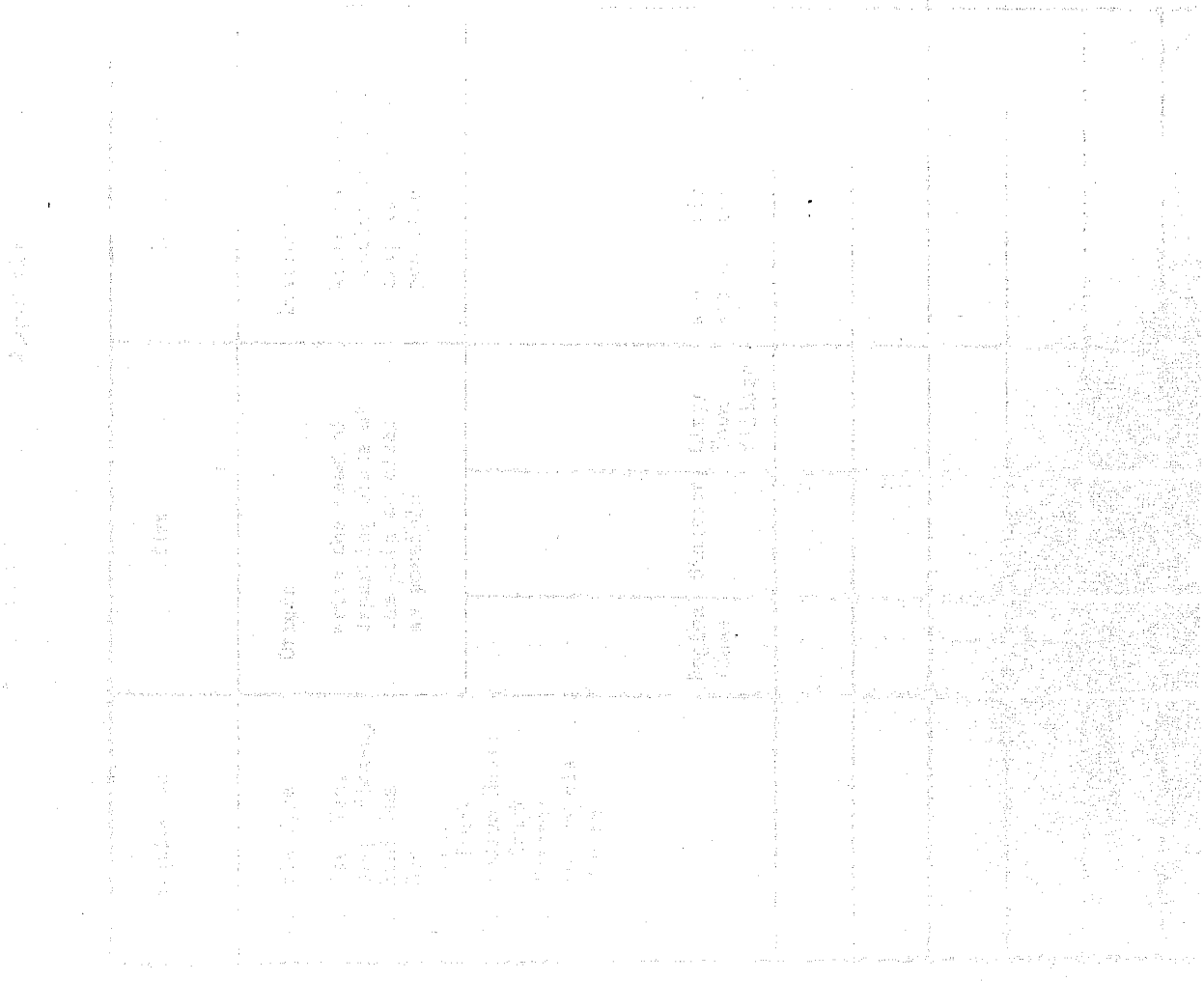
Appendix 5.2.1 OD Questionnaire Sheet



Appendix 5.2.1 (1) OD QUESTIONNAIRE SHEET

Station No.	Time			Interviewer			Only for Passenger Car/Mini Bus/Bus Motor-cycle (Vehicle Type, 1, 2, 3 & 7)		Only for Light Truck/ Medium, Heavy Truckk/Tractor (Vehicle Type 4, 5 & 6)	
Vehicle Type 1. Car, Van, Jeep, Pick-up 2. Mini Bus 3. Bus 4. Light Truck 5. Medium Heavy Truck 6. Tractor 7. Motorcycle 8. Others	Origin Write the name of departing place of the trip as clear as possible			Destination Write the name of destination of the trip as clear as possible			Purpose 1. To Work Place 2. Business 3. Home 4. Sightseeing 5. to School 6. Shopping/ Entertainment 7. Others		Commodity 1. No. Luggage 2. Jute 3. Rice 4. Timber 5. Other Agricultural 6. Oil 7. Mineral 8. Machinery 9. Light 10. Chemical 11. Construction material 12. Miscellaneous	Condition 1. Full 2. 3/4 full 3. 1/2 full 4. 1/4 full 5. Empty
	Region /Zone	District	City/ Town/ Village	Re-giion	Dis-trict	City/ Town/ Village		No. of Passen-gers		

Appendix 5.2.1 (2) TRAFFIC COUNTING SHEET

Name of the Station	Station Number	Day or Night	Direction	Name of Counter	Day	Weather
		1. Day (6:00 A.M. - 6:00 P.M.) 2. Night (6:00 P.M. - 6:00 A.M)	To		Dec th	

Time	Car Van Jeep Pick-up	Bus		Truck		Tractor	Motor-cycle	Others	Total
		Mini Bus	Bus	Light Truck	Medium. Heavy Truck				
6:00 - 7:00									
7:00 - 8:00									
8:00 - 9:00									
9:00 - 10:00									
10:00 - 11:00									
11:00 - 12:00									
12:00 - 1:00									
1:00 - 2:00									
2:00 - 3:00									
3:00 - 4:00									
4:00 - 5:00									
5:00 - 6:00									
Total									

Appendix 6.4.1 Vehicle OD Table

(Unit: Vehicle/day)

(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)		
0	94	0	0	0	0	0	2	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	98	(1)Mahottari
	0	25	0	0	108	0	39	0	2	0	0	5	12	65	5	0	2	3	0	0	0	6	0	0	366	(2)Dhanusha
		0	0	0	0	0	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	33	(3)Sindhuli
			0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	(4)Ramechhap
				0	0	0	25	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	27	(5)Dolakha
					0	0	21	0	0	0	0	0	42	0	9	0	0	2	3	0	2	0	0	0	187	(6)Sarlahi
						0	527	22	7	0	0	0	0	0	3	0	2	0	2	0	5	0	0	0	568	(7)Kabhreplanchok
							0	0	0	135	0	131	107	156	48	35	72	2	216	0	94	44	4	123	1791	(8)Kathmandu
								0	0	0	0	0	4	2	8	0	0	0	2	0	0	0	0	0	38	(9)Bhaktapur
									0	0	0	2	2	6	2	0	6	0	0	0	0	0	0	0	27	(10)Lalitpur
										0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	135	(11)Sindhupalchok
											0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	(12)Nuwakot/Rasuwa
												0	0	0	0	0	0	0	0	0	0	0	0	0	138	(13)Dhading
													0	196	0	6	14	2	0	0	0	0	0	5	392	(14)Makawanpur
														0	105	16	25	12	56	0	18	13	0	0	670	(15)Rauthat/Bara/Parsa
															0	2	17	6	0	0	0	0	0	0	207	(16)Chitwan
																0	0	0	0	0	2	0	0	0	61	(17)Mechi
																	0	0	7	0	4	3	0	0	152	(18)Koshi
																		0	0	0	6	0	0	0	33	(19)Sagarmatha
																			0	0	0	0	0	0	286	(20)Gandaki
																				0	0	0	0	0	0	(21)Dhawalagiri
																					0	0	0	0	131	(22)Lumbini
																						0	0	0	66	(23)Mid-West Dev. R.
																							0	0	4	(24)Far-West Dev. R.
																								0	128	(25)India
																									5540	

Appendix 6.4.1 (1) Vehicle OD Table (1986) (All Vehicles)

(Unit: Vehicle/day)

(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)		
0	199	0	0	0	0	0	15	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	219	(1)Mahottari
	0	167	0	0	360	0	89	0	5	0	0	12	26	115	11	0	5	7	0	0	0	14	0	0	1009	(2)Dhanusha
		0	0	0	0	0	51	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	218	(3)Sindhuli
			0	0	0	0	20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20	(4)Ramechhap
				0	0	0	56	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	60	(5)Dolakha
					0	0	66	0	0	0	0	0	164	0	36	0	0	7	10	0	9	0	0	0	653	(6)Sarlahi
						0	1181	60	13	0	0	0	0	0	9	0	9	0	7	0	16	0	0	0	1296	(7)Kabhreplanchok
							0	0	0	278	0	244	202	306	95	123	197	6	429	0	218	96	9	231	3912	(8)Kathmandu
								0	0	0	0	0	10	3	21	0	0	0	5	0	0	0	0	2	102	(9)Bhaktapur
									0	0	0	4	4	8	5	0	18	0	0	0	0	0	0	6	63	(10)Lalitpur
										0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	278	(11)Sindhupalchok
											0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	(12)Nuwakot/Rasuwa
												0	0	0	0	0	0	0	0	0	0	0	0	0	260	(13)Dhading
													0	467	0	18	37	4	0	0	0	0	0	14	952	(14)Makawanpur
														0	267	52	70	26	143	0	52	37	0	0	1546	(15)Rauthat/Bara/Parsa
															0	6	53	13	0	0	0	0	0	0	521	(16)Chitwan
																0	0	0	0	0	5	0	0	0	204	(17)Mechi
																	0	0	22	0	12	9	0	0	431	(18)Koshi
																		0	0	0	14	0	0	0	77	(19)Sagarmatha
																			0	0	0	0	0	0	615	(20)Gandaki
																				0	0	0	0	0	0	(21)Dhawalagiri
																					0	0	0	0	327	(22)Lumbini
																						0	0	0	156	(23)Mid-West Dev. R.
																							0	0	9	(24)Far-West Dev. R.
																								0	253	(25)India
																									13180	

Appendix 6.4.1 (2) Vehicle OD Table (1995) (All Vehicles)

(Unit: Vehicle/day)

	(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)		
	0	13	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	14	(1)Mahottari
		0	114	0	0	16	0	37	0	2	0	0	1	1	5	0	0	0	0	0	0	0	1	0	0	191	(2)Dhanusha
			0	0	0	0	0	35	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	149	(3)Sindhuli
				0	0	0	0	16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	16	(4)Ramechhap
					0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	(5)Dolakha
						0	0	3	0	0	0	0	0	3	0	1	0	0	0	0	0	0	0	0	0	24	(6)Sarlahi
							0	99	5	1	0	0	0	0	0	0	0	3	0	0	0	1	0	0	0	111	(7)Kabhreplanchok
								0	0	0	22	0	13	9	14	4	32	51	2	19	0	9	4	0	74	448	(8)Kathmandu
									0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	1	8	(9)Bhaktapur
										0	0	0	0	0	1	0	0	4	0	0	0	0	0	0	1	10	(10)Lalitpur
											0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	22	(11)Sindhupalchok
												0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	(12)Nuwakot/Rasuwa
													0	0	0	0	0	0	0	0	0	0	0	0	0	15	(13)Dhading
														0	7	0	1	1	0	0	0	0	0	0	0	23	(14)Makawanpur
															0	4	1	2	1	2	0	1	0	0	0	38	(15)Rauthat/Bara/Parsa
																0	0	1	0	0	0	0	0	0	0	13	(16)Chitwan
																	0	0	0	0	0	0	0	0	0	34	(17)Mechi
																		0	0	1	0	0	0	0	0	64	(18)Koshi
																			0	0	0	0	0	0	0	4	(19)Sagarmatha
																				0	0	0	0	0	0	23	(20)Gandaki
																					0	0	0	0	0	0	(21)Dhawalagiri
																						0	0	0	0	12	(22)Lumbini
																							0	0	0	5	(23)Mid-West Dev. R.
																								0	0	0	(24)Far-West Dev. R.
																									0	76	(25)India
																										1305	

Appendix 6.4.1 (3) Vehicle OD Table (1995) (Induced Traffic)

(Unit: Vehicle/day)

(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)		
0	272	0	0	0	0	0	20	0	0	0	0	0	8	0	0	0	0	0	0	0	0	0	0	0	300	(1)Mahottari
	0	229	0	0	547	0	120	0	7	0	0	16	36	149	15	0	6	9	0	0	0	19	0	0	1426	(2)Dhanusha
		0	0	0	0	0	74	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	303	(3)Sindhuli
			0	0	0	0	27	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	27	(4)Ramechhap
				0	0	0	77	0	0	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	84	(5)Dolakha
					0	0	102	0	0	0	0	0	258	0	57	0	0	10	16	0	14	0	0	0	1005	(6)Sarlahi
						0	1640	87	18	0	0	0	0	0	13	0	13	0	9	0	24	0	0	0	1803	(7)Kabhreplanchok
							0	0	0	376	0	324	289	424	134	188	287	9	591	0	314	137	12	322	5468	(8)Kathmandu
								0	0	0	0	0	15	5	32	0	0	0	7	0	0	0	0	3	148	(9)Bhaktapur
									0	0	0	5	6	10	7	0	25	0	0	0	0	0	0	8	85	(10)Lalitpur
										0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	376	(11)Sindhupalchok
											0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	(12)Nuwakot/Rasuwa
												0	0	0	0	0	0	0	0	0	0	0	0	0	344	(13)Dhading
													0	661	0	27	55	6	0	0	0	0	0	21	1383	(14)Makawanpur
														0	384	79	102	37	201	0	75	53	0	0	2180	(15)Rauthat/Bara/Parsa
															0	9	81	18	0	0	0	0	0	0	755	(16)Chitwan
																0	0	0	0	0	7	0	0	0	311	(17)Mechi
																	0	0	33	0	19	13	0	0	634	(18)Koshi
																		0	0	0	21	0	0	0	110	(19)Sagarmatha
																			0	0	0	0	0	0	857	(20)Gandaki
																				0	0	0	0	0	0	(21)Dhawalagiri
																					0	0	0	0	474	(22)Lumbini
																						0	0	0	223	(23)Mid-West Dev. R.
																							0	0	12	(24)Far-West Dev. R.
																								0	354	(25)India
																								18663		

Appendix 6.4.1 (4) Vehicle OD Table (2000) (All Vehicles)

(Unit: Vehicle/day)

(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)		
0	17	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	19	(1)Mahottari
	0	157	0	0	25	0	49	0	3	0	0	2	2	6	1	0	0	1	0	0	0	1	0	0	263	(2)Dhanusha
		0	0	0	0	0	51	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	208	(3)Sindhuli
			0	0	0	0	22	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	22	(4)Ramechhap
				0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	(5)Dolakha
					0	0	5	0	0	0	0	0	5	0	1	0	0	0	0	0	0	0	0	0	37	(6)Sarlahi
						0	138	8	1	0	0	0	0	0	1	0	5	0	1	0	1	0	0	0	154	(7)Kabhreplanchok
							0	0	0	29	0	18	13	20	6	49	74	3	26	0	13	5	0	153	680	(8)Kathmandu
								0	0	0	0	0	1	0	2	0	0	0	0	0	0	0	0	1	11	(9)Bhaktapur
									0	0	0	0	0	1	0	0	6	0	0	0	0	0	0	3	15	(10)Lalitpur
										0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	29	(11)Sindhupalchok
											0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	(12)Nuwakot/Rasuwa
												0	0	0	0	0	0	0	0	0	0	0	0	0	20	(13)Dhading
													0	10	0	1	2	0	0	0	0	0	0	0	33	(14)Makawanpur
														0	6	2	3	1	3	0	1	1	0	0	53	(15)Rauthat/Bara/Parsa
															0	0	2	1	0	0	0	0	0	0	19	(16)Chitwan
																0	0	0	0	0	0	0	0	0	52	(17)Mechi
																	0	0	1	0	0	0	0	0	93	(18)Koshi
																		0	0	0	1	0	0	0	7	(19)Sagarmatha
																			0	0	0	0	0	0	31	(20)Gandaki
																				0	0	0	0	0	0	(21)Dhawalagiri
																					0	0	0	0	17	(22)Lumbini
																						0	0	0	7	(23)Mid-West Dev. R.
																							0	0	0	(24)Far-West Dev. R.
																								0	157	(25)India
																									1935	

Appendix 6.4.1 (5) Vehicle OD Table (2000) (Induced Traffic)

Appendix 6.4.2 Inter-regional Travel Time for Trucks and Buses

(Unit: minutes)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)	
0	53	183	350	921	132	609	573	589	573	677	724	464	251	246	348	339	353	188	546	979	588	1393	2809	(1)Mahottari
	0	130	297	868	79	555	519	535	519	623	670	411	198	193	294	285	300	135	492	926	534	1340	2756	(2)Dhanusha
		0	167	984	195	672	636	652	636	740	787	527	314	309	411	415	430	265	609	1042	651	1456	2872	(3)Sindhuli
			0	1151	362	839	803	819	803	907	954	694	481	476	578	582	597	432	776	1209	818	1623	3039	(4)Ramechhap
				0	789	312	348	332	350	244	500	457	670	762	574	1153	1168	1003	675	1109	814	1619	3035	(5)Dolakha
					0	477	441	457	441	545	592	332	119	114	216	364	379	214	414	847	456	1261	2677	(6)Sarlahi
						0	36	20	38	68	187	144	358	449	261	841	855	690	363	796	501	1307	2723	(7)Kabhreplanchok
							0	16	6	104	151	108	322	413	225	805	819	654	327	760	465	1271	2687	(8)Kathmandu
								0	18	88	167	124	338	429	241	821	835	670	343	776	481	1287	2703	(9)Bhaktapur
									0	106	157	108	322	413	225	805	819	654	327	760	465	1271	2687	(10)Lalitpur
										0	255	212	426	517	329	909	923	758	431	864	569	1375	2791	(11)Sindhupalchok
											0	260	473	564	376	956	970	805	478	911	616	1422	2838	(12)Nuwakot/Rasuwa
												0	213	305	117	696	711	546	218	652	357	1162	2578	(13)Dhading
													0	92	97	483	498	333	295	728	337	1142	2558	(14)Makawanpur
														0	188	478	493	328	386	820	428	1234	2650	(15)Rauthat/Bara/Parsa
															0	580	594	429	198	632	240	1046	2462	(16)Chitwan
																0	185	194	778	1211	820	1625	3041	(17)Mechi
																	0	208	792	1226	834	1640	3056	(18)Koshi
																		0	627	1061	669	1475	2891	(19)Sagarmatha
																			0	433	344	1150	2566	(20)Gandaki
																				0	778	1583	2999	(21)Dhawalagiri
																					0	806	2222	(22)Lumbini
																						0	2397	(23)Mid-West Dev. R.
																							0	(24)Far-West Dev. R.

Appendix 6.4.2 (1) Inter-regional Travel Time for Trucks and Buses (1986)

(Unit: minutes)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)	
0	51	104	143	525	126	277	311	296	314	341	418	402	230	226	326	323	337	175	489	591	475	934	1153	(1)Mahottari
	0	53	93	474	75	226	260	245	263	291	367	352	179	175	276	272	286	124	438	540	424	883	1102	(2)Dhanusha
		0	39	421	116	173	207	192	209	237	314	298	220	216	316	325	339	178	465	567	465	924	1143	(3)Sindhuli
			0	395	155	147	182	166	184	212	288	273	259	255	355	364	378	217	439	541	504	963	1182	(4)Ramechhap
				0	536	248	282	267	285	183	389	374	571	637	474	746	760	598	540	642	623	1082	1301	(5)Dolakha
					0	288	322	307	325	353	429	301	104	100	201	347	361	199	363	465	349	808	1027	(6)Sarlahi
						0	34	19	37	65	141	126	323	388	226	498	512	350	292	394	375	834	1053	(7)Kabhreplanchok
							0	15	6	99	107	91	288	358	192	532	546	385	258	360	340	800	1018	(8)Kathmandu
								0	18	84	122	107	303	373	207	517	531	369	273	375	356	815	1034	(9)Bhaktapur
									0	102	113	91	288	358	192	534	548	387	258	360	340	800	1018	(10)Lalitpur
										0	206	190	387	453	291	562	576	415	357	459	439	899	1117	(11)Sindhupalchok
											0	198	395	465	298	639	653	491	364	466	447	906	1125	(12)Nuwakot/Rasuwa
												0	197	267	100	623	637	476	166	268	249	708	927	(13)Dhading
													0	70	97	451	465	303	259	361	245	704	923	(14)Makawanpur
														0	166	447	461	300	329	431	315	774	993	(15)Rauthat/Bara/Parsa
															0	547	561	400	163	265	149	608	827	(16)Chitwan
																0	177	180	710	812	696	1155	1374	(17)Mechi
																	0	194	724	826	710	1169	1388	(18)Koshi
																		0	563	665	549	1008	1227	(19)Sagarmatha
																			0	102	197	656	875	(20)Gandaki
																				0	299	758	977	(21)Dhawalagiri
																					0	459	678	(22)Lumbini
																						0	507	(23)Mid-West Dev. R.
																							0	(24)Far-West Dev. R.

Appendix 6.4.2 (2) Inter-regional Travel Time for Trucks and Buses
(1995 and 2000: With the Project Road)

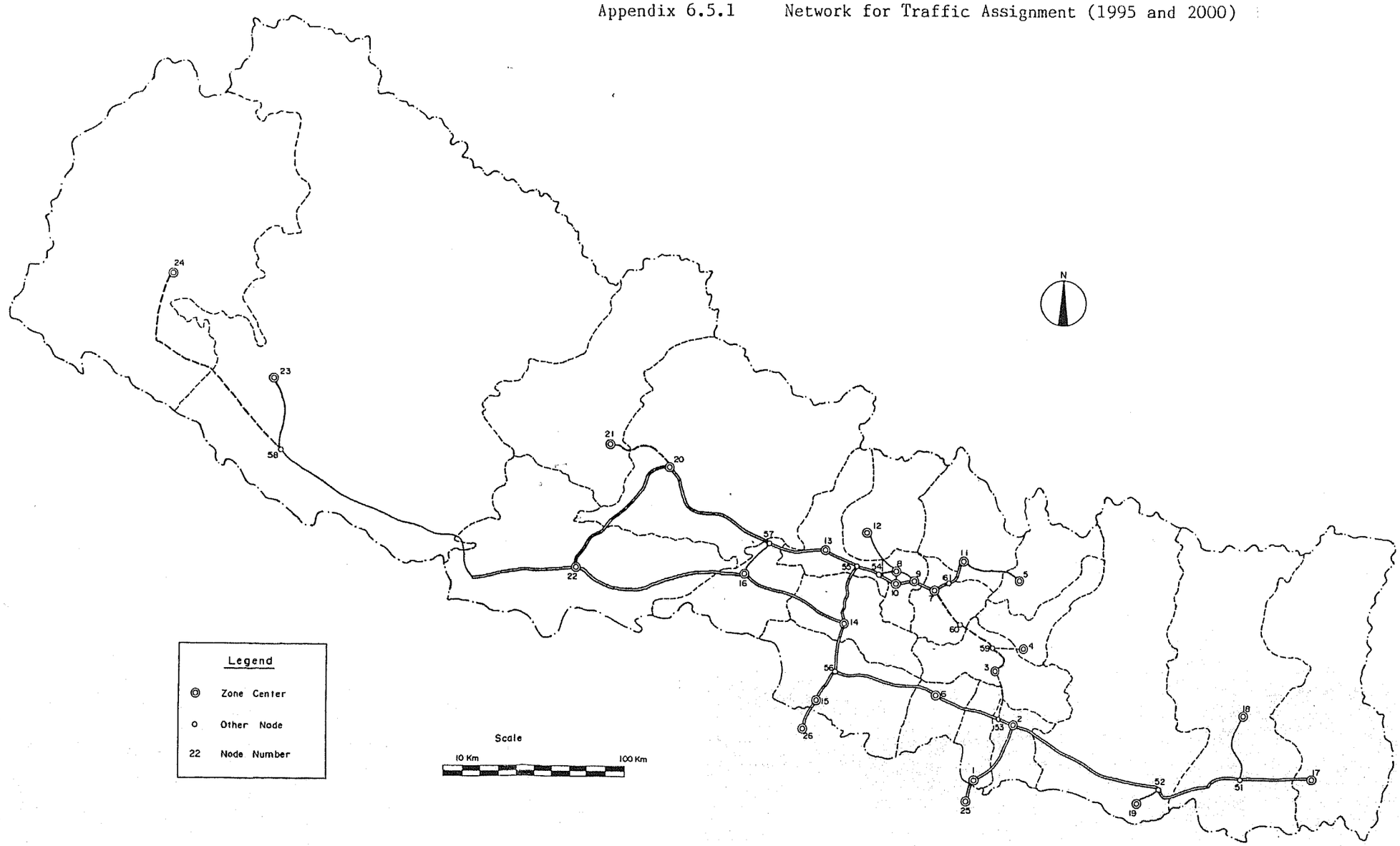
(Unit: minutes)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)	
0	51	104	143	800	126	552	518	533	518	617	625	427	230	226	326	323	337	175	489	591	475	934	1153	(1)Mahottari
	0	53	93	750	75	502	467	483	467	566	574	376	179	175	276	272	286	124	438	540	424	883	1102	(2)Dhanusha
		0	39	790	116	542	508	523	508	607	615	417	220	216	316	325	339	178	479	581	465	924	1143	(3)Sindhuli
			0	830	155	581	547	562	547	646	654	456	259	255	355	364	378	217	518	620	504	963	1182	(4)Ramechhap
				0	675	248	282	267	285	183	389	374	571	640	474	1021	1035	874	540	642	623	1082	1301	(5)Dolakha
					0	427	392	408	392	491	499	301	104	100	201	347	361	199	363	465	349	808	1027	(6)Sarlahi
						0	34	19	37	65	141	126	323	392	226	773	787	626	292	394	375	834	1053	(7)Kabhreplanchok
							0	15	6	99	107	91	288	358	192	739	753	592	258	360	340	800	1018	(8)Kathmandu
								0	18	84	122	107	303	373	207	754	768	607	273	375	356	815	1034	(9)Bhaktapur
									0	102	113	91	288	358	192	739	753	592	258	360	340	800	1018	(10)Lalitpur
										0	206	190	387	457	291	838	852	691	357	459	439	899	1117	(11)Sindhupalchok
											0	198	395	465	298	846	860	698	364	466	447	906	1125	(12)Nuwakot/Rasuwa
												0	197	267	100	648	662	500	166	268	249	708	927	(13)Dhading
													0	70	97	451	465	303	259	361	245	704	923	(14)Makawanpur
														0	166	447	461	300	329	431	315	774	993	(15)Rauthat/Bara/Parsa
															0	547	561	400	163	265	149	608	827	(16)Chitwan
																0	177	180	710	812	696	1155	1374	(17)Mechi
																	0	194	724	826	710	1169	1388	(18)Koshi
																		0	563	665	549	1008	1227	(19)Sagarmatha
																			0	102	197	656	875	(20)Gandaki
																				0	299	758	977	(21)Dhawalagiri
																					0	459	678	(22)Lumbini
																						0	507	(23)Mid-West Dev. R.
																							0	(24)Far-West Dev. R.

Appendix 6.4.2 (3) Inter-regional Travel Time for Trucks and Buses
(1995 and 2000: Without the Project Road)

Appendix 6.5.1 Network for Traffic Assignment

Appendix 6.5.1 Network for Traffic Assignment (1995 and 2000)



Appendix 7.2.1 Load

Appendix 7.2.1 Load

(1) Dead Load

The dead load consists of the weight of the structure complete, including the handrail and other public utilities if any. For the computation of the dead load the unit weights of materials shall be as specified in Article 1.8.3 of HBS.

(2) Live Load

The live load consists of the weight of the moving load of the vehicles, cars and pedestrians. TL-20 loading specified in Article 1.8.4 of HBS shall be applied in accordance with Article 10.5 of NRS, since TL-20 loading is equivalent to HS20-44 (AASHTO).

(3) Impact Fraction

The following formula shall be applied to calculate impact fraction as specified in Article 1.8.5 of HBS.

(4) Wind Load

Wind data available in Nepal is inadequate to analyse frequency and estimate wind velocity for the Study. In this connection wind load shall follow I.R.C. as specified in following formula:

$$P = 1.6H + 72.5$$

where H: The average height in meters of the exposed surface above the mean retarding surface (ground line or water level)

P: Horizontal wind pressure in kg per sq. meter at height H

. Earthquake Load

A horizontal force of 0.18 W (W is considered as a dead load) is proposed as an earthquake load based on the analysis which is shown in Section 8.4.

. Thermal Effects

The range of temperature for thermal effects shall follow I.R.C. Code.

For Concrete Bridge	+22°C/1	±17°C
For Steel Bridge	-18°C	- +50°C

/1 The average temperature during the year 1976 - 1982 at Hetauda (Station Index No. -0917) where is the nearest meteorological station from the Study area and where has been recording the temperature similar nature to the Study area.

(5) Stream Current Force

The effect of flowing water on piers shall be calculated by the following formula as stipulated on I.R.C. code.

$$P = 52\ kV^2$$

where P = intensity of pressure in kg/m^2

V = velocity of water in m/s: 2.6 m/s for substructure design and 1.5 m/s for temporary structure design

K = a constant depending on the shape of pier: 1.50 for square ended piers, 0.66 for circular piers or for piers with semi-circular cutwaters, 0.5 to 0.9 for triangular cutwaters, and 1.25 for trestle type piers.

. Earth Pressure

As given by the Coulomb's formula.

Appendix 7.3.1 Control Factors for Initial Route Selection

Appendix 7.3.1 Control Factors for Initial Route Selection

There are two major control factors considered in routing the project road as follows:

- Sun Kosi No.2 Dam Construction Project proposed in "The Master Plan Study of Kosi River Water Resource Development" conducted by JICA in 1985.

- Sun Kosi No.3 Dam Construction Project proposed in the above master plan study as the top priority project.

Detailed of the above are described below:

(1) Sun Kosi No.2 Dam Construction Project

The Sun Kosi No.2 Dam Construction Project was planned in the Master Plan Study by JICA, 1985, as a reservoir type hydropower station with a 166 m high dam. The dam site was selected near Chyakutar Village approx. 15 km downstream from the confluence of Sun Kosi River and Tama Kosi as shown in the Fig. A.7.1.

The Project Road in the seciton between Nabughat and Nepalthok might be affected by the high water level (575 m) of the Sun Kosi No.2 Dam Construction Project, if it is implemented.

Therefore, it should be confirmed whether the Sun Kosi No.2 Dam Project should be considered in the planning of the Project Road or not, taking into consideration the possibility of implementation, project cost, social problems which might be occured when implemented, etc.

The dam project, however, is not recommended to implement within the Master Plan Period from 1985 to 2005 because of the relatively low priority (6th priority).

(2) Sun Kosi No.3 Dam Construction Project

This project was also planned in the Master Plan Study as a reservoir type hydropower station with a 140 m high dam. The dam site was selected 5 km downstream of Panchuwar Village or approx. 8 km upstream from the confluence of Sun Kosi River and Rosi Khola.

The project was selected as the top priority in the Master Plan Study and the implementation is urgently recommended.

The location of Project Road, therefore, should be determined taking into consideration the Sun Kosi No.3 Dam Project.

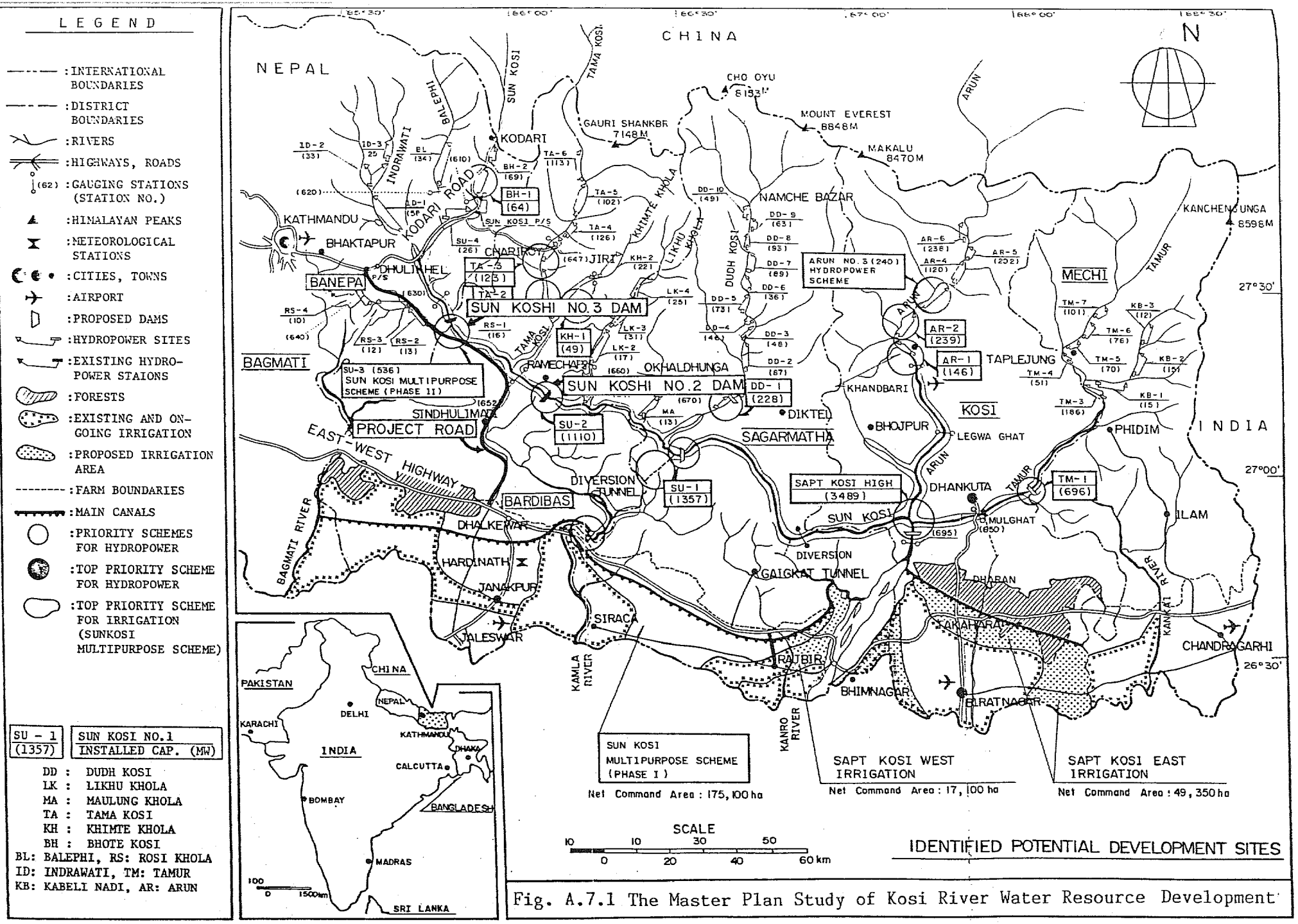


Fig. A.7.1 The Master Plan Study of Kosi River Water Resource Development

Appendix 7.4.1 Summary of Evaluation on Each Alternative Route

Appendix 7.4.1 Summary of Evaluation on Each Alternative Route (1)

Items	SECTION II-1 (Sindhuli Bazar - Nabughat)			
	Alternative II-1a	Alternative II-1b	Alternative II-1c	Alternative II-1(a)
1. Route	Sindhuli Bazar-Gwangu Khola -Sindhuli Garhi-Andheri Khola (Right hillside) - Nabughat	Sindhuli Bazar-Gwangu Khola -Sindhuli Garhi-Andheri Khola (Left hillside) - Nabughat	Sindhuli Bazar-Gwangu Khola -(Tunnel) - Andheri Khola -Nabughat	Partial Comparison of Alternative II-1a in the section between Sindhuli Bazar - Sindhuli Garhi
2. Principle	Minimization of the construction cost and maintenance cost by passing through favourable and stable hill slope	Maximization of accessibility to the populated and agricultural developed area of Rupakhot	Direct connection by providing long tunnel with a 2,000m in length to shorten the route length	Shortening the route length by providing loops
3. Lenght (km)	39	41	26	37
4. Route Comparison				
4.1 Engineering Viewpoint				
- Construction cost	A	B	C	(B)
- Maintenance cost	B	C	A	(C)
- Route length	B	C	A	(C)
- Route alignment	B	C	A	(C)
- Ease of construction and maintenance	A	C	C	(B)
4.2 Socio-economic Viewpoint				
- Incentive to local community	B	A	C	(B)
- Accessibility to village	B	A	C	(B)
- Enhancement of land use pattern	B	C	A	(B)
- Techology Transfer	B	C	A	(B)
Total marked	2A+7B=2x3+7x2 = 20	2A+1B+6C=2x3+1x2x6x1 = 14	5A+4C=5x3+4x1 = 19	6B+3C=6x2+3x1 = 15
5. Evaluation and Conclusion	(1) Alternative II-1a is the most advantageous route among four and therefore recommended as the optimum route in this section. (2) Alternative II-1c is attractive route, however, the construction cost for long tunnel is quite large. In addition, there would be difficulty with the operation and maintenance on the ancillary facilities, such as lighting system, ventilation system and telephone system. Alternative II-1c is therefore not recommended.			

Note: Classes A, B and C get the marks 3, 2 and 1 respectively.

Summary of Evaluation on Each Alternative Route (2)

Items	SECTION II-2. (Nabughat - Nepalthok)		SECTION II-3 (Rosi Section)	
	Alternative II-2a	Alternative II-2b	Alternative II-3a	Alternative II-3b
1. Route	Nabughat - Nepalthok along Sun Kosi River	Nabughat - Nepalthok running hillside at EL. 600	Nepalthok - Confluence of Dabcha Khola along Rosi Khola	Nepalthok - Confluence of Dabcha Khola, running hillside in the strech between STA. 9+500 and STA. 17+000
2. Principle	Minimization of construction cost and maintenance cost by passing along left bank	Consideration of future development plan of Sun Kosi No. 2 Dam Project	Minimization of route length of keep better alignment along Rosi Khola	Minimization of construc tion cost by avoiding large land slide area
3. Length (km)	35	53	20	23
4. Route Comparison				
4.1 Engineering Viewpoint				
- Construction cost	A	B	B	A
- Maintenance cost	A	B	A	B
- Route length	A	B	A	B
- Route alignment	A	B	A	B
- Ease of construction and maintenance	A	B	A	B
4.2 Socio-economic Viewpoint				
- Incentive to local community	A	B	B	A
- Accessibility to village	A	B	B	A
- Enhancement of land use pattern	A	B	B	A
- Techonology Transfer	A	B	A	B
Total marked	9A=9x3 = 27	9B=9x2 = 18	5A+4B=5x3+4x2 = 23	4A+5B=4x3+5x2 = 22
5. Evaluation and Conclusion	(1) Alternative II-2a is advantageous in every aspects therefore, it is recommended as the optimum route in the Section II-2. (2) Alternative II-2b shall be determined politically taking into account of Sun Kosi No. 2 Dam Project.		(2) Threre is not much difference between Alt. II-3a and Alt. II-3b, however, Alt. II-3a is recommended in this section because of the following reasons: - Routes length and alignment of Alt. II-3a is superior than that of Alt. II-3b. - Village located along Alt. II-3b is relatively small.	

Summary of Evaluation on Each Alternative Route (3)

Items	SECTION II-3 (BANEPA SECTION)		SECTION I (Bardibas-Sindhuli Bazar)
	Alternative II-3c	Alternative II-3d	No Alternative Route
1. Route	Confluence of Dabcha Khola - Banepa under passing Thakurichhap Hill by tunnel (100m)	Confluence of Dabcha Khola-Banepa by open road	Bardibas - Sindhuli Bazar along the existing route constructed by DOR
2. Principle	Shortening the route length by providing short tunnel with a 100m in length	Maximum utilization of existing small track between old Phaskot and Banepa	Maximum utilization of the existing road between Bardibas and Sindhuli Road
3. Length (km)	27	29	37
4. Route Comparison			
4.1 Engineering Viewpoint			
- Construction cost	B	A	
- Maintenance cost	A	B	
- Route length	A	B	
- Route alignment	A	B	
- Ease of construction and maintenance	B	A	
4.2 Socio-economic Viewpoint			
- Incentive to local community	A	B	
- Accessibility to village	B	A	
- Enhancement of land use pattern	A	B	
- Techology Transfer	A	B	
Total marked	6A+3B=6x3+3x2 = 24	3A+6B=3x3+6x2 = 21	
5. Evaluation and Conclusion	(1) Alternative II-3C is advantegeous and recommended as the optimum route in this section.		(1) There is no alternative route in this section.

Note: Classes A, B and C get the marks 3, 2 and 1 respectively.

Appendix 8.2.1 Description of Detailed Geological Conditions

Appendix 8.2.1 Description of Detailed Geological Conditions

(1) Section I (Bardibas to Sindhuli Bazar L = 36.5 km)

From the beginning point up to STA. 19, the road passes on the alluvial terraces with thick deposits consisting of mainly silt and sand loose in general. Under such slope protection works for cut slope and channel treatment at in/outlet of drainage structure may be required in order to prevent erosion.

At the right bank of Ratu River, massive fine sand- stone or alternation of sandstone and siltstone which is typical formation of the upper Siwalik was observed and is weakly consolidated in general.

In this connection, it is presumed that the required bearing capacity of bridge foundation attains to the upper Siwalik formation.

In the section between STA. 19 and STA. 28 + 900, the road runs on the northern foot of Siwalik hill range along the Kamala river in which area is entirely covered by terrace deposits or river deposits (so called locally as "Dun gravels") consisting of mainly quartzite gravels of various sizes up to 20 cm in diameter. Due to the characteristics of the materials deposited and its weak consolidation, the area has high potentials of the debris (gravel) flow and it is no doubt that debris flow activity will continue in the future.

At STA. 28 + 900 the road crosses the Siwalik thrust plane situated at the center of Kamala River. This thrust devides the Siwalik group into lower formation of northern area and upper formation of southern area. No fractured rock or fault clay generated by thrusting has been observed since the thrust has been under the river deposits.

After crossing the Kamala River, the road runs in the lower Siwalik formation province along the Gwangu Khola and reaches Sindhuli Bazar. In this section, the typical lower Siwalik formation consisting of dark- coloured coase sandstone, shale, conglomerate and their alternation has been observed beneath the topsoil which mainly generated by weathered lower formation. At a part of the section at STA. 32, rock mass slide likely occured due to the weak zones running though the rock observed in 1985.

In this regard, slope protection by stone pitching for cut slope will be required at the location of erodible topsoil deposited or of the weak zones of rock.

(2) Section II-1 (Sindhuli Bazar to Nabughat L = 39 km)

After passing on the alluvial terrace from STA. 0 to STA. 4, the alignment runs still in the lower Siwalik formation province along the Gwangu Khola. At the slope foot portion near the valley floor of the Gwangu Khola, unconsolidated and loose detritus orginated in the lower Siwalik formation have sporadically predominated.

At several stations, the alignment crosses the Main Boundary Thrust (MBT) which is an thrust plane that separates the northern older metamorphic rocks (Kathmandu group) with the southern younger sedimen- tary rocks (Siwalik group).

At the northern zone along the MBT, the bedrock situated infracture zone consists of mica schist sheared and clayey material originated from mica schist. Several slope failure scars have been observed at these places and it is presumed that solid type of slope protection works for cut slope will be required to prevent cut slope failure.

At the section between STA. 16 and STA. 18, the route passes on the limestone and mica schist province covered by thin topsoil, silt and clay, generated by weathering of the bedrock. Due to steep slope of the existing ground, shallow surface degradations have caused at the section of steep slope due to penetration of surface water.

In the section between STA. 18 and STA. 21, the route passes on the granite province and through very steep main ridge of the Mahabharat range at near Sindhuli Garhi. In the excessive weathered granite area, surface failures have occured at the head of deeply eroded valleys. In addition, the rock mass fall scars caused by the joint plane developed has been also observed in and around the area.

At the boundary between granite and mica schist, STA. 21, the route crosses the area of a large scale of slope failure scar which has been caused by fractured mica schist resulting from granite intrusion. It is no doubt that slope failure activity will continue in the future. In this regard, rock shed or other counter measures may be required taking into consideration of a magnitude and mass-movement potential of the slope failure.

At the STA. 31, the alignment crosses Main Central Thrust (MCT) which separates the metamorphic rocks of the southern Kathmandu group with the metasediment rocks of the northern Nuwakot group. It extends for an indefinite distance northwestward along the Sun Kosi and Rosi River via Nepalthok. At any places, traces of slope failure traces have been observed sporadically along the thrust plane since there has been situated the unstable zone of highly sheared and weathered rocks caused by the activity of MCT. Under such the slope protection works will be required at these places to prevent cut slope failure.

In the section between STA. 31 and STA. 35, the route passes on the mica schist and phyllitic muddy schist province in which bedrock is moderately hard and is relatively susceptible to weathering. After STA. 35, the route runs on the alluvial terraces and then reaches Nabughat after crossing the Andheri river in which river bed has filled with boulders and cobbles of granite caused by the debris flow.

(3) Section II-2 (Nabughat to Nepalthok L = 35 km)

In general, the river side slope predominated on sandy schist and mica schist along the Sun Kosi River are stable since highly weathered rock in the slope have been eroded by tractive force of the Sun Kosi River. However, at the isolated places such as STA. 3 + 600, STA. 3 + 900, STA. 11 + 200, STA. 13, STA. 15 + 900, STA. 17 and STA. 17 + 200, surface slope failure scarred on highly weathered rock have been observed and at such places, slope protection work is required since the weathered strata might be thick.

In the sections between STA. 8 - STA. 11, STA. 17 - STA. 23 and STA. 28 - STA. 29, the route passes on the old alluvial terraces covered by the thick laterized materials which are very friable and erodible by intensity of rainfall. Thus, deep eroded gullys are well developed in and around the area.

In this connection, cut slope protection work by stone pitching and channel treatment at in/outlet of drainage structure by gabion or stone masonry will be required from the stability of cut slope or erosion protection.

The alignment crosses the several tributaries of the Sun Kosi River in which river bed has been filled by debris flow deposit. These debris are cobbles and boulders of granite resulting from large scale of landslide caused by weathering

slope failures due to water penetration into the sheared and fractured bed rock caused by the activity of the fault have been observed. Resulting from these slope failure the debris flow generated shall be considered into bridge planning.

From STA. 25 to STA. 29, the route runs on the slightly sloping plain covered by the thick alluvial silty deposits resulting from weathering of bedrock phyllite. In the hilly slopes, the well developed gully caused by erosion has been observed. Therefore, channel treatment will be required at in/out let of cross drainage structures since the alluvial silty deposits has been erodible.

At the section between STA. 29 and 39, the alignment passes on the steep northern slope of the ridge running in NW to SE direction. This slope on the moderately thick talus unconformably overlied bedrocks consisting of phyllite, mica schist and schistosed sandstone, is likely to be stable. However, surface slope failure scarred at isolated areas such as STA. 33 + 700, STA. 34 + 100 and STA. 35 + 100 have been observed.

After crossing the ridge at the STA. 39, the route runs on the slope of Dhulikhel Hill upto STA. 46 + 300. The bedrock is generally soft and is relatively susceptible to weathering.

Appendix 8.2.2 Results of Laboratory Tests and Soil Profile

Appendix 8.2.2 Results of Laboratory Test and Soil Profile

The geological investigation and material survey were conducted in the Section I between Bardibas and Sindhuli Bazar, and Section II between Sindhuli Bazar and Dhulikhel during March and June, 1987 respectively. The work was tendered and entrusted to a local consultant, namely SILT Consultants (P.) Ltd. and carried out under the supervision of the Study Team accompanied by counterpart engineer of DOR.

Superficial soil profile and summary of the result obtained from the above investigation and survey including the result of laboratory tests are presented in Fig. A.8.1 and Table A.8.1 respectively.

All the test data are compiled in separate volume.

STA.		0	1	2	3	4	5	6	7	8	9	10
SOIL TYPE	SYMBOL											
	DESCRIP	Common soil	Weathered rock									
EXPLORATION			AG-18						MB 9	MB 8		AG 19
ATTERBERG LIMITS	LL (%)		24									23
	PI		7									16
CBR (%)			3.6									8.2
CLASSIFICATION			A-4									A-1
GROUP INDEX			3									0

STA.		10	11	12	13	14	15	16	17	18	19	20
SOIL TYPE	SYMBOL											
	DESCRIP	Weathered rock			Sand / Gravel	Weathered rock					Gravelly soil	
EXPLORATION					MB 7				AG 20		TPQ6	
ATTERBERG LIMITS	LL (%)								NP			
	PI								NP			
CBR (%)									11.1			
CLASSIFICATION									A-3			
GROUP INDEX									0			

STA.		20	21	22	23	24	25	26	27	28	29	30
SOIL TYPE	SYMBOL											
	DESCRIP	Gravelly soil		Alternation Gravel and Gravelly soil						Weathered rock	Gravel	Weathered rock
EXPLORATION			AG 21						MB 6		MB 5	
ATTERBERG LIMITS	LL (%)		NP									
	PI		NP									
CBR (%)			8.3									
CLASSIFICATION			A-1									
GROUP INDEX												

STA.		30	31	32	33	34	35	36 End of SECTION I	37	38	39	40
SOIL TYPE	SYMBOL											
	DESCRIP	Weathered rock		Gravel	Weathered rock		Gravel	Weathered rock	Gravel	Weathered rock		
EXPLORATION			MB 4		AG 22		MB 3		MB 2			
ATTERBERG LIMITS	LL (%)				25							
	PI				8							
CBR (%)				–	3.6							
CLASSIFICATION					A-1							
GROUP INDEX					0							

STA.		40	41	42	43	44	45	46	47	48	49	50
SOIL TYPE	SYMBOL											
	DESCRIP											
EXPLORATION												
ATTERBERG LIMITS	LL (%)											
	PI											
CBR (%)												
CLASSIFICATION												
GROUP INDEX												

LEGEND: (GEOLOGY)

- Alluvium (Sands, silt, clays, gravels)
- Sandstone, siltstone, shale, conglomerate (Swalik group)
- Sandy schist, mica schist (Nuwakot group)
- Limestone (Kathomandu group)
- Mica schist, quartzite, schistosed sandstone (Kathomandu group)
- Rhyllite (Kathomandu group)
- Granite
- Granitic gneiss

NOTE:
- MB : Boring
- AG : Auger boring
- TPB : Test pit for borrow
- TPQ : Test pit for quarry
- AG, TPB : Out of proposed route

Fig. A.8.1 Superficial Soil Profile Section I

STA.		0	1	2	3	4	5	6	7	8	9	10
SOIL TYPE	SYMBOL											
	DESCRIP	Weathered rock	Common soil but partially gravelly							Weathered rock	Weathered rock	
EXPLORATION				TPQ 5		AG 17						
ATTERBERG LIMITS	LL (%)			36								
	PI			15								
CBR (%)				4.8								
CLASSIFICATION				A-6								
GROUP INDEX				9								

STA.		10	11	12	13	14	15	16	17	18	19	20
SOIL TYPE	SYMBOL											
	DESCRIP	Weathered rock			Weathered rock			Hard / Moderately weathered rock	Weathered rock		Hard rock	
EXPLORATION									AG 16			
ATTERBERG LIMITS	LL (%)								29			
	PI								NP			
CBR (%)									5.4			
CLASSIFICATION									A-4			
GROUP INDEX									3			

STA.		20	21	22	23	24	25	26	27	28	29	30
SOIL TYPE	SYMBOL											
	DESCRIP	Hard rock	Hard / Moderately weathered rock								Hard rock	
EXPLORATION										AG 15		
ATTERBERG LIMITS	LL (%)									(Rock)		
	PI									—		
CBR (%)										—		
CLASSIFICATION										—		
GROUP INDEX										—		

STA.		30	31	32	33	34	35	36	37	38	39 END of SECTION II-1	40
SOIL TYPE	SYMBOL											
	DESCRIP		Hard / Moderately weathered rock							Gravel / Gravelly soil		
EXPLORATION			AG 14									
ATTERBERG LIMITS	LL (%)		NP									
	PI		NP									
CBR (%)			11.5									
CLASSIFICATION			A-4									
GROUP INDEX			1									

STA.		40	41	42	43	44	45	46	47	48	49	50
SOIL TYPE	SYMBOL											
	DESCRIP											
EXPLORATION												
ATTERBERG LIMITS	LL (%)											
	PI											
CBR (%)												
CLASSIFICATION												
GROUP INDEX												

LEGEND: (GEOLOGY)

- Alluvium (Sands, silt, clays, gravels)
- Sandstone, siltstone, shale, conglomerate (Swalik group)
- Sandy schist, mica schist (Nuwakot group)
- Limestone (Kathomandu group)
- Mica schist, quartzite, schistosed sandstone (Kathomandu group)
- Rhyllite (Kathomandu group)
- Granite
- Granitic gneiss

NOTE:
- MB : Boring
- AG : Auger boring
- TPB : Test pit for borrow
- TPQ : Test pit for quarry
- AG / TPB : Out of proposed route

Superficial Soil Profile Section II-1

STA.		0	1	2	3	4	5	6	7	8	9	10
SOIL TYPE	SYMBOL											
	DESCRIP	Gravelly soil / Sand gravel	Common soil but partially gravelly		Hard/Moderately weathered rock	Clayey soil	Sand gravel	Clayey soil		Hard/Moderately weathered rock	Clayey soil	
EXPLORATION										AG 13		
ATTERBERG LIMITS	LL (%)									61		
	PI									38		
CBR (%)										3.9		
CLASSIFICATION										A-7		
GROUP INDEX										20		

STA.		10	11	12	13	14	15	16	17	18	19	20
SOIL TYPE	SYMBOL											
	DESCRIP	Clayey soil / Gravelly	Hard / Moderately weathered rock		Gravelly soil	Hard / Moderately weathered rock			Gravelly soil	Clayey soil		Sand gravel / Common soil
EXPLORATION										AG 12		
ATTERBERG LIMITS	LL (%)									50		
	PI									16		
CBR (%)										3.4		
CLASSIFICATION										A-7		
GROUP INDEX										14		

STA.		20	21	22	23	24	25	26	27	28	29	30
SOIL TYPE	SYMBOL											
	DESCRIP	Common soil but partially gravelly / Sand gravel / Common soil but partially gravelly				Hard/Moderately weathered rock / Gravelly soil / Hard/Moder. weath. rock / Sand Gravel	Hard/Moderately weathered rock				Clayey soil	Gravelly soil
EXPLORATION			AG 11							SG 10		
ATTERBERG LIMITS	LL (%)		26							40		
	PI		9							19		
CBR (%)			7.1							6.2		
CLASSIFICATION			A-4							A-6		
GROUP INDEX			1							5		

STA.		30	31	32	33	34	35 END of SECTION II-2	36	37	38	39	40
SOIL TYPE	SYMBOL											
	DESCRIP	Gravelly soil	Hard/Moderately weathered rock		Gravelly soil / Sand gravel / Gravelly soil	Hard / Moderately weathered rock						
EXPLORATION												
ATTERBERG LIMITS	LL (%)											
	PI											
CBR (%)												
CLASSIFICATION												
GROUP INDEX												

STA.		40	41	42	43	44	45	46	47	48	49	50
SOIL TYPE	SYMBOL											
	DESCRIP											
EXPLORATION												
ATTERBERG LIMITS	LL (%)											
	PI											
CBR (%)												
CLASSIFICATION												
GROUP INDEX												

LEGEND: (GEOLOGY)

- Alluvium (Sands, silt, clays, gravels)
- Sandstone, siltstone, shale, conglomerate (Swalik group)
- Sandy schist, mica schist (Nuwakot group)
- Limestone (Kathomandu group)
- Mica schist, quartzite, schistosed sandstone (Kathomandu group)
- Rhyllite (Kathomandu group)
- Granite
- Granitic gneiss

NOTE:
- MB : Boring
- AG : Auger boring
- TPB : Test pit for borrow
- TPQ : Test pit for quarry
- AG / TPB : Out of proposed route

Superficial Soil Profile Section II-2

STA.		0	1		2	3	4	5	6	7	8	9	10
SOIL TYPE	SYMBOL												
	DESCRIP	Hard/Moderately weathered rock		Sand gravel	Hard / Moderately weathered rock				Common soil partially gravelly	Hard / Moderately weathered rock		Sand gravel	Hard / Moderately weathered rock
EXPLORATION									AG 9				AG 8
ATTERBERG LIMITS	LL (%)								22				(Rock)
	PI								NP				—
CBR (%)									10.2				—
CLASSIFICATION									A-2				—
GROUP INDEX									0				—

STA.		10	11	12	13	14	15	16	17	18	19	20
SOIL TYPE	SYMBOL											
	DESCRIP	Hard / Moderately weathered rock			Gravelly soil	Hard / Moderately weathered rock			Gravelly	Hard/Modera. weathered rock	Gravel / Gravelly soil	Hard rock
EXPLORATION					AG 7						MB 1 AG 6	TPQ 3
ATTERBERG LIMITS	LL (%)				28						34	—
	PI				NP						7	—
CBR (%)					9.5						8.1	—
CLASSIFICATION					A-4						A-4	—
GROUP INDEX					9						6	—

STA.		20	21	22	23	24	25	26	27	28	29	30
SOIL TYPE	SYMBOL											
	DESCRIP	Hard rock		Weathered rock				Clayey soil and silty sand (Decomposed rock)				
EXPLORATION				AG 5				AG 4	TPB 3			TPQ 2
ATTERBERG LIMITS	LL (%)			NP				22	65			
	PI			NP				NP	22			
CBR (%)				8.1				3.5	1.4			
CLASSIFICATION				A-4				A-4	A-7			
GROUP INDEX				0				1	17			

STA.		30	31	32	33	34	35	36	37	38	39	40
SOIL TYPE	SYMBOL										Weathered rock	Decomposed rock
	DESCRIP	Hard / Moderately weathered rock										
EXPLORATION										AG 3		
ATTERBERG LIMITS	LL (%)									29		
	PI									NP		
CBR (%)										11.0		
CLASSIFICATION										A-4		
GROUP INDEX										3		

STA.		40	41	42	43	44	45	46 END of SECTION II-3	47	48	49	50
SOIL TYPE	SYMBOL											
	DESCRIP	Decomposed rock	Weathered rock		Decomposed rock							
EXPLORATION			TPB 2	AG 2	TPB 1			AG 1				
ATTERBERG LIMITS	LL (%)		NP	27	36			41				
	PI		NP	NP	14			19				
CBR (%)			16.8	8.2	5.4			1.4				
CLASSIFICATION			A-4	A-4	A-6			A-6				
GROUP INDEX			7	8	8			12				

LEGEND: (GEOLOGY)

- Alluvium (Sands, silt, clays, gravels)
- Sandstone, siltstone, shale, conglomerate (Swalik group)
- Sandy schist, mica schist (Nuwakot group)
- Limestone (Kathmandu group)
- Mica schist, quartzite, schistosed sandstone (Kathmandu group)
- Rhyllite (Kathmandu group)
- Granite
- Granitic gneiss

NOTE:
- MB : Boring
- AG : Auger boring
- TPB : Test pit for borrow
- TPQ : Test pit for quarry
- AG / TPB : Out of proposed route

Superficial Soil Profile Section II-3

Table A.8.1 Summary of Laboratory Test (1)

SAMPLE			Gradation									Atterberg's Limit		Description	Specific gravity	Water content (%)	Compaction		CBR		Uniaxial compressive strength	Triaxial shear CU	UU
NO.	LOCATION	DEPTH	Gravel (%)	Sand (%)	Silt clay (%)	Dmax	D 60	D 30	D 10	Cc	Cu	LL (%)	PI				OMC (%)	MDD (t/m^3)	Soaked (%)	Unsoaked (%)		(t/m^2)	Ø (°)
MB 9 - 1	7 + 750	0 - 2.0	48.8	48.0	3.2		3.0	0.40	0.17	0.31	17.64	-	-	River Sand and Gravel diposit	2.65	5.2							
MB 9 - 2	7 + 750	3 - 4.5	0	90.8	9.2		0.33	0.17	0.08	0.75	4.12	-	-	Bluish Hard Clay and Siltbound well Graded Sand.	2.63	6.8					11.4	2.3	25.0
MB 9 - 3	7 + 750	14 - 15.5	0	0.9	99.1		0.03					49.1	17.9	Light Brown to Ashgray Hard Clayey Silt	2.69	14.3					22.6	8.9	6.2
MB 9 - 4	7 + 750	18 - 19.2	0	68.1	31.9		0.13	0.03	0.003			31.3	20.1	Light Gray to Brown Medium Stiff Sand Stone	2.71	9.1							
MB 8 - 1	8 + 000	0 - 1.7	28.8	63.6	7.6		1.60	0.34	0.18	0.38	8.88	-	-	Well Graded Silty Sand and Gravel	2.68	13.5							
MB 8 - 2	8 + 000	5 - 6.3	0	78.4	21.6		0.15	0.18	0.004			45.9	14.1	Bluish Hard Uniform Micacious Clay and Silt Bound Uniform Fine Sand	2.63	7.3					21.3		
MB 8 - 3	8 + 000	9.5 - 10.8	0	75.7	24.3		0.14	0.075	0.001			48.1	16.8	" "	2.63	7.3					19.2		
MB 8 - 4	8 + 000	17.0-18.2	0	3.1	96.9		0.006	0.001				33.1	11.5	Ash Gray Hard Clay and Silt	2.70	4.9					26.3	11.2	0
MB 8 - 5	8 + 000	18.6-19.0	0	74.4	25.6		0.13	0.08	0.001			48.2	12.2	Bluish Hard Uniform Micaceous Clay and Silt Bound Fine Sand	2.63	8.1					7.3	2.3	23.0
MB 7 - 1	12 + 450	3.5 - 5.2	28.5	68.3	3.2		1.22	0.38	0.21	0.54	5.80	-	-	Brown very Dense well graded Sand Gravels and Boulders.	2.68	8.81							
MB 7 - 2	12 + 450	6.0 - 8.1	30.9	63.8	5.3		1.21	0.34	0.18	0.50	6.72	-	-	" "	2.69	9.3							
MB 7 - 3	12 + 450	10.2-12.0	8.0	89.9	2.1		1.20	0.18	0.085	0.29	14.11	-	-	Brown very Dense well graded sand occasional Pebbles	2.67	14.7							
MB 7 - 4	12 + 450	16.2-18.0	0	2.6	97.4		0.004	0.0009				48.8	8.6	Brown Hard Silty Clay.	2.7	8.3					9.4	2.7	3.0
MB 7 - 5	12 + 450	18.0-20.0	0	1.9	98.1		0.004					43.8	9.7	" "	2.7	9.1					11.1	3.2	3.0

Summary of Laboratory Test (2)

SAMPLE			Gradation									Atterberg's Limit		Description	Specific gravity	Water content (%)	Compaction		CBR		Uniaxial compressive strength	Triaxial CU	Triaxial UU
NO.	LOCATION	DEPTH	Gravel (%)	Sand (%)	Silt clay (%)	Dmax	D 60	D 30	D 10	Cc	Cu	LL (%)	PI				OMC (%)	MDD (t/m^3)	Soaked (%)	Unsoaked (%)		(t/m^2)	Ø (°)
MB 6 - 1	28 + 000	1.0 - 1.7	45.5	14.7	39.8		2.80	0.03	0.003			36.1	15.9	Light Brown Silty Sandy Gravel and Boulder	2.69	16.3							
MB 6 - 2	28 + 000	3.2 - 3.9	0	4.7	95.3		0.036	0.004	0.0008			49.3	21.0	Yellowish Brown Stiff highly Plastic Clayey Silt Fraces of Fine Sand	2.69	7.8					31.2	13.1	0
MB 6 - 3	28 + 000	7.5 - 8.9	0	63.7	36.3		0.14	0.05	0.001			32.7	12.3	Bluish Hard Sandstone	2.68	11.2					8.4	2.2	12.0
MB 6 - 4	28 + 000	12.0-13.2	0	1.4	98.6		0.006	0.0008				39.3	10.2	Greyish Brown Hard Clay and Silt	2.75	14.3					25.2	11.0	0
MB 5 - 1	28 + 850	0 - 10.5												Brown Dense Silty Sandy Gravels and Boulders	2.66								
MB 5 - 2	28 + 850	10.5-12.2	27.4	67.5	5.1		1.70	1.00	0.17	3.46	10.00			Brown Dense Coarse sand to Medium Sand with Boulders	2.65	8.3							
MB 5 - 3	28 + 850	14.2-15.6	0	8.7	91.3		0.018	0.004				39.3	10.2	Greyish Hard Plastic clayey silt traces of fine sand	2.69	12.3					27.8	12.3	0
MB 5 - 4	28 + 850	18 - 19.2	0	10.9	89.1		0.03	0.004				41.6	15.5	" "	2.69	14.6					21.2	13.1	0
MB 4 - 1	32 + 200	1.6 - 2.2	0.03	1.17	98.8		0.03	0.01				35.3	12.3	Yellowish Brown Clayey Silt with Pebbles	2.7	16.2							
MB 4 - 2	32 + 200	3.0 - 3.9					0.15	0.10	0.01					Yellowish Brown Hard Clayey Silt with Little Sand								12.0	3.0
MB 4 - 3	32 + 200	4.1-5.3												Dark Ash Grey hard Clay Traces of Silt							24.3		
MB 4 - 4	32 + 200	7.2 - 7.5	0	86.9	13.1							43.3	4.3	Bluish Hard Clay and Silt bound uniform Fine sand	2.65	9.3							
MB 4 - 5	32 + 200	10.1-12.0	1.70	90.68	7.62		0.50	0.26	0.10	1.20	5.00			Dark Blue Hard Silt Bound well graded Sand	2.66	9.7						0	25.0
MB 4 - 6	32 + 200	12.20-15.00	0	81.7	18.3							48.2	15.2	Bluish Hard Clay and Silt Bound Uniform Fine Sand	2..65	9.5							
MB 4 - 7	32 + 200	15.50-20.00	0	0	100		0.004	0.001				46.6	18.0	Ash Gray Hard Clay and Silt	2.69	6.3					29.5	11.8	5.0

Summary of Laboratory Test (3)

SAMPLE			Gradation									Atterberg's Limit		Description	Specific gravity	Water content (%)	Compaction		CBR		Uniaxial compressive strength	Triaxial CU	sheer UU
NO.	LOCATION	DEPTH	Gravel (%)	Sand (%)	Silt clay (%)	Dmax	D 60	D 30	D 10	Cc	Cu	LL (%)	PI				OMC (%)	MDD (t/m^3)	Soaked (%)	Unsoaked (%)		(t/m^2)	Ø (°)
MB 3 - 1	34 + 100	0 - 6.20	0	94.9	5.1		0.32	0.23	0.12	1.30	2.66	NP	-	Brown Medium Dense silty Medium to fine sand	2.63	11.6						0	16.0
MB 3 - 2	34 + 100	6.2-16.10	46.5	50.3	3.2		3.82	0.86	0.24	0.80	15.91	NP	-	Light Brown Dense Silt bound Sandy Pebbles (Conglomerate)	2.66	7.3							
MB 3 - 3	34 + 100	16.1-18.3	1.7	90.4	7.9		0.51	0.17	0.08	0.70	6.37	NP	-	Light Brown Dense Medium to fine Sand	2.66	12.1					7.1	0	21.0
MB 3 - 4	34 + 100	18.3-20.0	37.2	55.6	7.2		1.73	0.26	0.07	0.55	24.71	-	-	Light Brown Dense Silt Bound Sandy Pebbles (Conglomerate)	2.67	4.9							
MB 2 - 1	36 + 000	0 - 2.20	79.7	19.8	0.5		4.10	2.50	0.92	1.65	4.45	-	-	Brown Silty Sand with Gravel Boulders and Cobble Fill up Material	2.68								
MB 2 - 2	36 + 000	4.5 - 7.7	0	70.9	29.1		0.18	0.06	0.0048			35.2	5.6	Light Brown Dense Micaceous Silt Bound Medium to fine Sand	2.63	6.8					12.0	2.3	36.0
MB 2 - 3	36 + 000	8.0 - 10.4	58.8	36.4	4.8		49.80	0.93	0.22	0.07	226.3	NP	-	Light Brown Dense Micaceous Silt Bond Sand and Pebble (Conglomerate)	2.63	8.6							
MB 2 - 4	36 + 000	12.1-18.4	38.7	52.4	8.9		2.00	0.29	0.08	0.52	25.00	-	-	" "	2.65	9.1							
MB 1 - 1	19 +100	0 - 2.40										-	-	Light Brown to Ash gray Silty sandy gravels boulders and cobbles	2.66								
MB 1 - 2	19 +100	3.4 - 5.6										-		" "	2.67								
MB 1 - 3	19 +100	6.1 - 7.4												Fractured Bed rock of Dark Meta sand - stone with Micaceous bedding Dominant	2.63								
MB 1 - 4	19 +100	7.8 - 12.0												" "	2.63								

Summary of Laboratory Test (4)

SAMPLE			Gradation									Atterberg's Limit		Description	Specific gravity	Water content (%)	Compaction		CBR		Uniaxial compressive strength	Triaxial CU	sheer UU
NO.	LOCATION	DEPTH	Gravel (%)	Sand (%)	Silt clay (%)	Dmax	D 60	D 30	D 10	Cc	Cu	LL (%)	PI				OMC (%)	MDD (t/m^3)	Soaked (%)	Unsoaked (%)		(t/m^2)	Ø (°)
AG 1	46 + 500 SEC II-3	0.25-1.60	0	20.1	79.9		0.035					40.5	18.5	Dark Brown Clay and Silt	2.54	16.86	21.9	1.58	1.39	3.98		4.5	0
AG 2	42 + 200 SEC II-3	0.25-1.45	0	20.67	79.33		0.031					26.6	-	Yellowish Brown Clay and Silt	2.45	7.8	17.8	1.68	8.23	11.81		5.6	2.0
AG 3	38 + 500 SEC II-3	0.25-1.80	15.09	36.53	48.38		0.100	0.042	0.010			29.0	NP	Dark Brown Silt with Pebbles and Gravels	2.67	3.28	12.5	7.00	10.96	17.61			
AG 4	26 + 300 SEC II-3	0.25-1.20	0	62.99	37.01		0.100	0.050	0.0018			22.3	NP	Reddish Brown Clayey Silt	2.64	7.0	15.0	1.74	3.54	5.14		8.9	6.0
AG 5	21 + 600 SEC II-3	0.25-1.60	1.91	62.46	35.63		0.285	0.040	0.011			NP	NP	Light Gray Silt with Traces of fine sand	2.63	7.10	9.80	1.98	8.14	9.74			
AG 6	19 + 200 SEC II-3	0 - 1.10	0	34.89	65.11		0.065	0.032	0.010			34.2	6.95	Dark Brown Clayey Silt with Trace of Fine Sand	2.68	12.8	13.5	1.91	8.12	10.48		4.2	10.0
AG 7	13 + 400 SEC II-3	0.25-1.80	0	28.3	71.7		0.033	0.015	0.004			28.0	NP	Light Gray Silt with Traces of fine Sand	2.67	8.43	17.65	1.62	9.52	19.3		6.3	10.0
AG 8	10 + 000 SEC II-3																						
AG 9	5 + 500 SEC II-3	0.25-1.30	14.10	52.19	33.71		0.230	0.060	0.020			22.4	NP	Light Gray sandy silt with Pebbles and Gravels	2.66	3.4	14.35	1.78	10.23	12.14			
AG 10	27 + 700 SEC II-2	0.25-1.40	17.75	37.29	44.96		0.850	0.044	0.009			40.0	19.0	Reddish Brown Silt with Pebbles and Gravels	2.65	6.3	13.39	1.91	6.19	7.59			
AG 11	21 + 800 SEC II-2	0.25-1.20	15.7	46.2	38.1		1.250	0.040	0.005			25.7	9.2	Reddish Brown and Clayey Silt with Pebbles and Gravel	2.67	5.46	11.68	1.92	7.14	8.17			
AG 12	17 + 400 SEC II-2	0.25-1.20	0	9.65	90.35		0.035	0.014	0.003			50.0	16.0	Reddish Brown Silty Clayey	1.49	9.2	19.5	1.66	3.78	4.44			
AG 13	7 + 610 SEC II-2	0 - 1.10	0	23.76	76.24		0.047	0.018	0.001			61.2	37.7	Limonitic Red Clay	2.52	8.9	21.0	1.65	3.94	4.16			
AG 14	30 + 700 SEC II-1	0.25-1.20	11.37	50.18	38.45		0.190	0.052	0.018			NP	NP	Dark Brown Sandy Silt with clay and pebbles	2.69	4.6	14.4	1.78	11.5	12.45			
AG 15	27 + 900 SEC II-1																						
AG 16	17 + 300 SEC II-1	0.25-2.70	22.66	28.95	48.39		0.590	0.011				29.0	NP	Dark Brown Clayey Silt with Pebbles	2.62	3.8	21.0	1.63	5.40	6.54			
AG 17	2 + 700 SEC II-1	0.25-1.00	0	29.45	70.55		0.042	0.004				36.2	14.6	Dark Brown Clayey Silt with traces of sand	2.62	16.99	16.1	1.73	4.76	6.96		8.9	5.0
AG 18	4 + 000 SEC I	0 - 4.6	16.66	34.87	48.47		0.160	0.024	0.002			23.4	7.0	Dark Reddish Brown Brown Stiff Clayey Silt of low plasticity	2.59	11.3	15.2	1.96	3.6	9.9		12.4	6.5
AG 19	10 + 000 SEC I	0 - 2.50	49.24	44.28	6.48		0.018	0.008				23.1	16.3	Light Brown Compacted Silty Sandy Gravels and Boulders	2.67	8.1	17.2	1.81	8.2	12.6			
AG 20	16 + 800 SEC I	0 - 2.20	33.7	58.08	8.22		0.019	0.005	0.002	0.65	9.50	NP	NP	Light Brown Silty Sandy Gravels and Boulders	2.66	6.1	18.6	1.87	11.1	13.6			

Summary of Laboratory Test (5)

SAMPLE			Gradation									Atterberg's Limit		Description	Specific gravity	Water content (%)	Compaction		CBR		Uniaxial compressive strength	Triaxial shear CU	Triaxial shear UU
NO.	LOCATION	DEPTH	Gravel (%)	Sand (%)	Silt clay (%)	Dmax	D 60	D 30	D 10	Cc	Cu	LL (%)	PI				OMC (%)	MDD (t/m^3)	Soaked (%)	Unsoaked (%)		(t/m^2)	Ø (°)
AG 21	28 + 000 SEC I	0 - 2.60	48.79	48.49	2.72		0.017	0.003				NP	NP	Light Brown Silty Sandy Gravels and Boulders	2.63	6.3	18.3	1.80	8.3	12.8			
AG 22	33 + 000 SEC I	0 - 5.00	50.92	39.48	9.60		0.019	0.005				24.9	7.95	Light Brown Clayey Silty Sand and Gravel (Fill up Mat.)	2.64	12.3	19.6	1.935	3.6	12.3			
TPB 1	44 + 600 SEC II-3	0 - 0.90	0	31.6	68.40							36.20	14.10	Light brown silty clay	2.69	20.34	16.5	1.67	5.40	10.37			
	- do -	0.90-1.80	0	20.43	79.57							33.00	10.90	- do -	2.68	25.12	17.8	1.76	5.90	11.80			
TPB 2	41 + 300 SEC II-3	0 - 0.90	2.88	10.70	86.42							NP	NP	Greyish White Silt	2.64	6.97	18.3	1.57	6.81	12.5			
	- do -	0.90-1.80	4.20	28.0	67.80							NP	NP	- do -	2.63	8.21	20.0	1.56	16.82	26.67			
TPB 3	7 + 700 SEC II-3	0 - 0.90	0	14.80	85.20							48.3	12.20	Reddish brown sandy silt	2.73	7.80	24.0	1.64	1.00	1.42			
	- do -	0.90-1.80	0	6.44	93.56							65	22.10	- do -	2.76	10.60	22.1	1.67	1.42	1.49			
TPQ 2	29 + 500 SEC II-3	0.90												Light grey weak weathered slaty rock	2.63								
	- do -	1.80												- do -	2.62								
TPQ 3	19 + 800 SEC II-3	0.90												Light grey medium hard weathered slaty rock	2.60								
	- do -	1.80												- do -	2.62								
TPQ 5	2 + 700 SEC II-1	0.90												Boulders & greavel with well graded sand	2.61								
	- do -	1.80												- do -	2.58								
TPQ 6	19 + 200 SEC I	0.90												Light grey silty sandy gravelly boulders & cobbles	2.65								
	- do -	1.80												- do -	2.66								

Appendix 8.2.3 CBR-values and Group Index by AASHTO Standard

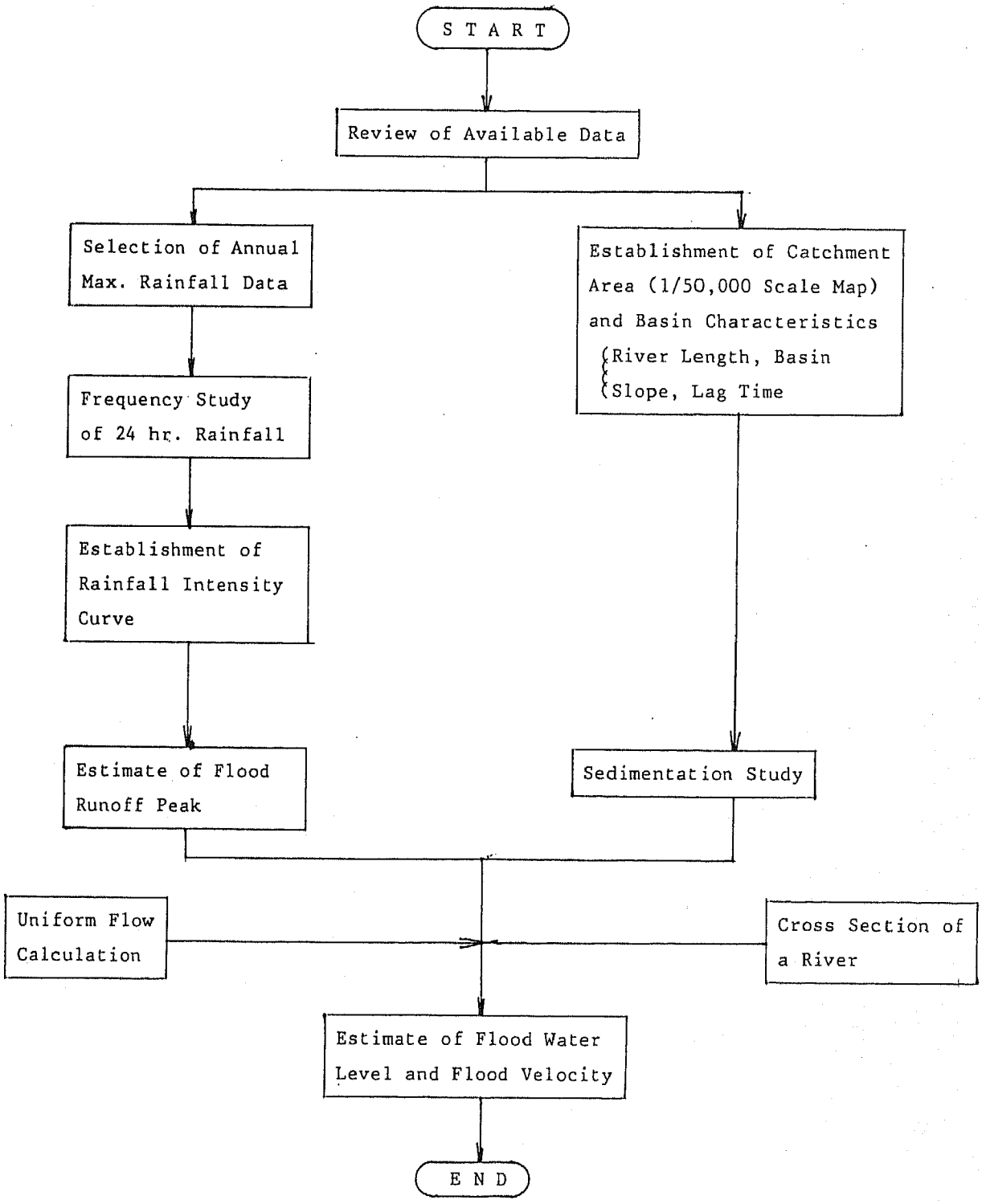
Appendix 8.2.3 CBR-values and Group Index by AASHTO Standard

		A-1	A-2	A-3	A-4	A-5	A-6	A-7
CBR (%)	0 - 2	0	0	0	0	0	1	2
	2 - 4	1	0	0	2	0	0	2
	4 - 6	0	0	0	1	0	3	0
	6 - 8	0	0	0	2	0	1	0
	8 - 10	2	0	0	4	0	0	0
	10 - 12	0	1	1	2	0	0	0
	12 - 14	0	0	0	0	0	0	0
	14 - 16	0	0	0	0	0	0	0
	16 - 18	0	0	0	1	0	0	0
	18 -	0	0	0	0	0	0	0
Group Index	0 - 2	3	1	1	4	0	0	0
	2 - 4	0	0	0	3	0	0	0
	4 - 6	0	0	0	0	0	1	0
	6 - 8	0	0	0	2	0	0	0
	8 - 10	0	0	0	3	0	3	0
	10 - 12	0	0	0	0	0	1	1
	12 - 14	0	0	0	0	0	0	0
	14 - 16	0	0	0	0	0	0	1
	16 - 18	0	0	0	0	0	0	1
	18 - 20	0	0	0	0	0	0	1

Note: Figures in the Table show frequency. CBR was measured on the test pieces compacted by the standard Proctor's test procedure and soaked in water for 96 hours.

Appendix 8.3.1 Work Flow on Preliminary Hydrological Study

Appendix 8.3.1 Work Flow on Preliminary Hydrological Study



Appendix 8.3.2 Catchment Area