

APPENDIX 5-1

MONTHLY METEOROLOGICAL DATA OF OMAN

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Station	Items	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
1. Khasab	1 Total Rainfall (mm)	67.2	48.3	45.1	3.7	0.1	0.0	0.8	0.0	0.0	2.1	11.8	51.8	230.9
	2 Mean Humidity (%)	62	62	60	55	54	60	64	65	66	60	60	62	61
	3 Absolute max. Temp. (°C)	27.8	28.4	32.5	38.8	42.8	44.5	44.1	42.2	40.5	38.1	33.5	29.2	36.9
	4 Mean Temperature (°C)	19.3	21.6	23.7	28.0	32.0	34.0	34.7	34.5	32.8	30.4	26.2	22.9	28.3
	5 Absolute min. Temp. (°C)	12.9	12.9	16.6	20.4	24.9	28.4	30.1	29.8	28.2	23.7	18.9	15.4	21.8
	6 Prevailing wind direction	164	171	163	164	97	111	205	182	164	159	152	155	157
		Mean speed (Knots)	6.2	6.2	5.6	5.5	5.2	5.1	5.4	6.4	5.4	4.2	4.7	5.5
	7 Max. gust direction	241	255	248	248	230	248	161	138	203	155	281	285	224
Max. gust speed (Knots)		42.8	42.5	40.1	37.1	33.2	31.9	31.6	33.3	27.8	30.7	29.7	34.2	34.6
2. Buraimi	1 Total Rainfall (mm)	13.2	16.8	17.1	3.9	0.6	1.2	24.3	1.4	1.3	0.2	0.0	12.9	93.0
	2 Mean Humidity (%)	64	59	46	32	26	28	35	34	37	38	50	60	42
	3 Absolute max. Temp. (°C)	28.3	31.8	36.6	41.7	45.1	47.2	47.1	46.3	45.7	40.2	35.0	31.7	39.7
	4 Mean Temperature (°C)	16.7	19.4	23.6	28.7	33.1	35.9	36.5	37.0	33.8	29.9	24.2	20.3	28.3
	5 Absolute min. Temp. (°C)	6.4	7.0	9.2	12.4	16.7	20.9	22.8	24.9	22.3	16.3	11.1	8.2	14.8
	6 Prevailing wind direction	240	168	217	200	179	174	126	131	139	276	232	229	193
		Mean speed (Knots)	5.3	5.8	6.2	6.0	6.1	5.9	6.2	6.4	6.3	5.2	4.7	4.6
	7 Max. gust direction	197	170	129	173	189	185	153	147	197	225	229	238	186
Max. gust speed (Knots)		27.7	28.7	30.8	28.3	30.6	34.5	39.1	33.4	35.1	29.6	22.5	24.7	30.4
3. Sohar	1 Total Rainfall (mm)	23.7	22.4	21.4	4.8	0.0	0.0	3.5	0.5	0.2	10.9	5.0	18.2	110.4
	2 Mean Humidity (%)	71	72	71	66	63	70	75	80	77	71	69	72	71
	3 Absolute max. Temp. (°C)	28.0	29.9	33.6	40.5	42.7	42.9	42.3	39.8	37.6	35.9	33.1	30.0	36.4
	4 Mean Temperature (°C)	19.9	20.5	22.6	26.8	31.0	32.9	33.1	31.9	30.3	27.8	24.3	21.4	26.9
	5 Absolute min. Temp. (°C)	9.7	9.3	11.1	15.2	19.7	24.1	26.1	25.7	21.6	17.0	14.0	11.4	17.1
	6 Prevailing wind direction	247	261	156	94	85	95	102	106	97	102	231	219	150
		Mean speed (Knots)	5.6	5.5	5.2	5.1	4.9	4.6	5.2	5.5	4.7	4.2	4.8	5.0
	7 Max. gust direction	202	242	227	288	202	221	102	101	115	261	163	216	195
Max. gust speed (Knots)		30.9	31.8	31.0	33.2	29.8	23.3	20.8	18.8	18.8	20.8	26.4	27.0	26.1

Station	Items	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual	
4. Rustaq	1 Total Rainfall (mm)	11.0	7.9	4.5	9.8	4.9	1.2	4.2	2.2	1.2	6.6	7.5	0.4	61.4	
	2 Mean Humidity (%)	63	55	45	27	25	32	39	41	49	40	56	62	45	
	3 Absolute max. Temp. (°C)	29.4	33.3	34.4	39.4	42.1	42.5	42.2	42.8	40.1	37.0	31.3	28.4	36.9	
	4 Mean Temperature (°C)	19.5	20.7	25.1	30.7	35.1	36.5	36.2	35.0	32.6	29.7	24.9	21.6	29.0	
	5 Absolute min. Temp. (°C)	10.6	10.5	14.1	18.3	24.6	26.5	26.2	25.5	24.2	20.2	15.8	12.7	19.1	
	6 Prevailing wind direction	360	360	360	360	360	360	360	360	360	360	360	360	360	360
		Mean speed (Knots)	3.0	3.5	4.0	4.0	4.0	4.0	4.3	4.0	4.0	3.2	3.0	3.0	3.7
	7 Max. gust direction	198	148	200	103	100	220	190	210	234	124	164	164	171	
		Max. gust speed (Knots)	22.0	22.0	24.8	29.8	28.0	47.2	47.8	36.2	28.4	28.6	24.4	17.2	29.7
5. Mina Sultan Qaboos	1 Total Rainfall (mm)	18.3	8.6	3.6	0.8	0.0	0.0	0.0	0.0	0.0	0.0	1.1	0.0	32.5	
	2 Mean Humidity (%)	94	95	95	94	95	95	94	93	93	92	93	93	94	
	3 Absolute max. Temp. (°C)	29.4	27.5	34.0	38.8	43.4	43.9	43.8	39.7	39.4	37.9	33.2	30.7	36.8	
	4 Mean Temperature (°C)	22.4	23.0	25.5	29.8	34.2	35.1	34.0	30.7	31.1	30.8	27.3	25.0	29.1	
	5 Absolute min. Temp. (°C)	15.8	17.4	19.6	23.2	28.4	28.7	27.6	25.9	26.0	25.4	22.2	19.6	23.3	
	6 Prevailing wind direction	265	245	245	188	135	135	98	105	90	144	264	204	176	
		Mean speed (Knots)	5.8	6.7	5.7	5.3	5.3	5.0	5.8	5.8	3.7	3.5	3.3	4.2	5.0
	7 Max. gust direction	232	274	286	235	265	190	160	110	90	248	178	242	209	
		Max. gust speed (Knots)	28.7	33.3	22.8	29.3	26.0	21.5	25.3	26.0	20.4	23.2	22.6	21.3	25.0
6. Saiq	1 Total Rainfall (mm)	33.4	32.0	46.8	35.7	31.5	17.8	58.4	60.5	32.0	21.1	9.6	7.6	386.4	
	2 Mean Humidity (%)	54	45	40	32	25	24	34	37	34	33	45	50	38	
	3 Absolute max. Temp. (°C)	20.6	21.9	23.1	28.1	32.1	33.8	34.0	32.5	30.8	27.2	23.0	21.4	27.4	
	4 Mean Temperature (°C)	10.1	12.1	14.7	18.3	22.8	25.0	25.4	24.6	22.2	18.4	14.0	11.8	18.3	
	5 Absolute min. Temp. (°C)	-0.6	2.8	3.5	7.7	12.8	15.7	15.4	14.4	13.0	9.2	4.1	1.2	8.3	
	6 Prevailing wind direction	171	219	233	263	316	312	319	321	309	277	155	155	254	
		Mean speed (Knots)	4.9	6.0	6.5	6.5	6.6	6.3	6.0	6.3	6.7	5.5	4.2	4.2	5.8
	7 Max. gust direction	234	250	244	203	218	181	190	150	140	140	164	166	190	
		Max. gust speed (Knots)	30.5	35.6	37.0	37.3	36.3	34.7	37.9	37.6	33.1	30.4	28.5	29.1	34.0
7. Nizwa	1 Total Rainfall (mm)	9.4	10.4	23.7	5.4	7.3	1.3	12.3	9.0	0.9	5.0	1.0	1.4	87.0	
	2 Mean Humidity (%)	59	54	52	44	38	42	47	51	49	43	54	62	49	
	3 Absolute max. Temp. (°C)	30.9	33.1	37.6	41.7	46.0	47.4	48.2	46.1	43.7	40.4	34.9	31.7	40.1	
	4 Mean Temperature (°C)	19.0	21.1	24.6	29.1	33.9	35.8	35.5	34.1	31.9	29.7	23.8	20.8	28.3	
	5 Absolute min. Temp. (°C)	6.6	9.1	10.7	14.7	20.6	23.7	23.7	21.8	20.7	15.4	12.2	9.4	15.7	
	6 Prevailing wind direction	232	274	207	202	298	225	161	227	94	77	242	199	203	
		Mean speed (Knots)	27.8	28.2	31.3	36.3	36.1	44.0	51.7	51.4	45.0	34.0	24.8	27.0	36.5
	7 Max. gust direction	175	186	190	150	180	124	185	150	150	160	144	175	164	
		Max. gust speed (Knots)	2.7	3.4	4.0	4.5	4.4	4.3	4.5	4.0	3.5	3.2	2.8	2.0	3.6

Station		Items	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
8. Fahud	1	Total Rainfall (mm)	1.0	8.0	1.0	7.8	0.0	0.0	0.0	0.6	0.7	0.5	0.0	0.1	19.6
	2	Mean Humidity (%)	54	51	40	29	24	24	30	35	37	33	43	50	38
	3	Absolute max. Temp. (°C)	30.5	33.3	38.5	42.6	46.9	45.5	48.6	47.3	45.2	41.9	36.3	32.0	40.7
	4	Mean Temperature (°C)	19.7	21.5	24.9	30.3	34.5	36.8	37.0	35.8	33.4	30.2	25.0	21.5	29.2
	5	Absolute min. Temp. (°C)	7.7	9.0	11.2	15.9	19.3	23.4	25.3	24.1	22.3	17.5	13.2	9.6	16.5
	6	Prevailing wind direction	236	233	244	266	282	223	140	120	123	145	210	189	201
		Mean speed (Knots)	7.3	8.8	9.0	7.9	9.4	8.1	9.0	9.4	8.0	5.7	5.0	6.0	7.8
	7	Max. gust direction	302	317	299	304	295	288	203	125	167	212	255	270	253
Max. gust speed (Knots)		31.4	30.8	33.3	34.4	44.2	30.9	42.1	40.0	33.2	31.7	26.1	29.6	34.0	
9. Qurm Alam	1	Total Rainfall (mm)	0.0	0.0	0.0	3.1	0.0	0.0	0.0	0.0	0.0	0.7	0.0	3.8	
	2	Mean Humidity (%)	49	44	34	33	33	41	40	47	49	37	48	53	42
	3	Absolute max. Temp. (°C)	29.7	34.4	37.3	43.7	47.2	48.0	48.7	46.7	44.0	41.6	36.0	32.8	40.9
	4	Mean Temperature (°C)	19.8	20.9	25.2	30.3	34.5	35.4	34.0	32.9	31.0	29.5	25.2	22.2	28.4
	5	Absolute min. Temp. (°C)	7.9	8.4	11.5	16.3	20.0	23.9	23.1	22.1	21.3	17.7	12.8	10.8	16.3
	6	Prevailing wind direction	240	270	225	60	100	110	165	165	130	130	170	160	161
		Mean speed (Knots)	8.5	9.3	10.0	9.0	10.7	10.3	11.0	10.5	9.3	7.7	6.3	6.7	9.1
	7	Max. gust direction	90	67	15	20	107	160	154	285	120	235	230	160	137
Max. gust speed (Knots)		30.0	36.3	43.0	34.0	30.3	37.3	56.0	34.5	32.3	18.7	27.0	25.7	33.8	
10. Masirah	1	Total Rainfall (mm)	7.2	4.1	8.7	8.9	0.0	5.9	4.2	0.0	0.0	3.7	5.7	3.2	51.7
	2	Mean Humidity (%)	69.5	71.2	70.2	71.4	72.7	77.9	79.6	81.3	79.3	74.8	72.4	72.6	74
	3	Absolute max. Temp. (°C)	29.9	31.1	35.4	38.4	39.7	40.4	36.2	33.8	34.9	36.7	33.3	30.6	35.0
	4	Mean Temperature (°C)	22.9	23.5	25.4	28.3	30.3	29.6	27.2	26.2	26.7	27.5	26.2	24.3	26.5
	5	Absolute min. Temp. (°C)	25.1	15.5	17.0	20.1	24.3	23.9	21.8	21.2	21.4	21.1	19.9	17.4	20.7
	6	Prevailing wind direction	92	120	166	217	358	213	210	210	212	171	82	72	177
		Mean speed (Knots)	7.6	7.8	7.6	8.9	11.8	13.2	16.2	13.9	10.3	7.0	7.5	7.8	10.0
	7	Max. gust direction	174	240	214	240	234	200	215	217	214	114	82	110	188
Max. gust speed (Knots)		30.8	27.0	25.7	34.2	28.7	33.7	35.8	33.2	25.5	23.3	22.0	22.0	28.5	
11 Yalooni	1	Total Rainfall (mm)	0.0	0.0	0.0	3.2	0.0	0.0	0.0	0.0	7.4	4.3	0.0	14.9	
	2	Mean Humidity (%)	66	61	57	59	54	59	63	70	76	62	62	68	63

	3	Absolute max. Temp. (°C)	30.9	32.7	37.5	40.7	44.6	46.2	46.6	44.2	43.9	39.1	34.8	31.1	39.4
	4	Mean Temperature (°C)	19.8	21.3	24.0	27.9	31.4	31.6	30.8	28.3	27.7	27.0	23.8	21.2	26.2
	5	Absolute min. Temp. (°C)	8.2	8.9	11.3	15.7	19.5	21.7	20.6	19.2	18.3	14.9	13.3	11.0	15.2
	6	Prevailing wind direction	276	260	195	199	213	202	196	195	200	175	139	246	208
		Mean speed (Knots)	5.8	7.3	8.1	8.7	9.9	10.7	12.1	11.8	10.3	6.4	5.4	5.8	8.5
	7	Max. gust direction	159	160	160	165	177	172	262	215	198	197	144	170	182
		Max. gust speed (Knots)	29.9	30.0	33.8	29.5	32.1	31.8	36.1	30.2	26.2	26.5	24.5	27.9	29.9

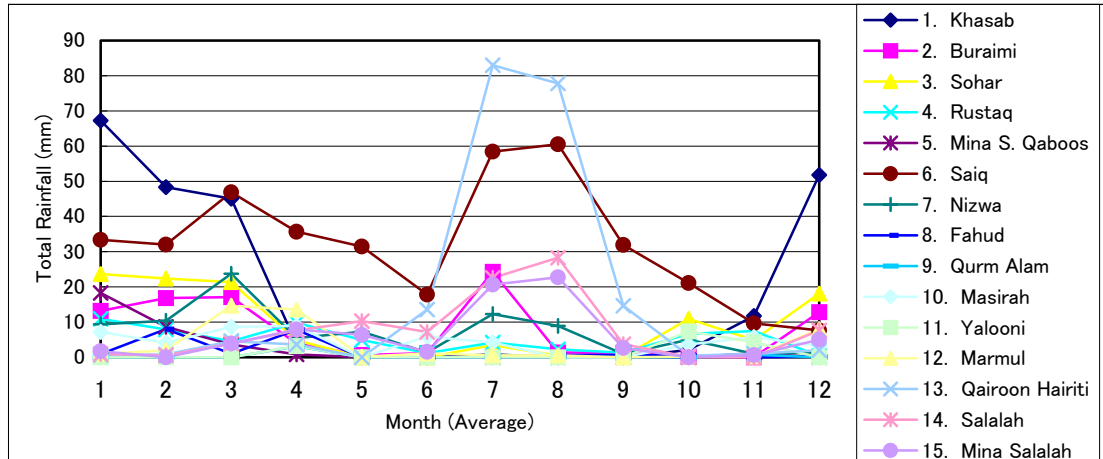
Station	Items	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual	
12. Marmul	1	Total Rainfall (mm)	0.9	2.0	14.7	13.6	0.2	1.1	0.5	0.6	0.0	0.2	0.2	8.0	42.0
	2	Mean Humidity (%)	60	54	54	49	38	36	34	37	49	52	55	63	49
	3	Absolute max. Temp. (°C)	30.8	33.3	37.7	40.6	44.3	45.7	46.0	45.3	43.8	38.9	34.5	30.5	39.3
	4	Mean Temperature (°C)	19.0	21.2	24.3	28.1	31.8	33.8	34.4	33.6	29.7	27.0	23.6	20.7	27.3
	5	Absolute min. Temp. (°C)	7.1	8.2	12.6	16.0	20.2	22.2	22.6	22.0	37.7	15.7	13.1	9.7	17.3
	6	Prevailing wind direction	137	137	135	135	133	134	163	153	133	131	131	130	138
		Mean speed (Knots)	8.4	10.9	11.8	10.3	9.0	9.7	9.6	8.7	9.8	8.6	7.5	7.9	9.3
	7	Max. gust direction	125	133	143	140	187	217	248	187	119	147	110	201	163
Max. gust speed (Knots)		34.0	38.4	39.2	34.3	36.7	33.8	34.6	34.2	37.2	34.1	33.1	33.0	35.2	
13. Qairoon Hairiti	1	Total Rainfall (mm)	0.7	0.8	4.5	3.7	0.0	13.5	83.0	77.8	14.7	0.5	1.0	2.0	170.5
	2	Mean Humidity (%)	24	24	26	28	29	29	26	25	27	27	35	25	26
	3	Absolute max. Temp. (°C)	25.2	26.4	29.9	33.0	36.5	35.0	30.9	28.6	32.8	32.8	29.0	25.7	37.3
	4	Mean Temperature (°C)	16.8	18.2	20.6	23.4	25.5	24.2	21.5	21.5	21.9	23.2	20.9	16.8	21.4
	5	Absolute min. Temp. (°C)	8.2	11.2	13.4	16.7	18.5	19.6	18.4	17.9	16.6	16.3	14.3	10.9	13.0
14. Salalah	1	Total Rainfall (mm)	0.9	0.5	3.9	7.6	10.3	7.2	22.6	28.3	3.7	0.1	0.0	7.6	92.8
	2	Mean Humidity (%)	54	57	62	68	75	81	88	90	82	68	56	55	70
	3	Absolute max. Temp. (°C)	30.9	32.9	35.3	37.4	36.7	35.1	31.3	29.5	31.0	35.6	35.5	31.9	33.6
	4	Mean Temperature (°C)	15.6	16.8	18.4	20.8	23.9	25.5	23.2	22.6	22.5	20.0	19.0	17.2	20.5

	5	Absolute min. Temp. (°C)	23.4	24.3	26.1	28.0	29.5	29.2	26.3	25.1	26.3	27.0	22.3	24.9	26.0
	6	Prevailing wind direction	238	213	192	187	194	194	189	178	192	201	254	295	211
		Mean speed (Knots)	6.5	6.0	5.2	5.2	6.2	7.4	5.8	4.8	5.3	4.1	4.7	6.1	5.6
	7	Max. gust direction	328	282	313	290	207	226	199	196	196	186	202	199	235
		Max. gust speed (Knots)	34.9	32.0	30.0	27.8	26.8	24.9	22.2	19.8	21.9	21.5	27.5	29.4	26.6
15. Mina	1	Total Rainfall (mm)	1.8	0.0	3.9	7.9	6.3	1.5	20.6	22.7	2.6	0.0	0.6	5.0	73.1
Salalah	2	Absolute max. Temp. (°C)	31.0	31.7	34.2	34.8	34.3	35.1	28.1	28.5	30.8	33.0	34.3	31.4	32.3
	3	Mean Temperature (°C)	24.2	24.9	26.6	28.2	29.4	28.9	25.7	24.3	25.8	27.0	26.9	25.6	26.5
	4	Absolute min. Temp. (°C)	16.2	17.5	19.1	21.4	24.2	24.5	22.4	21.2	21.6	20.5	19.7	18.2	20.5
	5	Max. gust direction	309	327	242	210	221	259	217	217	228	220	250	187	241
		Max. gust speed (Knots)	29.6	25.6	25.5	16.0	17.0	19.7	14.7	11.7	10.8	14.2	16.3	18.0	18.2

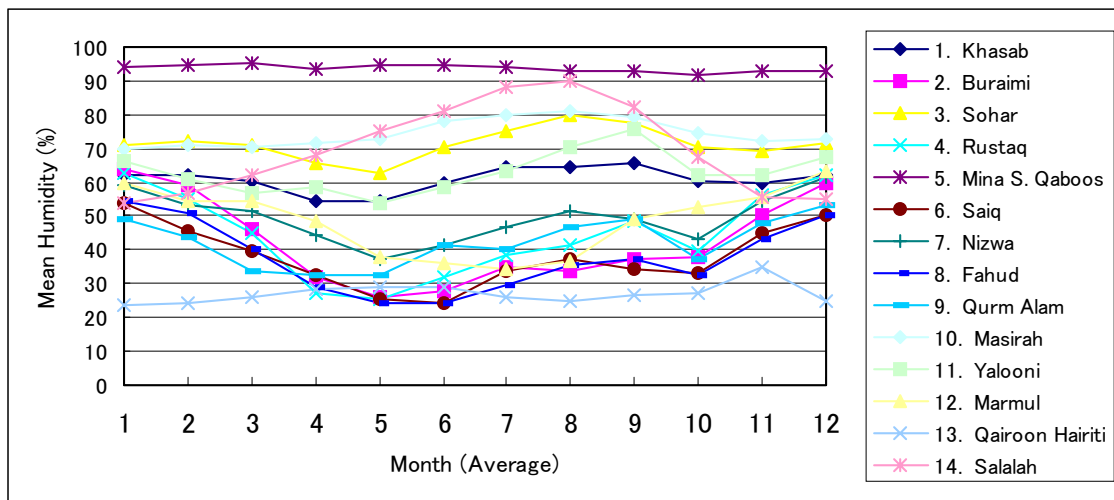
APPENDIX 5-2

YEARLY METROLOGICAL DATA OF OMAN

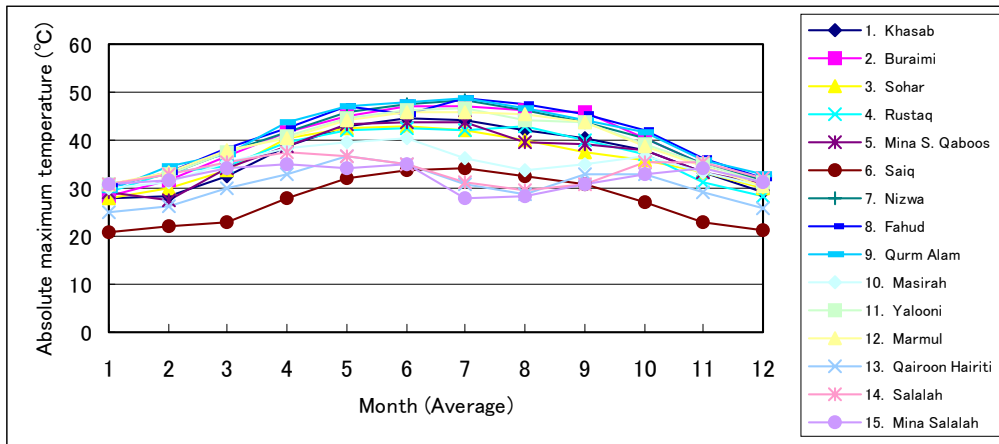
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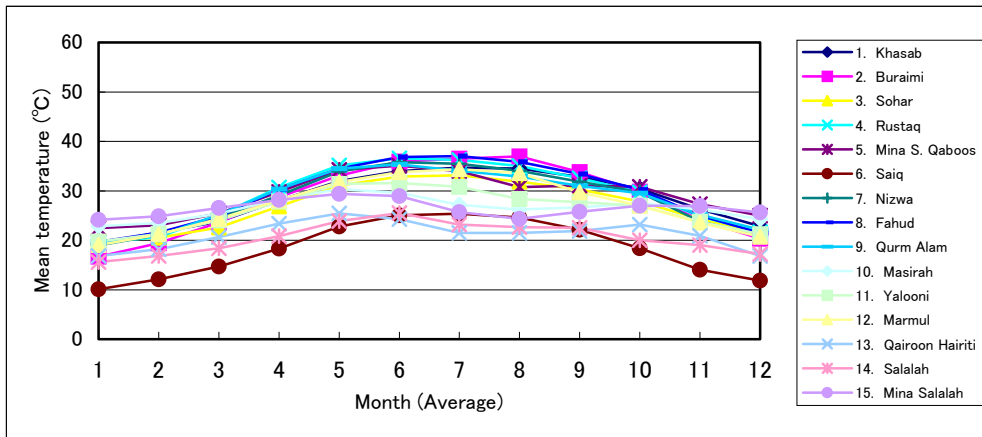
(1) Monthly Total Rainfall



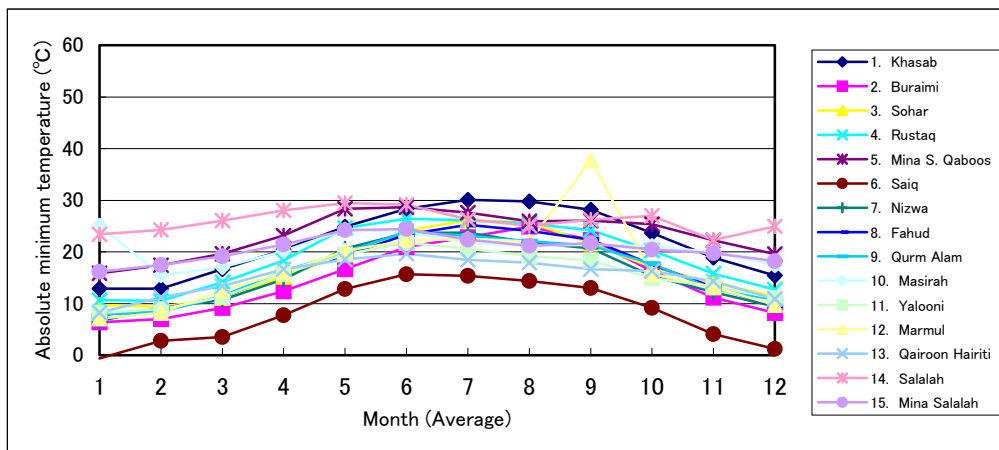
(2) Monthly Mean Humidity (%)



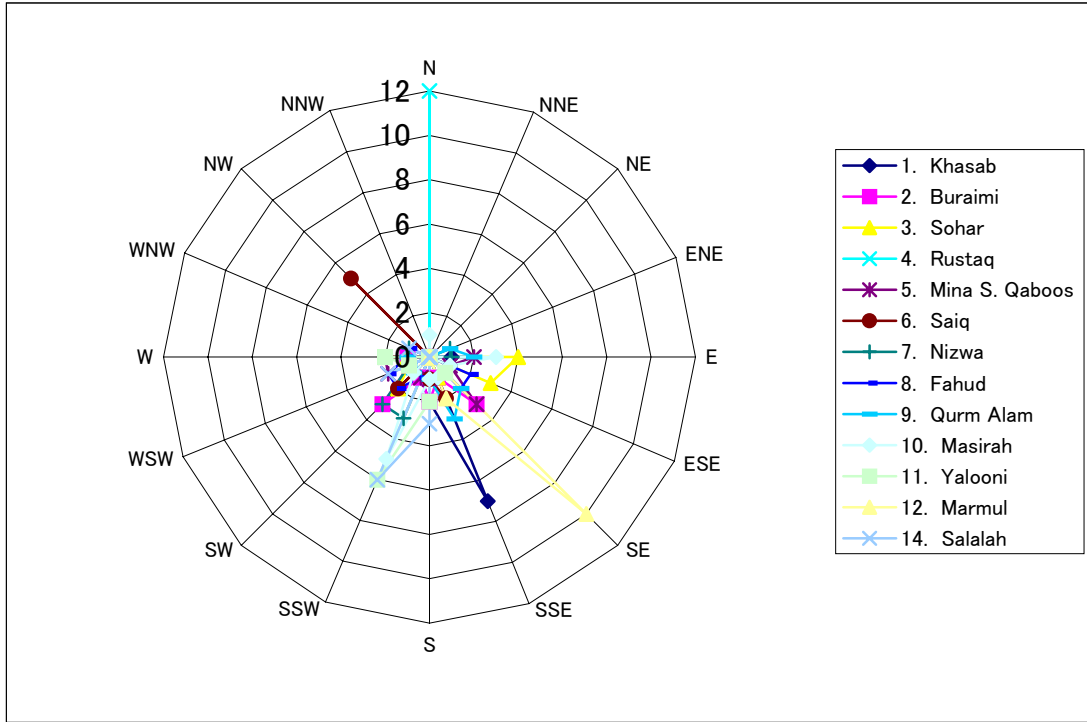
(3) Monthly Absolute Maximum Temperature (°C)



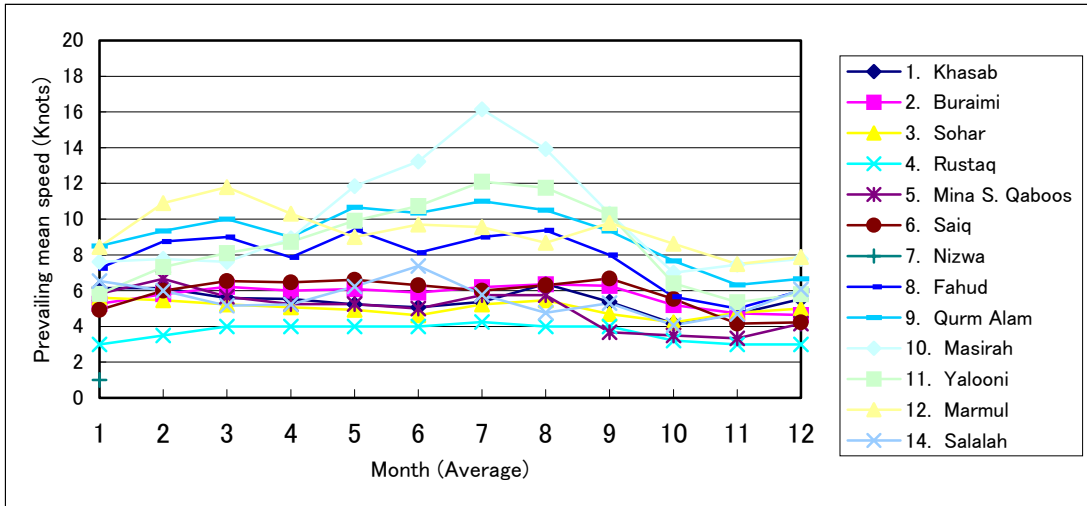
(4) Monthly Mean Temperature (°C)



(5) Monthly Absolute Minimum Temperature (°C)



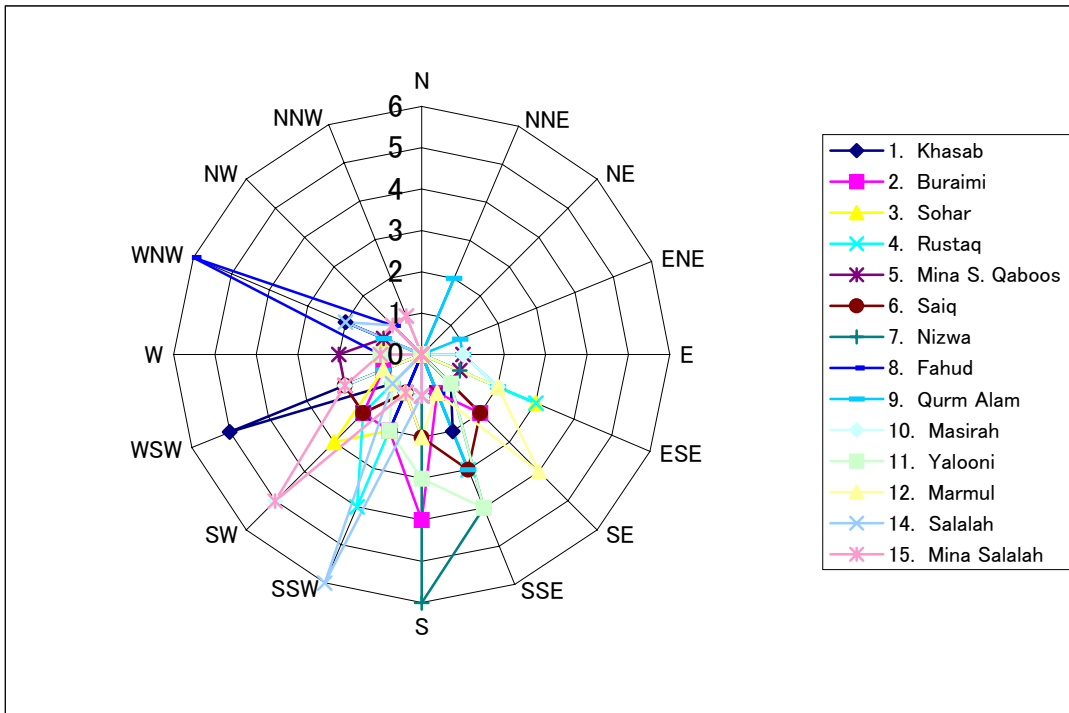
(6) Prevailing Wind Direction



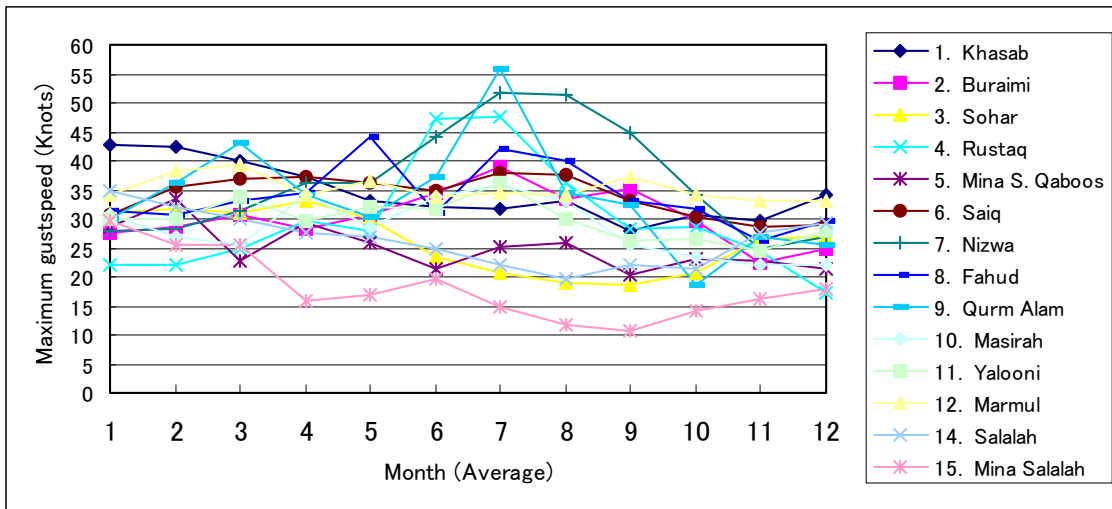
(7) Maximum Wind Speed (Knots)



(8) Prevailing Wind Direction in Oman



(9) Maximum Gust Direction



(10) Gust Speed (Knots)

APPENDIX 5-3

HISTORICAL HERITAGE RECOGNIZED BY MINISTRY OF HERITAGE AND CULTURE

**HISTORICAL HERITAGE RECOGNIZED BY
THE MINISTRY OF HERITAGE AND CULTURE**

No.	Region/ Governorate	Location	Content
1	Muscat Governorate	Wattiyha	The stone age (5000 B.C.)
		Raas Al Hamra	(4000 B.C.)
		Bandar Jusa	The Iron Age, period of Samad Al Shan (300 B.C. - 900 A.C.)
		Al Bustan	Samad period (300 B.C. - 900 A.C.)
		Bosher	(1000 B.C.)
		Saad at Bosher	Samad period (300 B.C. - 900 A.C.)
		Yatti	Old and Islamic cemetery
		Sarooj	Old Stone Age
2	Muscat Governorate (Qurayyat area)	Wadi Dhaiqa	Old Stone Age
		Sawaqim	Old Stone Age
		Daghmar	(4000 B.C.)
		Khawr Malah	(4000 B.C.)
		Siyaa	Iron Age
		Al Faj	Iron Age
3	Musandam Governorate	Al Hawami cemetery	(3000 B.C.)
		Marami Al Dayir	(3000 B.C.)
		Al Hasa	Islamic period
4	Al Batinah Region	Willayat Barkah	Al Sawadi
		Willayat Liwa	Khashishat Al Milih (3000 B.C.)
		Willayat Al Rustaq	Al Allaya Af Tabaqa Wabil area Disley (Al Aqar area)
		Willayat Saham	Al Jadah location Kour Al Hamam (Pigeon Bay)

No.	Region/ Governorate	Location	Content
4	Al Batinah Region	Willayat Al Khaboura	Wadi Al Hawasna : Silver currencies, rocky sculpture Al Majza city
		Willayat Sohar	Falaj Al suq (3000 B.C.) Sohar Forte: A- Period before Islam (Century 1-6 A.C.) B- Early Islamic period (Century 1 H/7 A.C. - 7 H 13 A.C.) C- Modern Islamic period: (Century 8H/i4 A.C.- present time) Al Malab Area: Islamic currencies Al Hambar: The Iron Age Wadi al Jizi Al Aseel : 690 - 970 A.C. (Century 9th A.C.) Arja : (3000 B,C, - 1000 B.C.) Ai Baidha : First Thousand before Christ - Early-Islamic ages Tiwa Abeela : Islamic Ages Al Siyab Houra Bargha the 12th & 13th A.C
5	Ad Dhakhliyah Region	Willayat Bidbid	Al Amqat city: Samad period 300 P.C - 900 A.C. Al Mo]taqa : The Iron Age
		Willayat Samail	Manal Wadi Al Safafeer Al Khobar area Al Ain Sarour area Seeja
		Willayat Izki	Imti city Al Qaraytain village Zakait
		Willayat Manah	Mamad city
		Willayat Adam	Houshi / The Stone Age

No.	Region/ Governorate	Location	Content
5	Ad Dhakhliyah Region	Willayat Nizwa	A Cemetery, east of Nizwa: Late of the Bronze Age (1500 - 1200 B.C.) Passageway beside Nizwa Forte Al Houra mountains; Late of the Bronze Age Wadi Tanouf : Drawings on the BC 3000 Farq : The towers of the BC 3000
		Willayat Bahla	Masqoota Area Al Khamila: Cemetery related to the period before Islam Wadi Bahla: BC 3000 Basiya : BC 3000 Salout : BC1000 & the Islamic period Al Aqar: 2500-200 B.C
6	Adh Dhahirah Region		Willayat Ibrī Batt : BC 3000 Ammla : The late of Iron Age. Al Ain : BC 3000 Al Araqi :1200 B.C.-300 B.C. Al Khatm : BC 3000 Mawa : BC #000 Al Saleef : The Iron Age Qarn Kabsh : BC 3000 Maqnayat
		Willayat Dhanak	Qumaira (Ain Bani Saidah) : BC Qumaira (Ain Bani Saidah) : BC 3000
		Willayat Yanqul	Tiwa Raki: BC 1000
		Willayat Al Buraimi	Ajran : BC 3000 Al Wasit : 2000-1200 B.C Willayat Mahdha
7	Ash Sharqiyah Region		Al Sharqiya sands
		Willayat Al Mudhaibi	Samad Al Shan : 300 B.C.- 900 A.C. Al Moyasar : BC 3000 Lazaq : 1200-500 B.C Al Khadra : The period of Samad Al Shan " 300 B.C. - 900 A.C."

No.	Region/ Governorate	Location	Content
7	Ash Sharqiyah Region	Willayat Al Mudhaibi	Sinao : Al oyoon Village "Cemetery belong to the period before Islam" Al Khashaba : BC 3000 Al Maidin : Lazaq period: 1200-300 B.C.
		Willayat Dimaa & Al Taieen	Al Hamam location (pigeons location) : BC 3000 Alkka location: The iron age Al Badia location: Islamic period
		Willayat Al Qabil	Al Nabba : BC 3000 Shana: BC 3000 Tiwa Saleem
		Willayat Badiyah	Al Dhahir : BC 3000
		Willayat Al Kamil & Al Wafi	Old cemetery in Al wafi on the coasts of Wadi Al Batha " 300 B,C.-900 A.C"
		Willayat Sur	Raas A Janz : BC 3000 Raas Al Haad : BC 3000 Qalahat : A.C 800- A.C. 1400 Wadi Al Shajar area (Trees Wadi): 2900 - 2500 B.C.
		Willayat Jaltan Bani Bu Hussan	Al Shaiba Area: graveyards belong to the Iron Age
		Willayat Jaltan Bani Bu Ali	Al Swaih village: BC 4000 Asee ah Al Khaba
8	Al Wusta Region	Willayat Haima	Ghaneem : The middle of BC 6000
		Willayat Mahout	: Haj location
		Willayat Massira	Location in the south east of Halaf village Safaiq Sur Massira
9	Dhofar Governorate		Sadah Raiysout Albaleed : 10th century Taqqa Rori bay (Samharm)

No.	Region/ Governorate	Location	Content
9	Dhofar Governorate		Mirbat Al Mighsail Sawli bay Taqa bay Alhareez bay Sawli bay Al Mahla bay Rakhyout bay Kharfout antiquities r,laqshan Hanoon
		Willayat Thamara't - Madhay	Alshsar Al Halaniyat islands
			<p>- The Survey held by BaoloBiaji on the Omani coast from Raas Abu Dawood in Willayat Quriyat till Sharbtat in Dhofar Region:</p> <p>Raas Abu Dawood : Shell hill Al Hajir : Old flint mine Quriyat : Old tower (AI Seera Tower) Quriyat : The tocation is ancient building Quriyat : Ancient tower Al Milih bay: Shell hill AI Milih bay: Ancient location Bilad : o[d castle Daghmar : Stones houses Daghmar : Shelf hitf Dibat : Shell hill on a high place Fins: Old castle Maqlla : Shell hill on a high place Shab : Islamic graveyard Shab : Old castle Shab : Shell hiil Tiwi : Small Islamic graveyard</p>

No.	Region/ Governorate	Location	Content
9	Dhofar Governorate		<p>Tiwi: Old castle</p> <p>Tlwi : Islamic city</p> <p>Qalahat : Islamic city</p> <p>Bar Buaira : Shell hill</p> <p>Sur : Old castle</p> <p>Sur : Shell hill in a ring-shaped building</p> <p>Sur : Shell hill</p> <p>Sur Old towers</p> <p>Sheeh : Shell hill</p> <p>Sheeh : Graveyards belong to BC 1000</p> <p>Raas Sheeh : The location is a land with first implements and pieces of crockery</p> <p>Raas Sheeh : A village with graveyards, flint and shells</p> <p>Sheeh : Shell hill</p> <p>Sheeh : Remnant of shell hill</p> <p>Sheeh : Old locat'on</p> <p>Jarama Bay: Stones belong to BC 3000</p> <p>Jarama Bay: Location belong to the Islamic period</p> <p>Jarama Bay: Shell hill and Islamic crockery</p> <p>Jarama Bay: 2 graves on top of a hill</p> <p>Jarama bay: 7 shell hills</p> <p>Jarama bay: Islamic location</p> <p>Jarama bay: a ring-shaped stones</p> <p>Jarama bay: Old location</p> <p>Jarama bay: Old location</p> <p>Jarama bay: Old location</p> <p>Jarama bay: Some frint implements spread on the place</p> <p>Jarama bay: big graveyard</p> <p>Jarama bay: big village</p> <p>Raas Al Haad : old village</p> <p>Jarama bay: Big village</p> <p>Raas Al Haad : 2 she h' s</p> <p>Raas Al Haad : Islamic location</p>

No.	Region/ Governorate	Location	Content
9	Dhofar Governorate		<p>Raas Al Haad : Islamic crockery location</p> <p>Raas Al Haad : 3 graveyards</p> <p>Raas Al Haad : Old castle</p> <p>Raas Aljinz : important old and ancient buildings</p> <p>Raas Wadiah : Graveyards</p> <p>Raas Wadiah : Graveyards</p> <p>Raas Wadiah : a ring-shaped stone buildings</p> <p>Al Dafa : A village with big ring-shaped buildings.</p> <p>Al Dafa : Location with some flint implements</p> <p>Al Khaba : 3 shell hills</p> <p>Rass Al Rwa's : shell hill</p> <p>Al Swaih : 2 shell hills, 2 locations belong to BC 3000</p> <p>Aseela : 2 shell hills</p> <p>Al Shakhra : a hill on the south of the modern village (Islamic antiques).</p> <p>Raas Al Jifan : 2 shell hills</p> <p>Raas Al Sharik : 3 shell hills</p> <p>Awairib: shel hill</p> <p>Raas Saqala: shell hill</p> <p>Raas jabash : 3 shell hills</p> <p>Al Aiqra : small shells hill</p> <p>Judaima : shell hill</p> <p>Falam : big graveyard</p> <p>Falam : some graves</p> <p>Raas Tamaytam : 3 Islamic graveyards</p> <p>Raas Hullat : 2 shell hills</p> <p>Raas Sa'rab: 7 shell hills</p> <p>Raas Sairab : old location</p> <p>Halmait : small shell hill</p> <p>Raas Hudood : 2 shell hills</p> <p>Raas Hudood : around 10 Islamic graves</p> <p>Raas Al Aqait : 3 graveyards</p>

No.	Region/ Governorate	Location	Content
9	Dhofar Governorate		<p>Raas Al Aqait : shell hill</p> <p>Shwair : big 2 graveyards</p> <p>Shwair : big shell hill</p> <p>Shwair : Location with some flint implements</p> <p>Raas Madraka : some flint in front of big rock.</p> <p>Raas Madraka : big settling down area</p> <p>Raas Madraka : 4 shell hills</p> <p>Madraka Island: Flint implements spread on the location</p> <p>Madraka island: flint implements on the north coast of the island</p> <p>Raas Madraka : big graveyard</p> <p>Wadi Al Abaitam : Islamic grave</p> <p>Wadi Gharam : graveyard with agglomeration of number of stones</p> <p>Wadi Gharam : Agglomeration of stones</p> <p>Wadi Haitam : Grave yard with number of stones</p> <p>Wadi Haitam : graveyard with many agglomeration of stones</p> <p>Wadi Haitam : Graveyard with agglomeration of stones</p> <p>Wadi Ghadoan : Graveyard with agglomeration of stones</p> <p>Wadi Lazaq: Big graveyard</p> <p>Swqra : Big graveyard with agglomeration of stones</p> <p>Sharbathat : Wide graveyard with stone items</p> <p>Sharbathat : shell hill</p>

APPENDIX 5-4

FORTS AND CASTLES BELONG TO THE MINISTRY OF HERITAGE AND CULTURE

APPENDIX 5-4**FORTS AND CASTLES BELONG TO
THE MINISTRY OF HERITAGE AND CULTURE**

No.	Location	Region	Willayat
1	Al Muqham House	Muscat	Bosher
2	Bidbid Castle	Dakhlyah	Bidbid
3	Sarooj House	Dakhlyah	Samail
4	Fiyqain Castle	Dakhlyah	Manah
5	Rawdha Castle	Ash Sharqiya	Al Mudhaiba
6	Al Yahmadi House	Ash Sharqiya	Ibra
7	Al Aiji Castle	Ash Sharqiya	Sur
8	Al Tharmud Castle	Batinah	Al Swaiq
9	Al Mughabsha Fence	Batinah	Al Swaiq
10	Al Hilal Fence	Batinah	Al Swaiq
11	Saham Castle	Batinah	Saham
12	Shinas Castle	Batinah	Shinas
13	Daba Castle	Musandam	Daba
14	Barka Castle	Musandam	Barka
15	Others (under compiling)		

APPENDIX 5-5

HISTORICAL HERITAGE BELONG TO THE MINISTRY OF COMMERCE AND INDUSTRY

APPENDIX 5-5

**HISTORICAL HERITAGE BELONGING TO
THE MINISTRY OF COMMERCE AND INDUSTRY**

No.	Location	Region	Willayat
1	Nizwa Fort	Dakhlyah	Nizwa
2	Jabrin Castle	Dakhlyah	Jabrin
3	Bayt ar Ridaydah	Dakhlyah	Nizwa
4	Ar Rustaq Fort	Batinah	Rustaq
5	Al Hazm Castle	Batinah	Rustaq
6	Nakhal Fort	Batinah	Nakhal
7	Bayt an Naman	Batinah	Barka
8	Barka Castle	Batinah	Barka
9	As Suwayq Castle	Batinah	Suwayq
10	Al Mintzrib Castle	Ash Sharqiyah	Mintarib
11	Sunaysilah Castle	Ash Sharqiyah	Sur
12	Bilad Sur Castle	Ash Sharqiyah	Sur
13	Ras al Hadd Castle	Ash Sharqiyah	Ras al Hadd
14	Jaalan Bani Bu Hasan Castle	Ash Sharqiyah	Jaalan Bani Bu Hasan
15	Al Hillah Castle	Al Dhairah	Buraimi
16	Al Khandaq Castle	Al Dhairah	Buraimi
17	Ibri Castle	Al Dhairah	Ibri
18	Qurqyyat Castle	Muscat	Qurqyyat
19	Khasab Castle	Musandam	Khasab
20	Taqah Castle	Dhofar	Salalah
21	Mirbat Castle	Dhofar	Mitbat
22	Sadah Castle	Dhofar	Sadah

APPENDIX 7-1

TRAFFIC SURVEYS AND ANALYSIS

TRAFFIC SURVEY AND ANALYSIS

A7.1 SURVEY PLANNING

A7.1.1 Objectives of Traffic Survey

Traffic surveys provided information on the present traffic characteristics and trip patterns. The main objective of the surveys is to establish the present Origin-Destination (OD) tables, which is the base of estimating the future transport demand on the road network. Because in this Study, the maximum entropy method¹ is applied to establish OD tables, surveys are focused to get volumes of traffic crossing borders among different zones.

1.1.2 Roadside Interview OD Survey

1) Purpose

The purposes of this survey are as follows:

- i. To prepare the present OD tables
- ii. To forecast the future OD tables
- iii. To estimate the future traffic volume on the road network

OD tables are estimated based on crossing border traffic, but data such as the number of passengers on board in average by each vehicle type, and commodity type and its loading by type of truck/trailer are necessary for establishing passenger OD and commodity OD. Interviews are focused on collecting these kinds of information. The number of survey stations is based on data required at critical links of the road network which can cover trips necessary for the establishment of OD tables.

OD information at the UAE borders is essential because the Sultanate has enclaves and crossing border traffic between the Sultanate proper and enclaves, can be obtained only through OD stations near to the border.

¹ The Maximum entropy model is OD table estimation model, which utilize the available link traffic volumes and collected initial OD table information for estimating the current trip OD table. A maximum entropy model attempts to cover maximum degree of disorder or random exchange between zones to define a trip OD table.

2) Survey items

Drivers of the following 8 types of vehicles were interviewed during the OD survey.

- Passenger car
- Taxi
- 4WD
- Bus
- Light Truck (pickup, van)
- Heavy Truck
- Trailer
- Oil Tanker

In the addition to the typical information of each survey station, the following data were obtained:

- Vehicle type
- Number of passengers
- Origin and destination
- For trucks: Commodity type and volume
- Trip purpose

3) Procedure

The survey forms for recording data in the field are shown in figure A7.1-1. Forms were designed in a simple pattern to be easily understood and filled with coding areas to ease data processing.

The survey was carried out, with the attendance of Royal Oman Police (ROP), in the two directions of traffic for twelve hours (6 am – 6 pm). The survey was conducted on weekdays, and for one week starting from March 6, 2004. Survey teams used portable traffic signs and cones for the traffic control and safety purposes.

ROADSIDE INTERVIEW OD SURVEY FORMAT

Sheet No.: _____ of _____

Station No.: _____

Road : _____

Region / Governorate : _____

Wilayat : _____

Interviewer : _____

Date : _____

Hour : _____ : _____

Direction / From : _____

To : _____

I. Vehicle Type <input type="checkbox"/> 1. Private Cars <input type="checkbox"/> 2. Taxi <input type="checkbox"/> 3. 4WD <input type="checkbox"/> 4. Bus <input type="checkbox"/> 5. Pick-up, Van	<input type="checkbox"/> 6. Medium and Large Truck <input type="checkbox"/> 7. Trailer <input type="checkbox"/> 8. Oil Tanker <input type="checkbox"/> 9. etc.
II. Number plate (4digit) <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> 	
III. Origin Wilayat / Town : _____ Region / Governorate : _____ Country : _____ <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> 	
IV. Destination Wilayat / Town : _____ Region / Governorate : _____ Country : _____ <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> 	
V. Trip Purpose <input type="checkbox"/> 1. To Work <input type="checkbox"/> 3. Business <input type="checkbox"/> 5. To Home <input type="checkbox"/> 7. Others <input type="checkbox"/> 2. Education <input type="checkbox"/> 4. Shopping <input type="checkbox"/> 6. Social	
VI. Number of Persons (including Driver) Person (s) : _____ <input type="text"/> <input type="text"/> 	
VII. Commodity Type(I) <input type="checkbox"/> 1. Agri, Animal, ... <input type="checkbox"/> 2. Mine, Cement, ... <input type="checkbox"/> 3. Etc., ...	
VIII. Commodity Type(II) _____ (describe more detail) <input type="text"/> <input type="text"/> 	
IX. Commodity Weight (Net) Weight : _____ kg <input type="text"/> <input type="text"/> 	

Note : Comodity type(I)

1. --- Live animals, Animal Products, Vegetable products, Animal or vegetable fats & oil and Prepared foodstuff
2. --- Mineral products, Cement, Plaster, Ceramic products and Base metals
3. --- Chemical products, Plastic & rubbers, Wood & Wood products, Pulp & Papers Textile, Machiner, Electric equipment
 Manufactural & miscellaneous and Vehicles

Figure A7.1-1 Roadside Interview OD Survey Format



Driver Interview



Road OD Survey Station

The target number of samples was estimated for each survey station according to the Average Daily Traffic (ADT) in 2002. The following simplified formula was used for high sampling rates with low ADT and low rates with high ADT. The formula is derived from the methodology of the Department of Transport in the United Kingdom and provides $\pm 5\%$ accuracy rate.

$$\text{Target Sample Rate} = \{ADT / (0.0003 ADT + 1)\} / ADT$$

Based on the above formula, the target sample rate for the survey stations can be generalized as follows:

<u>ADT Range</u>	<u>Target Sample Rate</u>
- 1,500	75%
1,501 - 5,000	45%
5,001 - 20,000	20%
20,001 -	10%

7.1.3 Traffic Count Survey

1) Purpose

The purposes of this survey are as follows:

- i. To adjust the present OD table by traffic volume at crossing borders between different zones.
- ii. To estimate conversion rate (24h/12h rate) to be used in expanding the OD data collected for 12-hours sampling base to 24-hours OD table.
- iii. To investigate the traffic conditions and characteristics on the present nationwide road network.

2) Procedure

The survey is carried out at same OD stations for twenty four hours (6 am to 6 am) and at other 38 stations for twelve hours (6 am to 6 pm). Manual counters are used to record the number of vehicles for each vehicle category separately for each direction on hourly basis. Categories of vehicles are as follows:

- Passenger car
- Taxi
- 4WD
- Bus
- Light Truck (pickup, van)
- Heavy Truck
- Trailer
- Oil Tanker

3) DGR Traffic Data

Though DGR carries out traffic counts every year, survey of the last year (2003) was interrupted because of the shortage of budget. Even so, the data of traffic counts in 2002 provided many findings that were utilized in the preparation of the survey plan.

As mentioned in A7.1.2, crossing border traffic counts are vital information for establishing OD tables. Actually it is necessary to count traffic at all crossing borders of zones. As the survey did not cover all crossing borders, some of DGR traffic count data was utilized as supplementary data after adjusting the expected growth of traffic from 2002 (the year of the latest DGR traffic counts) to 2004.

A7.1.4 Travel Speed Survey

1) Purpose

The purpose of this survey is to get basic data to estimate the travel time for each designated link in the road network.

2) Procedure

The survey is carried out by two teams for 12 days during February 2004 using the floating car method. Under this method, reference points (mainly intersections and roundabouts) with some kilometers intervals within the route are established beforehand. The survey is conducted by a survey vehicle traveling at the average speed of the traffic flow. The survey consists of three runs for each traffic direction. The collected data are as follows.

- Start and finish time and average speed for each direction
- Passing times between reference points
- Cause of slow-down and/or stoppage

A7.1.5 Survey Stations and Travel Speed Survey Routes

Figure A7.1-2 shows survey stations and travel speed survey routes.

A7.1.6 Survey Schedule

Survey schedule is shown in Table A7.1-1. Due to time limitations, survey was carried out in different locations in the same day.

Table A7.1-1 Traffic Survey Schedule

Survey	Stations/Routes	Survey Periods
12 hrs OD Roadside Interview Survey	7 stations	From 6 am to 6 pm. Mar/6/2004 - Mar/13/2004 (Weekday Sat.-Wed.)
24 hrs Traffic Count Survey	7 stations	From 6 am to 6 am. Mar/6/2004 - Mar/13/2004 (Weekday Sat.-Wed.)
12 hrs Traffic Count Survey	38 stations	From 6 am to 6 pm. Feb/9/2004 - Mar/10/2004 (Weekday Sat.-Wed.)
Travel Speed Survey	12 routes	3 times (am, pm,& after sunset) per day Feb/16/2004 - Mar/1/2004 (Weekday Sat.-Wed.)

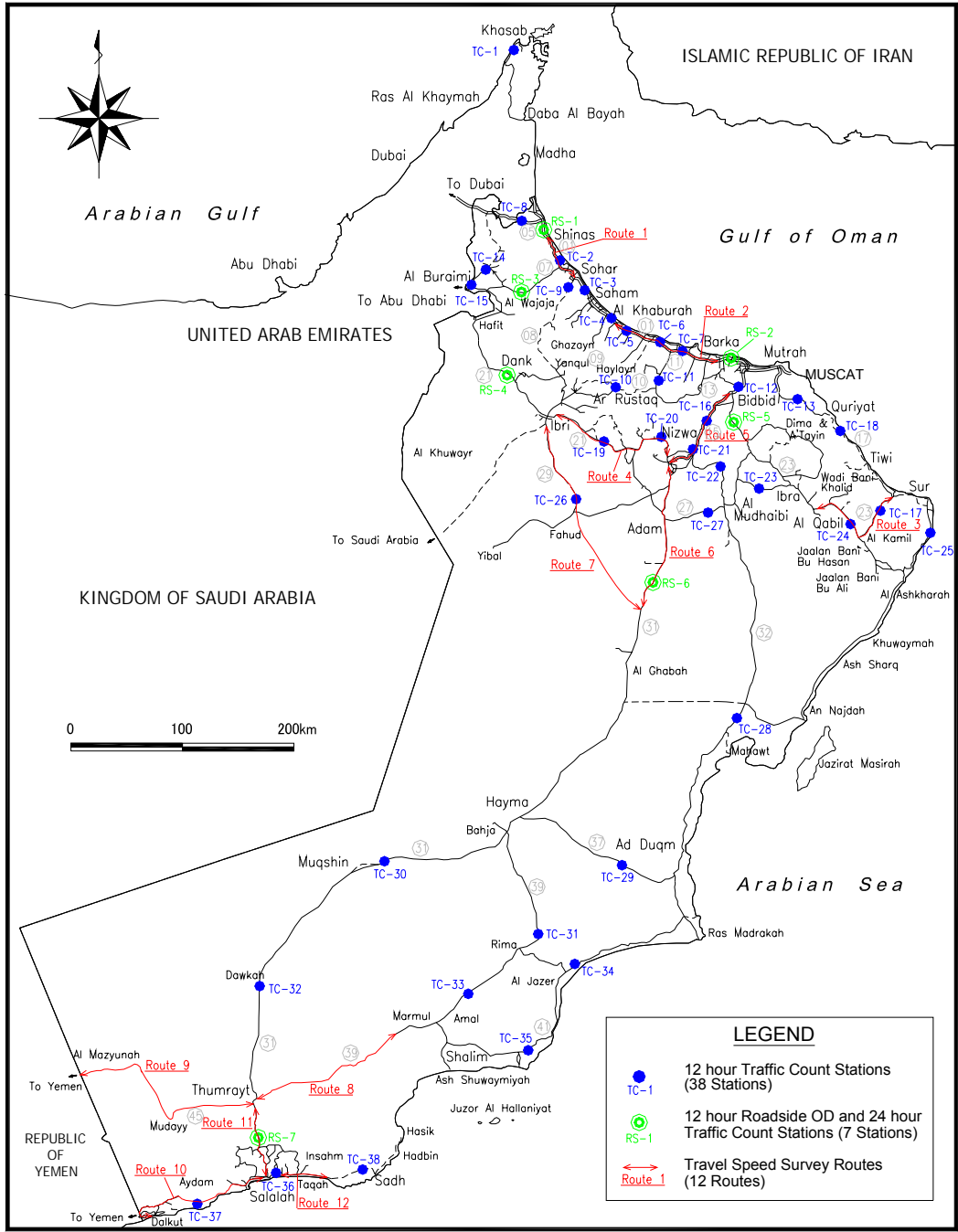


Figure A7.1-2 Traffic Survey Stations and Routes of Travel Speed Survey

A7.2 CHARACTERISTICS OF TRAFFIC

A7.2.1 Traffic by Vehicle Category

Traffic volumes by vehicle types along major roads are shown in Figure A7.2-1. The characteristics of the traffic for each road can be summarized as follows;

- Road No. 1 (Batinah Highway) runs in populated areas of Muscat Governorate and Batinah Region. The share of private car is relatively high (49% of all vehicular), reflecting the land use (commercial and residential area). Small share of bus (1%), also, is noted. It is supposed that shared taxi (15%) takes over the position of bus as the predominant public transportation mode.
- Road No. 31 (Nizwa-Thumrayt Road) connects Muscat and Salalah. It runs 1,000 km across the desert. The share of private car is smaller (9%), but the share of heavy truck and trailer is larger (10%) than the average of all roads (private car: 23% truck and trailer: 5% to 30%, respectively).
- Roads No. 5, 7, and 15 are connected with Road No. 1. Road No. 5 extends to the UAE border while Roads No. 7 and 15 connect medium-sized cities located in the southern side of Road No. 1. They have composition of vehicular types similar to that of Road No.1. Difference is the larger share of 4WD (10 to 11% compared with the average of 7%) and light truck (19% compared with average of 14%).
- Roads No. 21 and 23 are running along the southern side of the mountain range of Gharbi and Sharqi connecting medium-sized cities located there. The traffics on these roads show the mixture of characteristics of trunk road in urbanized area, such as Road No. 1, and trunk road in rural area, such as Road No. 31.

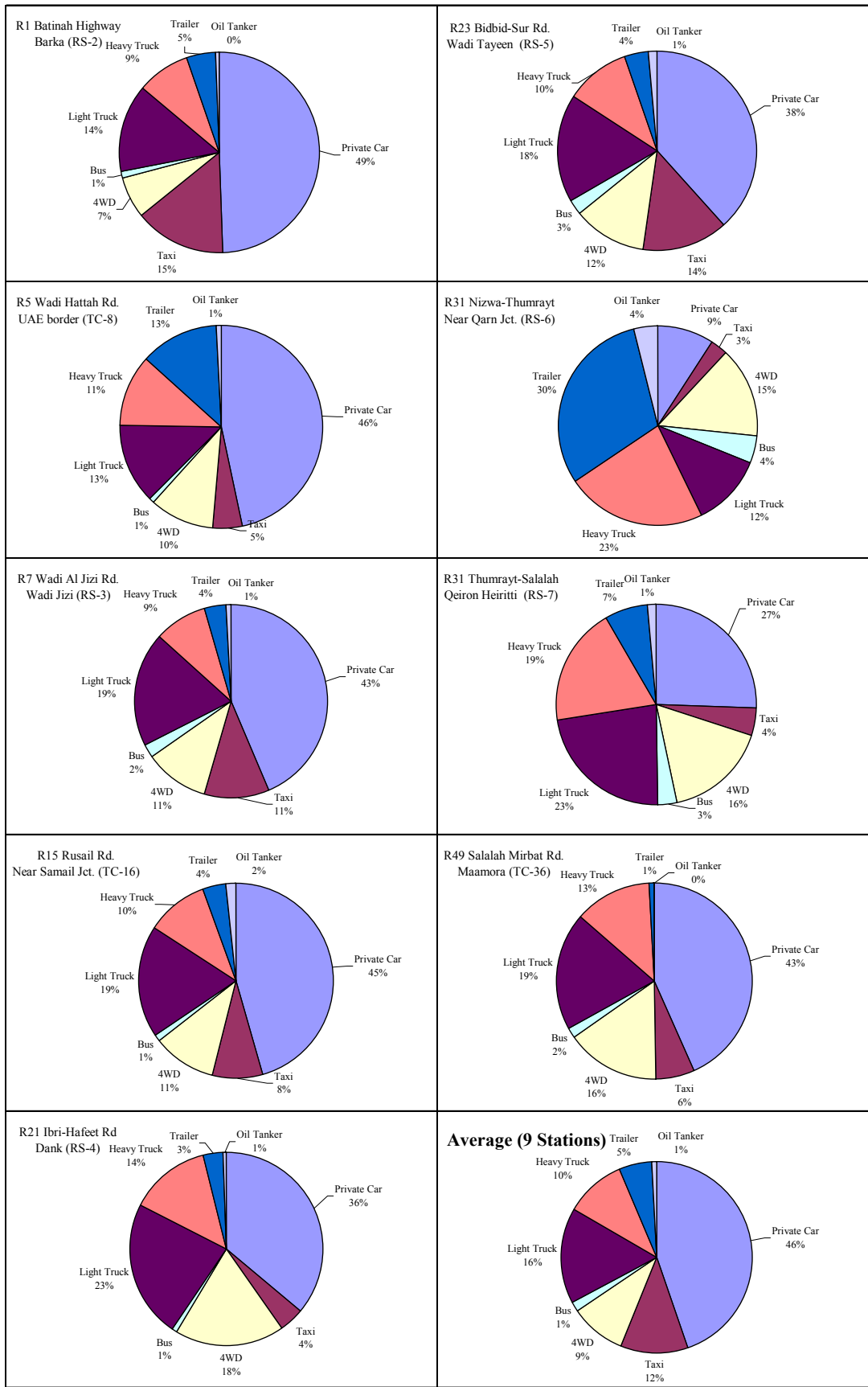


Figure A7.2-1 Traffic Composition by Road

A7.2.2 Hourly Traffic Volume

Hourly traffic volumes along major roads are shown in Figure A7.2-2. The characteristics of the hourly traffic for each road can be summarized as follows;

- Roads are used in a relatively constant manner from 7 am to 10 pm. Table A7.2-1 shows ratio of (24-hr traffic volume) / (12-hr traffic volume). Because of relatively high usage of roads between 6 pm and 10 pm, ratios of (24-hr traffic volume) / (12-hr traffic volume) show relatively high value and average at 1.54. The differences of the 24-hr / 12-hr ratios among types of vehicles are smaller than those among roads. Considering this, 24-hr / 12-hr ratio of 1.54 is applied to all types of vehicles.
- Traffic observed at Station RS-2 on Road No. 1 (Batinah Highway), located about 80 km away from Muscat, shows the characteristics of commuting traffic. Peak hour traffic in Muscat direction is seen from 6 am to 8 am.
- Peak hour traffic on Road No. 23 (Bidbid - Sur Road) shows similar pattern to those described above. The traffic volume during morning peak hours between 7 am and 9 am towards Muscat is 243 veh/h and that during evening peak hours of 2 pm - 6 pm to Sur is 240 veh/h.
- Traffic volume on Road No. 31 (RS-6) is low but persistent.

Table A7.2-1 Conversion Rate (24h/12h rate)

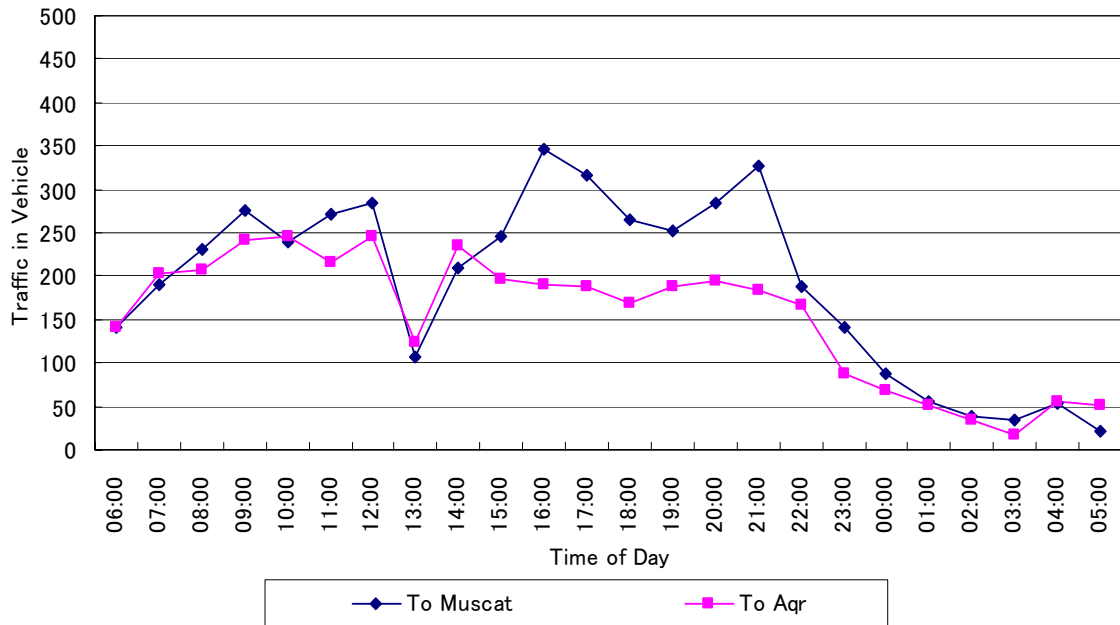
Station No.	Passenger Car		Bus		Truck		Weighted Mean
	Conv. R	Veh. No	Conv. R	Veh. No	Conv. R	Veh. No	
RS1	1.57	5,035	1.15	118	1.59	3,148	1.57
RS2	1.54	16,871	1.49	266	1.46	6,706	1.52
RS3	1.80	3,117	1.55	101	1.79	1,557	1.79
RS4	1.35	1,294	1.78	16	1.53	893	1.43
RS5	1.44	3,456	1.79	136	1.36	1,798	1.42
RS6	1.78	255	1.68	42	1.59	659	1.64
RS7	1.35	848	1.34	59	1.48	915	1.41
Weighted Mean	1.55	30,876	1.50	738	1.52	15,676	1.54

Passenger Car: private car, taxi and 4WD

Truck: light truck, heavy truck trailer and oil tanker

R1 Batinah Highway (500m from Aqr R/A [RS-1])

Hourly Distribution of Daily Traffic



R1 Batinah Highway (Near Al Naseem R/A [RS-2])

Hourly Distribution of Daily Traffic

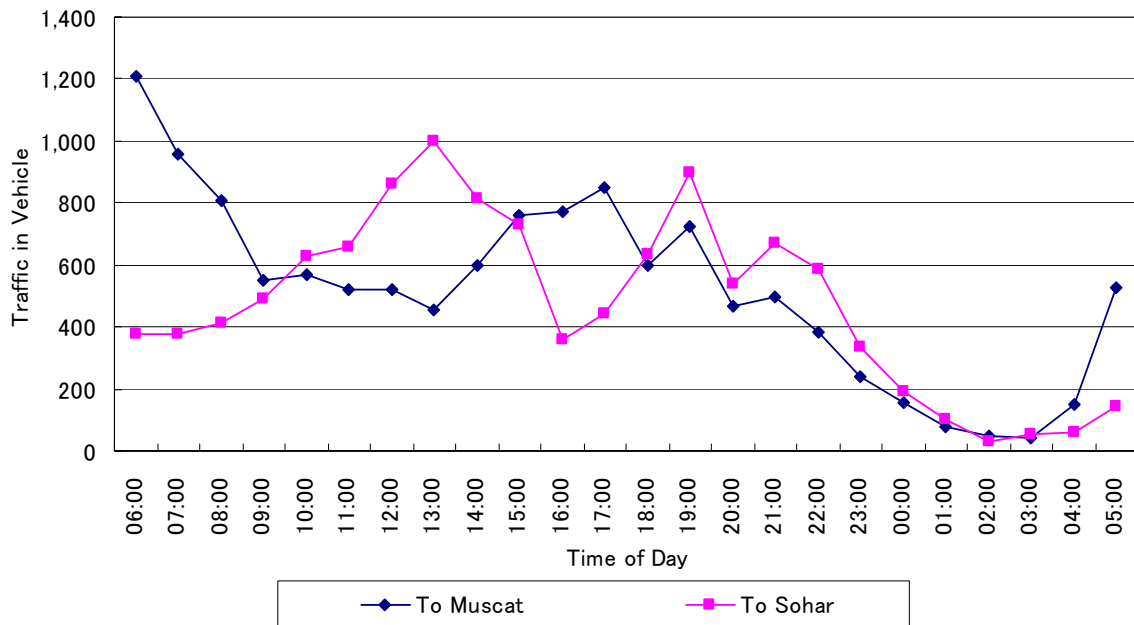
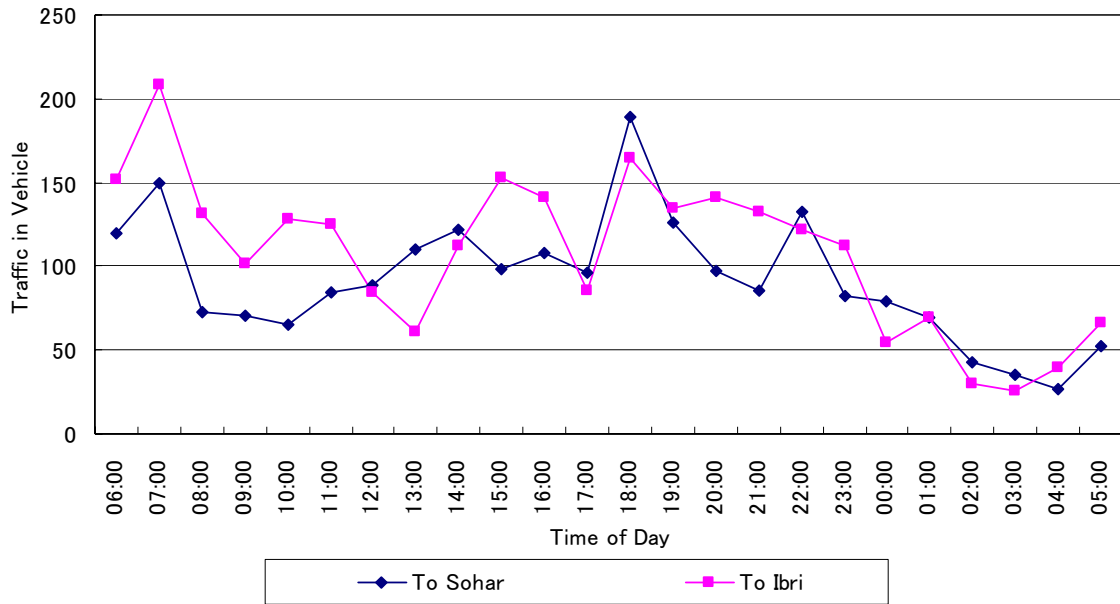


Figure A7.2-2(1) Hourly Traffic Volume along Major Roads

R7 Wadi Al Jizi Road (Wadi Jizi [RS-3])

Hourly Distribution of Daily Traffic



R21 Ibri-Hafet Road (5km before Dank Village [RS-4])

Hourly Distribution of Daily Traffic

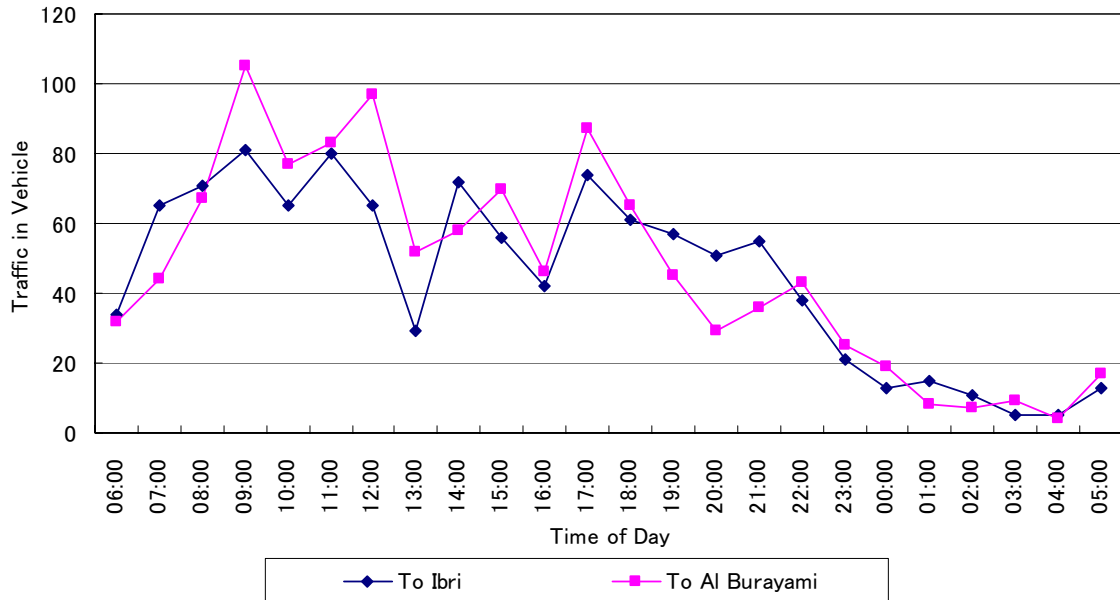
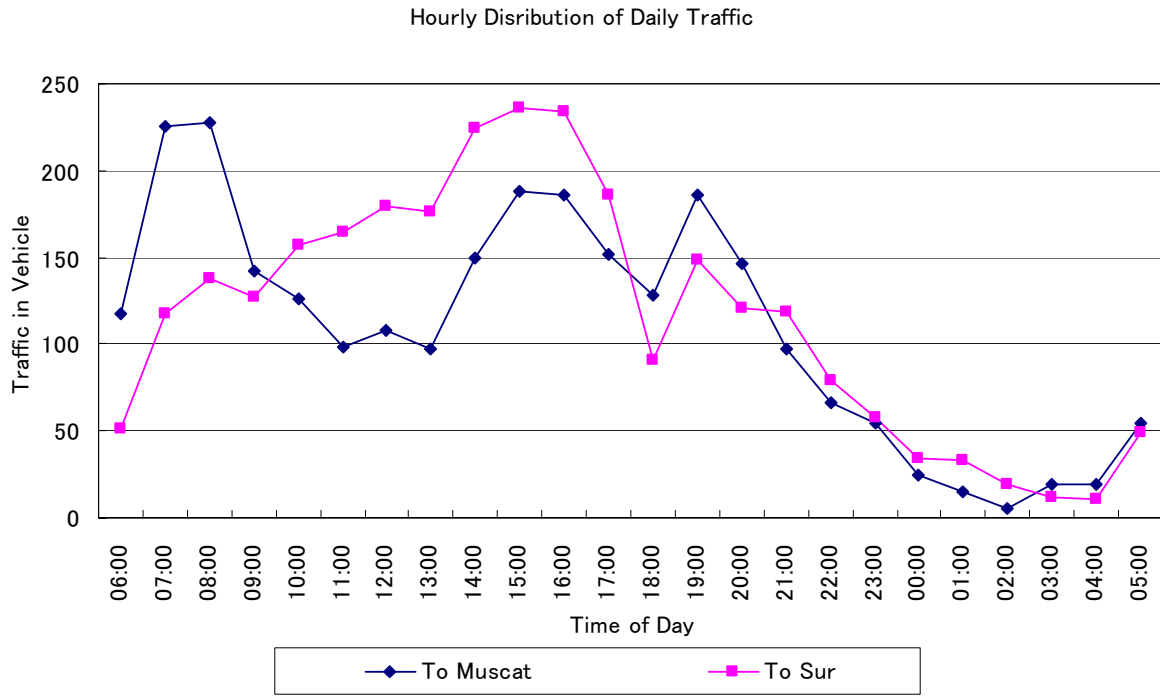


Figure A7.2-2(2) Hourly Traffic Volume along Major Roads

R23 Bidbid Sur Road (Wadi Tayeen Jct. [RS-5])



R31 Nizwa-Salalah Road (Near Qarn Jct. [RS-6])

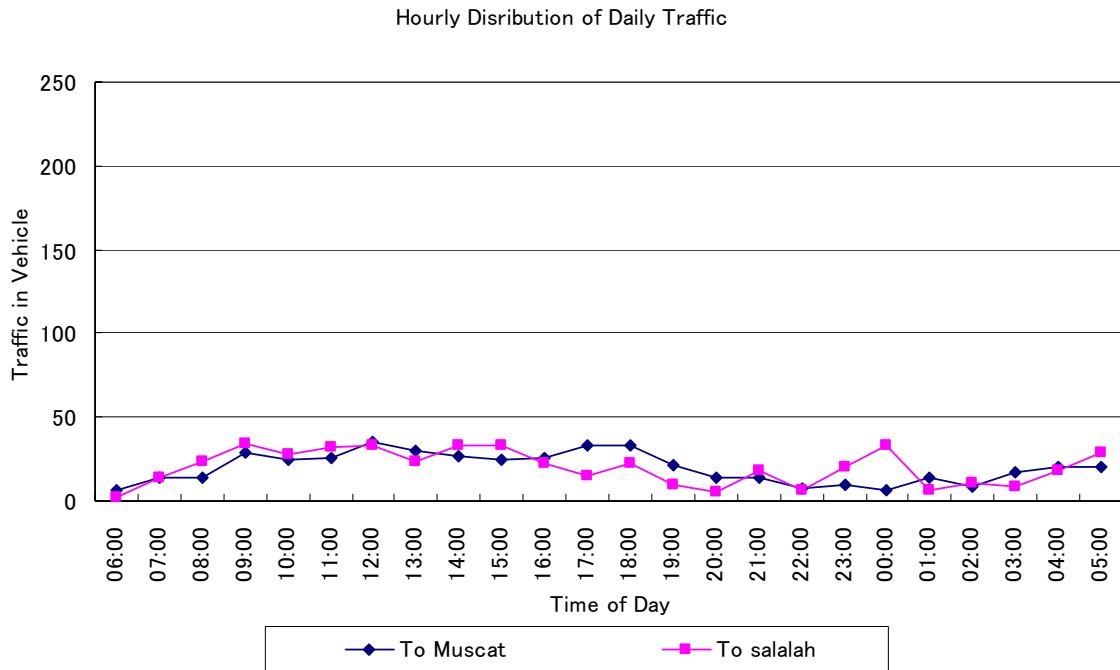
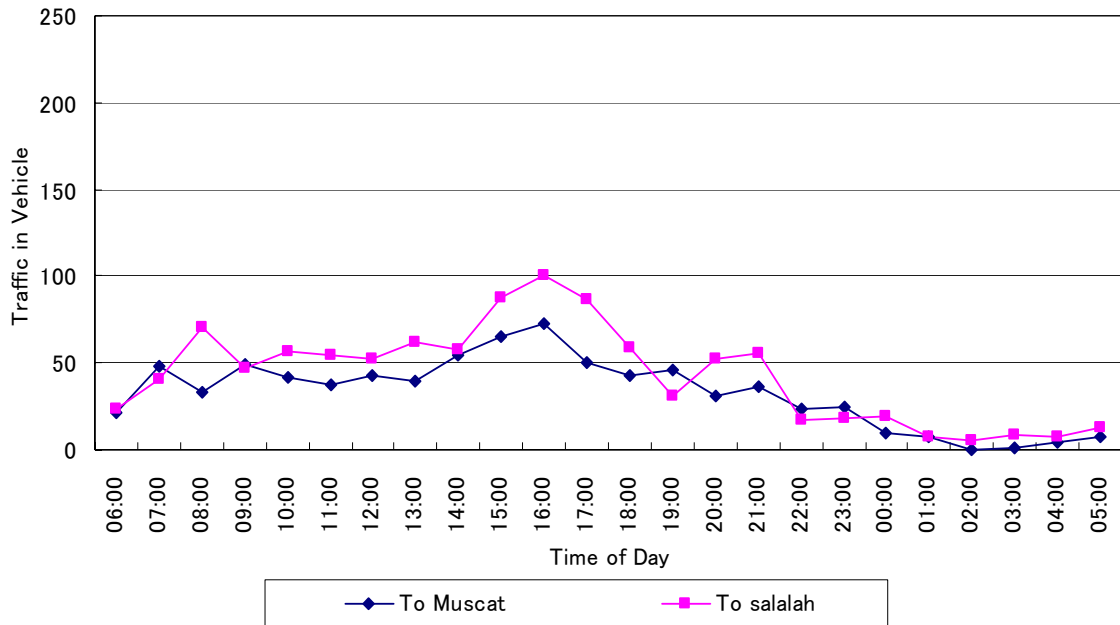


Figure A7.2-2(3) Hourly Traffic Volume along Major Roads

Hourly Disribution of Daily Traffic



R31 Salalah – Thumrayt Road (500m after Qeiroon Heiritti Jct. [RS-7])

Figure A7.2-2(4) Hourly Traffic Volume along Major Roads

A7.2.3 Average Number of Passengers by Vehicle Category

Vehicle OD is linked to passenger OD through the vehicle occupancy (the average number of passenger on board) by type of vehicles. Table A7.2-2 shows the average number of passenger on board by type of vehicles. The characteristics of vehicle occupancy for each road that can be concluded from the table are:

- There was no distinct difference in the average number of passenger by road excluding those of buses.
- Average number of passenger of bus on Road No. 1 (Batinah Highway) was lower than those of other roads because many minibuses are operated on Road No. 1 which traverses conurbation area.

Table A7.2-2 Average Number of Passengers by Vehicle Category and by Road
(Person/vehicle, including Driver)

Road No. & Location (Station no.)	Private Car	Taxi	4WD	Bus	Light Truck	Heavy Truck	Trailer	Oil Tanker
R1 Batinah Highway Arq R/A (RS-1)	1.9	2.4	1.9	5.0	3.1	1.4	1.1	1.0
R1 Batinah Highway Barka (RS-2)	1.9	3.3	1.7	5.3	3.4	1.8	1.3	1.1
R7 Wadi Al Jizi Rd. Wadi Jizi (RS-3)	2.1	2.9	2.0	23.0	2.3	1.7	1.0	1.0
R21 Ibri-Hafeet Rd. Dank (RS-4)	2.2	2.9	2.5	10.8	2.3	1.5	1.3	2.0
R23 Bidbid-Sur Rd. Wadi Tayeen (RS-5)	2.3	3.1	2.4	9.0	2.6	1.8	1.6	1.1
R31 Nizwa-Thumayat Near Qarn Jct. (RS-6)	2.2	1.7	2.3	11.1	2.0	1.4	1.3	1.3
R31 Thumayat-Salalah Qeiron Heiritti (RS-7)	2.4	3.0	2.5	19.4	2.7	1.7	1.3	1.1
Average	2.0	3.1	2.2	12.3	2.6	1.6	1.2	1.2

As for the data of average number of passengers per vehicle for roads in the Sultanate, there are two other sources, namely, the report of JICA Study, 1995 and the report of New Batinah Expressway F/S, 1997. The data of average number of passengers per vehicle presented in these reports are summarized in Table A7.2-3. The Study for Highway User Cost, 1998 (HUC 1998 by DGR) did not carry out occupancy survey but used these information.

Table A7.2-3 Occupancy Presented in the Reports of Other Studies

Vehicle Type	JICA 1995	New Batinah F/S 1997	JICA 2004	
	(person/veh)	(person/veh)	(person/veh)	No. Observed
Private Car	1.94	2.40	2.0	2,719
Light Truck (Pickup, Van)	3.50	2.10	2.6	477
4WD	1.94	2.10	2.2	451
Heavy Truck	-	-	1.6	734
Bus	21.0	-	12.3	58

A7.2.4 Traffic by Type of Commodity

Based on statistics of commodities in the Sultanate, three representative commodity items were selected in this study. They are Food Products, Ores and Construction Materials, and Industrial Products. Others commodities not included in the first two categories are considered to be included in the third category. Because seasonal fluctuation is anticipated especially for food products, the survey results were adjusted by applying yearly production/ consumption. The main features of the results, which are summarized in Table A7.2-4, are as follows.

- On average, the volume of ‘Ores and Construction Materials’ and ‘Industrial Products and Others’ are almost the same (38.7 – 39.8%) while share of ‘Food Products’ is smaller than them at 21.5%.
- Commodity volume observed at Aqr R/A (RS-1) which is located near UAE border is large (17,000 ton/day) though traffic volume there is only 8,300 veh/day. Compared with this, the commodity volume observed at RS-2 is 22,000 ton/day and the traffic volume is 22,300 veh/day. These commodities are mainly from/to Dubai and are transported by heavy trucks.
- Road No. 23, which connects Bidbid and Sur, caters relatively high commodity volume for all items.
- Though traffic volume on Road No. 31 is low, commodity volumes of ‘Ores and Construction Materials’ and ‘Industrial Products and Others’ are more than 1,000 ton/day. Road No. 31 has the role of connecting not only north and south areas but also center dessert area. Water, ores, a portion of petrol and gas (petrol and gas are mostly transported by pipeline) are transported from/to central areas by trucks according to the OD interview survey result.
- In conclusion, these roads have important role for commodity transportation.

Table A7.2-4 Traffic by Commodity Type and by Road (ton/day)

Road No. & Location (Station no.)	Food Products	Ores and Construction Materials	Industrial Products and Others
R1 Batinah Highway Arq R/A (RS-1)	3,624	7,126	6,307
R1 Batinah Highway Barka (RS-2)	4,560	7,856	9,687
R7 Wadi Al Jizi Rd. Wadi Jizi (RS-3)	1,021	2,275	385
R21 Ibri-Hafeet Rd Dank (RS-4)	480	64	1,131
R23 Bidbid-Sur Rd. Wadi Teyeen (RS-5)	2,234	5,004	4,150
R31 Nizwa-Thumayyat Near Qarn Jct. (RS-6)	576	1,633	1,190
R31 Thumayyat-Salalah Qeiron Heiritti (RS-7)	1,093	1,144	1,558
Average	1,941	3,586	3,487
Share %	21.5%	39.8%	38.7%

A7.2.5 Average Load by Type of Truck

Vehicle OD is linked to commodity OD through the average load by type of truck. Table A7.2-5 shows the average load by type of truck. The followings can be said from the table:

- The average load of ‘Light Truck’ is 0.8 tons, while that of ‘Heavy Truck’ is 6.2 tons, that of ‘Trailer’ is 24.4 tons and that of ‘Oil Tanker’ is 26.9 tons.
- ‘Food Products’ are transported by light truck, heavy truck and trailer with large portion transported by ‘Trailer’.

- ‘Ores and Construction Materials’ and ‘Industrial Products and Others’ are mainly transported by heavy truck and trailer. Considerable volume of oil tanker traffic is observed on Road No. 31 which connects Muscat and Salalah across the desert.

Table A7.2-5 Average Load by Type of Truck and by Road

(Unit: tons/truck; Empty trucks are not included)

	Light Truck		Heavy Truck		Trailer		Oil Tanker	
	Average Loading	No. of Vehicles	Average Loading	No. of Vehicles	Average Loading	No. of Vehicles	Average Loading	No. of Vehicles
1. Food Products								
R1 Batinah Highway Arq R/A (RS-1)	0.5	2	4.7	25	22.8	12		
R1 Batinah Highway Barka (RS-2)			4.8	25	50.0	1		
R7 Wadi Al Jizi Rd. Wadi Jizi (RS-3)	1	3	2.6	5	4.0	1		
R21 Ibri-Hafeet Rd Dank (RS-4)	0.6	2	2.4	7	40.0	1		
R23 Bidbid-Sur Rd. Wadi Tayeen (RS-5)	1.5	3	2.7	5	1.2	1		
R31 Nizwa-Thumayat Near Qarn Jct. (RS-6)	2.5	1	5.9	13	24.8	7		
R31 Thumayat-Salalah Qeiron Heiritti (RS-7)	0.9	4	5.9	27	22.5	11		
Average	1.1	15	4.8	107	23.2	34		
2. Ores and Construction Materials								
R1 Batinah Highway Arq R/A (RS-1)			21.8	6	31.8	24		
R1 Batinah Highway Barka (RS-2)			4.9	12	26.5	6		
R7 Wadi Al Jizi Rd. Wadi Jizi (RS-3)			27.0	2	41.7	3		
R21 Ibri-Hafeet Rd Dank (RS-4)					2.0	1		
R23 Bidbid-Sur Rd. Wadi Tayeen (RS-5)			10.7	5	29.3	7		
R31 Nizwa-Thumayat Near Qarn Jct. (RS-6)			6.7	7	23.8	19	30.0	1
R31 Thumayat-Salalah Qeiron Heiritti (RS-7)			2.0	8	26.7	8		
Average			8.8	40	28.2	68	30.0	1
3. Industrial Products and Others								
R1 Batinah Highway Arq R/A (RS-1)			7.1	18	24.7	22		
R1 Batinah Highway Barka (RS-2)			4.7	27	19.1	5		
R7 Wadi Al Jizi Rd. Wadi Jizi (RS-3)			13.0	2				
R21 Ibri-Hafeet Rd Dank (RS-4)	0.4	4	2.1	11			50	1
R23 Bidbid-Sur Rd. Wadi Tayeen (RS-5)			22.0	4	31.0	3		
R31 Nizwa-Thumayat Near Qarn Jct. (RS-6)			12.9	8	19.7	11	26.4	6
R31 Thumayat-Salalah Qeiron Heiritti (RS-7)	0.5	3	4.1	14	17.3	24	23.1	6
Average	0.5	7	6.6	84	21.0	65	26.7	13
Average(1+2+3)	0.8	22	6.2	231	24.4	167	26.9	14

A7.3 TRAFFIC VOLUME

A7.3.1 Total Traffic Volume on Roads

Traffic flows of two categories of vehicles were prepared based on the data collected through the traffic count survey. Traffic counts were made for eight types of vehicles. Private car, taxi, 4WD and bus were combined as one group (passenger transportation mode) while light truck, heavy truck, trailer and oil tanker were combined as another group (commodity transportation mode). Traffic volume of all vehicles and for the two integrated groups are shown in Figures A7.3-1, A7.3-2 and A7.3-3, respectively. From these figures, the following results can be concluded:

- Road No. 1 (Batinah Highway) shows distinctively high traffic volume in comparison to other roads. The largest traffic volume of 23,800 veh/day, for both directions, on Road No. 1 was counted at Barka. It is observed that traffic volume on Road No. 1 generally decreases as the distance from Muscat increases.
- Road No. 15 between As Seeb and Bidbid also caters high traffic volume of 17,700 veh/day.
- Other roads with high traffic volumes are;

- Road No. 5 (Wadi Hattah Road)	3,300 veh/day,
- Road No. 7 (Wadi Al Jizi Road)	4,800 veh/day,
- Road No. 21(Ibri-Haffet Road)	2,200 ~ 6,100 veh/day,
- Road No. 23(Bidbid-Sur Road)	4,000 ~ 5,400 veh/day, and
- Road No. 49(Nizwa-Thumrayt Road)	800 ~ 4,400 veh/day.

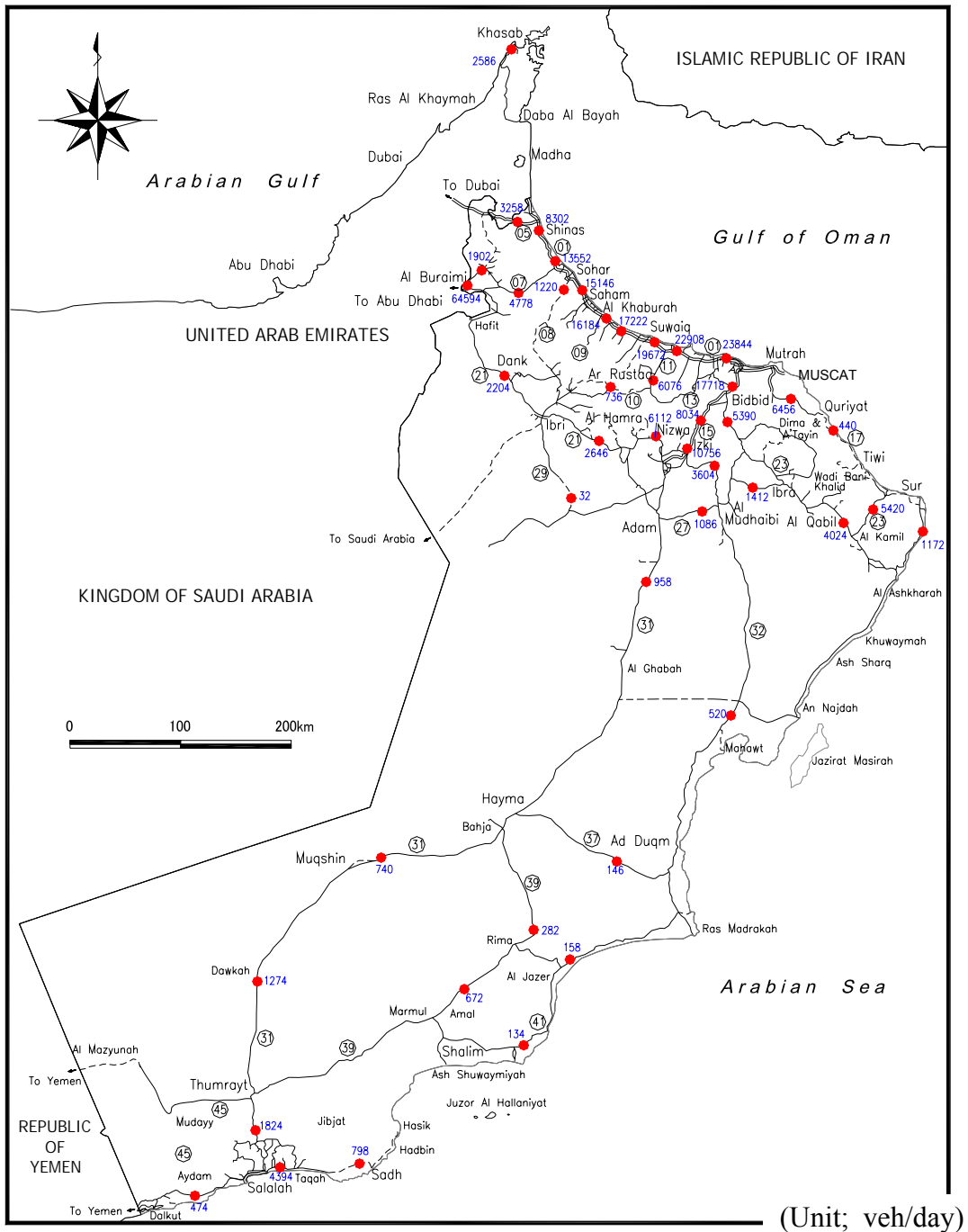


Figure A7.3-1 Traffic Volumes at Counting Stations (All Veh (Unit; veh/day)

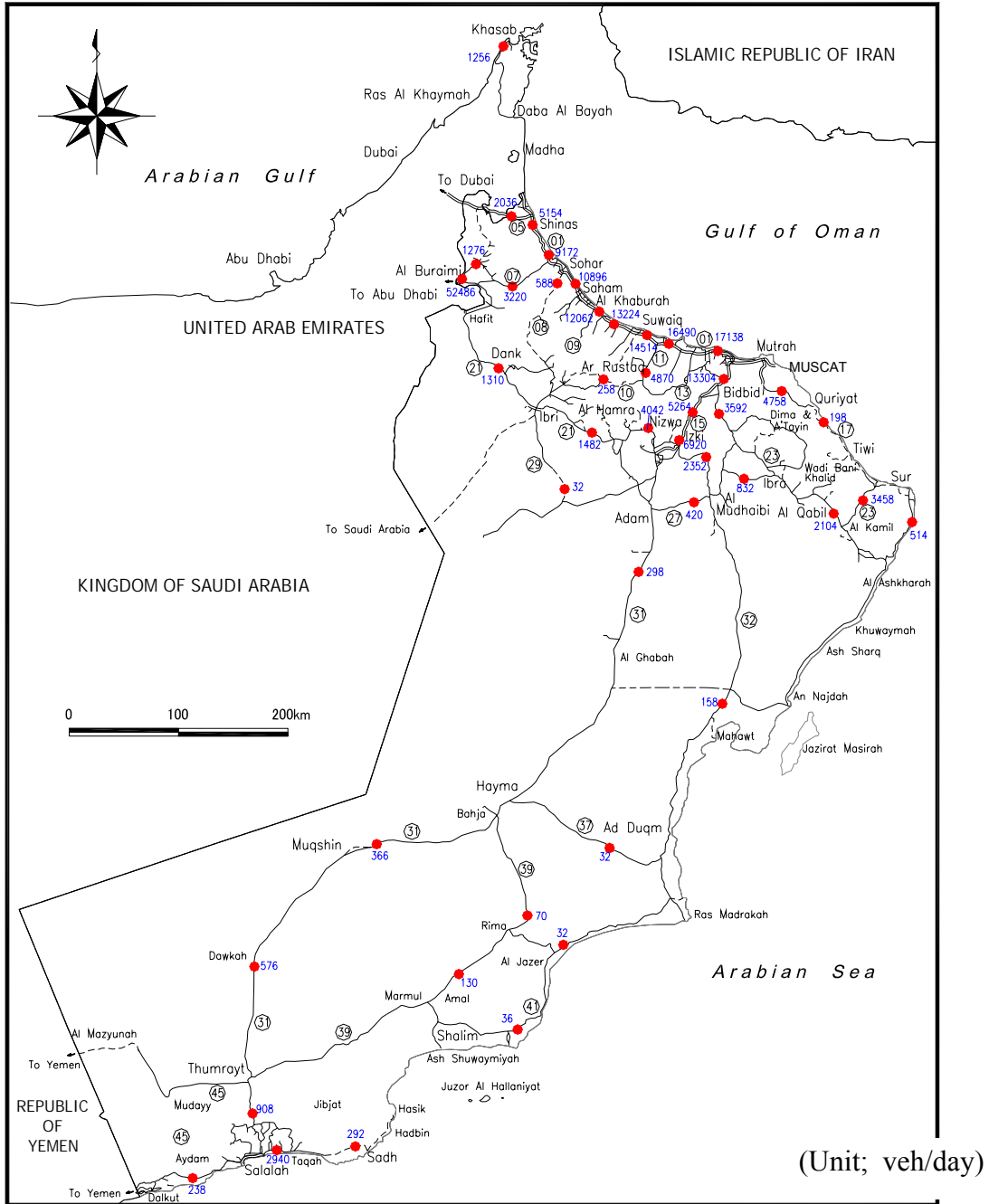


Figure A7.3-2 Traffic Volume of Passenger Vehicles

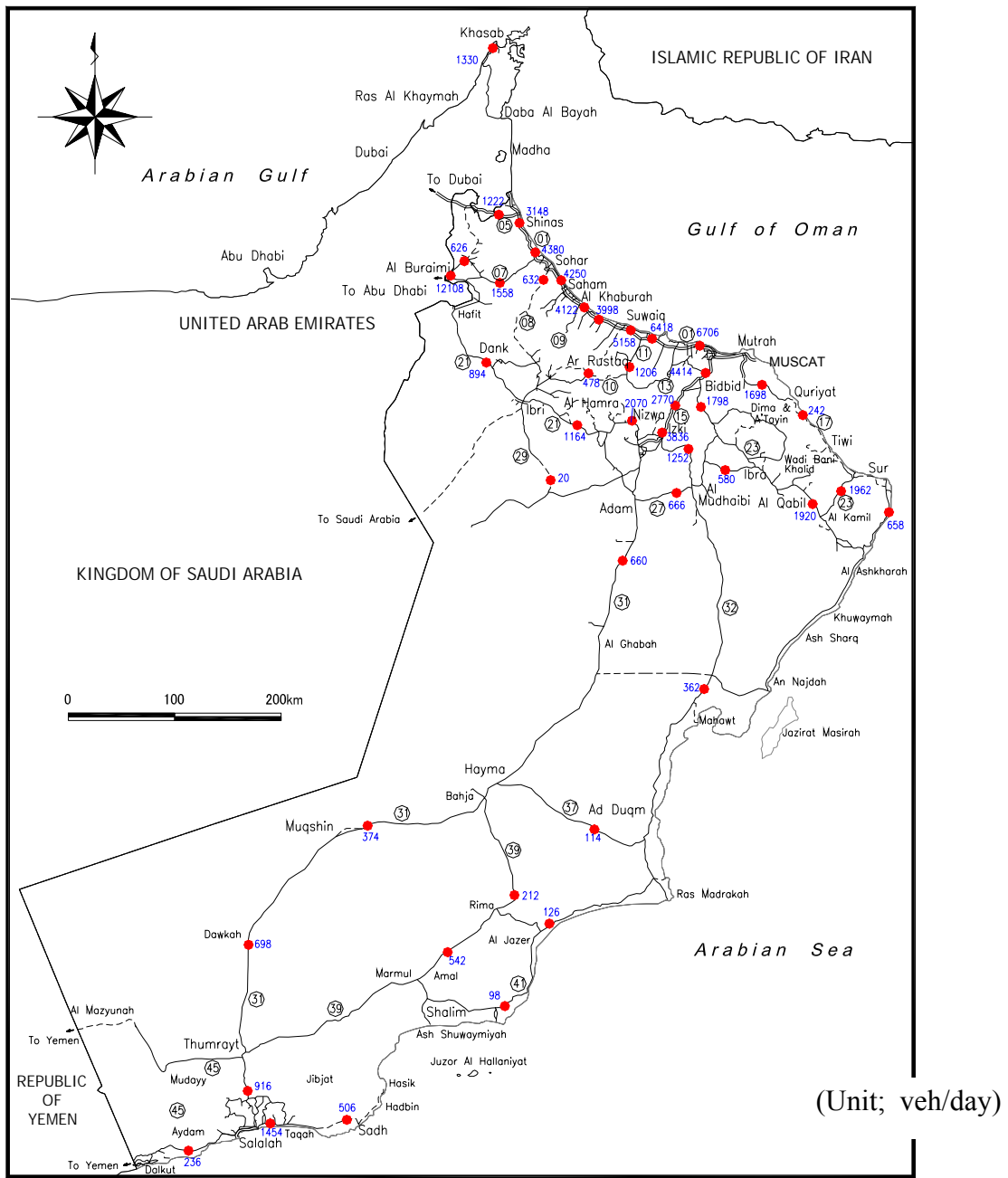


Figure A7.3-3 Traffic Volume of Commodity Vehicles

A7.4 TRAVEL SPEED SURVEY

The twelve routes, shown in Table A7.4-1 are selected to represent different types of roads. Travel speeds are measured on both directions during peak and off peak hours.

Table A7.4-1 Routes of Travel Speed Survey

Route No.	Road No.	From	Till	Km
1	1	Saham	Shinas	85
2	1	Barka	Al Khaburah	89
3	23	Al Ghabbi	Sur	108
4	21	Nizwa	Ibri	136
5	15	Bidbid	Nizwa	103
6	31	Nizwa	Quarat Al Milh	142
7	29	Ibri	Quarat Al Milh	217
8	39	Thumrayt	Marmul	154
9	45	Thumrayt	Al Mazyunah	181
10	47	Dalkut	Salalah	126
11	31	Thumrayt	Salalah	131
12	49	Salalah	Mirbat	65

Note: Figure A7.1-2 shows in travel speed survey routes.

A7.4.1 Travel Speed Survey Result

Average travel speeds on each route are presented in Table A7.4-2. Relatively high travel speeds of 75 km/h or higher were recorded on all routes, excluding route 9 (Thumrayt - Al Mazyunah), in the morning, afternoon and evening periods. Route 9 is partially under construction at present.

A7.4.2 Travel Speed and Congestion

Travel speeds during congested periods (peak hours) are shown in Figures A7.4-1 to A7.4-3.

- In general, all roads, excluding Izki – Nizwa section, provide environment for vehicles run at sufficient speed. On Izki – Nizwa section, some slow-down of the travel speed due to the congestion of traffic was observed near Nizwa city built-up area.
- Speeds lower than 60 km/h were observed at sections on route 8 (Thumrayt - Marmul) and route 9 (Thumrayt - Al Mazyunah) which are unpaved (under construction) and in bad condition.

Table A7.4-2 Results of Travel Speed Survey

Route No.	Start Point	End Point	Average Travel Speed (km/h)			
			morning	afternoon	evening	Average
1	Shinas	- Saham	103	112	108	108
	Saham	- Shinas	98	109	104	104
2	Al Khaburah	- Barka	89	102	93	95
	Barka	- Al Khaburah	82	90	93	88
3	Al Minystib	- Sur	100	105	105	103
	Sur	- Al Minystib	102	104	92	99
4	Nizwa	- Ibri	93	95	94	94
	Ibri	- Nizwa	102	96	99	99
5	Bidbid	- Nizwa	95	92	108	98
	Nizwa	- Bidbid	89	83	94	89
6	Nizwa	- Qarat Al Milh	92	96	88	92
	Qarat Al Milh	- Nizwa	93	96	99	96
7	Qarat Al Milh	- Ibri	80	78	82	80
	Ibri	- Qarat Al Milh	92	91	91	91
8	Thumarayt	- Marmul	77	80	79	79
	Marmul	- Thumarayt	80	80	79	80
9	Thumarayt	- Al Mazynah	57	56	56	56
	Al Mazynah	- Thumarayt	63	62	62	62
10	Salalah	- Dalkut	81	91	85	86
	Dalkut	- Salalah	91	77	85	84
11	Thumarayt	- Salalah	78	87	83	83
	Salalah	- Thumarayt	80	91	85	85
12	Mirbat	- Salalah	90	96	92	93
	Salalah	- Mirbat	84	91	88	88

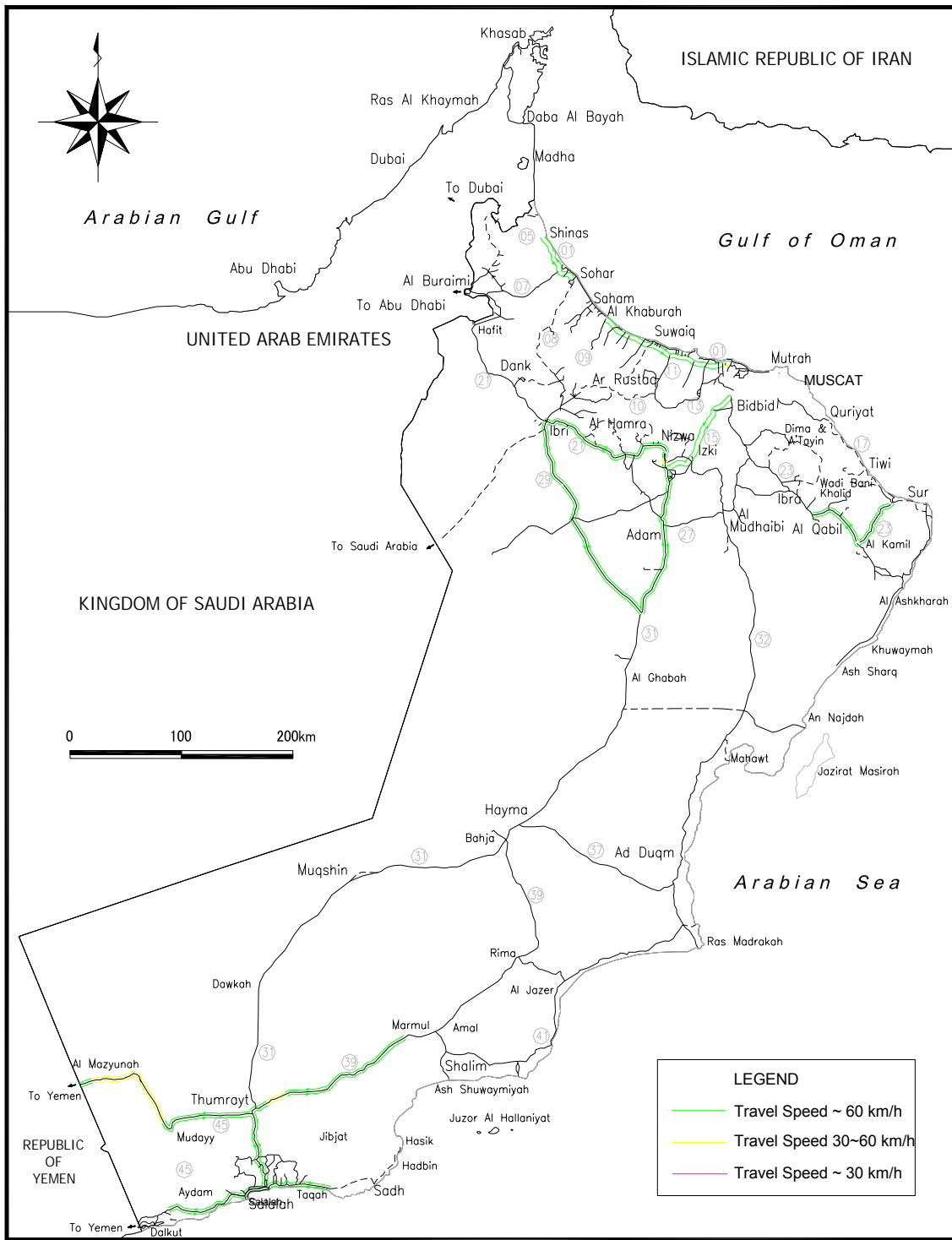


Figure A7.4-1 Travel Speed and Congestion (morning)

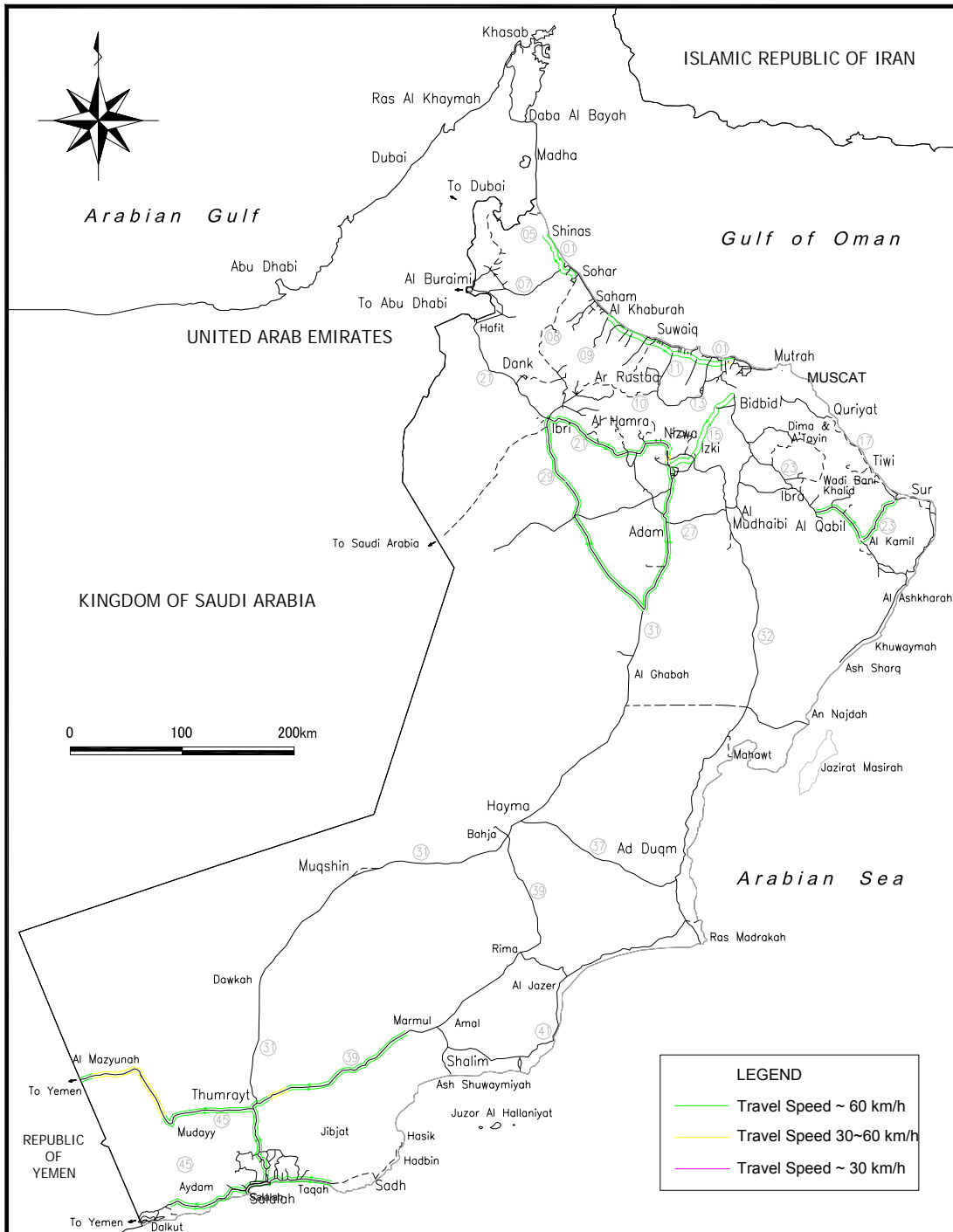


Figure A7.4-2 Travel Speed and Congestion (afternoon)

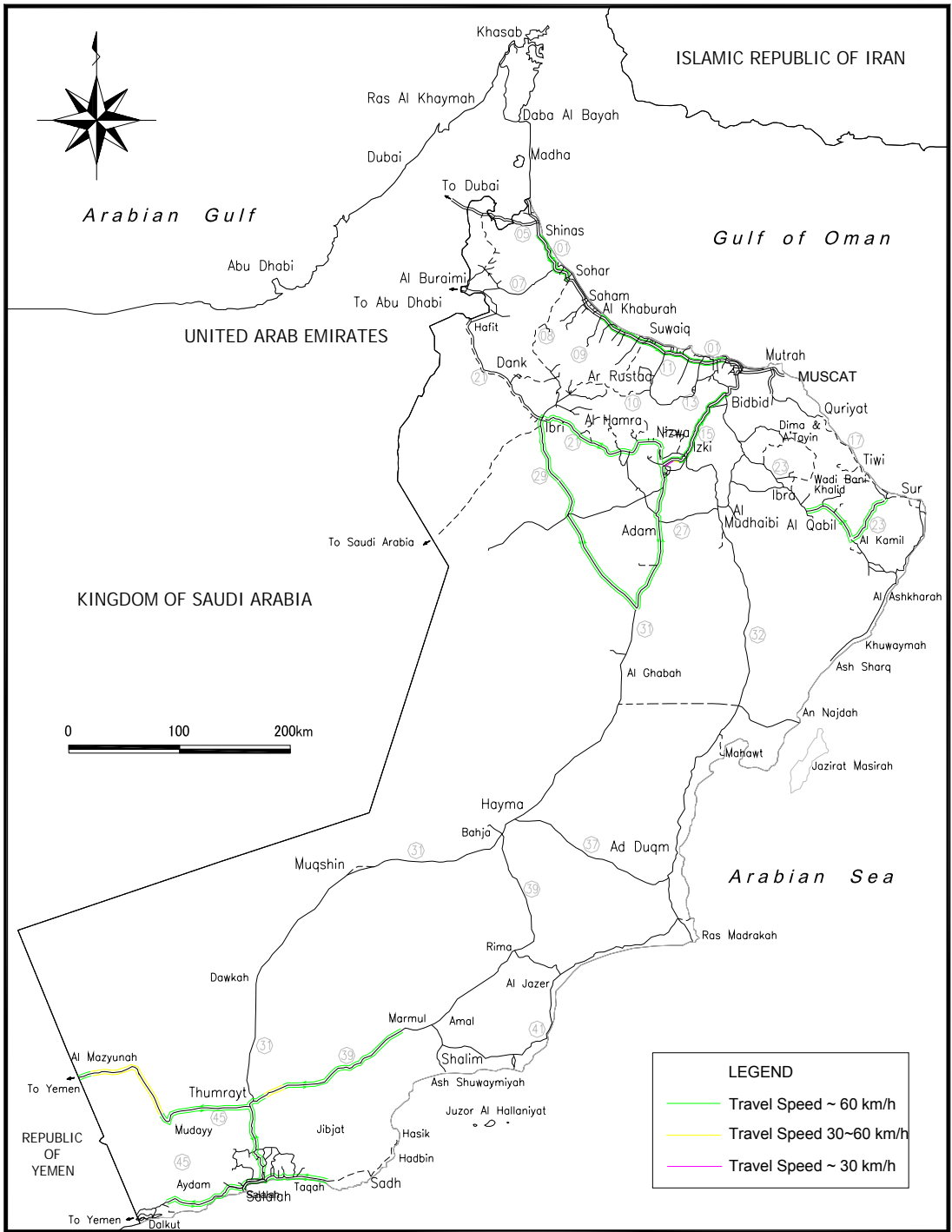


Figure A7.4-3 Travel Speed and Congestion (evening)

A7.5 PRESENT OD TABLE

A7.5.1 OD Table Preparation Policy

OD tables were prepared by the Maximum Entropy Method using the data of traffic volumes crossing Wilayat borders. OD tables are prepared for large zoning system and for small zoning. Zoning system is described in the Chapter 7 Section 7.1.1.

A7.5.2 Simplified Road Network

A simplified road network, in which links are connecting a small zone with an adjacent small zone by only one road, was prepared in order to estimate the Car OD. The simplified road network is shown in Figure A7.5-1.

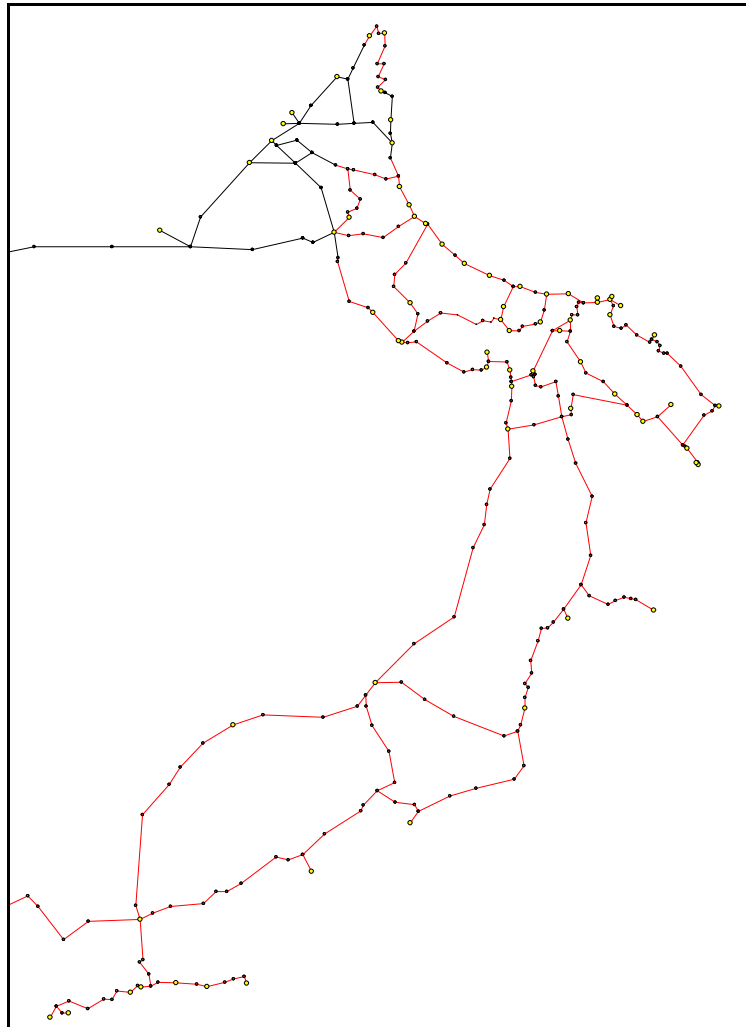
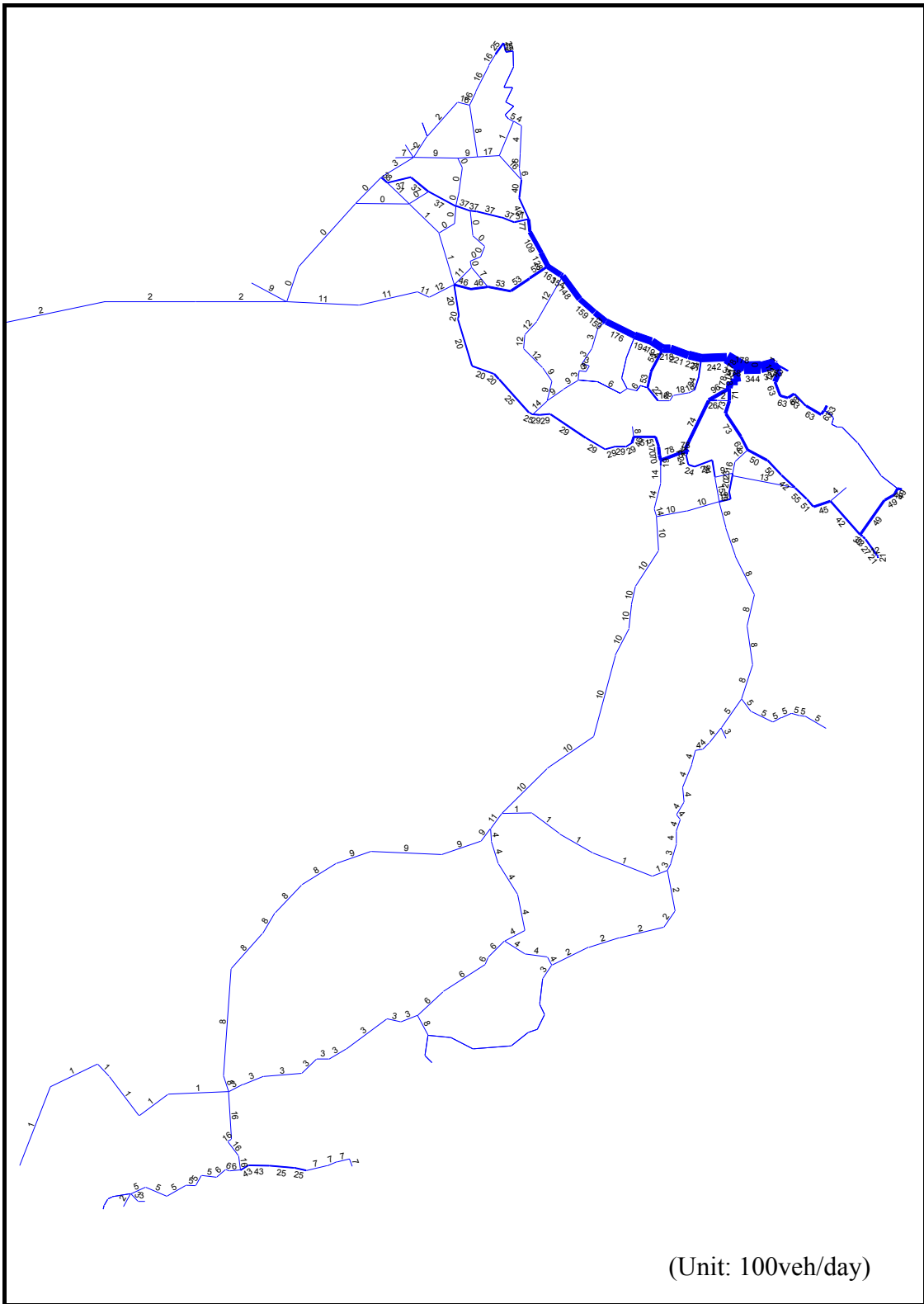


Figure A7.5-1 Simplified Road Network

A7.5.3 Present OD Tables

1) Procedure of Estimating the Present OD Tables

- a) The maximum entropy method was applied to obtain the OD tables of aggregated vehicle types, which are private car, taxi and 4WD (hereafter passenger car), and light trucks and heavy trucks including trailer and oil tanker (hereafter truck). For the application of the maximum entropy method, it is necessary to utilize the traffic volumes by type of car crossing all the zones of the simplified network described in Section A7.5.2.
- b) The traffic volumes crossing zone border were obtained from the traffic counting survey results and supplemented by DGR survey records. The traffic volumes of survey station counted for 12-hour were converted to 24-hour volumes using the conversion coefficient of 1.54 obtained as the average of 24 hour count results.
- c) Under the process described above, the simplified maximum entropy method was applied and the OD tables for 24-hour period by vehicle category (Passenger car, Bus and Truck) were produced. Figures A7.5-2 through A7.5-4 presents the traffic volumes resulted through traffic assignment procedure of the OD trips on the road network.
- d) For the examination of the accuracy of OD tables, the established all vehicle OD was assigned on the present road network. The differences between surveyed traffic volumes and assigned volumes are presented in Table A7.5-2. The assigned volumes in this manner show good consistency to the observed traffic.



Note: Assigned trips are those with origin/destination in Oman i.e., intra-UAE traffic does not included.

Figure A7.5-2 Present Traffic Flow

Table A7.5-2 Difference of Assigned and Observed Trips

(Vehicle/day)

Road	No.	Location	Sta.No.	Assigned Trip (a)	Observed Trip (b)	Difference c=ABS[a-b]	Ratio (c / b)
R1	1	Aqr R/A	RS1	7,720	8,301	581	7%
	2	Majis	TC2	12,752	13,550	798	6%
	3	Saham	TC3	14,836	15,166	330	2%
	4	Wadi Shafan	TC4	15,872	16,183	311	2%
	5	Muladdah	TC5	17,610	17,227	383	2%
	6	Wadi Bani Ghafir	TC6	19,374	19,670	296	2%
	7	Barka	TC7	22,106	22,926	820	4%
	8	Al Naseem R/A	RS2	24,170	23,849	321	1%
R2	9	Khasab	TC1	2,532	2,583	51	2%
R5	10	UAE border	TC8	3,744	3,255	489	15%
R7	11	Falaj Al Qabail	RS3	5,316	4,777	539	11%
R8	12	Sohal R/A	TC9	1,176	1,219	43	4%
R10	13	At Tayyib	TC10	624	734	110	15%
R11	14	Muladdah	TC11	5,316	6,082	766	13%
R15	15	Fanja	TC12	17,772	17,716	56	0%
	16	Samail Jct.	TC16	7,386	8,034	648	8%
R17	17	Wadi Adai	TC13	6,346	6,455	109	2%
R21	18	Wilayat Bahla	TC19	2,938	2,643	295	11%
	19	Birkat Al Mauz junction	TC20	5,136	6,119	983	16%
	20	Dank Village	RS4	1,996	2,204	208	9%
R23	21	Wadi Tayeen Jct.	RS5	6,266	5,395	871	16%
	22	Al kamil	TC24	4,238	4,024	214	5%
	23	Wilayat Al Kamil	TC17	4,864	5,428	564	10%
R27	24	Adam jct.	TC27	958	1,083	125	12%
R31	25	Qarn Al Alam	RS6	1,008	956	52	5%
	26	Thumrait	TC32	836	738	98	13%
	27	Qeiron Heiritti Jct.	RS7	1,676	1,825	149	8%
R32	28	Shanna jct.	TC28	502	519	17	3%
R37	29	Hyma jct.	TC29	136	145	9	6%
R39	30	Amal Village	TC33	570	698	128	18%
R47	31	Mughsayl	TC37	512	472	40	8%
R49	32	Mirbat	TC38	744	797	53	7%
	33	Maamora R/A	TC36	4,280	4,394	114	3%
Others	34	between Mudaibi to Al Qa	TC23	1,284	1,413	129	9%
	35	Rimah	TC31	334	284	50	18%
	36	Ras Madrasah	TC34	192	172	20	12%
Total				223,122	227,036	10,770	4.7%

Note: Station No. is shown in Figure A7.1-2.

2) Present OD Table Characteristics

Vehicle OD shows concentration to Muscat-Batinah area. As for passenger transport mode the area generates and attracts more than 60% of the trips. As per commodity transport mode the area loses share a little but maintains around 55% of the total trips.

Table A7.5-3 shows share of inter-wilayat trips within the region (hereafter referred to as 'intra-region trip') to total trips in the region. As for all regions, intra-region trips occupy 52% of all trips. Share of intra-region trips in Dhofar is 87% and it reflects strong isolated nature of this region. The area of Muscat - Batinah shows 78% as the

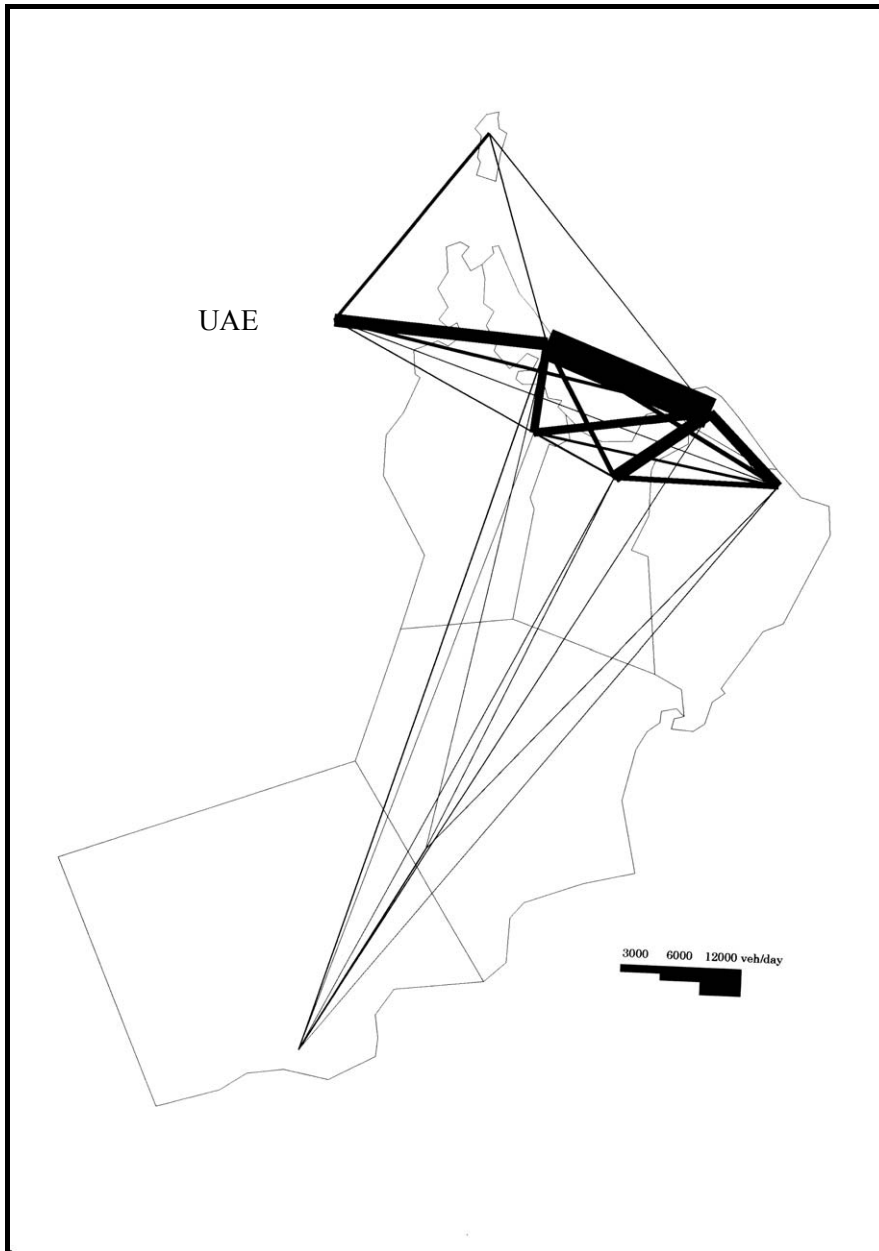
share of intra-region trips but Muscat and Batinah separately show 65% and 40%, respectively. From these figures, the mutual dependencies of both regions are clear. It was also pointed out at Section A7.2.2 that the commuting pattern of hourly changes in the traffic volume was seen at 80km west point from Muscat (in Batinah Region).

Table A7.5-3 Share of Intra-Region Trips to the Total Trips

Region	Total Traffic (trips)	Intra Traffic (trips)	Share (%)
Muscat	44,796	29,088	65
Batinah	24,369	9,652	40
Muscat+Batina	69,165	53,620	78
Musandam	2,419	1,370	57
Dahira	7,149	2,162	30
Dakhiya	6,787	1,078	16
Shargiya	8,499	3,232	38
Wusta	562	88	16
Dhofar	6,244	5,436	87
All Regions	100,825	52,106	52

A7.5.4 Desire Line

Desire line of all vehicles, passenger cars and buses, and trucks are illustrated in Figures A7.5-4 to A7.5-6. Three figures show similar pattern. Traffic demand between Muscat and Batinah is outstanding. It is followed by Muscat – Nizwa and the third is Muscat – Sur. Ibri also shows high generated and attracted trips with both Muscat and Batinah. For outer zones, UAE has the highest share, especially with Batinah.



Note: Desire line shows more than 100 vehicles

Figure A7.5-4 Desire Line of All Vehicles

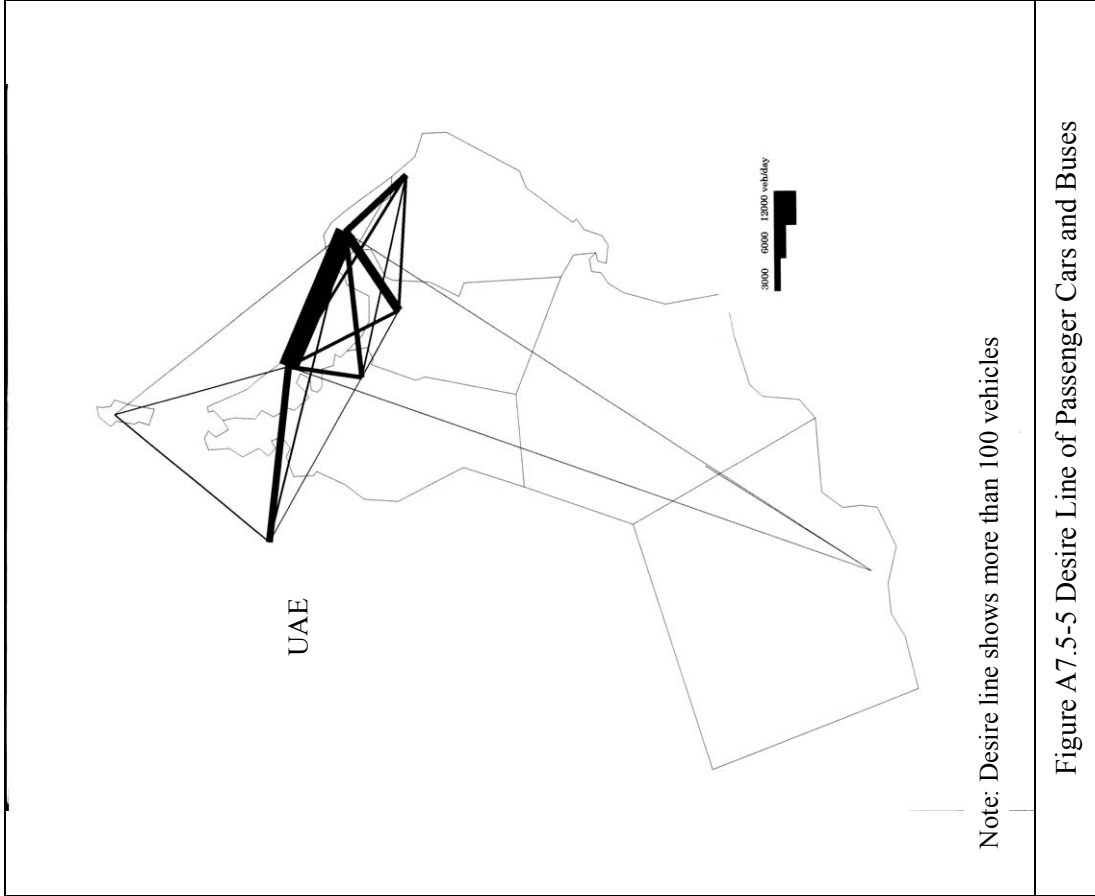


Figure A7.5-5 Desire Line of Passenger Cars and Buses

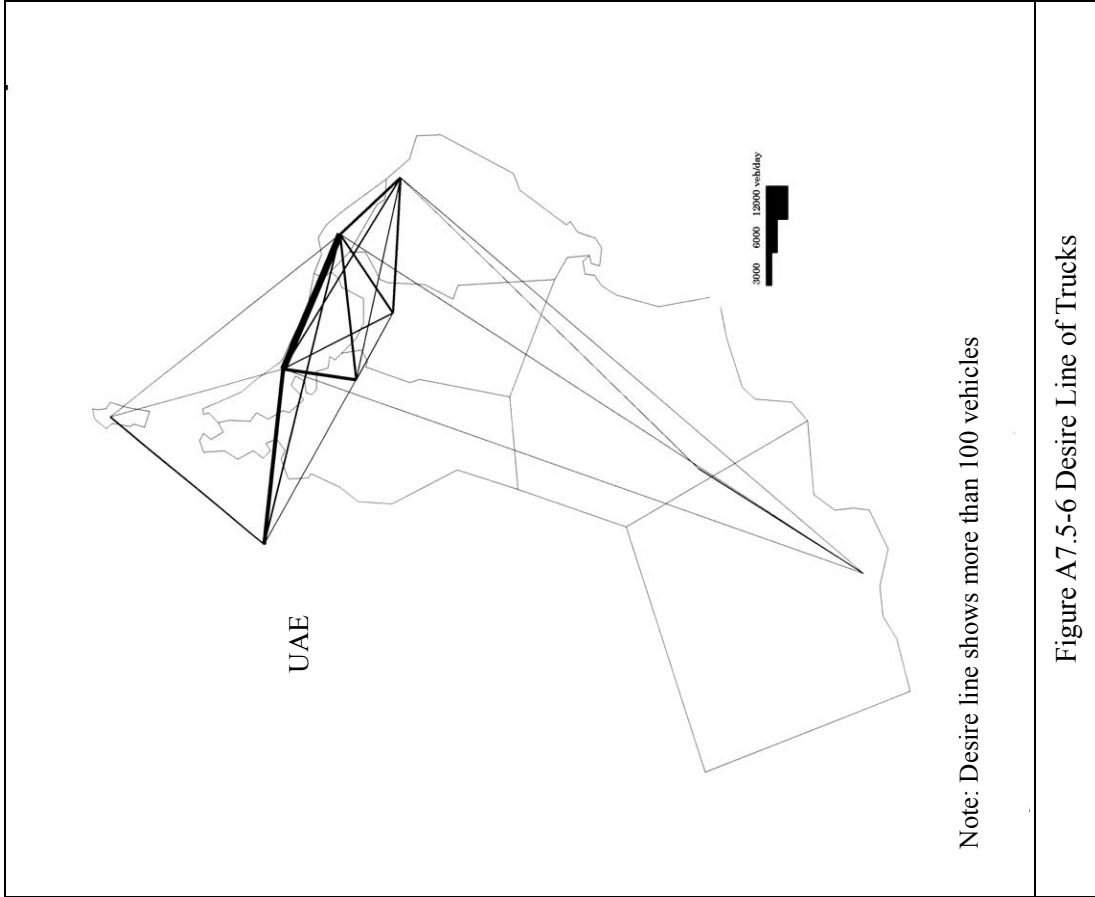


Figure A7.5-6 Desire Line of Trucks

APPENDIX 7-2

WILAYAT CHARACTERISTICS

Wilayat Characteristics of 2005, 1/2

Region/Wilayat	Employed Population by Economic Activity										Monthly Income/capita	Car Ownership		GVA* of Industry		FGM**	
	Residence Base			Workplace Base			Total	Vehicles/1000psns	Number of Private Cars	RO 1000		RO 1000	RO 1000	RO 1000			
	Primary Sector	Secomnda sector	Tertiary Sector	Primary Sector	Secomnda sector	Tertiary Sector											
Oman	2,421,050	73,296	222,003	527,578	822,877	73,296	222,003	527,578	822,877	97	126	305,736	730,876	2,111,599			
Muscat	655,654	4,718	89,396	226,363	320,477	4,718	102,024	274,480	381,222	157	172	112,722	246,378	642,505			
Muttrah	151,433	205	21,024	57,204	78,433	205	26,090	90,779	117,074	194	191	28,895	32,645	87,682			
Baushar	161,311	481	20,839	54,637	75,957	481	27,494	106,440	134,415	182	187	30,086	94,168	259,260			
A'Seeb	237,780	1,167	32,755	79,420	113,342	1,167	34,213	61,547	96,927	136	160	37,977	111,612	279,554			
Al-Amirat	42,424	194	6,136	14,404	20,734	194	5,477	5,344	11,015	108	139	5,899	5,458	10,927			
Muscat	25,716	409	3,511	8,652	12,572	409	4,278	5,206	9,893	137	171	4,408	1,374	2,745			
Qurivat	39,757	2,262	5,131	12,046	19,439	2,262	4,472	5,164	11,898	103	137	5,457	1,123	2,337			
Al-Batinah	677,537	38,751	36,709	109,979	185,439	38,751	29,903	80,345	148,999	65	105	70,937	40,336	110,365			
Sohar	108,042	4,585	6,192	18,817	29,594	4,585	6,504	32,422	43,511	76	114	12,296	26,091	75,729			
Al-Rustaq	76,936	2,242	4,915	13,892	21,049	2,242	2,884	5,872	10,998	56	95	7,342	563	1,389			
Shinas	49,048	3,296	2,506	7,626	13,428	3,296	1,880	3,992	9,168	59	94	4,635	28	51			
Liwa	26,469	1,464	1,469	4,310	7,243	1,464	1,005	2,080	4,549	57	95	2,515	55	102			
Saham	87,670	6,244	4,429	13,322	23,995	6,244	3,381	7,350	16,975	64	105	9,241	584	1,377			
Al-Khabourah	48,268	3,173	2,517	7,514	13,204	3,173	1,804	4,034	9,011	63	106	5,100	0	0			
Al-Suwa'iq	104,922	6,397	5,596	16,727	28,720	6,397	4,472	9,029	19,898	66	105	10,982	5,945	12,789			
Nakhal	16,929	890	983	2,764	4,637	890	594	1,267	2,751	55	96	1,622	0	0			
W. Al-Maawil	11,685	645	648	1,904	3,197	645	465	877	1,987	55	96	1,118	309	583			
Al-Awabi	10,922	532	627	1,827	2,986	532	400	824	1,756	54	96	1,049	0	0			
Al-Musana'a	58,560	3,408	3,176	9,439	16,023	3,408	2,193	4,963	10,564	65	105	6,142	626	1,619			
Barka	78,086	5,875	3,651	11,837	21,363	5,875	4,321	7,635	17,831	76	114	8,895	6,136	16,727			
Musandam	29,354	1,320	1,134	6,636	9,090	1,320	1,134	6,636	9,090	76	114	3,342	0	0			
Khasab	18,361	613	745	4,320	5,678	613	670	4,637	5,920	79	121	2,219	0	0			
Bukha	2,949	113	119	690	922	113	140	521	774	67	97	286	0	0			
Daba Al-baiya	5,711	502	173	1,095	1,770	502	227	1,085	1,814	75	107	611	0	0			
Madhaa	2,333	92	97	531	720	92	97	393	582	66	97	226	0	0			
Al-Dhahirah	212,132	7,206	24,091	35,768	67,065	7,206	23,410	31,904	62,520	78	133	28,277	15,255	34,538			
Al-Buraimi	66,132	972	7,735	12,201	20,908	972	6,330	17,256	24,558	96	145	9,581	7,580	18,629			
Ibri	102,347	3,726	11,797	16,832	32,355	3,726	10,274	10,297	24,297	72	132	13,491	2,709	6,138			
Mahdhah	9,356	1,024	648	1,286	2,958	1,024	1,502	1,130	3,656	77	122	1,138	4,686	8,966			
Yanqul	17,040	757	1,945	2,687	5,389	757	3,630	1,616	6,003	63	119	2,021	1,85	500			
Dhank	17,257	727	1,966	2,762	5,455	727	1,674	1,605	4,006	65	119	2,046	95	306			

* GVA: Gross Value Added
 ** FGM: Finished Goods Manufactured

Wilayat Characteristics of 2005, 2/2

Region/Wilayah	Population	Employed Population by Economic Activity										Monthly Income/capita	Car Ownership		GVA* of Industry		FGM**	
		Residence Base			Workplace Base			Total	Ownership Vehicles/1000psns	Number of Private Cars	RO 1000		RO 1000	RO 1000	RO 1000			
		Primary Sector	Secomdat sector	Tertiary Sector	Primary Sector	Secomdat sector	Tertiary Sector											
A'Dakkhilyyah	275,162	4,606	20,990	43,284	68,860	4,606	17,350	34,491	56,447	70	104	28,609	10,337	23,606				
Nizwa	72,248	951	5,553	11,585	18,089	951	5,024	16,706	22,681	79	109	7,860	6,538	15,099				
Samail	46,441	1,167	3,425	7,023	11,615	1,167	2,733	4,108	8,008	69	105	4,878	469	993				
Bahla	53,184	624	4,202	8,483	13,309	624	3,306	4,657	8,587	69	104	5,557	1,530	3,339				
Adam	14,211	297	1,026	2,235	3,558	297	929	1,257	2,483	64	90	1,274	294	548				
Al-Hamra	17,776	348	1,372	2,727	4,447	348	1,026	1,426	2,800	61	97	1,725	168	425				
Manah	13,124	256	994	2,033	3,283	256	767	1,088	2,111	63	93	1,223	164	316				
Izki	36,730	502	2,841	5,847	9,190	502	2,236	3,316	6,054	69	105	3,854	718	1,626				
Bidbid	21,448	461	1,577	3,331	5,369	461	1,329	1,933	3,723	69	104	2,238	458	1,260				
A'Sharqiyah	324,645	8,639	24,620	49,940	83,199	8,639	24,156	46,002	78,797	74	91	29,621	402,159	1,260,669				
Sur	69,156	818	5,530	11,378	17,726	818	5,402	20,404	26,624	89	97	6,714	379,815	1,191,369				
Ibra	25,563	727	1,847	3,982	6,556	727	1,901	2,872	5,500	78	91	2,332	21,308	66,647				
Biddiyah	18,461	563	1,372	2,798	4,733	563	1,372	1,806	3,741	67	86	1,588	55	143				
Al-Qabil	14,079	420	1,048	2,132	3,600	420	1,037	1,394	2,851	73	97	1,361	6	12				
Al-Mudhaili	61,416	2,631	4,343	8,761	15,735	2,631	4,570	6,262	13,463	73	96	5,912	320	852				
D. W. Al-Tayeen	17,657	942	1,221	2,368	4,531	942	1,264	1,626	3,832	64	89	1,563	0	0				
A. K. W. Alwafi	20,937	481	1,610	3,279	5,370	481	1,545	2,133	4,159	68	84	1,763	115	267				
J. B. B. Ali	52,853	880	4,278	8,386	13,544	880	3,813	5,175	9,868	66	86	4,558	479	1,242				
J. B. B. Hassan	26,693	819	1,999	4,022	6,840	819	1,955	2,556	5,330	65	87	2,328	53	122				
W. B. Khalid	8,241	184	659	1,264	2,107	184	573	760	1,517	63	89	733	9	16				
Massirah	9,589	174	713	1,570	2,457	174	724	1,014	1,912	72	80	769	0	0				
Al-Wusta	23,947	1,853	1,404	3,809	7,066	1,853	3,671	1,901	4,121	90	109	2,601	0	0				
Haima	3,314	165	227	594	986	165	54	559	778	119	110	364	0	0				
Mahut	10,131	757	615	1,624	2,996	757	161	602	1,520	79	123	1,243	0	0				
A'Duqum	4,440	440	238	625	1,303	440	76	296	812	78	106	472	0	0				
Al-Jazir	6,062	491	324	966	1,781	491	76	444	1,011	101	86	522	0	0				
Dhofar	222,619	6,203	23,659	51,819	81,681	6,203	23,659	51,819	81,681	96	133	29,627	16,411	39,916				
Salalah	162,663	5,322	16,733	37,636	59,691	5,322	17,673	42,485	65,480	101	137	22,354	16,139	39,327				
Thumrait	7,469	389	691	1,665	2,745	389	875	1,340	2,604	92	129	963	163	301				
Taqah	17,977	113	2,150	4,313	6,576	113	1,783	2,626	4,522	81	120	2,150	0	0				
Marbat	15,457	72	1,891	3,703	5,666	72	1,383	2,415	3,870	81	120	1,856	24	76				
Sadah	5,627	123	659	1,284	2,066	123	519	886	1,528	82	120	678	45	83				
Rakhiyout	4,617	20	573	1,101	1,694	20	465	686	1,171	81	120	554	0	0				
Dhalkout	2,994	41	357	704	1,102	41	302	411	754	81	120	359	0	0				
Magshan	556	10	65	126	201	10	43	116	169	83	121	67	0	0				
S. W. Al-Halanyiyat	5,309	113	540	1,287	1,940	113	616	854	1,583	84	122	646	40	129				

* GVA: Gross Value Added
 ** FGM: Finished Goods Manufactured

Wilayat Characteristics of 2010, 1/2

Region/Wilayat	Employed Population by Economic Activity											Monthly Income/capita	Car Ownership		GVA* of Industry RO 1000	FGM** RO 1000
	Residence Base			Workplace Base			Tertiary Sector	Total	Ownership Vehicles/1000psns	Number of Private Cars						
	Primary Sector	Secomdar sector	Total	Primary Sector	Secomdar sector	Total										
Oman	2,558,805	81,924	254,616	559,097	895,637	895,637	109	139	355,581	1,265,326	3,715,514					
Muscat	690,461	5,054	102,693	238,928	346,675	346,675	177	176	121,330	318,677	826,615					
Muttrah	149,673	202	20,745	57,081	78,028	78,028	219	201	30,112	43,533	117,342					
Baushar	173,599	515	25,447	58,880	84,842	84,842	204	192	33,366	117,918	321,899					
A'Seeb	254,562	1,250	38,952	85,243	125,445	125,445	153	162	41,118	146,527	365,949					
Al-Amrat	46,788	208	7,784	15,933	23,925	23,925	122	144	6,754	7,450	14,840					
Muscat	22,678	402	3,451	8,633	12,486	12,486	402	171	3,887	1,788	3,573					
Quriyat	43,161	2,477	6,314	13,158	21,949	21,949	116	141	6,093	1,462	3,044					
Al-Batinah	715,143	43,409	42,435	115,303	201,147	201,147	74	120	85,852	93,227	268,960					
Sohar	115,545	4,975	7,611	20,109	32,695	32,695	86	126	14,522	74,676	223,853					
Al-Rustaq	80,698	2,506	5,609	14,538	22,653	22,653	63	115	9,280	732	1,807					
Shimas	51,428	3,845	2,736	7,848	14,429	14,429	66	116	5,979	36	67					
Liwa	27,357	1,708	1,541	4,384	7,633	7,633	64	116	3,160	72	133					
Saham	92,623	6,979	5,111	13,961	26,051	26,051	72	119	11,036	760	1,793					
Al-Khabourah	50,055	3,546	2,719	7,713	13,978	13,978	71	119	5,944	0	0					
Al-Suwaig	111,052	7,150	6,525	17,591	31,266	31,266	74	120	13,349	7,742	16,655					
Nakhal	18,586	1,009	1,269	3,026	5,304	5,304	62	114	2,128	0	0					
W. Al-Maawil	12,012	721	684	1,940	3,345	3,345	62	115	1,377	402	759					
Al-Awabi	11,797	595	780	1,967	3,342	3,342	61	114	1,345	0	0					
Al-Musana'a	60,891	3,809	3,485	9,734	17,028	17,028	74	120	7,300	816	2,109					
Barqa	83,099	6,566	4,365	12,492	23,423	23,423	85	126	10,432	7,991	21,783					
Musandam	30,684	1,535	1,474	6,906	9,915	9,915	85	126	3,859	0	0					
Khasab	19,282	715	998	4,523	6,236	6,236	89	128	2,459	0	0					
Bukha	3,037	132	145	708	985	985	75	121	366	0	0					
Daba Al-baiya	6,003	585	222	1,136	1,943	1,943	84	125	750	0	0					
Madhaa	2,362	103	109	539	751	751	74	120	284	0	0					
A'Dhahirah	222,084	8,039	26,551	38,498	73,088	73,088	88	134	29,684	22,836	51,777					
Al-Buraimi	70,267	1,072	8,846	13,347	23,265	23,265	108	145	10,180	12,842	31,060					
Ibri	106,151	4,164	12,716	17,925	34,805	34,805	82	132	13,993	3,527	7,992					
Mahdhah	9,790	1,144	714	1,359	3,217	3,217	87	126	1,237	6,102	11,674					
Yanqul	17,889	846	2,135	2,904	5,885	5,885	71	119	2,122	241	651					
Dhank	18,007	813	2,140	2,963	5,916	5,916	73	120	2,153	124	399					

* GVA: Gross Value Added

** FGM: Finished Goods Manufactured

Wilayat Characteristics of 2010, 2/2

Region/Wilayat	Employed Population by Economic Activity										Monthly Income/capita	Car Ownership		GVA* of Industry	FGM**	
	Residence Base			Workplace Base				Tertiary Sector	Total	Ownership Vehicles/1000psns		Private Cars	RO 1000		RO 1000	
	Primary Sector	Secomndar sector	Tertiary Sector	Primary Sector	Secomndar sector	Tertiary Sector	Total									
A/Dakhiliyah	290,657	5,124	23,971	46,228	75,323	5,124	20,451	37,998	63,573	79	123	35,674	16,741	38,174		
Nizwa	76,750	1,039	6,446	12,460	19,945	1,039	7,080	18,171	26,290	89	127	9,766	11,796	27,100		
Samail	49,418	1,304	3,969	7,559	12,832	1,304	2,988	4,660	8,952	78	122	6,021	610	1,292		
Bahla	55,697	698	4,700	8,989	14,387	698	3,539	5,111	9,348	78	122	6,793	1,992	4,347		
Adam	14,916	332	1,159	2,367	3,858	332	1,010	1,394	2,736	72	119	1,779	383	715		
Al-Hamra	18,509	389	1,508	2,870	4,767	389	1,097	1,557	3,043	69	118	2,177	217	551		
Manah	13,706	286	1,103	2,145	3,534	286	833	1,198	2,317	70	118	1,622	214	413		
Izki	38,886	561	3,261	6,263	10,085	561	2,437	3,717	6,715	78	122	4,739	935	2,119		
Bidbid	22,775	515	1,825	3,575	5,915	515	1,467	2,190	4,172	78	122	2,778	596	1,641		
A'Sharqiyah	349,324	9,794	28,540	53,814	92,148	9,794	28,404	50,989	89,187	83	125	43,508	788,298	2,467,678		
Sur	75,597	954	6,667	12,466	20,087	954	8,386	22,473	31,813	101	133	10,077	762,928	2,389,137		
Ibra	27,944	813	2,248	4,366	7,427	813	2,097	3,290	6,200	88	127	3,548	24,021	75,086		
Biddiyah	19,385	629	1,499	2,932	5,060	629	1,425	1,932	3,986	75	121	2,336	71	185		
Al-Qabil	14,565	470	1,101	2,196	3,767	470	1,058	1,442	2,970	82	124	1,804	8	15		
Al-Mudhaibi	65,653	2,941	4,946	9,371	17,258	2,941	4,814	6,913	14,668	82	124	8,147	417	1,110		
D. W. Al-Tayeen	18,693	1,053	1,345	2,501	4,899	1,053	1,332	1,782	4,167	72	119	2,226	0	0		
A. K. W. Alwafi	22,215	538	1,810	3,482	5,830	538	1,630	2,324	4,492	77	121	2,698	150	348		
J. B. B. Ali	57,374	1,026	5,037	9,131	15,194	1,026	4,139	5,937	11,102	75	120	6,905	625	1,620		
J. B. B. Hassan	28,567	955	2,267	4,294	7,516	955	2,078	2,852	5,885	73	120	3,423	68	158		
W. B. Khalid	9,190	212	822	1,421	2,455	212	673	945	1,830	71	119	1,091	11	20		
Massirah	10,141	203	798	1,654	2,655	203	772	1,099	2,074	81	124	1,254	0	0		
Al-Wusta	26,881	2,159	1,767	4,148	8,074	2,159	704	2,369	5,232	102	134	3,598	0	0		
Haima	3,756	189	297	658	1,144	189	118	635	942	134	151	566	0	0		
Mahut	11,275	883	746	1,749	3,378	883	272	769	1,924	89	128	1,439	0	0		
A'Duqum	5,089	513	321	703	1,537	513	158	414	1,085	88	127	646	0	0		
Al-Jazir	6,761	574	403	1,038	2,015	574	156	551	1,281	114	140	947	0	0		
Dhofar	233,571	6,810	27,185	55,272	89,267	6,810	27,185	55,272	89,267	108	137	32,076	25,547	62,312		
Salalah	171,101	5,782	19,431	40,250	65,463	5,782	20,918	45,301	72,001	114	140	23,987	25,193	61,543		
Thumrait	7,904	454	805	1,775	3,034	454	942	1,445	2,841	104	135	1,066	212	392		
Taqah	18,551	132	2,375	4,545	7,052	132	1,838	2,753	4,723	91	128	2,382	0	0		
Marbat	16,244	84	2,156	3,967	6,207	84	1,469	2,579	4,132	91	129	2,088	31	100		
Sadah	5,984	143	766	1,391	2,300	143	579	973	1,695	92	129	772	59	109		
Rakhiyout	4,716	23	614	1,147	1,784	23	495	715	1,233	91	128	606	0	0		
Dhalkout	3,074	48	386	735	1,169	48	334	440	822	91	128	395	0	0		
Maqshan	607	12	80	140	232	12	60	131	203	93	129	79	0	0		
S. W. Al-Halanyiyat	5,390	132	572	1,322	2,026	132	550	935	1,617	95	130	702	52	167		

* GVA: Gross Value Added

** FGM: Finished Goods Manufactured

Wilayat Characteristics of 2015, 1/2

Region/Wilayat	Employed Population by Economic Activity										Monthly Income/capita	Car Ownership		GVA* of Industry RO 1000	FGM** RO 1000
	Residence Base					Workplace Base						Vehicles/1000psns	Private Cars		
	Primary Sector	Secomdntal sector	Tertiary Sector	Total	Primary Sector	Secomdntal sector	Tertiary Sector	Total							
Oman	2,692,542	91,566	299,027	592,500	983,093	91,566	299,027	592,500	983,093	124	145	393,822	2,718,530	8,183,257	
Muscat	723,461	5,453	120,750	252,356	378,559	5,453	131,331	293,096	429,880	201	190	136,938	413,714	1,067,452	
Muttrah	146,558	201	21,392	57,297	78,990	201	29,156	90,012	119,369	249	220	32,244	58,082	156,858	
Baushar	185,798	556	31,250	63,317	95,123	556	36,712	112,804	150,072	232	210	38,936	148,468	401,750	
A'Seeb	270,883	1,349	46,968	91,293	139,610	1,349	49,113	71,758	122,220	174	174	47,024	192,821	480,138	
Al-Amrat	51,238	224	9,801	17,487	27,512	224	6,936	7,191	14,351	138	153	7,860	10,061	19,989	
Muscat	22,406	401	3,545	8,657	12,603	401	4,207	4,915	9,523	175	174	3,903	2,357	4,710	
Quriyat	46,578	2,722	7,794	14,305	24,821	2,722	5,207	6,416	14,345	132	150	6,971	1,925	4,008	
Al-Batinah	750,484	48,604	50,130	121,420	220,154	48,604	44,707	95,416	188,727	84	125	93,771	229,260	686,713	
Sohar	122,838	5,429	9,387	21,514	36,330	5,429	14,448	37,486	57,363	97	132	16,153	204,820	627,287	
Al-Rustaq	84,153	2,801	6,562	15,266	24,629	2,801	3,578	6,997	13,376	72	119	10,017	965	2,383	
Shinas	53,611	4,440	3,092	8,135	15,667	4,440	2,307	4,721	11,468	75	120	6,460	47	87	
Liwa	28,098	1,972	1,683	4,493	8,148	1,972	1,180	2,314	5,466	73	120	3,361	94	174	
Saham	97,291	7,801	6,030	14,704	28,535	7,801	4,304	8,952	21,057	82	124	12,051	1,002	2,364	
Al-Khabourah	51,591	3,963	3,046	7,972	14,981	3,963	2,101	4,507	10,571	81	123	6,366	0	0	
Al-Suwa'iq	116,861	7,991	7,758	18,576	34,325	7,991	6,141	11,239	25,371	84	125	14,619	10,199	21,941	
Nakhal	20,257	1,140	1,615	3,304	6,059	1,140	964	1,890	3,994	71	118	2,399	0	0	
W. Al-Maawil	12,269	806	751	1,991	3,548	806	593	978	2,377	71	119	1,456	530	1,001	
Al-Awabi	12,662	665	970	2,118	3,753	665	617	1,152	2,434	69	118	1,493	0	0	
Al-Musana'a	62,934	4,257	3,953	10,102	18,312	4,257	2,639	5,622	12,518	84	125	7,850	1,075	2,778	
Barka	87,919	7,339	5,283	13,245	25,867	7,339	5,835	9,558	22,732	97	131	11,546	10,528	28,698	
Musandam	32,043	1,769	1,885	7,249	10,903	1,769	1,885	7,249	10,903	97	131	4,218	0	0	
Khasab	20,229	825	1,298	4,772	6,895	825	1,295	5,132	7,252	101	134	2,704	0	0	
Bukha	3,123	153	177	735	1,065	153	178	546	877	85	126	392	0	0	
Daba Al-baiya	6,304	676	283	1,189	2,148	676	278	1,171	2,125	95	131	823	0	0	
Madhaa	2,387	115	127	553	795	115	134	400	649	84	125	299	0	0	
A'Dhahirah	232,745	8,972	30,230	41,108	80,310	8,972	29,578	37,491	76,041	100	133	31,361	32,222	73,104	
Al-Buraimi	74,724	1,185	10,366	14,454	26,005	1,185	10,520	20,221	31,926	122	145	10,826	19,057	45,815	
Ibri	110,200	4,654	14,216	18,955	37,825	4,654	11,253	11,852	27,759	93	129	14,526	4,646	10,528	
Mahdha	10,255	1,279	813	1,437	3,529	1,279	2,114	1,532	4,925	99	132	1,356	8,039	15,380	
Yanqul	18,758	946	2,423	3,108	6,477	946	3,814	1,963	6,723	81	123	2,315	317	856	
Dhank	18,808	908	2,412	3,154	6,474	908	1,877	1,923	4,708	83	124	2,338	163	525	

* GVA: Gross Value Added

** FGM: Finished Goods Manufactured

Wilayat Characteristics of 2015, 2/2

Region/Wilayat	Population	Employed Population by Economic Activity										Monthly Income/capita	Car Ownership		GVA* of Industry RO 1000	FGM** RO 1000
		Residence Base					Workplace Base						Ownership Vehicles/1000psns	Number of Private Cars		
		Primary Sector	Secommdal sector	Tertiary Sector	Total	Primary Sector	Secommdal sector	Tertiary Sector	Total							
A'Dakhiliyah	305,848	5,706	28,062	49,254	83,022	5,706	24,505	41,535	71,746	90	128	39,170	24,407	55,614		
Nizwa	81,216	1,140	7,639	13,348	22,127	1,140	9,479	19,716	30,335	101	133	10,828	17,893	41,027		
Samail	52,381	1,457	4,697	8,106	14,260	1,457	3,379	5,207	10,043	88	127	6,652	803	1,701		
Bahla	58,102	780	5,414	9,507	15,701	780	3,933	5,549	10,262	89	127	7,387	2,624	5,726		
Adam	15,594	371	1,345	2,505	4,221	371	1,137	1,526	3,034	82	124	1,934	504	941		
Al-Hamra	19,195	435	1,714	3,017	5,166	435	1,219	1,682	3,336	78	122	2,343	287	729		
Manah	14,258	320	1,263	2,260	3,843	320	937	1,303	2,560	80	123	1,753	281	543		
Izki	41,011	627	3,832	6,686	11,145	627	2,749	4,111	7,487	88	127	5,210	1,231	2,789		
Bidbid	24,091	576	2,158	3,825	6,559	576	1,672	2,441	4,689	89	127	3,063	784	2,159		
A Sharqiyah	373,205	11,069	33,785	57,758	102,612	11,069	33,974	56,004	101,047	94	130	48,597	1,982,302	6,210,975		
Sur	82,034	1,103	8,116	13,562	22,781	1,103	11,778	24,648	37,529	114	140	11,518	1,953,434	6,121,804		
Ibra	30,321	908	2,755	4,757	8,420	908	2,390	3,704	7,002	100	133	4,032	27,093	84,626		
Biddiyah	20,198	703	1,694	3,073	5,470	703	1,543	2,050	4,296	85	125	2,534	94	245		
Al-Qabil	14,936	525	1,204	2,266	3,995	525	1,127	1,485	3,137	93	129	1,932	10	19		
Al-Mudhalibi	69,680	3,287	5,778	9,999	19,064	3,287	5,277	7,550	16,114	93	130	9,033	549	1,460		
D. W. Al-Tayeen	19,643	1,177	1,530	2,640	5,347	1,177	1,461	1,932	4,570	82	124	2,431	0	0		
A. K. W. Alwafi	23,398	601	2,094	3,690	6,385	601	1,789	2,509	4,899	87	127	2,961	197	457		
J. B. B. Ali	61,833	1,185	6,031	9,878	17,094	1,185	4,654	6,680	12,519	85	125	7,745	821	2,129		
J. B. B. Hassan	30,354	1,103	2,640	4,572	8,315	1,103	2,295	3,139	6,537	83	125	3,783	89	207		
W. B. Khalid	10,163	243	1,024	1,577	2,844	243	805	1,125	2,173	81	123	1,254	15	28		
Massirah	10,645	234	919	1,744	2,897	234	855	1,182	2,271	92	129	1,374	0	0		
Al-Wusta	29,600	2,491	2,214	4,510	9,215	2,491	1,076	2,864	6,431	115	141	4,176	0	0		
Haiba	4,174	216	381	724	1,321	216	188	718	1,122	152	161	672	0	0		
Mahut	12,309	1,020	912	1,884	3,816	1,020	396	945	2,361	102	134	1,646	0	0		
A'Duqum	5,720	593	420	783	1,796	593	248	535	1,376	100	133	761	0	0		
Al-Jazir	7,397	662	501	1,119	2,282	662	244	666	1,572	129	148	1,097	0	0		
Dhofar	245,156	7,502	31,971	58,845	98,318	7,502	31,971	58,845	98,318	123	145	35,591	36,625	89,399		
Salalah	180,044	6,314	23,031	42,964	72,309	6,314	25,037	48,354	79,705	130	149	26,738	36,160	88,389		
Thumrait	8,367	524	957	1,892	3,373	524	1,052	1,548	3,124	118	142	1,190	279	516		
Taqah	19,200	153	2,709	4,782	7,644	153	1,975	2,874	5,002	103	135	2,586	0	0		
Marbat	17,077	97	2,320	4,233	6,650	97	1,621	2,743	4,461	104	135	2,303	41	132		
Sadah	6,366	165	909	1,498	2,572	165	666	1,058	1,899	105	135	862	77	142		
Rakhiyout	4,816	27	683	1,193	1,903	27	547	742	1,316	104	135	649	0	0		
Dhalkout	3,155	56	432	767	1,255	56	382	465	903	104	135	425	0	0		
Maqshan	662	13	99	155	267	13	80	147	240	106	136	90	0	0		
S. W. Al-Halamiyat	5,469	153	631	1,361	2,145	153	611	914	1,678	107	137	748	68	219		

* GVA: Gross Value Added

** FGM: Finished Goods Manufactured

Wilayat Characteristics of 2020, 1/2

Region/Wilayat	Population	Employed Population by Economic Activity										Car Ownership		GVA* of Industry RO 1000	FGM** RO 1000
		Residence Base		Workplace Base		Monthly Income/capita	Ownership Vehicles/1000psns	Number of Private Cars	Workplace Base		Tertiary Sector	Total			
		Primary Sector	Secondary sector	Tertiary Sector	Total				Primary Sector	Secondary sector					
Oman	2,787,347	102,344	336,217	627,899	1,066,460	102,344	336,217	627,899	1,066,460	144	157	438,687	3,919,914	11,813,497	
Muscat	745,962	5,920	135,888	267,057	408,865	5,920	145,437	304,351	455,708	235	209	155,988	555,939	1,425,752	
Muttrah	140,529	204	21,519	57,696	79,419	204	30,593	90,172	120,969	290	247	34,659	80,329	217,169	
Baushar	195,600	604	36,299	68,106	105,009	604	41,160	116,666	158,430	271	234	45,821	192,819	516,423	
A'Seeb	283,162	1,464	53,850	97,881	153,195	1,464	56,328	77,462	135,254	202	191	54,087	262,902	652,396	
Al-Amrat	55,113	243	11,581	19,160	30,984	243	7,638	8,182	16,063	161	166	9,174	14,008	27,793	
Muscat	22,134	405	3,554	8,709	12,668	405	4,162	4,809	9,376	204	192	4,244	3,237	6,468	
Qurayt	49,424	3,000	9,085	15,509	27,590	3,000	5,556	7,060	15,616	154	162	8,003	2,644	5,504	
Al-Batinah	774,642	54,403	56,615	127,228	238,246	54,403	51,885	102,898	209,186	98	132	102,228	310,489	927,990	
Sohar	128,424	5,949	10,935	22,928	39,812	5,949	18,322	40,193	64,464	113	140	17,961	276,927	846,384	
Al-Rustaq	86,311	3,130	7,357	16,015	26,502	3,130	3,911	7,568	14,609	84	125	10,771	1,325	3,273	
Shinas	54,966	5,091	3,373	8,376	16,840	5,091	2,512	5,052	12,655	87	127	6,957	65	120	
Liwa	28,373	2,261	1,785	4,584	8,630	2,261	1,264	2,417	5,942	85	126	3,561	129	239	
Saham	100,516	8,719	6,803	15,378	30,900	8,719	4,748	9,698	23,165	95	131	13,130	1,375	3,244	
Al-Khaboura	52,285	4,430	3,299	8,193	15,922	4,430	2,242	4,715	11,387	94	130	6,800	0	0	
Al-Suwaig	120,955	8,932	8,803	19,507	37,242	8,932	6,947	12,308	28,187	98	132	15,979	14,006	30,131	
Nakhla	21,686	1,286	1,923	3,579	6,788	1,286	1,143	2,198	4,627	82	124	2,691	0	0	
W. Al-Maawi	12,316	901	800	2,036	3,737	901	654	1,025	2,580	83	124	1,531	728	1,375	
Al-Awabi	13,361	743	1,137	2,269	4,149	743	723	1,314	2,780	81	123	1,649	0	0	
Al-Musana'a	63,964	4,758	4,326	10,436	19,520	4,758	2,853	5,926	13,537	98	132	8,422	1,476	3,815	
Barka	91,485	8,203	6,074	13,927	28,204	8,203	6,566	10,484	25,253	113	140	12,776	14,457	39,411	
Musandam	33,171	2,025	2,250	7,571	11,846	2,025	2,250	7,571	11,846	113	140	4,645	0	0	
Khasab	21,037	947	1,567	5,013	7,527	947	1,562	5,432	7,941	118	142	2,997	0	0	
Bukha	3,184	175	205	760	1,140	175	206	551	932	99	133	422	0	0	
Daba Al-baiy	6,562	775	337	1,232	2,344	775	327	1,186	2,288	111	139	910	0	0	
Madhaa	2,388	128	141	566	835	128	155	402	685	99	132	316	0	0	
A'Dhahirah	241,106	10,017	33,179	44,003	87,199	10,017	32,543	40,489	83,049	116	142	34,313	45,884	104,134	
Al-Buraimi	78,527	1,314	11,635	15,688	28,637	1,314	12,557	21,837	35,708	143	156	12,241	27,803	66,654	
Ibri	113,076	5,202	15,372	20,113	40,687	5,202	11,708	12,675	29,585	108	137	15,498	6,381	14,459	
Mahdah	10,619	1,429	893	1,505	3,827	1,429	2,410	1,735	5,574	115	141	1,495	11,041	21,122	
Yanqul	19,465	1,057	2,653	3,332	7,042	1,057	3,895	2,155	7,107	94	130	2,531	436	1,177	
Dhank	19,419	1,015	2,626	3,365	7,006	1,015	1,973	2,087	5,075	97	131	2,548	224	721	

* GVA: Gross Value Added

** FGM: Finished Goods Manufactured

Wilayah Characteristics of 2020, 2/2

Region/Wilayah	Employed Population by Economic Activity										Monthly Income/capita	Car Ownership		FGM**	
	Residence Base					Workplace Base						Ownership Vehicles/100psns	Number of Private Cars		GVA* of Industry RO 1000
	Primary Sector	Secondary sector	Tertiary Sector	Total	Primary Sector	Secondary sector	Tertiary Sector	Total	RO 1000						
A'Dakkhilyah	317,163	6,358	31,476	52,543	90,377	6,358	27,968	45,294	79,620	105	136	43,048	35,299	80,395	
Nizwa	84,690	1,254	8,649	14,317	24,220	1,254	11,648	21,351	34,253	118	142	12,031	26,350	60,353	
Samail	54,714	1,629	5,311	8,689	15,629	1,629	3,689	5,774	11,092	103	134	7,354	1,104	2,340	
Bahla	59,726	872	5,997	10,080	16,949	872	4,232	6,029	11,133	103	135	8,038	3,604	7,865	
Adam	16,067	415	1,499	2,652	4,566	415	1,337	1,667	3,319	96	131	2,102	692	1,292	
Al-Hamra	19,614	486	1,878	3,179	5,543	486	1,311	1,818	3,615	91	128	2,519	394	1,002	
Manah	14,614	357	1,392	2,387	4,136	357	1,019	1,417	2,793	93	130	1,893	386	745	
Izki	42,625	701	4,311	7,147	12,159	701	2,995	4,532	8,228	103	134	5,731	1,690	3,829	
Bidbid	25,113	644	2,439	4,092	7,175	644	1,837	2,706	5,187	103	135	3,380	1,078	2,968	
A'Sharqiyah	389,688	12,481	38,215	61,953	112,649	12,481	38,725	61,281	112,487	110	138	53,923	2,919,834	9,147,156	
Sur	86,983	1,263	9,368	14,750	25,381	1,263	14,886	26,941	43,090	133	151	13,106	2,886,790	9,045,426	
Ibra	32,148	1,015	3,196	5,167	9,378	1,015	2,625	4,134	7,774	117	142	4,554	30,604	95,481	
Biddiyah	20,555	786	1,848	3,224	5,858	786	1,624	2,178	4,588	99	133	2,725	130	338	
Al-Qabil	14,943	587	1,278	2,342	4,207	587	1,169	1,535	3,291	108	137	2,051	14	26	
Al-Mudhhabi	72,276	3,674	6,471	10,646	20,791	3,674	5,612	8,207	17,493	109	138	9,945	754	2,006	
D. W. Al-Tay	20,168	1,316	1,679	2,777	5,772	1,316	1,555	2,084	4,955	95	131	2,632	0	0	
A. K. W. Alwa	24,081	672	2,327	3,915	6,914	672	1,905	2,709	5,286	102	134	3,224	271	629	
J. B. B. Ali	65,125	1,359	6,879	10,684	18,922	1,359	5,057	7,467	13,883	99	132	8,617	1,128	2,925	
J. B. B. Hass	31,521	1,264	2,949	4,866	9,079	1,264	2,457	3,441	7,162	97	132	4,147	123	287	
W. B. Khalid	10,971	277	1,202	1,742	3,221	277	917	1,313	2,507	94	130	1,427	21	38	
Massirah	10,917	268	1,018	1,840	3,126	268	918	1,272	2,458	108	137	1,495	0	0	
Al-Wusta	31,389	2,853	2,608	4,856	10,317	2,853	1,423	3,327	7,603	135	152	4,756	0	0	
Haima	4,468	245	455	792	1,492	245	253	798	1,296	177	176	785	0	0	
Mahut	12,939	1,169	1,058	2,011	4,238	1,169	511	1,109	2,789	118	143	1,845	0	0	
A'Duqum	6,189	680	508	859	2,047	680	333	648	1,661	117	142	877	0	0	
Al-Jazir	7,793	759	587	1,194	2,540	759	326	772	1,857	151	160	1,249	0	0	
Dhofar	254,226	8,287	35,986	62,688	106,961	8,287	35,986	62,688	106,961	143	156	39,786	52,467	128,063	
Salalah	187,178	6,926	26,076	45,854	78,856	6,926	28,551	51,600	87,077	151	161	30,045	51,828	126,676	
Thumrait	8,751	600	1,086	2,012	3,698	600	1,136	1,658	3,394	138	153	1,338	383	708	
Taqah	19,629	175	2,978	5,051	8,204	175	2,065	3,020	5,260	121	144	2,821	0	0	
Marbat	17,738	111	2,824	4,530	7,465	111	1,734	2,927	4,772	121	144	2,553	56	179	
Sadah	6,689	190	1,030	1,613	2,833	190	737	1,149	2,076	122	145	967	106	196	
Rakhiyout	4,855	31	735	1,249	2,015	31	586	776	1,393	121	144	698	0	0	
Dhalkout	3,198	64	468	803	1,335	64	421	495	980	121	144	460	0	0	
Magshan	712	15	115	170	300	15	98	164	277	103	145	103	0	0	
S. W. Al-Halq	5,476	175	674	1,406	2,255	175	658	899	1,732	125	146	801	94	303	

* Gross Value Added

** FGM: Finished Goods Manufactured

Wilayat Characteristics of 2025, 1/2

Region/Wilayat	Employed Population by Economic Activity										Monthly Income/capita	Car Ownership		GVA* of Industry RO 1000	FGM** RO 1000
	Residence Base			Workplace Base				Total	Tertiary Sector	Number of Vehicles/1000psns		Private Cars			
	Population	Primary Sector	Secomndar sector	Tertiary Sector	Total	Primary Sector	Secomndar sector						Tertiary Sector		
Oman	2,921,512	114,391	380,574	665,412	1,160,377	114,391	380,574	665,412	1,160,377	170	172	502,748	5,371,365	16,171,750	
Muscat	776,534	6,457	153,929	282,262	442,848	6,457	162,649	316,139	485,245	278	235	182,328	664,593	1,710,299	
Muttrah	135,267	208	22,107	58,170	80,485	208	32,684	90,447	123,339	343	280	37,937	97,933	267,685	
Baushar	207,805	659	42,119	73,021	115,799	659	46,485	120,706	167,850	320	266	55,281	230,709	618,607	
A-Seeb	298,950	1,597	61,886	104,658	168,141	1,597	64,748	83,328	149,673	239	214	63,994	312,093	776,539	
Al-Amrat	59,747	265	13,608	20,873	34,746	265	8,502	9,195	17,962	191	184	10,986	16,606	32,822	
Muscat	21,862	413	3,639	8,777	12,829	413	4,206	4,716	9,335	241	215	4,700	3,647	7,287	
Quriyat	52,903	3,315	10,570	16,763	30,648	3,315	6,024	7,747	17,086	181	178	9,430	3,605	7,359	
Al-Batinah	807,548	60,883	64,307	133,790	258,980	60,883	60,169	111,114	232,166	115	141	114,091	425,330	1,256,563	
Sohar	135,580	6,542	12,719	24,441	43,702	6,542	22,587	43,031	72,160	134	151	20,469	380,634	1,151,883	
Al-Rustaq	89,404	3,498	8,308	16,822	28,628	3,498	4,327	8,185	16,010	99	132	11,838	2,119	4,845	
Shinas	56,915	5,805	3,726	8,681	18,212	5,805	2,770	5,443	14,018	103	135	7,660	699	1,293	
Liwa	28,921	2,578	1,925	4,705	9,208	2,578	1,375	2,547	6,500	101	133	3,855	771	1,426	
Saham	104,884	9,756	7,721	16,154	33,631	9,756	5,293	10,540	25,589	113	140	14,639	2,175	4,812	
Al-Khabourah	53,499	4,951	3,623	8,472	17,046	4,951	2,431	4,977	12,359	112	139	7,430	625	1,156	
Al-Suwa'iq	126,439	9,983	10,036	20,562	40,581	9,983	7,901	13,492	31,376	116	141	17,879	16,406	35,105	
Nakhal	23,417	1,447	2,271	3,876	7,594	1,447	1,347	2,524	5,318	97	132	3,080	625	1,156	
W. Al-Maawil	12,476	1,007	866	2,092	3,965	1,007	729	1,083	2,819	98	132	1,645	1,446	2,708	
Al-Awabi	14,232	830	1,328	2,432	4,590	830	844	1,487	3,161	96	131	1,860	625	1,156	
Al-Musana'a	65,642	5,318	4,791	10,835	20,944	5,318	3,128	6,290	14,736	115	141	9,247	2,289	5,456	
Barka	96,139	9,168	6,993	14,718	30,879	9,168	7,437	11,515	28,120	134	151	14,489	16,916	45,565	
Musandam	35,012	2,306	2,662	7,925	12,893	2,306	2,662	7,925	12,893	133	151	5,296	2,500	4,625	
Khasab	22,307	1,080	1,869	5,270	8,219	1,080	1,888	5,726	8,694	140	154	3,440	625	1,156	
Bukha	3,308	199	237	788	1,224	199	231	565	995	117	142	470	625	1,156	
Daba Al-baiva	6,964	884	398	1,265	2,567	884	366	1,226	2,476	132	150	1,042	625	1,156	
Madhaa	2,433	143	158	582	883	143	177	408	728	116	141	344	625	1,156	
A'Dhahirah	294,133	11,184	36,835	47,088	95,107	11,184	36,201	43,674	91,059	138	154	39,169	74,582	172,431	
Al-Buraimi	83,953	1,457	13,152	16,966	31,575	1,457	14,861	23,509	39,827	169	171	14,339	51,708	125,574	
Ibri	118,043	5,814	16,856	21,364	44,034	5,814	12,413	13,578	31,805	128	148	17,413	7,816	17,450	
Mahdhah	11,187	1,598	992	1,590	4,180	1,598	2,757	1,957	6,312	136	152	1,702	13,065	24,956	
Yanqul	20,551	1,181	2,939	3,575	7,695	1,181	4,060	2,362	7,603	111	139	2,854	1,116	2,482	
Dhank	20,399	1,134	2,896	3,593	7,623	1,134	2,110	2,268	5,512	114	140	2,861	877	1,968	

* GVA: Gross Value Added

** FGM: Finished Goods Manufactured

Wilayah Characteristics of 2025, 2/2

Region/Wilayah	Employed Population by Economic Activity										Monthly Income/capita	Car Ownership		GVA* of Industry RO 1000	FGM** RO 1000
	Population		Residence Base		Workplace Base		Economic Activity		Ownership Vehicles/1000psns	Private Cars					
	Primary Sector	Secomdar sector	Primary Sector	Total	Primary Sector	Secomdar sector	Tertiary Sector	Total							
A/Dakhliah	333,988	7,088	35,559	55,992	98,639	7,088	32,026	49,205	88,319	124	146	48,729	67,784	158,832	
Nizwa	89,680	1,384	9,842	15,324	26,550	1,384	14,065	23,038	38,487	139	154	13,783	53,323	128,151	
Samail	58,032	1,821	6,038	9,304	17,163	1,821	4,077	6,369	12,267	122	144	8,370	18,700	3,795	
Bahla	62,341	974	6,709	10,679	18,362	974	4,622	6,529	12,125	122	144	9,006	4,686	10,019	
Adam	16,809	464	1,684	2,808	4,956	464	1,363	1,817	3,644	113	140	2,350	1,405	2,612	
Al-Hamra	20,347	543	2,082	3,352	5,977	543	1,431	1,963	3,937	108	137	2,785	1,070	2,286	
Manah	15,210	399	1,551	2,522	4,472	399	1,122	1,538	3,059	110	138	2,102	1,060	1,996	
Izki	44,987	783	4,881	7,630	13,294	783	3,305	4,969	9,057	122	144	6,492	2,530	5,472	
Bidbid	26,582	720	2,772	4,373	7,865	720	2,041	2,982	5,743	122	144	3,841	1,840	4,501	
A/Shariyah	412,282	14,049	43,459	66,388	123,896	14,049	44,301	66,803	125,153	130	149	61,517	4,042,758	12,641,672	
Sur	93,425	1,440	10,818	15,978	28,236	1,440	18,310	29,296	49,046	158	164	15,354	3,999,329	12,515,661	
Ibra	34,528	1,134	3,705	5,598	10,437	1,134	2,917	4,583	8,634	138	153	5,289	35,050	108,558	
Biddiyah	21,180	879	2,042	3,387	6,308	879	1,739	2,318	4,936	117	142	3,007	772	1,539	
Al-Qabil	15,120	656	1,380	2,427	4,463	656	1,236	1,594	3,486	128	148	2,234	642	1,188	
Al-Mudhaibi	75,957	4,106	7,301	11,350	22,757	4,106	6,067	8,917	19,090	129	148	11,255	1,475	3,418	
D. W. Al-Tayeh	20,976	1,470	1,864	2,935	6,269	1,470	1,681	2,255	5,406	113	139	2,925	625	1,156	
A. K. W. Alwafi	25,107	751	2,610	4,153	7,514	751	2,061	2,921	5,733	120	144	3,605	931	1,866	
J. B. B. Ali	69,494	1,550	7,874	11,524	20,948	1,550	5,568	8,283	15,401	117	142	9,844	1,896	4,452	
J. B. B. Hassan	33,166	1,442	3,321	5,181	9,944	1,442	2,672	3,762	7,876	115	141	4,667	764	1,479	
W. B. Khalid	11,988	315	1,405	1,913	3,633	315	1,049	1,506	2,870	112	139	1,665	649	1,201	
Massirah	11,341	306	1,139	1,942	3,387	306	1,001	1,368	2,675	127	147	1,672	625	1,156	
Al-Wusta	33,677	3,251	3,057	5,240	11,548	3,251	1,800	3,825	8,876	159	165	5,571	2,499	4,623	
Haima	4,838	278	539	863	1,680	278	324	881	1,483	209	195	945	625	1,156	
Mahut	13,761	1,333	1,226	2,154	4,713	1,333	636	1,287	3,256	140	154	2,124	625	1,156	
A/Duqum	6,772	775	607	944	2,326	775	425	770	1,970	138	153	1,038	625	1,156	
Al-Jazir	8,306	865	685	1,279	2,829	865	415	887	2,167	178	176	1,464	624	1,154	
Dhofar	288,338	9,173	40,766	66,727	116,666	9,173	40,766	66,727	116,666	169	172	46,047	91,319	222,705	
Salalah	198,070	7,621	29,674	48,897	86,192	7,621	32,707	54,977	95,305	179	177	34,964	85,598	211,889	
Thumrait	9,314	685	1,238	2,142	4,065	685	1,244	1,776	3,705	163	167	1,557	1,057	1,955	
Taqah	20,422	199	3,310	5,330	8,839	199	2,200	3,172	5,571	143	156	3,181	625	1,156	
Marbat	18,753	127	3,188	4,836	8,151	127	1,884	3,117	5,128	143	156	2,925	688	1,359	
Sadah	7,153	217	1,173	1,734	3,124	217	823	1,244	2,284	145	157	1,122	745	1,378	
Rakhiyout	4,977	35	803	1,306	2,144	35	638	812	1,485	143	156	776	625	1,156	
Dhalkout	3,298	73	514	841	1,428	73	468	527	1,068	143	156	514	625	1,156	
Maqshan	7,78	17	134	186	337	17	118	181	316	146	158	123	625	1,156	
S. W. Al-Halanyyat	5,573	199	732	1,455	2,386	199	684	921	1,804	148	159	885	731	1,498	

* GVA: Gross Value Added

** FGM: Finished Goods Manufactured

Wilayat Characteristics of 2030, 1/2

Region/Wilayat	Employed Population by Economic Activity										Monthly Income/capita	Car Ownership		GVA* of Industry RO 1000	FGM** RO 1000
	Residence Base					Workplace Base						Vehicles/1000psns	Private Cars		
	Population	Primary Sector	Secomndar sector	Tertiary Sector	Total	Primary Sector	Secomndar sector	Tertiary Sector	Total						
Oman	3,027,385	127,855	432,322	705,167	1,265,344	127,855	432,322	705,167	1,265,344	203	191	577,759	6,989,199	20,972,213	
Muscat	799,612	7,076	174,951	298,603	480,630	7,076	183,014	329,300	519,390	331	273	213,182	841,716	2,166,361	
Muttrah	127,937	215	23,125	58,979	82,319	215	35,411	91,260	126,886	409	321	41,035	126,838	349,100	
Baushar	218,294	722	48,760	78,212	127,694	722	52,714	125,414	178,850	382	305	66,500	288,900	772,290	
A-Seeb	311,849	1,750	71,110	111,806	184,666	1,750	74,416	89,353	165,519	285	244	75,977	395,393	984,306	
Al-Amrat	63,969	291	15,900	22,648	38,839	291	9,532	10,209	20,032	228	207	13,214	21,124	41,647	
Muscat	21,590	427	3,795	8,891	13,113	427	4,332	4,624	9,383	287	245	5,284	4,479	8,950	
Quriyat	55,973	3,671	12,261	18,067	33,999	3,671	6,609	8,440	18,720	216	200	11,172	4,982	10,063	
Al-Batinah	832,455	68,105	73,248	140,833	282,186	68,105	69,620	119,636	257,361	138	153	127,747	577,507	1,693,239	
Sohar	141,517	7,217	14,750	26,042	48,009	7,217	27,291	46,037	80,545	160	166	23,425	516,512	1,553,391	
Al-Rustaq	91,570	3,911	9,421	17,696	31,028	3,911	4,828	8,824	17,563	118	142	13,033	3,157	6,977	
Shinas	58,272	6,592	4,151	9,015	19,758	6,592	3,081	5,842	15,515	123	145	8,452	1,413	2,614	
Liwa	29,136	2,928	2,102	4,844	9,874	2,928	1,512	2,681	7,121	120	143	4,178	1,502	2,779	
Saham	108,219	10,892	8,789	17,003	36,684	10,892	5,941	11,424	28,257	135	151	16,371	3,226	6,936	
Al-Khabourah	54,110	5,535	4,017	8,781	18,333	5,535	2,667	5,247	13,449	133	150	8,139	1,323	2,448	
Al-Suwa'iq	130,695	11,159	11,465	21,683	44,307	11,159	9,008	14,698	34,865	139	154	20,069	20,704	44,141	
Nakhal	24,974	1,626	2,663	4,183	8,472	1,626	1,577	2,856	6,059	116	141	3,527	1,323	2,448	
W. Al-Maawil	12,487	1,125	948	2,158	4,231	1,125	818	1,141	3,084	117	142	1,768	2,330	4,350	
Al-Awabi	14,984	928	1,544	2,602	5,074	928	982	1,663	3,573	114	140	2,101	1,323	2,448	
Al-Musana'a	66,596	5,945	5,349	11,274	22,568	5,945	3,463	6,667	16,075	137	153	10,182	3,366	7,727	
Barka	99,895	10,248	8,049	15,551	33,848	10,248	8,452	12,556	31,256	159	165	16,502	21,328	56,982	
Musandam	36,669	2,616	3,128	8,320	14,064	2,616	3,128	8,320	14,064	159	165	6,085	5,292	9,790	
Khasab	23,468	1,226	2,208	5,556	8,990	1,226	2,251	6,052	9,529	167	170	3,980	1,323	2,448	
Bukha	3,410	226	274	820	1,320	226	261	581	1,068	140	154	526	1,323	2,448	
Daba Al-baiva	7,334	1,004	467	1,344	2,815	1,004	413	1,273	2,690	157	164	1,201	1,323	2,448	
Madhaa	2,457	160	179	600	939	160	203	414	777	139	154	378	1,323	2,448	
A'Dhahirah	285,404	12,492	41,208	50,222	103,922	12,492	40,564	46,882	99,938	164	168	45,013	111,906	260,671	
Al-Buraimi	88,910	1,618	14,925	18,271	34,814	1,618	17,455	25,253	44,326	201	190	16,920	81,594	199,018	
Ibri	122,086	6,500	18,668	22,634	47,802	6,500	13,359	14,470	34,329	152	161	19,680	10,153	22,456	
Mahdhah	11,678	1,786	1,110	1,677	4,573	1,786	3,158	2,166	7,110	162	167	1,950	16,600	31,675	
Yanqul	21,498	1,320	3,283	3,818	8,421	1,320	4,303	2,549	8,172	133	150	3,233	1,926	4,077	
Dhank	21,232	1,268	3,222	3,822	8,312	1,268	2,289	2,444	6,001	136	152	3,230	1,633	3,446	

* GVA: Gross Value Added

** FGM: Finished Goods Manufactured

Wilayat Characteristics of 2030, 2/2

Region/Wilayat	Employed Population by Economic Activity										Monthly Income/capita	Car Ownership		GVA* of Industry	FGM**
	Residence Base		Workplace Base		Total	Tertiary Sector	Tertiary Sector	Total	Ownership Vehicles/1000psns	Private Cars		RO 1000	RO 1000		
	Primary Sector	Secomdar sector	Primary Sector	Secomdar sector											
A/Dakhlīyah	347,937	7,908	40,335	59,598	107,841	7,908	36,706	53,246	97,860	148	159	55,396	108,095	255,597	
Nizwa	93,944	1,532	11,226	16,375	29,133	1,532	16,755	24,802	43,089	166	169	15,870	86,450	210,729	
Samail	60,889	2,036	6,883	9,942	18,861	2,036	4,545	6,979	13,560	145	157	9,566	2,851	5,685	
Bahla	64,368	1,088	7,551	11,311	19,950	1,088	5,101	7,043	13,232	146	157	10,130	6,310	13,331	
Adam	17,397	518	1,902	2,974	5,394	518	1,516	1,969	4,003	135	152	2,636	2,281	4,236	
Al-Hamra	20,876	607	2,327	3,534	6,468	607	1,579	2,110	4,296	128	148	3,088	1,869	3,834	
Manah	15,657	447	1,740	2,663	4,850	447	1,247	1,660	3,354	131	150	2,342	1,857	3,479	
Izki	46,971	876	5,547	8,132	14,555	876	3,679	5,417	9,972	145	157	7,383	3,662	7,747	
Bidbid	27,835	804	3,159	4,667	8,630	804	2,284	3,266	6,354	146	157	4,381	2,815	6,556	
A/Shariqiyah	429,501	15,793	49,547	70,987	136,327	15,793	50,738	72,481	139,012	155	163	70,185	5,198,740	16,233,907	
Sur	98,784	1,636	12,479	17,246	31,361	1,636	22,090	31,744	55,470	188	182	18,003	5,143,326	16,079,788	
Ibra	36,508	1,268	4,286	6,042	11,596	1,268	3,265	5,044	9,577	165	168	6,144	40,127	123,441	
Biddiyah	21,475	982	2,276	3,561	6,819	982	1,888	2,462	5,332	140	154	3,313	1,503	2,916	
Al-Qabil	15,033	733	1,508	2,520	4,761	733	1,327	1,654	3,714	153	161	2,428	1,343	2,465	
Al-Mudhaibi	78,599	4,589	8,273	12,079	24,941	4,589	6,640	9,639	20,868	154	162	12,736	2,366	5,223	
D. W. Al-Tayeh	21,475	1,643	2,085	3,097	6,825	1,643	1,840	2,425	5,908	134	151	3,245	1,323	2,448	
A. K. W. Alwafi	25,770	839	2,943	4,404	8,186	839	2,258	3,138	6,235	144	156	4,027	1,699	3,320	
J. B. B. Ali	73,015	1,760	9,022	12,392	23,174	1,760	6,187	9,118	17,065	139	154	11,235	2,884	6,496	
J. B. B. Hassan	34,360	1,638	3,758	5,508	10,904	1,638	2,939	4,088	8,665	137	153	5,247	1,494	2,845	
W. B. Khalid	12,885	356	1,635	2,089	4,080	356	1,201	1,703	3,260	133	150	1,939	1,352	2,501	
Massirah	11,597	348	1,282	2,050	3,680	348	1,103	1,466	2,917	152	161	1,868	1,323	2,448	
Al-Wusta	35,270	3,691	3,565	5,634	12,890	3,691	2,212	4,332	10,235	190	183	6,473	5,289	9,785	
Haima	5,115	315	633	936	1,884	315	401	969	1,685	250	221	1,129	1,323	2,448	
Mahut	14,284	1,514	1,417	2,302	5,233	1,514	774	1,466	3,754	167	170	2,424	1,323	2,448	
A/Duqum	7,230	880	718	1,030	2,628	880	525	893	2,298	165	168	1,217	1,323	2,448	
Al-Jazir	8,641	982	797	1,366	3,145	982	512	1,004	2,498	212	197	1,703	1,320	2,442	
Dhofar	280,537	10,174	46,340	70,970	127,484	10,174	46,340	70,970	127,484	202	191	53,678	140,654	342,858	
Salalah	207,597	8,412	33,850	52,089	94,351	8,412	37,499	58,530	104,441	213	197	40,989	129,186	321,358	
Thumrait	9,819	778	1,415	2,277	4,470	778	1,377	1,896	4,051	194	186	1,824	1,853	3,428	
Taqah	21,040	226	3,706	5,627	9,559	226	2,377	3,333	5,936	170	171	3,608	1,323	2,448	
Marbat	19,638	144	3,614	5,157	8,915	144	2,071	3,317	5,532	171	172	3,373	1,400	2,696	
Sadah	7,574	246	1,339	1,859	3,444	246	925	1,342	2,513	172	173	1,309	1,470	2,720	
Rakhiyout	5,050	40	887	1,367	2,294	40	702	849	1,591	170	172	867	1,323	2,448	
Dhalkout	3,366	82	570	883	1,535	82	525	560	1,167	170	172	578	1,323	2,448	
Maqshan	842	20	155	202	377	20	140	146	359	174	174	146	1,323	2,448	
S. W. Al-Halanyyat	5,611	226	804	1,509	2,539	226	724	944	1,894	177	175	984	1,453	2,867	

* GVA: Gross Value Added

** FGM: Finished Goods Manufactured

APPENDIX 7-3

FUTURE OD TABLES (SMALL-ZONE BASE)

Appendix Table 7.3-1 OD Matrix in 2005 (All Vehicles)

	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	31	32	33	34	35	36	37	38	
1	0	5910	4626	783	735	618	113	2	119	127	32	17	117	77	160	35	21	22	90	129	2	70	0	59	0	215	222	22	32	28	304	174	116	19	42	31	72	96	
2	5910	0	6108	623	540	597	120	2	133	142	36	18	130	87	182	42	23	24	103	145	3	0	0	0	0	234	233	24	35	32	341	204	126	21	46	34	82	121	
3	4626	6108	0	795	655	1032	126	3	236	279	67	33	248	172	374	87	46	46	243	251	3	0	0	0	0	408	393	47	80	51	262	321	211	35	71	54	133	186	
4	783	623	795	0	98	179	20	1	26	26	7	4	24	17	32	6	4	5	18	39	2	0	0	0	0	47	46	4	7	5	30	33	25	4	9	7	16	17	
5	735	540	655	98	0	107	20	1	18	19	6	3	18	11	25	5	3	3	14	32	3	0	0	0	0	37	35	3	6	4	24	26	19	3	6	5	11	13	
6	618	597	1032	179	107	0	19	0	30	31	9	5	34	19	41	6	7	4	24	53	3	0	0	0	0	68	89	7	13	12	55	40	42	7	16	10	25	16	
7	113	120	126	20	20	19	0	0	1	2	0	0	1	1	2	0	0	0	1	2	0	0	0	0	0	2	3	0	1	0	2	2	1	0	0	0	1	1	
8	2	2	3	1	1	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	0	0	0	
9	119	133	236	26	18	30	1	0	0	17	66	46	76	15	39	2	5	3	21	30	0	18	0	88	67	27	33	6	95	6	23	12	17	3	6	4	11	6	
10	127	142	279	26	19	31	2	0	17	0	4	2	19	15	40	24	28	42	47	61	2	0	0	0	0	28	7	2	1	1	18	12	13	2	3	4	8	5	
11	32	36	67	7	6	9	0	0	66	4	0	1	20	5	10	1	1	1	6	8	1	0	0	48	0	25	22	2	22	4	6	3	5	1	2	1	3	1	
12	17	18	33	4	3	5	0	0	46	2	1	0	11	2	5	0	1	0	3	4	1	0	0	0	0	12	11	1	10	2	4	1	2	0	1	1	1	1	
13	117	130	248	24	18	34	1	0	76	19	20	11	0	12	40	3	6	3	22	28	1	0	0	0	0	35	42	4	42	6	21	11	16	2	6	5	11	5	
14	77	87	172	17	11	19	1	0	15	15	5	2	12	0	68	2	5	4	21	24	1	0	0	0	0	15	34	2	12	3	12	7	9	2	3	3	6	3	
15	160	182	374	32	25	41	2	0	39	40	10	5	40	68	0	8	11	10	54	56	1	0	0	0	0	42	55	4	23	9	23	14	16	4	7	6	12	7	
16	35	42	87	6	5	6	0	0	2	24	1	0	3	2	8	0	6	0	16	32	0	0	0	0	0	4	12	0	2	2	3	3	2	1	1	1	2	1	
17	21	23	46	4	3	7	0	0	5	28	1	1	6	5	11	6	0	6	6	8	1	0	0	0	0	7	11	1	2	2	4	4	3	1	2	2	1	1	
18	22	24	46	5	3	4	0	0	3	42	1	0	3	4	10	0	6	0	12	18	0	0	0	0	5	10	1	2	2	2	2	2	2	1	1	1	1	1	
19	90	103	243	18	14	24	1	0	21	47	6	3	22	21	54	16	6	12	0	42	1	0	0	0	0	29	27	2	4	4	13	11	10	2	3	3	6	5	
20	129	145	251	39	32	53	2	0	30	61	8	4	28	24	56	32	8	18	42	0	2	0	0	0	0	45	47	4	7	7	25	21	19	4	7	5	12	10	
21	2	3	3	2	3	3	0	0	0	2	1	1	1	1	1	0	1	0	1	2	0	0	0	0	0	1	1	1	16	1	2	2	2	1	1	1	1	2	
22	70	0	0	0	0	0	0	0	18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	178	59	25	0	0	0	7	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	11	0	0	0	0	0	0	0	0	0	0	0	0	0
24	59	0	0	0	0	0	0	0	88	0	48	0	0	0	0	0	0	0	0	0	0	0	0	59	6	0	14	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	67	0	0	0	0	0	0	0	0	0	0	0	0	0	0	25	11	14	0	3	0	0	0	0	0	0	0	0	0	0	0
26	215	234	408	47	37	68	2	0	27	28	25	12	35	15	42	4	7	5	29	45	1	0	0	0	62	0	243	183	28	46	34	22	20	6	8	8	22	10	
27	222	233	393	46	35	89	3	0	33	7	22	11	42	34	55	12	11	10	27	47	1	0	0	0	0	243	0	48	183	222	89	16	26	16	7	15	29	6	
28	22	24	47	4	3	7	0	0	6	2	2	1	4	2	4	0	1	1	2	4	1	0	0	0	3	183	48	0	6	7	6	3	4	1	1	1	2	2	1
29	32	35	80	7	6	13	1	0	95	1	22	10	42	12	23	2	2	2	4	7	16	0	0	0	0	28	183	6	0	18	11	2	2	2	1	3	3	2	
30	28	32	51	5	4	12	0	0	6	1	4	2	6	3	9	2	2	2	4	7	1	7	0	0	0	46	222	7	18	0	11	3	3	2	1	3	4	1	
31	304	341	262	30	24	55	2	0	23	18	6	4	21	12	23	3	4	2	13	25	2	0	0	0	34	89	6	11	11	0	9	180	23	61	72	100	4	4	
32	174	204	321	33	26	40	2	0	12	12	3	1	11	7	14	3	4	2	11	21	2	0	0	0	0	22	16	3	2	3	9	0	12	2	5	2	5	27	
33	116	126	211	25	19	42	1	0	17	13	5	2	16	9	16	2	3	2	10	19	2	0	0	0	20	26	4	2	3	180	12	0	12	76	25	46	5		
34	19	21	35	4	3	7	0	0	3	2	1	0	2	2	4	1	1	1	2	4	1	0	0	0	6	16	1	2	2	2	23	2	12	0	5	6	8	0	
35	42	46	71	9	6	16	0	0	6	3	2	1	6	3	7	1	2	1	3	7	1	0	0	0	8	7	1	1	1	61	5	76	5	0	9	18	2		
36	31	34	54	7	5	10	0	0	4	4	1	1	5	3	6	1	2	1	3	5	1	0	0	0	8	15	1	3	3	72	2	25	6	9	0	21	0		
37	72	82	133	16	11	25	1	0	11	8	3	1	11	6	12	2	1	1	6	12	1	0	0	0	22	29	2	3	4	100	5	46	8	18	21	0	2		
38	96	121	186	17	13	16	1	0	6	5	1	1	5	3	7	1	1	1	5	10	2	0	0	0	10	6	1	2	1	4	27	5	0	2	0	2	0		
39	211	219	426	50	38	93	7	0	19	17	5	3	18	10	20	2	4	2	14	28	3	0	0	0	48	83	4	13	11	63	33	40	14	14	10	22	14		
40	70	78	116	14	11	17	0	0	9	7	2	2	8	4	7	2	2	1	5	9	0	0	0	0	20	15	2	1	2	8	5	9	7	4	2	3	2		
41	44	48	72	9	7	11	0	0	6	4	2	1	4	4	6	1	2	1	4	5	0	0	0	0	12	17	1	3	3	12	3	9	5	4	2	5	1		
42	40	45	64	8	6	10	0	0	5	4	2	1	5	2	5	1	2	1	4	6	0	0	0	0	12	16	1	2	2	11	2	8	3	2	2	3	1		
43	90	100	154	19	14	25	0	0	12	9	3	2	11	6	13	2	3	2	8	14	0	0	0	1	30	51	3	6	7	61	9	51	160	14	15	161	4		
44	102	118	76	9	7	9	0	0	3	3	1	0	3	2	4	1	1	3	4	1	0	0	0	0	7	4	1	1	1	16	3	0	1	0	1	7	1		
45	11	13	19	2	1	5	0	0	2	1	1	0	3	1	3	0	2	0	1	2	0	0	0	0	12	11	1	1	2	5	1	6	3	2	0	3	1		
46	23	26	39	5	4	8	0	0	5	3	1	1	5	3	4	1	2	1	2	3	0	0	0	0	25	27	3	3	13	4	11	4	4	2	4	1	1		
47	12	12	19	2	2	4	0	0	2	1	1	1	2	1	3	0	1	0	1	2	0	0	0	0	11	13	1	1	2	6	1	5	2	2	0	3</			

Appendix Table 7.3-2 OD Matrix in 2010 (All Vehicles)

	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	31	32	33	34	35	36	37	38	
1	0	5,796	4,399	758	601	575	106	2	294	237	75	38	238	142	314	68	34	36	158	239	2	62	0	33	0	218	211	22	24	28	287	155	100	17	36	26	63	85	
2	5,796	0	6,381	661	485	612	127	2	354	287	91	46	286	174	389	88	41	44	197	293	2	0	0	0	0	257	239	26	27	34	346	198	119	21	43	32	77	116	
3	4,399	6,381	0	823	578	1,038	136	3	603	525	153	73	507	321	748	171	78	80	431	471	3	0	0	0	0	435	387	49	63	51	270	295	191	32	65	49	119	170	
4	758	661	823	0	86	180	20	1	69	52	17	8	52	32	66	13	7	9	33	75	2	0	0	0	0	52	48	6	6	31	32	23	4	8	6	14	17		
5	601	485	578	86	0	92	17	1	41	31	11	6	33	19	43	8	4	5	22	52	2	0	0	0	0	34	30	3	5	4	21	21	15	2	5	4	9	10	
6	575	612	1,038	180	92	0	19	0	79	57	22	10	64	34	80	11	12	7	43	96	3	0	0	0	0	74	86	8	10	12	59	37	38	7	14	9	23	15	
7	106	127	136	20	17	19	0	0	3	2	1	0	2	1	3	1	0	0	2	3	0	0	0	0	0	3	3	0	0	2	2	1	0	0	0	1	1		
8	2	2	3	1	1	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	0	0	0	
9	294	354	603	69	41	79	3	0	0	88	411	285	382	71	200	13	22	14	102	151	1	42	0	133	118	62	87	17	197	16	59	28	41	9	14	11	26	13	
10	237	287	525	52	31	57	2	0	88	0	20	11	78	54	169	95	103	150	183	244	2	0	0	0	0	58	11	6	2	2	36	22	23	5	7	8	15	9	
11	75	91	153	17	11	22	1	0	411	20	0	8	99	20	53	3	7	3	27	36	2	0	0	76	0	62	54	5	39	9	16	6	10	3	5	2	7	3	
12	38	46	73	8	6	10	0	0	285	11	8	0	53	11	25	1	4	1	14	17	1	0	0	0	0	29	25	5	18	5	8	4	5	1	2	1	3	1	
13	238	286	507	52	33	64	2	0	382	78	99	53	0	44	181	13	20	12	92	123	1	0	0	0	0	73	88	10	65	14	45	22	32	6	12	11	21	9	
14	142	174	321	32	19	34	1	0	71	54	20	11	44	0	288	11	20	15	78	97	1	0	0	1	0	29	64	4	17	5	24	13	16	4	6	7	10	7	
15	314	389	748	66	43	80	3	0	200	169	53	25	181	288	0	35	43	36	217	237	1	0	0	0	0	89	107	8	37	19	47	27	32	6	12	11	22	13	
16	68	88	171	13	8	11	1	0	13	95	3	1	13	11	35	0	18	0	55	126	0	0	0	0	0	9	23	2	2	3	6	7	4	1	1	1	3	2	
17	34	41	78	7	4	12	0	0	22	103	7	4	20	20	43	18	0	17	19	30	1	0	0	0	0	13	16	2	3	5	6	6	2	4	3	2	2		
18	36	44	80	9	5	7	0	0	14	150	3	1	12	15	36	0	17	0	42	61	0	0	0	0	0	9	18	2	2	3	5	3	3	1	1	1	2	1	
19	158	197	431	33	22	43	2	0	102	183	27	14	92	78	217	55	19	42	0	153	1	0	0	0	0	57	47	6	6	7	23	18	17	3	6	5	10	8	
20	239	293	471	75	52	96	3	0	151	244	36	17	123	97	237	126	30	61	153	0	3	0	0	0	0	93	86	8	9	14	50	38	35	6	12	9	23	19	
21	2	2	3	2	2	3	0	0	1	2	2	1	1	1	1	0	1	0	1	3	0	0	0	0	0	1	1	1	1	2	2	1	1	1	1	1	1	1	
22	62	0	0	0	0	0	0	0	42	0	0	0	0	0	0	0	0	0	0	0	0	0	0	174	32	16	0	0	0	7	0	0	0	0	0	0	0	0	0
23	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	0	0	0	0	0	0	0	0	
24	33	0	0	0	0	0	0	0	133	0	76	0	0	1	0	0	0	0	0	0	0	0	32	4	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	118	0	0	0	0	0	0	0	0	0	0	0	0	16	8	6	6	43	0	2	0	0	0	0	0	0	0	0	0	0	
26	218	257	435	52	34	74	3	0	62	58	62	29	73	29	89	9	13	9	57	93	1	0	0	0	43	0	261	205	23	50	38	23	20	6	8	7	22	9	
27	211	239	387	48	30	86	3	0	87	11	54	25	88	64	107	23	16	18	47	86	1	0	0	0	0	261	0	51	141	225	91	16	23	15	6	14	26	5	
28	22	26	49	6	3	8	0	0	17	6	5	5	10	4	8	2	2	2	6	8	1	0	0	0	2	205	51	0	4	8	7	3	4	1	1	1	2	1	
29	24	27	63	6	5	10	0	0	197	2	39	18	65	17	37	2	3	2	6	9	12	0	0	0	0	23	141	4	0	13	9	2	2	1	0	1	3	2	
30	28	34	51	6	4	12	0	0	16	2	9	5	14	5	19	3	5	3	7	14	1	7	0	0	0	50	225	8	13	0	12	3	3	2	1	3	4	1	
31	287	346	270	31	21	59	2	0	59	36	16	8	45	24	47	6	6	5	23	50	2	0	0	0	0	38	91	7	9	12	0	9	169	24	57	68	96	5	
32	155	198	295	32	21	37	2	0	28	22	6	4	22	13	27	7	6	3	18	38	2	0	0	0	0	23	16	3	2	3	9	0	10	2	4	2	4	25	
33	100	119	191	23	15	38	1	0	41	23	10	5	32	16	32	4	6	3	17	35	1	0	0	0	0	20	23	4	2	3	169	10	0	11	63	21	39	3	
34	17	21	32	4	2	7	0	0	9	5	3	1	6	4	6	1	2	1	3	6	1	0	0	0	0	6	15	1	1	2	24	2	11	0	4	5	8	0	
35	36	43	65	8	5	14	0	0	14	7	5	2	12	6	12	1	4	1	6	12	1	0	0	0	0	8	6	1	0	1	57	4	63	4	0	7	15	2	
36	26	32	49	6	4	9	0	0	11	8	2	1	11	7	11	1	3	1	5	9	1	0	0	0	0	7	14	1	1	3	68	2	21	5	7	0	18	0	
37	63	77	119	14	9	23	1	0	26	15	7	3	21	10	22	3	2	2	10	23	1	0	0	0	0	22	26	2	3	4	96	4	39	8	15	18	0	2	
38	85	116	170	17	10	15	1	0	13	9	3	1	9	7	13	2	2	1	8	19	1	0	0	0	0	9	5	1	2	1	5	25	3	0	2	0	2	0	
39	239	272	534	61	40	112	9	0	56	35	14	7	42	22	48	4	8	4	28	62	3	0	0	0	0	62	97	5	12	13	84	39	43	15	14	11	24	16	
40	70	84	118	16	10	19	0	0	25	14	7	5	21	9	18	4	3	1	10	21	0	0</																	

Appendix Table 7.3-3 OD Matrix in 2020 (All Vehicles)

	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	31	32	33	34	35	36	37	38	
1	0	6903	5481	899	565	651	155	1	410	272	85	40	280	159	385	84	37	41	179	297	2	85	0	38	0	282	234	26	24	31	370	185	115	19	40	29	72	99	
2	6903	0	9617	948	552	840	227	2	594	398	124	59	405	234	577	127	54	62	268	437	2	0	0	0	0	399	320	37	35	46	537	282	162	27	57	43	106	163	
3	5481	9617	0	1222	680	1485	254	3	1127	765	226	102	760	455	1195	265	108	117	626	764	3	0	0	0	0	716	538	72	78	73	465	433	268	43	88	66	169	245	
4	899	948	1222	0	97	241	33	1	120	74	23	11	75	44	101	20	10	13	46	117	2	0	0	0	0	83	65	7	7	9	51	46	32	6	11	8	20	23	
5	565	552	680	97	0	96	23	1	57	36	12	6	39	21	52	10	4	6	25	63	1	0	0	0	0	43	32	3	4	4	28	24	16	3	5	5	9	12	
6	651	840	1485	241	96	0	30	0	147	79	31	14	93	47	121	17	16	10	58	147	3	0	0	0	0	117	114	10	11	15	96	50	49	8	18	11	29	20	
7	155	227	254	33	23	30	0	0	10	5	2	1	5	3	8	1	1	1	4	7	0	0	0	0	0	6	4	1	1	1	5	2	2	0	1	0	1	1	
8	1	2	3	1	1	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	0	0	0	0
9	410	594	1127	120	57	147	10	0	0	136	640	418	603	107	318	19	31	21	149	251	3	71	0	187	150	132	147	32	331	28	117	49	64	13	21	16	40	22	
10	272	398	765	74	36	79	5	0	136	0	27	14	105	68	232	136	122	203	227	333	2	0	0	0	0	86	19	7	2	4	57	30	31	5	9	10	20	13	
11	85	124	226	23	12	31	2	0	640	27	0	10	132	25	70	4	8	4	32	50	2	0	0	95	0	93	70	7	50	11	24	9	13	3	5	3	8	4	
12	40	59	102	11	6	14	1	0	418	14	10	0	69	13	32	1	4	1	17	23	1	0	0	0	0	41	31	5	22	6	12	5	6	1	2	2	4	2	
13	280	405	760	75	39	93	5	0	603	105	132	69	0	59	252	18	26	17	119	175	2	0	0	0	0	114	117	15	86	19	72	31	43	7	15	13	29	14	
14	159	234	455	44	21	47	3	0	107	68	25	13	59	0	371	14	22	17	96	130	1	0	0	1	0	42	80	5	22	7	36	17	21	5	7	8	13	8	
15	385	577	1195	101	52	121	8	0	318	232	70	32	252	371	0	49	55	51	289	354	2	0	0	0	0	139	149	12	49	27	79	40	45	9	16	15	31	19	
16	84	127	265	20	10	17	1	0	19	136	4	1	18	14	49	0	24	0	73	181	1	0	0	0	0	14	34	3	4	6	10	8	6	1	2	2	4	4	
17	37	54	108	10	4	16	1	0	31	122	8	4	26	22	55	24	0	21	21	39	1	0	0	0	0	17	21	3	4	6	10	8	7	2	4	3	3	3	
18	41	62	117	13	6	10	1	0	21	203	4	1	17	17	51	0	21	0	53	82	0	0	0	0	0	13	24	2	2	4	7	4	5	1	2	2	3	1	
19	179	268	626	46	25	58	4	0	149	227	32	17	119	96	289	73	21	53	0	215	1	0	0	0	0	82	60	7	6	9	36	24	23	4	7	6	14	11	
20	297	437	764	117	63	147	7	0	251	333	50	23	175	130	354	181	39	82	215	0	4	0	0	0	0	149	126	11	13	19	86	59	50	9	16	13	33	28	
21	2	2	3	2	1	3	0	0	3	2	2	1	2	1	2	1	1	1	0	1	4	0	0	0	0	1	1	1	1	9	1	3	1	1	1	1	1	1	1
22	85	0	0	0	0	0	0	0	71	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	237	51	23	0	0	0	0	0	0	0	0	0	0	0
23	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	0	0	0	0	0	0	0	0	0
24	38	0	0	0	0	0	0	0	187	0	95	0	0	1	0	0	0	0	0	0	0	0	0	0	0	51	4	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	150	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	23	8	7	0	0	0	0	0	0	0	0	0	0	0
26	282	399	716	83	43	117	6	0	132	86	93	41	114	42	139	14	17	13	82	149	1	0	0	0	56	0	385	320	32	76	74	35	31	9	12	11	32	15	
27	234	320	538	65	32	114	4	0	147	19	70	31	117	80	149	34	21	24	60	126	1	0	0	0	0	385	0	66	173	288	145	21	31	19	8	17	35	7	
28	26	37	72	7	3	10	1	0	32	7	7	5	15	5	12	3	3	2	7	11	1	0	0	0	2	320	66	0	6	10	12	3	5	2	2	2	2	4	2
29	24	35	78	7	4	11	1	0	331	2	50	22	86	22	49	4	4	2	6	13	9	0	0	0	0	32	173	6	0	17	12	2	2	2	0	1	3	2	
30	31	46	73	9	4	15	1	0	28	4	11	6	19	7	27	6	6	4	9	19	1	11	0	0	0	76	288	10	17	0	19	3	4	2	1	3	4	1	
31	370	537	465	51	28	96	5	0	117	57	24	12	72	36	79	10	10	7	36	86	3	0	0	0	74	145	12	12	19	0	16	262	37	85	99	151	8		
32	185	282	433	46	24	50	2	0	49	30	9	5	31	17	40	8	8	4	24	59	1	0	0	0	0	35	21	3	2	3	16	1	14	2	5	2	6	33	
33	115	162	268	32	16	49	2	0	64	31	13	6	43	21	45	6	7	5	23	50	1	0	0	0	0	31	31	5	2	4	262	14	0	13	82	27	52	5	
34	19	27	43	6	3	8	0	0	13	5	3	1	7	5	9	1	2	1	4	9	1	0	0	0	0	9	19	2	2	2	37	2	13	0	5	6	9	0	
35	40	57	88	11	5	18	1	0	21	9	5	2	15	7	16	2	4	2	7	16	1	0	0	0	0	12	8	2	0	1	85	5	82	5	0	9	19	2	
36	29	43	66	8	5	11	0	0	16	10	3	2	13	8	15	2	3	2	6	13	1	0	0	0	0	11	17	2	1	3	99	2	27	6	9	0	23	0	
37	72	106	169	20	9	29	1	0	40	20	8	4	29	13	31	4	3	3	14	33	1	0	0	0	0	32	35	4	3	4	151	6	52	9	19	23	0	2	
38	99	163	245	23	12	20	1	0	22	13	4	2	14	8	19	4	3	1	11	28	1	0	0	0	0	15	7	2	2	1	8	33	5	0	2	0	2	0	
39	320	443	909	96	50	171	17	0	122	59	23	11	71	36	86	8	12	6	45	112	3	0	0	0	0	113	150	8	16	20	165	61	65	24	21	16	38	26	
40	87	125	182	23	12	28	1	0	39	20	9	6	30	12	26	5	4	2	14	32	1	0	0	0	0	35	22	3	2	3	15	7	11	10	5	3	5	4	
41	47	67	97	14	7	15	0	0	24	11	6	3	13	9	19	2	3	2	9	16	0	0	0	0	18	21	1	3	4	18	5	12	6	4	2	6	1		
42	38	57	78	11	5	12	0	0	18	11	6	2	12	5	13	2	3	2	9	16	0	0	0	0	0	16	18	1	1	2	14	3	9	3	2	2	4	1	
43	115	164	249	31	16	41	1	0	54	27	13	5	37	17	43	6	8	4	24	47	0	0	0	0	0	52	77	4	7	10	111	14	72	221	18	19	237	5	
44	118	173	112	14	8	13	0	0	15	10	3	1	11	6	12	2	3	1	9	14	1	0	0	0	0	12	6	1	1	1	2	22	3	0	1	0	2	9	
45	12	18	25	4	1	6	0	0	8	3	2	1	7	4	8	1	3	1	3	6	0	0	0	0	0	18	15	1	1	2	9	2	7	3	2	0	4	1	
46	29	42	64	9	5	13	0	0	24																														

39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	Total
320	87	47	38	115	118	12	29	13	30	25	0	0	4	4	0	57	2	1	1	2	3	0	0	3	2	259	21	0	0	17	3	48	26	5	3	10	18	19,898
443	125	67	57	164	173	18	42	17	44	34	0	0	6	5	0	80	3	1	2	3	4	0	0	5	3	371	31	0	0	25	0	50	16	4	3	11	10	26,461
909	182	97	78	249	112	25	64	27	62	53	0	0	5	4	0	101	3	2	3	6	4	5	0	5	4	402	32	0	0	27	1	72	24	6	4	19	13	31,109
96	23	14	11	31	14	4	9	4	8	6	0	0	4	3	0	16	0	1	1	2	0	0	0	2	1	0	0	0	0	0	0	0	0	0	0	0	4,715	
50	12	7	5	16	8	1	5	2	5	5	0	0	3	2	0	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2,662	
171	28	15	12	41	13	6	13	5	9	10	0	0	3	2	0	59	2	0	0	1	0	0	0	3	3	2	0	0	0	0	0	0	0	0	0	0	5,072	
17	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	10	1	0	0	1	0	3	1	0	1	1	836	
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	0	0	0	0	0	0	0	8	
122	39	24	18	54	15	8	24	9	16	16	0	7	7	5	0	32	4	1	1	3	4	0	0	4	1	944	109	0	33	449	0	436	970	37	0	22	0	9,995
59	20	11	11	27	10	3	10	3	8	9	0	4	4	3	0	13	0	1	1	2	0	0	0	2	1	22	4	0	0	0	0	0	0	0	0	0	3,755	
23	9	6	6	13	3	2	5	2	3	4	0	2	2	2	3	8	1	0	0	1	2	2	73	1	0	89	23	16	0	0	0	65	289	4	0	0	2,561	
11	6	3	2	5	1	1	3	2	2	2	0	2	2	2	3	4	1	0	0	1	1	2	65	1	0	74	16	0	0	27	19	170	15	0	4	1,422		
71	30	13	12	37	11	7	17	7	10	13	0	6	6	5	0	19	3	1	1	3	0	0	0	3	1	285	33	0	53	0	152	13	0	0	0	4,621		
36	12	9	5	17	6	4	8	3	5	2	0	4	4	3	0	8	0	1	1	0	0	0	0	0	0	120	0	0	0	40	0	0	0	0	0	2,446		
86	26	19	13	43	12	8	15	7	14	10	0	0	6	5	0	17	4	1	1	3	0	0	0	3	1	240	34	0	23	0	57	19	0	0	0	5,811		
8	5	2	2	6	2	1	2	1	2	2	0	2	4	4	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1,188		
12	4	3	3	8	3	3	4	3	4	4	0	0	8	6	0	8	0	0	0	0	0	0	0	0	0	7	0	0	0	0	0	0	0	0	0	775		
6	2	2	2	4	1	1	2	1	2	2	0	2	4	3	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	827		
45	14	9	9	24	9	3	8	3	4	8	0	0	7	6	0	9	0	0	0	0	0	0	0	0	0	26	7	0	0	0	0	0	0	0	0	2,978		
112	32	16	16	47	14	6	13	6	8	14	0	0	12	10	0	20	0	2	2	0	0	0	0	1	1	299	42	0	0	0	1	0	0	0	15	0	4,970	
3	1	0	0	0	1	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	61		
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	75	0	0	0	13	401	0	0	0	0	967		
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	22	0	0	0	0	32	0	0	0	0	303		
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	28	0	0	0	2	0	0	0	0	413			
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	22	0	0	0	0	0	0	6	0	0	274		
113	35	18	16	52	12	18	43	17	15	19	0	0	5	4	0	21	3	1	1	2	0	0	0	3	1	0	3	0	0	0	0	0	0	0	0	4,059		
150	22	21	18	77	6	15	40	17	12	20	0	0	7	6	0	28	0	1	1	3	0	0	0	5	1	46	309	0	0	0	6	0	0	5	0	4,197		
8	3	1	1	4	1	1	4	1	1	1	0	2	2	2	0	4	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	739		
16	2	3	1	7	1	1	3	1	2	2	0	0	3	3	0	4	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	1,065		
20	3	4	2	10	1	2	5	2	3	3	0	0	5	4	0	6	0	0	0	0	0	0	0	0	0	0	7	0	0	3	0	0	0	0	0	845		
165	15	18	14	111	2	9	23	9	11	22	0	0	6	5	0	14	1	0	1	0	0	0	0	7	1	2	11	0	0	0	0	0	0	1	0	3,469		
61	7	5	3	14	22	2	5	2	2	3	0	0	0	0	0	7	1	0	0	0	0	0	0	0	0	15	1	0	0	0	0	0	0	0	1,600			
65	11	12	9	72	3	7	16	7	9	13	0	3	5	4	0	7	0	0	1	2	0	0	0	0	0	3	7	0	0	0	0	0	0	0	0	1,743		
24	10	6	3	221	0	3	5	3	4	12	0	0	7	6	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	581		
21	5	4	2	18	1	2	5	2	3	3	0	3	5	4	0	6	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	642		
16	3	2	2	19	0	0	3	0	3	3	0	0	6	5	0	4	0	0	0	0	0	0	0	0	0	2	2	0	0	0	0	0	0	0	0	526		
38	5	6	4	237	2	4	7	4	3	10	0	0	5	4	0	4	0	0	0	0	0	0	0	0	0	6	1	0	0	0	0	0	0	0	0	1,289		
26	4	1	1	5	9	1	2	1	2	2	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	829		
0	72	61	43	83	22	411	857	381	36	16	2	5	5	4	8	71	3	1	1	2	4	1	3	4	3	23	11	0	0	0	6	0	0	0	0	5,462		
72	0	30	28	15	4	0	4	0	18	4	0	0	0	0	9	4	0	0	1	0	0	0	0	0	0	5	0	0	0	5	0	0	0	0	982			
61	30	0	34	8	2	2	4	2	17	0	0	0	0	0	8	4	0	0	0	0	0	0	0	0	6	2	0	0	0	0	0	0	0	0	645			
43	28	34	0	6	1	0	3	0	9	0	0	0	0	0	8	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	512		
83	15	8	6	1	7	4	7	4	5	27	0	0	1	0	7	5	1	1	1	2	0	0	1	0	0	0	9	0	0	5	0	0	1	0	2	1,952		
22	4	2	1	7	0	1	1	1	2	2	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	636		
411	0	2	0	4	1	0	94	41	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	734		
857	4	4	3	7	1	94	0	288	4	4	0	0	0	0	8	0	1	1	3	0	0	0	3	0	4	5	0	0	0	0	0	0	0	0	0	1,725		
381	0	2	0	4	1	41	288	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	906		
36	18	17	9	5	2	0	4	0	0	0	0	0	0	10	5	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	413		
16	4	0	0	27	2	0	4	0	0	0	0	7	0	0	10	9	0	0	0	0	0	0	0	5	0	1	0	0	0	0	0	0	0	1	0	418		
2	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	0	0	0	0	0	2		
5	0	0	0	0	0	0	0	0	0	7	0	0	26	21	0	0	0	0	0	0	0	0	0	67														

Appendix Table 7.3-4 OD Matrix in 2030 (All Vehicles)

	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	31	32	33	34	35	36	37	38	
1	0	8,524	6,836	1,112	596	806	251	1	554	311	94	43	323	175	473	100	40	48	204	365	1	127	0	44	1	388	280	31	28	36	497	234	142	34	22	47	33	88	123
2	8,524	0	14,181	1,398	693	1,229	419	2	959	548	167	75	565	312	850	184	70	86	370	644	2	0	0	0	0	658	464	54	48	64	873	432	243	39	81	59	156	244	
3	6,836	14,181	0	1,784	845	2,163	453	3	1,943	1,092	311	134	1,095	627	1,837	403	145	169	895	1,178	3	0	0	0	1	1,247	807	110	117	107	883	692	418	63	129	94	256	383	
4	1,112	1,398	1,784	0	120	348	59	1	196	103	32	14	106	59	151	31	13	18	64	179	1	0	0	0	0	139	96	10	10	12	91	72	49	7	16	12	30	35	
5	596	693	845	120	0	119	35	1	81	42	15	7	46	24	66	13	5	6	30	82	1	0	0	0	0	61	41	5	5	5	44	33	21	3	6	5	12	15	
6	806	1,229	2,163	348	119	0	55	0	261	115	42	17	134	65	188	25	22	16	83	231	2	0	0	0	0	210	170	15	16	24	192	86	79	13	27	16	45	34	
7	251	419	453	59	35	55	0	0	26	10	3	1	11	5	19	3	1	1	7	15	0	0	0	0	0	16	10	2	1	1	15	6	5	1	1	1	3	3	
8	1	2	3	1	1	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	0	0	0	0
9	554	959	1,943	196	81	261	26	0	202	956	586	921	159	485	30	41	32	209	403	3	126	0	255	183	311	268	63	594	49	260	93	105	19	33	22	65	42		
10	311	548	1,092	103	42	115	10	0	202	0	35	16	134	83	307	189	138	273	272	439	2	0	0	0	0	132	41	10	4	8	96	45	42	7	11	12	28	18	
11	94	167	311	32	15	42	3	0	956	35	0	13	169	32	92	6	9	5	39	67	2	1	0	120	0	146	93	8	69	15	41	14	18	4	7	4	12	6	
12	43	75	134	14	7	17	1	0	586	16	13	0	82	15	39	2	5	3	19	29	1	0	0	0	0	61	40	7	27	7	18	7	8	1	4	3	5	3	
13	323	565	1,095	106	46	134	11	0	921	134	169	82	0	77	335	25	30	21	146	241	1	0	0	0	0	185	162	22	121	26	125	48	59	9	21	16	41	20	
14	175	312	627	59	24	65	5	0	159	83	32	15	77	0	455	17	24	21	112	169	1	0	0	2	0	64	104	8	29	8	61	26	27	6	9	10	17	11	
15	473	850	1,837	151	66	188	19	0	485	307	92	39	335	455	0	68	68	68	377	516	2	0	0	0	0	222	219	17	69	37	146	66	67	11	22	20	44	30	
16	100	184	403	31	13	25	3	0	30	189	6	2	25	17	68	0	30	0	90	252	1	0	0	0	0	22	55	3	6	9	16	15	9	1	3	3	7	6	
17	40	70	145	13	5	22	1	0	41	138	9	5	30	24	68	30	0	25	24	49	1	0	0	0	0	24	27	4	5	7	15	11	9	3	5	4	3	5	
18	48	86	169	18	6	16	1	0	32	273	5	3	21	21	68	0	25	0	66	107	0	0	0	0	0	19	37	3	5	8	12	6	7	1	3	3	4	4	
19	204	370	895	64	30	83	7	0	209	272	39	19	146	112	377	90	24	66	0	298	1	1	0	0	0	119	85	10	8	13	59	36	31	6	8	7	19	16	
20	365	644	1,178	179	82	231	15	0	403	439	67	29	241	169	516	252	49	107	298	0	4	0	0	0	0	243	200	15	19	28	166	96	75	13	23	18	47	45	
21	1	2	3	1	1	2	0	0	3	2	2	1	1	1	2	1	1	0	1	4	0	0	0	0	2	1	1	1	8	1	4	2	1	1	1	1	1	1	1
22	127	0	0	0	0	0	0	0	126	0	1	0	0	0	0	0	0	0	1	0	0	0	326	93	37	0	0	0	0	18	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	326	0	4	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0
24	44	0	0	0	0	0	0	0	255	0	120	0	2	0	0	0	0	0	0	0	0	93	4	0	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0
25	1	0	1	0	0	0	0	0	183	0	0	0	0	0	0	0	0	0	0	0	0	37	7	9	0	73	0	2	0	0	0	0	0	0	0	0	0	0	0
26	388	658	1,247	139	61	210	16	0	311	132	146	61	185	64	222	22	24	19	119	243	2	0	0	0	73	0	659	571	53	127	191	67	61	15	22	17	53	27	
27	280	464	807	96	41	170	10	0	268	41	93	40	162	104	219	55	27	37	85	200	1	0	0	0	0	659	0	97	231	388	292	39	54	26	13	24	54	14	
28	31	54	110	10	5	15	2	0	63	10	8	7	22	8	17	3	4	3	10	15	1	0	0	0	2	571	97	0	9	15	25	7	8	2	2	2	5	3	
29	28	48	117	10	5	16	1	0	594	4	69	27	121	29	69	6	5	5	8	19	8	0	0	0	0	53	231	9	0	22	23	3	4	2	1	3	5	2	
30	36	64	107	12	5	24	1	0	49	8	15	7	26	8	37	9	7	8	13	28	1	18	0	0	0	127	388	15	22	0	37	5	7	3	2	4	7	1	
31	497	873	883	91	44	192	15	0	260	96	41	18	125	61	146	16	15	12	59	166	4	0	0	0	0	191	292	25	23	37	1	45	514	80	151	182	291	21	
32	234	432	692	72	33	86	6	0	93	45	14	7	48	26	66	15	11	6	36	96	2	0	0	0	0	67	39	7	3	5	45	1	27	4	9	4	12	59	
33	142	243	418	49	21	79	5	0	105	42	18	8	59	27	67	9	9	7	31	75	1	0	0	0	0	61	54	8	4	7	514	27	0	20	118	38	79	10	
34	22	39	63	7	3	13	1	0	19	7	4	1	9	6	11	1	3	1	6	13	1	0	0	0	0	15	26	2	2	3	80	4	20	0	7	8	14	1	
35	47	81	129	16	6	27	1	0	33	11	7	4	21	9	22	3	5	3	8	23	1	0	0	0	0	22	13	2	1	2	151	9	118	7	0	12	26	3	
36	33	59	94	12	5	16	1	0	22	12	4	3	16	10	20	3	4	3	7	18	1	0	0	0	0	17	24	2	3	4	182	4	38	8	12	0	32	0	
37	88	156	256	30	12	45	3	0	65	28	12	5	41	17	44	7	3	4	19	47	1	0	0	0	0	53	54	5	5	7	291	12	79	14	26	32	0	3	
38	123	244	383	35	15	34	3	0	42	18	6	3	20	11	30	6	5	4	16	45	1	0	0	0	0	27	14	3	2	1	21	59	10	1	3	0	3	0	
39	577	933	2,003	201	92	384	50	0	316	123	43	20	141	72	189	18	19	12	88	257	4	0	0	0	0	284	323	18	32	42	544	175	155	49	47	35	88	74	
40	115	201	312	38	17	51	2	0	64	29	13	8	44	18	39	8	7	4	20	51	1	0	0	0	0	60	36	5	3	4	35	15	21	14	9	6	9	8	
41	56	97	150	20	9	23	1	0	35	14	8	5	16	11	26	3	5	3	12	22	1	0	0	0	0	29	29	2	4	6	34	9	17	9	6	4	8	4	
42	44	78	114	15	6	19	1	0	24	14	7	2	16	7	17	3	4	2	11	22	1	0	0	0	0	24	24	2	3	4	24	6	12	6	4	4	6	4	
43	156	266	440	52	24	75	4	0	94	40	19	7	54	26	65	9	12	6	34	76	1	0	0	1	0	90	125	8	11	17	251	30	112	344	28	29	437	11	
44	137	247	182	22	10	23	1	0	28	14	4	2	17	8	20	4	4	3	11	22	1	0	0	0	0	23	11	2	1	1	9	37	7	1	3	0	3	14	
45	14	24	39	5	2	8	0	0	12	5	2	1	9	5																									

APPENDIX 9-1

UNIT VEHICLE OPERATING COST

Appendix 9-1

UNIT VEHICLE OPERATING COST

A.9.1.1 Background

a. Highway User Cost, update-1998 (HUC98)

HUC98 is used for the economic evaluation in this Study with some adjustments mainly for changes of price over time.

Changes of price over time are verified against Consumer Price Index. Table 9.1-1 shows Muscat Governorate Consumer Price Index. The change of Price Index is relatively small and remains within the range of 2.5%. This figure provides good ground to use 1998 VOC after necessary adjustments.

Table 9.1-1 Muscat Governorate Consumer Price Index (1998~2002)

Year	2002	2001	2000	1999	1998
General Price Index	97.1	97.8	98.8	100.0	99.5
Difference from 1998	-2.4	-1.7	-0.7	0.5	0.0

Source: Statistical Year Book 2003

HUC98 was calculated on financial base because there is no substantial difference between financial and economic costs as described at page 23 of HUC98. Based on this principle, financial costs of HUC98 were converted to economic value. Hereafter economic price and financial price are distinguished only when it is necessary.

b. Tax

The Custom Union for the Arab Gulf Countries was started in January 1, 2003 with 3 years of transitional period. It is expected to move to the next step in January 1, 2006. Oman joined the Union at the time of its start. According to the agreement of the Custom Union, custom duty is 5% flat excluding some strategic custom goods. Vehicle is not considered as the strategic custom goods. Internal duties are not levied.

A.9.1.2 Unit Vehicle Operating Cost

1) Vehicle Categories and Representative Price

a. Vehicle Type Categories

HUC98 uses six vehicle type categories and DGR traffic counts survey uses eight type categories. All types are integrated into three vehicle type categories and adopted in the traffic demand forecast. Relationship of the different types and the three categories is shown in Table 9.1-2.

Table 9.1-2 DGR Vehicle Type Categories to HUC Vehicle Type Categories

Study Team Categories	HUC98 Categories	DGR Categories
Passenger Car	Medium Car	Private Cars
	Medium Car	Taxi
	Utility Vehicle	4WD
Bus	Bus	Bus
Truck	Utility Vehicle	Pick-up, Van
	Medium Truck	Medium/Heavy Truck
	Heavy Truck	Trailer
	Heavy Truck	Oil Tanker

b. New Vehicle Price

Sales prices of different models are collected from motor vehicle distributors, but data shows that prices slightly change from 1998 to 2004. Prices of HUC98 are, therefore, used for this study. Table 9.1-3 summarizes the characteristics of representative vehicles.

Table 9.1-3 Representative Vehicle at Present

Unit: RO/Unit

Type of Vehicle	Passenger Car	Bus*	Truck*
Cost			
Financial Cost	6200	9000	5700
Economic Cost	5890	8550	5415
No. of Tires	4	6	10
Fuel Type	Gasoline	Diesel	Diesel
Annual Duties	0	0	0

* Based on the Study Team's Roadside Counts, majority of buses was mini bus and majority of trucks was light truck. Therefore, mini bus is adopted as representative type of bus, and light truck as truck.

2) Fuel and Lubrication Costs

a. Fuel and Lubrication Costs in 2004

Fuel and lubrication cost are quoted from HUC98, but adjusted by gasoline price, diesel oil price and lubrication oil applying Muscat selling price in 2004. Table 9.1-4 shows the fuel and lubricant oil cost.

Table 9.1-4 Fuel Cost and Lubrication Oil Cost by Vehicle Type Unit: RO/Liter

Type of Vehicle	Passenger Car	Bus	Truck
Fuel Type	Gasoline	Diesel	Diesel
Fuel Price	0.121	0.105	0.105
of which, tax	0	0	0
Lubricant Oil Price	0.655	0.496	0.496
of which, tax	0	0	0

b. Fuel Consumption by Vehicle Type and Speed

Fuel consumption is highly dependent on running speed and vehicle type. There are some empirical studies to explore that relationship, known as the Kenyan Study¹, the Brazilian Study¹, the Caribbean Study¹ and the Indian Stud^{y1}. Formulas of the Indian Study are applied here. Indian experimental formulas were simplified to apply to flat and good surface conditioned road as follows;

Passenger Car $F = 10.31 + 1676 / V + 0.0133V^2$

Diesel Jeep $F = 30.83 + 2258 / V + 0.0242V^2$

Light Truck $F = 49.84 + 319 / V + 0.035V^2$

Medium Truck $F = 85.07 + 3905 / V + 0.0206V^2$

Where, $F =$ Fuel Consumption (liter/1000km)

$V =$ Velocity (km/hr)

From the Indian Empirical Formulas with conversion factors induced from HUC98, fuel cost by type of vehicle and speed in flat and bitumen surface are calculated as shown in Table 9.1-5.

Table 9.1-5 Fuel Cost by Vehicle Type and Speed Unit: RO/km

Type of Vehicle	Passenger Car	Bus	Truck
Speed (km/hr)			
5	0.042	0.091	0.091
30	0.009	0.025	0.025
50	0.009	0.023	0.023
70	0.012	0.026	0.026
90	0.016	0.031	0.031
110	0.023	0.039	0.039
130	0.030	0.049	0.049
150	0.039	0.061	0.061

c. Oil Consumption by Vehicle Type

Strictly speaking, oil consumption rate is also dependent on vehicle speed. However, a flat function is used on oil consumption to vehicle speed because no empirical study to

clarify vehicle speed and lubrication oil consumption relationship is found out. Table 9.1-6 shows oil consumption by vehicle type.

Table 9.1-6 Oil Consumption by Vehicle Type

Type of Vehicle	Passenger Car	Bus	Truck
Oil Change Cycle (/km)	3,000	4,500	4,500
Engine Oil Quantity (liter)	4	6	6
Oil Consumption (liter/km)	0.0013	0.0013	0.0013
Oil Consumption Cost (RO/km)	0.0009	0.0007	0.0007

3) Tire Cost

Tire costs of HUC98 were used without adjustment after examining by prices collected from tire retailers. Results are shown in Table 9.1-7.

Table 9.1-7 Tire Cost

Type of Vehicle	Passenger Car	Bus	Truck
Tire Price (RO/unit)	22.70	40.10	40.10
Import Tax (RO/unit)	1.14	2.01	2.01
Economic Tire Cost (RO/unit)	21.57	38.10	38.10
Financial Tire Cost (RO/unit)	22.70	40.10	40.10
No. of Tires	4	6	6
Tire Change Cycle (km)	30,000	60,000	60,000
Economic Tire Consump. Cost (RO/Car/km)	0.003	0.004	0.004
Financial Tire Consump. Cost (RO/Car/km)	0.003	0.004	0.004

4) Repair/Maintenance Cost

Repair/maintenance cost is considered as 4% of the new vehicle price per year based on Study Team experience and it is converted to per-km for convenience of economic/financial evaluation (see Table 9.1-8). Average running km by type of vehicle shown in HUC98, Table 3.4, was applied to this study.

Table 9.1-8 Repair and Maintenance Cost by Vehicle Type

Type of Vehicle	Passenger Car	Bus	Truck
Financial Vehicle Cost (RO/unit)	6,200	9,000	5,700
Annual Rep. and Maint. Cost (RO)	248	360	228
Average Running per Year (km)	30,000	80,000	30,000
Rep. and Maint. Cost per km (RO)	0.008	0.005	0.008

5) Depreciation Cost

The legal depreciation method for vehicle or heavy machine is linear depreciation of three years. The average service life, however, is distributed from 6 years till 10 years based on HUC98. The average service life in HUC98 Table 3.3 is adopted here, and calculated yearly depreciation is shown in Table 9.1-9.

Table 9.1-9 Depreciation Cost by Vehicle Type

Type of Vehicle	Passenger Car	Bus	Truck
Economic Vehicle Cost (RO)	5,890	8,550	5,415
Economic Tire Cost (RO)	86	229	229
Econo. Veh. Cost w/o Tire (RO)	5,804	8,321	5,186
Average Service Life	8	8	10
Depreciation (% p.a.)	12.5	12.5	10.0
Annual Depreciation (RO)	725	1,040	519
of which, subject to use (RO)	363	728	363
of which, subject to time (RO)	363	312	156
Average Running in a Year (km)	30,000	80,000	30,000
Average Running Speed (km/hr)	90	80	75
Average Running Hour (hr/yr)	333	1,000	400
Depreciation Cost			
subject to use (RO/km)	0.012	0.009	0.012
subject to time (RO/hr)	1.088	0.312	0.389

6) Crew Cost and Overhead Cost

HUC98 data of crew cost and overhead cost are used with adjustment of passenger car crew cost and overhead cost to zero as shown in Table 9.1-10.

Table 9.1-10 Crew Cost and Overhead Cost

Type of Vehicle	Passenger Car	Bus	Truck
Annual Cost (RO/Year)			
Crew Cost	0	3317.6	3317.6
Assistant Cost	0	0	1716
Overhead Cost	0	165.9	165.9
Hourly Cost (RO/hr)			
Crew Cost	0	1.45	1.45
Assistant Cost	0	0	0.75
Overhead Cost	0	0.07	0.07
Total	0	1.52	2.27

7) Summary of VOC

Based on the above discussions on all involved items, results of VOC on paved roads are summarized as Table 9.1-11.

Table 9.1-11 Summary of VOC on Paved Surface

Unit: RO/km or RO/hr

Type of Vehicle	Passenger Car	Bus	Truck
VOC subject to Running km			
Speed (km/hr)			
5	0.066	0.109	0.116
30	0.034	0.043	0.049
50	0.033	0.041	0.047
70	0.036	0.044	0.050
90	0.041	0.049	0.055
110	0.047	0.057	0.063
130	0.054	0.067	0.073
150	0.063	0.079	0.085
VOC subject to Running hours			
	1.088	1.835	2.661

Difference of VOC running on paved surface and gravel surface are discussed in HUC92. Table 9.1-12 gives the difference in running cost on both surfaces.

Table 9.1-12 Vehicle Running Costs on Paved and Unpaved Surface

R.O./km

Type of Vehicle	Passenger Car	Bus	Truck
Running cost on paved	63.7	114.3	279.2
Running cost on unpaved	100.3	184.5	346.4
RC unpaved/ RC paved	1.575	1.614	1.241

These unpaved/paved ratios are applied to Table 9.1-11 and VOC on unpaved roads is obtained as shown in Table 9.1-13.

Table 9.1-13 Summary of VOC on Unpaved Surface

Unit: RO/km or RO/hr

Type of Vehicle	Passenger Car	Bus	Truck
VOC subject to Running km			
Speed (km/hr)			
5	0.104	0.177	0.143
30	0.053	0.069	0.061
50	0.053	0.066	0.058
70	0.057	0.070	0.062
90	0.064	0.079	0.069
110	0.073	0.092	0.078
130	0.085	0.108	0.091
150	0.099	0.127	0.105
VOC subject to Running hours			
	1.088	1.835	2.661

A.9.1.3 Travel Time Cost (TTC)

Travel time cost (for passenger) of HUC98 is used in this study as there are only small changes on salary scale between 1998 and 2004. Table 9.1-14 summarizes present travel time value.

Table 9.1-14 Present Hourly Income and Travel Time Value, as of 1998

Item	Passenger Car User	Bus Passenger	Unit
Hourly Income	1.20	1.20	RO/Hour/Person
Time Value			
Business Trip	1.20	1.20	RO/Hour/Person
Other Trip	0.30	0.30	RO/Hour/Person
Trip Composition			
Business Trip	0.20	0.10	
Other Trip	0.80	0.90	
Travel Time Value			
Person Base	0.48	0.39	RO/Hour/Person
Vehicle Base			
Average Occupancy	2.20	12.30	Person/Car
Per Vehicle	1.06	4.80	RO/Hour/Car

Travel costs (for passenger) of 2005 are projected in accordance with the forecast of per capita income on the same years (Table 9.1-15).

Table 9.1-15 Travel Time Cost (2005)

Year	1998	2000	2005	Note
Per Capita Income (Muscat, Monthly)	131.21	152.63	157.36	RO/Cap/Month
Increase by each year period		1.163	1.031	
Travel Time Cost (Person Base)				
Passenger Car User	0.48	0.56	0.58	RO/Cap/hr
Bus Passenger	0.39	0.45	0.47	RO/Cap/hr
Travel Time Cost (Vehicle Base)				
Passenger Car	1.06	1.23	1.27	RO/Veh/hr
Bus	4.80	5.58	5.75	RO/Veh/hr

APPENDIX 11-1

PROCEDURES OF PRELIMINARY DESIGN

PROCEDURES OF PRELIMINARY DESIGN

The general procedures of preliminary design for the projects are presented in the following:

1) **Ground Condition**

Regardless the nature or location of works, it will be necessary to investigate the ground conditions. Particular soil problems found in Oman include:

- Expanding clays: when water penetrated into this material, very high expansion pressures can be generated. Pressures in excess of 400 kN/m² and have of over 200 mm have been reported.
- Gypsum: Can have a cementing effect, but when subsequently subjected to water, can be leached out leading to an apparent loss of compaction and settlement.
- Metastable sands: Standard penetration or cone penetrometer tests in these weakly cemented sands can give misleadingly high results. Penetration of water into this layer can then lead to considerable loss of bearing capacity and higher settlements than predicted.

The common subsoil investigations are:

- Boreholes
- Trial pits
- Soakage tests
- Cone penetrometer tests

For soil problems mentioned before, large trial pits are preferred method of testing at shallow depths.

For road reconstruction schemes it will be also necessary to carry out a condition survey of the existing pavement, subgrade and embankments.

2) **Summary of Major Design Standards**

a. Lane Width and Carriageway Width

The standard lane width in the Sultanate of Oman is 3.65 m on primary and secondary roads and 3.5 m on local roads. The lane widening is required on small radius curves as shown in Table 11-1.

Less width can be adopted for short distance where necessary to overcome particular problems and when significant cost savings can be made. However, in such cases maximum speed is 60 km/hr.

Mountainous areas offer particular problems as often the road has to turn back on itself and return across the same ground slope at a higher level. Hairpin bends as mentioned in HDM can be adopted as a last resort after agreement of the client. The width as mentioned on the Manual under vertical alignment standard should be 3.3 m for climbing lane. Figure 11-1 presents the recommended standard in case of hairpin bends.

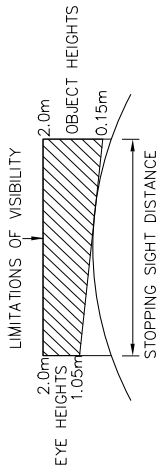
b- Highway Capacity

Table 11-2 shows the design capacity of 2-lane 2-way highways for various running speeds, in different types of terrain and varying percentage of trucks. A 70-80 km/h average running speed should be used for most rural roads in level and rolling terrain. A 60-70 km/h average running speed would be applicable for roads approaching urban areas and wherever feasible for roads in mountainous areas. 50-60 km/h should be used for rural roads in mountainous terrain where higher speeds are not feasible.

Table 11-3 gives the absolute maximum capacity for highways constructed for high standard, i.e. 3.65 m lanes, adequate shoulders, lateral clearances greater than 1.8 m, no substandard stopping or passing sight distances and no trucks. Practical design capacities are less than the absolute maximum. The typical further reduction are 2% reduction for 3.5 m lane and PCEs for one truck are equal to 1.7, 4 and 8 in level, rolling and mountainous terrains, respectively.

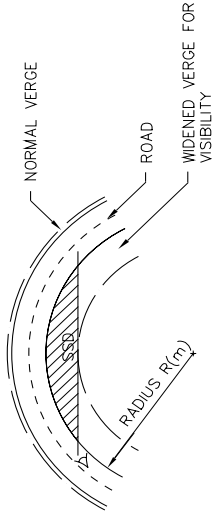
c- Edge of the Carriageway

On the rural roads paved shoulder without curbs should normally be provided. Lip curbs shall be used to delineate channelizing islands where speeds are 80 km/h and over. Beyond paved shoulder an unpaved verge or unpaved shoulder at least 1.0 m wide should be provided. The verge should slope at 5% from the paved area.



VERTICAL VISIBILITY ENVELOPE

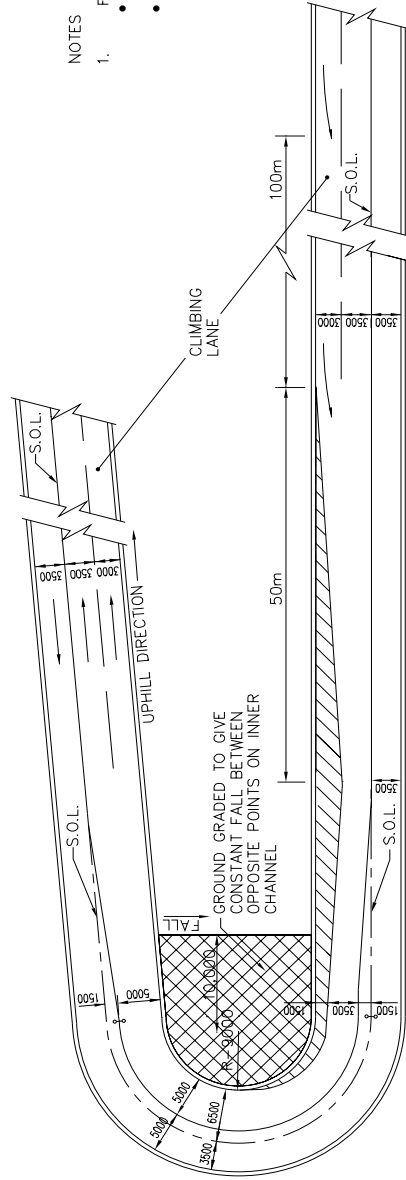
A DRIVER AT EYE HEIGHT 1.05m MUST BE ABLE TO SEE OBJECTS BETWEEN 0.15m AND 2m HIGH. PASSING SIGHT DISTANCE SIMILAR BUT MINIMUM OBJECT HEIGHT 1.05m.



HORIZONTAL VISIBILITY ENVELOPE

VERGE MUST BE KEPT CLEAR OF OBSTRUCTION TO GIVE AT LEAST THE MINIMUM STOPPING SIGHT DISTANCE. THE VISIBILITY IS MEASURED FROM THE CENTRELINE OF RUNNING LANE TO CENTRELINE OF RUNNING LANE.

ON DUAL CARRIAGEWAYS SIMILAR REQUIREMENTS APPLY AT THE MEDIAN. CARE SHOULD BE TAKEN THAT THE GUARDRAIL DOES NOT INTERFERE WITH THE SIGHTLINE IN DIFFICULT CIRCUMSTANCES THE OBJECT HEIGHT MAY BE ASSUMED TO BE 1.05m (I.E. BRAKE LIGHTS) WITH THE CLIENT'S AGREEMENT.



NOTES

- FOR FURTHER INFORMATION SEE:
 - HORIZONTAL VISIBILITY – PARAS 5.3 TO 5.12
 - HAIRPIN BENDS – PARAS 4.8 TO 4.9

TYPICAL LAYOUT OF HAIRPIN BENDS

Figure 11-1 Layout of Hairpin Bends

Table 11-1 Lane Widening on Small Radius

Lane Width (m)	Radius (m)		
	50 to 150	150 to 300	300 to 400
3.65	0.3 m/lane	not required	not required
< 3.65	0.6 m/lane	0.5 m/lane	0.3 m/lane

Table 11-2 Design Capacity of 2-Lane 2-Way Highways

Average Running Speed		70-80 (km/h)			60-70 (km/h)			50-60 (km/h)		
% of Trucks		0	10	20	0	10	20	0	10	20
Terrain	Sight Distance Restriction (Note 1)	Total Vehicles/Hour Both Direction (3.5 m Lanes)								
		<i>Note 1: Percentage of total length of highway where sight distance is less than 450m, measured from height of eye to road surface considering both vertical and horizontal alignments.</i>								
Design Speed 100 km/h										
Level	0	900	780	690	1150	1000	880	1500	1300	1160
	20%	860	750	660	1120	970	860	1450	1260	1120
	40%	800	700	620	1070	930	820	1400	1220	1080
Rolling	20%	860	615	485	1120	800	630	1450	1030	820
	40%	800	570	450	1070	760	600	1400	1000	780
	60%	720	510	400	920	650	520	1350	960	750
Design Speed 80 km/h										
Level	0	900	780	690	1150	1000	880	1500	1300	1160
	20%	810	705	625	1050	910	810	1410	1230	1080
	40%	700	610	540	930	810	720	1320	1150	1020
	60%	585	510	450	810	700	620	1220	1060	940
Rolling	20%	810	580	450	1050	800	630	1410	1000	790
	40%	700	500	390	930	660	520	1320	940	740
	60%	585	420	325	810	580	450	1220	870	680
	80%	480	340	270	680	480	380	1110	790	620
Design Speed 60 km/h										
Level	0							1200	1040	930
	20%							1070	930	820
	40%							900	780	690
Rolling	20%							1070	760	600
	40%							900	640	500
	60%							720	510	400
	80%							460	330	260
Mountainous	40%							900	480	320
	60%							720	380	260
	80%							460	240	170

Table 11-3 Maximum Capacity of High Standard Highways (veh/hr/lane)

Type of Highway	Average Running Speed (km/hr)			Absolute Maximum Capacity (veh/hr/lane)
	70-80	60-70	50-60	
2-Lane 2-Way, each direction	450	600	750	1000
Multilane	1000	1200	1500	2000

d- Medians (Central Reserves)

Medians would normally be appropriate on multi-lane roads with high traffic movements where speed limits are > 50 km/h. Table 11-4 presents the preferred width of central medians.

If it is intended in the future to increase the carriageway from 2-lane to 3-lane the additional width should be allowed in the median.

Table 11-4 Width of Medians (Central Reserves)

Standard	Median Width (m)		
	Rural	Semi-Urban	Urban
Preferred	12.0	12.0 (Expressway) 11.3 (other Primary Routes)	6.0
Desirable Minimum	10.0	4.5	2.5
Absolute Minimum	4.5	3.0	2.0 (Secondary Street)

e- Crossfall (Cross-slope)

Carriageway should have a Crossfall of 2% from the crown on a single carriageway or from the central median of dual carriageway. A maximum Crossfall of 4% is recommended, but this may be increased to 10% at crossovers or dropped curbs. Care should be taken that when the longitudinal fall is combined with normal Crossfall, it does not give falls in excess of 10% in any direction.

f- Vertical Clearance (Headroom)

Light structures such as gantries and celebration arches should have a minimum clearance of 5.8 m. Heavy structures, unlikely to be significantly damaged by over height vehicles, should have a minimum clearance of 5.5 m.

g- Design and Running Speeds

Table 11-5 shows the relation between design and running speeds. Design speed is the maximum safe speed that can be maintained over a specific section of the highway. The choice of design speed is influenced principally by the character of the terrain, type of the highway, traffic volumes and economic considerations. Basic geometric criteria are functions of design speed. Running speed is the average speed for all traffic or traffic components. Table 11-6 shows the standard design speeds for the different of road types.

h- Stopping Sight Distance (SSD) and Passing Sight Distance (PSS)

SSD consists of the perception-reaction distance and braking distance. The reaction time is assumed to be 2.5 second. The comfortable deceleration rate is 0.25g (2.45 m/sec²). The forward visibility requires a clear line of sight between driver's eye and the obstruction. The height of the obstruction should be between 0.15 and 2.0 m, while the eye height of the driver lies between 1.05 and 2.4 m. Forward visibility using these criteria should be provided in both horizontal and vertical plans.

Table 11-5 Relation between Design and Running Speeds

Design Speed (km/h)	Average Running Speed (km/h)		
	Low Volume	Intermediate Volume	Approaching Capacity
50	45	42	40
60	54	51	48
80	70	66	56
100	85	78	60
120	98	90	62

Table 11-6 Design Speeds for the Different of Road Types

Road Type	Design Speed (km/hr)	Specified Speed Limit (Normal), (km/hr)
Primary		
- Road (Rural)	120	120
- Semi-urban	120	100
- Street	100	80
Secondary		
- Road (Rural)	100	100
- Semi-urban Dual Carriageway	100	80
- Dual Carriageway Street	80	60
- Single Carriageway Street	60	50

On single carriageway roads, overtaking vehicles need to use the opposing traffic lane. AASHTO (1990) and DOT-TD9/81 “Road Layout and Geometry: Highway Link Design” DOT (1981) plus Amendment No. 1 (1985) will be adopted in rural areas.

Tables 11-7, 11-8 and 11-9 show the standard SSD, PSS and friction factors versus to design speeds.

Table 11-7 Stopping Sight Distance

Design Speed (km/h)	40	50	60	70	80	100	120
Desirable Minimum (m)	50	75	95	125	155	225	310
Absolute Minimum (m)	45	65	85	110	140	205	285

Table 11-8 Passing Sight Distance

Design Speed (km/h)	40	50	60	70	80	100	120
Passing Sight Distance (m)	240	310	380	440	510	650	790

Table 11-9 Friction Factors

Design Speed (km/h)	40	50	60	70	80	100	120
Maximum Safe Friction Factor	0.17	0.16	0.15	0.145	0.14	0.12	0.10

i- Horizontal Curvature

Horizontal curvature used in the design is related to the design speed as shown in Figure 11-2. The figure illustrates the bands of radii relative to design speed and their applicability in the design of single carriageways. Band A provide an overtaking section for both direction of travel. Non-overtaking sections should be designed using the radii shown in Band D. In difficult circumstance curves in Band E can be used.

For dual carriageway different criteria apply, and in principle radii in any band are acceptable, although Band E should be avoided wherever possible.

Radius of Curve (m)								
Upper 4080 1440 640 530 Wh e	11500						Band A: $V^2/R < 1.25$ Stright and nearly straight overtaking sections in both directions.	
		8160	5130					
				4080				
		2880			2880	2040		
			1810	1440				
		1020			1020	720		
			640	510				
		440						
		360	280	360		450		
			215	215				
			160	160		160	Band D: $V^2/R = 10 \sim 22.6$ Non-overtaking sections with warning lines as required.	
				115	115		Band E: Adverse camber (-ev. Crossfall) should be replaced by favourable crossfall of 2% when in rural areas $3 < V^2/R < 7$.	
					75	75		
						50		
						40		
	120	100	80	70	60	50	40	
	Design speed km/hr							

Figure 11-2 Horizontal Curve Radii for Single Carriageway

V^2/R is greater than 7 where V is the design speed (km/h) and R is the radius (m), the percentage Superelevation required S is derived from:

$$S = V^2 / 2.828 R; \text{ (maximum desirable 8\%)}$$

In difficult terrain a Superelevation up to 10% may be used. In addition, more account can be taken of side friction and the radius reduced to:

$$R = V^2 / 1.266 (S+100f); \text{ where } f \text{ is a side friction factor.}$$

In general on dual carriageways care should be taken to ensure that a minimum longitudinal gradient of at least 0.5% is maintained wherever superelevation is to be applied or reversed to overcome drainage problems. In difficult areas, further measures may be needed.

k- Transition Curves

The basic length of the transition curve L can be derived from:

$$L = V^3 / 46.7 q R$$

Where, q is the rate of increase of radial acceleration (m³/sec). The q value should be less than 0.3. Shallow curves, where superelevation is not required do not require a transition.

l- Vertical Alignment

The desirable maximum gradients for design are shown in Table 11-10. Gradients steeper than 8% should be avoided where possible.

Table 11-10 Maximum Gradients (%)

Design Speed (km/h)	120	100	80/70	60/50	40
Desirable Maximum Gradient	3	4	5	6	6
Absolute Maximum Gradient in Rolling Terrain	5	6	7	8	10
Absolute Max. Gradient in Mountainous Terrain	6	7	8	10	12

Vertical curves should be parabolic. The length (L) of a vertical sag or crest curve can be obtained from the equation:

$$L = KA \quad \text{Where,}$$

L = Curve Length (m)

K = Design Speed Related Coefficient (chosen from Table 11-11)

A = Algebraic Difference in Grades (%)

Table 11-11 K Value for Vertical Curve

Design Speed (km/h)	120	100	80	70	60	50	40
PSD Crest K Value (Single Carriageway only)	625	450	280	200	145	100	588
Desirable Minimum Crest K Value	240	125	60	40	17	12	4
Absolute Minimum Crest K Value	200	105	49	30	11.5	9	4
Minimum Sag K Value for Unit Roads	47	36	24	20	13	9	5.5
Absolute Min. Sag K Value for Well Lit Roads*	37	27	17	13	10	7	4

* Apply minimum curve length as shown in Table 10.4-15.

In addition, for appearance a minimum length of curve should be adopted as shown in Table 11-12.

Table 11-12 Comfort Criteria for Vertical Curve

Design Speed (km/h)	120	100	80	70	60	50	40
Applies when Algebraic Difference (A%) is <	1.4	2.0	2.8	3.6	4.7	7.2	11.2
Minimum Crest K Value (Comfort Value)	37	27	17	13	10	7	4
Minimum Curve Length (m) (for Appearance)	120	100	80	70	60	50	40

Climbing lane is to be considered where the ADT exceeds 4000, the gradient exceeds 2% and the length of hill is more than 500m in order to provide overtaking opportunities.

m- Drainage and Utilities

The Sultanate of Oman lies on the eastern fringes of one of the driest desert areas in the world. The average annual rainfall for most parts of the country is less than 100 mm. However, because of the extreme variability of the rainfall pattern, the annual average rainfall can be exceeded in just a single day's rainfall.

This hydrological characteristic has a tendency to produce short duration-high intensity storm giving rise to flash floods with consequent damage and disruption to the transport network.

Flood frequency curves have been developed which predict the flood discharge for a variety of storm return periods from a 1 in 5 year event to a 1 in 100 year event. Rainfall data obtained from the extensive network of gauging stations throughout the country. Since the gauging stations are generally located in the foothills of mountains the estimation of flood flows elsewhere in the lower reaches of the catchment will need to be adjusted to take account of transmission losses. Furthermore, for catchment areas less than 10 km² the flood frequency curves should be used with caution and compared against other traditional empirical methods of estimation such as the Rational Method.

Catchment Discharge

For natural catchment areas > 10 km² the Flood Frequency Curves for Oman as produced by the Ministry of Water Resources shall be used. Figure 11-3 presents these flood frequency curves. If the site under consideration is located in the flood plain, remote from the foothill, the Ministry of Water Resources should be consulted to determine the adjustment factor to be applied to account for transmission losses. Table 11-13 shows the minimum flood frequencies to be accommodated in particular situation without damage to the road or drainage structure or disruption of traffic. For Irish Crossing and Bridges, disruption to traffic can be assumed to occur when the water depth across more than half of the carriageway exceeds 150 mm.

Table 11-13 Frequency of Flooding for Design of Highway Elements

Road Class	Bridges	Culverts, Irish Crossing and Irish Bridges	Channels and Ditches	Storm Sewer Systems
Primary	1 in 100 years	1 in 50 years	1 in 10 years	1 in 5 years
Secondary	1 in 100 years	1 in 50 years	1 in 10 years	1 in 5 years

For natural catchments < 10 km² the discharge shall be estimated using the Rational Method and compared against that using the Flood Frequency Curves of Oman that presented in Figure 11-4.

Open Channel Flow Analysis

The Manning equation will be used for open channel analysis. The typical value of Manning roughness coefficient are:

Concrete lined channel	0.06
Smooth rubble channel	0.020
Reno mattresses or gabions	0.025
Rough rip-rap	0.040
Gravel, cobbles and not many large boulders	0.030 – 0.50
Cobbles with large boulders	0.040 – 0.70

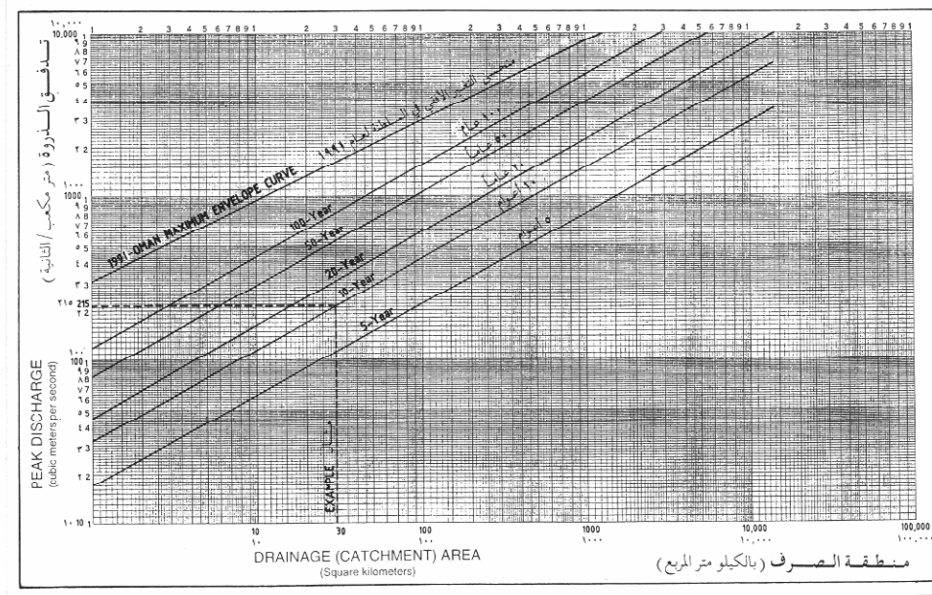


Figure 11-3 Flood Frequency Curves for Catchment Area $> 10 \text{ km}^2$

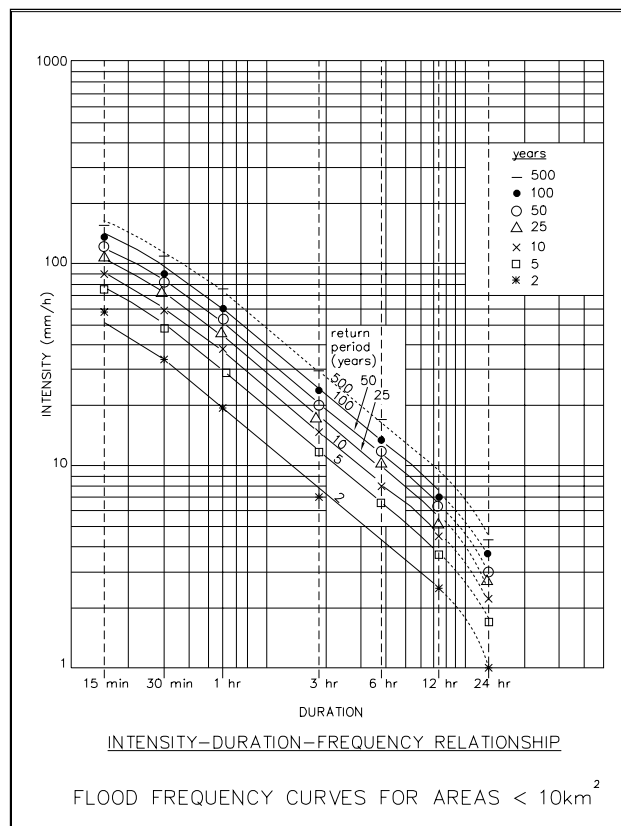


Figure 11-4 Flood Frequency Curves for Catchment Area $< 10 \text{ km}^2$

The depth of the flow in the channel is an important guideline in choosing the type of drainage structure to be adopted and the optimum elevation of the highway. In the case of bridges, a minimum vertical clearance (freeboard) between the top water level and underside of bridge deck must be allowed which will determine the lowest elevation of the bridge. However, the elevation of the road may be chosen to allow overtopping in the design of flood depending on the importance of the route and the vulnerability of the structure to damage.

Irish Crossing

Irish crossing can provide an economical and practical alternative to culverts or bridges in appropriate circumstance. They can best be utilized in the following situations:

- Where the drainage path is a wide shallow wadi
- Where the magnitude of discharge along the drainage path is difficult to predict with any accuracy because no rainfall records exist in the area (e.g. interior desert region)
- The horizontal alignment of the road is straight or superelevated on a curved alignment with the cross fall in the same direction as the wadi bed slope
- The daily traffic is relatively low and occasional closure of the road due to flooding would not be of strategic importance

Irish Bridges

Irish bridge is more suited to location where the wadi channel is more defined and where it is not economically justified to discharge the peak flow by culverts alone or by bridging.

Irish bridge configuration acts as a restriction to the uninterrupted flow, and consequently creates a backwater upstream of the crossing under medium to full flow conditions. The effect of increased upstream flood level should be considered.

The hydraulics of Irish Bridge design is a combination of:

- i. Broad crested weir and
- ii. Culvert design

Initially the charge over the highway is calculated using the broad crested weir formula for a depth of flow of 150 mm. The discharge equation is:

$$Q = 1.67 W H^{1.5}$$

Where Q = Discharge (m^3/sec)

W = width of crossing measured along the highway (m)
H = $h + V^2/2g$ = total specific energy head (m)
h = depth of flow (m) over the highway (normally 0.15m)
V = velocity of flow (m/sec)
g = acceleration due to gravity = 9.81 m/sec²

Since there are two unknowns in the equation (Q and V) the value of V will initially have to be estimated and the calculation processed iteratively until the discharge is in balance with the continuity equation, $Q = VhW$.

The discharge overtopping the highway is deducted from the peak discharge to give the discharge to be accommodated by the culverts. The depth of headwater to be used in the culvert analysis under these conditions is the depth of flow over the highway (i.e. h) plus the vertical height from top of highway to culvert invert elevation at the inlet side. It should be noted that in culvert design the upstream water is assumed to be in ponded condition and therefore the energy head element $V^2/2g$ is zero

n- Pavement

Pavement shall be designed using AASHTO interim guide for design of pavement structure 1972, revised 1981. As mentioned by the HDM even this reference is updated by 1986 issue but there is currently no experience within the Sultanate of using the soil-modulus test used by the later guide of 1986.

Roadbed Soils

For pavement design, the CBR of the anticipated subgrade should be determined. Detailed study in case of expansive soils or highly compressible soils is required. Tests should also carry out on likely sources of material for Subbase, aggregate Basecourse and aggregates for bituminous courses, so that an assessment may be made of the required thickness of pavement.

Load Equivalency Factors

For existing roads a traffic count should be carried out. If an axle load survey is not undertaken, then the Equivalent Single Axle Load (ESAL) may be taken 1.5 for primary roads carrying larger commercial vehicles.

For new roads, the initial traffic must be assessed together with the likely growth. Factors that may affect the potential ESALs such as industrial area or cement factory should be noted.

Growth rate for all classes of vehicle may be assumed as 10%/year up to 2005, and 8%/year up to 2020, unless more accurate estimations can be obtained.

Where axle loads are known, ESALs may be derived from Table 11-14.

Regional Factor

The regional factor shall be taken as 0.8 for the major part of Sultanate of Oman. In areas affected by the summer monsoon (Salalah coastal and mountain (jebel) areas) a regional factor 1.5 shall be used. These factors take into consideration the weather conditions and subsoil drainage values difference between Illinois, USA AASHTO test site and the Sultanate.

Terminal Serviceability Index

The Terminal Serviceability Index (p_t) is a number between 0 and 5 which is based on a subjective assessment of the road condition. Exceptionally good road after construction get the rank 5 while rank 0 represents a completely failed road.

For roads in the Sultanate of Oman p_t of 2.5 shall be assumed as the terminal serviceability index. At this level, the pavement life is probable to be extended by adding an overlay. If road is allowed to deteriorate to below this level, it is likely that the only satisfactory means of repair will be to reconstruct it completely.

The design life of pavement should normally be taken as 20 years.

Where the road is required to be constructed in stages, the anticipated timetable for the stages should be agreed with the client.

Structural Layer Coefficients

As mentioned in HDM, structural layer coefficient may be based on those used by the Arizona State Highway Department. There are close similarities in the climate and topography between Arizona and Sultanate of Oman. The structural layer coefficient to be used is the sum of the base figure and the enhancement for the various properties of pavement layer. Typical enhancements are given in Table 11-15 for commonly used pavement layer types.

Table 11-14 Axle Load Equivalency Factors for Flexible Pavement, $P_t = 2.5$

Axle Load		Axle Load Equivalency Factor (ESAL)		
Kips (1 kip = 1000 lb)	tone	Single Axle	Tandem Axle	Triple Axle
2	0.9	0.0003	0.0001	0.0000
4	1.8	0.0040	0.0004	0.0002
6	2.7	0.0170	0.0020	0.0005
8	3.6	0.0510	0.0050	0.0010
10	4.5	0.1180	0.0110	0.0030
12	5.4	0.2290	0.0230	0.0060
14	6.3	0.3990	0.0420	0.0100
16	7.3	0.6460	0.0700	0.0180
18	8.2	1.0000	0.1090	0.0280
20	9.1	1.4900	0.1620	0.0420
22	10.0	2.1700	0.2290	0.0600
24	10.9	3.0900	0.3150	0.0840
26	11.8	4.3100	0.4200	0.1140
28	12.7	5.9000	0.5480	0.1510
30	13.6	7.9000	0.7030	0.1950
32	14.5	10.5000	0.8890	0.2470
34	15.4	13.7000	1.1100	0.3080
36	16.3	17.7000	1.3800	0.3790
38	17.2	22.6000	1.6900	0.4610
40	18.1	28.5000	2.0600	0.5540
42	19.0	35.6000	2.4900	0.6610
44	20.0	44.0000	2.9900	0.7810
46	20.9	54.0000	3.5800	0.9180
48	21.8	65.7000	4.2500	1.0720
50	22.7	79.0000	5.0300	1.2400
52	23.6		5.9300	1.4400
54	24.5		6.9500	1.6600
56	25.4		8.1000	1.9000
58	26.3		9.4000	2.1700
60	27.2		10.9000	2.4800
62	28.1		12.6000	2.8200
64	29.0		14.5000	3.1900
66	29.9		16.6000	3.6100
68	30.8		18.9000	4.0600
70	31.7		21.5000	4.5700
72	32.7		24.4000	5.1300
74	33.6		27.6000	5.7400
76	34.5		31.1000	6.4100
78	35.4		35.0000	7.1400
80	36.3		39.2000	7.9500
82	37.2		43.9000	8.8000
84	38.1		49.0000	9.8000
86	39.0		54.5000	10.8000
88	39.9		60.6000	11.9000
90	40.8		67.1000	13.2000

Note: P_t is Terminal Serviceability Index, 2.5 is the value for the roads in Sultanate of Oman.

Source: HDM

Other typical values for less commonly used materials are:

- Cement stabilized basecourse, strength	< 3.0 KN/mm ²	0.060
	3.0 – 4.5 KN/mm ²	interpolate
	> 4.5 KN/mm ²	0.090
- Bitumen stabilized bass course,	coarse graded	0.107
	sand asphalt	0.094
- Lime stabilized subbase		0.060

Structural Number

With the abovementioned described coefficients, the structural number (SN) for the pavement can be derived from the chart presented in Figure 11-5.

The SN number can be used to obtain combinations of layer thickness satisfy the following general equation: $SN = a_1D_1 + a_2D_2 + a_3D_3$

Where:

a_1 , a_2 and a_3 are layer coefficients for wearing course, basecourse and subbase course materials, respectively.

D_1 , D_2 and D_3 are thickness of each layer in cm.

SN is the structural number for the total pavement structure.

A range of alternative materials and thicknesses should be considered, and the minimum cost solution determined. The minimum asphalt layer is 50 mm and the minimum construction should be:

- 50 mm asphalt wearing course
- 150 mm aggregate basecourse
- 100 mm subbase
- 300 mm Subgrade

The subbase may be omitted where the CBR of the subgrade is > 25%.

Table 11-15 Structural Layer Coefficients

Pavement Layer	Property	Property Value	Coefficient
Bituminous courses (asphalt wearing course: asphalt basecourse)	Base Value		0.102
	Gradation	Class A	0.008
		Class B	0.008
		Class C	0.000
	Material Stability	1000 kg	0.008
		700 to 1000 kg < 1000 kg	Interpolate 0.000
	Abrasion	< 25	0.008
25 to 40		Interpolate	
> 40		0.000	
Asphalt Type	Penetration grade 60-70	0.020	
	Penetration grade 85-100	0.020	
	Other grades	0.000	
Example for wearing course of the following properties: Base value = 0.102 Gradation Class B = 0.008 Stability, 1000 kg = 0.008 Abrasion 30 = 0.005 Asphalt type 60-70 = 0.020 Layer Coefficient = 0.143/cm thickness			
Aggregate Basecourse	Base value		0.035
	Plasticity index (PI)	Non – plastic	0.008
		0 to 6	Interpolate
		> 6	0.000
	Passing 4.75mm sieve	45% to 75%	0.004
	Passing 75µm sieve	0 to 8%	0.004
> 8%		0.000	
Abrasion	40 or less	0.004	
Example for aggregate basecourse of the following properties: Base value = 0.035 Plasticity Index, non-plastic = 0.008 Passing 75 µm, 8% = 0.004 Passing 4.75mm, 60% = 0.004 Abrasion, 35% = 0.004. Layer coefficient = 0.055/cm thickness			
Granular subbase	Base value		0.024
	Plasticity Index (PI)	Non-plastic	0.006
		0 to 6%	Interpolate
		> 6%	0.000
	Passing 4.75mm sieve	30 - 70%	0.008
Passing 2mm sieve	20 - 50%	0.004	
Example for subbase material of the following properties: Base value = 0.024 PI 3% = 0.003 Passing 4.75mm 60% = 0.008 Passing 2mm 40% = 0.004 Layer coefficient = 0.039			

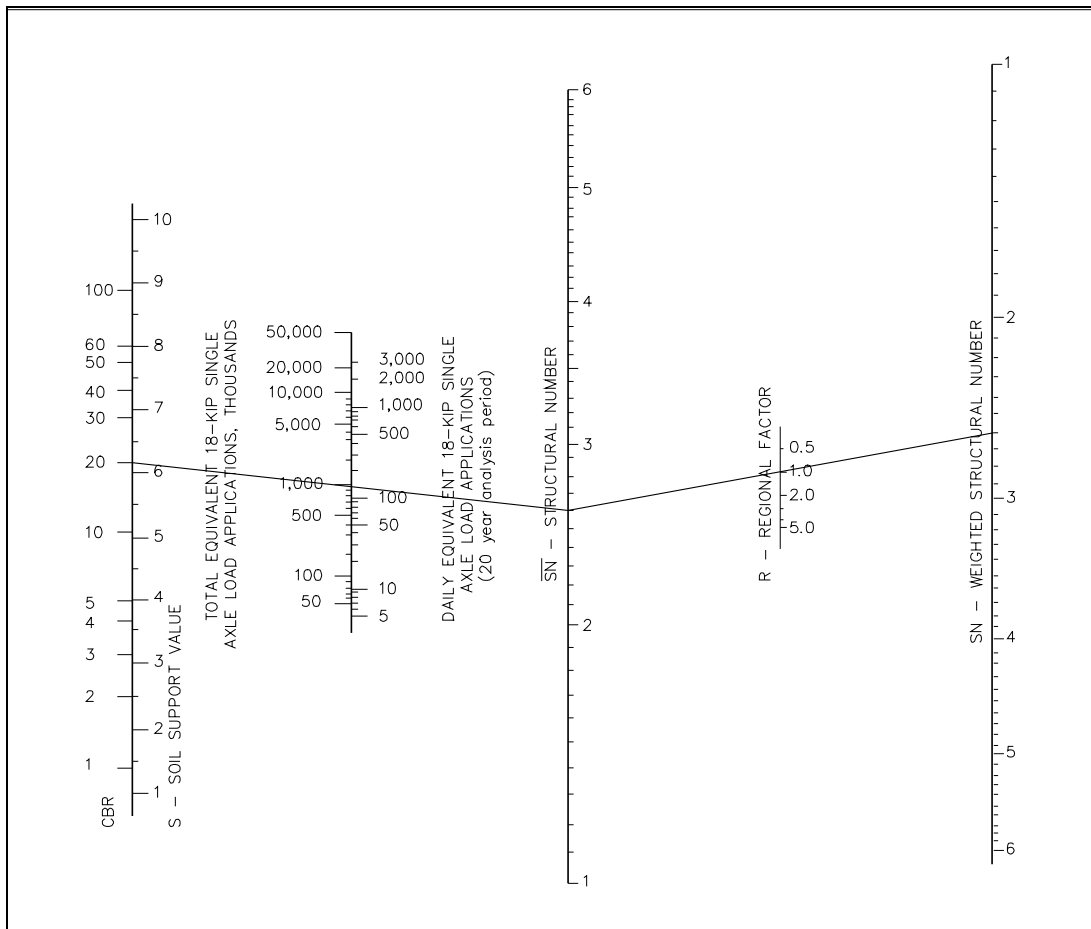


Figure 11-5 Design Chart for Flexible Pavement ($p_t = 2.5$)

However, 40 mm wearing course is the practice thickness applied in the Sultanate of Oman. This can be attributed to decrease the cost while still apply a reasonable practice thickness.

The HDM highlighted that there is a difference in terminology for typical pavement layers as shown in Table 11-16.

Table 11-16 Terminology for Typical Pavement Layers

Oman	USA	UK
Wearing course	Wearing course	Wearing course
Basecourse	Binder course	Basecourse (proposed to change to binder course)
Aggregate basecourse	Aggregate basecourse	Unbound road base
Subbase	Subbase	Subbase
Subgrade layer	Prepared roadbed	capping layer

Concrete Roads

Concrete roads are not generally used in Sultanate of Oman except at certain wadi crossing where flows faster than 2.5 m/sec are expected. The design life shall be taken 40 years. Where an asphalt road meets a concrete road the detail shown in Figure 11-6 may be used. Figure 11-7 shows typical expansion and contraction joint details for use at Irish crossings and bridges.

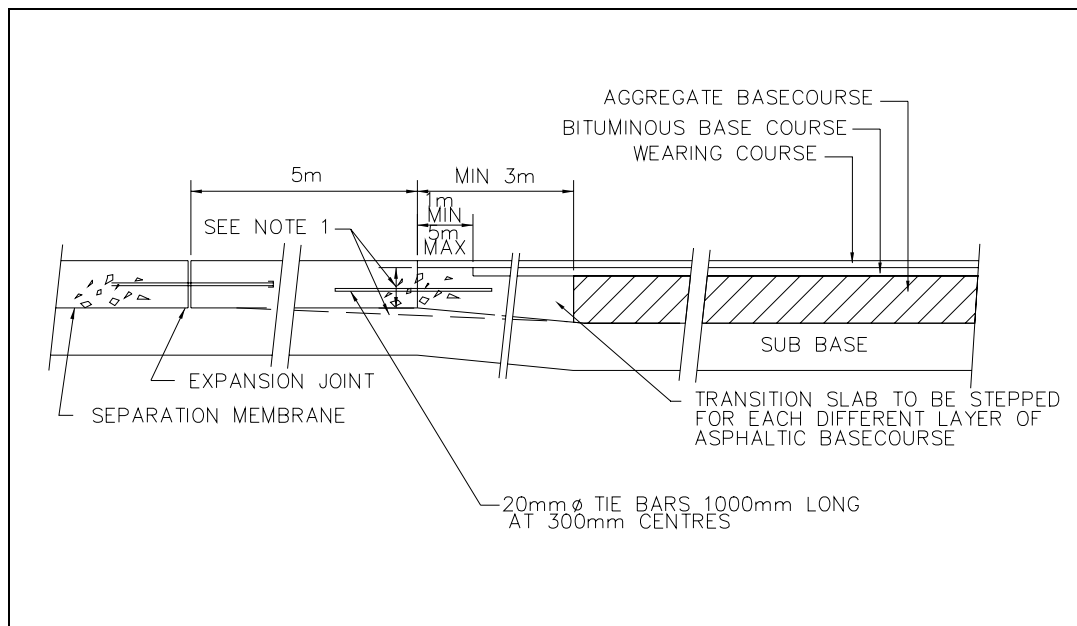
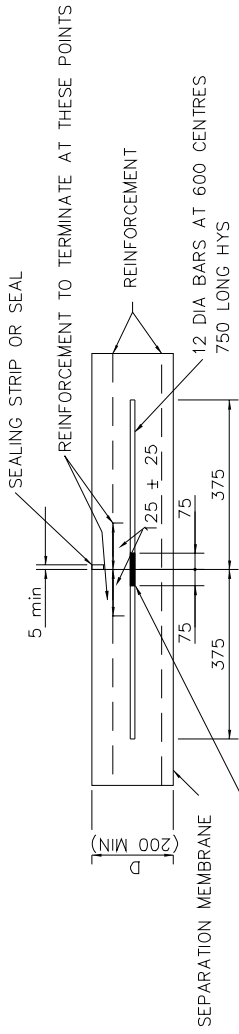


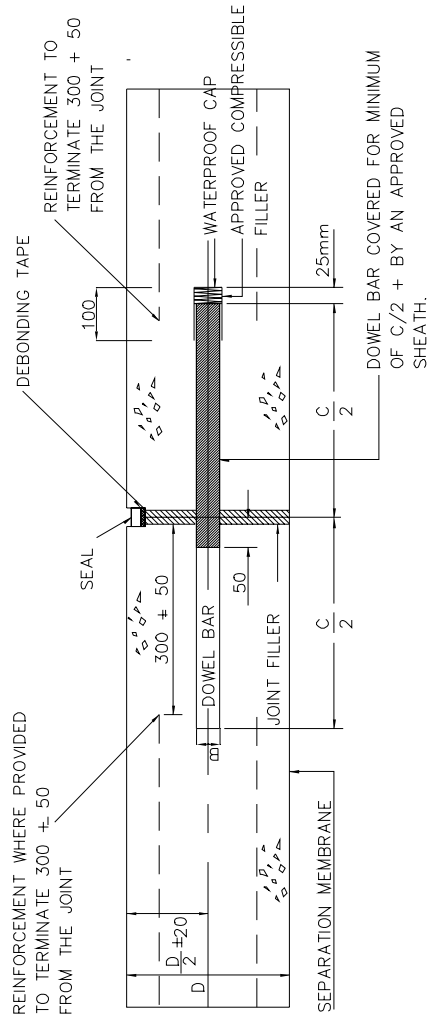
Figure 11-6 Junction between Concrete and Asphalt Carriageway



CONTRACTION JOINT

NOTES:

1. DIMENSIONS ARE IN MILLIMETRES.
2. DOWEL BARS PLACED AT 300mm CENTRES. ADJUST SPACING SO THAT NO DOWEL BAR IS WITHIN 150 OF A SLAB EDGE OR JOINT PARALLEL TO BARS.
3. COVER TO BARS SHALL BE:
 50 FOR SLABS LESS THAN 200 THICK
 60 FOR SLABS 200 TO 270 THICK
 70 FOR SLABS GREATER THAN 270 THICK



EXPANSION JOINT

SLAB THICKNESS (mm)	DOWEL BAR DIMENSION	
	B	C
150 TO 240	25	550
> 240	32	650

Figure 11-7 Concrete Pavements at Irish Crossing

Edges of Pavement

On major roads the paved shoulder should be of the same construction as the carriageway. This allows future use of the paved shoulder during road maintenance operations.

On asphalted roads with low amounts of traffic, it is permissible to adopt a slightly reduced strength of paved shoulder by replacing the asphalt wearing course with an equal thickness of aggregate basecourse. This should be sealed with bitumen and stone chipping.

o- Structures

Where bridge cross wadi the effect of flood events on the bridge and its supports must be carefully considered. The under side of the structures should be clear of the 1 in 100 year flood level by the heights shown in Table 11-17.

Table 11-17 Vertical Clearance above Flood

Discharge (m ³ /sec)	Vertical Clearance between Soffit and Flood Level (cm)
< 0.3	15
0.3 to 3.0	45
3.0 to 30.0	60
30 to 300.0	90
> 300.0	120

Where it is not possible to achieve the clearances at reasonable cost, then the flood event can be reduced to a one (1) in fifty (50) year occurrence with the agreement of client. In this case the bridge must be designed to resist possible flooding and in addition should also be:

- Constructed in concrete.
- Have a flat soffit (i.e. solid or voided slab, or box construction).
- If of box construction, vent holes should be provided so that the voids freely fill up with water as the water rises and empty as the water subsides.

Durability of concrete can be a problem in the Sultanate if good practice is not followed. It is important to specify concrete that can resist the onerous climatic conditions, rapid carbonation and aggressive soil conditions. The requirements shown in Table 11-18 shall be adopted for all reinforced and prestressed structural concrete.

At least 7.5 cm thickness of asphalt surfacing should be applied to bridge decks to waterproof them and prevent damage to the structural concrete.

Table 11-18 Requirements for Reinforced and Prestressed Concrete

Exposure Condition	Minimum Cement Content (kg/m ³)	Maximum Water/Cement Ratio	Cement Type	Minimum Cover (mm)	External Protection
Superstructure and piers above the capillary rise zone.	320	0.42	OPC	45	
Permanently below sea or ground water.	350	0.42	ASTM Type II	50	Tanking with thick membrane
Underground but above the influence of capillary rise.	350	0.42	ASTM Type II	50	Two coats bituminous paint
Within ground water capillary rise zone.	370 with entrained air	0.40	ASTM Type II	75	Tanking with thick membrane
	420	0.38	ASTM Type II	100	Two coats bituminous paint
Inter-tidal and splash zone. Subject to wetting and drying with saline water.	400 with entrained air	0.40	ASTM Type II	100	Surface coating. Preferable to design in mass concrete.

p- Barriers

Road safety barriers should be provided on all primary and secondary roads and where one of the following occurs:

- Embankments are higher than 3m.
- Other embankments where there is a hazard at the base, e.g. road, water subway, large culverts and large boulders.
- At outside of curves of radius less than the midpoint of band D for the design speed and where the embankment is more than 2m high.
- At obstructions such as bridge piers, abutments, large signs gantries, celebration arches.
- At substantial obstructions closer than 4.4m to the running edge of the carriageway such as retaining walls, steep sided rock cuttings, large trees, high mast lighting.

Median safety barriers should be provided at:

- In medians 11 m wide or less where there are no curbs.
- In medians where the difference in the carriageway inner channel levels is greater than 0.5 m and the slope across the median is more than 15%.
- Where the lighting columns are sited in the median.

The major aspects of the layout of the guardrail are:

- Guardrails must start 30 m in advance of hazard, and continue 15 m beyond the end of the hazard.
- The approach end and preferably the departure end must be flared by at least 1.14 m. Terminal should be ramped down into the ground.
- The face of the barrier should be set at least 60 cm behind any paved shoulder and at least 1.6m from the running edge of the carriageway.

q- Traffic Signs

Traffic signs generally follow the international conventions and these include:

- Upright message signs alongside or over the road. These may be warning, regulatory or informative signs
- Road marking including road studs
- Traffic signals
- Flashing beacons
- Cones

Transliteration of Arabic into English should follow the list issued by the Ministry of Interior.

APPENDIX 12-1

ENVIRONMENTAL CHECKLIST

ENVIRONMENTAL CHECKLIST (W1)

Road Section: From Bait Al Barakah to Al Muladdah, Existing road condition: Paved 4-lane road
Project No.: W1, National Road No.1, Planning road: Paved 6-lane road, Distance: 54km

Environmental Items	Present Condition	Impact Rating 1 = Slight 2 = Moderate 3 = Significant	Major Anticipated Impact with Project Predicted traffic volume in 2030: 40,000 ~ 45,000 veh/day
Air Pollution	: Location of each road unit is explained at item of "Topography and Geology". (1)~ (3): Present traffic volume is 22,000~24,000 veh/day. Air quality seems not to be critical yet; urban area ad roundabout at rush time is likely much polluted.	2	- Extremely high traffic volume is predicted. Air pollution might be visible in residential areas.
Effluent	(1)~ (3): Drainage systems are installed in the wadis and slope. But other places are not installed side ditches. During rainfall, much rainwater is accumulated in some places.	1	- Discharge volume from road surface will be increased.
Noise and Vibration	(1)~ (3): Present traffic volume is 22,000~ 24,000 veh/day. Air quality seems not to be critical yet; urban area ad roundabout at rush time is likely much polluted.	2	- Extremely high traffic volume is predicted. Noise pollution might be visible in residential area.
Land Subsidence	(1)~ (3): Not existing.	1	- Not existing.
Topography and Geology	Topography: (1)~ (3): 0~ 54 km: Flat on the terraces and Alluvial terrains. Many wadis intersect the proposed road and depth between bottom of wadis and terrace plain ranges from 2 to 5m.	1	- Not significant impact due to road widening along existing road. - However, it is necessary to make carefully arrangement to operate borrow pits, to use construction camps, during for road construction.
Soil	(1)~ (3): Rare natural soil is covered road alignment. Geology: Terrace and Alluvial plains mostly consist of gravel, sand and clay, underlain with Tertiary and Mesozoic sedimentary origin.	1	- Not significant, but the area of road alignment and borrow pits, etc. should be minimized to excavate for surface soil as well as vegetation, especially wadi vegetation.
Hydrology, groundwater	(1)~ (3): Alluvial soil is locally developed along the wadis, but generally thin because of wadi and wind erosion. (1)~ (3): Many wadis intersect the existing and proposed roads. Present road crosses wadis mostly	1	- Not significant impact due to widening of road.

	<p>by Irish crossing and box culverts. Main wadis are Wadi al Ajar, Wadi Ma Awil, Wadi al Wabiyat, etc. from east to west. Numerous water wells are distributed in the area for the irrigation of farms.</p> <p>(1)~ (3): Relatively sparse vegetation is found along the entire stretch of the project area. Increased vegetation is found within wadi channels.</p>		
Eco-system, Flora and Fauna		1	<ul style="list-style-type: none"> - No significant impact is expected to occur to naturally vegetation as a result of the proposed road. Because, no widening the ROW. - There are no protected areas along the proposed route. - Numerous domestic animals are grazed and suffered traffic accidents.
Landscape	(1)~ (3): Flat and terraced hilly land.	1	<ul style="list-style-type: none"> - Proposed route follows along existing road and no widening the ROW.
Hazards	Flash flood.	1	<ul style="list-style-type: none"> - Proposed route follows along existing road and no widening the ROW.
Regional Development on Natural Environment	Not existing so far.	1	<ul style="list-style-type: none"> - Unknown.
Other Impacts on Natural environment	Not existing so far.	1	<ul style="list-style-type: none"> - Not existing.
Cultural Heritage	Not existing so far.	1	<ul style="list-style-type: none"> - No widening the ROW.
Wastes	(1)~ (3): Domestic wastes are scattered in some places.	1	<ul style="list-style-type: none"> - Very high traffic volume in future. Wastes along the road will be increased together with increasing traffic volume.
Regional Development on Social Environment	Not existing so far.	1	<ul style="list-style-type: none"> - Not existing.
	<p>(1)~ (3): Not existing so far. 0 km point: Bait Al Barakah. 10 km point: Rumais village. 21 km point: Junction to Barka. 22 km point: Microwave tower and junction to Nakhul. 33 km point: Uqdah village. 54 km point: Junction at Muladdah to Rustaq and Masna'ah village.</p>	1	<ul style="list-style-type: none"> - Increased chance of traffic accident, especially for domestic animals, due to increased traffic.

Evaluation	Air pollution	2	Increased traffic volume
	Noise and Vibration	2	Increased traffic volume
	Other items	1	

ENVIRONMENTAL CHECKLIST (W2)

Road Section: From Barka to Al Khabrah, Existing road condition: No road
 Project No.: W2, National Road No.1, Planning road: Paved 6-lane road, Distance: 95 km

Environmental Items	Present Condition	Impact Rating 1 = Slight 2 = Moderate 3 = Significant	Major Anticipated Impact with Project Predicted traffic volume in 2030: 52,000~56,000 veh/day
Air Pollution	: Location of each road unit is explained at item of "Topography and Geology".	2	- Extremely high traffic volume is predicted. Air pollution might be visible in residential areas.
Effluent	(1)~(6): Not existing so far.	1	- Discharge volume from road surface will be increased.
Noise and Vibration	(1)~(6): Not existing so far.	2	- Extremely high traffic volume is predicted. Noise pollution might be visible in residential area.
Land Subsidence	- Not existing.	1	- Not existing.
Topography and Geology	Topography: (1) ~ (2): 20 to 40 km: Flat, terrace and small hilly land. But low relief mountainous topography in some places. Many wadis intersect the proposed road and depth between bottom of wadis and terrace plain ranges approximately from 2 to 10 m. (2) ~ (6): 40 to 127 km: Flat on the terraces and Alluvial terrains. Many wadis intersect the proposed road and depth between bottom of wadis and terrace plain ranges approximately from 2 to 5m. Geology: The project area is located in the Batinah coastal plain. Wide alluvial and terraced gravel plains are approximately 200 km long. The plain is traversed by several wadis, which flow, from the northern Al Hajar Mountains towards the coast. The composition of the coastal plain within the project area is primarily sand and gravel underlain with autochthonous Tertiary and allochthonous Mesozoic rocks.	1	- Not significant impact due to road widening along existing road. However, it is necessary to make carefully arrangement to operate borrow pits, to use construction camps, during for road construction.
Soil	(1)~(6): Alluvial soil is locally developed along the wadis, but generally thin because of wadi and wind erosion.	1	- Not significant, but the area of road alignment and borrow pits, etc. should be minimized to excavate for surface soil as well as vegetation, especially wadi vegetation.

Hydrology, groundwater	(1)~(6): Wadis: Many wadis will be intersect along the proposed road alignment. Main wadis are Wadi al Ajar, Wadi Ma Awil, Wadi al Wabiyat, Wadi Far, Wadi al Hawqayn, Wadi Mabrah, etc. from east to west. Several water wells and falag system are distributed around the villages in the area.	1	- Not significant impact due to widening of road.
Eco-system, Flora and Fauna	(1)~(6): Relatively sparse vegetation is found along the entire stretch of the project area. Increased vegetation is found within wadi channels.	1	- No significant impact is expected to occur to naturally vegetation as a result of the proposed road. Because, no widening the ROW. - There are no protected areas along the proposed route. - Numerous domestic animals are grazed and suffered traffic accidents.
Landscape	(1)~(6): Flat and terrace hilly land.	1	- Proposed route follows along existing road and no widening the ROW.
Hazards	- Flash flood.	1	- Proposed route follows along existing road and no widening the ROW.
Regional Development on Natural Environment	- Not existing so far.	1	- Unknown.
Other Impacts on Natural environment	- Not existing so far.	1	- Not existing.
Cultural Heritage	(1)~(6): Unknown.	1	- The investigation of the cultural heritage is required in the site.
Wastes	(1)~(6): Domestic wastes scatter in some places.	1	- Very high traffic volume in future. Wastes along the road will be increased together with increasing traffic volume.
Regional Development on Social Environment	- Not existing so far.	1	- Not existing.
Other Impacts on Social Environment	(1)~(6): 0 km point: Afi village and north of Barka. 13 km point: Khatum village. 30 km point: Jamma village. 38 km point: Al Hazm Ruin, cultural heritage. 54 km point: Tawi al Badu village. 68 km point: Wadi al Uliya village. 95 km point: Ghuzayn village.	1	- Increased chance of traffic accident, especially for domestic animals, due to increased traffic.

Evaluation	Air pollution Noise and Vibration Other items	2 2 1	Increased traffic volume Increased traffic volume

ENVIRONMENTAL CHECKLIST (D2)

**Road Section: From Bidbid to Sur, Existing road condition: Paved 2-lane road
Project No.: D2, National Road No.23, Planning road: Paved 4-lane road, Distance: 258km**

Environmental Items	Present Condition : Location of each road unit is explained at item of “Topography and Geology”.	Impact Rating 1 = Slight 2 = Moderate 3= Significant	Major Anticipated Impact with Project Predicted traffic volume in 2030: 11,000~20,000 veh/day
Air Pollution	(1)~ (5): Present traffic volume is 4,200~ 7,300 veh/day. Not significant so far.	1	- Slight air pollution may occur in urban areas due to increase of traffic volume.
Effluent	(1)~ (5): Drainage systems are installed in the wadis and slope near Izki.	1	- Discharge volume from road surface will be increased.
Noise and Vibration	(1)~(5): Not significant so far.	1~2	- Slight to moderate noise may occur in urban areas due to increase of traffic volume.
Land Subsidence	(1)~(5): Not existing.	1	- Not existing.
Topography and Geology	Topography: (1) 0 (Bidbid)~ 50km (Mudayhfah): The road crosses the eastern Oman Mountains (Al Hajar Ash Sharqi). The area mostly shows hilly to low ~ moderate relief mountainous topographic feature. Two wadis, Wadi Mansah and Wadi Andam cross the existing road. (2) 50~ 100km (Ibra): The area is mostly flat and hilly land between them. (3) 100~ 140km (Al Mintirib): The area is typically flat between Ibra and Al Kamil, where various sizes of hills are apparent. And the road near Al Mintilib is faced huge sand dune of Wahibah. (4) 140~ 200 km (Al Kamil): The area is typically flat between Al Kamil and Al Mintilib. And the road is faced and adjoined to the sand dune of Wahibah. (5) 200~ 258km (Sur): The road passes low land between the Oman Mountains (Jabal Bani Jabir) and Jabal Khamis. And the road crosses many tributaries of Wadi Falayl by a number of box culverts and bridges.	1~2	- Slight to moderate impact is likely to occur due to alteration of topography by massive excavation and embankment.due for road widening along existing road. - It is necessary to make carefully arrangement to operate borrow pits, to use construction camps, during for road construction.

	Geology: The project area is located in the Ash Sharqiyah Region and consists of alluvial and terraced plain, mostly gravels and sands. (1)~ (5): Alluvial soil is locally developed along the wadis, but generally thin because of wadi and wind erosion.		1	- Not significant, but the area of road alignment and borrow pits, etc. should be minimized to excavate for surface soil as well as vegetation, especially wadi vegetation. - Not significant impact due to road dualization. - Flash flood likely occurs many times and places in the project area, particularly south and southeast of Jabal Bani Jabir. - Numerous domestic animals are grazed and suffered traffic accidents.
Soil	(1)~ (5): Many sections of the existing road pass within wadi flow areas. Some sections of the existing road and related support have been eroded by wadi flow, however, severe erosion was not noted and in general the existing road is considered to be in good condition.		1	- In the Wilayat of Al Kamil Royal Decree 50,97 has designated the As Saleel Nature Reserve since 28 June 1997. - It should be noted that the area around the reserve is considered valuable for future education and tourism.
Hydrology, groundwater	Flora and Fauna: (1)~ (5): Vegetation is found along the entire stretch of the project area is sparse in most localities. Increased vegetation is concentrated in the wadis and depressions in the plain, and acacia woodland also occurs on areas of the alluvial plain. Vegetation varies from one to 40 trees per hectare. (4) ~ (5): In the Wilayat of Al Kamil the As Saleel Nature Reserve has been designated since 28 June 1997 by Royal Decree 50,97. Whilst the existing road alignment does not pass directly within the boundaries.		2	
Eco-system, Flora and Fauna				
Landscape	(1) ~ (2): Hilly and mountainous land. (3) ~ (5): Flat and hilly land. And Jabal Bani Jabir shows steep and panoramic scene.		1	- Dualization might be followed along existing road alignment.
Hazards	(1)~ (5): Flash flood is caused many times in this area, and sand dune and sand storm are usually suffered in this area. - Not existing so far.		1	- Dualization might be followed along existing road alignment. -Unknown.
Regional Development on Natural Environment	- Not existing so far.		1	- Not existing.
Other Impacts on Natural environment	- Not existing so far.		1	
Cultural Heritage	(1)~ (5): Old houses and towers.		1~2	- Dualization might be followed along existing road alignment. But, The investigation of the cultural heritage is required in the site.

Wastes	(1)~(5): Not significant so far.	1	- High traffic volume is predicted. Wastes along the road will be increased together with increasing traffic volume. - Unknown.
Regional Development on Social Environment	- Not existing so far.	1	- Unknown.
Other Impacts on Social Environment	(1)~(5): 0 km point: Bidbid town. 10 km point: Luzugh village. 17 km point: Dasir village. 22 km point: Tawiyah village 49 km point: Mudayhfah village. 62 km point: Junction to Sanaw. 89 km point: Al Ahmadi village. 100 km point: Ibra town. 130 km point: Al Wasil village. 140 km point: Al Mintirib town. 200 km point: Al Kamil village. 234 km point: Gharayfah village. 258 km point: Sur city.	1~2	- Increased chance of traffic accident as well as domestic animals due to increased traffic volume.

Evaluation	Noise and Vibration	1~2	Increased traffic volume
	Topography and Geology	1~2	Increased traffic volume
	Eco-system, Flora and Fauna	2	Passing near the As Saleel National Park area
	Cultural heritage	1~2	Influence to cultural heritage
	Other Impacts on Social Environment	1~2	Increased traffic volume
	Other items	1	

ENVIRONMENTAL CHECKLIST (D3)

Road Section: From Nizwa to Ibri, Existing road condition: Paved 2-lane road
Project No.: D3, National Road No.21, Planning road: Paved 4-lane road, Distance: 135km

Environmental Items	Present Condition	Impact Rating 1 = Slight 2 = Moderate 3 = Significant	Major Anticipated Impact with Project Predicted traffic volume in 2030: 7,000~12,000 veh/day
Air Pollution	: Location of each road unit is explained at item of "Topography and Geology".	1	- Slight air pollution might be caused in urban areas due to increase of traffic volume.
Effluent	(1) ~ (3): Present traffic volume is 2,000~ 4,800 veh/day. Air quality is not significant. But, sand storm periodically occurs during the hot season.	1	- Discharge volume from road surface will be increased.
Noise and Vibration	(1)~ (3): Drainage systems are installed in the wadis and slope near Izki.	1	- Slight noise may occur in urban areas due to increase of traffic volume.
Land Subsidence	(1)~ (3): Present traffic volume is 2,000~ 4,800 veh/day. Air quality is not significant.	1	- Not existing.
Topography and Geology	(1)~ (3): Not existing. Topography: (1) 0 (Nizwa)~ 36 km (Bahla): The road area is mostly flat on the Low Terrace and Alluvial wadi Plains along the middle stream of Wadi Khalbuh until Tanuf. The Tanuf area, located approximately 20 km distance from Nizwa, crosses hill area consisting of peridotite (ophiolite) terrain. (2) 35~ 75km (Junction to Amlah): The road passes flat area on the Low Terrace and wadi plains along the foot of the Jabal Al Akhdar Mountains. (3) 75~ 125 km (Ibri): The road passes flat area on the Low and Lowermost Terraces and wadi plain of Wadi Buwaydah and Wadi Lusayl. Before Ibri city, the road closed to the cliff of limestone hill. Geology: Northern part of the road area consists mainly of Paleozoic to Mesozoic sedimentary rocks of the autochthonous unit, and southern part of the road area is mainly composed of limestone, chert, mudstone, etc. of Paleozoic to Mesozoic sedimentary rocks belonging to the Hawasinah and ophiolite allochthonous unit.	1	- Not significant impact due to road widening along existing road. However, it is necessary to make carefully arrangement to operate borrow pits, to use construction camps, during for road construction.

Soil	(1)~ (3): Soil is poorly developed and mostly suffered by rain and wind erosion. Alluvial soil is found in the wadi, but mostly thin.	1	- Not significant, but the area of road alignment and borrow pits, etc. should be minimized to excavate for surface soil as well as vegetation, especially wadi vegetation.
Hydrology, groundwater	(1)~ (3): No current flow along the wadis (upper stream of Wadi Kalbuh, Wadi Bahla and Wadi Buwaydah and Wadi Lusayl) and falaj system in the area. Several small villages and farmlands scattering along the road have water wells. And groundwater along the road is relatively rich derived from the Jabal al Akhdar.	1	- Not significant impact due to road dualization. - Road section of the proposed road north of Nizwa passes through areas where wadi flow is evident during rain and flood events. The rainfall, being 87mm/year at Nizwa between 1990 and 2000, was very low. But that of the mountain area is more than 300 mm/year. It is likely to occur flash flood in the project area.
Eco-system, Flora and Fauna	Flora: (1)~ (3): Vegetation is mostly found along the road, where the vegetation can be classified as an open xenomorphic <i>Euphorbia</i> community type. These species are found in areas of rugged relief with rapid water run off and little soil cover. Fauna: - Wildlife known to the area north of Nizwa includes the endangered (IUCN 1990) gazelle (<i>Gazella gazella</i>) and other fauna such as the red fox (<i>Vulpes vulpes arabica</i>), and small rodents.	1~2	- Numerous domestic animals are grazed and suffered traffic accidents. - There are no protected areas along the proposed route.
Landscape	(1)~ (3): The road area is located foot of the Jabal al Akhdar Mountains and passes.	1	- Dualization might be followed along existing road alignment.
Hazards	(1) ~ (3): The flash flood and sand storm and sand dune occur along the road. The flash floods had occurred in Wadi Buwaydah, Wadi Lusayl and its tributary of Wadi al Ayn. The sand storm usually occurs around Ibri during hot season.	1	- Dualization might be followed along existing road alignment. - Hazards will occasionally occur flash flood along wadis and sand storm along the road.
Regional Development on Natural Environment	- Not existing so far.	1	- Unknown.
Other Impacts on Natural environment	- Not existing so far.	1	- Not existing.
Cultural Heritage	(1) ~ (3): 1.7 km point: Fort. 7.2 km point: Old fort. 9 km point: Fort along the road. 44.5 km point: Old fort (Bahla).	2~3	- The investigation of the cultural heritage is required in the site. - Influence to existing cultural heritage at Bahla.

Wastes	- Not significant so far.	1	- High traffic volume is predicted. Wastes along the road will be increased together with increasing traffic volume. - Unknown.
Regional Development on Social Environment	- Not existing so far.	1	- Unknown.
Other Impacts on Social Environment	(1) ~ (3): 0 km point: Nizwa city. 0.2km: Groveland and farmland. 2.2 ~4km point: Small settlement and strip of settlement along the road. 5 km point: Al Abyat village. 6.1 km point: Industrial site. 7 km point: Roundabout. 7.6 km point: Bridge. 12 km point: Small settlement. 19 km point: Rawda village. 26 km point: Junction to Al Hamra village. 30 km point: Hayl al Sa'ad village. 36 km point: Bahla town and strip of settlement along the road; 40m. 38 km point: Junction to Nattalah. 45 km point: Graveyard and fort. 46 km point: Graveyard. 75 km point: Junction to Amlah village. 87 km point: Kubarah village. 99 km point: Stripe settlement. 107 km, 112 km points: Farmland. 125 km point: Farmland.	1~2	- Increased chance of traffic accident as well as domestic animals due to increased traffic volume. - Relocation of small number of houses and a mosque at near Ibri.

Evaluation	Eco-system, Flora and Fauna	1~2	Deforestation of wadi vegetation, etc.
	Cultural heritage	2~3	Passing beside of Bahla Fort (World Heritage)
	Other Impacts on Social Environment	1~2	
	Other items	1	Relocation of houses and a mosque

ENVIRONMENTAL CHECKLIST (D4-1)

Road Section: From Junction of Nizwa to Ghabah, Existing road condition: Paved 2-lane road
Project No.: D4-1, National Road No.31, Planning road: Paved 4-lane road, Distance: 196km

Environmental Items	Present Condition : Location of each road unit is explained at item of “Topography and Geology”.	Impact Rating 1 = Slight 2 = Moderate 3= Significant	Major Anticipated Impact with Project Predicted traffic volume in 2030: 10,000~12,000 veh/day
Air Pollution	(1)~(4): Not significant so far.	1	- Slight air pollution may occur in urban areas due to increase of traffic volume.
Effluent	(1)~(4): Not significant so far.	1	- Not significant.
Noise and Vibration	(1)~(4): Not significant so far.	1	- Slight noise may occur in urban areas due to increase of traffic volume.
Land Subsidence	(1)~(4): Not existing.	1	- Not existing.
Topography and Geology	Topography: (1) 0 (Junction of Nizwa)~58km (Adam): The road area is mostly flat on the Low Terrace and wadi plains and hilly terrain consists of the Hawasinah sedimentary rocks. Flat area except small wadis (tributaries of Wadi al Ghabah) and salt domes. (2) 58~100km: Flat land with small wadis. 100~150km: Flat land with small wadis. (3) 150~196km (Ghabah): Flat and small wadis. Two places of salt dome are found around Al Ghaba in the flat terrain. Geology: The project road area is Mesozoic Hawasinah Group, consisting mainly limestone, chert and shale, as the allocthonous units in the Oman Mountains. The alluvial deposits, consisting of gravel and sand, occupy the wadis.	1	- Not significant impact due to road widening along existing road. However, it is necessary to make carefully arrangement to operate borrow pits, to use construction camps, during for road construction.
Soil	(1)~(4): Soil is poorly developed, mostly suffered by wind erosion. Alluvial soil is found in the wadi, but mostly thin.	1	Not significant, but the area of road alignment and borrow pits, etc. should be minimized to excavate for surface soil as well as vegetation, especially wadi vegetation.
Hydrology, groundwater	(1)~(4): No current flow along the wadis. Several drainage tubes are installed at the small wadis.	1	- Not significant impact due to road dualization.

Eco-system, Flora and Fauna	Flora: Mostly no to rare vegetation consisting of grasses (mostly halophytic and mesophyll plant). But there is slight vegetation along small wadis and depression zones. Fauna: Birds are rarely found in the area. - Almost flat and low hills land.	1	- There are no protected areas along the proposed route. - Numerous domestic animals are grazed and suffered traffic accidents.
Landscape		1	- Dualization might be followed along existing road alignment.
Hazards	(1)~ (4): Sand storm is suffered this area, particularly hot season. Small sand dunes sometimes cover road surface.	1	- Dualization might be followed along existing road alignment. - Sand storm and sand dune occasionally cross the road.
Regional Development on Natural Environment	- Oil development by PDO in the area.	1	- Unknown.
Other Impacts on Natural environment	- Not existing so far.	1	- Not existing.
Cultural Heritage	(1)~ (4): Old tower on the terraces.	1~2	- Dualization might be followed along existing road alignment (within the ROW). - The investigation of the cultural heritage is required in the site.
Wastes	- Not significant so far.	1	- High traffic volume in future. Wastes along the road will be increased together with increasing traffic volume.
Regional Development on Social Environment	- Not existing so far.	1	- Unknown.
Other Impacts on Social Environment	0km point: Junction of Nizwa. 58km point: Adam village, school, public office, etc., but no crossing inside of the village. 196km point: Ghaba Filling Station and Motel, etc. Junction access to the interior area.	1	- Increased chance of traffic accident as well as domestic animals due to increased traffic volume.

Evaluation	Cultural Heritage	1~2	Influence to cultural heritage
	Other items	1	

ENVIRONMENTAL CHECKLIST (D4-2)

Road Section: From Ghabah to Hyma, Existing road condition: Paved 2-lane road
Project No.: D4-2, National Road No.31, Planning road: Paved 4-lane road, Distance: 191km

Environmental Items	Present Condition : Location of each road unit is explained at item of "Topography and Geology".	Impact Rating 1 = Slight 2 = Moderate 3 = Significant	Major Anticipated Impact with Project Predicted traffic volume in 2030: 11,000 veh/day
Air Pollution	(1)~ (9): Not significant.	1	- Not significant, The project area is rare receptors.
Effluent	(1)~ (9): Not existing.	1	- Not significant.
Noise and Vibration	(1)~ (9): insignificant.	1	- Not significant. The project area is rare receptors.
Land Subsidence	(1)~ (9): Not existing.	1	- Not existing.
Topography and Geology	<p>Topography:</p> <p>(1) 0 (Junction to Fahud)~20km: Flat area except small wadis (tributaries of Wadi al Ghabah) and salt domes.</p> <p>(2) 20~40km: Flat area.</p> <p>(3) 40~60km: Flat land with small wadis.</p> <p>(4) 60~80km: Flat area. Sand dunes exist near the road.</p> <p>(5) 80~100km: Flat. Sand dune gradually becomes small size.</p> <p>(6) 100~120km: Sand dune disappears in this road unit.</p> <p>(7) 120~140km: Flat and low terraces are scattered.</p> <p>(8) 140~160km: Flat land.</p> <p>(9) 160~ 191km (Junction to Duqm): Flat land.</p> <p>Geology: Horizontal marl and limestone beds are widely distributed in the area. And Quaternary wadi sediments are partly covered along the poor wadis. And aeolian sand is widely covered the area, but mostly thin. And sand dunes are found at the middle part of the section.</p> <p>(1)~(9): Height of embankment of the road is less than 2.2m.</p>	1	- Not significant impact due to road widening along existing road. However, it is necessary to make carefully arrangement to operate borrow pits, to use construction camps, during for road construction.
Soil	(1)~ (9): soil is poorly developed, mostly suffered by wind erosion. Alluvial soil is found along the small wadis with aeolian sand.	1	- Not significant impact due to road dualization.

Hydrology, groundwater	(1)~ (9): No current flow along the wadis. Several drainage tubes are installed at the small wadis.	1	- Not significant impact due to road dualization.
Eco-system, Flora and Fauna	Flora: Mostly no to rare vegetation consisting of grasses (mostly halophytic and mesophyll plant). But there is slight vegetation along small wadis and depression zones. Fauna: Birds are rarely found in the area. - Almost flat and low hills land.	1	- There are no protected areas along the proposed route. - Domestic animals are grazed and suffered traffic accidents. - Dualization might be followed along existing road alignment.
Hazards	(1)~ (9): Sand storm is suffered this area, particularly hot season. Small sand dunes sometimes cover road surface.	1	- Dualization might be followed along existing road alignment. - Sand storm and sand dune occasionally cross the road.
Regional Development on Natural Environment	- Oil development by PDO in the area.	1	- Unknown.
Other Impacts on Natural environment	- Not existing so far.	1	- Not existing.
Cultural Heritage	- Not existing so far.	1	- Dualization might be followed along existing road alignment (within the ROW). - The investigation of the cultural heritage is required in the site.
Wastes	- Not significant. Litterbins are installed each 5km distance (parking areas) along the road. Most of litter boxes are clean. - Fragments of broken tire are scattered along the road	1	- High traffic volume in future. Wastes along the road will be increased together with increasing traffic volume.
Regional Development on Social Environment	(1)~ (9): Ghaba area is located in oilfield, there are two oil gathering station. No habitants except Hyma village.	1	-Unknown.
Other Impacts on Social Environment	(1) 0km point: Ghaba F/S and Motel, etc. Junction access to the interior area. (2) ~ (3): Electric lines along the road High-voltage transmission line crossing the road 88km point: Mitan village, school, public office, etc., but no crossing inside of the village. 176km point: Recreation park.	1	- Increased chance of traffic accident as well as domestic animals due to increased traffic volume.

Evaluation	All items	1
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ENVIRONMENTAL CHECKLIST (D4-3)
Road Section: From Hyma to Muntasar Southern Junction, Existing road condition: Paved 2-lane road
Project No.: D4-3, National Road No.31, Planning road: Paved 4-lane road, Distance: 198km

Environmental Items	Present Condition	Impact Rating 1 = Slight 2 = Moderate 3= Significant	Major Anticipated Impact with Project Predicted traffic volume in 2030: 9,600 veh/day
Air Pollution	: Location of each road unit is explained at item of "Topography and Geology". (1)~ (10): Not significant.	1	- Not significant. The project area is rare receptors.
Effluent	(1)~ (10): Not existing.	1	- Not significant.
Noise and Vibration	(1)~ (10): insignificant.	1	- Not significant. The project area is rare receptors.
Land Subsidence	(1)~ (10): Not existing.	1	- Not existing.
Topography and Geology	Topography: (1) 0 (Junction to Duqm)~ 8km: Flat with low hills like mesa. Height of hills ranges from 5 to 10m. 8~20km: Low hilly land shows bumpy topography. (2) 20~ 40km: Flat with low hills and small wadis (hollow-ground). (3) 40~ 60km: Flat with low hills and small wadis (hollow-ground). (4) 60~ 80km: Flat with low hills and small wadis (hollow-ground). (5) 80~ 100km: Low hills and wadis show bumpy topography. (6) 100~ 120km: Flat with low hills and aeolian sand is widely covered the area, and sand dunes are found along the road unit (about 2~3 km long). Particularly, 104km point is covered by sand on the road. (7) 120~ 140km: Mostly flat with low hills scattered. (8) 140~ 160km: Flat land with small low hills. (9) 160~ 180km: Flat land with small low hills. 180~ 198km (Junction to Muntasar village): Flat and with small low hills. Geology: Horizontal marl and limestone beds are widely distributed in the area. And Quaternary wadi	1	- Not significant impact due to road widening along existing road. However, it is necessary to make carefully arrangement to operate borrow pits, to use construction camps, during for road construction.

	sediments are partly covered along the poor wadis. And aeolian sand is widely covered the area, but mostly thin. Gypsum and kaolin are found in some places along the road. Particularly, gypsum is found in the road unit of (8)~(9). (1)~(9): Height of embankment of the road is 0.5~1.5m. Several small borrow pits, 20m x 20m x 2m, are remained along the road.		
Soil	(1)~(10): soil is poorly developed, mostly suffered by wind erosion. Alluvial soil is found along the small wadis with aeolian sand. Mostly wind and wadi erosion. Embankment of road is partly eroded by water (likely gully). (1)~(10): No current flow along the wadis. But many small wadis or hollow-grounds exist along the road.	1	- Not significant.
Hydrology, groundwater	Flora and Fauna: (1)~(7): Mostly no to rare vegetation consisting of grasses (mostly halophytic and mesophyll plant). But there is slight vegetation along small wadis and hollow-ground. (8) ~ (10): Muqshin and Muntasaar villages zone, not along the road, has relatively thick vegetation by trees consisting of mainly acacia and grasses. Numerous camels are fed.	1	- Not significant impact due to road dualization.
Eco-system, Flora and Fauna	(1)~(10): Almost flat and low hills land.	1	- There are no protected areas along the proposed route. - Domestic animals are grazed and suffered traffic accidents.
Landscape	(4) ~ (7): Sand storm is suffered this area during hot season. Sand dunes sometimes cover road surface.	1	- Dualization might be followed along existing road alignment. - Dualization might be followed along existing road alignment. - Sand storm and sand dune occasionally cross the road.
Hazards	- Oil development by PDO in the area.	1	- Unknown.
Regional Development on Natural Environment	- Not existing so far.	1	- Not existing.
Other Impacts on Natural environment	108km: Ruin, located 2km distance from the road. 158km: Askars Fort at Muqshin, located 7km distance from the road.	1	- Dualization might be followed along existing road alignment (within the ROW). - The investigation of the cultural heritage is required in the site.
Cultural Heritage			

Wastes	<p>- Not significant. Litterbins are installed each 5km distance (parking areas) along the road. Most of litter boxes are clean.</p> <p>- Fragments of broken tire are scattered along the road.</p> <p>(1)~ (10): Not significant so far.</p>	1	<p>- High traffic volume in future. Wastes along the road will be increased together with increasing traffic volume.</p>
Regional Development on Social Environment		1	-Unknown.
Other Impacts on Social Environment	<p>0km point: Hyma is regional capital of Al Wusta. It has official facilities consisting of Wali office, Police station, school, etc. The facilities for private sectors consist of various factories, filling station, driving school, markets, etc.</p> <p>(1): Oilfield. Microwave tower (3km point). Electric line is installed along the road.</p> <p>(2)~ (3): Electric lines along the road.</p> <p>High-voltage transmission line crossing the road</p> <p>88km point: Mitan village, school, public office, etc., but no crossing inside of the village.</p> <p>90km & 128km point: Oilfield and microwave tower.</p> <p>(4) ~ (6): PDO pipeline is installed along the road.</p> <p>(7): Microwave tower. Bus stop.</p> <p>148km point (near junction to Muqshin village): Rader system (Four-dish antenna) and Junction to Ghuwaisham and Amal (N31).</p> <p>190km point: Microwave tower.</p>	1	<p>- Increased chance of traffic accident as well as domestic animals due to increased traffic volume.</p>
Evaluation		1	

ENVIRONMENTAL CHECKLIST (D4-4)

Road Section: From Muntasaar Southern Junction to Dawkah, Preaent road condition: Paved 2-lane road
Project No.: D4-4, National Road No.31, Planning road: Paved 4-lane road, Distance: 86km

Environmental Items	Present Condition : Location of each road unit is explained at item of “Topography and Geology”.	Impact Rating 1 = Slight 2 = Moderate 3= Significant	Major Anticipated Impact with Project Predicted traffic volume in 2030: 9,200 veh/day
Air Pollution	(1)~ (5): Not significant.	1	- Not significant.
Effluent	(1)~ (5): Not existing.	1	- Not significant.
Noise and Vibration	(1)~ (5): insignificant.	1	- Not significant.
Land Subsidence	(1)~ (5): Not existing.	1	- Not existing.
Topography and Geology	<p>Topography: (1) 0 (Junction to Muntasar village)~15km: Flat with gentle slope on the Middle Terrace. 15~ 20km: Crossing th wadi (Wadi Qitabit). (2) 20~ 40km: Flat. (3) 40~ 60km: Flat and wadi (56km point: Wadi Baharawn). (4) 60~ 80km: Flat. (5) 80~ 86km (Junction at Dawkah to Shisur): Flat and wadi (Wadi Bin Khawtar). Geology: Horizontal white marl and limestone beds are widely distributed in the area. And Quaternary wadi sediments (white) are partly covered along the poor wadis. And white aeolian sand is widely covered the area. Kaolin is found in some places along the road. (1)~ (5): Height of embankment of the road is 0.3~ 1.0m.</p>	1	- Not significant impact due to road widening along existing road. However, it is necessary to make carefully arrangement to operate borrow pits, to use construction camps, during for road construction.
Soil	(1)~ (5): Soil is poorly developed, mostly suffered by wind erosion.	1	- Mostly wind and wadi erosion.
Hydrology, groundwater	(1)~ (5): No current flow along the wadis (Wadi Qitabit and Wadi Baharawn). But many small wadis or hollow-grounds exist along the road.	1	- Not significant impact due to road dualization.

	Several drainage tubes are installed at the small wadis.		
Eco-system, Flora and Fauna	(1)~ (5): Mostly no to rare vegetation consisting of grasses (mostly halophytic and mesophyll plant).	1	- There are no protected areas along the proposed route. - Domestic animals are grazed and suffered traffic accidents.
Landscape	(1)~ (5): Almost flat.	1	- Dualization might be followed along existing road alignment.
Hazards	(4) ~ (5): Sand storm is suffered this area during hot season.	1	- Dualization might be followed along existing road alignment. - Sand storm and sand dune occasionally cross the road.
Regional Development on Natural Environment	- Not existing so far.	1	- Unknown.
Other Impacts on Natural environment	- Not existing so far.	1	- Not existing.
Cultural Heritage	- Old tower and ruin.	1~2	- Dualization might be followed along existing road alignment (within the ROW). - The investigation of the cultural heritage is required in the site.
Wastes	- Not significant. Litterbins are installed each 5km distance (parking areas) along the road. Most of litter boxes are clean. Fragments of broken tire are scattered along the road.	1	- High traffic volume in future. Wastes along the road will be increased together with increasing traffic volume.
Regional Development on Social Environment	- Not existing so far.	1	-Unknown.
Other Impacts on Social Environment	13km point: Wadi Quitbat Filling Station. 28km point: Microwave tower, farm and restaurant.	1	- Increased chance of traffic accident as well as domestic animals due to increased traffic volume.
Evaluation	Cultural Heritage	1~2	Influence to cultural heritage
	Other items	1	

ENVIRONMENTAL CHECKLIST (D4-5 (1))

Road Section: From Junction to Marmul (Thumrayt) to Dawkah, Existing road condition: Paved 2-lane road
Project No.: D4-5 (1), National Road No.31, Planning road: Paved 4-lane road, Distance: 111km

Environmental Items	Present Condition : Location of each road unit is explained at item of "Topography and Geology".	Impact Rating 1 = Slight 2 = Moderate 3= Significant	Major Anticipated Impact with Project Predicted traffic volume in 2030: 9,200 veh/day
Air Pollution	(1)~(5): Not significant.	1	- Not significant.
Effluent	(1)~(5): Not existing.	1	- Not significant.
Noise and Vibration	(1)~(5): insignificant.	1	- Not significant.
Land Subsidence	(1)~(5): Not existing.	1	- Not existing.
Topography and Geology	Topography: (1) 0 (Junction to Marmul: located 4.5km distance from the center of Thumrayt village)~5km: Flat with low hills scattered (Middle Terrace) and small wadi (Wadi Thumrayt). 5~20km: Flat. (2) 20~40km: Flat. 40~44km: Flat with small hills scattered and isolated. 44~60km: Flat. (3) 60~80km: Flat and wide wadi (Wadi Baharawn). (4) 80~100km: Flat. (5) 100~111km (Junction at Dawkah to Shisur): Flat. Geology: Horizontal white marl and limestone beds are widely distributed in the area. And Quaternary wadi sediments (white) are partly covered along the poor wadis. And aeolian sand is widely covered the area. (1)~(5): Height of embankment of the road is 0.3~1.5m.	1	- Not significant impact due to road widening along existing road. However, it is necessary to make carefully arrangement to operate borrow pits, to use construction camps, during for road construction.
Soil	(1)~(5): Soil is poorly developed, mostly suffered by wind erosion.	1	- Not significant impact due to road dualization.
Hydrology, groundwater	(1)~(5): No current flow along the wadis (Wadi Thumrayt and Wadi Baharawn). But many small wadis or hollow-grounds exist between hills along the road. Several drainage tubes are installed at the small wadis.	1	- Not significant impact due to road dualization.

Eco-system, Flora and Fauna	(1)~ (5): Mostly no to rare vegetation consisting of grasses (mostly halophytic and mesophyll plant). Along the wadis, rare vegetation, consisting of grasses and small acacia trees, is found.	1~2	- There are no protected areas along the proposed route. However, "Jebel Samhan Nature Reserve" is topographically connected to the east of the road area. - Domestic animals are grazed and suffered traffic accidents. - Dualization might be followed along existing road alignment.
Landscape	(1)~(5): Almost flat.	1	- Dualization might be followed along existing road alignment. - Sand storm and sand dune occasionally cross the road.
Hazards	(4) ~ (5): Sand storm is suffered this area during hot season.	1	- Unknown.
Regional Development on Natural Environment	- Not existing so far.	1	- Not existing.
Other Impacts on Natural environment	- Not existing so far.	1	- Not existing.
Cultural Heritage	82km point: Ruin.	1~2	- Dualization might be followed along existing road alignment (within the ROW). - The investigation of the cultural heritage is required in the site.
Wastes	- Not significant. Litterbins are installed each 5km distance (parking areas) along the road. Most of litter boxes are clean. Fragments of broken tire are scattered along the road. - Not existing so far.	1	- High traffic volume in future. Wastes along the road will be increased together with increasing traffic volume. -Unknown.
Regional Development on Social Environment	0~ 2km: Military base and airport. Plant gardens. 2km point: Dish antennas. Royal Oman Police office. 11km point: Junction at Wadi Haluf to Schist. 20~30km: Gas pipeline and Telephone cable (GTO). 35km point: Farm. 44km point: Microwave tower. 59km point: Farm. 68km point: Junction to Shisur, Wali office, F/S. 71km point: Sayh al Khayrat, large scale of farm (Royal garden). 80km point: Farm (Ministry?). Microwave tower. 110km point: Microwave tower. 111km: Junction at Dawkah to Shisur	1 1~2	- Increased chance of traffic accident as well as domestic animals due to increased traffic volume.
Other Impacts on Social Environment			

Evaluation	Eco-system, Flora, Fauna	1~2	Passing near the "Jebel Samhan Reserve"	Nature
Cultural heritage		1~2	Influence to cultural heritage	
Other Impacts on Social Environment		1~2	Increased traffic accidents of domestic animals	
Other items		1		

ENVIRONMENTAL CHECKLIST (D4-5 (2))

**Road Section: From Junction to Marmul to Quyrun Hayriti (Salalah), Existing road condition: Paved 2 and 4-lane road
Project No.: D4-5(2), National Road No.31, Planning road: Paved 4-lane road, Distance: 46km**

Environmental Items	Present Condition	Impact Rating 1 = Slight 2 = Moderate 3 = Significant	Major Anticipated Impact with Project Predicted traffic volume in 2030: 11,400 veh/day
Air Pollution	<p>: Location of each road unit is explained at item of "Topography and Geology".</p> <p>(1)~(3): Not significant.</p>	1	- Slight air pollution may occur in residential areas due to increase of traffic volume. - Not significant.
Effluent	<p>(1)~(3): No current flow, but during wet season has drainage water along the road. Suspended solids (SS) are possible to occur during and after rain. It might occur in short time.</p>	1	
Noise and Vibration	<p>(1)~(3): insignificant. Although Road unit during long slope to Salalah is relatively noisy, because large vehicles run very slowly, receptors along the road do not exist.</p>	1~2	- Slight to moderate noise may occur in residential areas due to increase of traffic volume.
Land Subsidence	<p>(1)~(3): Not existing.</p>	1	- Not existing.
Topography and Geology	<p>Topography: (1) 0 (Junction at Thumrayt to Marmul)~4km: Flat. 4~ 14km: Flat with scattered low hills. 14~ 20km: Small hilly land, ranging in Height from 2 along the road. Particularly, gypsum is found in the road unit of (2)~(3). (2): Height of embankment of the road is 0.5~ 1.5m. Several small borrow pits, 20m x 20m x 2m, are remained along the road. 15m, shows humpy topography. (3) 20~ 38km: The area is occupied by hilly land, ranging in height from 5 to 20m, and narrow wadis (Wadi Thumrayt). 38~ 42km: Road runs long slope in the wadi (Wadi Dawkah). Wadi valley has 50~150m wide and 50~ 100m deep. 42~ 46km: Road runs on the hill, being gentle slope. Geology: Horizontal marl and limestone beds are</p>	1~2	- Alteration of topography by massive excavation and embankment for the road dualization.

	widely distributed in the area. And Terrace deposits and Alluvial (wadi) sediments are partly covered on the terraces and along the poor wadis, respectively. (1)~ (2): Height of embankment of the road is 0.5~1.5m. (2)~ (3): Cutting slope is so steep that slope failures are possible to occur.		
Soil	(1)~ (3): soil is poorly developed in the northern part of the road unit (Flat area), and soil in the southern part of the area is relatively developed as reddish to reddish brown soil in the marl and limestone region. The weathered soil is mostly suffered by rain erosion, because forest pasturage is widely done in the area.	1~2	- Thin soil is developed in the Salalah area. - Slight to moderate impacts will occur due to road dualization, therefore the area of road alignment and borrow pits, etc. should be minimized to excavate for surface soil as well as vegetation.
Hydrology, groundwater	(1) ~ (2): No current flow along the wadis in the northern part of the road section. (3): On the contrary, Southern part of the road section has rain in the summer season and current flows can be seen in the wadis. (1)~ (2): Several drainage tubes are installed in the wadi. (2)~(3): Several drainage tubes and box culverts are installed in the wadi. The road in the part of slope is installed ditches both sides.	1	- Not significant impact due to road dualization.
Eco-system, Flora and Fauna	Flora and Fauna: (1)~ (2): Mostly no to rare vegetation consisting of grasses (mostly halophytic and mesophyll plant). But there is slight vegetation along small wadis and hollow-ground. (3): Rich vegetation is found in the southern part of the road section; particularly slope faced to the south is richer than that of the north. Numerous camels, cows and goats are fed in the southern part of the area. However, several cows and goats are victims by traffic accidents. Numerous kinds of birds are found in the area.	2	- Moderate impact to flora and fauna due to deforestation by road construction in the sparse to thick vegetation in the project area. Road alignment should be followed along existing road. - Deforestation will be not only extinction of forest within the right of way but also disposal of large scaled cutting to both sides of the slope of the road. Therefore, the deforestation will be extend depend on the slope gradient and cutting volume. - Domestic animals are grazed and suffered traffic accidents.
Landscape	(1)~ (2): Almost flat and low hills land. (3): Slope is faced to the south and formed limestone and marl high cliff. High cliff is formed numerous calcareous caves.	1	- Dualization might be followed along existing road alignment.

Hazards	(1)~ (3): Flash floods sometimes occur and roads had been damaged due to erosion and gravels remained along the wadis. - Not existing so far.	1	- Dualization might be followed along existing road alignment. - Sand storm and sand dune occasionally cross the road. - Unknown.
Regional Development on Natural Environment	- Not existing so far, but road construction is bigger impacts on natural environment. - Old houses and tower.	1	- Not existing.
Cultural Heritage	- Not significant, but some dust, paper, plastic, etc., is scattered along the road. - Fragments of broken tire are scattered along the road. (1)~ (3): Not significant so far.	1~2	- Dualization might be followed along existing road alignment (within the ROW). - The investigation of the cultural heritage is required in the site.
Wastes	0km point: Junction to Marmul. 0~1km: Military base, airport. 2~3km: Thumrayt town, Wali office, ROP, school, Medical center, etc. (1)~ (2): Gas pipeline and Electric line. 14km point: Al Hatab village (7 houses). 22km point: Military base. 3 houses. 28km point: Military base. 34km point: Rader site. 42km point: Harit Police Station (ROP). 46km point: Junction to Zayk. Qayrun Hyriti village, Wali office, school, etc.	1	- High traffic volume in future. Wastes along the road will be increased together with increasing traffic volume. -Unknown.
Regional Development on Social Environment		1	- Unknown.
Other Impacts on Social Environment		1~2	- Increased chance of traffic accident as well as domestic animals due to increased traffic volume.

Evaluation	Noise and vibration	1~2	Increased traffic volume
	Topography and Geology	1~2	Alteration of topography
	Soil	1~2	Alteration of topography
	Eco-system, Flora and Fauna	2	Deforestation by excavation and embankment
	Cultural heritage	1~2	Influence to cultural heritage
	Other Impacts on Social Environment	1~2	Increased traffic accidents of domestic animals
	Other items	1	

ENVIRONMENTAL CHECKLIST (D5)

Road Section: From Majjis (Sohar) to Buraymi, Existing road condition: Paved 2-lane road
Project No.: D5, National Road No.7, Planning road: Paved 4-lane road, Distance: 97km

Environmental Items	Present Condition	Impact Rating 1 = Slight 2 = Moderate 3 = Significant	Major Anticipated Impact with Project Predicted traffic volume in 2030: 19,000~21,000 veh/day
Air Pollution	: Location of each road unit is explained at item of "Topography and Geology".	1	- Slight air pollution may occur in urban areas due to increase of traffic volume.
Effluent	(1)~(4): Not significant so far.	1	- Discharge volume from road surface will be increased.
Noise and Vibration	(1)~(4): Not significant so far.	1~2	- Slight to moderate noise may occur in urban areas due to increase of traffic volume.
Land Subsidence	(1)~(4): Not existing.	1	- Not existing.
Topography and Geology	<p>Topography:</p> <p>(1) 0 (Roundabout at Al Falaj Al Qabail: Majjis)~ 20km: 1~ 6km: Flat on the Low Terrace and wadi plains (Wadi Suq). 6~ 15km: Road runs Flat land of foot of hilly land along the Wadi Suq. 15~ 20km: Road passes hilly and Low Terrace area along the Eadi Suq.</p> <p>(2) 20~ 40 km: Road passes from the catchment of Wadi Suq to that of Wadi al Jizi through small path located in the OMCO smelting plant. After pass, the road runs deep and opened valley of Wadi al Jizzi, crossing by many bridges.</p> <p>(3) 40~ 60 km: The road runs Low and Middle Terraces in the terrain of deep and opened valley of Wadi al Jizzi, passing in the low and middle relief of mountainous area.</p> <p>(4) 60~ 97 km (Buraymi): 60~ 70km: The road runs western wing and foot of the northern Oman Mountains (Jabal Hajar). 70~ 97km: The road runs flat and low hilly land along Wadi Jawwal, located in the interior of Oman. Buraymi is located in the eastern part of the desert area.</p>	2	<p>- Moderate impacts due to alteration of topography by massive excavation and embankment for the road dualization in the hilly areas and narrow terrace.</p> <p>- It is necessary to make carefully arrangement to operate borrow pits, to use construction camps, during for road construction.</p>

	<p>Geology: (1): The area consists mainly of Low Terrace and Alluvial deposits composed of gravel, sand and clay. Hills consist of Miocene sedimentary rocks mainly calcareous sandstone and clay stone. (2): The area is allocthonous unit terrain consisting of Batinah supra sediments and Ophiolite Nappes. (3): The area mainly consists of ultrabasic rocks (harzburgite, gabbro and dorelite) of ophiolite and Batinah supra sediments of Hawasinah groups. (4): The area is composed of the Hawasinah naps, mainly limestone, chert mudstone, etc. Proposed road alignment will be followed the existing 2-lane paved road. Alteration of topography by excavation and embankment</p>		
Soil	<p>(1)~ (4): Soil is relatively developed, but mostly suffered by rain and wind erosion. Thick alluvial soil is locally found in the wadis and those areas are mostly cultivated.</p>	1	- Not significant impact due to road dualization.
Hydrology, groundwater	<p>(1)~ (4): Small permanent current flows are locally found in Wadi al Jizi. And Wadi al Jizi and Wadi Suq have several times of flash flood in a year in some places. Most of the villages and OMCO have water wells in their sites. Particularly near coast, much farmland is situated and has pumping wells and traditional falaj system. Recently the groundwater level is likely down due to much pumping and less rainfall.</p>	1	<ul style="list-style-type: none"> - Not significant impact due to road dualization. - Bridges for crossing Wadi al Jizi. - Road in and along the wadis is required drainage system and to protect against the erosion due to the flash flood.
Eco-system, Flora and Fauna	<p>Flora and Fauna: (1)~ (2): Relatively thick vegetation, forming acacia woodland, is found along the wadis. But hilly land is sparse vegetation is found in the project area. The vegetation can be classified as an open xenomorphic <i>Euphorbia</i> community type. 7.9 km point: Al Ones National Park in the alluvial plain of Wadi Suq. (3): Mountainous area and wadis are sparse vegetation.</p>	2	<ul style="list-style-type: none"> - Acacia woodland in Wadi Suq and tributaries of Wadi al Jizi. Although proposed road follows along existing road alignment, road dualization will cut numerous big trees of rare woodland in Oman. - There are no protected areas along the proposed route. - Numerous domestic animals, goats, sheep, camels, etc., are grazed and suffered traffic accidents.

	(4): The area is semi-arid area and very thin vegetation. (1)~ (4): The road cross the northern Oman Mountains, consisting of terrace, wadi and mountainous terrain. Numerous villages are located along Wadi al Jizi. (1)~ (4): Flash flood and slope failures.			- Not significant impact due to road dualization. - Massive cut and embankment are required in some places for road dualization. - Not significant impact due to road dualization. - Flash flood in Wadi al Jizzi periodically occur every year. - Gas pipelines.
Landscape		1		
Hazards		1		
Regional Development on Natural Environment	- Two gas pipelines. Project road is close to the pipelines. - Not existing so far.	1		
Other Impacts on Natural environment		1		
Cultural Heritage	(1)~ (4): Numerous ancient forts and heritages exist along the road and wadis. - Some wastes are scatted along the road.	1~2		- The investigation of the cultural heritage is required in the site. - Very high traffic volume is predicted. Wastes along the road will be increased together with increasing traffic volume.
Wastes		1		
Regional Development on Social Environment	- Underconstruction of second gas pipeline.	1		- There are two places of narrow wadi channel of Wadi Suq, approximately 50m wide. Its width is not likely enough to construct road dualization.
Other Impacts on Social Environment	(1): 0.8 km point: Strip settlement, mosque. 7.9 km point: Al Ones National Park in the alluvial plain of Wadi Suq. 15km point: Settlement, mosque. 18 km point: Settlement, mosque. (2) 23.5 km point: OMCO plantsite. 29.9 km point: Suhaylah village, mosque, school, farmland. 32 km point: Junction to Khan village. 35.2 km point: Al Hensey village, mosque. 37 and 37.6 km points: Settlement. 45 km point: Farmland, mosque. 48 and 48 km points: Settlement, mosque. 50 km point: Border checkpoint, ROP. 97 km point: Buraymi town.	2		- Increased chance of traffic accident as well as domestic animals due to increased traffic volume. - Possible relocation of tens of houses in some villages along the proposed road.

Evaluation	Noise and Vibration			Increased traffic volume
	Topography and Geology		1~2	Alteration of topography
	Eco-system, Flora and Fauna		2	Deforestation by excavation and embankment
	Cultural heritage		2	Influence to cultural heritage
	Other Impacts on Social Environment		1~2	Increased traffic accidents of domestic animals
	Other items		2	
			1	

ENVIRONMENTAL CHECKLIST (D6)

Road Section: From Izki to Mizbar, Existing road condition: Paved 2-lane road
Project No.: D6, National Road No.25, Planning road: Paved 4-lane road, Distance: 85km

Environmental Items	Present Condition : Location of each road unit is explained at item of "Topography and Geology".	Impact Rating 1 = Slight 2 = Moderate 3= Significant	Major Anticipated Impact with Project Predicted traffic volume in 2030: 8,000 veh/day
Air Pollution	(1)~(2): Not significant so far.	1	- Not significant.
Effluent	(1)~(2): Not significant so far.	1	- Discharge volume from road surface will be increased.
Noise and Vibration	(1)~(2): Not significant so far.	1	- Slight noise may occur in urban areas due to increase of traffic volume.
Land Subsidence	(1)~(2): Not existing.	1	- Not existing.
Topography and Geology	Topography: (1) 0 (Izki) ~ 55 km (Wadi al Taiyyin): The topography of the area of the proposed 4-lane paved road is mostly hilly and mountainous. The existing paved road is traversed by a number of wadis and the alignment of the existing road has been constructed within some of the wadi channels (Wadi Indam). (2) 55 to 85 km (Mizbar): The area, mostly hilly and mountainous terrain, is along the upper stream of Wadi Indam. Geology: The mountains within the project area consist of the Hawasinah Nappes, Paleozoic to cretaceous sedimentary rocks and ophiolite Nappe.	1~2	- Alteration of topography due to massive excavation and embankment in the mountainous and hilly regions. - While road construction, it is necessary to make carefully arrangement to operate borrow pits, to use construction camps, etc. for environment
Soil (Soil erosion, etc.)	(1)~(2): Soil is poorly developed, mostly suffered by rain and wind erosion. Alluvial soil is found in the wadi.	1	- Not significant impact due to road dualization.
Hydrology, groundwater	(1)~(2): Many sections of the existing road pass through areas of wadi flow (Wadi Indam).	1	- Not significant impact due to road dualization.
Eco-system, Flora and Fauna	(1)~(2): Sparse vegetation is found along the entire stretch of the existing road alignment. Wildlife in the area includes; The last population of the Arabian	1~2	- There are no protected areas along the proposed route. - Domestic animals are grazed and suffered traffic accidents.

	Leopard, the Arabian Gazelle, Wild Cats, Caracal, Stripped Hyena, Wolves and Foxes. A number of rare species of birds such as Herons, Masked Boobies and Socotra Cormorants are also found breeding in the area and on the cliffs.			
Landscape	(1)~(2): Mountainous and hilly topography.	1	- Dualization might be followed along existing road alignment.	
Hazards	(1)~(2): Flash flood.	1	- Dualization might be followed along existing road alignment.	
Regional Development on Natural Environment	- Not existing so far.	1	- Unknown.	
Other Impacts on Natural environment	- Not existing so far.	1	- Not existing.	
Cultural Heritage	(1)~(2): Not existing so far.	1	- Dualization might be followed along existing road alignment (within the ROW). - The investigation of the cultural heritage is required in the site.	
Wastes	- Not significant so far.	1	- High traffic volume in future. Wastes along the road will be increased together with increasing traffic volume.	
Regional Development on Social Environment	- Not existing so far.	1	- Unknown.	
Other Impacts on Social Environment	(1) ~ (2): 0 km point: Junction at Izki to Mizbar. Izki town, school, mosque, public offices. 28.5 km point: Junction to Said bin Sahrhan. 55 km point: Junction to N/R No.23 (Bidbid and Sur). 77 km point: Naqsi village. 85 km point: Mizbar village, Junction to Samkat.	1~2	- Increased chance of traffic accident as well as domestic animals due to increased traffic volume. - The road passes through a number of areas where there are likely to be impacts to the settlements and to a lesser extent, the farmland.	

Evaluation	Topography and geology	1~2	Alteration of topography
	Eco-system, Flora and Fauna	1~2	Deforestation by excavation and embankment
	Other Impacts on Social Environment	1~2	Relocation of some houses
	Other items	1	

ENVIRONMENTAL CHECKLIST (D7)

Road Section: From Mamura R/A to Taqah R/A, Existing road condition: Paved 2-lane road
Project No.: D7, National Road No.49, Planning road: Paved 4-lane road, Distance: 18km

Environmental Items	Present Condition : Location of each road unit is explained at item of "Topography and Geology".	Impact Rating 1 = Slight 2 = Moderate 3= Significant	Major Anticipated Impact with Project Predicted traffic volume in 2030: 4,600 veh/day
Air Pollution	(1)~(2): Not significant.	1	- Not significant.
Effluent	(1)~(2): Not existing.	1	- Not significant.
Noise and Vibration	(1)~(2): insignificant.	1	- Not significant.
Land Subsidence	(1)~(2): Not existing.	1	- Not existing.
Topography and Geology	Topography: (1) 0 (Roundabout at Mamurah) ~12km (Junction of N12): 0~3km: Mostly flat on the Low Terrace except wadis. (2) 12~18km: Road run on the Low Terrace, mostly flat and gentle slope, and crosses relatively shallow wadis. Geology: Coarse and fine gravels cover the terrace. Base rocks are mostly marl and calcareous conglomerate and sandstone.	1	- Not significant impact due to road dualization.
Soil	(1)~(2): Soil is poorly developed.	1	- Not significant impact due to road dualization.
Hydrology, groundwater	(1)~(2): No current flow in wadis. But current flow might appear during rain season.	1	- Not significant impact due to road dualization. - Bridges are recommended to cross the wadis, where thick wadi vegetation is found and flood is not rare.
Eco-system, Flora and Fauna	(1)~(2): Mostly low vegetation, but relatively thick vegetation consisting of small acacia trees and grasses exists in the wadis.	1	- There are no protected areas along the proposed route. - Domestic animals are grazed and suffered traffic accidents.
Landscape	(1)~(2): Almost flat of Low Terrace.	1	- Dualization might be followed along existing road alignment.
Hazards	(1)~(2): Flash flood may occur during rain season.	1	- Dualization might be followed along existing road alignment.

Regional Development on Natural Environment	- Development for urban area.	1	- Unknown.
Other Impacts on Natural environment	- Not existing so far.	1	- Not existing.
Cultural Heritage	- Unknown.	1	- Dualization might be followed along existing road alignment (within the ROW).
Wastes	- Not significant.	1	- High traffic volume in future. Wastes along the road will be increased together with increasing traffic volume.
Regional Development on Social Environment	- Development for urban area.	1	-Unknown.
Other Impacts on Social Environment	(1)~(2): 0km: Roundabout at Mamurah. Royal garden. 12km point: Junction to N12. 18km point: Roundabout at Taqah. Filling station. Taqah village. (1)~(2): Electric line.	1	- Presently, no habitants along the road planned. But, numerous temporary camping houses build on the terrace plain during rain season. - Increased chance of traffic accident as well as domestic animals due to increased traffic volume.

Evaluation	All items	1
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ENVIRONMENTAL CHECKLIST (D8)

Road Section: From Muladdah to Hazm Road, Existing road condition: Paved 2-lane road
Project No.: D8, National Road No.11, Planning road: Paved 4-lane road, Distance: 24km

Environmental Items	Present Condition : Location of each road unit is explained at item of "Topography and Geology".	Impact Rating 1 = Slight 2 = Moderate 3= Significant	Major Anticipated Impact with Project Predicted traffic volume in 2030: 6,000~11,000 veh/day
Air Pollution	(1): Not significant so far.	1	- Slight air pollution may occur in urban areas due to increase of traffic volume.
Effluent	(1): Not significant so far.	1	- Discharge volume from road surface will be increased.
Noise and Vibration	(1): Not significant so far.	1	- Slight noise may occur in urban areas due to increase of traffic volume.
L and Subsidence	(1): Not existing.	1	- Not existing.
Topography and Geology	Topography: (1): The project area is located on part of the Batinah coastal plain. The area is predominantly flat on the Low Terrace and Alluvial terrains. The project area rises gently from the sea level to an altitude of around 100 m inland. Small sand dunes are widely found in the area, including Rustaq area. Geology: Terrace and alluvial deposits in the area consist of gravel, sand and clay. The hills are mainly composed of the Hawasinah units, ranging in age from Paleozoic to Mesozoic origin. And Jabal Nakhl and Jabal Al Akhdar Mountains are mainly composed of the autochthonous units of Paleozoic and Mesozoic sedimentary rocks.	1	- Not significant impact due to road dualization.
Soil	(1): Soil is poorly developed, mostly suffered by rain and wind erosion. Alluvial soil is found in the wadi.	1	- Not significant impact due to road dualization.
Hydrology, groundwater	(1): The road runs on the Low Terrace along the Wadi al Fara.	1	- Not significant impact due to road dualization.
Eco-system, Flora and Fauna	Flora and Fauna: Trees and plants are found along the	1	- Most land close to the existing road has already

	entire stretch of the project. Particularly, acacia woodland and scrub near coastline are widely found in the wadi plains. The vegetation can be classified as an open xenomorphic <i>Euphorbia</i> community type. Wildlife can usually be found in the area. There are no known specific wildlife travel corridors crossing project.	been impacted due to construction activities of the current 2-lane road. However, due to relatively sparse vegetation this is considered to have been relatively minor. - The road does not pass within any protected areas or reserves.
Landscape	(1): Flat land on the Low Terrace and wadis.	- Dualization might be followed along existing road alignment.
Hazards	(1): Sand storm and sand dunes.	- Dualization might be followed along existing road alignment. - Unknown.
Regional Development on Natural Environment	- Not existing so far.	- Not existing.
Other Impacts on Natural environment	- Not existing so far.	- Not existing.
Cultural Heritage	(1): Old tower on the terraces.	- Dualization might be followed along existing road alignment (within the ROW). - The investigation of the cultural heritage is required in the site.
Wastes	- Not significant so far.	- High traffic volume in future. Wastes along the road will be increased together with increasing traffic volume.
Regional Development on Social Environment	- Not existing so far.	-Unknown.
Other Impacts on Social Environment	(1): 0 km point: Al Muladdah village. 2 km point: Electric sub-station. 24 km point: Al Hazm village.	- Increased chance of traffic accident as well as domestic animals due to increased traffic volume.

Evaluation	Cultural heritage	1~2	Influence to cultural heritage
	Other Impacts on Social Environment	1~2	Increased chance of traffic accidents
	Other items	1	

ENVIRONMENTAL CHECKLIST (D9)

Road Section: From Quriyat to Sur Phase III, Existing road condition: Paved 2-lane road
Project No.: D9, National Road No.17, Planning road: Paved 4-lane road, Distance: 18km

Environmental Items	Present Condition : Location of each road unit is explained at item of "Topography and Geology".	Impact Rating 1 = Slight 2 = Moderate 3 = Significant	Major Anticipated Impact with Project Predicted traffic volume in 2030: 24,000 veh/day
Air Pollution	(1): Not significant so far.	1~2	- Slight to moderate air pollution may occur in urban areas due to increase of traffic volume.
Effluent	(1): Not significant so far.	1	- Discharge volume from road surface will be increased.
Noise and Vibration	(1): Not significant so far.	1~2	- Slight to moderate noise may occur in urban areas due to increase of traffic volume.
Land Subsidence	(1): Not existing.	1	- Not existing.
Topography and Geology	Topography: (1) 0 (Quriyat)~18 km (Sur: Phase III): The topography of the project area consists of gravel coastal plain that is flanked by high mountains to the southwest and traversed by a number of wadis of variable depth that run from mountains towards the shoreline. Geology: The coastal area consists of Tertiary limestone and alluvial deposits (wadi sediments) gravel and sand. The coastal limestone is usually hard and soft reef limestone.	1~2	- Alteration of topography by massive excavation and embankment in some sections, particularly along and near coastal line.
Soil	(1): Soil is found in the wadi, but mostly thin.	1	- Not significant impact due to road dualization.
Hydrology, groundwater	(1): The wadis have evidences of rapid runoff wadi flows. Many sections of the current 2-lane road pass within and over wadi flow areas.	1~2	- Slight to moderate impact due to massive excavation near and in the wadis and wadi mouths for road dualization. - Bridges are recommended to cross the wadis, where thick wadi vegetation is found and flood is not rare.
Eco-system, Flora and Fauna	Flora: Sparse vegetation is found along the entire stretch of the project area. Vegetation in the project area tends	1~2	- There are no protected areas along the proposed route. - Domestic animals are grazed and suffered traffic accidents.

	to be concentrated in the wadis and depressions along the plain. The vegetation can be classified as an open xenomorphic <i>Euphorbia</i> community type. Fauna: Wildlife known to the area include gazelle (<i>Gazella gazella</i>) and other fauna such as the red fox (<i>Vulpes vulpes arabica</i>) and small rodents. The IUCN red list of threatened animals (IUCN 1990) describes the mountain gazelle in the area. Birds present in the area. (1): Coastal line.			
Landscape		1		- Dualization might be followed along existing road alignment.
Hazards		1		- Dualization might be followed along existing road alignment. - Unknown.
Regional Development on Natural Environment		1		- Not existing.
Other Impacts on Natural environment		1		- Not existing.
Cultural Heritage	(1): Old towers and houses.	1~2		- Dualization might be followed along existing road alignment (within the ROW). - The investigation of the cultural heritage is required in the site.
Wastes	- Not significant so far.	1		- Very high traffic volume in future. Wastes along the road will be increased together with increasing traffic volume. -Unknown.
Regional Development on Social Environment		1		- Unknown.
Other Impacts on Social Environment	(1): The latter sections of the road pass through the outskirts of Sur where settlements and nearby farmland exist on either side of the existing 2-lane road. The existing road passes within 10 m of much of this settlement area. 0 km point: Quriyat town. 18 km point: Al Ghalilah (LNG Site).	1~2		- Increased chance of traffic accident as well as domestic animals due to increased traffic volume.

Evaluation	Air Pollution				Increased traffic volume	
	Noise			1~2	Increased traffic volume	
	Topography and Geology			1~2	Alteration of topography	
	Hydrology and Groundwater			1~2	Influence to hydrological features at coastal line	
	Eco-system, Flora and Fauna			1~2	Deforestation by excavation and embankment	
	Cultural heritage			1~2	Influence to cultural heritage	
	Other Impacts on Social Environment			1~2	Increased chance of traffic accidents	
	Other items			1		

ENVIRONMENTAL CHECKLIST (D10)

**Road Section: From Barka to Rustaq Road, Existing road condition: Paved 2-lane road
Project No.: D10, National Road No.13, Planning road: Paved 4-lane road, Distance: 84km**

Environmental Items	Present Condition : Location of each road unit is explained at item of "Topography and Geology".	Impact Rating 1 = Slight 2 = Moderate 3= Significant	Major Anticipated Impact with Project Predicted traffic volume in 2030: 5,000~10,000 veh/day
Air Pollution	(1)~(3): Not significant so far.	1	- Slight air pollution may occur in urban (Rustaq) areas due to increase of traffic volume.
Effluent	(1)~(3): Not significant so far.	1	- Discharge volume from road surface will be increased.
Noise and Vibration	(1)~(3): Not significant so far.	1	- Slight noise may occur in urban (Rustaq) areas due to increase of traffic volume.
Land Subsidence	(1)~(3): Not existing.	1	- Not existing.
Topography and Geology	Topography: (1) 0 (Junction at Barka to Al Rustaq)~20 km: The project area is predominantly flat with mountains near Jabal Nakhhal Mountains. The road starts near coastal green belt located alluvial coastal plain and Low Terrace. Small sand dunes are locally found in the area. (3) 20~60 km: The road runs mostly flat and locally bumpy on the Low and Middle Terraces and wadi (Wadi Ma'awil) plains along the northern foot of the Jabal Al Akhdar Mountains. The project area rises gently from the sea level to an altitude of around 500 m inland. (4) 60~84 km (Rustaq): The road area passes hilly and mountainous terrain between Awabi and Rustaq. Geology: Terrace and alluvial deposits in the area consist of gravel, sand and clay. The hills are mainly composed of the Hawasinah units, ranging in age from Paleozoic to Mesozoic origin. And Jabal Nakhli and Jabal Al Akhdar Mountains are mainly composed of the autochthonous units of Paleozoic and Mesozoic sedimentary rocks.	1	- Not significant impact due to road dualization. However, it is necessary to make carefully arrangement to reclaimate the sites of borrow pit for road construction.

Soil	(1)~ (3): Soil is poorly developed, mostly suffered by wind erosion. Alluvial soil is found in the wadi, but mostly thin.	1	- Not significant impact due to road dualization.
Hydrology, groundwater	(1)~ (3): The area is mostly the catchment of Wadi Ma'awil. These events can produce rapid runoff in the wadi. Fortunately very few sections of the current road alignment pass within wadi flow areas, however, in the areas closer to Rustaq where the road passes through some ridges, mountains and hills, localized runoff occurs during rainy conditions and this appears to have caused erosion and rock. Falaj systems are locally found in the area.	1	- Not significant impact due to road dualization.
Eco-system, Flora and Fauna	Flora: Trees and plants are found along the entire stretch of the project. The vegetation can be classified as an open xenomorphic <i>Euphorbia</i> community type. Fauna: Wildlife can usually be found in the area. There are not known specific wildlife travel corridors crossing project. No rare, endangered or threatened species have been identified in the area. Smaller mammals including rodents and foxes (<i>Lupes lupes arabica</i>) are found in the area, along with a number of bird species.	1	- Most land close to the existing road has already been impacted due to construction activities of the current 2-lane road. However, due to relatively sparse vegetation this is considered to have been relatively minor. - The road does not pass within any protected areas or reserves.
Landscape	(1)~ (3): Flat terrace and alluvial plains, and Jabal Al Akhdar and Jabal Nakhhal Mountains.	1	- Dualization might be followed along existing road alignment.
Hazards	(1)~ (3): Flash flood, sand storm.	1	- Dualization might be followed along existing road alignment.
Regional Development on Natural Environment	- Not existing so far.	1	- Unknown.
Other Impacts on Natural environment	- Not existing so far.	1	- Not existing.
Cultural Heritage	(1)~ (3): There is fort in Al Rustaq.	1~2	- Dualization might be followed along existing road alignment (within the ROW). - The investigation of the cultural heritage is required in the site.
Wastes	- Not significant so far.	1	- Not significant impact due to road construction. - High traffic volume in future. Wastes along the

Regional Development on Social Environment	- Not existing so far.	1	road will be increased together with increasing traffic volume. -Unknown.
Other Impacts on Social Environment	(1)~ (3): Some sections of the road pass through and nearby towns and villages (Barka, Hibra, Muslimat, Nakhhal, Mahalil, Awabi and Rustaq), and some irrigated farmland on the outskirts of the towns. Villages along the road are fairly small, some serving as trading centers and supply points for the local people in the surrounding areas. These urban areas are characteristically long strip developments of dwellings and small businesses along both sides of the road. Larger settlements are found at Nakhhal and Rustaq. 0 km point: Junction at Barka to Al Rustaq. 20 km point: Hibra village. 27 km point: Muslimat village. 29 km point: Junction to Nakhhal village. 49 km point: Mahalil village. 64 km point: Junction to Awabi village. 84 km point: Rustaq city.	1~2	- Increased chance of traffic accident as well as domestic animals due to increased traffic volume.

Evaluation	Cultural heritage	1~2	Influence to cultural heritage
	Other Impacts on Social Environment	1~2	Increased chance of traffic accidents of domestic animals
	Other items	1	

ENVIRONMENTAL CHECKLIST (D11)

Road Section: From Ibri to Ad Dariz Road, Existing road condition: Paved 2-lane road
 Project No.: D11, National Road No.21, Planning road: Paved 4-lane road, Distance: 19km

Environmental Items	Present Condition	Impact Rating 1 = Slight 2 = Moderate 3 = Significant	Major Anticipated Impact with Project Predicted traffic volume in 2030: 10,000 veh/day
Air Pollution	: Location of each road unit is explained at item of "Topography and Geology".		
Effluent	(1): Not significant so far. But sand storm periodically occurs during hot season. (1): Not significant so far.	1	- Slight air pollution may occur in urban (Ibri) areas due to increase of traffic volume.
Noise and Vibration	(1): Not significant so far.	1	- Discharge volume from road surface will be increased.
Land Subsidence	(1): Not existing.	1	- Slight noise may occur in urban (Ibri) areas due to increase of traffic volume.
Topography and Geology	Topography: (1): The area is predominantly flat on the Low Terrace and alluvial plains with some low-lying hills to the north east of Ibri. Geology: The project area consists of mid tertiary sedimentary limestone, and terrace and alluvial deposits, comprising of gravel, sand and clay.	1	- Not existing. - Not significant impact due to road widening along existing road. However, it is necessary to make carefully arrangement to operate borrow pits, to use construction camps, during for road construction.
Soil	(1): Soil is poorly developed, mostly suffered by wind erosion. Alluvial soil is found in the wadi, but mostly thin.	1	- Not significant impact due to road dualization.
Hydrology, groundwater	(1): The road runs along the wadi diversion of Wadi Al Khabir (Wadi Khuwaybah). Watercourse of Wadi Al Khabir disappears north of Ibri town site, because of wadi diversion of Wadi Khuwaybah as mainstream. This wadi diversion had occurred numerous flash floods. During flood, houses at the opposite bank were isolated within a day. Ibri town site is supplied by pipe water, but out of Ibri is mostly used water well.	1	- Not significant impact due to road dualization.

Eco-system, Flora and Fauna	<p>Flora: The project area is sparsely vegetated. The vegetation can be classified as an open xenomorphic <i>Euphorbia</i> community type.</p> <p>Fauna: There are no known specific wildlife travel corridors crossing project area. No rare, endangered or threatened species have been identified in the area. Small mammals including rodents and hedgehogs, along with a number of bird species, are found in the area.</p>	1	<ul style="list-style-type: none"> - There are no protected areas along the proposed route. - Domestic animals are grazed and suffered traffic accidents.
Landscape	(1): Flat on the terrace and alluvial plains.	1	- Dualization might be followed along existing road alignment.
Hazards	(1): Flash flood, sand storm.	1	- Dualization might be followed along existing road alignment.
Regional Development on Natural Environment	- Not existing so far.	1	- Unknown.
Other Impacts on Natural environment	- Not existing so far.	1	- Not existing.
Cultural Heritage	(1): Not existing so far.	1	<ul style="list-style-type: none"> - Dualization might be followed along existing road alignment (within the ROW). - The investigation of the cultural heritage is required in the site.
Wastes	- Not significant so far.	1	<ul style="list-style-type: none"> - High traffic volume in future. Wastes along the road will be increased together with increasing traffic volume.
Regional Development on Social Environment	- Not existing so far.	1	- Unknown.
Other Impacts on Social Environment	(1): The existing alignment passes through a number of strip settlements along the route, some of which were may be significantly impacted as a result of the additional works. Few areas of farmland were noted along the project area. 0 km point: Ibri. 19 km point: Junction at Ad Dariz to Yanqul.	2	<ul style="list-style-type: none"> - Increased chance of traffic accident as well as domestic animals due to increased traffic volume. - Some houses along the road will be relocated for widening. It is necessary to examine the road alignment.

Evaluation	Other Impacts on Social Environment	2	Relocation of some houses
	Other items	1	

ENVIRONMENTAL CHECKLIST (D12)

Road Section: From Taqah to Mirbat, Existing road condition: Paved 2-lane road
Project No.: D12, National Road No.49, Planning road: Paved 4-lane road, Distance: 37km

Environmental Items	Present Condition : Location of each road unit is explained at item of "Topography and Geology".	Impact Rating 1 = Slight 2 = Moderate 3 = Significant	Major Anticipated Impact with Project Predicted traffic volume in 2030: 1,700 veh/day
Air Pollution	(1)~(2): Not significant.	1	- Not significant.
Effluent	(1)~(2): Not existing.	1	- Not significant.
Noise and Vibration	(1)~(2): insignificant.	1	- Not significant.
Land Subsidence	(1)~(2): Not existing.	1	- Not existing.
Topography and Geology	<p>Topography: (1) 0 (Roundabout at Mamurah) ~12km (Junction of N12): 0~3km: Mostly flat on the Low Terrace except wadis. (2)12~18km: Road run on the Low Terrace, mostly flat and gentle slope, and crosses relatively shallow wadis.</p> <p>Geology: Coarse and fine gravels cover the terrace. Base rocks are mostly marl and calcareous conglomerate and sandstone.</p>	1	- Not significant impact due to road widening along existing road. However, it is necessary to make carefully arrangement to operate borrow pits, to use construction camps, during for road construction.
Soil	(1)~(2): Soil is poorly developed.	1	- Not significant impact due to road dualization.
Hydrology, groundwater	(1)~(2): No current flow in wadis. But current flow might appear during rain season.	1	- Not significant impact due to road dualization. - Bridges are recommended to cross the wadis, where thick wadi vegetation is found and flood is not rare.
Eco-system, Flora and Fauna	(1)~(2):: Mostly low vegetation, but relatively thick vegetation consisting of small acacia trees and grasses exists in the wadis.	1	- There are no protected areas along the proposed route. - Not significant impact due to road dualization. - Domestic animals are grazed and suffered traffic accidents.
Landscape	(1)~(2): Almost flat of Low Terrace.	1	- Dualization might be followed along existing road alignment.
Hazards	(1)~(2): Flash flood may occur during rain season.	1	- Dualization might be followed along existing road alignment.

Regional Development on Natural Environment	- Development for urban area.	1	- Unknown.
Other Impacts on Natural environment	- Not existing.	1	- Not existing.
Cultural Heritage	- Unknown.	1	- Dualization might be followed along existing road alignment (within the ROW). - The investigation of the cultural heritage is required in the site.
Wastes	- Not significant.	1	- Low traffic volume in future. Wastes along the road will be increased together with increasing traffic volume.
Regional Development on Social Environment	- Development for urban area.	1	-Unknown.
Other Impacts on Social Environment	0km: Roundabout at Mamurah. Royal garden. 12km point: Junction to N12. 18km point: Roundabout at Taqah. Filling station. Taqah village. (1)~(2): Electric line.	1~2	- Presently, no habitants along the road planned. But, numerous temporary camping houses build on the terrace plain during rain season. - Increased chance of traffic accident as well as domestic animals due to increased traffic volume.

Evaluation	Other Impacts on Social Environment	1~2	Increased traffic accident of domestic animals
	Other items	1	

ENVIRONMENTAL CHECKLIST (D13)

Road Section: From Raysut to Shahb Asayb, Existing road condition: Paved 2-lane road
Project No.: D13, National Road No.47, Planning road: Paved 4-lane road, Distance: 71km

Environmental Items	Present Condition : Location of each road unit is explained at item of "Topography and Geology".	Impact Rating 1 = Slight 2 = Moderate 3 = Significant	Major Anticipated Impact with Project Predicted traffic volume in 2030: 2,000 veh/day
Air Pollution	(1)~(2): Not significant.	1	- Not significant.
Effluent	(1)~(2): Not existing.	1	- Not significant.
Noise and Vibration	(1)~(2): insignificant.	1	- Not significant.
Land Subsidence	(1)~(2): Not existing.	1	- Not existing.
Topography and Geology	<p>Topography: (1) 0 (Roundabout at Raysut) ~27km (Al Mughsayl): Mostly flat on the Low Terrace and gentle slope near coastal line, road crosses Khawr and wadis. (1) 27 (Al Mughsayl)~71km (Shahb Asayb): 27~40km: Road run ragged mountainous area and crosses the deep wadi. 40 ~771km: Road runs gentle slope on the Middle Terrace. Geology: Coarse and fine gravels cover the terrace. Base rocks are mostly marl and calcareous conglomerate and sandstone.</p>	1~2	<p>- Slight to moderate impacts due to massive alteration of topography for road dualization. Particularly, section 27km to 35km. - Bridges are recommended to cross the wadis, where thick wadi vegetation is found and flood is not rare. - It is necessary to plan massive cutting and embankment for crossing the wadis.</p>
Soil	(1)~(2): Soil is poorly developed.	1	- Not significant impact due to road dualization.
Hydrology, groundwater	(1)~(2): No current flow in wadis. But current flow might appear during rain season.	1	- Not significant impact due to road dualization.
Eco-system, Flora and Fauna	<p>Flora: Thick vegetation forming the dominant woodland species consisting of various species with various species of wildlife. The vegetation mainly consists of <i>Accacia spp.</i>, <i>Anogeissus dhofarica</i> (<i>zerkin</i>), <i>Blepharispermum bitum</i> (<i>khfuf</i>), <i>Boscia arabica</i> (<i>simer</i>), <i>Bostwellia sacra</i> (<i>huban</i>), <i>Craton confertus</i> (<i>hor</i>), <i>Maytenus spp.</i>, etc. The chief species is <i>Anogeissus dhofarica</i>, which is associated with</p>	2	<p>- Moderate impact to flora and fauna due to deforestation by road construction in the thick vegetation in the project area. Road alignment should be followed along existing road alignment. - Deforestation will be not only extinction of forest within the right of way but also disposal of large scaled cutting to both sides or one side of the slope of the road. Therefore, the deforestation will be extend depend on the slope gradient and cutting</p>

	<p>several other trees and large shrubs such as <i>Commiphora</i> and <i>Acacia species</i>, forms the woodland vegetation.</p> <p>Fauna: Wildlife in the area includes; The last population of the Arabian Leopard, Nubian ibex, Arabian Gazelle, Striped Hyenas, Wild Cats, Caracal, Wolves and Foxes. Smaller mammals including rodents and foxes (<i>Lupes lupes arabica</i>) are found in the area, along with a number of bird species. A number of rare species of birds such as Herons, Masked Boobies and Socotra Cormorants are also found breeding in the area and on the cliffs.</p> <p>Numerous camels, cows and goats are fed in the area. However, several cows and goats are victims by traffic accidents. Numerous kinds of birds are found in the area.</p>		<p>volume.</p> <p>- Domestic animals are grazed and suffered traffic accidents.</p>
Landscape	(1)~ (2): Almost flat of Low Terrace.	1	<p>- Not significant impact due to road dualization.</p> <p>- Dualization might be followed along existing road alignment.</p>
Hazards	(1)~ (2): Flash flood may occur during rain season.	1	<p>- Not significant impact due to road dualization.</p> <p>- Dualization might be followed along existing road alignment.</p>
Regional Development on Natural Environment	- Tourism Development.	1	- Unknown.
Other Impacts on Natural environment	- Not existing so far.	1	- Not existing.
Cultural Heritage	- Unknown.	1	<p>- Dualization might be followed along existing road alignment (within the ROW).</p> <p>- The investigation of the cultural heritage is required in the site.</p>
Wastes	- Not significant.	1	- Low traffic volume in future. Wastes along the road will be increased together with increasing traffic volume.
Regional Development on Social Environment	- Tourism Development.	1	- Unknown.
Other Impacts on Social Environment	0km: Roundabout at Raysut. Several villages are located along the road.	1~2	- Increased chance of traffic accident as well as domestic animals due to increased traffic volume.

	12km point: Junction to N12. 18km point: Roundabout at Taqah. Filling station. Taqah village. (1)~(2): Electric line.		-
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Evaluation	Topography, geology	1~2	Alteration of topography
	Eco-system, Flora and Fauna	2	Deforestation by excavation and embankment
	Other Impacts on Social Environment	1~2	Traffic accident of domestic animals
	Other items	1	

	<p>(Watershed). Gentle slope is connected to the Middle and High Terraces. 33 (Difa village) ~56km (Junction to Sulfait): Paved road: road runs gentle slope on the top of the hill (High Terrace). Southern side of the road is steep cliff of limestone. 56 (Junction before Dhalkut to Salfait)~68km (Center of Dhalkut village): Access road to Dhalkut village is long slope and newly paved road. Height of cutting along the road ranges 2 to 15 m.</p> <p>(2) 58 (Junction before Rhakhut to Rakhyut) ~ 77km (Junction to Salalah): 58~58.5km: Paved road (under construction), gentle slope. 58.5~70km: Relatively gentle slope on the Middle Terrace, covered by trees. Northern side of the road is vertical cliff of limestone. Southern side of the road is steep slope and thick forest. 70 (Junction to Salalah, paved road under construction)~77km (International Border Checkpoint): Relatively gentle slope on the Middle Terrace, covered by forest.</p> <p>Geology: Horizontal limestone and marl beds are widely distributed in the area. Limestone beds are formed mostly vertical cliffs and three flat terraces in the area. Three terraces consist of High, Middle and Low Terraces. Terrace deposits are partly covered on the terraces and alluvial deposits are found along the wadis.</p>		
Soil	(1)~ (3): Reddish to reddish brown soil is relatively developed in the area. Surface soil is mostly suffered by rain erosion, because forest	1~2	<ul style="list-style-type: none"> - Slight to moderate impact due to road dualization passing the area where surface soil is developed. - Soil is developed in the Salalah area.
Hydrology, groundwater	(1)~ (3): No current flow along the road section. Most of the rainwater might be infiltrated into limestone ground. Wadi is no current flow, but current flow will be appeared during rain season. Each village has water wells for drinking water. (2): Box culverts and tubes are installed for crossing wadi at the junction.	1	<ul style="list-style-type: none"> - Not significant impact due to road dualization.

<p>Eco-system, Flora and Fauna</p>	<p>(1)~(3): Flora: Thick vegetation forming the dominant woodland species consisting of various species with various species of wildlife. The vegetation mainly consists of <i>Accacia spp.</i>, <i>Anogeissus dhofarica (zerkin)</i>, <i>Blebarispermum bitum (khful)</i>, <i>Boscia arabica (simer)</i>, <i>Bostvella sacra (luban)</i>, <i>Craton confertus (hor)</i>, <i>Maytenus spp.</i>, etc. The chief species is <i>Anogeissus dhofarica</i>, which is associated with several othertrees and large shrubs such as <i>Commiphora</i> and <i>Acacia species</i>, forms the woodland vegetation.</p> <p>Fauna: Wildlife in the area includes; The last population of the Arabian Leopoard, Nubian ibex, Arabian Gazelle, Striped Hyaenas, Wild Cats, Caracal, Wolves and Foxes. Smaller mammals including rodents and foxes (<i>Lupes lopes arabica</i>) are found in the area, along with a number of bird species. A number of rare species of birds such as Herons, Masked Boobies and Socotra Comorants are also found breeding in the area and on the cliffs. Numerous camels, cows and goats are fed in the area. However, several cows and gouts are victims by traffic accidents. Numerous kinds of birds are found in the area.</p>	<p>2</p>	<ul style="list-style-type: none"> - Moderate impact to flora and fauna due to deforestation by road widening, dualization, in the thick vegetation in the project area. - There are no protected areas along the proposed route. - Domestic animals are grazed and suffered traffic accidents.
<p>Landscape</p>	<p>(1)~ (3): High limestone cliffs and thick forest on the flat gentle slope.</p>	<p>1~2</p>	<ul style="list-style-type: none"> - Forest land. Much forest will be disappeared due to the road construction, not only right of way but also large scaled cutting and disposal of cuttings to both side of the road.
<p>Hazards</p>	<ul style="list-style-type: none"> - Not significant. 	<p>1</p>	<ul style="list-style-type: none"> - Not significant impact due to road construction. - Dualization might be followed along existing road alignment.
<p>Regional Development on Natural Environment</p>	<ul style="list-style-type: none"> - Construction of road and electricity line as the regional development including tourism development. 	<p>1</p>	<ul style="list-style-type: none"> - Unknown.
<p>Other Impacts on Natural environment</p>	<ul style="list-style-type: none"> - Not existing so far. 	<p>1</p>	<ul style="list-style-type: none"> - Not existing.

Cultural Heritage	- Not existing so far.	1	<ul style="list-style-type: none"> - Dualization might be followed along existing road alignment (within the ROW). - The investigation of the cultural heritage is required in the site.
Wastes	- Not significant so far.	1	<ul style="list-style-type: none"> - Low traffic volume in future. Wastes along the road will be increased together with increasing traffic volume.
Regional Development on Social Environment	- Construction of road and electricity line as the regional development, including tourism development.	1	-Unknown.
Other Impacts on Social Environment	<p>0km point: Junction at Rakhyut to Difa village. School, Wali office, mosque, etc. The village is 0.5km distance from junction of N20 and N11.</p> <p>1km point: Electric line.</p> <p>3km point: Microwave tower.</p> <p>5km point: Small village (20 houses).</p> <p>19~20km: Difa village. School, mosque, etc.</p> <p>22km point: 5 houses.</p> <p>31km point: village. School, mosque, etc.</p> <p>42km (Junction before Rakhyut to Salfait): village.</p> <p>54km: Dalkut village, School, public office, mosque, etc.</p>	2	<ul style="list-style-type: none"> - Increased chance of traffic accident as well as domestic animals due to increased traffic volume. - Relocation of some houses is required at the part of Rakhyut and Salfait villages.

Evaluation	Topography and geology	2	Alteration of topography
	Soil	1~2	Alteration of topography
	Eco-system, Flora and Fauna	2	Deforestation by excavation and embankment
	Landscapes	1~2	Massive cutting and embankment
	Other Impacts on Social Environment	2	Relocation of some houses
	Other items	1	

ENVIRONMENTAL CHECKLIST (D15)

Road Section: From Al Mazyunah to Shisur, Existing road condition: Gravel road
Project No.: D15, National Road No.43, Planning road: Paved 4-lane road, Distance: 142km

Environmental Items	Present Condition : Location of each road unit is explained at item of "Topography and Geology".	Impact Rating 1 = Slight 2 = Moderate 3= Significant	Major Anticipated Impact with Project Predicted traffic volume in 2030: 50 veh/day
Air Pollution	(1)~ (5): Not significant. But dust is significant.	1	- Not significant.
Effluent	(1)~ (5): Not existing.	1	- Not significant.
Noise and Vibration	(1)~ (5): insignificant.	1	- Not significant.
Land Subsidence	(1)~ (5): Not existing.	1	- Not existing.
Topography and Geology	<p>Topography:</p> <p>(1) 0 (Al Mazyunah)~58km (Junction at Qafa to Mudayy): Flat with low hills scattered. Aeolian sand and small sand dunes cover surface. Road crosses several relatively small wadis (Wadi Shiha, Wadi Tawinat, and Wadi al Atinah). Numerous small borrow pits are found along the road.</p> <p>(2) 58 (Junction at Qafa to Mudayy) ~ 78km: Low hilly and flat land. Aeolian sand is covered the ground, but mostly thin. Several large borrow pits are found along the road.</p> <p>(3) 78~98km: Flat with low hills scattered. Aeolian sand and much sand dunes cover surface. Road crosses wide and shallow wadi (Wadi al Atinah).</p> <p>(4) 98~118km: Flat and small low hills (Low Terrace) scattered. Sand dunes are found.</p> <p>118~142km (Junction to Shisur village): Flat and small hills (Low Terrace) scattered. Sand dunes increase in the area. Road crosses wide and shallow wadi (Wadi Ghadun).</p> <p>Geology: Horizontal white marl, limestone and chert beds are widely distributed in the area. Aeolian sand is widely covered the area. (1)~ (5): Height of embankment of the road is 0.3~1.2m.</p>	1	- Not significant impact due to road dualization.

Soil	(1)~ (5): Soil is poorly developed, mostly suffered by wind erosion.	1	- Not significant impact due to road dualization.
Hydrology, groundwater	(1)~ (5): No current flow in wadis (Wadi Shihan, Wadi Tawsinat, Wadi al Atinah and tributary of Wadi Ghadun). The large scaled irrigation system for farms at Shisur.	1	- Not significant impact due to road dualization.
Eco-system, Flora and Fauna	(1)~ (5): Mostly no to rare vegetation consisting of grasses (mostly halophytic and mesophyll plant).	1	- There are no protected areas along the proposed route. - Not significant impact due to road dualization. - Numerous domestic animals are grazed and suffered traffic accidents.
Landscape	(1)~ (5): Almost flat and low hilly land.	1	- Flat land.
Hazards	(1)~ (5): Sand storm and sand dune are suffered this area during hot season.	1	- Hot season.
Regional Development on Natural Environment	- Large scaled farms are developed in the Shisur areas.	1	- Unknown
Other Impacts on Natural environment	- Not existing so far.	1	- Not existing.
Cultural Heritage	- There is fort in Shisur.	1	- The investigation of the cultural heritage is required in the site.
Wastes	- Not significant.	1	- Very low traffic volume.
Regional Development on Social Environment	- Not existing so far.	1	- Unknown.
Other Impacts on Social Environment	0km point: International Border Checkpoint near Al Mazyunah village. 58 km point: Qafa Junction nar Qafa village. There are several huts around the Junction. 83km point: Shisur village, Wali office, school, etc.	1	- Very low traffic volume is predicted and rare receptors.

Evaluation	All items	1
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ENVIRONMENTAL CHECKLIST (N1: N1-1~N1-5)

Road Section: From Barka to Shinas, Existing road condition: Not existing road
Project No.: N1, Planning road: Paved 4-lane road, Distance: 270 km

Environmental Items	Present Condition : Location of each road unit is explained at item of "Topography and Geology".	Impact Rating 1 = Slight 2 = Moderate 3= Significant	Major Anticipated Impact with Project Predicted traffic volume in 2030: 11,000~56,000 veh/day
Air Pollution	(1)~(6): Not existing so far. Sometimes dust occurs.	1~2	- Although extremely high traffic volume is predicted, air pollution will not be visible in the project area because low population zone.
Effluent	(1)~(6): Not significant so far.	1	- Discharge volume from road surface will be increased.
Noise and Vibration	(1)~(6): Not existing so far.	1~2	- Although extremely high traffic volume is predicted, noise pollution will not be visible in the project area because low population zone.
Land Subsidence	(1)~(6): Not existing.	1	- Not existing.
Topography and Geology	Topography: (1) 0~64 km, (2) 64~127 km, (3) 127~178 km, (4) 178~226 km, (5) 226~270 km. (1)~(6): The project area is located on part of the Batinah coastal plain and parallel to the existing highway with distance of approximately 10 km interior of the area. The proposed road is predominantly low-lying and flat; the alignment crosses some areas of low hills, Low and Lowermost (Alluvial) Terraces, and alluvial wadi plains. The road, located in Barka, Sohar, Liwa and Shinas areas, should be traversed in the hilly land, consisting Tertiary sedimentary rocks, limestone, shale, etc. Numerous wadis running from the northern Al Hajar mountains to the sea traverse the plain. Geology: The project area mostly consists of Low Terrace and alluvial deposits, gravel, sand and clay. Several wadis, running in the area, consist of sand and gravel.	1~2	- Not significant impact due to road construction. - Massive cut and embankment in the hilly areas.
Soil	(1)~(6): Soil is poorly developed, mostly suffered by	2	- Moderate impact due to new road construction

	<p>wind erosion. Alluvial soil is found in the wadi, but mostly thin.</p>			<p>(Paved 4-laned road), because the area is widely covered by alluvial soil on the Low and Lowermost Terraces and in the extensive wadi plains.</p> <ul style="list-style-type: none"> - Slight to moderate impact due to road construction. - Proposed route crosses numerous wadis and several recharge dams. It is necessary to make arrangement to avoid effects to these dams and wadis.
Hydrology, groundwater	<p>(1)~ (6): A number of sections of the alignment will cross-areas of periodic wadi flow, these will require culverts and in some instances bridging. In areas where the alignment is close to the base of the mountain range, run off may transport material on to the road unless these sections are partially raised. Numerous wadis running from the northern Al Hajar mountains to the sea traverse the plain.</p>	1~2		<ul style="list-style-type: none"> - Moderate impact to vegetation due to deforestation of road construction, particularly wadi vegetation. - There are no protected areas along the proposed route. - Domestic animals are grazed and suffered traffic accidents.
Eco-system, Flora and Fauna	<p>Flora: The area is characterized by the xenomorphic <i>Euphorbia</i> community typical of this region. In the most part the cover is sparse to thin vegetation, although in some wadi channels coverage and species diversity can be higher and consists of acacia woodland. Recorded wildlife in the area includes large mammals such as gazelle (<i>Gazella gazella cora</i>), Arabian red fox (<i>Vulpes vulpes arabica</i>) and a number of smaller mammals can undoubtedly be found, including several rodents and bats. The last record of the Arabian Wolf (<i>Canis lupus arabs</i>) in the region was 1993, and the Arabian tahr (<i>Hemitragus jayakari</i>) has not been recorded since the late 1970's. A number of birds also inhabit the area including raptors, the Grey Francolin and small passerines (<i>Francolemus pondicerianus</i>).</p> <p>Fauna: Despite the occasional records of rare wildlife in the Batimah, the region does not support abundant and diverse assemblages due to disturbance from coastal development, hunting pressure, limited diversity of habitat and the infrequency of fresh water.</p>	2		
Landscape Hazards	<p>(1)~ (6): Mostly flat, locally hilly land. (1)~ (6): Flash flood in the area, sand storm around the Al Rustaq area.</p>	1 1		<ul style="list-style-type: none"> - Not significant impact due to road construction. - Not significant impact due to road construction. - Flash flood in the area, sand storm around the Al Rustaq area.

Regional Development on Natural Environment	- Sohar area has been developed as Development Plan, and Sohar Port is constructing in Majjis. - Not existing so far.	1	- Sohar Development Plan and Sohar Port in Majjis.
Other Impacts on Natural environment	- Not existing so far.	1	- Not existing.
Cultural Heritage	(1)~(6): Unknown so far, however there is a potential to exist cultural heritage along the route.	1~2	- The investigation of the cultural heritage is required in the site.
Wastes	- Not significant so far.	1	- Not significant impact due to road construction. - Very high to moderate traffic volume is predicted. Wastes along the road will be increased together with increasing traffic volume.
Regional Development on Social Environment	- Not existing so far.	1	- Unknown.
Other Impacts on Social Environment	(1)~(6): There are a number of small settlements and limited areas of farmland to consider when finalizing the alignment of this route. However, given the flat terrain and available space this does not represent a significant constraint. The proposed road will be intersected the following villages: Mushayq, Fardah, Falaj Bani Rabiah, Khasaf, Rawdah/ Mahab, Sihlat and Fizh.	1~2	- Very high to moderate traffic volume is predicted. - Increased chance of traffic accident as well as domestic animals due to increased traffic volume.

Evaluation	Air pollution	1~2	Increased traffic volume
	Noise and Vibration	1~2	Increased traffic volume
	Topography and geology	1~2	Alteration of topography
	Soil	2	Alteration of topography
	Hydrology, groundwater	1~2	Crossing of wadis
	Eco-system, Flora and Fauna	2	Deforestation by excavation and embankment
	Cultural Heritage	1~2	Influence to cultural heritage
	Other Impacts on Social Environment	1~2	Traffic accident of domestic animals
	Other items	1	

ENVIRONMENTAL CHECKLIST (N3)
Road Section: From Bait Al Barakah to Khatmet Malahah (Coastal), Existing road condition: Gravel and paved road
Project No.: N3, Planning road: Paved 2-lane road, Distance: 255 km

Environmental Items	Present Condition : Location of each road unit is explained at item of "Topography and Geology".	Impact Rating 1 = Slight 2 = Moderate 3 = Significant	Major Anticipated Impact with Project Predicted traffic volume in 2030: 28,000~45,000 veh/day
Air Pollution	(1)~(5): Not significant so far.	2	- Extremely high traffic volume is predicted. Air pollution might be visible in residential areas.
Effluent	(1)~(5): Not significant so far.	1	- Not significant/
Noise and Vibration	(1)~(5): Not significant so far.	2	- Extremely high traffic volume is predicted. Noise pollution might be visible in residential area.
Land Subsidence	(1)~(5): Not existing.	1	- Not existing.
Topography and Geology	Topography: (1) 0 (Bait Al Barakah)~17 km (Barka, coastal): The project road is typically flat coastal plain and wadis (Wadi al Ajal, etc.). (2) 17~70 km (Suwayq, coastal): The project road is mostly flat coastal plain and several wadis (Wadi Ma'awil, etc.) accompanied with various sizes of sand dunes and small inlets. Sand dunes arrange parallel to the coastal line. Most of dunes have been fixed in the places, but smaller dunes are locally mobilized. (3) 70~141 km (Saham, coastal): The project road is mostly flat coastal plain and numerous wadis (Wadi Al Abyad, Wadi Al Hawqayn, Wadi Mabrah, Wadi Sarami, etc.) with locally sand dunes. (4) 141~171 km (Sohar, coastal): The project road is mostly flat coastal plain with several wadis (Wadi Al Hilti, etc.) and small inlets. (5) 171~255 km (Khatmet Malahah, coastal): The project road is typically flat coastal plain with several wadis (Wadi al Jizi, Wadi Suq, Wadi Bani Umar Al Gharbi, Wadi Fizh, Wadi Hatta, etc.) and several inlets and Khabrah near Ljwa.	1~2	- Slight to moderate impact due to road of coastal line through numerous wadi mouths, khabra, sabka, sand dune areas, etc.

	<p>Geology: The project area is located on part of the Batinah coastal plain, consisting mainly of sand, clay and gravels. Sand is alluvial sand and aeolian sand formed sand dunes.</p>		
Soil	<p>(1)~ (5): Soil is poorly developed, mostly suffered by wind erosion. Alluvial soil is found in the wadi, but mostly thin.</p>	2	<ul style="list-style-type: none"> - Moderate impact due to road improvement mostly along existing road, but the project area occupies by the most cultivated zone, Batinah green belt, and rich fertile region in Oman.
Hydrology, groundwater	<p>(1) ~ (5): Few sections of the current road alignment pass within wadi flow areas. Route is adjacent to the coast and many wadis terminate in the project area where runoff may occur.</p> <p>(2) Main wadis intersected by the proposed road are as follows: Wadi al Ajal, Wadi Ma'awi, Wadi Al Abyad, Wadi Al Hawqayn, Wadi Mabrah, Wadi Sarami, Wadi Al Hilti, Wadi al Jizi, Wadi Suq, Wadi Bani Umar Al Gharbi, Wadi Fizh, Wadi Hatta, etc.</p>	1~2	<ul style="list-style-type: none"> - Slight to moderate impact due to road of coastal line through numerous wadi mouths, khabra, sabka, etc. And there are so many water wells pumped for irrigation in the area.
Eco-system, Flora and Fauna	<p>Flora: Trees and plants are found along the entire stretch of the project area. Most of the existing tracks and surfaced roads also pass within dense farmland and date plantations. Depending on the final alignment of the road significant impacts are expected. Apart from the irrigated farmland and date plantations along the proposed route the native vegetation can be classified as an open xenomorphic <i>Euphorbia</i> community type.</p> <p>Fauna: Due to the heavily irrigated farmland and plantations along the Al Batinah coast the project area hosts many resident, as well as, migratory birds. Few mammals are found in the area. Domestic herds are common.</p>	2~3	<ul style="list-style-type: none"> - Although the tracks and surfaced road, the existing vegetation appears not to have been heavily impacted, it is necessary to examine the road alignment for mitigating the existing vegetation and farmland (coastal green belt in Oman). - There are no protected areas along the proposed route. - Numerous domestic animals are grazed and suffered traffic accidents.
Landscape	(1)~ (5): Coastal plain and green belt in Oman.	1	- Not significant impact due to road construction.
Hazards	(1)~ (5): Sand storm.	1	- Not significant impact due to road construction.
Regional Development on Natural Environment	- Not existing so far.	1	- Not existing.
Other Impacts on Natural environment	- Not existing so far.	1	- Unknown.

Cultural Heritage	(1)~(5): Not existing so far.	1	- The investigation of the cultural heritage is required in the site.
Wastes	- Not significant so far.	1	- Very high traffic volume is predicted. Wastes along the road will be increased together with increasing traffic volume.
Regional Development on Social Environment	- Not existing so far.	1	- Unknown.
Other Impacts on Social Environment	(1)~(5): Many sections of the project area pass through and nearby villages, towns, irrigated farmland (plantations), etc. Villages and towns along the road forms typically fishing and farming communities. Towns and villages along route are as follows: Seeb, Ma abilah, Manumah, Ad Duwaykah, Haradi, Muraysi, Hifri al Batha, Suwadi Al Batha, Al Masanah, Sur Ma awil, As Suwaiq, Harat al Ju, Khail, Al Abbasah, Qasabiyat, Kuwayrat, Al Khabura, Al Qasabiyat, Harat al Murakah, Dil Yal Burak, Radah, Al Mukaylif, Khawr Hamman, Saham, Majiz Sagirah, Majiz Kabhira, Hilat Al Balush, Ghail Shabul, Harat Al Subarah, Hadirah, Sallan, Fasiqah, Sanqar, Harmul, Nabr, Dawanij, Al Asrar Bani Umar, Al Husayfin, Sur Khusaybi, Sur Bani Khuzaymat, Shinas, Falarah, Wadiyat, Aqr, Bu Baqarah, Al Muarayr, Khatmat, and Al Malahah.	2	- Very high traffic volume is predicted. - Increased chance of traffic accident as well as domestic animals due to increased traffic volume. - Possible relocation of a number of houses in some villages along the proposed road.

Evaluation	Air pollution	2	Increased traffic volume
	Noise and Vibration	2	Increased traffic volume
	Topography and geology	1~2	Alteration of topography
	Soil	2	Alteration of topography
	Hydrology, groundwater	1~2	Influence to coastal line, wadi mouth, etc.
	Eco-system, Flora and Fauna	2~3	Deforestation by excavation and embankment
	Other Impacts on Social Environment	2	Resettlement, Traffic accident of domestic animals
	Other items	1	

ENVIRONMENTAL CHECKLIST (N4)

Road Section: From Diba to Kasab, Existing road condition: Gravel road
Road Unit: (1), Project No. N4, Planning road: Paved 2-lane road, Distance: 90km

Environmental Items	Present Condition : Location of each road unit is explained at item of “Topography and Geology”.	Impact Rating 1 = Slight 2 = Moderate 3= Significant	Major Anticipated Impact with Project Predicted traffic volume in 2030: 800~1,900 veh/day
Air Pollution	Not significant so far.	1	- Not significant.
Effluent	Not significant so far.	1	- Not significant.
Noise and Vibration	Not significant so far.	1	- Not significant.
Land Subsidence	Not existing.	1	- Not existing.
Topography and Geology	<p>Topography: (1) 0~ 90 km: The project area primarily consists of high mountains that form part of the Jabal Al Hajar Mountain Range. The mountains rise to a height of approximately 1,800 m above sea level. There is comparatively little flat terrain and where there is this tends to be dominated by settlements in the coastal areas.</p> <p>Geology: The mountains consist of thinly bedded dolomite, limestone and mudstones of Mesozoic autochthonous unit. The fossiliferous shelf limestones, being the early Jurassic to the Cretaceous period, are found in the higher areas in Misandum.</p>	1~2	- Slight to moderate impact due to road construction accompanied with large scale of excavation in many places. - It is necessary to examine to emplace safely cuttings after excavation of the rocks. - Numerous domestic animals are grazed and suffered traffic accidents.
Soil	- Soil is poorly developed, mostly suffered by rain and wind erosion. Alluvial soil is found in the wadi.	1	- Not significant impact due to road construction.
Hydrology, groundwater	(1): These events can produce rapid runoff and major wadi flows. Many sections of the current graded road pass within wadi flow areas. Sections of graded track have been severely washed out and eroded due to previous wadi flow. Given the extent of the mountainous topography in the project area the proposed road will be subject to heavy wadi flow at times.	1	- Not significant impact due to following existing road alignment.
Eco-system, Flora and Fauna	Flora: Sparse vegetation is found along the entire stretch of the	1~2	- There are no protected areas along the proposed route.

	<p>project area. The current graded and surfaced roads have already impacted the vegetation along the proposed alignment and therefore further impacts to the vegetation are considered insignificant so long as the current alignment is followed. However, despite the existing road impact the area in general represents a good example of habitat.</p> <p>Fauna: Wildlife known to the project area includes Arabian Tahr, Arabian gazelle, Caracal and Red Fox. Birdlife includes, Palm Dove, etc. Numerous gulls and other seabirds occur along the coastline.</p> <p>Whilst the area does not have official reserve status it is considered an area of significant natural importance.</p>		<ul style="list-style-type: none"> - Slight to moderate impact due to road widening with massive excavation and embankment along proposed road. However, it is necessary to make carefully arrangement to minimize as working areas, including road alignment, borrow pits, to use construction camps, during for road construction. - Numerous domestic animals are grazed and suffered traffic accidents.
Landscape	(1): Mostly mountainous topography and ria coast line.	1	<ul style="list-style-type: none"> - Not significant impact due to road construction. - Promoting tourism in this area.
Hazards	(1): Flash flood.	1	<ul style="list-style-type: none"> - Not significant impact due to road construction. - Unknown.
Regional Development on Natural Environment	- Not existing so far.	1	<ul style="list-style-type: none"> - Not existing.
Other Impacts on Natural environment	- Not existing so far.	1	<ul style="list-style-type: none"> - Not existing.
Cultural Heritage	(1): Fort and towers.	1~2	<ul style="list-style-type: none"> - The investigation of the cultural heritage is required in the site.
Wastes	- Not significant so far.	1	<ul style="list-style-type: none"> - Low traffic volume is predicted. Wastes along the road will be increased together with increasing traffic volume.
Regional Development on Social Environment	- Not existing so far.	1	<ul style="list-style-type: none"> - Unknown.
Other Impacts on Social Environment	(1): Some sections of the road pass through and nearby towns and farmland, which is typically located on the outskirts of the towns as well as on terracing in the mountains. These towns along the road are relatively small strip settlement communities. It is considered that some areas of the current road alignment will benefit from being re aligned for the development of the new 2-lane paved road. Villages town along route: Dibba and Khasab.	1	<ul style="list-style-type: none"> - Low traffic volume is predicted. - Increased chance of traffic accident as well as domestic animals due to increased traffic volume.

Evaluation	Topography and geology			
	Eco-system, Flora and Fauna		1~2	Alteration of topography
	Cultural heritage		1~2	Deforestation by excavation and embankment
	Other items		1~2	Influence to cultural heritage
			1	

ENVIRONMENTAL CHECKLIST (N5)

Road Section: From Lima Link to Khasab, Existing road condition: Gravel road
Project No.: N5, Planning road: Paved 2-lane road, Distance: 25km

Environmental Items	Present Condition	Impact Rating 1 = Slight 2 = Moderate 3 = Significant	Major Anticipated Impact with Project Predicted traffic volume in 2030: 800 veh/day
Air Pollution	- Not significant so far.	1	- Not significant.
Effluent	- Not significant so far.	1	- Not significant.
Noise and Vibration	- Not significant so far.	1	- Not significant.
Land Subsidence	- Not existing.	1	- Not existing.
Topography and Geology	<p>Topography: The project area primarily consists of high mountains that form part of the Jabal Al Hajar Mountain Range. The mountains rise to a height of approximately 1,800 m above sea level. There is comparatively little flat terrain and where there is this tends to be dominated by settlements in the coastal areas.</p> <p>Geology: The mountains consist of thinly bedded dolomite, limestone and mudstones of Mesozoic autochthonous unit. The fossiliferous shelf limestones, being the early Jurassic to the Cretaceous period, are found in the higher areas in Musandum.</p>	1~2	- Slight to moderate impact due to road construction accompanied with large scale of excavation in many places. - It is necessary to examine to emplace safely cuttings after excavation of the rocks. - Numerous domestic animals are grazed and suffered traffic accidents.
Soil	- Soil is poorly developed, mostly suffered by rain and wind erosion. Alluvial soil is found in the wadi.	1	- Not significant impact due to road construction.
Hydrology, groundwater	(1): These events can produce rapid runoff and major wadi flows. Many sections of the current graded road pass within wadi flow areas. Sections of graded road have been severely washed out and eroded due to previous wadi flow. Given the extent of the mountainous topography in the project area the proposed road will be subject to heavy wadi flow at times.	1	- Not significant impact due to following existing road alignment.
Eco-system, Flora and Fauna	<p>Flora: Sparse vegetation is found along the entire stretch of</p>	1~2	- There are no protected areas along the proposed route.

	<p>the project area. The current graded and surfaced roads have already impacted the vegetation along the proposed alignment and therefore further impacts to the vegetation are considered insignificant so long as the current alignment is followed. However, despite the existing road impact the area in general represents a good example of habitat.</p> <p>Fauna: Wildlife known to the project area includes Arabian Tahr, Arabian gazelle, Caracal and Red Fox. Birdlife includes, Palm Dove, etc. Numerous gulls and other seabirds occur along the coastline. Whilst the area does not have official reserve status it is considered an area of significant natural importance.</p>		<p>- Slight to moderate impact due to road widening with massive excavation and embankment along proposed road. However, it is necessary to make carefully arrangement to minimize as working areas, including road alignment, borrow pits, construction camps, during for road construction.</p> <p>- Numerous domestic animals are grazed and suffered traffic accidents.</p>
Landscape	(1): Mostly mountainous topography and ria coast line.	1	- Not significant impact due to road construction. - Promoting tourism in this area.
Hazards	(1): Flash flood.	1	- Not significant impact due to road construction. - Unknown.
Regional Development on Natural Environment	- Not existing so far.	1	- Not existing.
Other Impacts on Natural environment	- Not existing so far.	1	- Not existing.
Cultural Heritage	(1): Fort and towers.	1~2	- The investigation of the cultural heritage is required in the site.
Wastes	- Not significant so far.	1	- Low traffic volume is predicted. Wastes along the road will be increased together with increasing traffic volume. - Unknown.
Regional Development on Social Environment	- Not existing so far.	1	- Unknown.
Other Impacts on Social Environment	(1): Some sections of the road pass through and nearby towns and farmland, which is typically located on the outskirts of the towns as well as on terracing in the mountains. These towns along the road are relatively small strip settlement communities. It is considered that some areas of the current road alignment will benefit from being re aligned for the development of the new 2-lane paved road. Villages town along route: Lima.	1	- Low traffic volume is predicted. - Increased chance of traffic accident as well as domestic animals due to increased traffic volume.

Evaluation	Topography and geology			
	Eco-system, Flora and Fauna		1~2	Alteration of topography
	Cultural heritage		1~2	Deforestation by excavation and embankment
	Other items		1~2 1	Influence to cultural heritage

ENVIRONMENTAL CHECKLIST (N6)

Road Section: From Al Ashkharah to Shanna, Existing road condition: Gravel road
Project No.: N6, Planning road: Paved 2-lane road, Distance: 150km

Environmental Items	Present Condition	Impact Rating 1 = Slight 2 = Moderate 3 = Significant	Major Anticipated Impact with Project Predicted traffic volume in 2030: 1,000 veh/day
Air Pollution	: Location of each road unit is explained at item of "Topography and Geology".	1	- Not significant.
Effluent	- Not significant so far.	1	- Not significant.
Noise and Vibration	- Not significant so far.	1	- Not significant.
Land Subsidence	- Not existing.	1~2	- Proposed road passes in the sabkha terrain, which has soft layer and salt lake.
Topography and Geology	<p>Topography: The project area is located in the eastern part of the Wahibah sand.</p> <p>(1) 0~ 30km (Junction at As Sharij to Balid Bani Bu Ali): The 2-lane paved road is installed between Al Ashkharah to 10 km point. The road area is coastal line with low hilly land. Aeolian coastal sand and relatively small-scaled sand dunes are widely covered in the area.</p> <p>(2) 30~ 60km (Junction to Aurun village): The road area is flat on the lower terraced plain covered by thick aeolian sand and barchan type sand dunes are found in the area. And sabkhas (flat and dried up salt lake), where the road crosses, are widely found in the area.</p> <p>(3): 60~ 105km (Junction at Quryat Juhayd to Ibra): The road runs flat along the coastal line within 1 km from seashore with aeolian sand and sand dunes (Wahibah sand). But the road crossing the sand dunes is very bumpy like wave.</p> <p>(4): 105~ 140km (Sanna): The proposed road area is flat along the beach, but road crossing the sand dunes is very bumpy. The location between 120 (Bil'Ukayrish) ~130 km (Ras Al Ruays) is not</p>	2	<p>- Slight to moderate impact due to road construction in the area of coastal line and sand dune.</p> <p>- It is necessary to examine to emplace safely sand after cut sand dune terrain.</p> <p>- Numerous domestic animals are grazed and suffered traffic accidents.</p>

	existing truck road, because of sand dune. Geology: The northern part of the project area until Khuwaimah is mainly composed of Hawasimah Unit, consisting of limestone, shale and chert. The central and southern parts of the area are completely covered by sand dunes of Wahiba sand. Near Shannah is found Sabkha deposits.			
Soil	(1)~ (4): Soil is rarely developed, mostly suffered by wind erosion. Aeolian sand is widely covered in the area.	1	- Not significant impact due to road construction.	
Hydrology, groundwater	(1)~ (4): No wadi flow channels were evident within the project area. precipitation is very low.	1	- Not significant impact due to road construction.	
Eco-system, Flora and Fauna	Falora: (1)~ (4): Sparse vegetation is found along the entire stretch of the project area. Halophytic vegetation close to the shoreline has been heavily impacted due to the current graded road and associated activities. The low-lying hills and plain area also has sparse vegetation cover consisting of grasses. Despite the impacts of grading in the coastal zone, this area remains predominantly undisturbed. Fauna: This area of Oman's coast is widely recognized as hosting an important number and species of birds, particularly resident and migratory and wading birds. Domestic animals including goats and camels are common.	2~3	- There are no protected areas along the proposed route. However, Wahibah sand has a important potential to have valuable eco-system of sand desert. - Moderate to extensive impact due to road widening with massive excavation and embankment along proposed road and split between sand zone and coastal beach. Therefore, it is necessary to make carefully arrangement to minimize as working areas, including road alignment, borrow pits, to use construction camps, during for road construction.	
Landscape	(1): Sand dunes.	2	- Moderate impact to the scenic sand dune and beach due to road construction. - Promoting tourism in this area.	
Hazards	- Sand storm and sand dunes.	1~2	- Not significant impact due to road construction. - Road will be permanently suffered sand stoam and sand dune.	
Regional Development on Natural Environment	- Not existing so far.	1	- Unknown.	
Other Impacts on Natural environment	- Not existing so far.	1	- Not existing.	

Cultural Heritage	(1): Fort and old towers.	1~2	- The investigation of the cultural heritage is required in the site.
Wastes	- Not significant.	1	- Low traffic volume is predicted. Wastes along the road will be increased together with increasing traffic volume.
Regional Development on Social Environment	- Not existing so far.	1	- Unknown.
Other Impacts on Social Environment	(1)~(4): Sections of the road pass through and nearby towns. The settlements are mostly strip settlements. The settlements have been built either side of the existing graded. No farmland was present along the proposed alignment. Villages along route are as follows: Al Ashkarah, Khywaymah, Ash Sharq, An Najdah, and Shanna.	1	- Increased chance of traffic accident as well as domestic animals due to increased traffic volume.

Evaluation	Topography and geology	2	Alteration of topography
	Eco-system, Flora and Fauna	2~3	Influence to sand desert wildlife
	Landscape	2	Alteration of topography, massive cut and embankment of sand dune
	Hazards	1~2	Sand dunes
	Cultural heritage	1~2	Influence to cultural heritage
	Other items	1	

ENVIRONMENTAL CHECKLIST (N7)

Road Section: From Hasiq to Al Shuwaymiyah, Existing road condition: No road
Project No.: N7, Planning road: Paved 2-lane road, Distance: 80km

Environmental Items	Present Condition : Location of each road unit is explained at item of “Topography and Geology”.	Impact Rating 1 = Slight 2 = Moderate 3= Significant	Major Anticipated Impact with Project Predicted traffic volume in 2030: 300 veh/day
Air Pollution	(1): Not existing.	1	- Not significant.
Effluent	(1): Not existing.	1	- Not significant.
Noise and Vibration	(1): Not existing.	1	- Not significant.
Land Subsidence	(1): Not existing.	1	- Proposed road alignment near Hasiq and shuwaymiyah passes sandy coastal line. - It is necessary to carry out geological investigation before detail planning of road.
Topography and Geology	<p>Topography:</p> <p>(1) 0 (Hasiq, Ra's Tibrat)~100km (Shuwaymiyah): 0~10km: The road unit is coastal line with sand beach, ranging in width from 100 to 300m. Backside of beach forms mostly vertical cliff consisting of marl, limestone, calcareous conglomerate and sandstone. Dipping of the beds is mostly flat and very gentle. The cliffs extend from Jabel Samhan. The height of vertical cliff ranges approximately from 100 to 400m. About 10 km point: River mouth of Wadi Dahanat, and sand beach extends around the wadi. 10~ 25km: Sand (and/or gravel) beach extends in the road unit. 23km point: River mouth of Wadi Simayk. 25~40km (Ra's Muntajib): Beach might be so narrow and in many places and limestone cliff is directly closed to the sea. 40km (Ra's Muntajib)~60km (Bandar Qanawt): This road unit might be narrow beach or limestone cliff is directly closed to the sea. 60 km (Bandar Qanawt village)~80km (Shuwaymiyah village): Wide sand beach extends from Bandar Qanawt to Shuwaymiyah. Backside of beach between them</p>	2	- Moderate impact due to new road construction in the area of coastal line and sand beach.

	<p>forms also vertical cliff consisting of marl, limestone, calcareous conglomerate and sandstone same as Hasiq side. The height of vertical cliff ranges approximately from 100 to 200m.</p> <p>Geology: Mostly Tertiary flat marl, limestone, calcareous conglomerate and sandstone beds are widely distributed in the area. And Terraces consisting of Low, Middle and High Terraces, are locally found in the area. Some stalactites are found in the limestone vertical cliff.</p>		
Soil	(1): soil is poorly developed in the area.	1	- Not significant impact due to road construction.
Hydrology, groundwater	(1): Current flow may not be found along the wadis in the area.	1~2	- Slight to moderate impact due to new road construction passing coastal line as well as wadi mouths and inlets.
Eco-system, Flora and Fauna	<p>(1): Beach side is low vegetation, but around downstream and river mouths of the wadis are relatively thick vegetation more than others.</p> <p>- The area between Hasik and 60km west from Ash shuwaymiyah (Ra's Tibrar) proclaimed as "Jabel Samhan Nature Reserve" on 28/6/1997 by Royal Decree 48/97.</p> <p>Flora: Thick vegetation forming the dominant woodland species consisting of various species with various species of wildlife. The vegetation mainly consists of <i>Acacia spp.</i>, <i>Anogeissus dhofarica (zerkin)</i>, <i>Blepharispernum bitum (khyfut)</i>, <i>Boscia arabica (simer)</i>, <i>Bostwellia sacra (luban)</i>, <i>Craton confertus (hor)</i>, <i>Maytenus spp.</i>, etc. The chief species is <i>Anogeissus dhofarica</i>, which is associated with several othertrees and large shrubs such as <i>Commiphora</i> and <i>Acacia species</i>, forms the woodland vegetation.</p> <p>Fauna: Wildlife in the area includes; The last population of the Arabian Leopard, Nubian ibex, Arabian Gazelle, Striped Hyenas, Wild Cats, Caracal, Wolves and Foxes. Smaller mammals including</p>	3	<p>- The project road is located in the protection area of "Jabel Samhan Nature Reserve".</p> <p>- There are a number of valuable species of flora and fauna, including marine life, in the area. Therefore, significant impact to the eco-system of the area due to road construction and increase of visitors as well as air pollution, water contamination, noise, wastes, etc.</p>

	rodents and foxes (<i>Lupes lupes arabica</i>) are found in the area, along with a number of bird species. A number of rare species of birds such as Herons, Masked Boobies and Socotra Comorants are also found breeding in the area and on the cliffs.		
Landscape	(1): The area is rocky and coastal zone in the Jabel Samhan Nature Reserve.	2	- Moderate impact to the landscape in the area due to alteration of topography by massive excavation of cliff for road construction.
Hazards	(1): Not significant.	1	- Not significant impact due to road construction. - Rocks fall will occur after massive cutting of cliff.
Regional Development on Natural Environment	- Not existing so far.	1	- Unknown.
Other Impacts on Natural environment	- Not existing so far, but road construction is bigger impacts on natural environment.	1	- Not existing.
Cultural Heritage	- Unknown so far, however there is a potential to exist cultural heritage along the route.	1~2	- The project road is newly construction. Therefore, investigation of the cultural heritage is required in the site.
Wastes	- Not significant.	1	- Not significant impact due to road construction.
Regional Development on Social Environment	(1): Not significant so far.	1	- The road is major road connecting between because low future traffic volume. However, it is necessary to make arrangement to keep clean in the area.
Other Impacts on Social Environment	0km point: Hasiq village. School, public office, mosque, etc. 60km point: Bandar Qanawt village. 80km point: Shuwaymiyah village. School, public office, mosque, etc.	1	- Low traffic volume is predicted and low receptors.

Evaluation	Topography and geology	2	Alteration of topography
	Hydrology	1~2	Influence to inlets and wadi mouths
	Eco-system, Flora and Fauna	3	Passing in the Jabel Samhan Natural Reserve, Influence to mountainous and marine wildlife including beach and inlets
	Landscape	2	Alteration of topography
	Cultural heritage	1~2	Influence to cultural heritage
	Other items	1	

ENVIRONMENTAL CHECKLIST (N9 (1))

Road Section: From Marmul to Ra's Sawqirah, Existing road condition: Gravel road
 Project No.: N9 (1), Panning road: Paved 2-lane road, Distance: 153km

Environmental Items	Present Condition	Impact Rating 1 = Slight 2 = Moderate 3= Significant	Major Anticipated Impact with Project Predicted traffic volume in 2030: 300 veh/day
Air Pollution	: Location of each road unit is explained at item of "Topography and Geology".	1	- Not significant.
Effluent	(1)~ (7): Not significant, but dust is significant.	1	- Not significant.
Noise and Vibration	(1)~ (7): Not existing.	1	- Not significant.
Land Subsidence	(1)~ (7): No existence.	1	- Not existing.
Topography and Geology	Topography: (1) 0 (Roundabout at Amal to Shuwaymiyah and Marmul)~ 20km: Mostly flat with small wadis and aeolian sand covers in the area. (2) 20~54km (Roundabout at Shalim): Mostly flat with small wadis and aeolian sand covers in the area. (3) 54 (Roundabout at Shalim)~ 74km: Flat with aeolian sand and small wadis (Wadi Hurkat). (4) 74~94km: Road runs small hilly land of Middle Terrace. Hills, likely mesa topography, range in height from 3 to 15m. (5) 94~ 114km: Flat land and partly small wadis (Wadi Hurkanawt). (6) 114~ 134km: Flat on the Middle Terrace. 122km point: Junction to Sharbithat. (7) 134~ 153km (Junction at Ra's Sawqirah): Hilly land (Middle and Low Terraces) with wadi (Wadi Hurkat). Hills range in height from 50 to about 100m. Wadi alluvial plain is wider and thick aeolian sand cover wadi sediment. 50km point: Steep slope downwards from Low Terrace to Alluvial (Coastal) plain is paved by asphalt. 60~ 65km: Road runs sand beach plain near seashore. Geology: Tertiary horizontal marl and limestone beds are	1	- Not significant impact due to road construction, mostly following existing road alignment.

	widely distributed in the area, belonging to the Low Terrace. Quaternary wadi sediments are widely covered along the broad wadis. And aeolian sand is widely covered the area, but mostly thin. (1)~ (7): Height of embankment of the road is 0.1~0.5m and only cut surface.			
Soil	(1)~ (7): White alluvial soil is poorly developed, mostly suffered by wind erosion.	1~2	- Slight to moderate impact to surface soil due to road construction. It is necessary to follow the existing road alignment for minimizing of cutting. - Not significant impact due to road construction mostly following existing road alignment.	
Hydrology, groundwater	(1)~ (7): No current flow along the wadis (wadi Hurkat and Wadi Harkanawt). 94~95km: Two places of road crossing the Wadi Harkanawt are damaged by flood, and road damage is mostly eroded deeply.	1	- Slight to moderate impact due to road improvement with excavation along proposed road. - It is necessary to make arrangement to minimize as working areas, including road alignment, borrow pits, construction camps, during for road construction. - There are no protected areas along the proposed route. - Numerous domestic animals are grazed and suffered traffic accidents.	
Eco-system, Flora and Fauna	Flora and Fauna: (1)~ (2): Mostly no to rare vegetation consisting of grasses (mostly halophytic and mesophyll plant). But there is slight vegetation, consisting of small acacia and grasses, along small wadis. (3): Relatively high vegetation in the wadi. (4): Low vegetation in coastal area.	1~2	- Not significant impact due to road construction.	
Landscape	(1)~ (2): Almost flat. (3): Hilly land. (4): Coastal land. Vertical high cliffs of limestone forms wide landscape.	1	- Not significant impact due to road construction.	
Hazards	- Not significant.	1	- Not significant impact due to road construction.	
Regional Development on Natural Environment	(1)~(3): Oil development by PDO in the area. (4): Fishery development and community development (Under construction).	1	- Unknown.	
Other Impacts on Natural environment	- Not existing so far.	1	- Not existing.	
Cultural Heritage	- Not existing so far.	1	- The investigation of the cultural heritage is required in the site.	
Wastes	- Not significant.	1	- Low traffic volume is predicted. Wastes along the road will be increased together with increasing traffic volume.	

Regional Development on Social Environment	(1)-(3): Oil development by PDO in the area. (4): Fishery development and community development (Under construction).	1	- Unknown.
Other Impacts on Social Environment	0km: Marmul oilfield and PDO complex. 0~20km: Electric line and oil pipeline. 54km point: Roundabout. Shalim village: School, Wali office, Medical center, mosque, etc. Junction to Road Section N10. 54~60km: Electric line. 60km point: Zakhir village. School, etc. 22km point: Shalim village: School, Wali office, Medical center, mosque, etc. Junction to Road Section N9. 22~60km: Electric line. 28km point: Microwave tower. 65km point: Shuwaymyah village. School, mosque, Wali office, Medical center, other public office, etc.	1	- Low traffic volume is predicted. - Increased chance of traffic accident as well as domestic animals due to increased traffic volume.

Evaluation	Eco-system, Flora and Fauna	1~2	Passing near Jabel Samhan Natural Reserve
	Other items	1	

ENVIRONMENTAL CHECKLIST (N9 (2))

Road Section: From Junction in N9 to Sharbithat, Existing road condition: Gravel road
 Project No.: N9 (2), Planning road: Paved 2-lane road, Distance: 17km

Environmental Items	Present Condition : Location of each road unit is explained at item of “Topography and Geology”.	Impact Rating 1 = Slight 2 = Moderate 3= Significant	Major Anticipated Impact with Project Predicted traffic volume in 2030: 300 veh/day
Air Pollution	(1): Not significant, but dust is significant.	1	- Not significant.
Effluent	(1): Not existing.	1	- Not significant.
Noise and Vibration	(1): No existence.	1	- Not significant.
Land Subsidence	(1): Not existing.	1	- Not existing.
Topography and Geology	Topography: (1) 0 (Junction of N9)~ 17km: 0~3km: Road goes down from High Terrace to Middle Terrace and wadis. 3~5km: Road goes low hilly land from Middle Terrace to Low Terrace. 5~15km: Road runs in the wide wadi. Mostly flat with aeolian sand. 15~ 17km: Alluvial coastal plain is occupied alluvial and coastal white sand. Geology: Tertiary horizontal marl and limestone beds are widely distributed in the area, belonging to the High, Middle and Low Terraces. Quaternary wadi sediment and coastal beach sand are widely covered in downstream of wadi. And aeolian sand is widely covered the area. (1): Height of embankment of the road is 0.1~1.5m.	1	- Not significant impact due to road construction. - Mostly following existing road alignment.
Soil	(1): Alluvial soil is poorly developed, mostly suffered by wind erosion.	1	- Not significant impact due to road construction mostly following existing road alignment.
Hydrology, groundwater	(1): No current flow along the wadis.	1	- Not significant impact due to road construction mostly following existing road alignment.
Eco-system, Flora and Fauna	(1): Mostly low vegetation consisting of grasses (mostly halophytic and mesophyll plant). But there is	1~2	- There are no protected areas along the proposed route.

	slight vegetation, consisting of small acacia and grasses, along the wadi. Low vegetation in coastal area.		<ul style="list-style-type: none"> - Slight to moderate impact due to road improvement with excavation along proposed road. - It is necessary to make arrangement to minimize as working areas, including road alignment, borrow pits, construction camps, during for road construction. - Numerous domestic animals are grazed and suffered traffic accidents.
Landscape	(1): Hilly land and Coastal land.	1	- Not significant impact due to road construction.
Hazards	- Not significant.	1	- Not significant impact due to road construction.
Regional Development on Natural Environment	(1) Fishery development and community development (Under construction).	1	- Unknown.
Other Impacts on Natural environment	- Not existing so far.	1	- Not existing.
Cultural Heritage	- Not existing so far.	1	- The investigation of the cultural heritage is required in the site.
Wastes	- Not significant.	1	- Low traffic volume is predicted. Wastes along the road will be increased together with increasing traffic volume.
Regional Development on Social Environment	(1): Fishery development and community development (Under construction).	1	- Unknown.
Other Impacts on Social Environment	0km: Junction to N9. 16km point: Small village, 20 houses. 17km point: Sharbithat village. School, mosque, etc.	1	<ul style="list-style-type: none"> - Low traffic volume is predicted. - Increased chance of traffic accident as well as domestic animals due to increased traffic volume.
Evaluation	Eco-system, Flora and Fauna	1-2	Passing near Jabel Samhan Natural Reserve
	Other items	1	

ENVIRONMENTAL CHECKLIST (N10)

Road Section: From Amal to Shuwaymiyah, Existing road condition: Gravel road
Project No.: N10, Planning road: Paved 2-lane road, Distance: 65km

Environmental Items	Present Condition : Location of each road unit is explained at item of “Topography and Geology”.	Impact Rating 1 = Slight 2 = Moderate 3= Significant	Major Anticipated Impact with Project Predicted traffic volume in 2030: 600 veh/day
Air Pollution	(1)~(4): Not significant, but dust is significant.	1	- Not significant.
Effluent	(1)~(4): Not existing.	1	- Not significant.
Noise and Vibration	(1)~(4): No existence.	1	- Not significant.
Land Subsidence	(1)~(4): Not existing.	1	- Not existing.
Topography and Geology	<p>Topography:</p> <p>(1) 0 (Amal)~ 20km: Flat with aeolian sand. (2) 20~ 40km: Flat with low hills (High and Middle Terraces) and small wadis (Wadi Hurkat). (3) 40~ 55km: 40~ 54km: Low hilly land (Middle to Low Terraces) with small wadis. Road goes down from Middle Terrace to Low Terrace. 54~ 55km: Steep slope going down from Low Terrace to Alluvial Plain is paved by asphalt. (4) 55~ 65km: Alluvial plain and coastal plain. Shuwaymiyah is located in the sand beach plain.</p> <p>Geology:</p> <p>Tertiary horizontal marl and limestone beds are widely distributed in the area, belonging to the High, Middle and Low Terraces. Quaternary wadi sediment and coastal beach sand are widely covered near Shuwaymiyah. And aeolian sand is widely covered the area. (1)~ (4): Height of embankment of the road is 0.1~ 0.5m.</p>	1	- Not significant impact due to road construction mostly following existing road alignment. - There is coastal line near shuwaymiyah.
Soil	(1)~(4): White alluvial soil is poorly developed, mostly suffered by wind erosion.	1~2	- Slight to moderate impact to surface soil due to road construction. It is necessary to follow the existing road alignment for minimizing of cutting.
Hydrology, groundwater	(1)~ (4): No current flow along the wadis (wadi Hurkat).	1	- Not significant impact due to road construction, mostly following existing road alignment.

Eco-system, Flora and Fauna	Flora and Fauna: (1)~ (2): Mostly no to rare vegetation consisting of grasses (mostly halophytic and mesophyll plant). But there is slight vegetation, consisting of small acacia and grasses, along small wadis. (3): Relatively high vegetation in the wadi. (4): Low vegetation in coastal area.	1~2	- The road section area is adjoined to the “Jabel Samhan Natural Reserve”. - The project road passes coastal line near shuwaymiyah. - Numerous domestic animals are grazed and suffered traffic accidents.
Landscape	(1)~ (2): Almost flat. (3): Hilly land. (4): Coastal land. Vertical high cliffs of limestone forms wide landscape.	1	- Not significant impact due to road construction.
Hazards	- Not significant.	1	- Not significant impact due to road construction.
Regional Development on Natural Environment	(1)~(3): Oil development by PDO in the area. (4): Fishery development and community development (Under construction).	1	- Unknown.
Other Impacts on Natural environment	- Not existing so far.	1	- Not existing.
Cultural Heritage	- Old house and tower near Shuwaymiyah.	1~2	- The investigation of the cultural heritage is required in the site.
Wastes	- Not significant.	1	- Low traffic volume is predicted. Wastes along the road will be increased together with increasing traffic volume.
Regional Development on Social Environment	(1)~(3): Oil development by PDO in the area. (4): Fishery development and community development (Under construction).	1	- Unknown.
Other Impacts on Social Environment	0km: Roundabout at Amal. 0~22km: Electric line. 9km point: Oilfield. 10km point: Oilfield. 19~20km: Oilfield. 21km point: Roundabout of Shalim. 21km point: Oilfield. 22km point: Shalim village: School, Wali office, Medical center, mosque, etc. Junction to Road Section N9. 22~60km: Electric line. 28km point: Microwave tower. 65km point: Shuwaymiyah village. School, mosque, Wali office, Medical center, other public office, etc.	1	- Low traffic volume is predicted. - Increased chance of traffic accident as well as domestic animals due to increased traffic volume.

Evaluation	Soil		1~2	Alteration of topography
	Eco-system, Flora and Fauna		1~2	Passing near Jebel Samhan Natural Reserve
	Cultural heritage		1~2	Influence to cultural heritage
	Other items		1	

ENVIRONMENTAL CHECKLIST (N11)

Road Section: From Rakhyut to Dhalkut through Difa, Existing road condition: Paved (newly) road
Project No.: N11, Planning road: Paved 2-lane road, Distance: 54km

Environmental Items	Present Condition : Location of each road unit is explained at item of “Topography and Geology”.	Impact Rating 1 = Slight 2 = Moderate 3= Significant	Major Anticipated Impact with Project Predicted traffic volume in 2030: 1,000 veh/day
Air Pollution	(1)~ (3): Not significant.	1	- Not significant.
Effluent	(1)~ (3): No current flow, but during wet season has drainage water along the road. Suspended solids (SS) are possible to occur during and after rain. It might be occurred in short time.	1	- Not significant.
Noise and Vibration	(1)~ (3): insignificant so far. Road section is so steep that the noise will be occurred, because the several houses and villages are located along the road.	1	- Not significant.
Land Subsidence	(1)~ (3): Not existing so far.	1	- Not existing.
Topography and Geology	<p>Topography: (1) 0 (Junction at Rakhyut)~3.5km: Paved road: Steep slope along the mountain ridge. Massive cutting and embankment are done for road construction. Most of the cuttings were disposed both side of the road. Height of cutting of the road ranges from 5 to 15m. Drainage ditches are installed both side of the road. 3.5~ 19km (Difa village): On the top of the mountain ridge (Watershed). Gentle slope is connected to the Middle and High Terraces. (2) 19 (Difa village) ~42km (Junction to Sulfait): Paved road: road runs gentle slope on the top of the hill (High Terrace). Southern side of the road is steep cliff of limestone. (3) 42 (Junction before Dhalkut to Salfait)~54km (Center of Dhalkut village): Access road to Dhalkut village is long slope and newly paved road. Height of cutting along the road ranges 2 to 15 m. Geology:</p>	1~2	- Slight to moderate impact due to road construction in the thick vegetation area near coastal line. It is necessary to follow the existing road alignment for minimizing of cutting.

	<p>Tertiary horizontal limestone and marl beds are widely distributed in the area. Limestone beds are formed mostly vertical cliffs and three flat terraces in the area. Three terraces consist of High, Middle and Low Terraces. Terrace deposits are partly covered on the terraces and alluvial deposits are found along the wadis.</p> <p>(1)~ (3): Reddish to reddish brown soil is relatively developed in the area. Surface soil is mostly suffered by rain erosion, because forest pasturage (camels and cows) is widely done in the area.</p>		
Soil		1~2	<ul style="list-style-type: none"> - Slight to moderate impact due to road construction in the thick vegetation area as well as relatively thick surface soil near coastal line. It is necessary to follow the existing road alignment for minimizing of cutting. - Not significant impact due to road construction.
Hydrology, groundwater	<p>(1)~ (3): No current flow along the road section. Most of the rainwater might be infiltrated into limestone ground.</p> <p>Wadi is no current flow, but current flow will be appeared during rain season.</p> <p>(2): Box culverts and tubes are installed for crossing wadi at the junction.</p> <p>(1)~ (3): Each village has water wells for drinking water.</p>	1	
Eco-system, Flora and Fauna	<p>(1)~ (3):</p> <p>Flora: Thick vegetation forming the dominant woodland species consisting of various species with various species of wildlife. The vegetation mainly consists of <i>Accacia spp.</i>, <i>Anogeissus dhofarica (zerkin)</i>, <i>Blepharispernum bitum (khyfut)</i>, <i>Boscia arabica (simer)</i>, <i>Bostvella sacra (luban)</i>, <i>Craton confertus (hor)</i>, <i>Maytenus spp.</i>, etc. The chief species is <i>Anogeissus dhofarica</i>, which is associated with several othertrees and large shrubs such as <i>Commiphora</i> and <i>Acacia species</i>, forms the woodland vegetation.</p> <p>Fauna: Wildlife in the area includes; The last population of the Arabian Leopard, Nubian ibex, Arabian Gazelle, Striped Hyaenas, Wild Cats, Caracal,</p>	2	<ul style="list-style-type: none"> - Moderate impact to flora and fauna due to deforestation by road widening in the thick vegetation in the project area. Road alignment should be followed along existing road. - There are no protected areas along the proposed route. - Domestic animals are grazed and suffered traffic accidents.

	<p>Wolves and Foxes. Smaller mammals including rodents and foxes (<i>Lupes lupes arabica</i>) are found in the area, along with a number of bird species. Numerous camels, cows and goats are fed in the area. However, several cows and goats are victims by traffic accidents. Numerous kinds of birds are found in the area.</p> <p>(1)~ (3): High limestone cliffs and thick forest on the flat gentle slope.</p>		
Landscapes		1~2	<ul style="list-style-type: none"> - Much forest will be disappeared due to the road construction; therefore it is necessary to conduct minimized area of deforestation.
Hazards		1	<ul style="list-style-type: none"> - Not significant impact due to road construction.
Regional Development on Natural Environment	<ul style="list-style-type: none"> - Construction of road and electricity line as the regional development including tourism development. 	1	<ul style="list-style-type: none"> - Unknown.
Other Impacts on Natural environment	<ul style="list-style-type: none"> - Not existing so far. 	1	<ul style="list-style-type: none"> - Not existing.
Cultural Heritage	<ul style="list-style-type: none"> - Old house at border. 	1~2	<ul style="list-style-type: none"> - Road construction might be followed along existing road alignment (within the ROW). - The investigation of the cultural heritage is required in the site.
Wastes	<ul style="list-style-type: none"> - Not significant so far. 	1	<ul style="list-style-type: none"> - Low traffic volume in future. Wastes along the road will be increased together with increasing traffic volume.
Regional Development on Social Environment	<ul style="list-style-type: none"> - Construction of road and electricity line as the regional development, including tourism development. 	1	<ul style="list-style-type: none"> - Unknown.
Other Impacts on Social Environment	<ul style="list-style-type: none"> 0km point: Junction at Rakhyut to Difa village. School, Wali office, mosque, etc. The village is 0.5km distance from junction of N20 and N11. 1km point: Electric line. 3km point: Microwave tower. 5km point: Small village (20 houses). 19~20km: Difa village. School, mosque, etc. 22km point: 5 houses. 31km point: village. School, mosque, etc. 42km (Junction before Rakhyut to Salfait): village. 54km: Dalkut village, School, public office, mosque, etc. 	2	<ul style="list-style-type: none"> - Increased chance of traffic accident as well as domestic animals due to increased traffic volume. - Resettlement of several houses at the part in the village will be required.

Evaluation	Topography and geology			
	Soil		1~2	Alteration of topography
	Eco-system, Flora and Fauna		1~2	Alteration of topography
	Landscape		2	Deforestation by excavation and embankment
	Cultural heritage		1~2	Deforestation by excavation and embankment
	Other Impacts on Social Environment		1~2	Influence to cultural heritage
	Other items		2	Increased traffic accidents and Resettlement
			1	

ENVIRONMENTAL CHECKLIST (N12)
Road Section: From Junction before Taqah to Medinat al Haq, Existing road condition: Gravel road
Project No.: N12, Planning road: Paved 2-lane road, Distance: 21km

Environmental Items	Present Condition	Impact Rating 1 = Slight 2 = Moderate 3= Significant	Major Anticipated Impact with Project Predicted traffic volume in 2030: 600 veh/day
Air Pollution	: Location of each road unit is explained at item of "Topography and Geology". (1)~ (2): Not significant.	1	- Not significant.
Effluent	(1)~ (2): No current flow, but during wet season has drainage water along the road. SS is possible to occur during and after rain. It might occur in short time.	1	- Not significant.
Noise and Vibration	(1)~ (2): insignificant. Although Road unit during long slope to Salalah is relatively noisy, because large vehicles run very slowly, receptors along the road do not exist.	1	- Not significant.
L and Subsidence	(1)~ (2): Not existing	1	- Not existing.
Topography and Geology	Topography: (1) 0 (Junction before Taqah to Medinat al Haq)~4km: Flat and gentle slope on the Low Terrace. 4~8km: Slope ~ steep slope from Low Terrace to Middle Terrace. 8~11km (Alam village): Gentle slope om the Middle Terrace. (2) 11 (Alam village)~21km (Medinat al Haq village): Road runs gentle slope on the Middle Terrace. Geology: Tertiary horizontal marl and limestone beds are widely distributed in the area. And Terrace deposits are partly covered on the terraces and wadi sediments are distributed along the wadis. (1)~ (2): Height of embankment of the road is 0.5~1.0m. (1)~ (2): Cutting slope is so steep that slope failures are possible to occur.	1	- Not significant impact due to road construction.

Soil	(1)~ (2): soil is developed as reddish-to-reddish brown soil in the marl and limestone region in the area. The weathered soil is mostly suffered by rain erosion, because forest pasturage is widely done in the area.	1~2	- Slight to moderate impact due to road construction in the thick vegetation area as well as relatively thick surface soil near coastal line. It is necessary to follow the existing road alignment for minimizing of cutting.
Hydrology, groundwater	(1)~ (2): No current flow along the wadis (Wadi Hasheem) in the area. There are relatively small-scaled flooding evidences at intersection of the wadis.	1	- Not significant impact due to road construction. But, it is necessary to install drainage system such as tubes and box culverts and ditches in both sides of the road.
Eco-system, Flora and Fauna	(1): Rare vegetation on the Low Terrace. 4km to (2): Rich vegetation is found in the northern part of the road section. Flora: Thick vegetation forming the dominant woodland species consisting of various species with various species of wildlife. The vegetation mainly consists of <i>Accacia spp.</i> , <i>Anogeissus dhofarica (zerkin)</i> , <i>Blepharispernum bitum (khfut)</i> , <i>Boscia arabica (simer)</i> , <i>Bostvelliia sacra (luban)</i> , <i>Craton confertus (hor)</i> , <i>Maytenus spp.</i> , etc. The chief species is <i>Anogeissus dhofarica</i> , which is associated with several other trees and large shrubs such as <i>Commiphora</i> and <i>Acacia species</i> , forms the woodland vegetation. Fauna: Wildlife in the area includes; The last population of the Arabian Leopard, Nubian ibex, Arabian Gazelle, Striped Hyenas, Wild Cats, Caracal, Wolves and Foxes. Smaller mammals including rodents and foxes (<i>Lupes lupes arabica</i>) are found in the area, along with a number of bird species. Numerous camels, cows and goats are fed in the area. However, several cows and goats are victims by traffic accidents. Numerous kinds of birds are found in the area.	2	- Moderate impact to flora and fauna due to deforestation by road construction in the thick vegetation in the project area. Road alignment should be followed along existing road. - Deforestation will be not only extinction of forest within the right of way but also disposal of large scaled cutting to both sides of the slope of the road. Therefore, the deforestation will be extend depend on the slope gradient and cutting volume. - Domestic animals are grazed and suffered traffic accidents.
Landscape	0~4km: Almost flat terrace 4km to (1): Slope is faced to the south and formed limestone and marl high cliff. High cliff is formed	1~2	- Much forest will be disappeared due to the road construction; therefore it is necessary to conduct minimized area of deforestation.

	numerous calcareous caves. (2): Flat on the Middle Terrace.			
Hazards	(1)~ (2): Flash floods sometimes occur and roads had been damaged due to erosion and gravels remained along the wadis. - Not existing so far.	1		- Not significant impact due to road construction.
Regional Development on Natural Environment	- Not existing so far.	1		- Unknown.
Other Impacts on Natural environment	- Not existing so far, but road construction is bigger impacts on natural environment.	1		- Not existing.
Cultural Heritage	- Not existing so far.	1		- Road costrection might be followed along existing road alignment (within the ROW). - The investigation of the cultural heritage is required in the site.
Wastes	- Not significant, but some dust, paper, plastic, etc., is scatted along the road. - Fragments of broken tire are scattered along the road.	1		- Low traffic volume in future. Wastes along the road will be increased together with increasing traffic volume.
Regional Development on Social Environment	(1)~ (2): Not significant so far.	1		-Unknown.
Other Impacts on Social Environment	0km point: Junction to Medinat al Haq. 8km point: Alam village. 12km point: Matabtoy village. 21km point: Medinat al Haq village. School, Police station, public offices, etc.	1		- Increased chance of traffic accident as well as domestic animals due to increased traffic volume.

Evaluation	Soil	1~2	Alteration of topography
	Eco-system, Flora and Fauna	2	Deforestation by excavation and embankment
	Landscape	1~2	Deforestation and alteration of topography
	Other items		

ENVIRONMENTAL CHECKLIST (N13)

Road Section: From Hujaiif to Asir and Junction of No.31, Existing road condition: Paved and gravel road
Project No.: N13, Planning road: Paved 2-lane road, Distance: 25km

Environmental Items	Present Condition : Location of each road unit is explained at item of “Topography and Geology”.	Impact Rating 1 = Slight 2 = Moderate 3= Significant	Major Anticipated Impact with Project Predicted traffic volume in 2030: 400 veh/day
Air Pollution	(1)~(2): Not significant.	1	- Not significant.
Effluent	(1)~(2): No current flow, but during wet season has drainage water along the road. Suspended solids (SS) are possible to occur during and after rain. It might be occurred in short time.	1	- Not significant.
Noise and Vibration	(1)~(2): insignificant.	1	- Not significant.
Land Subsidence	(1)~(2): Not existing.	1	- Not existing.
Topography and Geology	Topography: (1) 0 (Junction at Hujaiif to Kaftat) ~5km: Paved road runs mostly gentle slope on the High Terrace. 5~ 16km (Village): Gravel road runs mostly gentle slope on the Middle Terrace, after slope from High to Middle Terrace. (2) 18 (village)~25km (Junction of No.31): 16~ 20km: Steep slope from the Middle Terrace to Low Terrace. Slope is paved by thin asphalt. 20~ 25km: Flat plain on the Low Terrace. Before junction to No.31, the road is paved by asphalt (Under construction). Geology: Tertiary horizontal white marl and limestone beds are widely distributed in the area. Limestone forms vertical cliff, faced to the south.	2	- Moderate impact due to road construction in the steep slope north of Salalah, where the slope is mostly covered by thick vegetation. It is necessary to follow the existing road alignment for minimized cutting of slope.
Soil	(1)~(2): Reddish to reddish brown soil is relatively developed in the area. Surface soil is mostly suffered by rain erosion, because forest pasturage (camels and cows) is widely done in the area.	2	- Moderate impact due to road construction in the steep slope north of Salalah, where the slope is mostly covered by thick vegetation as well as fertile soil. - It is necessary to follow the existing road alignment for minimized cutting of slope.

<p>Hydrology, groundwater</p>	<p>(1)~(2): No current flow along the road section. 10~18km: Wadi is no current flow, but current flow will be appeared during rain season.</p>	<p>1</p>	<p>- Not significant impact due to road construction. (1)~ (2): It is necessary to install for drainage during rain season.</p>
<p>Eco-system, Flora and Fauna</p>	<p>Flora and Fauna: (1) 0~5km:Low vegetation. (2) 5~18km: Thick vegetation consisting of high to low trees consisting of various species. And many kinds of birds inhabit in the area. Flora: Thick vegetation forming the dominant woodland species consisting of various species with various species of wildlife. The vegetation mainly consists of <i>Accacia spp.</i>, <i>Anogeissus dthofarica (zerkin)</i>, <i>Blepharispernum bitum (khyfut)</i>, <i>Boscia arabica (simer)</i>, <i>Bostvella sacra (luban)</i>, <i>Craton confertus (hor)</i>, <i>Maytenus spp.</i>, etc. The chief species is <i>Anogeissus dthofarica</i>, which is associated with several othertrees and large shrubs such as <i>Commiphora</i> and <i>Acacia species</i>, forms the woodland vegetation. Fauna: Wildlife in the area includes; The last population of the Arabian Leopoard, Nubian ibex, Arabian Gazelle, Striped Hyaenas, Wild Cats, Caracal, Wolves and Foxes. Smaller mammals including rodents and foxes (<i>Lupes lupes arabica</i>) are found in the area, along with a number of bird species. Numerous camels, cows and goats are fed in the area. However, several cows and gouts are victims by traffic accidents. Numerous kinds of birds are found in the area. 18 (village)~25km (Junction of No.31): Rare vegetation. Numerous camels and cows are fed in the forest as forest pasturage. Most of grasses disappear during dry season and surface in the forest is bare-ground. As the result of bare-ground, surface soil erosion is promoted so far.</p>	<p>2</p>	<p>- Moderate impact to flora and fauna due to deforestation by road construction in the thick vegetation in the project area. Road alignment should be followed along existing road. - Deforestation will be not only extinction of forest within the right of way but also disposal of large scaled cutting to both sides of the slope of the road. Therefore, the deforestation will be extend depend on the slope gradient and cutting volume. - Domestic animals are grazed and suffered traffic accidents.</p>

Landscape	(1)~(2): High limestone cliffs and thick forest.	1~2	- Much forest will be disappeared due to the road construction; therefore it is necessary to conduct minimized area of deforestation. - Not significant impact due to road construction. - Unknown.
Hazards	(1)~(2): Flash floods may occur in the wadi. - Not existing so far.	1	- Not existing.
Regional Development on Natural Environment	- Not existing so far.	1	- Not existing.
Other Impacts on Natural environment	- Not existing so far.	1	- Not existing.
Cultural Heritage	- Not existing so far.	1	- Road construction might be followed along existing road alignment (within the ROW). - The investigation of the cultural heritage is required in the site.
Wastes	- Not significant.	1	- Low traffic volume in future. Wastes along the road will be increased together with increasing traffic volume. -Unknown.
Regional Development on Social Environment	- Not existing so far.	1	- Unknown.
Other Impacts on Social Environment	0km: Junction to Kaftat. Military base, etc. 0~5km: Electric line and water pipe. 3km point: Small settlement (10 houses). 4km point: High-voltage transmission line. 18km point: Village (Asir). 24~25km: Paved road. 25km point: Junction of No.31.	1~2	- Increased chance of traffic accident as well as domestic animals due to increased traffic volume.

Evaluation	Topography and Geology	2	Alteration of topography
	Soil	2	Alteration of topography
	Eco-system, Flora and Fauna	2	Deforestation by excavation and embankment
	Landscape	1~2	Deforestation and alteration of topography
	Cultural heritage	1~2	Influence to cultural heritage
	Other Impacts on Social Environment	1~2	Increased traffic accidents
	Other items	1	

ENVIRONMENTAL CHECKLIST (N14)

Road Section: From Qafat to Raysut, Existing road condition: Gravel road
Project No.: N14, Planning road: Paved 2-lane road, Distance: 24km

Environmental Items	Present Condition	Impact Rating 1 = Slight 2 = Moderate 3 = Significant	Major Anticipated Impact with Project Predicted traffic volume in 2030: 400 veh/day
Air Pollution	: Location of each road unit is explained at item of "Topography and Geology". (1)~(2): Not significant.	1	- Not significant.
Effluent	(1)~(2): No current flow, but during wet season has drainage water along the road. Suspended solids (SS) are possible to occur during and after rain. It might be occurred in short time.	1	- Not significant.
Noise and Vibration	(1)~(2): insignificant.	1	- Not significant.
Land Subsidence	(1)~(2): Not existing.	1	- Not existing.
Topography and Geology	Topography: (1) 0 (Junction at Qafat to Raysut) ~6km: Road runs mostly gentle slope on the High Terrace. 6~about 15km: Road runs mostly gentle slope on the Middle Terrace, after slope from High to Middle Terrace. (1) About 15~24km (Junction of No.49, Raysut Industrial area): Flat plain on the Low Terrace. Geology: Tertiary horizontal white marl and limestone beds are widely distributed in the area. Limestone forms vertical cliff, faced to the south.	2	- Moderate impact due to road construction in the steep slope north of Salalah, where the slope is mostly covered by thick vegetation. It is necessary to follow the existing road alignment for minimized cutting of slope.
Soil	(1)~(2): Reddish to reddish brown soil is relatively developed in the area. Surface soil is mostly suffered by rain erosion, because forest pasturage (camels and cows) is widely done in the area.	2	- Moderate impact due to road construction in the steep slope north of Salalah, where the slope is mostly covered by thick vegetation as well as fertile soil. - It is necessary to follow the existing road alignment for minimized cutting of slope.
Hydrology, groundwater	(1)~(2): No current flow along the road section. 10~18km: Wadi is no current flow, but current flow will be appeared during rain season.	1	- Not significant impact due to road construction. (1)~(2): It is necessary to install for drainage during rain season.

<p>Eco-system, Flora and Fauna</p>	<p>Flora: (1) 0~10km: No and rare vegetation. 10~18km: Thick vegetation forming the dominant woodland species consisting of various species with various species of wildlife. The vegetation mainly consists of <i>Accacia spp.</i>, <i>Anogeissus dhofarica (zerkin)</i>, <i>Blepharispermum bitum (khful)</i>, <i>Boscia arabica (simer)</i>, <i>Bostvella sacra (luban)</i>, <i>Craton confertus (hor)</i>, <i>Maytenus spp.</i>, etc. The chief species is <i>Anogeissus dhofarica</i>, which is associated with several other trees and large shrubs such as <i>Commiphora</i> and <i>Acacia species</i>, forms the woodland vegetation. (2): No and rare vegetation.</p> <p>Fauna: Wildlife in the area includes; The last population of the Arabian Leopard, Nubian ibex, Arabian Gazelle, Striped Hyenas, Wild Cats, Caracal, Wolves and Foxes. Smaller mammals including rodents and foxes (<i>Lupes lupes arabica</i>) are found in the area, along with a number of bird species. Numerous camels and cows are fed in the forest as forest pasturage. Most of grasses disappear during dry season and surface in the forest is bare-ground. As the result of bare-ground, surface soil erosion is promoted so far.</p>	<p>2</p>	<ul style="list-style-type: none"> - Moderate impact to flora and fauna due to deforestation by road construction in the thick vegetation in the project area. Road alignment should be followed along existing road. - Deforestation will be not only extinction of forest within the right of way but also disposal of large scaled cutting to both sides of the slope of the road. Therefore, the deforestation will be extend depend on the slope gradient and cutting volume. - Domestic animals are grazed and suffered traffic accidents.
<p>Landscape</p>	<p>(1)~(2): High limestone cliffs and thick forest.</p>	<p>1~2</p>	<ul style="list-style-type: none"> - Much forest will be disappeared due to the road construction; therefore it is necessary to conduct minimized area of deforestation.
<p>Hazards</p>	<p>(1)~(2): Flash floods may occur in the wadi.</p>	<p>1</p>	<ul style="list-style-type: none"> - Not significant impact due to road construction.
<p>Regional Development on Natural Environment</p>	<p>- Not existing so far.</p>	<p>1</p>	<ul style="list-style-type: none"> - Unknown.
<p>Other Impacts on Natural environment</p>	<p>- Not existing so far.</p>	<p>1</p>	<ul style="list-style-type: none"> - Not existing.
<p>Cultural Heritage</p>	<p>- Not existing so far.</p>	<p>1</p>	<ul style="list-style-type: none"> - Road construction might be followed along existing road alignment (within the ROW). - The investigation of the cultural heritage is required in the site.

Wastes	- Not significant.	1	- Low traffic volume in future. Wastes along the road will be increased together with increasing traffic volume. -Unknown.
Regional Development on Social Environment	- Not existing so far.	1	- Unknown.
Other Impacts on Social Environment	0km: Junction at Qafraat village. (1): Electric line and water pipe. 3~5km: Small villages. 22~24km: Paved road.	1~2	- Increased chance of traffic accident as well as domestic animals due to increased traffic volume.

Evaluation	Topography and Geology	2	Alteration of topography
	Soil	2	Alteration of topography
	Eco-system, Flora and Fauna	2	Deforestation by excavation and embankment
	Landscape	1~2	Deforestation and alteration of topography
	Other Impacts on Social Environment	1~2	Increased traffic accidents
	Other items	1	

ENVIRONMENTAL CHECKLIST (N15)

Road Section: From Junction of No.31 (Al Hatab) to Haluf, Existing road condition: Gravel road
Project No.: N15, Planning road: Paved 2-lane road, Distance: 10km

Environmental Items	Present Condition	Impact Rating 1 = Slight 2 = Moderate 3 = Significant	Major Anticipated Impact with Project Predicted traffic volume in 2030: 400 veh/day
Air Pollution	: Location of each road unit is explained at item of "Topography and Geology".		
Effluent	(1): Not significant.	1	- Not significant.
Noise and Vibration	(1): Not existing.	1	- Not significant.
Land Subsidence	(1): insignificant.	1	- Not significant.
Topography and Geology	(1): Not existing.	1	- Not existing.
	Topography: (1) 0 (Junction at No.31 (Al Hatab) to Haruf) ~ 3km: Small hilly land and wadis (Wadi Vistah). Hills show mesa topography. 3~10km: Hilly land and wadis (Wadi Vistah). Hills range in height from 3 to 25m. 10km point: Haluf villages are located wadi plain. Geology: Tertiary horizontal white marl and limestone beds are widely distributed in the area. Aeolian sand is partly covered in the area.		- Not significant impact due to road construction.
Soil	(1): Soil is poorly developed, mostly suffered by wind erosion.	1	- Not significant impact due to road construction.
Hydrology, groundwater	(1): No current flow in wadis (Wadi Vistah).	1	- Not significant impact due to road construction.
Eco-system, Flora and Fauna	(1): Mostly no to rare vegetation, but low vegetation consisting of small acacia trees and grasses exist in the wadis.	1	- Not significant impact due to road construction. - Domestic animals are grazed and suffered traffic accidents.
Landscape	(1): Almost low hilly land.	1	- Construction might be followed along existing road alignment.
Hazards	(1): Sand storm and sand dune are suffered this area during hot season.	1	- Construction might be followed along existing road alignment. - Sand storm and sand dune occasionally cross the road.
Regional Development on Natural Environment	- Not existing so far.	1	- Unknown.

Other Impacts on Natural environment	- Not existing so far.	1	- Not existing.
Cultural Heritage	- Not existing so far.	1	- Construction might be followed along existing road alignment (within the ROW). - The investigation of the cultural heritage is required in the site.
Wastes	- Not significant.	1	- Low traffic volume in future. Wastes along the road will be increased together with increasing traffic volume.
Regional Development on Social Environment	- Not existing so far.	1	-Unknown.
Other Impacts on Social Environment	(1): Electric line. 10km point: Haluf villages are located wadi plain. School, mosques, and public office, military bases, water wells, etc.	1~2	- Increased chance of traffic accident as well as domestic animals due to increased traffic volume.

Evaluation	Other Impacts on Social Environment	1~2	Increased traffic accidents
	Other items	1	

ENVIRONMENTAL CHECKLIST (N16)

Road Section: From Dawkah to Shisur, Existing road condition: Gravel road
Project No.: N16, Planning road: Paved 2-lane road, Distance: 65km

Environmental Items	Present Condition	Impact Rating 1 = Slight 2 = Moderate 3 = Significant	Major Anticipated Impact with Project Predicted traffic volume in 2030: 50 veh/day
Air Pollution	: Location of each road unit is explained at item of "Topography and Geology".		
Effluent	(1)~(4): Not significant.	1	- Not significant.
Noise and Vibration	(1)~(4): Not existing.	1	- Not significant.
Land Subsidence	(1)~(4): insignificant.	1	- Not significant.
Topography and Geology	(1)~(4): Not existing.	1	- Not existing.
	Topography: (1) 0 (Junction at Dawkah to Shisur)~20km: Flat Aeolian sand covers surface. Numerous small borrow pits are found along the road. (2) 20~40km: Flat with small isolated hills and wadi (Wadi Dawkah). (3) 40~60km: Flat with small hills scattered and wadis (Wwadi Haluf). (4) 60~65km: Flat. Geology: Tertiary horizontal white marl and limestone beds are widely distributed in the area. aeolian sand is widely covered the area. (1)~(4): Height of embankment of the road is 0.0~0.7m.		- Not significant impact due to road construction.
Soil	(1)~(4): Soil is poorly developed, mostly suffered by wind erosion.	1	- Not significant impact due to road construction.
Hydrology, groundwater	(1)~(4): No current flow in the wadis (Wadi Dawkah and Wadi Haluf). The large scaled irrigation system for farms at Dawkah and Shisur.	1	- Not significant impact due to road construction.
Eco-system, Flora and Fauna	(1)~(4): Mostly no to rare vegetation consisting of grasses (mostly halophytic and mesophyll plant).	1	- Not significant impact due to road construction. - There are no protected areas along the proposed route. - Numerous domestic animals are grazed and suffered traffic accidents.

Landscapes Hazards	(1)~(4): Almost flat. (1)~(4): Sand storm and sand dune are suffered this area during hot season.	1 1	- Not significant impact due to road construction. - Not significant impact due to road construction.
Regional Development on Natural Environment	- Large scaled farms are developed in the Dawkah and Shisur areas.	1	- Unknown.
Other Impacts on Natural environment	- Not existing so far.	1	- Not existing.
Cultural Heritage	- There is fort in Shisur.	1~2	- There is fort and towers in the area. The investigation of the cultural heritage is required in the site.
Wastes	- Not significant.	1	- Not significant impact due to road construction.
Regional Development on Social environment	- Not existing so far.	1	- Unknown
Other Impacts on Social Environment	0km point: Two huts. 0~1km: Large scaled farm with irrigation system. 65km point: Shisur village. Wali office, school, etc. Dawkah and Shisur villages.	1	- Very low traffic volume is predicted.

Evaluation	Cultural heritage	1~2	Influence to cultural heritage
	Other items	1	

ENVIRONMENTAL CHECKLIST (N17-1)

Road Section: From Shisur to Wadi Halif, Existing road condition: Gradvel road
Project No.: N17 (1), Planning road: Paved 2-lane road, Distance: 76km

Environmental Items	Present Condition : Location of each road unit is explained at item of "Topography and Geology".	Impact Rating 1 = Slight 2 = Moderate 3= Significant	Major Anticipated Impact with Project Predicted traffic volume in 2030: 100 veh/day
Air Pollution	(1)~ (4): Not significant.	1	- Not significant.
Effluent	(1)~ (4): Not existing.	1	- Not significant.
Noise and Vibration	(1)~ (4): insignificant.	1	- Not significant.
Land Subsidence	(1)~ (4): Not existing.	1	- Not existing.
Topography and Geology	<p>Topography: (1) 0 (Junction at Shisur to Qafa and Dawkah) ~20km: Flat Aeolian sand covers surface. Numerous small borrow pits are found along the road. (2) 20~40km: Flat with sand dunes and across the wadi (Wadi Haluf). (2) 40~60km: Flat. And wadis (Wadi al Hawf). (3) 60~76km: Flat land with small wadis (Wadi Dawkah). Geology: Horizontal white marl and limestone beds are widely distributed in the area. Aeolian sand is widely covered the area. (1)~ (4): Height of embankment of the road is 0.3~0.5m.</p>	1	- Not significant impact due to road construction.
Soil	(1)~ (4): Soil is poorly developed, mostly suffered by wind erosion.	1	- Not significant impact due to road construction.
Hydrology, groundwater	(1)~ (4): No current flow in wadis (Wadi Haluf and Wadi Dawkah). The large scaled irrigation system for farms at Shisur.	1	- Not significant impact due to road construction.
Eco-system, Flora and Fauna	(1)~ (4): Mostly no to rare vegetation consisting of grasses (mostly halophytic and mesophyll plant).	1	- Not significant impact due to road construction. - There are no protected areas along the proposed route.

				- A number of domestic animals are grazed and suffered traffic accidents.
Landscape Hazards	(1)~(4): Almost flat. (1)~(4): Sand storm and sand dune are suffered this area during hot season.	1 1	1 1	- Not significant impact due to road construction. - Not significant impact due to road construction.
Regional Development on Natural Environment	- Large scaled farms are developed in the Shisur areas. (1)~(3): Water pipeline is installed along the roads.	1	1	- Unknown.
Other Impacts on Natural environment	- Not existing so far.	1	1	- Not existing.
Cultural Heritage	- There is fort in Shisur.	1~2	1~2	- There is fort and towers in the area. The investigation of the cultural heritage is required in the site.
Wastes	- Not significant.	1	1	- Not significant impact due to road construction.
Regional Development on Social Environment	- Not existing so far.	1	1	- Unknown
Other Impacts on Social Environment	Okm point: Shisur village. Wali office, school, etc. 0~10km: Electric line. Water tank on the hill. (1)~(3): Water pipeline. 76km point: Junction with Major road No.31 and Shisur villages.	1	1	- Very low traffic volume is predicted.

Evaluation	Cultural heritage	1~2	Influence to cultural heritage
	Other items	1	

ENVIRONMENTAL CHECKLIST (N17-2)

Road Section: From Shisur to Major road No.31, Existing road condition: Gravel road
Project No.: ND17 (2), Planning road: Paved 2-lane road, Distance: 49km

Environmental Items	Present Condition	Impact Rating 1 = Slight 2 = Moderate 3 = Significant	Major Anticipated Impact with Project Predicted traffic volume in 2030: 50 veh/day
Air Pollution	: Location of each road unit is explained at item of "Topography and Geology".		
Effluent	(1)~ (3): Not significant.	1	- Not significant.
Noise and Vibration	(1)~ (3): Not existing.	1	- Not significant.
Land Subsidence	(1)~ (3): insignificant.	1	- Not significant.
Topography and Geology	(1)~ (3): Not existing.	1	- Not existing.
	Topography: (1) 0 (Junction at Shisur to Qafa and Dawkah) ~20km: Flat. Aeolian sand covers surface and across the wadi (Wadi Haluf). (2) 20~40km: Flat with sand dunes (3) 40~49km: Flat and wadis (Wadi Dawkah). Geology: Horizontal white marl and limestone beds are widely distributed in the area. Aeolian sand is widely covered the area. (1)~(4): Height of embankment of the road is 0.3~0.5m.		
Soil	(1)~ (3): Soil is poorly developed, mostly suffered by wind erosion.	1	- Not significant impact due to road construction.
Hydrology, groundwater	(1)~ (3): No current flow in wadis (Wadi Haluf and Wadi Dawkah). The large scaled irrigation system for farms at Shisur.	1	- Not significant impact due to road construction.
Eco-system, Flora and Fauna	(1)~ (3): Mostly no to rare vegetation consisting of grasses.	1	- Not significant impact due to road construction. - There are no protected areas along the proposed route. - Numerous domestic animals are grazed and suffered traffic accidents.
Landscape	(1)~ (3): Almost flat.	1	- Not significant impact due to road construction.
Hazards	(1)~ (3): Sand storm and sand dune are suffered this area during hot season.	1	- Not significant impact due to road construction.

Regional Development on Natural Environment	- Large scaled farms are developed in the Shisur areas.	1	- Unknown.
Other Impacts on Natural environment	- Not existing so far.	1	- Not existing.
Cultural Heritage	- There is fort in Shisur.	1~2	- There is fort and towers in the area. The investigation of the cultural heritage is required in the site.
Wastes	- Not significant.	1	- Not significant impact due to road construction.
Regional Development on Social Environment	- Large scaled farms are developed in the Shisur areas.	1	- Unknown
Other Impacts on Social Environment	0km point: Shisur village. Wali office, school, etc. 49km point: Junction with Major road No.31.	1	- Very low traffic volume is predicted.

Evaluation	Cultural heritage	1~2	Influence to cultural heritage
	Other items	1	

ENVIRONMENTAL CHECKLIST (N18)

Road Section: From Aydam To Mudayy, Existing road condition: Gravel road
Project No.: N18, Planning road: Paved 2-lane road, Distance: 77km

Environmental Items	Present Condition	Impact Rating 1 = Slight 2 = Moderate 3= Significant	Major Anticipated Impact with Project Predicted traffic volume in 2030: 100 veh/day
Air Pollution	: Location of each road unit is explained at item of "Topography and Geology". (1)~ (4): Not existing except dust. Dust is significant because of gravel road.	1	- Not significant.
Effluent	(1)~ (4): Not significant, but current flow causes during rain season along the wadi.	1	- Not significant.
Noise and Vibration	(1)~ (4): Not existing ~ very low.	1	- Not significant.
Land Subsidence	(1)~ (4): Not existing.	1	- Not existing.
Topography and Geology	Topography: (1) 0km: Junction at Aydam to Mudayy. 1km: Junction to Aydam village. School, Military base, etc. 0~20km: Low hilly and Middle and Low Terraces with small wadi (Wadi Aydim). Cutting slope both side of the road is 1 to 5 m high. Slope failures cause in the cutting slopes. (2) The hills show mesa and infancy topographic feature. (3) 20~40km: Low hilly and terraced land, developed deep valley incised (tributary of Wadi Gharah). The hills show mesa and infancy topographic feature. (4) 40~60km: Road runs in the wadi (Wadi Gharah). Width of wadi ranges from 50 to 150m and 20 to 30m high. Low and Middle Terraces, but mostly Low Terrace occupies in the area. 60~77km: Road runs jaggy ground consisting of wadi (Wadi Gharah) and Low Terrace. Height of the Middle Terrace is 15 to 20m. Geology: Low to Middle Terraces, mesa topography. Terraced area shows infancy topography. Arabian	1~2	- Slight to moderate impact due to road construction in the narrow wadi channel with high cliff in both sides.and relatively thick wadi vegetation.

	platform sedimentation; white marl, limestone, mostly flat structure. No sediments exist on the terraces. Road is constructed mostly banked 0.3 to 0.7m high and slightly cutting. Old borrow pits are scattered along the road, but mostly small size less than 20m wide. Aeolian sand is slightly covered surface. (1)~(4): Height of embankment of the road is between 0.3 and 1.5m.			
Soil	(1)~(4): soil is poorly developed, mostly suffered by wind erosion. Alluvial soil is found in the wadi, but mostly thin.	1~2	- Slight to moderate impact due to road construction in the narrow wadi channel with surface soil and relatively thick wadi vegetation.	
Hydrology, groundwater	(1)~(4): No current flow along the wadis (Wadi Aydim and Wadi Gharah), but current flow rarely causes during rain season along the wadi. 76km point: Falaj system to Mudayy village.	1	- Not significant impact due to road construction. But road alignment passes mostly in the narrow wadi channels. - Current flow during rain season.	
Eco-system, Flora and Fauna	(1)~(4): No to very low vegetation on the terraced and flat land, but vegetation in the wadi valley is found poor and slight vegetation consisting of acacia trees and grasses. Numerous camels are found in the wadi. The road section is far from thick vegetation area; the area is sub arid zone.	1~2	- Slight to moderate impact to flora and fauna due to road construction, particularly along wadi channels with wadi vegetation. - There are no protected areas along the proposed route. - Numerous domestic animals are grazed and suffered traffic accidents.	
Landscape	- Mesa topography.	1	- Not significant impact due to road construction.	
Hazards	(1)~(4): Rare flash flood along the wadis.	1	- Not significant impact due to road construction.	
Regional Development on Natural Environment	- No other regional development related to the road construction.	1	- Unknown.	
Other Impacts on Natural Environment	- Not significant.	1	- Not existing.	
Cultural Heritage	- Not existing so far.	1	- There is towers in the area. The investigation of the cultural heritage is required in the site.	
Wastes	- Not significant.	1	- Not significant impact due to road construction.	
Regional Development on Social Environment	- Several military bases are located along the road section.	1	- Unknown	
Other Impacts on Social Environment	0 km: Aydum village. 1km point: 10 houses and huts (Temporary houses).	1	- Very low traffic volume is predicted.	

	<p>Military base. 6km point: Village, school, Military base, etc. 23km point: Microwave tower. 44km point: Village (approximately 30 houses), school, Military base, etc. 64km point: 3 houses. 70km point: Microwave tower. 77 km (Junction to Thumrayt): Mudday village. Military base, public office, etc.</p>		
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Evaluation	Topography and Geology	1~2	Alteration of topography
	Soil	1~2	Alteration of topography
	Eco-system, Flora and Fauna	1~2	Deforestation by excavation and embankment
	Other items	1	

ENVIRONMENTAL CHECKLIST (N19-1)

Road Section: From Aydam To Habrut, Existing road condition: Gravel road
Project No.: N19-1, Planning road: Paved 2-lane road, Distance: 123km

Environmental Items	Present Condition	Impact Rating 1 = Slight 2 = Moderate 3= Significant	Major Anticipated Impact with Project Predicted traffic volume in 2030: 100 veh/day
Air Pollution	: Location of each road unit is explained at item of "Topography and Geology".	1	- Not significant.
Effluent	(1)~ (7): Not existing except dust. Dust is significant because of gravel road.	1	- Not significant.
Noise and Vibration	(1)~ (7): Not existing	1	- Not significant.
Land Subsidence	(1)~ (7): Not existing ~ very low	1	- Not significant.
Topography and Geology	(1)~ (7): Not existing	1	- Not existing.
	<p>Topography:</p> <p>(1) 0 (Junction to Mudayy)~20km: Low hilly and terraced land with small wadis (Wadi Aydim).</p> <p>(2) 20~ 40km: Low hilly and terraced land, developed deep valley incised.</p> <p>(3) 40~ 55km: Checkpoint: Low terraced and flat land.</p> <p>(4) 55~ 75km: Middle terraced and flat land.</p> <p>(5) 75~ 95km: Road runs in the wadi (Wadi Aydim). Wadi ranges in width from 150 to 400m and in height of both cliffs from 100 to 300m.</p> <p>(6) 95~ 110km: low to Middle Terraced land</p> <p>(7) 110~ 123km (Junction and checkpoint to Harbut village): low hilly land.</p> <p>Geology:</p> <p>Low to Middle Terraces, mesa topography. Terraced area shows infancy topography. Arabian platform sedimentation; white marl, limestone, mostly flat structure. No sediments exist on the terraces. Road is constructed mostly banked 0.3 to 0.7m high and slightly cutting. Old borrow pits are scattered along the road, but mostly small size less than 20m wide.</p>	1 ~ 2	- Slight to moderate impact due to road construction in the narrow wadi channel with low cliff in both sides.and sparse wadi vegetation.

	<p>Aeolian sand is slightly covered surface. (1)~(7): Height of embankment of the road is between 0.3 and 1.5m.</p>		
Soil	<p>(1)~ (7): soil is poorly developed, mostly suffered by wind erosion.</p>	1~2	<p>- Slight to moderate impact to surface soil due to road construction. It is necessary to follow the existing road alignment for minimizing of cutting.</p>
Hydrology, groundwater	<p>(1)~ (7): No current flow along the wadis (Wadi Aydim) and falaj system in the area. Several small villages scattering along the road have water wells.</p>	1	<p>- Not significant impact due to road construction. But road alignment passes mostly in the narrow wadi channels.</p>
Eco-system, Flora and Fauna	<p>(1)~ (4): No to very low vegetation on the terraced and flat land, but vegetation in the wadi valley is found poor and slight vegetation consisting of acacia trees and grasses. Numerous camels are found. (5) ~ (7): No to very low vegetation.</p>	1~2	<p>- Slight to moderate impact to flora and fauna due to road construction, particularly along wadi channels with wadi vegetation. - There are no protected areas along the proposed route. - Numerous domestic animals are grazed and suffered traffic accidents.</p>
Landscape	<p>Wadis are likely small scale of grand canyon.</p>	1	<p>- Not significant impact due to road construction.</p>
Hazards	<p>(1)~ (7): No existence or rare. Sand storm could be suffered this area.</p>	1	<p>- Not significant impact due to road construction.</p>
Regional Development on Natural Environment	<p>- No other regional development related to the road construction.</p>	1	<p>- Unknown.</p>
Other Impacts on Natural Environment	<p>- Not significant so far.</p>	1	<p>- Not existing.</p>
Cultural Heritage	<p>- Not existing so far.</p>	1	<p>- The investigation of the cultural heritage is required in the site.</p>
Wastes	<p>- Not significant.</p>	1	<p>- Not significant impact due to road construction.</p>
Regional Development on Social Environment	<p>(5): Habrut village and military base.</p>	1	<p>- Unknown</p>
Other Impacts on Social Environment	<p>(1)~ (4): No habitants except Hawib and Al Muzyunah village. 0 to5km: Numerous cows and camels. 19km point: 8 houses. 24km point: Water tank for villagers. 40 to 60 km: Several houses in wadi. 55km point: Harwib Village, but no crossing inside of the village.</p>	1	<p>- Very low traffic volume is predicted.</p>

Evaluation	Topography and Geology			Alteration of topography
	Soil		1~2	Alteration of topography
	Eco-system, Flora and Fauna		1~2	Deforestation by excavation and embankment
	Cultural heritage		1~2	Influence to cultural heritage
	Other items		1	

ENVIRONMENTAL CHECKLIST (N19-2)

Road Section: From Habrut To Al Muzaynah, Existing road condition: Gravel road

Project No.: N19-2, Planning road: Paved 2-lane road, Distance: 65km

Environmental Items	Present Condition : Location of each road unit is explained at item of "Topography and Geology".	Impact Rating 1 = Slight 2 = Moderate 3 = Significant	Major Anticipated Impact with Project Predicted traffic volume in 2030: 400 veh/day
Air Pollution	(1)~ (4): Not existing except dust. Dust is significant because of gravel road.	1	- Not significant.
Effluent	(1)~ (4): Not existing.	1	- Not significant.
Noise and Vibration	(1)~ (4): Not existing ~ very low.	1	- Not significant.
Land Subsidence	(1)~ (4): Not existing.	1	- Not existing.
Topography and Geology	<p>Topography: (1) 0 (Junction and checkpoint to Harbut village)~20km: In the wide and deep wadi (Wadi Madi). (2) 20~ 40km: On the Middle terraced, and isolated small hill are scattered. (3) 40~ 60km: Flat land with small wadis (Wadi Tawsinat and Wadi Shihan). (4) 60~ 65km (Roundabout to Milton): Flat on the low terraced.</p> <p>Geology: The area is flat and covered by aeolian sand. Hills consist of mainly white marl, limestone, and mostly flat structure. No sediments exist on the terraces. (1)~ (4): Height of embankment of the road is between 0.3 and 0.7m.</p>	1	- Not significant impact due to road construction.
Soil	(1)~ (4): soil is poorly developed, mostly suffered by wind erosion.	1~2	- Slight to moderate impact to surface soil due to road construction. It is necessary to follow the existing road alignment for minimizing of cutting.
Hydrology, groundwater	(1)~ (4): No current flow along the wadis (Wadi Madi, Wadi Tawsinat and Wadi Shihan) and falaj system in the area. Several small villages scattering along the road have water wells.	1	- Not significant impact due to road construction. But road alignment passes mostly in the narrow wadi channels.
Eco-system, Flora and Fauna	(1)~ (4): No to very low vegetation on the terraced	1~2	- Slight to moderate impact to flora and fauna due to

	and flat land, but vegetation in the wadi valley is found poor and slight vegetation consisting of grasses. Several camels are found in the wadi.		road construction, particularly along wadi channels with wadi vegetation. - There are no protected areas along the proposed route. - Numerous domestic animals are grazed and suffered traffic accidents.
Landscape	(1): Southern part of the road section: Wadi and flat land. (2)~(4): Almost flat and terraced land.	1	- Not significant impact due to road construction.
Hazards	(1)~(4): No existence or rare. Sand storm could be suffered this area.	1	- Not significant impact due to road construction.
Regional Development on Natural Environment	- No other regional development related to the road construction.	1	- Unknown.
Other Impacts on Natural Environment	- Not existing so far.	1	- Not existing.
Cultural Heritage	- Not existing so far.	1	- There is fort and towers in the area. The investigation of the cultural heritage is required in the site.
Wastes	- Not significant.	1	- Not significant impact due to road construction.
Regional Development on Social Environment	- Not existing so far.	1	- Unknown
Other Impacts on Social Environment	(1)~(4): No inhabitants except Habrut village.55km point: Harwib Village, but no crossing inside of the village. 8km point: 6 houses in wadi. 23km point: small village (20 houses) with school. (5): Al Mazyunah village and military base.	1	- Very low traffic volume is predicted.

Evaluation	Topography and Geology	1~2	Alteration of topography
	Soil	1~2	Alteration of topography
	Eco-system, Flora and Fauna	1~2	Deforestation by excavation and embankment
	Cultural heritage	1~2	Influence to cultural heritage
	Other items	1	

ENVIRONMENTAL CHECKLIST (N20)

Road Section: From Shahb Asayb to Rakhyut, Existing road condition: Gravel road
Project No.: D20, Planning road: Paved 2-lane road, Distance: 14km

Environmental Items	Present Condition : Location of each road unit is explained at item of "Topography and Geology".	Impact Rating 1 = Slight 2 = Moderate 3= Significant	Major Anticipated Impact with Project Predicted traffic volume in 2030: 1,000 veh/day
Air Pollution	(1)~(2): Not significant.	1	- Not significant.
Effluent	(1)~(2): No current flow, but during wet season has drainage water along the road. Suspended solids (SS) are possible to occur during and after rain. It might be occurred in short time.	1	- Not significant.
Noise and Vibration	(1)~(2): insignificant so far. Road section is so steep that the noise will be occurred, because the several houses are located near the road.	1	- Not significant.
Land Subsidence	(1)~(2): Not existing so far.	1	- Not existing.
Topography and Geology	<p>Topography: (1) 0 (Junction at Shahb Asayb)~1km: Flat to gentle slope. 1~3km: Gentle slope and partly steep on the top of the hill (High Terrace) covered by trees. 3~4km: Steep slope in forest. High slope is faced to the south. 4~8km: Partly flat and gentle slope on the terrace (Middle Terrace). 8~12km: slope, partly steep in the forest. (2): 12~14km (Junction at Rakhyut): Very steep slope in the forest. 14km: Road runs in the wadi, and intersect to the N11.</p> <p>Geology: Horizontal limestone and marl beds are widely distributed in the area. Limestone beds are formed mostly vertical cliffs and three flat terraces in the area. Three terraces consist of High, Middle and Low Terraces. Terrace deposits are partly covered on the terraces and alluvial deposits are found along the wadis.</p>	2	- Moderate impact due to road construction in the thick vegetation area near coastal line. It is necessary to follow the existing road alignment for minimizing of cutting.

	(1)~ (2): Cutting slope is partly so steep that small-scaled (surface) slope failures are possible to occur.		
Soil	(1)~ (2): Reddish to reddish brown soil is relatively developed in the area. Surface soil is mostly suffered by rain erosion, because forest pasturage (camels and cows) is widely done in the area.	1~2	- Slight to moderate impact due to road construction in the thick vegetation area as well as relatively thick surface soil near coastal line. It is necessary to follow the existing road alignment for minimizing of cutting.
Hydrology, groundwater	(1)~ (2): No current flow along the road section. Most of the rainwater might be infiltrated into limestone ground. (2): Wadi is no current flow, but current flow will be appeared during rain season. Box culverts are installed for crossing wadi at the junction.	1	- Not significant impact due to road construction.
Eco-system, Flora and Fauna	(1)~ (2): Thick vegetation consisting of high to low trees consisting of various species. And many kinds of birds inhabit in the area. Flora: Thick vegetation forming the dominant woodland species consisting of various species with various species of wildlife. The vegetation mainly consists of <i>Acacia spp.</i> , <i>Anogeissus dhofarica</i> (<i>zerkin</i>), <i>Blebarispermum bitum</i> (<i>khfit</i>), <i>Boscia arabica</i> (<i>simer</i>), <i>Bostvella sacra</i> (<i>luban</i>), <i>Craton confertus</i> (<i>hor</i>), <i>Maytenus spp.</i> , etc. The chief species is <i>Anogeissus dhofarica</i> , which is associated with several othertrees and large shrubs such as <i>Commiphora</i> and <i>Acacia species</i> , forms the woodland vegetation. Fauna: Wildlife in the area includes; The last population of the Arabian Leopard, Nubian ibex, Arabian Gazelle, Striped Hyenas, Wild Cats, Caracal, Wolves and Foxes. Smaller mammals including rodents and foxes (<i>Lupes lupes arabica</i>) are found in the area, along with a number of bird species. Numerous camels, cows and goats are fed in the area. However, several cows and goats are victims by	2	- Moderate impact to flora and fauna due to deforestation by road widening in the thick vegetation in the project area. Road alignment should be followed along existing road. - There are no protected areas along the proposed route. - Domestic animals are grazed and suffered traffic accidents.

	traffic accidents. Numerous kinds of birds are found in the area.		
Landscape	(1)~(2): High limestone cliffs and thick forest.	2	- Much forest will be disappeared due to the road construction; therefore it is necessary to conduct minimized area of deforestation.
Hazards	(1)~(2): Flash floods sometimes occur in the wadi.	1	- Not significant impact due to road construction.
Regional Development on Natural Environment	- Construction of road and electricity line as the regional development.	1	- Unknown.
Other Impacts on Natural environment	- Not existing so far.	1	- Not existing.
Cultural Heritage	- Not existing so far.	1	- Road costrection might be followed along existing road alignment (within the ROW). - The investigation of the cultural heritage is required in the site.
Wastes	- Not significant so far.	1	- Low traffic volume in future. Wastes along the road will be increased together with increasing traffic volume.
Regional Development on Social Environment	- Construction of road and electricity line as the regional development including tourism development.	1	-Unknown.
Other Impacts on Social Environment	0km point: Junction at Shahb Asayb to Aydum. Police station, public office, etc. 0~1km: Approximately 200 houses exist in the village. (1)~(2): Electric line is built under construction. (1): Several houses are scattered in the forest. (2): Rakhyut village, school, Wali office, mosque, etc. The village is 0.5km distance from junction of N20 and N11.	1~2	- Increased chance of traffic accident as well as domestic animals due to increased traffic volume. - Resettlement of several houses at the part in the village will be required.
Evaluation	Topography and geology	2	Alteration of topography
	Soil	1~2	Alteration of topography
	Eco-system, Flora and Fauna	2	Deforestation by excavation and embankment
	Landscape	2	Deforestation by excavation and embankment
	Other Impacts on Social Environment	1~2	Increased traffic accidents and resettlement
	Other items	1	

ENVIRONMENTAL CHECKLIST (N21)
Road Section: From Junction before Dhalkhut to Salfait, Existing road condition: Gravel road (partly paved)
Project No.: N21, Planning road: Paved 2-lane road, Distance: 19km

Environmental Items	Present Condition : Location of each road unit is explained at item of "Topography and Geology".	Impact Rating 1 = Slight 2 = Moderate 3 = Significant	Major Anticipated Impact with Project Predicted traffic volume in 2030: 1,000 veh/day
Air Pollution Effluent	(1)~(2): Not significant. (1)~(2): No current flow, but during wet season has drainage water along the road. Suspended solids (SS) are possible to occur during and after rain. It might be occurred in short time.	1 1	- Not significant. - Not significant.
Noise and Vibration	(1)~(2): insignificant so far. Road section is so steep that the noise will be occurred, because numerous houses and villages are located along the road.	1	- Not significant.
Land Subsidence	(1)~(2): Not existing so far.	1	- Not existing.
Topography and Geology	Topography: (1) 0 (Junction before Rhakhut to Rakhyut)~12km (Junction to Salalah): 0~0.5km: Paved road (under construction), gentle slope. 0.5~12km: Relatively gentle slope on the Middle Terrace, covered by trees. Northern side of the road is vertical cliff of limestone. Southern side of the road is steep slope and thick forest. (2) 12 (Junction to Salalah, paved road under construction)~19km (International Border Checkpoint): Relatively gentle slope on the Middle Terrace, covered by forest. Geology: Horizontal limestone and marl beds are widely distributed in the area. Limestone beds are formed mostly vertical cliffs and three flat terraces in the area. Three terraces consist of High, Middle and Low Terraces. Terrace deposits are partly covered on the terraces	2	- Moderate impact due to road construction in the thick vegetation area near coastal line. It is necessary to follow the existing road alignment for minimizing of cutting.

Soil	(1)~(2): Reddish to reddish brown soil is relatively developed in the area. Surface soil is mostly suffered by rain erosion, because forest pasturage (camels and cows) is widely done in the area.	2	<ul style="list-style-type: none"> - Moderate impact due to road construction in the thick vegetation area as well as relatively thick surface soil near coastal line. It is necessary to follow the existing road alignment for minimizing of cutting. - Not significant impact due to road construction.
Hydrology, groundwater	<p>(1)~(2): No current flow along the road section. Most of the rainwater might be infiltrated into limestone ground.</p> <p>(2): Wadi is no current flow, but current flow will be appeared during rain season. Box culverts are installed for crossing wadi at the junction.</p>	1	
Eco-system, Flora and Fauna	<p>(1)~(2): Flora: Thick vegetation forming the dominant woodland species consisting of various species with various species of wildlife. The vegetation mainly consists of <i>Acacia spp.</i>, <i>Anogeissus dhofarica</i> (<i>zerkan</i>), <i>Blepharispermum bitum</i> (<i>khfut</i>), <i>Boscia arabica</i> (<i>simer</i>), <i>Bostvella sacra</i> (<i>luban</i>), <i>Craton confertus</i> (<i>hor</i>), <i>Maytenus spp.</i>, etc. The chief species is <i>Anogeissus dhofarica</i>, which is associated with several other trees and large shrubs such as <i>Commiphora</i> and <i>Acacia species</i>, forms the woodland vegetation.</p> <p>Fauna: Wildlife in the area includes; The last population of the Arabian Leopard, Nubian ibex, Arabian Gazelle, Striped Hyenas, Wild Cats, Caracal, Wolves and Foxes. Smaller mammals including rodents and foxes (<i>Lupes lupes arabica</i>) are found in the area, along with a number of bird species. Numerous camels, cows and goats are fed in the area. However, several cows and goats are victims by traffic accidents. Numerous kinds of birds are found in the area.</p>	2	<ul style="list-style-type: none"> - Moderate impact to flora and fauna due to deforestation by road widening in the thick vegetation in the project area. Road alignment should be followed along existing road. - There are no protected areas along the proposed route. - Domestic animals are grazed and suffered traffic accidents.
Landscape	(1)~(2): High limestone cliffs and thick forest.	1~2	<ul style="list-style-type: none"> - Much forest will be disappeared due to the road construction; therefore it is necessary to conduct minimized area of deforestation.

Hazards	- Not existing so far. - Construction of road and electricity line as the regional development, including tourism development.	1	- Not significant impact due to road construction. - Unknown.
Other Impacts on Natural environment	- Not existing so far.	1	- Not existing.
Cultural Heritage	- Not existing so far.	1	- Road construction might be followed along existing road alignment (within the ROW). - The investigation of the cultural heritage is required in the site.
Wastes	- Not significant so far.	1	- Low traffic volume in future. Wastes along the road will be increased together with increasing traffic volume.
Regional Development on Social Environment	- Construction of road and electricity line as the regional development, including tourism development.	1	-Unknown.
Other Impacts on Social Environment	0km point: Junction before Rhakhut to Rakhyut. (1)~(2): Electric line. 19km point: Salfait village, School, public office, mosque, Military base, International Border C,P, etc.	1~2	- Increased chance of traffic accident as well as domestic animals due to increased traffic volume.

Evaluation	Topography and geology	2	Alteration of topography
	Soil	2	Alteration of topography
	Eco-system, Flora and Fauna	2	Deforestation by excavation and embankment
	Landscape	1~2	Deforestation and alteration of topography
	Other Impacts on Social Environment	1~2	Increased traffic accidents
	Other items	1	

ENVIRONMENTAL CHECKLIST (N22)

Road Section: From Al Muzyunah to Mitan, Existing road condition: Gravel road
Project No.: N22, Planning road: Paved 2-lane road, Distance: 97km

Environmental Items	Present Condition	Impact Rating 1 = Slight 2 = Moderate 3 = Significant	Major Anticipated Impact with Project Predicted traffic volume in 2030: 100 veh/day
Air Pollution	: Location of each road unit is explained at item of "Topography and Geology".	1	- Not significant.
Effluent	(1)~ (5): Not existing except dust. Dust is significant because of gravel road.	1	- Not significant.
Noise and Vibration	(1)~ (5): Not existing ~ very low.	1	- Not significant.
Land Subsidence	(1)~ (5): Not existing.	1	- Not existing.
Topography and Geology	<p>Topography:</p> <p>(1) 0 (Roundabout to Milton)~20km: Middle terrace land. Terraces are deeply incised and relatively small wadis (Wadi Shiha) are developed as a dendritic pattern.</p> <p>(2) 20~40km: Flat area (Middle to low terraces).</p> <p>(3) 40~60km: Flat land with small wadis.</p> <p>(4) 60~80km: Flat on the low terraced and wadis (Wadi Mitan).</p> <p>(5) 80~97km (Junction to Mitan village): Flat on the low terraced. Sand dune appears at end of the section.</p> <p>Geology: Wadis are diminished gradually from southern area to the northern area. Flat terraces are widely covered by Aeolian sand. Terraces consist of mainly white marl, limestone, and mostly flat structure.No sediments exist on the terraces. Quaternary deposits are generally thin sand dune is particularly covered small hills.</p> <p>(1)~(5): Height of embankment of the road is between 0.3 and 0.7m.</p>	1	- Not significant impact due to road construction.
Soil	(1)~ (5): soil is poorly developed, mostly suffered by wind erosion.	1	- Not significant impact due to road construction.

Hydrology, groundwater	(1)~ (5): No current flow along the wadis (Wadi Shihan and Wadi Mitan).	1	- Not significant impact due to road construction.
Eco-system, Flora and Fauna	Flora and Fauna: (1): rare to slight vegetation consisting small acacia and grasses. Several camels are eating grasses. (2) ~ (4): No to very low vegetation on the terraced and flat land, but vegetation in the wadi valley is found poor and slight vegetation consisting of grasses. Several camels are found in the wadi. (5): slight vegetation of grasses, several camels are eating them.	1	- Not significant impact due to road construction. - There are no protected areas along the proposed route.
Landshape	Almost flat and terraced land.	1	- Not significant impact due to road construction.
Hazards	(1)~ (5): No existence or rare. Sand storm likely affect to this area.	1	- Not significant impact due to road construction. However, sand storm will permanently affect to this area.
Regional Development on Natural Environment	- No other regional development related to the road construction.	1	- Unknown.
Other Impacts on Natural environment	- Not existing so far.	1	- Not existing.
Cultural Heritage	- Not existing so far.	1	- The investigation of the cultural heritage is required in the site.
Wastes	- Not existing so far.	1	- Not significant impact due to road construction.
Regional Development on Social Environment	- Not existing so far.	1	- Unknown
Other Impacts on Social Environment	(1)~ (4): No habitants except Al Muzyunah village. 0km point: Al Mazyunah village, school, etc., but no crossing inside of the village. Electric lines along the road High-voltage transmission line crossing the road 88km point: Mitan village, school, public office, etc., but no crossing inside of the village. (5): Milton village and military base.	1	- Very low traffic volume is predicted.

Evaluation	All items	1
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ENVIRONMENTAL CHECKLIST (N23)

Road Section: From Hajaif to Masahilah-Haluf, Existing road condition: Gravel road
Project No.: N23, Planning road: Paved 2-lane road, Distance: 25km

Environmental Items	Present Condition	Impact Rating 1 = Slight 2 = Moderate 3 = Significant	Major Anticipated Impact with Project Predicted traffic volume in 2030: 400 veh/day
Air Pollution	: Location of each road unit is explained at item of "Topography and Geology".		
Effluent	(1): Not significant.	1	- Not significant.
Noise and Vibration	(1): Not existing.	1	- Not significant.
Land Subsidence	(1): insignificant.	1	- Not significant.
Topography and Geology	(1): Not existing.	1	- Not existing.
	Topography: (1) 0 (Junction at Hajaif to Haruf) ~25km: Small hilly land and wadis (Wadi Vistah). Hills show mesa topography. Hills range in height from 3 to 25m. 25km point: Masahilah and Haluf villages are located wadi plain. Geology: Horizontal white marl and limestone beds are widely distributed in the area. Aeolian sand is partly covered in the area.		- Not significant impact due to road construction.
Soil	(1): Soil is poorly developed, mostly suffered by wind erosion.	1	- Not significant impact due to road construction.
Hydrology, groundwater	(1): No current flow in wadis (Wadi Vistah).	1	- Not significant impact due to road construction.
Eco-system, Flora and Fauna	(1): Mostly no to rare vegetation, but low vegetation consisting of small acacia trees and grasses exist in the wadis.	1	- Not significant impact due to road construction. - There are no protected areas along the proposed route. - Numerous domestic animals are grazed and suffered traffic accidents.
Landscape	(1): Almost low hilly land.	1	- Not significant impact due to road construction.
Hazards	(1): Sand storm and sand dune are suffered this area during hot season.	1	- Not significant impact due to road construction. However, sand storm will permanently affect to this area.
Regional Development on Natural Environment	- Not existing so far.	1	- Unknown.

Other Impacts on Natural environment	- Not existing so far.	1	- Not existing.
Cultural Heritage	- Not existing so far.	1	- The investigation of the cultural heritage is required in the site.
Wastes	- Not significant.	1	- Not significant impact due to road construction.
Regional Development on Social Environment	- Not existing so far.	1	- Unknown
Other Impacts on Social Environment	(1): Electric line. 10km point: Masahilah and Haluf villages are located wadi plain. School, mosques, and public office, military bases, water wells, etc.	1	- Very low traffic volume is predicted.

Evaluation	All items	1
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ENVIRONMENTAL CHECKLIST (N24)

Road Section: From Junction of Sayyaad to Medinat al Hag, Existing road condition: Gravel road
Project No.: N24, Planning road: Paved 2-lane road, Distance: 85km

Environmental Items	Present Condition : Location of each road unit is explained at item of "Topography and Geology".	Impact Rating 1 = Slight 2 = Moderate 3= Significant	Major Anticipated Impact with Project Predicted traffic volume in 2030: 600 veh/day
Air Pollution	(1)~ (5): Not significant, but dust is significant.	1	- Not significant.
Effluent	(1)~ (5): Not existing.	1	- Not significant.
Noise and Vibration	(1)~ (5): insignificant.	1	- Not significant.
Land Subsidence	(1)~ (5): Not existing.	1	- Not existing.
Topography and Geology	Topography: (1) 0 (Junction at Dhahadan south)~2km: Low hilly land. 2~8km: Flat. 8~9km: Wadi (Wadi Dhahabun). 8~20km: Flat with low hills (Middle Terrace) and small wadis. (2) 20~25km: Low hilly land and rugged road. 25~40km: Road runs Lowermost and Low Terrace and wadi along the wadi (Wadi Dhahabun), which is mostly 300~400m wide. In the wadi is gravel bumpy road. (3) 40~60km: Road runs in the wadi (Wadi Dhahabun), being 100~200m wide. In the wadi is bumpy road due to small and large gravels. (4) 60~80km: Road runs Lowermost and Low traces along the wadi (Wadi Dhahabun). (5) 80~82km: Flat on the Hilly land consisting of Middle Terrace. Geology: Horizontal marl and limestone beds are widely distributed in the area. Terrace deposits are not found in the area. And Quaternary wadi sediments, consisting of gravels, are covered along the wadis.	2	- Moderate impact due to road construction in the along the wadi. It is necessary to follow the existing road alignment for minimizing of cutting.
Soil	(1)~ (5): White soil is poorly developed, mostly suffered by wind erosion. Mostly eroded due to wind and wadi.	1~2	- Slight to moderate impact due to road construction in the wadi with sparse vegetation. It is necessary to follow the existing road alignment for minimizing of cutting.

Hydrology, groundwater	(1)~ (5): No current flow along the wadi (Wadi Dhahabun). But the wadi shows features of temporary water current (like flash flood?).	1	- Not significant impact due to road construction. - Flash flood may occur during rain season.
Eco-system, Flora and Fauna	(1)~ (5): Mostly no to rare vegetation consisting of grasses. But there is slight vegetation, consisting of small acacia and grasses, along the wadi.	2	- The road section is close to the Jabel Samhan Nature Reserve area. - Relatively much excavation and embankment will be required for road construction. - Numerous domestic animals are grazed and suffered traffic accidents.
Landscape	(1)~ (5): In the wadi.	1	- Not significant impact due to road construction.
Hazards	- Flash flood.	1	- Not significant impact due to road construction. However, sand storm will permanently affect to this area.
Regional Development on Natural Environment	- Oil development by PDO between Junction at Dhahadan south and Jazal.	1	- Unknown.
Other Impacts on Natural environment	- Not existing so far.	1	- Not existing.
Cultural Heritage	- Not existing so far.	1	- The investigation of the cultural heritage is required in the site.
Wastes	- Not significant.	1	- Not significant impact due to road construction.
Regional Development on Social Environment	(1) ~ (5): Oilfield, airstrip of PDO at Jazal. The road is PDO road connecting between Junction and Jazal.	1	- Unknown
Other Impacts on Social Environment	0km point: Junction on road between Thumrayt and Marul. 6.5km point: Airstrip of PDO. 20km point: Barbazum village. Public office, school, etc. In the wadi (Wadi Dhahabun): Four places of temporary huts exist in the wadi. 79km point: Military Checkpoint (Jibjat). 81km point: Village with school and public offices, electric power station, and military base. 85km point: Junction to Medinat al Haq, paved road. From junction to Medinat al Haq: Paved 2-lane road.	1~2	- Low traffic volume is predicted. - Increased chance of traffic accident as well as domestic animals due to increased traffic volume.

Evaluation	Topography and Geology			Alteration of topography
	Soil		2	Alteration of topography
	Eco-system, Flora and Fauna		1~2	Passing beside the Jabel Samhan Nature Reserve
	Other Impacts on Social Environment		2	Increased traffic accidents
	Other items		1~2	
			1	

ENVIRONMENTAL CHECKLIST (N25)

Road Section: From Junction (No.31) to Ar Rakah, Existing road condition: Gravel road
 Project No.: N25, Planning road: Paved 2-lane road, Distance: 18km

Environmental Items	Present Condition	Impact Rating 1 = Slight 2 = Moderate 3= Significant	Major Anticipated Impact with Project Predicted traffic volume in 2030: 100 veh/day
Air Pollution	: Location of each road unit is explained at item of "Topography and Geology".		
Effluent	(1)~(2): Not significant.	1	- Not significant.
Noise and Vibration	(1)~(2): Not existing.	1	- Not significant.
Land Subsidence	(1)~(2): insignificant.	1	- Not significant.
Topography and Geology	(1)~(2): Not existing.	1	- Not existing.
	<p>Topography:</p> <p>(1) 0 (Junction to Ar Rakah)~10km: Flat and wide wadi (Wadi Dawkah). Aeolian sand and small sand dunes covers surface.</p> <p>(2) 10~18km (Junction at Ar Rakah): Flat with aeolian sand covers. Junction is to the direction to Shisur, but road is stopped soon (approximately 2km long).</p> <p>After Junction: 18~61km: Flat and wide wadi (Wadi al Hawf). The area is covered by aeolian sand.</p> <p>Geology:</p> <p>Horizontal white marl and limestone beds are widely distributed in the area. Aeolian sand is widely covered the area.</p> <p>(1)~(4): Height of embankment of the road is 0.0~0.7m.</p>		- Not significant impact due to road construction.
Soil	(1)~(2): Soil is poorly developed, mostly suffered by wind erosion.	1	- Not significant impact due to road construction.
Hydrology, groundwater	(1)~(2): No current flow. The large scaled irrigation system for farms at Dawkah and Shisur.	1	- Not significant impact due to road construction.
Eco-system, Flora and Fauna	(1)~(2): Mostly no to rare vegetation consisting of grasses.	1	- Not significant impact due to road construction. - There are no protected areas along the proposed route. - Numerous domestic animals are grazed and suffered traffic accidents.

Landscape Hazards	(1)~ (2): Almost flat. (1)~ (2): Sand storm and sand dune are suffered this area during hot season.	1 1	- Not significant impact due to road construction. - Not significant impact due to road construction.
Regional Development on Natural Environment	0km: Start point. Royal garden. Large scaled farms are developed in the Ar Rakah. Road construction will be contributed to the agricultural development in the area.	1	- Unknown.
Other Impacts on Natural environment	- Not existing so far.	1	- Not existing.
Cultural Heritage	- Not existing so far.	1	- The investigation of the cultural heritage is required in the site.
Wastes	- Not significant.	1	- Not significant impact due to road construction.
Regional Development on Social Environment	18km point: Large scaled farm with irrigation system.	1	- Unknown.
Other Impacts on Social Environment	0km point: Filling station, Ministry office of MRMEWR. 0~18km: Electric line. 18km point: Large scaled farm with irrigation system. Dawkah and Shisur villages.	1	- Low population.

Evaluation	All items	1
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ENVIRONMENTAL CHECKLIST (N26)

Road Section: From Thumrayt to Marmul, Existing road condition: Gravel road
Project No.: N26, Planning road: Paved 2-lane road, Distance: 142km

Environmental Items	Present Condition : Location of each road unit is explained at item of "Topography and Geology".	Impact Rating 1 = Slight 2 = Moderate 3= Significant	Major Anticipated Impact with Project Predicted traffic volume in 2030: 700 veh/day
Air Pollution	(1)~ (8): Not significant, but dust is significant.	1	- Not significant.
Effluent	(1)~ (8): Not existing.	1	- Not significant.
Noise and Vibration	(1)~ (8): insignificant.	1	- Not significant.
Land Subsidence	(1)~ (8): Not existing.	1	- Not existing.
Topography and Geology	<p>Topography:</p> <p>(1) 0 (Junction to Marmul)~6km: Flat. 6~ 10km: Flat with low hills (Middle Terrace) and small wadis (Wadi Thumrayt and Wadi Ribkut). 10~ 20km: Flat.</p> <p>(2) 20~ 30km: Flat. 30~ 40km: Flat with small wadis (Wadi Dhahabun and Wadi al Haradhyt).</p> <p>(3) 40~ 60km: Flat with small hills (Middle Terrace). 48km point: Wadi (100mwide: tributary of Wadi al Haradhyt).</p> <p>(4) 60~ 80km: Flat. 69km point: Wadi (200m wide: Wadi Adhur).</p> <p>(5) 80~ 100km: Low hilly land. 85km point: Wadi (2~3km wide). Hills show mostly mesa topographic feature.</p> <p>(6) 100~ 120km: Low hilly land. Aeolian sand slightly becomes thick and some hills are covered by aeolian sand. 108km point: Wadi Arah</p> <p>(7) 120~ 140km: Flat and wide wadis (Wadi Qaharir al Gharbi).</p> <p>(8) 140~ 142km (Roundabout to Birba and Amal): Flat and wide wadis (Wadi Qaharir al Gharbi).</p> <p>Geology: Horizontal marl and limestone beds are widely distributed in the area. Kaolin is found in the hills. Terrace deposits are not found in the area. And</p>	1	- Not significant impact due to road construction.

	Quaternary wadi sediments are partly covered along the wadis. Aeolian sand is widely covered the area, but mostly thin. Several small borrow pits are remained along the road. (1)~ (8): Height of embankment of the road is 0.3~1.5m.			
Soil	(1)~ (8): White soil is poorly developed, mostly suffered by wind erosion. Alluvial soil is found along the wadis.	1		- Not significant impact due to road construction. - Surface soil is mostly eroded due to wind and wadi.
Hydrology, groundwater	(1)~ (8): No current flow along the wadis (Wadi Thumrayt, Wadi Ribkut, Wadi Arah and Wadi Qaharir al Gharbi). But many small wadis or hollow-grounds exist along the road.	1		- Not significant impact due to road construction. - Several drainage tubes are installed at the small wadis.
Eco-system, Flora and Fauna	(1)~ (8): Mostly no to rare vegetation consisting of grasses (mostly halophytic and mesophyll plant). But there is slight vegetation, consisting of small acacia and grasses, along small wadis and hollow-ground.	1		- Not significant impact due to road construction. - There are no protected areas along the proposed route. - A number of domestic animals are grazed and suffered traffic accidents.
Landscape	(1)~ (8): Almost flat.	1		- Not significant impact due to road construction.
Hazards	- Not significant.	1		- Not significant impact due to road construction.
Regional Development on Natural Environment	- Oil development by PDO in the area.	1		- Unknown.
Other Impacts on Natural environment	- Not existing so far.	1		- Not existing.
Cultural Heritage	- Not existing so far.	1		- There is fort and towers in the area. The investigation of the cultural heritage is required in the site.
Wastes	- Not significant. - Fragments of broken tire are scattered along the road.	1		- Not significant impact due to road construction.
Regional Development on Social Environment	(3) ~ (8): Oilfield, PDO facilities at Dhahaban, Harab and Marmul. The road is PDO road connecting between Hyma and Murmul. The road passes bus line.	1		- Unknown

<p>Other Impacts on Social Environment</p>	<p>(1)~(8): Gas and partly oil pipelines. 6km point: Crusher plant. 25km point: Junction to Rubkut. 30km point: Junction to Angudan village. 43km point: Small settlement (5 temporary houses). 45km point: Junction to Sayyaad village and Medinat al Haqh. 59km point: Fatheit settlement (7 houses), bus stop. 69km point: Microwave tower. 76km point: Junction to Harweel (Oilfield). 83km point: Junction to Rabab (Oilfield). 85~95km: Newly road construction by PDO (?). 108km point: Junction to Wadi Arah, bus stop. 111km point, (6)~(7): Microwave tower. Electric line. 117km point: Rafut Farm (Large scaled farming). 125km point: Kobout settlement (20 houses), Zumrrud oilfield. 128km point: Junction to Amjad oilfield. 134km point: Airstrip (Amjad) of PDO. 140km point: Marmul villag, oilfield and Oil Gathering Station.</p>	<p>1</p>	<p>- Low traffic volume is predicted.</p>
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<p>Evaluation</p>	<p>1</p>
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ENVIRONMENTAL CHECKLIST (N27)

Road Section: From Rustaq Road Stage (4) to Haat, Existing road condition: Gravel road
Project No.: N27, Planning road: Paved 2-lane road, Distance: 57km

Environmental Items	Present Condition	Impact Rating 1 = Slight 2 = Moderate 3= Significant	Major Anticipated Impact with Project Predicted traffic volume in 2030: 10,000 veh/day
Air Pollution	: Location of each road unit is explained at item of "Topography and Geology".	1~2	
Effluent	- Not significant so far.	1	- Increased traffic volume.
Noise and Vibration	- Not significant so far.	1~2	- Not significant.
Land Subsidence	- Not significant so far.	1	- Increased traffic volume.
Topography and Geology	- Not existing.	1	- Not existing.
	Topography: (1)~ (2): The proposed road area is typical rugged mountainous terrain of the central part of the Oman Mountains (Jabal Al Hajar). The mountains in this area are the highest in Oman and rise to an approximate height of 2,000 m. Sections of the road will also pass between the mountains on flatter terrain, lower lying hills and wadi channels. Geology: The Hajar mountains are comprised of autochthonous units of the metamorphic Paleozoic to Mesozoic rocks and allochthonous units of the Hawasimah groups and igneous rocks (Oman Ophiolite). During the Tertiary period and following uplift, erosion carved out rugged mountains, incised by sharply convoluted wadis.	1~2	- Slight to moderate impact due to road construction in the central part of Al Hajar Mountains with relatively thick wadi vegetation. It is necessary to follow the existing road alignment for minimizing of cutting.
Soil	(1) ~ (2): Soil is poorly developed, mostly suffered by wind erosion. Alluvial soil is found in the wadi, but mostly thin.	1~2	- Slight to moderate impact due to road construction with surface soil and relatively thick wadi vegetation. It is necessary to follow the existing road alignment for minimizing of cutting.
Hydrology, groundwater	(1) ~ (2): These events can produce rapid runoff and major wadi flows. Many sections of the proposed road will pass within major wadi flow channels and areas, which are likely to experience flooding.	1	- Not significant impact due to road construction. - There are several evidences of flooding in the area. Drainage systems will be required for road construction.

<p>Eco-system, Flora and Fauna</p>	<p>Flora: Vegetation is found along the entire stretch of the project area. The lower lying hills have less vegetative cover than the higher areas, except for depressions and wadi flow channels. The vegetation can be classified as an open xenomorphic <i>Euphorbia</i> community type. Much of this area represents a good example of undisturbed habitat in northern Oman.</p> <p>Fauna: Wildlife known to the area includes the Arabian Leopard, Gazelle, Arabian tahr and other fauna such as the red fox, etc. The IUCN red list of threatened animals (IUCN 1990) describes the mountain gazelle as vulnerable. Leopard and the tahr are considered endangered. Whilst the area does not have official reserve status, permits are required to enter some areas. Any development in the area will be considered as having a significant impact as a result of the valuable nature of the habitat.</p>	<p>2</p>	<ul style="list-style-type: none"> - Moderate impact to flora and fauna due to deforestation and paved road in the marked wadi vegetation and eco-system in the project area. Road alignment should be followed along existing road. - Domestic animals are grazed and suffered traffic accidents.
<p>Landscape</p>	<p>(1) ~ (2): Mountainous area of the Central part of the Oman Mountains.</p>	<p>1</p>	<ul style="list-style-type: none"> - Much forest will be disappeared due to the road construction; therefore it is necessary to conduct minimized area of deforestation.
<p>Hazards</p>	<p>(1) ~ (2): Flash flood, slope failures, etc.</p>	<p>1</p>	<ul style="list-style-type: none"> - Not significant impact due to road construction.
<p>Regional Development on Natural Environment</p>	<p>- Not existing so far.</p>	<p>1</p>	<ul style="list-style-type: none"> - Unknown.
<p>Other Impacts on Natural environment</p>	<p>- Not existing so far.</p>	<p>1</p>	<ul style="list-style-type: none"> - Not existing.
<p>Cultural Heritage</p>	<p>(1) ~ (2): Not existing so far.</p>	<p>1</p>	<ul style="list-style-type: none"> - Road construction might be followed along existing road alignment (within the ROW). - The investigation of the cultural heritage is required in the site.
<p>Wastes</p>	<p>- Not significant.</p>	<p>1</p>	<ul style="list-style-type: none"> - Low traffic volume in future. Wastes along the road will be increased together with increasing traffic volume.
<p>Regional Development on Social Environment</p>	<p>- Not existing so far.</p>	<p>1</p>	<ul style="list-style-type: none"> -Unknown.

<p>Other Impacts on Social Environment</p>	<p>(1) ~ (2): Some sections of the road pass through and nearby towns and areas of farmland, which may be impacted by the proposed development. The first 15 kilometers of track from Rustaq, south through the mountains towards Al Hamra will be the most affected. There are narrow wadis along the route, which will require cut, and narrow access roads in the smaller settlements, which will need to be passed. In most instances sensible alignment should be able to avoid more significant impacts, but narrow wadis in particular will be affected. 0 km point: Junction at Ar Rustaq to Hatt. 0~7.9 km: Paved 2-lane road. 7.9~57 km: gravel road. 12 km point: Settlement. 13.2 km point: Settlement, necessary to consider road alignment. 30 km point: Village. 57 km point: Hatt.</p>	<p>1~2</p>	<p>- Increased chance of traffic accident as well as domestic animals due to increased traffic volume.</p>
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<p>Evaluation</p>	<p>- Air Pollution - Noise - Topography and Geology - Soil - Eco-system, Flora and Fauna - Other Impacts on Social Environment - Other items</p>	<p>1~2 1~2 1~2 1~2 2 1~2 1</p>	<p>Increased traffic volume Increased traffic volume Alteration of topography Alteration of topography High potential of existing various species of fauna, Visitors and wastes due to rapidly increase of traffic volume Increase of chance of traffic accidents due to increase of traffic volume</p>
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ENVIRONMENTAL CHECKLIST (N28)

Road Section: From Yanqul to Dank, Existing road condition: Gravel road
Project No.: N28, Planning road: Paved 2-lane road, Distance: 41km

Environmental Items	Present Condition : Location of each road unit is explained at item of "Topography and Geology".	Impact Rating 1 = Slight 2 = Moderate 3= Significant	Major Anticipated Impact with Project Predicted traffic volume in 2030: 300 veh/day
Air Pollution	- Not significant so far.	1	- Not significant.
Effluent	- Not significant so far.	1	- Not significant.
Noise and Vibration	- Not significant so far.	1	- Not significant.
Land Subsidence	- Not existing.	1	- Not existing.
Topography and Geology	<p>Topography: (1) 0 (Dank)-30 km: The project road runs in narrow and deeply incised valley along Wadi Dank. Both side of the wadi forms mostly vertical cliff of limestone, shows mesa and tabletop type topography. The road is mostly flat and crosses permanent current flow with thick vegetation from Dank to 5 km point. Between 5 and 30 km point is flat graded gravel road along Wadi Dank. (2) 30-41 km (Junction of N/R No.8 to Yanqul): After cliff of tabletop type limestone, the road runs in the wide alluvial plain of Wadi Maizi and Wadi Feda. Geology: The road area consists of Late-Cretaceous to Eocene Shelf limestone, forming tabletop type topography, overlies the allocthonous Hawasinah Unit. The rocks are mostly flat and gentle slope. The wadi is occupied by the coarse to fine grained gravels, sand and clay.</p>	1~2	<p>- Slight to moderate impact due to road construction in the central part of Al Hajar Mountains with relatively thick wadi vegetation. It is necessary to follow the existing road alignment for minimizing of cutting.</p>
Soil	- Soil is poorly developed, mostly suffered by rain and wind erosion. Alluvial soil is found in the wadi, but mostly thin.	1~2	<p>- Slight to moderate impact due to road construction with surface soil and relatively thick wadi vegetation. - It is necessary to follow the existing road alignment for minimizing of cutting.</p>

Hydrology, groundwater	- The current graded road passes near mountains and wadi channels where permanent water flow is found near Dank, and other places of the wadi are expected to occur during rainy periods and flash flood events. No continuous wadi flow was noted in the project area.	1	- Not significant impact due to road construction. - There are several evidences of flooding in the area. Drainage systems will be required for road construction.
Eco-system, Flora and Fauna	Flora: Sparse vegetation is found along the entire stretch of the project area dominated by Acacia scrub (<i>Acacia tortilis</i>). Fauna: The Arabian red fox (<i>Vulpes vulpes arabica</i>), small rodents and a limited number of bird species are found in the area..	2	- Moderate impact to flora and fauna due to deforestation of thick wadi vegetation by road construction. Road alignment should be followed along existing road. - Domestic animals are grazed and suffered traffic accidents.
Landscape	- Tabletop type limestone topography and vegetation in the wadi.	1	- Not significant impact due to road construction.
Hazards	- Flash flood.	1	- Not significant impact due to road construction.
Regional Development on Natural Environment	- Not existing so far.	1	- Unknown.
Other Impacts on Natural environment	- Not existing so far.	1	- Not existing.
Cultural Heritage	- Old tower and houses on the terraces.	1~2	- Road construction might be followed along existing road alignment. - The investigation of the cultural heritage is required in the site.
Wastes	- Not significant.	1	- Low traffic volume in future. Wastes along the road will be increased together with increasing traffic volume. -Unknown.
Regional Development on Social Environment	- Water supply system, supplying from southwest of Ibri, was completed to install.	1	- Increased chance of traffic accident as well as domestic animals due to increased traffic volume.
Other Impacts on Social Environment	- Few sections of the road pass through, or nearby, towns that would be impacted as a result of the proposed road development. Impacts are therefore considered to be negligible. - Village and town along the route: 0 km point: Dank. 13 km point: Alayat Dank village.	1	- Increased chance of traffic accident as well as domestic animals due to increased traffic volume.

	<p>34 km point: Junction to Yanqul through Wadi Feda. 34~36 km point: numerous huts, schools, mosques, etc. 36 km point: Village, schools, mosques, public office, etc. 41 km point: Junction to Yanqul (10 km).</p>		
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Evaluation	Topography and geology	1~2	Alteration of topography
	Soil	1~2	Alteration of topography
	Eco-system, Flora and Fauna	2	Deforestation by excavation and embankment
	Cultural Heritage	1~2	Influence to cultural heritage
	Other items	1	

ENVIRONMENTAL CHECKLIST (N29)

Road Section: From Yanqul to Murray A'Dhahira, Existing road condition: Gravel road
 Project No.: N29, Planning road: Paved 2-lane road, Distance: 26km

Environmental Items	Present Condition	Impact Rating 1 = Slight 2 = Moderate 3 = Significant	Major Anticipated Impact with Project Predicted traffic volume in 2030: 1,600 veh/day
Air Pollution	- Not significant so far.	1	- Not significant.
Effluent	- Not significant so far.	1	- Not significant.
Noise and Vibration	- Not significant so far.	1	- Not significant.
Land Subsidence	- Not existing.	1	- Not existing.
Topography and Geology	Topography: (1): The road area runs mostly hilly land and alluvial plains along the upper stream of Wadi Feda. Geology: The road area consists of Late-Cretaceous to Eocene Shelf limestone, forming tabletop type topography, and the allochthonous Hawasinah and Samail Ophiolite Units. The wadi is occupied by the coarse to fine grained gravels, sand and clay.	1~2	- Slight to moderate impact due to road construction in the central part of Al Hajar Mountains with relatively thick wadi vegetation. It is necessary to follow the existing road alignment for minimizing of cutting.
Soil	(1): Soil is poorly developed, mostly suffered by wind erosion. Alluvial soil is found in the wadi, but mostly thin.	1~2	- Slight to moderate impact to surface soil due to road construction. - It is necessary to follow the existing road alignment for minimizing of cutting.
Hydrology, groundwater	(1): The current graded track passes near mountains and wadi channels where water flow is expected to occur during rainy periods and storm events. No continuous wadi flow was noted in the project.	1	- Not significant impact due to road construction.
Eco-system, Flora and Fauna	Flora: Sparse vegetation is found along the entire stretch of the project area. Vegetation consists predominantly of Acacia scrub (<i>Acacia tortilis</i>). Fauna: Wildlife is limited in the project area. Birds and small rodents are evident along with at least one	1~2	- Slight to moderate impact to flora and fauna due to deforestation of thick wadi vegetation by road construction. Road alignment should be followed along existing road. - Domestic animals are grazed and suffered traffic accidents.

	species of desert hedgehog, and the Arabian red fox (<i>Vulpes vulpes arabs</i>).		
Landscape	- Hilly land and wadi.	1	- Not significant impact due to road construction.
Hazards	- Flash flood.	1	- Not significant impact due to road construction.
Regional Development on Natural Environment	(1): Not existing so far.	1	- Unknown.
Other Impacts on Natural environment	(1): Not existing so far.	1	- Not existing.
Cultural Heritage	(1): Not existing so far.	1	- Road construction might be followed along existing road alignment. - The investigation of the cultural heritage is required in the site.
Wastes	- Not significant.	1	- Low traffic volume in future. Wastes along the road will be increased together with increasing traffic volume.
Regional Development on Social Environment	(1): Not existing so far.	1	- Unknown.
Other Impacts on Social Environment	(1): Only occasional small settlements are located within the project area. Village and towns along the route: 0 km point: Junction of N/R No.8 to Sohar, at Yanqul. 3 km point: Mushir village. 15 km point: Muzaynah village. 26 km point: Murray village.	1	- Increased chance of traffic accident as well as domestic animals due to increased traffic volume.

Evaluation	Topography and geology	1~2	Alteration of topography
	Soil	1~2	Alteration of topography
	Eco-system, Flora and Fauna	1~2	Deforestation by excavation and embankment
	Other items	1	

ENVIRONMENTAL CHECKLIST (N30)

Road Section: From Madha to Dafta, Existing road condition: Gravel road
Project No.: N30, Planning road: Paved 2-lane road, Distance: 15km

Environmental Items	Present Condition	Impact Rating 1 = Slight 2 = Moderate 3= Significant	Major Anticipated Impact with Project Predicted traffic volume in 2030: 1,700 veh/day
Air Pollution	: Location of each road unit is explained at item of "Topography and Geology".		
Effluent	- Not significant so far.	1	- Not significant.
Noise and Vibration	- Not significant so far.	1	- Not significant.
Land Subsidence	- Not significant so far.	1	- Not significant.
Topography and Geology	- Not existing.	1	- Not existing.
	Topography: (1): Topography in the project area is mountainous terrain with wadis.	1~2	- Slight to moderate impact due to alteration of topography by excavation and embankment. - It is necessary to follow the existing road alignment for minimizing of cutting.
	Geology: The project area mainly consists of ultrabasic and basic plutonic rocks belonging the Ophiolite sequence as an allochthonous unit.		
Soil	(1): Soil is poorly developed, mostly suffered by wind erosion. Alluvial soil is found in the wadi, but mostly thin.	1~2	- Slight to moderate impact to surface soil due to road construction. - It is necessary to follow the existing road alignment for minimizing of cutting.
Hydrology, groundwater	(1): Due to the mountainous topography there are a number of wadi channels and older wadi courses within the project area. Flow would be expected to occur during rain and flood events from the mountains.	1	- Not significant impact due to road construction. - Flash flood.
Eco-system, Flora and Fauna	Flora: Sparse vegetation is found along the entire stretch of the project area, but numerous scattered trees, including acacia, willow, cypress, are found in the wadis. The current graded roads in the western part of the route have already impacted the vegetation along the proposed alignment and therefore further impacts to the vegetation are generally considered	1~2	- Slight to moderate impact to flora and fauna due to destruction of sparse wadi vegetation by road construction. Road alignment should be followed along existing road. - Domestic animals are grazed and will be suffered traffic accidents.

	to be insignificant so long as the current alignment is followed as far as possible. However, plants in the eastern part of the route are not harmed yet. Fauna: There are not known specific wildlife travel corridors crossing project area. Although endangered or threatened species have not been identified in the area, Hedgehog, Red Fox, Wild Cat, Arabian Gazelle, etc. are likely to male habitats in the area. Numerous domestic animals are present.		
Landscape	(1): Mountainous topography.	1	- Not significant impact due to road construction.
Hazards	(1): Flash flood.	1	- Not significant impact due to road construction.
Regional Development on Natural Environment	- Not existing so far.	1	- Unknown.
Other Impacts on Natural environment	- Not existing so far.	1	- Not existing.
Cultural Heritage	(1): Not existing so far.	1	- Road construction might be followed along existing road alignment. - The investigation of the cultural heritage is required in the site.
Wastes	- Not significant.	1	- Low traffic volume in future. Wastes along the road will be increased together with increasing traffic volume.
Regional Development on Social Environment	- Not existing so far.	1	- Unknown.
Other Impacts on Social Environment	(1): Settlements and farmland are present within the project area.	1	- Increased chance of traffic accident as well as domestic animals due to increased traffic volume.
Evaluation	Topography and Geology	1~2	Alteration of topography
	Soil	1~2	Alteration of topography
	Eco-system, Flora and Fauna	1~2	Deforestation by excavation and embankment
	Other items	1	

ENVIRONMENTAL CHECKLIST (N31)

Road Section: From Amal to Mugshin, Existing road condition: Gravel road
Project No.: N31, Panning road: Paved 2-lane road, Distance: 211km

Environmental Items	Present Condition : Location of each road unit is explained at item of "Topography and Geology".	Impact Rating 1 = Slight 2 = Moderate 3= Significant	Major Anticipated Impact with Project Predicted traffic volume in 2030: 50 veh/day
Air Pollution	(1)~ (8): Not significant, but dust is significant.	1	- Not significant.
Effluent	(1)~ (8): Not existing.	1	- Not significant.
Noise and Vibration	(1)~ (8): No existence.	1	- Not significant.
Land Subsidence	(1)~ (8): Not existing.	1	- Not existing.
Topography and Geology	Topography: (1) 0 (Roundabout to Ghuwaisham and Marmul)~20km: Flat. (2) 20~40km: Flat. (3) 40~60km: Flat with small hills and hollow-ground (wadis). (4) 60~80km: Flat with small hills. (5) 80~100km: Flat. (6) 100~120km: Flat. (7) 120~130km (Airstrip): Flat (low terrace) with wadis. (8) 130~211km (Junction to Ghuwaisham): Flat on the low terrace and wadis. Geology: Horizontal marl and limestone beds are widely distributed in the area, belonging to the Low Terrace. Quaternary wadi sediments are widely covered along the broad wadis. And aeolian sand is widely covered the area, but mostly thin. (1)~(12): Height of embankment of the road is 0.1~0.5m and only cut surface.	1	- Not significant impact due to road construction.
Soil	(1)~ (8): White alluvial soil is poorly developed, mostly suffered by wind erosion.	1	- Not significant impact due to road construction.
Hydrology, groundwater	(1)~ (8): No current flow along the wadis.	1	- Not significant impact due to road construction.

Eco-system, Flora and Fauna	(1)~ (8): Mostly no to rare vegetation consisting of grasses (mostly halophytic and mesophyll plant). But there is slight vegetation, consisting of small acacia and grasses, along small wadis. (1)~ (8): Almost flat. - Not significant. - Oil development by PDO in the area.	1	- Not significant impact due to road construction. - Domestic animals are grazed and suffered traffic accidents.
Landscape	(1)~ (8): Almost flat.	1	- Not significant impact due to road construction.
Hazards	- Not significant.	1	- Not significant impact due to road construction.
Regional Development on Natural Environment	- Oil development by PDO in the area.	1	- Unknown.
Other Impacts on Natural environment	- Not existing so far.	1	- Not existing.
Cultural Heritage	- Not existing so far.	1	- Road costrection might be followed along existing road alignment. - The investigation of the cultural heritage is required in the site.
Wastes	- Not significant.	1	- Not significant impact due to road construction.
Regional Development on Social Environment	- Oil development by PDO in the area.	1	-Unknown.
Other Impacts on Social Environment	110km point: Airstrip (Ghuwaisham) for PDO. And there are some oil wells, but not product. 205km point: Dish antenna for military.	1	- Low population.

Evaluation	All items	1
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ENVIRONMENTAL CHECKLIST (N32)

Road Section: From Amal to Dawkah, Existing road condition: Gravel road
Project No.: N32, Planning road: Paved 2-lane road, Distance: 162km

Environmental Items	Present Condition : Location of each road unit is explained at item of "Topography and Geology".	Impact Rating 1 = Slight 2 = Moderate 3= Significant	Major Anticipated Impact with Project Predicted traffic volume in 2030: 50 veh/day
Air Pollution	(1)~(2): Not significant, but dust is significant.	1	- Not significant.
Effluent	(1)~(2): Not existing.	1	- Not significant.
Noise and Vibration	(1)~(2): No existence.	1	- Not significant.
Land Subsidence	(1)~(2): Not existing.	1	- Not existing.
Topography and Geology	Topography: (1) 0 (Roundabout to Birba and Amal)~20km: Flat. (2) 20~ 162km (Junction to Salah and Muscat): Flat with small wadi. Geology: Horizontal marl and limestone beds are widely distributed in the area, belonging to the Low Terrace. Quaternary wadi sediments are widely covered along the broad wadis. And aeolian sand is widely covered the area, but mostly thin.	1	- Not significant impact due to road construction.
Soil	(1)~(2): White alluvial soil is poorly developed, mostly suffered by wind erosion.	1	- Not significant impact due to road construction.
Hydrology, groundwater	(1)~(2): No current flow along the wadis.	1	- Not significant impact due to road construction.
Eco-system, Flora and Fauna	(1)~(2): Mostly no to rare vegetation consisting of grasses (mostly halophytic and mesophyll plant). But there is slight vegetation, consisting of small acacia and grasses, along small wadis.	1	- Not significant impact due to road construction. - Domestic animals are grazed and suffered traffic accidents.
Landscape	(1)~(2): Almost flat.	1	- Not significant impact due to road construction.
Hazards	- Not significant.	1	- Not significant impact due to road construction.
Regional Development on Natural Environment	- Oil development by PDO in the area.	1	- Unknown.
Other Impacts on Natural environment	- Not existing so far.	1	- Not existing.
Cultural Heritage	- Not existing so far.	1	- Road construction might be followed along existing road alignment.

				- The investigation of the cultural heritage is required in the site.
Wastes			1	
Regional Development on Social Environment	- Not existing so far.			- Not significant impact due to road construction.
Other Impacts on Social Environment	- Not existing so far.		1	-Unknown.
	110km point: Airstrip (AIAfeef) for PDO and oilfield. 162km point: Dawkah village.		1	- Low population.
Evaluation	All items		1	

ENVIRONMENTAL CHECKLIST (N33)

Road Section: From Tiwi to Ismayyah, Existing road condition: Gravel road
Project No.: N33, Planning road: Paved 2-lane road, Distance: 50km

Environmental Items	Present Condition	Impact Rating 1 = Slight 2 = Moderate 3 = Significant	Major Anticipated Impact with Project Predicted traffic volume in 2030: 1,000 veh/day
Air Pollution	: Location of each road unit is explained at item of "Topography and Geology".	1	- Not significant.
Effluent	- Not significant so far.	1	- Not significant.
Noise and Vibration	- Not significant so far.	1	- Not significant.
Land Subsidence	- Not existing.	1	- Not existing.
Topography and Geology	Topography: (1) 0 (Tiwi)~20 km (Qaran near Jaylah village): The road alignment of proposed road is not fixed, but the road might be aligned on the watershed along Wadi Tiwi. Wadi Yiwi is famous tourism location for permanent water flow. The topography of the project area ranges from thick vegetated along the wadi and coastal plain to high tabletop type mountains, which separate the project area from the Quriyat- Sur coastal plain. (2) 20~50 km (Ismayyah): The existing road (proposed road) passes on hilly land, shown likely tabletop type topography due to shelf limestone. The road between 30 and 50 km is rugged slope from hilltop to the wadi plain of Wadi Khabbah. Geology: The project area consists of Paleogene limestone and alluvial wadi sediments of gravel and sand.	1~2	- Slight to moderate impact due to road construction in the central part of Al Hajar Ash Sharqi Mountains with relatively sparse wadi vegetation except near Tiwi. It is necessary to follow the existing road alignment for minimizing of cutting.
Soil	(1): Soil is poorly developed, mostly suffered by wind erosion. Alluvial soil is found in the wadi, but mostly thin. The project area consists of Paleogene limestone and alluvial wadi sediments of gravel and sand.	1~2	- Slight to moderate impact to surface soil due to road construction. - It is necessary to follow the existing road alignment for minimizing of cutting.
Hydrology, groundwater	(1): These events can produce rapid runoff and major wadi flows. A number of sections of the current graded road are traversed by wadi channels. The high	1	- Not significant impact due to road construction.

	<p>mountains to the east of the project area experience large amounts of run-off during rain and storm events.</p> <p>Flora: Sparse vegetation is found almost throughout the project area. Denser vegetation is present only in the wadis and depressions in the plain areas as well as the wadi channels in the mountains. The vegetation can be classified as an open xenomorphic <i>Euphorbia</i> community type.</p> <p>Fauna: Wildlife known to the project area includes gazelle and other fauna such as the red fox and small rodents. The IUCN red list of threatened animals (IUCN 1990) describes the mountain gazelle as vulnerable.</p>	1~2	<ul style="list-style-type: none"> - Slight to moderate impact to wadi vegetation due to road construction along the wadi in the project area. - Road alignment should be followed along existing road. - Domestic animals are grazed and suffered traffic accidents.
Landscape	(1): Mountainous area.	1~2	<ul style="list-style-type: none"> - Tiwi is famous sightseeing spot of wadi and wadi forest. Therefore, it is necessary to conduct minimized area of cutting work along the route.
Hazards	(1): Flash flood, and slope failure.	1	<ul style="list-style-type: none"> - Not significant impact due to road construction.
Regional Development on Natural Environment	- Not existing so far.	1	<ul style="list-style-type: none"> - Unknown.
Other Impacts on Natural environment	(1): Not existing so far.	1	<ul style="list-style-type: none"> - Not existing.
Cultural Heritage	(1): Old towers.	1~2	<ul style="list-style-type: none"> - Road construction might be followed along existing road alignment. - The investigation of the cultural heritage is required in the site.
Wastes	(1): Not significant.	1	<ul style="list-style-type: none"> - Low traffic volume in future. Wastes along the road will be increased together with increasing traffic volume.
Regional Development on Social Environment	- Not existing so far.	1	<ul style="list-style-type: none"> - Unknown.
Other Impacts on Social Environment	(1): Some sections of the road pass through or near to villages and farmland. Due to the fact that the alignment is not clearly defined and there is sufficient space available to re-align where necessary, it is unlikely that settlement areas will be impacted.	1	<ul style="list-style-type: none"> - Increased chance of traffic accident as well as domestic animals due to increased traffic volume.

	<p>Villages along the route: 0 km point: Tiwi village. 18 km point: Jaylah settlement. 50 km point: Ismaiya village.</p>		
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Evaluation			
Topography and geology		1~2	Alteration of topography
Soil		1~2	Alteration of topography
Eco-system, Flora and Fauna		2	Deforestation by excavation and embankment
Landscape		1~2	Deforestation and alteration of topography
Other Impacts on Social Environment		1	Increased traffic volume
Other items			

ENVIRONMENTAL CHECKLIST (N34)
Road Section: From Hasheer to Junction before Medinat al Haq, Road condition: Paved and gravel road
Project No.: N34, Planning road: Paved 2-lane road, Distance: 43km

Environmental Items	Present Condition	Impact Rating 1 = Slight 2 = Moderate 3= Significant	Major Anticipated Impact with Project Predicted traffic volume in 2030: 600 veh/day
Air Pollution Effluent	: Location of each road unit is explained at item of "Topography and Geology". (1)~ (3): Not significant. (1)~ (3): No current flow, but during wet season has drainage water along the road. SS is possible to occur during and after rain. It might occur in short time.	1 1	- Not significant. - Not significant.
Noise and Vibration	(1)~ (3): insignificant. Although Road unit during long slope to Salalah is relatively noisy, because large vehicles run very slowly, receptors along the road do not exist.	1	- Not significant.
Land Subsidence	(1)~ (3): Not existing	1	- Not existing.
Topography and Geology	Topography: (1) 0 (Junction before Medinat al Haq)~10km (Junction to N24 road): Gentle slope on the High Terrace. (2) 10~ 25km: 10~18km: Gentle slope on the High Terrace. 18~20km: Slope from High Terrace to Middle Terrace. 20~25km: Gentle slope on the Middle Terrace. (3) 25~ 43km (Junction to No.49): Road runs gentle slope on the Middle Terrace, crossing wadi, and slope to Low Terrace and alluvial plain. Geology: Tertiary horizontal marl and limestone beds are widely distributed in the area. And Terrace deposits are partly covered on the terraces and wadi sediments are distributed along the wadis.	1	- Not significant impact due to road construction. It is necessary to follow the existing road alignment for minimizing of cutting.
Soil	(1)~ (3): soil is developed as reddish-to-reddish brown soil in the marl and limestone region in the area. The weathered soil is mostly suffered by rain erosion, because forest pasturage is widely done in the area.	1~2	- Slight to moderate impact to surface soil due to road construction. - It is necessary to follow the existing road alignment for minimizing of cutting.

Hydrology, groundwater	(1)~ (3): No current flow along the wadis in the area. But during rain season has partly current flow in the wadis.	1	- Not significant impact due to road construction. (1)~ (2): It is necessary to install drainage system such as tubes and box culverts and ditches in both sides of the road.
Eco-system, Flora and Fauna	<p>(1)~ (2): Rich vegetation is found in the northern part of the road section. Numerous camels, cows and goats are fed in the area. However, several cows and goats are victims by traffic accidents. Numerous kinds of birds are found in the area.</p> <p>Flora: Thick vegetation forming the dominant woodland species consisting of various species with various species of wildlife. The vegetation mainly consists of <i>Acacia spp.</i>, <i>Anogeissus dhofarica (zerkin)</i>, <i>Blepharispermum bitum (khfut)</i>, <i>Boscia arabica (simer)</i>, <i>Bostvella sacra (luban)</i>, <i>Craton confertus (hor)</i>, <i>Maytenus spp.</i>, etc. The chief species is <i>Anogeissus dhofarica</i>, which is associated with several othertrees and large shrubs such as <i>Commiphora</i> and <i>Acacia species</i>, forms the woodland vegetation.</p> <p>Fauna: Wildlife in the area includes; The last population of the Arabian Leopard, Nubian ibex, Arabian Gazelle, Striped Hyaenas, Wild Cats, Caracal, Wolves and Foxes. Smaller mammals including rodents and foxes (<i>Lupes lupes arabica</i>) are found in the area, along with a number of bird species. A number of rare species of birds such as Herons, Masked Boobies and Socotra Comorants are also found breeding in the area and on the cliffs. Numerous camels, cows and goats are fed in the area. However, several cows and goats are victims by traffic accidents. Numerous kinds of birds are found in the area.</p>	2	<ul style="list-style-type: none"> - Moderate impact to flora and fauna due to deforestation by road construction in the thick vegetation in the project area. Road alignment should be followed along existing road. - Deforestation will be not only extinction of forest within the right of way but also disposal of large scaled cutting to both sides of the slope of the road. Therefore, the deforestation will be extend depend on the slope gradient and cutting volume. - Domestic animals are grazed and suffered traffic accidents.
Landscape	0~10km: Almost flat terrace 10km ~ (2): Slope is faced to the south and formed limestone and marl high cliff. High cliff is formed	1	- Much forest will be disappeared due to the road construction; therefore it is necessary to conduct minimized area of deforestation.

	numerous calcareous caves. (3): Flat on the Middle to Low Terraces.			
Hazards	(1)~ (3): Flash floods sometimes occur and roads had been damaged due to erosion and gravels remained along the wadis.	1	- Not significant impact due to road construction.	
Regional Development on Natural Environment	- Not existing so far.	1	- Unknown.	
Other Impacts on Natural environment	- Not existing so far, but road construction is bigger impacts on natural environment.	1	- Not existing.	
Cultural Heritage	- Not existing so far.	1	- Road construction might be followed along existing road alignment (within the ROW). - The investigation of the cultural heritage is required in the site.	
Wastes	- Not significant, but some dust, paper, plastic, etc., is scattered along the road. - Fragments of broken tires are scattered along the road.	1	- Low traffic volume in future. Wastes along the road will be increased together with increasing traffic volume.	
Regional Development on Social Environment	(1)~ (3): Not significant so far.	1	- Unknown.	
Other Impacts on Social Environment	0km point: Junction to Medinat al Haq. 10km point: Jibjat village and junction to N24. 25km point: Adh'eet village. 30km point: A'tayr village. 43km point: Junction of No. 49.	1	- Increased chance of traffic accident as well as domestic animals due to increased traffic volume.	

Evaluation	Soil	1~2	Alteration of topography
	Eco-system, Flora and Fauna	2	Deforestation by excavation and embankment
	Other items	1	

ENVIRONMENTAL CHECKLIST (N36)

Road Section: From Mahlah to Ismaiyah, Existing road condition: Gravel road
 Project No.: N36, Planning road: Paved 2-lane road, Distance: 45km

Environmental Items	Present Condition	Impact Rating 1 = Slight 2 = Moderate 3 = Significant	Major Anticipated Impact with Project Predicted traffic volume in 2030: 1,000 veh/day
Air Pollution	: Location of each road unit is explained at item of "Topography and Geology".		
Effluent	- Not significant so far.	1	- Not significant.
Noise and Vibration	- Not significant so far.	1	- Not significant.
Land Subsidence	- Not significant so far.	1	- Not significant.
Land Subsidence	- Not existing.	1	- Not existing.
Topography and Geology	Topography: (1): The proposed road passes along Wadi Khabbah (Wadi Tayin in the lower part of the wadi), in the middle and high relief mountainous terrain. Geology: The project road passes along the structural line in the direction of west-northwest to east-southeast. The northern part of the structural line is found the Khafmah Group (Jurassic – Middle Cretaceous) as the autochthonous unite. On the contrary, the southern part of the structural line is composed of harzburgite of mantle sequence of Ophiolite as the allochthonous unite. The project road area consists of alluvial plain in the wadis, mainly gravel and sand.	1	- Not significant impact due to road construction. It is necessary to follow the existing road alignment for minimizing of cutting.
Soil	(1): Soil is poorly developed, mostly suffered by wind erosion. Alluvial soil is found in the wadi, but mostly thin.	1	- Not significant impact due to road construction. It is necessary to follow the existing road alignment for minimizing of cutting.
Hydrology, groundwater	(1): These events can produce rapid runoff and major wadi flows. A number of sections of the current graded road are traversed by wadi channels. The high mountains to the east of the project area experience large amounts of run-off during rain and storm events.	1	- Not significant impact due to road construction. It is necessary to follow the existing road alignment for minimizing of cutting.

<p>Eco-system, Flora and Fauna</p>	<p>Flora: Sparse vegetation is found almost throughout the project area. Denser vegetation is present only in the wadis and depressions in the plain areas as well as the wadi channels in the mountains. The vegetation can be classified as an open xenomorphic <i>Euphorbia</i> community type.</p> <p>Fauna: Wildlife known to the project area includes gazelle and other fauna such as the red fox and small rodents. The IUCN red list of threatened animals (IUCN 1990) describes the mountain gazelle as vulnerable.</p>	<p>2</p>	<ul style="list-style-type: none"> - Moderate impact to wadi vegetation due to road construction along the wadi in the project area. - Road alignment should be followed along existing road. - Domestic animals are grazed and suffered traffic accidents.
<p>Landscape</p>	<p>(1): Mountainous area.</p>	<p>1</p>	<ul style="list-style-type: none"> - Not significant impact due to road construction.
<p>Hazards</p>	<p>(1): Flash flood, and slope failure.</p>	<p>1</p>	<ul style="list-style-type: none"> - Not significant impact due to road construction.
<p>Regional Development on Natural Environment</p>	<p>- Not existing so far.</p>	<p>1</p>	<ul style="list-style-type: none"> - Unknown.
<p>Other Impacts on Natural environment</p>	<p>(1): Not existing so far.</p>	<p>1</p>	<ul style="list-style-type: none"> - Not existing.
<p>Cultural Heritage</p>	<p>(1): 1~9 km point: Old towers and fort along the road.</p>	<p>1~2</p>	<ul style="list-style-type: none"> - Road costrection might be followed along existing road alignment. - The investigation of the cultural heritage is required in the site.
<p>Wastes</p>	<p>(1): Not significant.</p>	<p>1</p>	<ul style="list-style-type: none"> - Low traffic volume in future. Wastes along the road will be increased together with increasing traffic volume.
<p>Regional Development on Social Environment</p>	<p>- Not existing so far.</p>	<p>1</p>	<ul style="list-style-type: none"> -Unknown.
<p>Other Impacts on Social Environment</p>	<p>(1): Some sections of the road pass through or near to villages and farmland. Due to the fact that the alignment is not clearly defined and there is sufficient space available to re-align where necessary, it is unlikely that settlement areas will be impacted. Villages along the route: 0 km point: Mahalah, Ar Rakakiyah. 15 km point: Ghubrat at Tam village. 45 km point: Ismaiayah.</p>	<p>1~2</p>	<ul style="list-style-type: none"> - Increased chance of traffic accident as well as domestic animals due to increased traffic volume.

Evaluation	Eco-system, Flora and Fauna	2	Deforestation by excavation and embankment
	Cultural heritage	1~2	Influence to cultural heritage
	Other Impacts on Social Environment	1~2	Increased traffic volume
	Other items	1	

ENVIRONMENTAL CHECKLIST (N37)
Road Section: From Qaran to Sabt (N/R No. 23), Existing road condition: None road and gravel road
Project No.: N37, Planning road: Paved 2-lane road, Distance: 55km

Environmental Items	Present Condition	Impact Rating 1 = Slight 2 = Moderate 3= Significant	Major Anticipated Impact with Project Predicted traffic volume in 2030: 500~1,400 veh/day
Air Pollution	: Location of each road unit is explained at item of "Topography and Geology".	1	- Not significant.
Effluent		1	- Not significant.
Noise and Vibration		1	- Not significant.
Land Subsidence		1	- Not existing.
Topography and Geology	<p>Topography:</p> <p>(1) 0 (Qaran)~30 km: The project road is going down from high land of the tabletop type limestone to Low Terrace along Wadi Bani Khalid. The road shows rugged topography.</p> <p>(2) 30~55 km (Sabt, junction of N/R No.23): The road runs wide wadi plains to the junction of National Road No. 23 at Sabt. The area is mostly flat and gently slope with hilly land.</p> <p>Geology:</p> <p>The project area consists of Paleogene limestone and alluvial wadi sediments of gravel and sand.</p>	1~2	- Slight to moderate impact due to road construction in the southeastern part of Al Hajar Ash Sharqi Mountains with relatively sparse wadi vegetation. It is necessary to follow the existing road alignment for minimizing of cutting.
Soil	(1)~ (2): Soil is poorly developed, mostly suffered by wind erosion. Alluvial soil is found in the wadi, but mostly thin.	1	- Not significant impact due to road construction. - It is necessary to follow the existing road alignment for minimizing of cutting.
Hydrology, groundwater	(1)~ (2): These events can produce rapid runoff and major wadi flows. A number of sections of the current graded road are traversed by wadi channels. The high mountains to the east of the project area experience large amounts of run-off during rain and storm events.	1	- Not significant impact due to road construction.
Eco-system, Flora and Fauna	<p>Flora:</p> <p>Sparse vegetation is found almost throughout the project area. Denser vegetation is present only in the wadis and depressions in the plain areas as well as the wadi channels in the mountains.</p>	2	- Moderate impact to wadi vegetation due to road construction along the wadi in the project area. - Road alignment should be followed along existing road. - Domestic animals are grazed and suffered traffic accidents.

	The vegetation can be classified as an open xenomorph <i>Euphorbia</i> community type. Fauna: Wildlife known to the project area includes gazelle and other fauna such as the red fox and small rodents. The IUCN red list of threatened animals (IUCN 1990) describes the mountain gazelle as vulnerable.		
Landscape	(1)~ (2): Mountainous area.	1	- Not significant impact due to road construction.
Hazards	(1)~ (2): Flash flood, and slope failure.	1	- Not significant impact due to road construction.
Regional Development on Natural Environment	- Not existing so far.	1	- Unknown.
Other Impacts on Natural environment	(1)~ (2): Not existing so far.	1	- Not existing.
Cultural Heritage	(1)~ (2): Old towers and houses.	1~2	- Road construction might be followed along existing road alignment. - The investigation of the cultural heritage is required in the site.
Wastes	(1)~ (2): Not significant.	1	- Low traffic volume in future. Wastes along the road will be increased together with increasing traffic volume.
Regional Development on Social Environment	- Not existing so far.	1	-Unknown.
Other Impacts on Social Environment	(1)~ (2): Some sections of the road pass through or near to villages and farmland. Due to the fact that the alignment is not clearly defined and there is sufficient space available to re-align where necessary, it is unlikely that settlement areas will be impacted. Villages along the route: 0 km point: Qaran village. 30 km point: Zilaft village. 40 km point: Bani Khalid village. 55 km point: Sabt, junction of N/R No.23.	1	- Increased chance of traffic accident as well as domestic animals due to increased traffic volume.

Evaluation	Topography and geology	1~2	Alteration of topography
	Eco-system, Flora and Fauna	2	Deforestation by excavation and embankment
	Cultural heritage	1~2	Influence to cultural heritage
	Other items	1	

ENVIRONMENTAL CHECKLIST (N38)

Road Section: From Al Mazari to Ghubrat at Tam, Existing road condition: Gravel road
Project No.: N38, Planning road: Paved 2-lane road, Distance: 40km

Environmental Items	Present Condition	Impact Rating 1 = Slight 2 = Moderate 3= Significant	Major Anticipated Impact with Project Predicted traffic volume in 2030: 50 veh/day
Air Pollution	: Location of each road unit is explained at item of "Topography and Geology".		
Effluent	- Not significant so far.	1	- Not significant.
Noise and Vibration	- Not significant so far.	1	- Not significant.
Land Subsidence	- Not significant so far.	1	- Not significant.
Topography and Geology	- Not existing. Topography: (1) 0~25 km: The project road runs mostly flat and aeolian sand area in the alluvial plain along the wadis (downstream of Wadi Khabbah). The road between Hayl Al Ghaf and Asayh is slope and hilly land. (2) 25~40 km: The project road that leads to Ghubrat at Tam is aligned on bumpy alluvial plain along Wadi Khabbah. From the village of Asayh the topography becomes mountainous and is traversed by some deeply incised wadi channels. Geology: The project area consists of the Khafmah Group (Jurassic – Middle Cretaceous) as the autochthonous unite, the Paleogene limestone and alluvial wadi sediments of gravel and sand.	1~2	- Not existing. - Slight to moderate impact due to road construction in the central part of Al Hajar Ash Sharqi Mountains with relatively sparse wadi vegetation. It is necessary to follow the existing road alignment for minimizing of cutting.
Soil	(1)~ (2): Soil is poorly developed, mostly suffered by wind erosion. Alluvial soil is found in the wadi, but mostly thin.	1	- Not significant impact due to road construction. It is necessary to follow the existing road alignment for minimizing of cutting.
Hydrology, groundwater	(1)~ (2): Many sections of the existing road pass through areas of wadi flow. Impacts as a result of wadi flow are likely to be significant in parts of the project area.	1	- Not significant impact due to road construction.

<p>Eco-system, Flora and Fauna</p>	<p>Flora: Sparse vegetation is found along the entire stretch of the existing road alignment. The characteristic species are <i>Acacia tortilis</i>, <i>Commiphora spp.</i>, <i>Grewia erythraea</i>, <i>Euphorbia larica</i> and <i>Ochradenus arabicus</i>.</p> <p>Fauna: Wildlife known to the area includes the endangered (IUCN 1990) gazelle (<i>Gazella gazella</i>), the red fox (<i>Vulpes vulpes Arabica</i>) and a number of small rodents and desert hedgehogs. Domestic camels, goats and donkeys graze in the area. The area adjacent to the project area is recognized as being of valuable natural interest.</p>	<p>2</p>	<ul style="list-style-type: none"> - Moderate impact to wadi vegetation due to road construction along the wadi in the project area. - Road alignment should be followed along existing road. - Domestic animals are grazed and suffered traffic accidents.
<p>Landscape</p>	<p>(1)~(2): Mountainous area.</p>	<p>1</p>	<ul style="list-style-type: none"> - Not significant impact due to road construction.
<p>Hazards</p>	<p>(1)~(2): Flash flood.</p>	<p>1</p>	<ul style="list-style-type: none"> - Not significant impact due to road construction.
<p>Regional Development on Natural Environment</p>	<p>- Not existing so far.</p>	<p>1</p>	<ul style="list-style-type: none"> - Unknown.
<p>Other Impacts on Natural environment</p>	<p>- Not existing so far.</p>	<p>1</p>	<ul style="list-style-type: none"> - Not existing.
<p>Cultural Heritage</p>	<p>- Old towers and hoses.</p>	<p>1~2</p>	<ul style="list-style-type: none"> - Road costrection might be followed along existing road alignment. - The investigation of the cultural heritage is required in the site.
<p>Wastes</p>	<p>- Not significant.</p>	<p>1</p>	<ul style="list-style-type: none"> - Low traffic volume in future. Wastes along the road will be increased together with increasing traffic volume.
<p>Regional Development on Social Environment</p>	<p>- Not existing so far.</p>	<p>1</p>	<ul style="list-style-type: none"> -Unknown.
<p>Other Impacts on Social Environment</p>	<p>(1)~(2): There are a number of strip settlements along the existing surfaced road. Depending on the final proposed alignment of the road settlement areas and farmland may be significantly impacted. Villages along the route: 0 km point: Al Mazari village. 10 km point: Hayl Al Ghaf village. 25 km point: Asayh. 40 km point: Ghubrat at Tam village.</p>	<p>2</p>	<ul style="list-style-type: none"> - Increased chance of traffic accident as well as domestic animals due to increased traffic volume. - Resettlement of several houses at the part in the village will be required.

Evaluation	Topography and geology	1~2	Alteration of topography
	Eco-system, Flora and Fauna	2	Deforestation by excavation and embankment
	Cultural heritage	1~2	Influence to cultural heritage
	Other Impacts on Social Environment	2	Relocation of some houses
	Other items	1	

ENVIRONMENTAL CHECKLIST (N40)

Road Section: From Wadi Saa to Dank, Existing road condition: Gravel road
Project No.: N40, Planning road: Paved 2-lane road, Distance: 80km

Environmental Items	Present Condition	Impact Rating 1 = Slight 2 = Moderate 3 = Significant	Major Anticipated Impact with Project Predicted traffic volume in 2030: 1,600 veh/day
Air Pollution	: Location of each road unit is explained at item of "Topography and Geology".		
Effluent	- Not significant so far.	1	- Not significant.
Noise and Vibration	- Not significant so far.	1	- Not significant.
Land Subsidence	- Not significant so far.	1	- Not significant.
Topography and Geology	- Not existing.	1	- Not existing.
	Topography: (1) 0 (Wadi Saa)~38.4 km (Al Feth): The project area consists of flat and Low Terrace, hilly land and crossing the wadis (Upper stream of Wadi Murayku Hat and Wadi Sifah). (2) 38.4~80 km (Dank): The project road runs Low terrace and hilly land. The road from Tawi Nawimiyah to Dank is flat in the wadi (Tributaries of Wadi Dank). Geology: The northwestern part of the project road area consists of Qumayrah Formation as autochthonous unit, Hawasinah Group, Ophiolite as allochthonous units in ascending order. The southeastern part of the project area mainly consists of ultrabasic rocks of Ophiolite and Paleogene shelf limestone. The alluvial deposits, consisting of gravel, sand and clay, occupy wadis.		
Soil	(1)~ (2): Soil is poorly developed, mostly suffered by wind erosion. Alluvial soil is found in the wadi, but mostly thin.	1~2	- Slight to moderate impact due to road construction with surface soil and relatively thick wadi vegetation. It is necessary to follow the existing road alignment for minimizing of cutting.
Hydrology, groundwater	(1)~ (2): These events can produce rapid runoff and major wadi flows. The current graded road passes	1	- Not significant impact due to road construction. - There are several evidences of flooding in the area.

	within wadi flow areas. Whilst the wadis are not continuously flowing it is evident that wadi flow is likely during rainy periods. Previous wadi flow appears to have caused erosion and rock fall within the project area.		Drainage systems will be required for road construction.
Eco-system, Flora and Fauna	<p>Flora: Sparse vegetation is found along the entire stretch of the project area. Vegetation is mainly concentrated in the wadi channels and is virtually absent on the alluvial gravel plain areas. Land close to the existing road appears to be in good condition and not heavily exploited as a result of the existing road.</p> <p>Fauna: There are no known specific wildlife travel corridors crossing project area. No rare, endangered or threatened species have been identified in the area.</p>	1~2	<ul style="list-style-type: none"> - Slight to moderate impact to flora and fauna due to deforestation of thick wadi vegetation by road construction. Road alignment should be followed along existing road. - Domestic animals are grazed and suffered traffic accidents.
Landscape	(1)~(2): Flat and mountainous area.	1	- Not significant impact due to road construction.
Hazards	(1)~(2): Flash flood.	1	- Not significant impact due to road construction.
Regional Development on Natural Environment	- Not existing so far.	1	- Unknown.
Other Impacts on Natural environment	- Not existing so far.	1	- Not existing.
Cultural Heritage	(1)~(2): Not existing so far.	1	<ul style="list-style-type: none"> - Road construction might be followed along existing road alignment. - The investigation of the cultural heritage is required in the site.
Wastes	(1)~(2): Not significant.	1	<ul style="list-style-type: none"> - Low traffic volume in future. Wastes along the road will be increased together with increasing traffic volume.
Regional Development on Social Environment	- Not existing so far.	1	- Unknown.
Other Impacts on Social Environment	(1)~(2): Very few sections of the road pass through or nearby towns and impacts to settlement areas are therefore seen as insignificant. An existing 2-lane surfaced road has already been constructed through the village of Qumayrah.	1	- Increased chance of traffic accident as well as domestic animals due to increased traffic volume.

	<p>Villages along the route: 0 km point: Wadi Saa. 10 km point: Ajran. 16 km point: Junction to Harim. 30 km point: Qumayrah village. 40 km point: Hayl al Farfar village. 63 km point: Tawi Nawimiya village. 80 km point: Dank.</p>		
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Evaluation	Soil	1~2	Alteration of topography
	Eco-system, Flora and Fauna	1~2	Deforestation by excavation and embankment
	Other items	1	

ENVIRONMENTAL CHECKLIST (N41)

Road Section: From As Aunaynah to Al Wuqbah, Existing road condition: Gravel road
Project No.: N41, Planning road: Paved 4-lane road, Distance: 50km

Environmental Items	Present Condition : Location of each road unit is explained at item of "Topography and Geology".	Impact Rating 1 = Slight 2 = Moderate 3= Significant	Major Anticipated Impact with Project Predicted traffic volume in 2030: 1,600 veh/day
Air Pollution	- Not significant so far.	1	- Not significant.
Effluent	- Not significant so far.	1	- Not significant.
Noise and Vibration	- Not significant so far.	1	- Not significant.
Land Subsidence	- Not existing.	1	- Not existing.
Topography and Geology	Topography: (1) 0 (As Aunaynah)-25 km: The project road area is flat alluvial plain and Aeolian sand. 25 km point is southwestern boundary of outcrop of Tertiary limestone. (2) 25-50 km: The road area between 25 and 35 km passes along the wadis and low hilly land. The road between 35 and 50 km is low relief mountainous area. Geology: The project area of (1) consists of alluvial gravel and sand plains (alluvial fans). The road of the area (2) is mainly composed of Tertiary shelf limestone, ultrabasic rocks (mainly harzburgite, etc.) and Hawasinah Groups as allochthonous units of the Oman Mountains.	1~2	- Slight to moderate impact due to road construction in the western part of Al Hajar Mountains with relatively thick wadi vegetation. It is necessary to follow the existing road alignment for minimizing of cutting.
Soil	(1)~ (2): Soil is poorly developed, mostly suffered by wind erosion. Alluvial soil is found in the wadi, but mostly thin.	1~2	- Slight to moderate impact due to road construction with surface soil and relatively thick wadi vegetation. It is necessary to follow the existing road alignment for minimizing of cutting.
Hydrology, groundwater	(1)~ (2): Many sections of the existing road pass within wadi flow areas. Whilst the alluvial plain is traversed by a number of wadi channels, these are older, shallower courses and are unlikely to experience flow.	1	- Not significant impact due to road construction. - There are several evidences of flooding in the area. Drainage systems will be required for road construction.

	<p>Where the current graded road passes between the mountains, existing water flow is continuous in some areas.</p> <p>Flora: Sparse vegetation is typical of the project area. However, the project area has distinct vegetation zones. Virtually no vegetation is present on the alluvial gravel plain area from the main road (N/R No. 21) until the mountains. Where the existing graded road passes within the mountain and wadi channel areas increasingly dense areas of vegetation occur. Vegetation within the wadi areas consists mainly of date palms and grasses. Outside of the wadi channels the vegetation reverts to <i>Acacia</i> scrub.</p> <p>Fauna: Wildlife is limited in the area and includes small rodents and the red fox. Domestic herds graze in the area.</p>	2	<ul style="list-style-type: none"> - Moderate impact to flora and fauna due to deforestation of thick wadi vegetation by road construction. Road alignment should be followed along existing road. - Domestic animals are grazed and suffered traffic accidents.
Landscape Hazards	(1)~(2): Flat area and mountainous area.	1	- Not significant impact due to road construction.
Regional Development on Natural Environment	(1)~(2): Flash flood.	1	- Not significant impact due to road construction.
Other Impacts on Natural environment	(1)~(2): Not existing so far.	1	- Unknown.
Cultural Heritage	- Not existing so far.	1	- Not existing.
Wastes	(1)~(2): 40 km point: Ruin near the road.	1~2	<ul style="list-style-type: none"> - Road construction might be followed along existing road alignment. - The investigation of the cultural heritage is required in the site.
Regional Development on Social Environment	- Not significant.	1	<ul style="list-style-type: none"> - Low traffic volume in future. Wastes along the road will be increased together with increasing traffic volume.
Other Impacts on Social Environment	(1)~(2): Not existing so far.	1	-Unknown.
	(1)~(2): Few sections of the road pass through or nearby villages and farmland, being in the vicinity of wadi channels. Villages along the route:	1	<ul style="list-style-type: none"> - Increased chance of traffic accident as well as domestic animals due to increased traffic volume.

	0 km point: Junction at As Aunaynah to Al Wuqbah. 50 km point: Al Waqbah.	
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Evaluation	Topography and geology	1~2	Alteration of topography
	Soil	1~2	Alteration of topography
	Eco-system, Flora and Fauna	2	Deforestation by excavation and embankment
	Cultural heritage	1~2	Influence to cultural heritage
	Other items	1	

ENVIRONMENTAL CHECKLIST (N43)

Road Section: From Al Wajajah to Ash Shwayhah, Existing road condition: Gravel road
 Project No.: N43, Planning road: Paved 4-lane road, Distance: 30km

Environmental Items	Present Condition	Impact Rating 1 = Slight 2 = Moderate 3= Significant	Major Anticipated Impact with Project Predicted traffic volume in 2030: 50 veh/day
Air Pollution	: Location of each road unit is explained at item of "Topography and Geology".		
Effluent	- Not significant so far.	1	- Not significant.
Noise and Vibration	- Not significant so far.	1	- Not significant.
Land Subsidence	- Not significant so far.	1	- Not significant.
Topography and Geology	Topography: (1): The topography of the project area consists of mountain areas along with alluvial, gravel and sand plain traversed by a number of existing and older wadi channels. Geology: The project area is comprised of ultrabasic rocks (mainly harzburgite, etc.) and Hawasina Group as allochthonous units of the Oman Mountains. The wadis consist of alluvial deposits of gravel and sand.	1	- Not significant impact due to road construction.
Soil	(1): Soil is poorly developed, mostly suffered by wind erosion. Alluvial soil is found in the wadi, but mostly thin.	1	- Not significant impact due to road construction.
Hydrology, groundwater	(1): There are a number of wadi channels within the project area where the proposed road would need to cross. Flow would be expected to occur during rain and flood events from the mountains.	1	- Not significant impact due to road construction.
Eco-system, Flora and Fauna	Flora: Sparse vegetation is found along the entire stretch of the project area. The current roads have already impacted the vegetation along the proposed alignment and therefore further impacts to the vegetation are generally considered to be insignificant. The vegetation can be classified as an	1	- Not significant impact due to road construction. - Domestic animals are grazed and suffered traffic accidents.

	open xenomorphic <i>Euphorbia</i> community type. Fauna: There are no known specific wildlife travel corridors crossing project. Small mammals such as rodents, and birds are present in the area. No rare, endangered or threatened species have been identified in the area.		
Landscape	(1): Mountainous area.	1	- Not significant impact due to road construction.
Hazards	(1): Flash flood and slope failure.	1	- Not significant impact due to road construction.
Regional Development on Natural Environment	(1): Not existing so far.	1	- Unknown.
Other Impacts on Natural environment	- Not existing so far.	1	- Not existing.
Cultural Heritage	(1): Old towers and houses.	1~2	- Road construction might be followed along existing road alignment. - The investigation of the cultural heritage is required in the site.
Wastes	- Not significant.	1	- Very low traffic volume in future. Wastes along the road will be increased together with increasing traffic volume.
Regional Development on Social Environment	- Not existing so far.	1	-Unknown.
Other Impacts on Social Environment	(1): Settlement, villages and Farmlands are in the vicinity of wadi channels. Villages along the route: 0 km point: Junction at Al Wajajah to Shuwayhah. 30 km point: Shuwayhah.	2	- Increased chance of traffic accident as well as domestic animals due to increased traffic volume. - Relocation of several houses at the part in the village will be required.

Evaluation	Cultural heritage	1~2	Influence to cultural heritage
	Other Impacts on Social Environment	2	Relocation of some houses.
	Other items	1	

ENVIRONMENTAL CHECKLIST (N44 and N45)

Road Section: From Murri to Al Ayn and Al Wadi Al Ala, Existing road condition: Gravel road
Project No.: N44 and N45, Planning road: Paved 4-lane road, Distance: 30km

Environmental Items	Present Condition	Impact Rating 1 = Slight 2 = Moderate 3 = Significant	Major Anticipated Impact with Project Predicted traffic volume in 2030: 500 veh/day
Air Pollution	: Location of each road unit is explained at item of "Topography and Geology".		
Effluent	- Not significant so far.	1	- Not significant.
Noise and Vibration	- Not significant so far.	1	- Not significant.
Land Subsidence	- Not significant so far.	1	- Not significant.
Topography and Geology	<p>Topography:</p> <p>(1): The project area lies within the range of mountains known as the Al Hajar range. The mountains in this area are the highest in Oman and rise to an approximate height of 2000 m. Sections of the road will also pass between the mountains on flatter terrain and lower lying hills.</p> <p>Geology:</p> <p>The Hajar mountains are comprised of paleozoic, metamorphic and igneous rocks. During the Tertiary and following uplift, erosion carved out rugged mountains, incised by sharply convoluted wadis. Igneous rocks consist of Ophiolite sequence as an allocthonous unit.</p>	1~2	- Slight to moderate impact due to road construction in the central part of Al Hajar Mountains with relatively thick wadi vegetation. It is necessary to follow the existing road alignment for minimizing of cutting.
Soil	(1): Soil is poorly developed, mostly suffered by wind erosion. Alluvial soil is found in the wadi, but mostly thin.	1	- Not significant impact due to road construction. It is necessary to follow the existing road alignment for minimizing of cutting.
Hydrology, groundwater	(1): These events can produce rapid runoff and major wadi flows. Many sections of the proposed road will pass within major wadi flow areas.	1	- Not significant impact due to road construction. Flash flood.
Eco-system, Flora and Fauna	<p>Flora:</p> <p>Vegetation is found along the entire stretch of the project area. The lower lying hills have less vegetative cover than the higher areas, and areas of wadi flow. The vegetation can be classified as an open</p>	2	- Moderate impact to flora and fauna due to deforestation and paved road in the marked wadi vegetation and eco-system in the project area. Road alignment should be followed along existing road. - Domestic animals are grazed and suffered traffic accidents.

	<p>xenomorphic <i>Euphorbia</i> community type. Much of this area represents a good example of undisturbed habitat in northern Oman.</p> <p>Fauna: Wildlife known to the area includes the Arabian Leopard, Gazelle, Red Fox and small rodents. The IUCN red list of threatened animals (IUCN 1990) describes the mountain gazelle as vulnerable species. The taxon is likely to move into the 'endangered' species list. The Arabian Leopard is considered as critically threatened.</p>		
Landscape	(1): Mountainous area.	1	- Much forest will be disappeared due to the road construction; therefore it is necessary to conduct minimized area of deforestation.
Hazards	(1): Flash flood and slope failure.	1	- Not significant impact due to road construction.
Regional Development on Natural Environment	(1): Not existing so far.	1	- Unknown.
Other Impacts on Natural environment	(1): Not existing so far.	1	- Not existing.
Cultural Heritage	(1): Barut (Al Ayn) and Al Wadi Al Ali area: Numerous towers and forts.	2	- Road construction might be followed along existing road alignment (within the ROW). - The investigation of the cultural heritage is required in the site.
Wastes	- Not significant.	1	- Low traffic volume in future. Wastes along the road will be increased together with increasing traffic volume.
Regional Development on Social Environment	- Not existing so far.	1	-Unknown.
Other Impacts on Social Environment	(1): Some sections of the road pass through and nearby villages and areas of farmland. Villages along the route: Murri, Barut (Al Ayn), Al Hijr, Subaykah, Al Basatin, and Al Wadi Al Ali.	1	- Increased chance of traffic accident as well as domestic animals due to increased traffic volume.

Evaluation	Topography and geology	1-2	Alteration of topography
	Eco-system, Flora and Fauna	2	Deforestation by excavation and embankment
	Cultural heritage	2	Influence to cultural heritage
	Other items	1	

ENVIRONMENTAL CHECKLIST (N46)

Road Section: From Amin (Nimr) to Bahja, Existing road condition: Gravel road
Project No.: N46, Planning road: Paved 2-lane road, Distance: 154km

Environmental Items	Present Condition	Impact Rating 1 = Slight 2 = Moderate 3= Significant	Major Anticipated Impact with Project Predicted traffic volume in 2030: 600 veh/day
Air Pollution	(1)~ (6): Not significant, but dust is significant.	1	- Not significant.
Effluent	(1)~ (6): Not existing.	1	- Not significant.
Noise and Vibration	(1)~ (6): insignificant.	1	- Not significant.
Land Subsidence	(1)~ (6): Not existing.	1	- Not existing.
Topography and Geology	Topography: (1) 0 (Junction to Bahja)~60km: Flat and wadis (Wadi Tharawt). (2) 60~80km: Flat. (3) 80~100km: Flat. (4) 100~120km: Flat with small wadis. (5) 120~132km: Flat with small wadis (Unknown). (6) 132~154km: Flat. Geology: Tertiary marl, limestone and red partly shale are widely distributed in the area. And Quaternary wadi sediments are partly covered along the wadis. Several small borrow pits are remained along the road. (1)~ (6): Height of embankment of the road is .5~1.5m.	1	- Not significant impact due to road construction.
Soil	(1)~ (6): White soil is poorly developed, mostly suffered by wind erosion. Alluvial soil is found along the wadis.	1	- Not significant impact due to road construction.
Hydrology, groundwater	(1)~ (6): No current flow along the wadis (Wadi Tharawt, etc.). But many small wadis or hollow-grounds exist along the road.	1	- Not significant impact due to road construction. - Several drainage tubes are installed at the small wadis.
Eco-system, Flora and Fauna	(1)~ (6): Mostly no to rare vegetation consisting of grasses (mostly halophytic and mesophyll plant). But there is slight vegetation, consisting of small acacia and grasses, along small wadis and hollow-ground.	1	- Not significant impact due to road construction. - Domestic animals are grazed and suffered traffic accidents.

Landscape Hazards	(1)~(6): Almost flat. - Not significant.	1	- Not significant impact due to road construction.
Regional Development on Natural Environment	- Oil development by PDO, Ghufos, Bahaa and Mafoorah oilfield, in the area.	1	- Not significant impact due to road construction. - Unknown.
Other Impacts on Natural environment	- Not existing so far.	1	- Not existing.
Cultural Heritage	- Not existing so far.	1	- Road construction might be followed along existing road alignment. - The investigation of the cultural heritage is required in the site.
Wastes	- Not significant.	1	- Not significant impact due to road construction.
Regional Development on Social Environment	- Oil development by PDO, Ghufos, Bahaa and Mafoorah oilfield, in the area.	1	- Unknown.
Other Impacts on Social Environment	(1): Nimr oilfield. 13km point: Microwave tower. 56km point: Microwave tower. 89km point: Ghufos air strip of PDO. 96km point: Microwave tower. 132 km point: Junction to Amal and Bhaja (paved road).	1	- Low population.

Evaluation	All items	1
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ENVIRONMENTAL CHECKLIST (N47)

Road Section: From Mahawt to Mahawt island, Existing road condition: No road
Project No.: N47, Planning road: Paved 2-lane road, Distance: 5km

Environmental Items	Present Condition : Location of each road unit is explained at item of "Topography and Geology".	Impact Rating 1 = Slight 2 = Moderate 3 = Significant	Major Anticipated Impact with Project Predicted traffic volume in 2030: 1,000 veh/day
Air Pollution	(1): Not significant.	1	- Not significant.
Effluent	(1): Beach and shallow sea.	1	- Not significant.
Noise and Vibration	(1): insignificant so far.	1	- Not significant.
Land Subsidence	(1): Not existing so far.	1	- Soft earth including fine-grained beach silty sand will be compacted.
Topography and Geology	Topography: (1): Shallow beach and lagoon (Khabrah). Geology: Alluvial coastal deposits and Khbrah sediments.	1	- Not significant impact due to road construction.
Soil	(1): No soil.	1	- Not significant impact due to road construction.
Hydrology, groundwater	(1): No current flow, but groundwater is pumped up at near beach and water after purified is sent to island.	1	- Not significant impact due to road construction.
Eco-system, Flora and Fauna	(1): Mangroves are found around lagoon and island. Many fishermen work around island. Surrounding of the island is good fishing places.	3	- Significant impact to eco-system due to road construction in the area. - It is necessary to conserve natural environment around the Mahawt area.
Landscape	(1): Island and mangroves shows good landscape.	1~2	- Surrounding of Mahawt and Masirah island are planned to be resort area for tourism.
Hazards	- Not existing so far.	1	- Not significant impact due to road construction.
Regional Development on Natural Environment	- Fishery and tourism development. - Fishing places are located around the island.	1	- If access road to the island is constructed, present coastal current will be got the influence and fishing places due to the road construction.
Other Impacts on Natural environment	- Not existing so far.	1	- Not existing.
Cultural Heritage	- Unknown.	1	- The investigation of the cultural heritage is required in the site.
Wastes	- Not significant so far.	1~2	- Moderate traffic volume is predicted. Wastes along

Regional Development on Social Environment	- Fishery and tourism development.	1	the road will be increased together with increasing traffic volume. - Unknown.
Other Impacts on Social Environment	0km point: Pumping station of the Ministry. Fishing place. 5km point: Mahawt island. There are 60 to 100 families staying island during wet season (September to April) for fishery. Water for living in island is sending by water pipe from opposite shore.	1	- Low population. - Moderate traffic volume is predicted. - Increased chance of traffic accident as well as domestic animals due to increased traffic volume.

Evaluation	Eco-system, Flora and Fauna	3	Influence to marine wildlife and mangrove vegetation
	Landscape	1~2	Influence to marine scenery and mangrove vegetation
	Cultural Heritage	1~2	Influence to cultural heritage
	Waste	1~2	Increased waste due to visitors
	Other items	1	

ENVIRONMENTAL CHECKLIST (B1)

Road Section: Sinaw Bypass, Existing road condition: No road
 Project No.: B1 National Road No.32, Planning road: Paved 2-lane road, Distance: 6km

Environmental Items	Present Condition : Location of each road unit is explained at item of "Topography and Geology".	Impact Rating 1 = Slight 2 = Moderate 3 = Significant	Major Anticipated Impact with Project Predicted traffic volume in 2030: 700~1,800 veh/day
Air Pollution	(1): Not significant so far.	1	- Not significant.
Effluent	(1): Not significant so far.	1	- Not significant.
Noise and Vibration	(1): Not significant so far.	1	- Not significant.
Land Subsidence	(1): Not existing.	1	- Not existing.
Topography and Geology	Topography: (1): The project area is typically flat, with some low-lying hills in the southern region of the project area. Geology: The project area consists predominantly of wadi gravels and alluvium plain.	1	- Not significant impact due to road construction.
Soil	(1): Soil is poorly developed, mostly suffered by wind erosion. Alluvial soil is found in the wadi.	1	- Not significant impact due to road construction.
Hydrology, groundwater	(1): There are some wadi channels and older wadi courses in the project area. Wadi flow would occur during rain and flood events from the low-lying mountains to the south of the project area.	1	- Not significant impact due to road construction. Flash flood.
Eco-system, Flora and Fauna	Flora: The project area is sparsely vegetated with primarily acacia scrub vegetation dominated by <i>Acacia tortilis</i> . Fauna: There are no known specific wildlife travel corridors crossing project area. No rare, endangered or threatened species have been identified in the area. Small rodents and birds are present in the area. Domestic animals such as goats, camels and donkeys are common.	1	- The vegetation will not be significantly affected by the bypass construction.
Landscape	(1): Flat area.	1	- Not significant impact due to road construction.
Hazards	(1): Flash flood.	1	- Not significant impact due to road construction.

Regional Development on Natural Environment	(1): Not existing so far.	1	- Unknown.
Other Impacts on Natural environment	- Not existing so far.	1	- Not existing.
Cultural Heritage	(1): Not existing so far.	1	-The investigation of the cultural heritage is required in the site.
Wastes	- Not significant.	1	- Not significant impact due to road construction.
Regional Development on Social Environment	- Not existing so far.	1	- Unknown.
Other Impacts on Social Environment	(1): Settlements are present within the project area. The proposed bypass bisects the main road to Mudhaibi where strip settlements are present. Town along the route: Sinaw.	2	- Low traffic volume is predicted. - Some houses and farms will be possibly relocated due to road alignment.

Evaluation	Other Impacts on Social Environment	2	Relocation of some houses and farms.
	Other items	1	

ENVIRONMENTAL CHECKLIST (B2)

Road Section: Ibra South Bypass, Existing road condition: No road

Project No.: B2 National Road No.21, Planning road: Paved 2-lane road, Distance: 13km

Environmental Items	Present Condition : Location of each road unit is explained at item of “Topography and Geology”.	Impact Rating 1 = Slight 2 = Moderate 3= Significant	Major Anticipated Impact with Project Predicted traffic volume in 2030: 7,000~8,000 veh/day
Air Pollution	(1): Not significant so far.	1	- Not significant.
Effluent	(1): Not significant so far.	1	- Not significant.
Noise and Vibration	(1): Not significant so far.	1	- Not significant.
Land Subsidence	(1): Not existing.	1	- Not existing.
Topography and Geology	Topography: (1): Topography of the project area is mostly flat terrain. However, where the location of the proposed bypass is likely to start there are mountains that flank the east and west of N/R No. 21. Geology: The project area consists mainly of Tertiary limestone and alluvium, sand and gravel.	1	- Not significant impact due to road construction.
Soil	(1): Soil is poorly developed, mostly suffered by wind erosion. Alluvial soil is found in the wadi.	1	- Not significant impact due to road construction.
Hydrology, groundwater	(1): There are a number of wadi channels in the project area, none of which experience continuous wadi flow. However, flow would be expected during rain and flood events.	1	- Not significant impact due to road construction. Flash flood.
Eco-system, Flora and Fauna	Falora: The project area is sparsely vegetated. The vegetation can be classified as an open xenomorphic <i>Euphorbia</i> community type. Fauna: There are no known specific wildlife travel corridors crossing project area. Small mammals and a number of bird species are resident in the area. No rare, endangered or threatened species have been identified in the area. Domestic animals utilize the area for grazing.	1	- The vegetation will not be significantly affected by the bypass construction.

Landscape Hazards	(1): Flat area. (1): Flash flood.	1 1	- Not significant impact due to road construction. - Not significant impact due to road construction.
Regional Development on Natural Environment	(1): Not existing so far.	1	- Unknown.
Other Impacts on Natural environment	- Not existing so far.	1	- Not existing.
Cultural Heritage	(1): Not existing so far.	1	-The investigation of the cultural heritage is required in the site.
Wastes	- Not significant. - Not existing so far.	1 1	- Not significant impact due to road construction. - Unknown.
Regional Development on Social Environment	(1): Settlements and farmland are present within the whole project area. Both settlements and farmland become less concentrated further southwest from route 21. The impact to these will be subject to the proximity of the bypass to Ibri. Towns along the route: Ibra.	1~2	- Low traffic volume is predicted. - Some houses and farms will be possibly relocated due to road alignment.

Evaluation	Other Impacts on Social Environment	1~2	Relocation of some houses and farms.
	Other items	1	

ENVIRONMENTAL CHECKLIST (B3)

Road Section: Ibra Bypass, Existing road condition: No road
 Project No.: B3, National Road No.23, Planning road: Paved 2-lane road, Distance: 11km

Environmental Items	Present Condition	Impact Rating 1 = Slight 2 = Moderate 3 = Significant	Major Anticipated Impact with Project Predicted traffic volume in 2030: 14,000~18,000 veh/day
Air Pollution	: Location of each road unit is explained at item of "Topography and Geology". (1): Not significant so far.	1	- Slight air pollution may occur in urban areas due to increase of traffic volume.
Effluent	(1): Not significant so far.	1	- Not significant.
Noise and Vibration	(1): Not significant so far.	1	- Slight noise pollution may occur in urban areas due to increase of traffic volume.
Land Subsidence	(1): Not existing.	1	- Not existing.
Topography and Geology	Topography: (1): Topography of the project area is mostly flat terrain. However, where the location of the proposed bypass is likely to start there are mountains that flank the east and west of N/R No. 21. Geology: The project area consists mainly of Tertiary limestone and alluvium, sand and gravel.	1	- Not significant impact due to road construction.
Soil	(1): Soil is poorly developed, mostly suffered by wind erosion. Alluvial soil is found in the wadi.	1	- Not significant impact due to road construction.
Hydrology, groundwater	(1): There are a number of wadi channels in the project area, none of which experience continuous wadi flow. However, flow would be expected during rain and flood events.	1	- Not significant impact due to road construction. Flash flood.
Eco-system, Flora and Fauna	Flora: The project area is sparsely vegetated. The vegetation can be classified as an open xeromorphic <i>Euphorbia</i> community type. Fauna: There are no known specific wildlife travel corridors crossing project area. Small mammals and a number of bird species are resident in the area. No	1	- The vegetation will not be significantly affected by the bypass construction.

	rare, endangered or threatened species have been identified in the area. Domestic animals utilize the area for grazing.		
Landscape Hazards	(1): Flat area.	1	- Not significant impact due to road construction.
Regional Development on Natural Environment	(1): Flash flood.	1	- Not significant impact due to road construction.
Other Impacts on Natural environment	(1): Not existing so far. - Not existing so far.	1	- Unknown. - Not existing.
Cultural Heritage	(1): Not existing so far.	1	-The investigation of the cultural heritage is required in the site.
Wastes	- Not significant.	1	- Not significant impact due to road construction.
Regional Development on Social Environment	- Not existing so far.	1	- Unknown.
Other Impacts on Social Environment	(1): Settlements and farmland are present within the whole project area. Both settlements and farmland become less concentrated further southwest from route 21. The impact to these will be subject to the proximity of the bypass to Ibri. Towns along the route: Ibra.	1~2	- High traffic volume is predicted. - Some houses and farms will be possibly relocated due to road alignment. It is necessary to examine road alignment for mitigation.

Evaluation	Other Impacts on Social Environment	1~2	Relocation of some houses and farms.
	Other items	1	

ENVIRONMENTAL CHECKLIST (B5)

Road Section: Ibri East Bypass, Existing road condition: No road
 Project No.: B5, National Road No.21, Planning road: Paved 2-lane road, Distance: 6 km

Environmental Items	Present Condition : Location of each road unit is explained at item of "Topography and Geology".	Impact Rating 1 = Slight 2 = Moderate 3 = Significant	Major Anticipated Impact with Project Predicted traffic volume in 2030: 10,300 veh/day
Air Pollution	(1): Not significant so far.	1	- Slight air pollution may occur in urban areas due to increase of traffic volume.
Effluent	(1): Not significant so far.	1	- Not significant.
Noise and Vibration	(1): Not significant so far.	1	- Slight noise pollution may occur in urban areas due to increase of traffic volume.
Land Subsidence	(1): Not existing.	1	- Not existing.
Topography and Geology	Topography: (1): Topography of the project area is mostly flat terrain. However, where the location of the proposed bypass is likely to start there are mountains that flank the east and west of N/R No. 21. Geology: The project area consists mainly of Tertiary limestone and alluvium, sand and gravel.	1	- Not significant impact due to road construction.
Soil	(1): Soil is poorly developed, mostly suffered by wind erosion. Alluvial soil is found in the wadi.	1	- Not significant impact due to road construction.
Hydrology, groundwater	(1): There are a number of wadi channels in the project area, none of which experience continuous wadi flow. However, flow would be expected during rain and flood events.	1	- Not significant impact due to road construction. Flash flood.
Eco-system, Flora and Fauna	Flora: The project area is sparsely vegetated. The vegetation can be classified as an open xeromorphic <i>Euphorbia</i> community type. Fauna: There are no known specific wildlife travel corridors crossing project area. Small mammals and a number of bird species are resident in the area. No	1	- The vegetation will not be significantly affected by the bypass construction.

	rare, endangered or threatened species have been identified in the area. Domestic animals utilize the area for grazing.			
Landscape Hazards	(1): Flat area.	1		- Not significant impact due to road construction.
Regional Development on Natural Environment	(1): Flash flood.	1		- Not significant impact due to road construction.
Other Impacts on Natural environment	(1): Not existing so far. - Not existing so far.	1		- Unknown. - Not existing.
Cultural Heritage	(1): Not existing so far.	1		-The investigation of the cultural heritage is required in the site.
Wastes	- Not significant.	1		- Not significant impact due to road construction.
Regional Development on Social Environment	- Not existing so far.	1		- Unknown.
Other Impacts on Social Environment	(1): Settlements and farmland are present within the whole project area. Both settlements and farmland become less concentrated further southwest from route 21. The impact to these will be subject to the proximity of the bypass to Ibri. Towns along the route: Ibri.	1~2		- High traffic volume is predicted. - Some houses and farms will be possibly relocated due to road alignment. It is necessary to examine road alignment for mitigation.

Evaluation	Other Impacts on Social Environment	1~2	Relocation of some houses and farms.
	Other items	1	

ENVIRONMENTAL CHECKLIST (B6)
Road Section: Salalah Outer Bypass (Raysut to North of Mamurah R, A), Existing road condition: No road
Project No.: B6, Planning road: Paved 2-lane road, Distance: 33km

Environmental Items	Present Condition : Location of each road unit is explained at item of “Topography and Geology”.	Impact Rating 1 = Slight 2 = Moderate 3= Significant	Major Anticipated Impact with Project Predicted traffic volume in 2030: 2,400~11,400 veh/day
Air Pollution	(1)~ (3): Not significant.	1	- Slight air pollution may occur in urban areas due to increase of traffic volume.
Effluent	(1)~ (3): Not existing.	1	- Not significant.
Noise and Vibration	(1)~ (3): insignificant.	1~2	- Slight to moderate noise pollution may occur in urban areas due to increase of traffic volume.
Land Subsidence	(1)~ (3): Not existing.	1	- Not existing.
Topography and Geology	Topography: (1) 0 (Junction at Hajaif to Haruf) ~15km: 0~ 3km: Existing road (Raysut industrial road). 3~ 15km: Road runs on the Low Terrace, mostly flat, and cuts by wajis (8 places). Wadis range in width from 50 to 400m and mostly 10 to 30m deep. (2) 15~ 25.5km: a Road run on the Low Terrace, mostly flat and gentle slope, and cuts by of shallow and deep wajis (6 places). (3) 25.5~ 33km: Road runs on the Low Terrace, mostly flat, and cuts by relatively shallow wajis (4 places). Geology: The project area consists mainly of alluvium deposits of sand and gravel.	1	- Not significant impact due to road construction.
Soil	(1)~ (3): Soil is poorly developed.	1	- Not significant impact due to road construction.
Hydrology, groundwater	(1)~ (3): No current flow in wadis.	1	- Not significant impact due to road construction.
Eco-system, Flora and Fauna	(1)~ (3): Mostly rare vegetation, but low vegetation consisting of small acacia trees and grasses exist in the wadis.	1	- The vegetation will not be significantly affected by the bypass construction.
Landscape	(1)~ (3): Almost low terrace.	1	- Not significant impact due to road construction.
Hazards	(1)~ (3): Flash flood may occur during rain season.	1	- Not significant impact due to road construction.
Regional Development on	- Development for urban area.	1	- Unknown.

Natural Environment				
Other Impacts on Natural environment	- Not existing so far.	1		- Not existing.
Cultural Heritage	- Unknown.	1		-The investigation of the cultural heritage is required in the site.
Wastes	- Not significant.	1		- Not significant impact due to road construction.
Regional Development on Social Environment	- Development for urban area.	1		- Unknown.
Other Impacts on Social Environment	0km: Raysut industrial area and paved road (1): Electric line. 10km point: Masahilah and Haluf villages are located wadi plain. School, mosques, and public garden along the road. Electric line. 15km point: Paved 4-lane road to Ietin. Botanic garden along the road. Electric line. 25.5km point: Paved 4-lane road to Mascut. Botanic garden along the road. 33km point: Paved road to Ayn Rzak. Electric line. Filling station. Electric line.	1		- Presently, no habitants along the road planned, but the population will be increased in future along the road.
Evaluation	Noise and Vibration	1~2		Increased traffic volume
	Other items	1		

ENVIRONMENTAL CHECKLIST (B7)

Road Section: Adam Bypass, Existing road condition: No road
 Project No.: D2, National Road No.31, Planning road: Paved 2-lane road, Distance: 5km

Environmental Items	Present Condition	Impact Rating 1 = Slight 2 = Moderate 3 = Significant	Major Anticipated Impact with Project Predicted traffic volume in 2030: 11,600 veh/day
Air Pollution	: Location of each road unit is explained at item of "Topography and Geology".	1	- Slight air pollution may occur in urban areas due to increase of traffic volume.
Effluent	(1): Not significant so far.	1	- Not significant.
Noise and Vibration	(1): Not significant so far.	1	- Slight noise pollution may occur in urban areas due to increase of traffic volume.
Land Subsidence	(1): Not existing.	1	- Not existing.
Topography and Geology	Topography: (1): Topography of the project area is predominantly flat. High mountains both to the east and west of the town flank Adam. Geology: The project area consists mainly of alluvium deposits of sand and gravel.	1	- Not significant impact due to road construction.
Soil	(1): Soil is poorly developed, mostly suffered by wind erosion. Alluvial soil is found in the wadi, but mostly thin.	1	- Not significant impact due to road construction.
Hydrology, groundwater	(1): The consultants did not identify any wadi channels where Hydrological features may occur within the project area, however, localized run-off would be expected to occur from the nearby mountains in the event of heavy rain fall.	1	- Not significant impact due to road construction.
Eco-system, Flora and Fauna	Flora: The consultants did not identify any wadi channels where Hydrological features may occur within the project area, however, localized run-off would be expected to occur from the nearby mountains in the event of heavy rain fall. Fauna: There are no known specific wildlife travel	1	- The vegetation will not be significantly affected by the bypass construction.

	corridors crossing project area. Small mammals such as rodents, and a number of species of birds are present in the area. No rare, endangered or threatened species have been identified.		
Landscape	(1): Mostly flat and hills.	1	- Not significant impact due to road construction.
Hazards	(1): Flash flood.	1	- Not significant impact due to road construction.
Regional Development on Natural Environment	(1): Not existing so far.	1	- Unknown.
Other Impacts on Natural environment	- Not existing so far.	1	- Not existing.
Cultural Heritage	(1): Forts.	2	-The investigation of the cultural heritage is required in the site.
Wastes	- Not significant.	1	- Not significant impact due to road construction.
Regional Development on Social Environment	- Not existing so far.	1	- Unknown.
Other Impacts on Social Environment	(1): Given the sufficient area to the west of the town it is unlikely that the bypass will impact the settlement areas of Adam. Some farmland is present around the town however given the sufficient space between the settlement areas, farmland and the mountains to the west of the town it is unlikely that these will be impacted. Towns along the route: Adam.	2	- High traffic volume is predicted. - Some houses and farms will be possibly relocated due to road alignment. It is necessary to examine road alignment for mitigation.
Evaluation	Cultural Heritage	2	Influence to cultural heritage
	Other Impacts on Social Environment	2	Relocation of some houses and farms.
	Other items	1	

ENVIRONMENTAL CHECKLIST (B8)

Road Section: Al Kamil North Bypass, Existing road condition: No road
 Project No.: B8, ational Road No.23, Planning road: Paved 2-lane road, Distance: 9km

Environmental Items	Present Condition	Impact Rating 1 = Slight 2 = Moderate 3 = Significant	Major Anticipated Impact with Project Predicted traffic volume in 2030: 15,000~20,000 veh/day
Air Pollution	: Location of each road unit is explained at item of "Topography and Geology". (1): Not significant so far.	1	- Slight air pollution may occur in urban areas due to increase of traffic volume. - Not significant.
Effluent	(1): Not significant so far.	1	- Not significant.
Noise and Vibration	(1): Not significant so far.	1~2	- Slight to moderate noise pollution may occur in urban areas due to increase of traffic volume. - Not existing.
Land Subsidence	(1): Not existing.	1	- Not significant impact due to road construction.
Topography and Geology	Topography: (1): The area is predominantly flat with some low-lying hills, traversed by a small number of wadis. Geology: The project area consists mainly of alluvium deposits of sand and gravel.	1	
Soil	(1): Soil is poorly developed, mostly suffered by wind erosion. Alluvial soil is found in the wadi, but mostly thin.	1	- Not significant impact due to road construction.
Hydrology, groundwater	(1): The proposed bypass, depending on the alignment, may pass within some wadi flow areas. There are no continuous wadi flow areas, although localized wadi flow is likely to occur during rain and flood events.	1	- Not significant impact due to road construction.
Eco-system, Flora and Fauna	Flora: The vegetation in the project area has been widely impacted as a result of the propagation of date plantations. The consultants noted that the plantations have been declining as a result of over-pumping of the ground water supply. Outside of the plantation areas the native vegetation can be classified as an open xenomorphic <i>Euphorbia</i> community type.	2	- The road area is located near the National Park.

	<p>Fauna:</p> <p>There are no known specific wildlife travel corridors crossing project area. Wildlife is relatively diverse in the area including gazelle, Gordon's wildcat and the red fox, as well as rodents and birds are also present in the area.</p>		
Landscape	(1): Flat area.	1	- Not significant impact due to road construction.
Hazards	(1): Flash flood.	1	- Not significant impact due to road construction.
Regional Development on Natural Environment	(1): Not existing so far.	1	- Unknown.
Other Impacts on Natural environment	- Not existing so far.	1	- Not existing.
Cultural Heritage	(1): Not existing so far.	1	-The investigation of the cultural heritage is required in the site.
Wastes	- Not significant.	1	- Not significant impact due to road construction.
Regional Development on Social Environment	- Not existing so far.	1	- Unknown.
Other Impacts on Social Environment	(1): Depending on the alignment of the proposed bypass some sections of the road may pass through farmland (date plantations) as well as settlements. Towns along the route: Al Kamil.	2	- High to very high traffic volume is predicted. - Some houses and farms will be possibly relocated due to road alignment. It is necessary to examine road alignment for mitigation.

Evaluation	Noise	1~2	Increased traffic volume
	Eco-system, Flora and Fauna	2	Passing near the National Park
	Other Impacts on Social Environment	2	Relocation of some houses and farms
	Other items	1	

ENVIRONMENTAL CHECKLIST (B9)

Road Section: Al Wafi East (Al Kamil) Bypass, Existing road condition: No road
 Project No.: B9, National Road No.23, Planning road: Paved 2-lane road, Distance: 11km

Environmental Items	Present Condition	Impact Rating 1 = Slight 2 = Moderate 3= Significant	Major Anticipated Impact with Project Predicted traffic volume in 2030: 12,000 veh/day
Air Pollution	: Location of each road unit is explained at item of "Topography and Geology". (1): Not significant so far.	1	- Slight air pollution may occur in urban areas due to increase of traffic volume.
Effluent	(1): Not significant so far.	1	- Not significant.
Noise and Vibration	(1): Not significant so far.	1	- Slight to moderate noise pollution may occur in urban areas due to increase of traffic volume.
Land Subsidence	(1): Not existing.	1	- Not existing.
Topography and Geology	Topography: (1): The project area is mostly flat with some low-lying hills and traversed by a few wadis. Geology: The project area consists mainly of alluvium deposits of sand and gravel.	1	- Not significant impact due to road construction.
Soil	(1): Soil is poorly developed, mostly suffered by wind erosion. Alluvial soil is found in the wadi, but mostly thin.	1	- Not significant impact due to road construction.
Hydrology, groundwater	(1): The proposed bypass, depending on the alignment, may pass within some wadi flow areas. There are no continuous wadi flow areas, however, localized wadi flow is likely to occur during rain and flood events.	1	- Not significant impact due to road construction.
Eco-system, Flora and Fauna	Flora: The vegetation in the project area has (for the most part) been exploited or replaced as a result of the propagation of date plantations. However, the consultants noted that the plantations have been declining as a result of over-pumping of the ground water supply. Outside of the plantation areas the native vegetation can be classified as an open xeromorphic <i>Euphorbia</i> community type. <i>Acacia tortilis</i> is the dominant species of vegetation.	1	- The vegetation will not be significantly affected by the bypass construction.

	<p>Fauna:</p> <p>There are no known specific wildlife travel corridors crossing project area. No rare, endangered or threatened species have been identified in the area. Small rodents and a number of bird species are present. Domestic animals utilize the area for grazing.</p>		
Landscape	(1): Flat area.	1	- Not significant impact due to road construction.
Hazards	(1): Flash flood.	1	- Not significant impact due to road construction.
Regional Development on Natural Environment	(1): Not existing so far.	1	- Unknown.
Other Impacts on Natural environment	- Not existing so far.	1	- Not existing.
Cultural Heritage	(1): Not existing so far.	1	-The investigation of the cultural heritage is required in the site.
Wastes	- Not significant.	1	- Not significant impact due to road construction.
Regional Development on Social Environment	- Not existing so far.	1	- Unknown.
Other Impacts on Social Environment	(1): Depending on the alignment of the proposed bypass, some sections of the road may pass through farmland (date plantations). Due to the relatively poor condition of the plantations this would not be seen to be a significant impact. Villages along the route: Al Kamil, Al Wafi and Jaalan Bani Bu Hassan.	1	- High traffic volume is predicted.
Evaluation	All items	1	

ENVIRONMENTAL CHECKLIST (G1~G8)

Road Section: Batinah, Existing road condition: No road
 Project No.: G1~G8, National Road No.1, Planning road: Paved 2-lane road

Environmental Items	Present Condition	Impact Rating 1 = Slight 2 = Moderate 3 = Significant	Major Anticipated Impact with Project Predicted traffic volume in 2030: 24,000~45,000 veh/day
Air Pollution	: Location of each road unit is explained at item of "Topography and Geology".	1	- Slight air pollution may occur in urban areas due to increase of traffic volume.
Effluent	- Not existing so far.	1	- Not significant.
Noise and Vibration	- Not existing so far.	1	- Slight to moderate noise pollution may occur in urban areas due to increase of traffic volume.
Land Subsidence	- Not existing so far.	1	- Not existing.
Topography and Geology	Topography: The topography of the Project area is flat. The project area currently lies on existing developed 4-lane highway. Any previous topographical obstructions have already been considered and removed. Flat in urban area. Geology: The project area is located on part of the Batinah coastal plain. A narrow alluvial gravel plain approximately 200 km long. The plain is traversed by several wadis, which flow, from the northern mountains to the sea. Alluvial deposits consist mostly of gravel and sand.	1	- Not significant impact due to road construction.
Soil	- Alluvial soil.	1	- Not significant impact due to road construction.
Hydrology, groundwater	- Most of project sites are installed drainage system.	1	- Not significant impact due to road construction.
Eco-system, Flora and Fauna	- Very little native vegetation exists along the project areas. Irrigated vegetation is present along the existing highway. This can be replanted or relocated once the proposed grade separations have taken place. - No natural vegetation.	1	
Landscape	- Flat. Urban landscape.	1	- Not significant impact due to road construction.

Hazards	- Not existence.	1	- Not significant impact due to road construction.
Regional Development on Natural Environment	- Urban development: Sohar area, etc.	1	- Unknown.
Other Impacts on Natural environment	- Not existing so far.	1	- Not existing.
Cultural Heritage	- Not existing so far.	1	- Not significant impact due to road construction.
Wastes	- Not significant.	1	- Not significant impact due to road construction.
Regional Development on Social Environment	- Urban development: Sohar area, etc.	1	- Unknown.
Other Impacts on Social Environment	- Some sections of the road pass through strip settlement areas. Impacts as a result of grade separation are considered to be minor. - Towns along the route: Seeb, Barka, Muladdah, Suwaiq, Al Khaburrah, Saham, and Sohar.	1	- Very high traffic volume is predicted. Decrease of traffic accident will be expected.

Evaluation	All items	1
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