0	0	0	0	0
Grade Separation	420,000.00	0	0	0	0	0	0	0	0	0	0	0	0	0
Rotobla														
Signal System		104,200	104,200	104,000	112,000	100,200	85,800	109,800	109,800	100,200	83,800	29,200	54,400	64,800
Geometric Improvement		37,304	37,304	50,972	38,764	38,784	23,932	36,284	36,284	40,228	25,212	25,212	10,824	10,824
Grade Separation		143,504	151,504	315,372	140,784	314,048	92,932	138,064	148,064	218,048	86,812	94,212	108,812	40,024
Total														

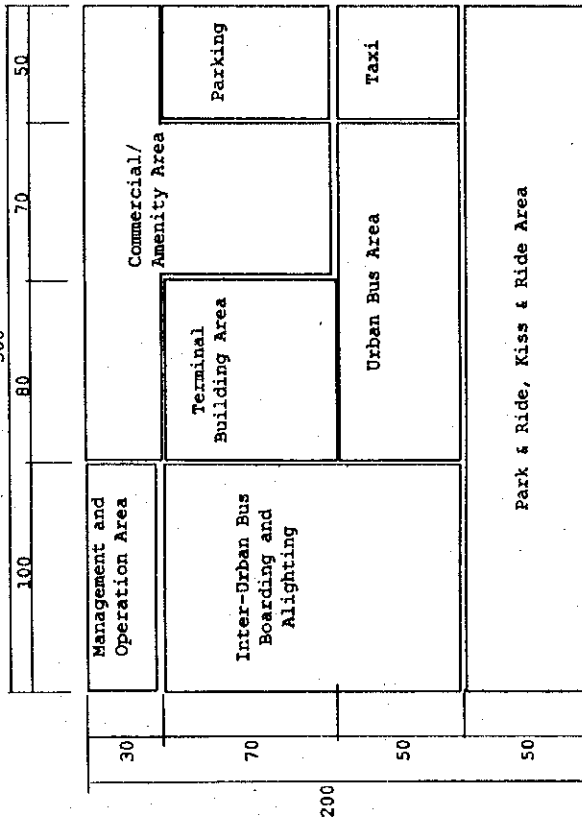
Cost Estimate for 3 Legs Intersection (per Intersection)

Signal System	6-6		6-4		6-2		4-4		4-2		2-2			
	Full-Actu.	Coordinates	Grade-Sep.	Full-Actu.	Coordinates	Grade-Sep.	Full-Actu.	Coordinates	Grade-Sep.	Full-Actu.	Coordinates	Pre-Timed	Semi-Actu.	Coordinates
Signal System	3,500.00	17,500	17,500	17,500	17,500	17,500	17,500	17,500	17,500	17,500	17,500	10,500	10,500	10,500
Mast Arm	900.00	7,200	7,200	7,200	7,200	7,200	7,200	7,200	7,200	7,200	7,200	4,800	4,800	3,800
Straight Pole	900.00	7,200	7,200	7,200	7,200	7,200	7,200	7,200	7,200	7,200	7,200	4,800	4,800	3,800
Signal Lantern (Vehicle)	900.00	6,300	6,300	6,300	6,300	6,300	6,300	6,300	6,300	6,300	6,300	4,500	4,500	2,700
Signal Lantern (Pedestrian)	1,000.00	10,000	10,000	10,000	10,000	14,000	10,000	10,000	10,000	10,000	10,000	6,000	6,000	6,000
Local Controller	21,000.00	21,000	21,000	21,000	21,000	21,000	21,000	21,000	21,000	21,000	21,000	0	21,000	21,000
Detector	11,000.00	9,900	9,900	5,500	9,900	5,500	7,700	7,700	7,700	7,700	7,700	0	1,100	5,500
Timing Parameter Set	2,000.00	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	0	2,000	2,000
Interconnection Cable (Coordination)	15.00	0	0	0	0	0	0	0	0	0	0	0	0	7,500
Coordination Timing	500.00	0	0	0	0	0	0	0	0	0	0	0	0	500
Pedestrian crossing (w=3)	12.00	1,212	1,212	878	1,152	846	878	1,032	1,032	878	912	488	488	468
Lane marking and sign (per lane)	100.00	1,900	1,900	1,700	1,500	1,500	1,300	1,500	1,500	1,500	1,000	600	600	600
Pavement (Additional lanes)	14.00	2,450	2,450	18,600	2,450	14,700	2,450	2,450	2,450	2,450	2,450	0	0	0
Pavement	7.50	8,750	8,750	8,750	8,750	6,750	8,750	8,750	6,750	6,750	6,750	5,400	5,400	2,700
Sidewalk	5.00	4,500	4,500	4,500	4,500	3,450	4,500	4,500	3,450	3,450	3,450	1,350	1,350	1,350
Planing	10.00	6,000	6,000	6,000	6,000	6,000	6,000	6,000	6,000	6,000	6,000	5,000	5,000	3,000
Drainage	1,000.00	0	0	0	0	0	0	0	0	0	0	0	0	0
Grade Separation	420,000.00	0	0	0	0	0	0	0	0	0	0	0	0	0
Rotobla														
Signal System		73,800	70,100	70,800	81,800	70,100	73,600	71,700	76,700	70,100	58,800	70,300	22,800	48,900
Geometric Improvement		22,812	36,128	22,552	22,552	33,746	18,878	22,032	22,032	33,706	18,212	18,212	8,118	8,118
Grade Separation		98,712	104,712	310,628	96,452	310,346	75,278	92,078	93,732	101,732	75,012	86,512	30,918	55,018
Total														

8. UNIT COST OF PUBLIC TRANSPORTATION CORRIDOR DEVELOPMENT, 1998

	Item	unit	unit Price (US\$)	Quantity (per KM)	Price (US\$)	Remarks
Normal Section	1 Cleaning and Crubbing	sq.m	1.00	12,000	12,000	w=12
	2 Pavement	sq.m	14.00	10,000	140,000	w=10
	3 Divider	m	25.00	2,000	50,000	w=1
	4 Drainage	m	10.00	2,000	20,000	
	5 Vehicle Guard Rail	m	30.00	2,000	60,000	
	6 Bus Signal	ea	2,900.00	2	5,800	Intersection interval 1 km
	7 Lane Marking and Sings	km	20,000.00	1	20,000	
	Subtotal				307,800	
	Miscellaneous 25% above				76,950	
	Total				384,750	
Station	1 Plat Form	sq.m	10.00	180	1,800	A=3x30 n=2
	2 Guard Rail	m	20.00	60	1,200	
	3 Drainage	m	10.00	60	600	
	4 Shelter	ea	5,000.00	2	10,000	
	5 Kiosk	ea	2,000.00	2	4,000	A=2x2
	6 Pedestrian Crossing	m	15.00	20	300	at grade
	7 Pedestrian Signal	ea	1,900.00	4	7,600	n=4
	Subtotal				25,500	
	Miscellaneous 25% above				6,375	
	Total				31,875	
	Per Km (2 stations)				64,000	
At-Grade Structure Estimate Cost per Unit Length (US\$/km)					448,750	
For Grade Separation Structure						
	1 Pedestrian Bridge	sq.m	300.00	105	31,500	L=35,w=3
	2 Elevated Station	sq.m	500.00	240	120,000	A=12x20
	3 Fly-over Bridge	sq.m	800.00	1,320	1,056,000	w=11,L=120

Concept of Integrated Public Transportation Terminal Development



9.

UNIT COST OF INTEGRATED PUBLIC TRANSPORTATION TERMINAL, 1998

Project Cost for Integrated Public Transportation Terminal

	unit	Unit Price	Quantity	Price	Remarks
Inter-Urban Bus Area	sq.m	13	12,000	156,000	A=120x100
Urban Bus Area	sq.m	13	7,500	97,500	A=150x100
Park & Ride, Kiss & Ride	sq.m	10	15,000	150,000	A=50*300
Taxi	sq.m	10	2,500	25,000	A=50x50
Parking	sq.m	10	3,500	35,000	A=50x70
Terminal Building	sq.m	300	5,600	1,680,000	A=70x80
Management and Operation	sq.m	300	3,000	900,000	A=100x30
Commercial/Amenity	sq.m	10	10,900	109,000	A=30x200, 70x70
Landscape	sq.m	5	6,000	30,000	10% of the total area
Pedestrian Bridge	sq.m	300	900	270,000	w=3 L=300
Intersection Improvement	ea	74,000	2	148,000	r=2
	Subtotal			3,600,500	
	Miscellaneous 25% above			900,125	
	Total			4,500,625	
	Total Area and unit price per ha excluding Land cost		60,000	750,000	US\$ 0.750 Million/ha
	Traffic Area		40,500		68%

Estimate Breakdown of the Mercat Mayoreo Terminal Construction Cost

	unit	Unit Price	Quantity	Price	Remarks
Inter-Urban Bus Area	sq.m	8	6,656	53,248	
Urban Bus Area	sq.m	13	0	0	
Park & Ride, Kiss & Ride	sq.m	10	0	0	
Taxi	sq.m	10	0	0	
Parking	sq.m	10	0	0	
Terminal Building	sq.m	80	1,302	104,160	
Management and Operation	sq.m	90	0	0	
Commercial/Amenity	sq.m	10	0	0	
Landscape	sq.m	5	0	0	
Pedestrian Bridge	sq.m	300	0	0	
Intersection Improvement	ea	74,000	0	0	
	Subtotal			157,408	
	Miscellaneous 25% above			39,352	
	Total			196,760	
	Total Area and unit price per ha		7,958	247,000	US\$ 0.247 Million/ha
	C\$			2,065,980	

APPENDIX 8 VEHICLE OPERATING COST (VOC)

Unit costs of vehicle operation are estimated in order to basic information to estimate savings in vehicle operating cost which is a main source of economic benefit of a transport project. These unit costs are estimated by type of vehicle (passenger car, microbus, bus, small truck and medium-size truck). VOC is composed of the following cost items:

- a. Fuel cost
- b. Oil cost
- c. Tire cost
- d. Maintenance cost
- e. Depreciation cost
- f. Capital opportunity cost (interest)
- g. Crew and overhead cost

In Nicaragua, the Ministry of Transport and Infrastructure (MTI) has been periodically updating VOC data as an input of the HDM Model developed by IBRD. Most input data and assumptions of the analysis in this appendix followed those of MTI. The HDM model is applied, however, to inter-municipal or inter-regional highways and then a key factor affecting VOCs is road surface conditions in terms of roughness. On the other hand, VOCs analyzed here will be used to evaluate Master Plan projects in the urban area of Managua City, where roads are mostly paved and then, the key factor is not roughness but operating speed. Then, unit VOC cost of each item is prepared by different operating speed.

1. General Characteristics of Representative Vehicles

To estimate VOCs by type of vehicles, representative makes and models which are popular in Managua City are selected for each vehicle type. Their market prices are averaged to a financial price and by deducting taxes from the financial price, economic prices of each models are estimated. Table 1 shows the vehicle prices and other operational assumptions. Annual operating distance follows the MTI's estimates but average operating speed is modified based on the survey results of this Master Plan Study.

2. Fuel Cost

Nicaragua does not produce but imports and refines crude oil. According to the MTI's data, the cost composition of petro-products is as shown in Table 2. Retail price of regular gasoline is US\$1.77 per gallon of which about 45% is various taxes and then economic price is US\$0.99 per gallon. In the same way, financial and economic prices of super gasoline are US\$1.89 and US\$1.10 per gallon, respectively and US\$1.40 and US\$0.85 for diesel oil.

Table 3 shows composition of fuel consumption by type of vehicles, which was estimated based on vehicle statistics of National Transport Safety Department (Dirección de Seguridad de Tránsito Nacional) and interviewing survey to major gas station in Managua. Making averages of fuel prices weighted by these consumption ratios, economic fuel costs of passenger car and microbus are estimated at US\$0.26/liter, bus at US\$0.23, small truck at US\$0.24 and medium size truck at US\$0.23.

Fuel consumption rate of a vehicle varies by its operating speed. The most economical speed is 45 to 50 km / hour for passenger car, and 50 to 60 km/hour for medium and large vehicles. Based on various data mainly developed by a series of IBRD Studies concerning the fuel consumption rate by operating speed, fuel costs per kilometer are tabulated by type of vehicle, as shown in Table 4.

3. Oil Cost

Retail price of lubricant oil is US\$1.5/liter and after deducting tax, economic cost is US\$1.2/liter. The relations between oil consumption and operating speed are as shown in Table 5. From this information, economic oil cost is estimated by operating speed.

4. Tyre Cost

Table 6 presents market price and economic price of tyres by type of vehicle. Under the condition of average speed of 35 mile/hour (56 km/hour) on paved roads, average tire life assumes 45,000 km for passenger car and 50,000 km for heavy vehicle. Thus, tire consumption rates per 1,000 km are 8.9% and 12.0%, respectively. On the other hand, it is empirically known that this consumption rate becomes higher as average operating speed rises. An IBRD report ("Quantification of road user savings", IBRD Occasional Paper No.2, 1966) shows the relationship between tyre wear and speed as in Table 7. Based on this information, economic tire cost per kilometer is obtained as shown in the same table.

Although some vehicles use re-treaded tyres, they are neglected by the reasons that their market share is not significant and that the life of re-treaded tire is shorter than brand new tire even if its prices is lower, so that there is no big difference in economic price per kilometer between the two.

5. Maintenance Cost

Calculating annual maintenance cost based on MTT's VOC data, the rate of annual maintenance cost to the vehicle price (excluding tyres cost) is estimated to be 4% for passenger car, and small truck and 8% for other commercial vehicles with longer operating distance. By assuming annual operating distance, maintenance cost per kilometer are calculated as shown in Table 8.

According to the said IBRD report referred to in the tyre cost estimation, the relationship between maintenance cost and operating speed shows that maintenance cost becomes lowest at around 50 km/hour of speed. Using these conversion rates, maintenance cost obtained at different speed (Table 9).

6. Depreciation Cost

Depreciable amount is defined as the vehicle cost (without tyre cost) less salvage cost after usage during vehicle life. In Nicaragua, where market of secondhand vehicles and spare parts is fairly developed, salvage value rate can be assumed at rather high rate, namely, 25% for passenger car, 20% for small truck and 15% for others (Table 10).

Vehicle are devaluated through their use in proportion to operating kilometers, while their value will decrease as they become older, even without using. Particularly, passenger car loses its value rapidly as time passes. Therefore, the proportion of depreciation subject to use and subject to time may be assumed as follows: 50:50 for passenger car and 70:30 for others.

Depreciation subject to use is furthermore subdivided into two parts. It is assumed that two third of this cost depends on the accumulated driven kilometers and one thirds are affected by operating speed. Costs of use-related depreciation and time-relate depreciation is shown in Table 11 and Table 12, respectively.

Time related depreciation in the table presents daily and hourly depreciation cost which is depreciable amount divided by number of days and operating hours during life period.

7. Capital Opportunity Cost (Interest)

This cost is not affected by use but accrues only as time passes and is determined by vehicle price, life period, salvage value rate and interest rate, using the following formula:

$$C = P (1 - r) F - P / n + i r P$$
$$F = i (1 + i)^n / ((1 + i)^n - 1)$$

Where,

- C : Capital opportunity cost
- P : Economic cost of vehicle
- F : Capital recovery factor
- r : Salvage value rate
- i : Interest rate
- n : Durability (Vehicle life)

Interest rate is 12 % which is the rate adopted by the MTC's analysis and also to be used as the discount rate when calculating evaluation indices. Table 13 presents hourly capital opportunity cost. Total capital opportunity cost in the study area is the product of this cost and total number of vehicles-hours.

8. Crew Cost and Overhead Cost

This cost is not affected by driven kilometer but is proportional to time. According to an interview survey to bus drivers, average annual wage of a bus driver is about US\$300 while that of a truck driver is US\$350, approximately 16% higher than bus driver's wage. Adding wages of assistants to this, annual crew cost per truck is estimated to be US\$450 (Table 14). Overhead cost of bus and truck transport business is assumed at 60% of crew cost.

9. Aggregate VOC

Aggregate unit VOCs are summarized as shown in Table 15. To calculate total VOC in a network, firstly, operating speed of each link is obtained from the traffic assignment result, secondly, total distance-related cost is calculated by summing up the cost in each link and finally, time-related cost calculated separately using total vehicle-hours is added to the distance-related cost.

Table 1 Characteristics of Representative Vehicle

	Car/Taxi	Microbus	Large Bus	L.Truck	H.truck
1 Representative Model	Nissan Ford Mitsubishi Toyota	Hyndai Toyota Kia	International Frigliner Mercedes B.	Hyndai Isuzu Toyota Mac	Mercedes B. Isuzu
2 Price(US\$)					
(1) Financial	15,870	22,595	78,380	22,595	58,340
(2) Economic	11,720	15,280	67,223	15,280	49,242
3 No. of Tires	4	4	6	4	6
4 Main Fuel Type	Gasoline	Gasoline	Diesel	Gasoline	Diesel
5 Annual Operation	25000	70000	70000	35000	35000
6 Average Speed	35	25	25	30	30
8 annual using hours	714	2800	2800	1167	1167

Table 2 Economic Cost of Fuel in Managua

US\$=10.2236

Item	Unit		Diesel	Regular Gasoline	Super Gasoline	Foreign Component
1 Crude Oil Price at Refinery	US\$/bri	17.3554				100
2 Margin of Refinery	US\$/bri		3.4017	5.1285	5.5711	50
3 Basic Price at Gulf	US\$/bri		20.7571	22.4839	22.9265	
4 Freight/Insurance	US\$/bri		2.4751	2.4485	2.3924	100
5 Inport Price(CIF)	US\$/bri		23.2322	24.9324	25.3189	
6 Storage/Handling Charge at Port	US\$/bri		2.2198	2.2251	2.157	25
7 Parity Value of Imported Product	US\$/bri		25.452	27.1575	27.4759	
gal/bri = 42	US\$/gal		0.6060	0.6466	0.6542	
8 Transport to Managua	US\$/gal		0.0293	0.0278	0.0293	50
9 Commercial Margin	%		20%	30%	40%	
	US\$/gal		0.1271	0.2023	0.2734	25
10 Local Transport	US\$/bri		0.0852	0.0852	0.1193	50
11 Tax (IEC)	US\$/bri		0.5578	0.8059	0.8089	0
12 Consumer Price	US\$/bri		1.4054	1.7678	1.8851	
	C\$/gal		14.3678	18.0736	19.2723	
l/gal= 3.785	US\$/liter		0.3713	0.4671	0.4980	
13 Economic Cost	US\$/gal		0.8500	0.9700	1.0900	
	US\$/liter		0.2246	0.2563	0.2880	
14 Additional Adjustment	US\$/liter		0.2200	0.2600		
15 Sales Price	C\$/liter		2.2900	2.6200		
16 Weight of Gasoline	US\$/bri			0.9200	0.0800	
17 Diesel with Additives	Peso		0.1500			
Additional Price	C\$/gal		1.0000			
18 Foreign Component	US\$/liter		0.1600	0.1800	0.1900	

Source: Ministerio de Transporte y Infraestructura

- Note:
- The margin of refinery was considered as a percentage of the base price, as 19.6% for diesel, 29.55% for regular gasoline and 32.1% for super gasoline.
 - The price of the crude oil was the average price regulated by INE as of February 12 to March 11, 1988.
 - According to INE, for Freight, Insurance, etc, the values of Premium (PM), Sea freight (FTM), calculation of Sea Insurance, In transit Loss, Letter of Credit and Bank Charge are included.
 - For storage and port charges was taken from INE's data which includes the following: Entrance Cost, Calculation of in Terminal Loss and Terminal Margin.
 - Only the base price and IEC (Petroleum Consumption Tax) were taken from investigations done in several Gas Stations to calculate the regular and super gasoline.

Table 3 Composition of Fuel Consumption and Average Fuel Cost by Type of Vehicle

Fuel Type	(% , US\$/liter)				
	Pass. Car & Taxi	Microbus	Bus	Light Truck	Medium Truck
Regular Gasoline	75	90	10	40	5
Super Gasoline	25	10		12	
Diesel			90	48	95
Total	100	100	100	100	100
Av. Financial Cost(US\$/liter)	0.47	0.47	0.38	0.42	0.38
Av Economic Cost(US\$/liter)	0.26	0.26	0.23	0.24	0.23

Table 4 Fuel Consumption Rate and Cost by Type of Vehicle

	Speed (Km/hour)	Pass. Car & Taxi	Microbus	Bus	Light Truck	Medium Truck
Fuel Consumption Rate(Litter/1000Km)	5	212.6	337.2	672.7	605.2	1210.4
	10	138.6	215.8	430.4	387.3	774.5
	20	100.2	156.0	311.2	280.0	560.0
	30	87.0	122.2	284.2	235.0	412.0
	40	80.2	107.9	264.5	225.0	342.0
	50	78.4	101.4	284.2	220.0	314.0
	60	81.0	97.5	326.1	225.0	303.0
	70	85.7	98.2	380.9	230.0	314.0
	80	92.7	102.0	438.1	250.0	340.0
	90	102.4	112.7	483.9	276.2	375.6
Financial Fuel Cost (US\$/1000km)	5	100.9	158.5	256.2	257.1	455.2
	10	65.8	101.5	163.9	164.5	291.3
	20	47.6	73.3	118.5	118.9	210.6
	30	41.3	57.5	108.2	99.8	154.9
	40	38.1	50.7	100.7	95.6	128.6
	50	37.2	47.7	108.2	93.5	118.1
	60	38.5	45.8	124.2	95.6	114.0
	70	40.7	46.2	145.1	97.7	118.1
	80	44.0	48.0	166.9	106.2	127.9
	90	48.6	53.0	184.3	117.3	141.3
Economic Fuel Cost (US\$/1000km)	5	56.2	87.5	153.2	148.2	273.7
	10	36.6	56.0	98.0	94.8	175.2
	20	26.5	40.5	70.9	68.6	126.6
	30	23.0	31.7	64.7	57.5	93.2
	40	21.2	28.0	60.2	55.1	77.3
	50	20.7	26.3	64.7	53.9	71.0
	60	21.4	25.3	74.3	55.1	68.5
	70	22.6	25.5	86.7	56.3	71.0
	80	24.5	26.5	99.8	61.2	76.9
	90	27.1	29.2	110.2	67.6	84.9

Table 5 Oil Consumption Rate and Cost by Type of Vehicle

	Speed (Km/hour)	Pass. Car & Taxi	Microbus	Bus	Light Truck	Medium Truck
Oil Consumption Rate(Litter/1000Km)	5	3.48	4.10	8.01	6.86	8.01
	10	2.24	2.63	5.14	4.40	5.14
	20	1.54	1.81	3.53	3.03	3.54
	30	1.27	1.49	2.92	2.50	2.92
	40	1.13	1.33	2.68	2.22	2.68
	50	1.10	1.29	2.58	2.08	2.58
	60	1.09	1.28	2.36	1.80	2.36
	70	1.07	1.26	2.14	1.68	2.14
	80	1.00	1.18	1.87	1.52	1.87
	90	0.90	1.06	1.68	1.37	1.68
Financial Oil Cost (US\$/1000km)	5	5.2	6.2	12.0	10.3	12.0
	10	3.4	3.9	7.7	6.6	7.7
	20	2.3	2.7	5.3	4.5	5.3
	30	1.9	2.2	4.4	3.8	4.4
	40	1.7	2.0	4.0	3.3	4.0
	50	1.7	1.9	3.9	3.1	3.9
	60	1.6	1.9	3.5	2.7	3.5
	70	1.6	1.9	3.2	2.5	3.2
	80	1.5	1.8	2.8	2.3	2.8
	90	1.4	1.6	2.5	2.1	2.5
Economic Oil Cost (US\$/1000km)	5	4.2	4.9	9.6	8.2	9.6
	10	2.7	3.2	6.2	5.3	6.2
	20	1.8	2.2	4.2	3.6	4.2
	30	1.5	1.8	3.5	3.0	3.5
	40	1.4	1.6	3.2	2.7	3.2
	50	1.3	1.5	3.1	2.5	3.1
	60	1.3	1.5	2.8	2.2	2.8
	70	1.3	1.5	2.6	2.0	2.6
	80	1.2	1.4	2.2	1.8	2.2
	90	1.1	1.3	2.0	1.6	2.0

Table 6 Financial and Economic Cost of Tyres

	Unit	Pass. Car & Taxi	Microbus	Bus	Light Truck	Medium Truck
No. of Tyres	No./set	4	4	6	6	6
Type of Tyre		155/R13 205/60R15	7.00.16 8c 750/16AT 205/75R14 205/R16	10.00.20 16c	10.00.20 16c 650/14 750/16AT	900/20 14c 12.00.20 18c
Financial Cost (Market Price)	US\$/Set	304.04	394.36	2292.54	960.00	1775.16
Tax	US\$/Set	25.76	77.88	299.16	123.48	231.54
Economic Cost	US\$/Set	278.28	316.48	1993.38	836.52	1543.62
Tyre Life	Km	45,000	45,000	50,000	45,000	50,000
Tyre Consumption Rate	% per 1000km	8.9	8.9	12.0	13.3	12.0

Table 7 Tyre Consumption Rate and Cost by Type of Vehicle

	Speed (Km/hour)	Pass. Car & Taxi	Microbus	Bus	Light Truck	Medium Truck
Tyre Consumption Indices (56km/hr =100)	5	53	53	53	53	53
	10	56	56	56	56	56
	20	60	60	60	60	60
	30	67	67	67	67	67
	40	78	78	78	78	78
	50	92	92	92	92	92
	56	100	100	100	100	100
	60	107	107	107	107	107
	70	125	125	125	125	125
	80	151	151	151	151	151
90	180	180	180	180	180	
Financial Tyre Cost (US\$/1000km)	5	14.3	18.6	145.8	67.8	112.9
	10	15.1	19.6	154.1	71.7	119.3
	20	16.2	21.0	165.1	76.8	127.8
	30	18.1	23.5	184.3	85.8	142.7
	40	21.1	27.3	214.6	99.8	166.2
	50	24.9	32.2	253.1	117.8	196.0
	60	28.9	37.5	294.4	137.0	227.9
	70	33.8	43.8	343.9	160.0	266.3
	80	40.8	52.9	415.4	193.3	321.7
	90	48.6	63.1	495.2	230.4	383.4
Economic Tyre Cost (US\$/1000km)	5	13.1	14.9	126.8	59.1	98.2
	10	13.9	15.8	134.0	62.5	103.7
	20	14.8	16.9	143.5	66.9	111.1
	30	16.6	18.8	160.3	74.7	124.1
	40	19.3	21.9	186.6	87.0	144.5
	50	22.8	25.9	220.1	102.6	170.4
	60	28.5	30.1	255.9	119.3	198.2
	70	30.9	35.2	299.0	139.4	231.5
	80	37.4	42.5	361.2	168.4	279.7
	90	44.5	50.6	430.6	200.8	333.4

Table 8 Assumptions for Maintenance Cost Estimation

	Unit	Pass. Car & Taxi	Microbus	Bus	Light Truck	Medium Truck
Vehicle Cost						
Financial	US\$	15,870	22,595	78,380	22,595	58,340
Economic	US\$	11,720	15,280	67,223	15,280	49,242
Tyre Cost						
Financial	US\$	304	394	2,293	960	1,775
Economic	US\$	278	316	1,993	837	1,544
Vehicle Cost w/o Tyre						
Financial	US\$	15,566	22,201	76,087	21,635	56,565
Economic	US\$	11,442	14,964	65,230	14,443	47,698
Annual Maintenance Cost						
% of Vehicle Cost	%	4.0	8.0	8.0	6.0	8.0
Financial	US\$	623	1,776	6,087	1,298	4,525
Economic	US\$	458	1,197	5,218	867	3,816
Annual Operation.	Km	25,000	70,000	70,000	35,000	35,000
Average Speed	Km/Hr	35	25	25	30	30
Maintenance Cost at Average Speed						
Financial	US\$	24.9	25.4	87.0	37.1	129.3
Economic	US\$	18.3	17.1	74.5	24.8	109.0

Table 9 Financial and Economic Maintenance Cost

	Speed (Km/hour)	Pass. Car & Taxi	Microbus	Bus	Light Truck	Medium Truck
Maintenance Cost Indices (Av. Speed = 100)	5	141	107	142	134	159
	10	133	100	131	126	147
	20	118	90	111	113	124
	30	105	80	89	100	100
	40	95	75	74	94	83
	50	94	74	72	93	81
	60	100	80	79	100	88
	70	108	85	88	107	98
	80	115	91	100	114	112
	90	122	96	112	120	125
Financial Maintenance Cost (US\$/1000km)	5	35.1	27.1	123.7	49.7	205.8
	10	33.1	25.5	114.0	46.8	189.6
	20	29.4	22.8	96.6	41.8	160.5
	30	27.8	25.4	87.0	39.4	144.9
	40	26.2	20.3	77.3	37.1	129.3
	50	24.9	19.7	71.0	36.0	118.5
	60	23.7	19.1	64.7	34.9	107.7
	70	23.4	18.9	62.8	34.6	104.5
	80	24.9	20.3	68.6	37.1	113.1
	90	26.9	21.6	76.3	39.6	126.1
Economic Maintenance Cost (US\$/1000km)	5	25.8	18.3	106.0	33.2	173.5
	10	24.3	17.2	97.7	31.3	159.9
	20	21.6	15.3	82.8	27.9	135.4
	30	20.4	17.1	74.5	26.3	122.2
	40	19.2	13.7	66.3	24.8	109.0
	50	18.3	13.3	60.9	24.0	99.9
	60	17.4	12.9	55.5	23.3	90.9
	70	17.2	12.7	53.8	23.1	88.1
	80	18.3	13.7	58.8	24.8	95.4
	90	19.8	14.6	65.4	26.4	106.3

Table 10 Assumptions for Depreciation Cost Estimation

	Unit	Pass. Car & Taxi	Microbus	Bus	Light Truck	Medium Truck
Vehicle Cost						
Financial	US\$	15,870	22,595	78,380	22,595	58,340
Economic	US\$	11,720	15,280	67,223	15,280	49,242
Tyre Cost						
Financial	US\$	304	394	2,293	960	1,775
Economic	US\$	278	316	1,993	837	1,544
Vehicle Cost w/o Tyre						
Financial	US\$	15,566	22,201	76,087	21,635	56,565
Economic	US\$	11,442	14,964	65,230	14,443	47,698
Salvage Value						
% of Vehicle Cost	%	25.0	15.0	15.0	20.0	15.0
Financial	US\$	3,891	3,330	11,413	4,327	8,485
Economic	US\$	2,860	2,245	9,784	2,889	7,155
Annual Operation.	Km	25,000	70,000	70,000	35,000	35,000
Average Speed	Km/Hr	35	25	25	30	30
Vehicle Life	Year	12	10	12	12	12
% of Dep. of Use & Time						
Subject to use	%	50	70	70	70	70
Subject to time	%	50	30	30	30	30
Depreciable Amount						
Financial						
subject to use	US\$	5,837	13,209	45,272	12,116	33,656
subject to time	US\$	5,837	5,661	19,402	5,192	14,424
Total	US\$	11,674	18,871	64,674	17,308	48,080
Economic						
subject to use	US\$	4,291	8,903	38,812	8,088	28,381
subject to time	US\$	4,291	3,816	16,634	3,466	12,163
Total	US\$	8,581	12,719	55,445	11,555	40,544

Table 11 Financial and Economic Depreciation Cost subject to Use

	Speed (Km/hour)	Pass. Car & Taxi	Microbus	Bus	Light Truck	Medium Truck
Indices for Depreciation Cost subject to Use (Av. Speed = 100)	5	136	119	131	126	146
	10	130	114	123	121	137
	20	119	104	108	110	119
	30	108	96	92	100	100
	40	100	91	81	96	86
	50	100	91	80	95	85
	60	104	96	84	100	90
	70	110	100	91	106	98
	80	116	105	99	111	109
	90	121	109	109	116	120
Financial Maintenance Cost (US\$/1000km)	5	26.6	22.4	70.5	36.5	117.1
	10	25.3	21.4	66.4	34.8	109.4
	20	23.1	19.7	58.3	31.7	95.5
	30	22.1	18.9	53.9	30.3	87.8
	40	21.1	18.1	49.5	28.8	80.1
	50	19.5	17.3	43.7	27.7	69.7
	60	19.5	17.2	43.4	27.6	69.0
	70	19.5	17.1	43.1	27.4	68.3
	80	20.3	18.1	45.4	28.8	72.5
	90	21.5	18.9	48.9	30.5	78.7
Economic Maintenance Cost (US\$/1000km)	5	19.5	15.1	60.4	24.4	98.7
	10	18.6	14.4	56.9	23.2	92.3
	20	17.0	13.2	50.0	21.1	80.5
	30	16.2	12.7	46.2	20.2	74.0
	40	15.5	12.2	42.5	19.3	67.6
	50	14.3	11.7	37.5	18.5	58.8
	60	14.3	11.6	37.2	18.4	58.2
	70	14.3	11.5	37.0	18.3	57.6
	80	14.9	12.2	39.0	19.3	61.1
	90	15.8	12.7	42.0	20.4	66.4

Table 12 Depreciation Cost subject to Time

	Unit	Pass. Car & Taxi	Microbus	Bus	Light Truck	Medium Truck
Financial Cost						
Daily Cost	US\$/Day	1.33	1.55	4.43	1.19	3.29
Hourly Cost	US\$/Hr	0.68	0.20	0.58	0.37	1.03
Economic Cost						
Daily Cost	US\$/Day	0.98	1.05	3.80	0.79	2.78
Hourly Cost	US\$/Hr	0.50	0.14	0.50	0.25	0.87

Table 13 Capital Opportunity Cost by Type of Vehicle

	Unit	Pass. Car & Taxi	Microbus	Bus	Light Truck	Medium Truck
Vehicle Cost						
Financial	US\$	15,870	22,595	78,380	22,595	58,340
Economic	US\$	11,720	15,280	67,223	15,280	49,242
Tyre Cost						
Financial	US\$	304	394	2,293	960	1,775
Economic	US\$	278	316	1,993	837	1,544
Vehicle Cost w/o Tyre						
Financial	US\$	15,566	22,201	76,087	21,635	56,565
Economic	US\$	11,442	14,964	65,230	14,443	47,698
Salvage Value						
% of Vehicle Cost	%	25.0	15.0	15.0	20.0	15.0
Financial	US\$	3,891	3,330	11,413	4,327	8,485
Economic	US\$	2,860	2,245	9,784	2,889	7,155
Annual Operation	Km	25,000	70,000	70,000	35,000	35,000
Average Speed	Km/Hr	35	25	25	30	30
Vehicle Life	Year	12	10	12	12	12
Capital Recovery Factor at $i = 12\%$		0.1614	0.1614	0.1614	0.1614	0.1614
Capital Opportunity Cost						
Financial	US\$/Day	2.9	3.4	15.0	4.1	11.1
	US\$/Hr	1.5	0.4	2.0	1.3	3.5
Economic	US\$/Day	1.7	2.3	13.9	2.5	7.0
	US\$/Hr	0.9	0.3	1.8	0.8	2.2

Table 14 Crew Cost and Overhead Cost by Type of Vehicle

	Unit	Pass. Car & Taxi	Microbus	Bus	Light Truck	Medium Truck
Annual Crew Cost						
Financial	US\$	-	3,900	3,900	-	5,850
Economic	US\$	-	3,510	3,510	-	5,265
Annual Overhead Cost						
Financial	US\$	-	2,340	2,340	-	3,510
Economic	US\$	-	2,106	2,106	-	3,159
Daily Crew and OH Cost						
Financial	US\$	-	17.10	17.10	-	25.64
Economic	US\$	-	15.39	15.39	-	23.08
Hourly Crew and OH Cost						
Financial	US\$	-	2.23	2.23	-	8.02
Economic	US\$	-	2.01	2.01	-	7.22

Table 15 Aggregate Vehicle Operating Cost by Type of Vehicle

(1) UOC subject to Use

(US\$/1000Km)

	Speed (Km/hour)	Pass. Car & Taxi	Microbus	Bus	Light Truck	Medium Truck
Financial Cost	5	182.2	232.8	608.2	421.4	903.0
	10	142.8	171.9	506.1	324.4	717.3
	20	118.6	139.5	443.8	273.7	599.7
	30	111.2	127.4	437.8	259.0	534.8
	40	108.1	118.4	446.2	264.7	508.2
	50	108.1	118.8	479.9	278.1	506.1
	60	110.2	119.1	511.0	288.8	507.2
	70	114.1	121.6	548.6	299.2	522.0
	80	124.5	131.9	627.6	334.4	582.5
	90	139.2	148.0	727.5	382.8	670.2
Economic Cost	5	154.3	188.9	824.5	444.4	939.0
	10	95.4	105.7	385.7	213.7	531.7
	20	80.8	87.0	341.8	183.7	450.5
	30	76.0	80.2	332.5	174.0	404.1
	40	73.8	74.3	332.4	176.5	381.3
	50	73.9	74.7	352.7	185.9	377.3
	60	77.2	77.2	389.9	201.6	390.8
	70	80.2	79.4	419.3	211.3	404.5
	80	85.4	83.8	455.7	226.4	433.8
	90	94.6	93.0	518.6	255.5	491.2

(2) VOC subject to Time

(\$/Hour)

	Pass. Car & Taxi	Microbus	Bus	Light Truck	Medium Truck
Financial Cost					
Depreciation	0.681	0.202	0.577	0.371	1.030
Capital Opportunity Cost	1.476	0.438	1.953	1.294	3.484
Crew and Overhead Cost	-	2.229	2.229	-	8.023
Total	2.157	2.868	4.759	1.665	12.537
Economic Cost					
Depreciation	0.501	0.136	0.495	0.248	0.869
Capital Opportunity Cost	0.892	0.295	1.814	0.790	2.202
Crew and Overhead Cost	-	2.006	2.006	-	7.221
Total	1.393	2.437	4.315	1.037	10.291

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