VILLAGE CODE	VILLAGE NAME	REFERENCE CODES					No. of household	
		Dehstan	Rural Service Center	Rural Cooperative	Irrigation District	Irrigation Zone	1985 MOA	1986 PBO
015131	Abdangsar	DN005	SC004	RC010	AE	AE5	59	48
015132	Abulhassanabad	DN005	SC004		AE	AE3	9	1
015133	Abu Mahaleh	DN005	SC004		AE	AE5	53	44
015134	Aspahi Kola Olia	DN005	SC004	RC010	AE	AE5	61	62
	Aspahi Kola Sofla	DN005	SC004	RC010	AE			
015135	Aspiari	DN005	SC004		AE	AE4	52	59
015136	Eski Mahaleh	DN005	SC004	RC011	HE	AE4	22	24
015137	Ashrafabad	DN005	SC004	RC012	HE	AE2	24	27
015138	Ashkar Kola Sofla	DN005	SC004	RC013	AE	AE3	80	58
015139	Ashkar Kola Olia	DN005	SC004	RC013	AE	AE3		22
015140	Alu	DN005	SC004	RC013	HE	AE1	64	37
015141	Aminabad Surak	DN005	SC004	RC013	HE	AE2	10	8
015142	Ojak	DN005	SC004	RC014	AE	AE3	123	130
015554	Ahangar Kola Olia	DN005	SC004	RC010	AE	AE5	(240)	160
015553	Ahangar Kola Sofla	DN005	SC004	RC010	AE	AE5		85
015144	Barik Mahaleh	DN005	SC004	RC014	AE	AE3	60	65
015145	Bamer Kola	DN005	SC004	RC012	AE	AE5	57	67
015146	Bansar Kola	DN005	SC004	RC011	AE	AE7	197	206
015148	Bur Mahaleh	DN005	SC004	RC013	HE	HE1	29	54
015149	Bish Mahaleh	DN005	SC004		HE	HE3	40	42
015151	Pasha Kola	DN005	SC004		HE	HE1	103	91
015216	Papin	DN005	SC004		AE	AE5	21	26
015152	Palham Keti	DN005	SC004	RC011	HE	HE4	40	44
015154	Tazehabad	DN005	SC004	RC012	AE	AE5	46	46
015156	Tanha Kola	DN005	SC004	RC011	HE	HE4	89	87
015559	Tarvijan	DN005	SC004	RC014	AE	AE3	99	111
015159	Jali Kola	DN005			AE	AE7	64	65
015316	Chareh	DN005	SC004	RC005	HE	HE2	59	64
015163	Hajiabad	DN005	SC004		HE	HE3	58	52
015561	Hajjabad	DN005			AE	AE3		8
015164	Hassanabad	DN005	SC004		HE	HE4	32	28
015165	Hosseinabad	DN005	SC004	RC012	HE	HE3	42	38
015167	Diyu Kola	DN005	SC004	RC005	HE	HE2	45	40
015168	Dangpia	DN005	SC004	RC012	HE	HE3	112	102
015169	Dotireh	DN005	SC004	RC014	AE	AE3	110	98
015319	Darzi Kola	DN005	SC004	RC005	HE	HE1	73	85
015320	Darvish Kheil	DN005	SC004	RC007	HE	HE3	39	117
015170	Div Kola Sofla	DN005	SC004		AE	AE5	74	63
015171	Div Kola Olia	DN005	SC004		AE	AE5	100	105
015172	Dieh	DN005	SC004	RC007	HE	HE3	67	63
015323	Rash Kola	DN005	SC004	RC009	HE	HE1	345	352
015174	Reisabad	DN005	SC004	RC012	HE	HE2	50	55
015175	Ziar Kola	DN005	SC004		AE	AE6	24	38
015301	Sefiddarbon	DN005	SC004	RC005	HE	HE2	87	104
015176	Saraj Mahaleh	DN005	SC004	RC010	AE	AE5	50	38

VILLAGE CODE	VILLAGE NAME	REFERENCE CODES					No. of household	
		Dehstan	Rural Service Center	Rural Cooperative	Irrigation District	Irrigation Zone	1985 MOA	1986 PBO
015177	Soltanabad	DN005	SC004		HE	HE4	12	12
015215	Sangar	DN005	SC004		AE	AE5	23	35
015179	Surak	DN005	SC004	RC013	HE	AE2	33	67
015180	Shaneband(Olia)	DN005	SC004		AE	AE5	59	69
	Shaneband(Sofla)	DN005	SC004		AE	AE5		
015572	Shah Keti	DN005	SC004	RC013	AE	AE3	138	136
015181	Shah Kola	DN005	SC004	RC010	HE	AE2	61	61
015182	Shariatabad	DN005	SC004	RC012	HE	HE3	17	15
015183	Shahr Keti	DN005	SC004		HE	HE4	23	24
015184	Sorat Kola	DN005	SC004	RC014	AE	AE5	36	38
015185	Taherabad	DN005	SC004		AE	AE5	10	9
015331	Tooleh Kola	DN005	SC004	RC013	HE	HE1	120	137
015581	Azimabad	DN005	SC004	RC013	AE	AE3	27	27
015158	Gheis Kola	DN005	SC004	RC010	AE	AE6	110	114
015189	Ghalla Keti	DN005	SC004		HE	HE3	-	13
015188	Ghara Kola	DN005	SC004	RC010	AE	AE6	74	81
	Kord Kheil	DN005	SC004	RC005	HE	HE1	54	-
015190	Kashi Mahaleh	DN005	SC004		HE	HE3	36	37
015192	Korsi Kola Sofla	DN005	SC004	RC010	AE	AE5	80	96
	Korsi Kola Olia	DN005	SC004	RC010	AE	AE5	55	
015585	Kabud Kola	DN005	SC004	RC014	AE	AE5	140	134
015195	Kaliksar	DN005	SC004		HE	AE3	96	98
015197	Kamangar Kola	DN005	SC004	RC013	AE	AE5	90	109
015348	Galesh Kola	DN005		RC013	HE	HE1	58	59
015200	Mahut Kola	DN005	SC004	RC010	AE	AE4	39	32
015592	Marzangu	DN005	SC004	RC014	AE	AE4	315	280
	Majidabad	DN005	SC004	RC007	AE	AE6	20	-
015201	Mahammadabad	DN005			AE	AE3	20	17
015202	Motaher Sofla	DN005	SC004	RC011	HE	HE4	84	85
015203	Motaher Olia	DN005	SC004	RC011	HE	HE4	94	112
015204	Mamrez Keti	DN005	SC004	RC012	HE	HE3	53	50
015205	Muzi Keti Sofla	DN005	SC004	RC011	AE	AE6	53	54
015206	Muzi Keti Olia	DN005	SC004	RC011	AE	AE6	34	33
015207	Musa Mahaleh	DN005	SC004		HE	HE4	38	39
015208	Mianrud	DN005	SC004	RC012	HE	HE3	25	26
015353	Naserabad	DN005	SC004		HE	HE2	-	17
015209	Naijabad	DN005	SC004	RC010	AE	AE4	57	56
015210	Narges Marz	DN005	SC004	RC007	AE	AE6	57	74
015603	Valik Sofla	DN005	SC004	RC013	AE	AE3	53	51
015604	Valik Olia	DN005	SC004	RC013	AE	AE3	-	112
015357	Vaskol	DN005	SC004	RC007	HE	HE3	41	47
015600	Vaskus	DN005	SC004	RC014	AE	AE3	235	206
015306	Heshtal Bala	DN005	SC004	RC005	HE	HE2	61	61

VILLAGE CODE	VILLAGE NAME	REFERENCE CODES					No. of household	
		Dehstan	Rural Service Center	Rural Cooperative	Irrigation District	Irrigation Zone	1985 MOA	1986 PBO
015311	Heshtal Poin	DN005	SC004	RC005	HE	HE1	110	176
	Hellalkhor Mahaleh	DN005	SC004	RC007	HE	HE4	84	-
015214	Yusefabad	DN005	SC004	RC013	AE	AE3	26	29
015143	Ahangar Kola	DN006	SC004		AW	AW8	47	52
015130	Absaraft	DN006	SC004	RC013	HE	HE1	36	34
015420	Eski Mahaleh	DN006	SC005	RC016	HW	HW6	112	116
015421	Ojiabad	DN006	SC005	RC016	HW	HW6	168	157
	Agha Mohammadabad	DN006	SC004				-	-
015147	Bakhtiar Keti	DN006	SC005	RC016	AW	AW8	29	32
015028	Bam Keti	DN006	SC005	RC003	HW	HW5	30	24
015422	Bish Mahaleh	DN006			AW	AW6	40	41
015423	Pasha Kola	DN006	SC005		AW	AW6	52	52
015310	Pasha Kola	DN006			HE	HE1	(195)	33
015153	Polkiadeh	DN006		RC013	AE	AE1	52	57
	Tokaran Farm	DN006					-	-
015155	Tamsak	DN006	SC005	RC017	AW	AW9	12	14
015162	Jamshidabad	DN006	SC004	RC017	AE	AE1	52	58
015161	Jafarabad	DN006	SC005	RC016	AW	AW8	37	66
	Jin-mod Factory	DN006			AE		-	-
015488	Hosseinabad	DN006	SC005	RC016	HW	HW5	22	25
015166	Kharab Mianrud	DN006	SC005		AW	AW8	17	15
015173	Rafiabad	DN006	SC005	RC017	AW	AW9	27	73
015674	Zaghdeh	DN006	SC005	RC018	AW	AW7	69	66
015492	Sang Keti	DN006	SC002	RC021	HW	HW6	55	58
015178	Sang Bast	DN006	SC005	RC017	AW	AW9	75	81
015424	Seiddin Kola	DN006	SC005	RC017	AW	AW8	62	52
015672	Rudbar	DN006		RC018	AW	AW7	165	162
015329	Sharm Kola	DN006	SC004	RC013	HE	HE1	101	100
015576	Sheikhabad	DN006	SC005		AW	AW9	49	47
	Salla Keti Farm	DN006					-	-
015186	Aali Kola Ahi	DN006		RC013	AE	AE5	135	141
015187	Farahabad	DN006	SC004	RC017	AE	AE1	-	11
015425	Ghadi Mahaleh	DN006	SC005	RC016	HW	HW6	86	81
015426	Ghorogh	DN006		RC016	HW	AU	85	85
015344	Kamangar Kola	DN006			HE	HE1	230	199
015194	Kelikan Olia	DN006	SC005		AW	AW8	60	24
015193	Kelikan Sofla	DN006	SC005		AW	AW8		34
015196	Kola Mahaleh	DN006	SC005	RC016	HW	HW6	20	22
015198	Kohnehdan	DN006		RC013	AE	AE2	120	103
015199	Lati Kola	DN006	SC004	RC013	AE	AE1	40	40
015503	Kola Safa	DN006	SC005	RC016	HW	HW5	98	117
015191	Kerati	DN006	SC004	RC013	AE	AE1	15	2
015507	Masumabad	DN006	SC002	RC016	HW	HW6	65	60
	Mohandis Farm	DN006					-	-
015427	Mianrud	DN006	SC005	RC017	AW	AW6	54	49

VILLAGE CODE	VILLAGE NAME	REFERENCE CODES					No. of household	
		Dehstan	Rural Service Center	Rural Cooperative	Irrigation District	Irrigation Zone	1985 MOA	1986 PBO
015212	No Kola	DN006	SC005		AW	AW8	72	71
015211	Nodeh	DN006	SC005	RC016	AW	AW8	45	41
015213	Hereh Pak	DN006	SC005	RC016	AW	AW8	13	14
015428	Hemmatabad	DN006	SC005	RC018	AW	AW6	35	38
015472	Abad Mahaleh	DN007	SC002	RC019	AW	AW4	-	113
015473 **	NIOC Camp	DN007			AW	AW3	-	21
015474	Azadmun	DN007	SC002	RC020	AW	AW3	300	311
015475	Ahlam	DN007	SC002	RC020	AW	AW3	215	218
015476 **	Ahu Mahaleh	DN007			AW	AW4	90	98
015477	Birjandeh	DN007	SC002	RC020	AW	AW1	165	183
015478	Bulideh	DN007			HW	HW4	-	45
015479	Bundeh	DN007	SC002	RC020	AW	AW2	95	96
015667	Bayudeh Olia	DN007	SC002	RC021	AW	AW6	96	105
015666	Bayudeh Sofla	DN007	SC002	RC018	AW	AW6	75	81
015480	Taj Kener	DN007	SC002	RC020	AW	AW3	100	52
015482	Tarsiab	DN007	SC002	RC019	AW	AW4	71	92
015483	Tashbandan	DN007	SC002	RC019	AW	AW5	-	35
015484 **	Talik Sar	DN007			AW	AW4	163	103
015485	Juni Kola	DN007	SC002	RC021	AW	AW4	81	90
015487	Hassanabad	DN007	SC002	RC021	HW	HW5	35	30
015489	Kheshtsar	DN007	SC002	RC020	AW	AW1	280	260
015490	Khordon Kola	DN007	SC002	RC021	AW	AW3	120	113
015675	Zangi Kola	DN007		RC021	AW	AW6	103	121
	Sayuja	DN007			AW		-	-
015493	Saiar Kola	DN007	SC002	RC019	AW	AW3	143	134
015494	Sherafti	DN007	SC002	RC020	AW	AW1	60	68
015495	Shurstagh	DN007	SC002	RC020	AW	AW1	50	43
015496	Shumia	DN007	SC002		AW	AW2	203	183
015497	Talaram	DN007	SC002	RC021	HW	HW4	72	80
015498	Esheghabad	DN007	SC002	RC021	AW	AW6	56	59
015499	Ghassab Keti	DN007	SC002	RC016	HW	HW5	97	116
015500	Karchak Larijani	DN007	SC002	RC021	HW	HW6	55	56
015501	Karchak Navai	DN007	SC002	RC016	HW	HW5	46	45
015502	Kuldeh	DN007	SC002	RC016/RC021	HW	HW5	220	166
	Kahlu Kaj	DN007	SC002	RC021	HW		-	-
015504	Galesh Pol	DN007	SC002	RC019	AW	AW3	175	171
015505	Gelird	DN007	SC002	RC021/RC012	HW	HW4	153	156
015506	Gilapei	DN007	SC002	RC021	AW	AW4	92	110
015508	Mir-alamdeh	DN007	SC002	RC021	HW	HW4	132	101
015509	Namusdeh(Eslamabad)	DN007	SC002	RC016	HW	HW5	103	107
015684	Naserabad	DN007	SC002	RC021	AW	AW6	85	43
015510	Yusefabad	DN007	SC002	RC019	AW	AW3	135	98
015550	Abulhassanabad	DN008	SC005	RC022	AW	AW9	60	58
015660	Arem	DN008	SC005	RC023	AW	AW5	157	148

VILLAGE CODE	VILLAGE NAME	REFERENCE CODES					No. of household	
		Dehstan	Rural Service Center	Rural Cooperative	Irrigation District	Irrigation Zone	1985 MOA	1986 PBO
015662	Asadollahabad	DN008	SC005	RC022	AW	AW7	30	26
015663	Eskandeh	DN008	SC005	RC018	AW	AW7	70	73
015664	Afra Takhat	DN008	SC005	RC018	AW	AW7	21	25
015665	Ahi Mahaleh	DN008		RC023	AW	AW5	180	190
015686	Ormak Kola	DN008	SC005	RC023	AW	AW5	73	79
015668	Bisheh Kola	DN008	SC005		AW	AW7	315	301
015558	Tazehabad	DN008	SC005	RC025	AW	AW9	100	91
015669	Jura Kola	DN008	SC005	RC023	AW	AW5	135	150
015670	Chahar Afra	DN008	SC005	RC022	AW	AW7	47	48
015486	Harabdeh	DN008	SC002	RC019	AW	AW5	85	85
	Hat Aahi	DN008			AW		-	-
015671	Daria Sar	DN008	SC005	RC022	AW	AW7	71	54
015565	Zardab	DN008	SC005	RC022	AW	AW9	205	223
015673	Rudposht	DN008	SC005	RC022	AW	AW7	136	131
015676	Siah Rudsar	DN008	SC005	RC022	AW	AW7	100	115
015570	Siah Kola	DN008	SC005	RC022	AW	AW9	32	48
015579	Abudallahabad	DN008	SC005	RC018	AW	AW9	240	234
015678	Alamdeh Sharghi	DN008	SC005	RC022	AW	AW9	46	49
015677	Alamdeh Gharbi	DN008	SC005	RC022	AW	AW9	70	67
015679	Aliabad	DN008	SC005	RC022	AW	AW7	150	159
015580	Ezzatabad	DN008	SC005	RC022	AW	AW9	52	44
015680	Urtihdasht	DN008	SC005	RC018	AW	AW5	42	43
015583	Faramdeh	DN008	SC005	RC018	AW	AW9	85	89
015589	Kulusa	DN008	SC005	RC017	AW	AW9	-	37
015681	Kolmarz Olia	DN008	SC005	RC022	AW	AW7	105	108
015682	Matorij	DN008	SC005		AW	AW5	85	93
015594	Moalem Kola	DN008	SC005	RC022	AW	AW9	526	375
015683	Mian Kolmarz	DN008	SC005	RC023	AW	AW7	50	54
015599	Vazik	DN008	SC005	RC018	AW	AW5	80	87
015602	Valem Olia	DN008	SC005	RC017	AW	AW9	41	49
015685	Yamchi	DN008	SC005		AW	AW5	70	108
015552	Afrasara	DN009	SC005	RC024	AW	AW9	43	46
015560	Chaksar	DN009	SC005	RC024	AW	AW9	85	91
015562	Haji Kola Bala	DN009	SC005		AW	AW9		83
015563	Haji Kola Poin	DN009			AW	AW9	110	108
015564	Darvishabad	DN009		RC024	AW	AW9	33	27
015566	Zangi Kola Sofla	DN009	SC005	RC024	AW	AW9	50	56
015567	Zangi Kola Olia	DN009	SC005	RC024	AW	AW9	200	204
015568	Sorkhrud Gharbi	DN009	SC005	RC024	AW	AW9	330	296
015569	Sorkhrud Sharghi	DN009	SC005	RC024	AE	AE3	320	317
015571	Sirjarun	DN009	SC004	RC024	AE	AE3	90	90
015573	Shah Kola Kelij Sofla	DN009	SC005		AW	AW9	45	71
015574	Shah Kola Kelij Olia	DN009	SC005		AW	AW9	81	86
015575	Islam(Shah) Mahaleh	DN009		RC024	AW	AW9	80	85

VILLAGE CODE	VILLAGE NAME	REFERENCE CODES					No. of household	
		Dehstan	Rural Service Center	Rural Cooperative	Irrigation District	Irrigation Zone	1985 MOA	1986 PBO
015582	Alavi Kola Mir	DN009		RC025	AW	AW9	125	135
015586	Kechab Sofla	DN009	SC004	RC014	AE	AE3	150	155
015587	Kechab Olia	DN009	SC004	RC014	AE	AE4	115	127
015588	Kechab Kulva	DN009	SC005	RC014	AE	AE3	179	140
015590	Kons Marz	DN009	SC004	RC025	AW	AW9	65	71
015591	Gol Mahaleh	DN009	SC004	RC024	AE	AE3	127	104
015593	Marich Mahaleh	DN009		RC024	AE	AE3	400	353
015595	Molla Kola	DN009	SC005	RC022	AW	AW9	300	294
015596	Mirdeh Sofla	DN009	SC005	RC025	AW	AW9	28	31
015597	Mirdeh Olia	DN009	SC005	RC025	AW	AW9	36	34
015601	Varza Mahaleh	DN009	SC006	RC024	AE	AE3	150	158
015551	Ezbaran	DN010	SC006	RC015	AE	AE4	408	366
	Asbu Kola	DN010	SC006		AE	AE8	-	-
015556	Bozorg Bisheh Mahaleh	DN010	SC006		AE	AE6	290	223
015555	Boneh Kenar	DN010	SC006	RC015	AE	AE4	215	179
015150	Binamad	DN010	SC006		AE	AE6	132	97
015160	Jazin	DN010	SC006	RC015	AE	AE7	75	76
016936	Zahed Kola	DN010	SC006		AE	AE8	76	81
015857	Darzi Mahaleh	DN010			AE	AE9		32
015768	Shahrak Farzadshahr	DN010	SC006		AE	AE3	-	14
015577	Shira(Hosseinabad)	DN010	SC006		AE	AE3	70	58
015578	Shir Mahaleh	DN010	SC006	RC015	AE	AE4	400	320
015157	Tooleh Sara	DN010	SC006	RC015	AE	AE6	52	36
015584	Kardgar Mahaleh	DN010	SC006	RC015	AE	AE4	325	314
	Kuleh Sara	DN010			AE		-	-
015828	Kalagar Sara	DN010	SC006	RC026	AE	AE7	75	77
015557	Kuchak Bisheh Mahaleh	DN010	SC006	RC014	AE	AE4	183	144
015830	Mangharpei	DN010	SC006	RC026	AE	AE6	120	104
015831	Mahlban	DN010	SC006	RC026	AE	AE6	275	252
015832	Mianbal	DN010			AE	AE9	46	49
015598	Navai Mahaleh	DN010	SC006		AE	AE4	235	228
015853	Ojaksar	DN011	SC007	RC027	AE	AE11	330	372
015825	Heidar Kola	DN011	SC006	RC026	AE	AE7	95	93
	Khaneh Dariai	DN011			AE		-	-
015867	Rudbast	DN011		RC027	AE	AE11	-	44
015860	Saadat Mahaleh	DN011	SC007	RC027	AE	AE11	197	169
015826	Suteh	DN011	SC006	RC026	AE	AE7	332	311
015858	Shahrak Dariasar	DN011	SC006		AE	AE11	-	20
015859	Shahrak Daria Kenar	DN011	SC006		AE	AE11	-	324
015856	Shahrak Khazar Shahr	DN011	SC006		AE	AE11	-	136
016942	Sharmeh Kola	DN011	SC006		AE	AE9	74	74
015767	Askarnia	DN011			AE	AE11	-	8
015827	Ferm	DN011	SC006	RC026	AE	AE7	170	182
015765	Firuzabad	DN011	SC006		AE	AE11	-	107
015865	Gavzan Mahaleh	DN011	SC007	RC027	AE	AE11	350	319
015829	Molla Kola	DN011	SC006	RC026	AE	AE8	50	55

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VILLAGE CODE	VILLAGE NAME	REFERENCE CODES					No. of household	
		Dehstan	Rural Service Center	Rural Cooperative	Irrigation District	Irrigation Zone	1985 MOA	1986 PBO
	Nurandaz	DN011			AE		-	-
015854	Armich Kola	DN012	SC007	RC027	AE	AE11	-	127
015855	Esfandiar Mahaleh	DN012	SC007	RC027	AE	AE11	28	25
016913	Barik Kola	DN012		RC028	HE	KL5	140	154
016927	Khoshkrud	DN012	SC007	RC027	AE	AE11	235	235
016931	Dughi Kola	DN012	SC007	RC033	AE	AE9	110	137
016934	Raz Kenar	DN012	SC007	RC033	AE	AE10	135	135
016935	Rekun	DN012	SC007	RC028	AE	AE11	45	51
015861	Seid Mahaleh	DN012	SC007		AE	AE11	-	73
016943	Shamshir Mahaleh	DN012		RC028	HE	KL5	27	24
015862	Ghadi Mahaleh	DN012	SC007	RC027	AE	AE11	38	40
016947	Kari Kola	DN012	SC007	RC027	AE	AE11	95	96
015863	Kalleh Bast	DN012	SC007	RC027	AE	AE11	535	512
015864	Kikha Mahaleh	DN012	SC007	RC027	AE	AE11	126	137
016951	Galleh Kola	DN012			HE	KL5	75	66
016945	Fulad Kola	DN012	SC007	RC028	AE	AE11	250	271
015866	Lari Mahaleh	DN012	SC007	RC027	AE	AE11	-	1
016955	Mashahdi Kola	DN012	SC007	RC028	AE	AE11	90	75
016963	Nosrat Kola	DN012	SC007		AE	AE11	84	88
016961	Valikrud Posht	DN012	SC006	RC033	AE	AE9	64	71
017164	Asbu Kola	DN013	SC008	RC030	HE	KL5	50	377
017016	Agha Malek	DN013	SC008	RC029	HE	KR5	300	256
017017	Aktij Kola	DN013	SC008	RC030	HE	KR5	95	91

VILLAGE CODE	VILLAGE NAME	REFERENCE CODES					No. of household	
		Dehstan	Rural Service Center	Rural Cooperative	Irrigation District	Irrigation Zone	1985 MOA	1986 PBO
017018	Allah Chal	DN013	SC008	RC029	HE	KR4	137	159
017019 *	Allah Rudbar	DN013	SC008	RC031	VCKL6	VCKL6	-	277
017059 *	Ahangar Kola	DN013			VCKR4	VCKR4		48
017020 *	Baba Abad	DN013	SC008	RC030	VCKL6	VCKL6	-	31
017167	Babulkan Sofla	DN013	SC010	RC031	HE	KL4	35	35
017168	Babulkan Olia	DN013	SC010	RC031	HE	KL4	88	68
017169	Baziar Bala	DN013	SC008	RC029	HE	KR4	152	160
017170	Baziar Poin	DN013	SC008	RC029	HE	KR4	220	235
016917	Buleh Kola	DN013	SC008		HE	KL6	140	118
017171	Bala Ahmad Chalehpei	DN013	SC008	RC029	HE	KL3	235	250
017021	Poin Ahmad Chalehpei	DN013	SC008	RC029	HE	KR5	305	218
016923	Tork Mahaleh	DN013	SC008	RC032	HE	KL6	200	191
017176	Chenarbon	DN013	SC008	RC029	HE	KL3	170	143
017022	Hamzeh Reza	DN013	SC008	RC029	HE	KR4	36	33
017028	Hamzeh Kola Shish Pol	DN013	SC008	RC030	HE	KR5	230	206
017179	Kharji Kola	DN013		RC035	HE	KL4	70	66
017023	Khorassan Mahaleh	DN013	SC008	RC030	HE	KR4	320	263
017180	Khateb	DN013	SC008	RC029	HE	KL3	93	71
017025	Delavar Kola	DN013			HE	KR5	120	120
017181	Davud Kola Astanehsar	DN013	SC008		HE	KL3	113	92
017024	Darzi Kola Agha Shafii	DN013	SC008	RC029	HE	KR4	230	190
	Darzi Kola Nurshirvan Kola	DN013					-	-
017184	Darvish Khak Bala	DN013	SC008	RC030	HE	KL6	129	138
	Darvish Khak Poin	DN013	SC008	RC030	HE	KL6		
	Rekaj	DN013	SC008	RC029		KR4	3	-
017185	Rangerz Kola	DN013			HE	KL4	-	6
017186	Zahed Kola	DN013		RC029	HE	KL3	106	95
017026 *	Saadat Mahaleh	DN013		RC030	VCKR4	VCKR4	87	90
017027	Shasb Kola	DN013			VCKR4	VCKR4		
017030	Sheikh Mahaleh	DN013			HE	KR4	60	117
017189	Torghchi Kola	DN013	SC008	RC029	HE	KL3	87	52
	Ghassab Amir	DN013			HE	VCKR6		95
017093 *	Ghassab Kola Zalkan	DN013			VCKR4	VCKR4		102
017032	Ghassab Kola Miandeh	DN013			HE	KR4	54	82
017094 *	Ghomi Kola	DN013			VCKR4	VCKR4		168
017031 *	Aali Zamin	DN013			VCKR4	VCKR4		80
017192	Kazem Beigi	DN013	SC008	RC029	HE	KL3	88	84
017196	Garmich	DN013	SC008	RC030	HE	KL4	54	46
017197	Gol Mahaleh	DN013	SC008		HE	KL3	-	51
017200	Laluk	DN013	SC008	RC029	HE	KR4	98	68
016953	Mati Kola	DN013	SC008	RC032	HE	KL6	220	186
017202	Mazafar Kola	DN013	SC008	RC029	HE	KL3	80	68
017034	Naghorechi Mahaleh	DN013			VCKL6	VCKL6	-	171
017016	Nushirvan Kola	DN013			VCKL4	VCKL4		

VILLAGE CODE	VILLAGE NAME	REFERENCE CODES					No. of household	
		Dehstan	Rural Service Center	Rural Cooperative	Irrigation District	Irrigation Zone	1985 MOA	1986 PBO
017206	Varmton	DN013	SC010	RC031	HE	KL4	114	98
017207	Yaghi Kola	DN013		RC029	HE	KR4	60	52
016910	Archi	DN014	SC009	RC033	AE	AE10	120	131
017163	Ard Kola	DN014	SC009		HE	KL4	145	161
016911	Asbushurpei	DN014	SC009	RC034	AE	AE8	180	178
017166	Imanabad	DN014	SC010		HE	KL3	268	295
017165	Andi Kola	DN014	SC010	RC034	HE	KL3	260	223
016914	Barseminan	DN014	SC010		HE	KL5	190	204
016915	Basera Bala	DN014	SC009	RC036	HE	KL4	140	186
	Basera Poin	DN014	SC009	RC036	HE	KL4	75	
016916	Buleh Kola Marzanabad	DN014		RC036	HE	BU	-	51
016920	Bizi Kola	DN014	SC010	RC034	HE	HE5	225	197
016918	Pahnahvar	DN014	SC010	RC034	AE	AE8	45	44
016919	Picha Kola	DN014	SC009	RC036	HE	KL4	250	194
016921	Tajaldoulleh	DN014	SC007	RC036	AE	AE11	46	34
016922	Tajnak	DN014	SC010	RC035	HE	KL4	250	218
017172	Tari Mahaleh	DN014	SC010		HE	HE5	90	93
016924	Talikaran	DN014	SC009	RC033	AE	AE10	250	210
017175	Chamazin	DN014		RC035	HE	KL5	95	105
017178	Hiji Kola Lalehabad	DN014	SC010		HE	KL6	132	132
016926	Khordon Kola	DN014	SC010		HE	KL6	180	171
016928	Khalil Kola	DN014	SC010	RC035	HE	KL4	100	86
017182	Darzi Kola Bozorg	DN014	SC010		HE	HE5	149	155
016929	Darzi Kola Karim Kola	DN014	SC009		AE	AE9	100	150
017183	Darzi Kola Kuchak	DN014	SC010	RC034	HE	HE5	35	33
016930	Darvish Kheil Marzanabad	BU		RC036	HE	BU	180	146
016932	Dahak	DN014	SC010	RC036	HE	KL6	100	119
016933	Rah Kola	DN014	SC009	RC036	HE	KL5	80	75
016937	Zargar Mahaleh	DN014	SC010		HE	KL4	85	64
016938	Sarvan Mahaleh	DN014	SC010	RC035	HE	KL4	28	27
016939	Sangchi	DN014	SC010	RC034	HE	HE5	45	46
016940	Shareh	DN014	SC009	RC033	AE	AE9	130	139
016944	Shahid Abudallah	DN014	SC009	RC034	AE	AE9	110	77
017188	Shariat Kola	DN014	SC009		HE	HE5	-	132
016941	Shariat(Shah)Kola Karim Kola	DN014	SC010	RC033	AE	AE9	96	71
017191	Aliabad	DN014	SC007		HE	HE5	70	73
017190	Toghan	DN014	SC009	RC035	HE	KL4	90	97
016946	Ghadi Kola	DN014	SC009		AE	AE10	112	113
	Ghassab Kola	DN014			HE		-	-
016948	Keti Sar	DN014	SC009		HE	KL5	73	79
016949	Kalangah	DN014	SC009	RC035	AE	AE9	115	87
	Karfu Kola	DN014	SC009	RC033	AE	AE9	64	-
016925	Karim Kola Tavakol	DN014	SC009		AE	AE9	22	20
017193	Kuru Kola Bala	DN014	SC010	RC028	HE	KL3	115	88

VILLAGE CODE	VILLAGE NAME	REFERENCE CODES					No. of household	
		Dehstan	Rural Service Center	Rural Cooperative	Irrigation District	Irrigation Zone	1985 MOA	1986 PBO
017194	Kuru Kola Poin	DN014	SC010	RC028	HE	KL3	200	136
017195	Kamangar	DN014	SC010	RC036	HE	KL5	120	124
016950	Gardan Bari Olia	DN014	SC009	RC035	HE	KL4	123	114
017199	Lotofaliabad	DN014	SC010	RC034	HE	HE5	26	25
016952	Motekeh	DN014	SC010	RC035	HE	KL4	81	87
017203	Monas Kola	DN014	SC010	RC035	HE	KL4	87	69
016954	Marzbal	DN014	SC009		HE	KL4	88	90
017201	Mosir Mahaleh	DN014	SC010	RC034	HE	KL3	63	67
016956	Muzirij Astanehsar	DN014	SC010	RC036	HE	BU	520	200
016957	Miandasteh	DN014	SC010	RC034	HE	KL3	110	111
016958	Mianrud	DN014		RC036	HE	KL5	25	22
016959	Nodahak	DN014	SC010	RC034	AE	AE7	113	110
017204	Navai Kola	DN014	SC010	RC034	HE	KL3	150	122
016960	Nei Kola	DN014	SC009		HE	KL5	45	45
016962	Halel Kola	DN014	SC010	RC034	HE	HE5	141	158
	Vish Mahaleh	DN014	SC009	RC034	HE		-	-
017033	Najjar Mahaleh	DN015			VCKL6	VCKL6	-	43

TABLE D.3-2 OUTLOOK OF RURAL COOPERATIVES IN THE PROJECT AREA

DEHSTAN	NAME OF COOPERATIVE	LOCATION OF CENTER	NO.OF MEMBER	CAPITAL	NO. OF MEMBER VILLAGES
(AMOL AREA)					
Bala Khiaban Latikuh	Golestan	Darazan	1,135	Rls 46,566,000	25
Poin Khiaban Latikuh	Aghuzbon	Aghuzbon	1,372	74,632,000	15
	Pishru	Hosseinabad	2,027	87,118,950	25
Dabu Junubi	Dabu	Marzangu	2,209	58,875,200	16
	Taher	Motaher	924	38,413,000	19
	Esfand	Hosseinabad	855	36,478,400	11
	Etemad	Div Kola	1,330	46,419,300	19
	Aresh	Surak	1,837	83,047,150	22
Dashtsar	Vahadat	Pasha Kola	1,636	79,680,250	12
	Nima	Keti Posht	1,529	74,188,100	11
	Vali Asr	Ghaleh Kosh	1,071	39,005,350	13
	Bahaman	Ejibar Kola	753	49,045,950	3
	Hendu Kola	Hendu Kola	985	58,203,300	12
Harazpei Junubi	Resalat	Ghadi Mahaleh	1,501	82,768,700	24
	Haghighat	Rudbar	1,166	53,375,850	12
	Momtaz	Sangbast	622	36,319,200	10
Ahlamrostagh	Taliksar	Taliksar	1,702	55,690,150	11
	Payam	Azadmun	1,334	56,827,250	8
	Tohid	Kuldeh	1,332	66,591,100	14
Dabu Shomali	Omid	Alavi Kola Mir	879	44,685,300	9
	Ettehad	Sorkhrud	2,150	70,946,450	16
	Molla Kola	Molla Kola	2,248	58,931,700	16
MEAN (TOTAL)			1,340	58,500,000	(321) 14
(BABOLSAR AREA)					
Emamzadeh Abudollah	Deh Feri*	Kardgar Mahaleh	1,607	49,960,700	9
Barikrud	Khazar	Suteh	1,645	56,378,550	12
Rudbast	Rudbast	Kaleh Bast	2,961	118,522,850	26
MEAN (TOTAL)			2,071	74,954.000	(47) 16
(BABOL AREA)					
Karipei	Azadi	Zargar Mahaleh	2,230	76,314,600	22
	Pishru	Darzi Kola Bozorg	2,369	93,072,050	22
	Hadaf	Barsemnan	2,312	126,568,400	15
	Hafez	Ghadi Kola	1,724	52,504,100	17
Lalehabad	Pol Ansari	Ahmad Chalehpei	2,686	104,019,600	17
	Andisheh	Tork Mahaleh	1,680	71,716,950	12
	Asbu Kola	Asbu Kola	1,802	84,920,200	10
MEAN (TOTAL)			2,115	83,400,000	(115) 16

* Transferred from Amol Area

TABLE D.3-3 RECORD OF RECEIPT OF CREDIT FROM BANK OF AGRICULTURE IN THE PROJECT AREA BY RURAL COOPERATIVES

NAME OF COOPERATIVE	1356	1357	1358	1359	1360	1361	1362	1363	1364	1365	1366	1367	1368	1369
(AMOL AREA)														
Golestan	11	12	7	34	45	11	65	33	31	40	45	60	60	70
Aghuzbon	14	15	3	30	53	80	80	37	84	50	70	85	50	135
Pishru	28	30	11	90	135	-	120	60	60	75	85	100	-	100
Dabu	28	29	15	90	130	33	130	-	70	77	-	85	85	-
Taher	14	15	18	40	75	18	60	24	20	45	50	60	60	-
Esfand	14	15	11	40	64	15	55	20	23	40	45	60	-	60
Etemad	20	21	28	53	100	24	106	-	40	55	60	65	65	90
Aresh	17	11	23	68	97	24	100	50	110	75	100	120	-	340
Vahadat	12	13	15	47	75	18	100	50	47	60	70	90	85	85
Nima	14	17	4	-	77	19	120	60	55	65	70	90	85	85
Vali Asr	19	20	-	68	85	19	80	25	21	51	55	55	-	-
Bahaman	10	14	5	37	55	13	48	25	25	35	50	55	55	75
Hendu Kola	10	11	24	40	60	80	80	40	40	50	55	70	63	70
Resalat	25	25	12	40	53	24	117	50	50	70	75	75	90	100
Haghighat	15	17	9	50	85	19	61	31	33	45	50	55	-	65
Momtaz	10	13	8	35	52	12	44	22	22	35	-	40	45	50
Taliksar	27	35	61	95	50	27	80	40	80	55	-	80	-	105
Payam	18	19	10	50	44	18	85	42	85	55	70	-	70	70
Tohid	-	27	11	71	82	21	80	50	100	70	80	98	98	200
Omid	14	16	6	41	68	72	-	57	57	60	70	-	70	70
Ettehad	18	20	18	81	110	33	128	65	130	75	92	-	92	110
Holla Kola	23	27	10	-	80	33	120	-	43	75	80	65	-	-
TOTAL	361	422	309	1,100	1,675	614	1,859	781	1,226	1,258	1,272	1,438	1,073	1,880
(BABOLSAR AREA)														
Deh Feri	23	24	11	69	95	-	90	-	30	60	65	75	75	-
Khazar	8	-	10	29	100	67	-	52	67	73	86	-	75	100
Rudbast	18	-	18	123	100	94	105	92	113	127	129	171	204	275
TOTAL	49	24	39	221	295	161	195	144	210	260	280	246	354	375
(BABOL AREA)														
Azadi	30	-	45	93	120	103	167	-	-	161	212	159	176	100
Pishru	29	12	139	96	40	123	140	-	151	-	160	145	163	163
Hadaf	22	-	110	120	90	77	-	75	113	150	169	191	153	290
Hafez	-	18	-	-	-	60	-	49	62	68	84	90	69	92
Pol Ansari	-	-	-	120	150	98	107	-	84	116	165	149	155	243
Andisheh	20	-	86	66	17	58	67	55	74	81	90	96	87	123
Asbu Kola	24	-	132	-	138	80	95	-	75	93	124	124	120	121
TOTAL	125	30	512	495	550	599	576	179	559	669	1,004	954	923	1,132

NOTE: The year of 1356 is starting from March 21, 1977

D. 4 Rural Infrastructures

(1) Data Applied

The Village Gazette in 1986 and the Census Report of Agriculture in 1988 are applied as the source of information.

(2) Analysis

All available data in the above sources were rearranged by villages and sorted into subtotal of the Dehstans or the Irrigation Zones as shown in the Tables D. 4-1 and D. 4-2.

As explained in the Section D. 3, the Village Gazette and Agricultural Census are not covering whole villages in the Project Area, but the trend of rural infrastructure availability can be read therefrom.

D. 4. 1 Availability of Social Infrastructure in the Project Area

Tables D. 4-1 and D. 4-2 are showing the details of availability of social infrastructure and main items of such infrastructure are plotted on the map as shown in Figure 3. 2-2 in the Main Report.

Followings are read from the above data:

* Access to the village was not so good in the Project Area. In 1986, only 20% of villages were located nearby asphalt paved road and the accessibility of 37.8% of villages were rather poor. Since the year, some improvement of road have been done, but more than one third of villages are still suffering for poor accessibility, especially in the rainy season.
* Most of villages have electricity nowadays, and availability of electricity changed rural life in considerable extent.
* Telephone is mostly available along the coastal road, old and new Amol-Babol roads, but the diffusion rate was only 4.6% in the year of Census.

* About 74% of villages were using shallow well water or canal water for their domestic use. Considering the quality of water at the shallow aquifer, improvement of water supply system is very important in the Project Area.
* Medical facilities are mainly located along the asphalt paved roads, but medical clinics or sanitary offices are spread in whole area and most of villages are located in a radius of less than 5 km. The qualitative improvement of medical facilities is main problem in future.
* Most of villages have primary school in the Project Area, and about 42% of villages had adult school for anti-illiteracy campaign, however, the secondary school were covering only 20% of villages. There are many villages, especially in Latikuh area, which are not included within a radius of 5 km of a secondary school. The acceptability of student of primary school is also not sufficient.

TABLE D.4-1 AVAILABILITY OF SOCIAL INFRASTRUCTURE IN THE PROJECT AREA BY DEHSTANS

REFERENCE CODES / Dehstan	Grade of Road in 1986				Bank, Shop, Repair-shop, etc. in 1988								Work shop, etc in 1988				
	Asphalt Paved	Gravel Paved	Earth Surface	Walk Path	Cooperative Shop	Bank	Dealer of Diesel Oil	Dealer of Gasoline	Dealer of Kerosin	Spare Part Shop	Repair Shop of Agri-Machinery	Repair Shop of Agri-tools	Sawmill	Iron-smith	Dairy	Rice Mill	Rice Screening
AU			1														
DN001	2						1	1	1				1				1
DN002		7	10		1				1	1	1		3	2		7	6
DN003	3	20	14		2				2	1	2	5	5	5		10	5
DN004	7	29	7		12	5		2	9	1	13	11	10	12	1	15	5
DN005	23	31	33		14	2	1	3	12		14	18	1	1		24	2
DN006		26	15		6				5		3	3				13	2
DN007	8	18	10		11	3		1	8	2	11	8	4	12		12	3
DN008	7	14	11			1		3	6	4	12	9	1	7	1	13	4
DN009	12	3	10		3	2		2	3	6	8	8	2	5	1	15	9
Sub-total	62	148	111		49	13	2	12	47	15	84	62	27	44	3	109	37
DN010	10	2	6		4	2			1		4	7	1	6		8	1
DN011	5	4	5		3	2	1	3	3		1	1	3	2	2	4	2
DN012	2	7	8		5	1		1	2	1	5	8	3	5		5	1
Sub-total	17	15	19		12	5	1	4	6	1	10	16	7	13	2	17	4
BU	1					1						1		1		1	
DN013	8	12	14	1	10	4		2	6	4	9	8	6	12		18	7
DN014	4	20	29		14	11	1	4	13	5	15	15	3	13	6	27	7
Sub-total	13	32	43	1	24	16	1	6	19	9	24	24	9	26	6	46	14
TOTAL	92	195	173	1	85	34	4	22	72	25	98	102	43	83	11	172	55

REFERENCE CODES	Livestock in 1988			Basic Human Needs in 1986					Medical Facility in 1986				Schooling in 1986		
Dehstan	Veterinary Station	Veterinary Technician	Extension Service Man	Electri-city	Telephone	Post Box	Piped Water	Common Bath	Medical Clinic	Sanitary Office	Physi-cian	Nurse/ Mid-mother	Primary School	Secondary School	Adult School
AU													1		
DN001							2	2		1			2		
DN002			1	18			5	17	1	1	1		17	2	5
DN003				36			6	29	3	5	5	2	30	3	9
DN004	2	1	3	43			26	33	6	13	3		34	10	9
DN005	1	1		86		6	12	66	7	13	12	8	62	12	28
DN006				40	1		17	27	2	5	4	4	22	7	15
DN007			1	35	2	2	8	33	5	7	8	6	28	12	17
DN008				32		1	4	29	2	5	3	4	23	8	10
DN009				24	4	3	5	24	1	5	4	2	20	8	16
Sub-total	3	2	5	313	7	12	85	260	27	55	40	26	239	62	109
DN010		2	2	18	2	1	6	15	2	7	6		16	4	12
DN011		6	5	14	5	5	4	9	1	1	1	3	10	5	6
DN012		1		18	2	5	1	12	2	1	1	2	12	4	12
Sub-total		9	7	50	9	11	11	36	5	9	8	5	38	13	30
BU		1		1				1					1		1
DN013		8	2	33	2	2	5	27	1	6	5	2	26	6	22
DN014		1	3	51	3	2	16	31		1	1	3	42	11	30
Sub-total		10	5	85	5	4	21	59	1	7	6	5	69	17	53
TOTAL	3	21	17	448	21	27	117	355	33	71	54	36	346	92	192

TABLE D.4-2 AVAILABILITY OF SOCIAL INFRASTRUCTURE IN THE PROJECT AREA BY IRRIGATION ZONES

REFERENCE CODES	Grade of Road in 1986				Bank, Shop, Repair-shop, etc. in 1988								Work shop, etc in 1988				
Irrigation zone	Asphalt Paved	Gravel Paved	Earth Surface	Walk Path	Cooperative Shop	Bank	Dealer of Diesel Oil	Dealer of Gasoline	Dealer of Kerosin	Spare Part Shop	Repair Shop of Agri-Machinery	Repair Shop of Agri-tools	Sawmill	Iron-smith	Dairy	Rice Mill	Rice Screening
HWU1	1																
HWU2	1					1	1	1	1				1				1
HWU3		1												1			
Sub-total	2	1					1	1	1				1	1			1
HW1			3													1	1
HW2	2	12	8						1		1	2	3	3		6	3
HW3		12	8		2				2	1	1	2	4	2		9	7
HW4		5	7		2	1											
HW5	2	3	3		1	1			2	1	2	1	1	2		3	1
HW6		3	4													2	1
Sub-total	4	35	33		5	2			5	2	4	5	8	7		21	13
Total of HW	6	36	33		5	2	1	1	6	2	4	5	9	8		21	14
KL1		1														1	
KL2			1		1				1		1	1	1	1			
KL3	2	5	8		4	3		2	4	2	4	5	1	5	1	5	3
KL4	4	6	8		6	2	1	3	3	2	3	2	1	4		8	5
KL5	1	5	4		1				1	1	4	3	2	4	2	6	
KL6	3	3	1		3	2			3	1	1	2		4		6	
Sub-total	10	20	23		15	7	1	5	12	6	13	13	5	18	3	26	8
KR2			2										1	1			
KR3	1	5	1								3	1	2	3		2	
KR4		6	4	1	2	1			1	1	3	2	4	3	1	5	1
KR5	1	2	2		4	2		1	2	2	3	3	1	2		4	3
Sub-total	2	13	9	1	6	3		1	3	3	9	6	8	9	1	11	4
HE1	3	5	6		5	1		1	5		4	5	1	1		8	2
HE2	1	5	3		1			1	2		1	1	1	1		2	1
HE3	2	11	3		2	1	1	1	2		3	4	1	1		3	1
HE4	4	11	6		8	2		1	5		2	2	1	1		2	1
HE5	3	3	8		3	5			3		4	4	1	4	1	8	3
Sub-total	13	35	26		19	9	1	4	17		14	16	5	8	1	23	8
Total of HE, KL, KR	25	68	58	1	40	19	2	10	32	9	36	35	18	35	5	60	20
AE1		2	3													1	
AE2	2	3			2			1	2							2	1
AE3	15	6	4		2	1		1	1	1	8	9	1	1		10	2
AE4	7	4	1		3	2			2		5	5	1	4		6	2
AE5	8	3	8		3				2		4	3				8	
AE6	3	2	6		4	1			1			3		3		4	
AE7		2	6		4	1		1	2	1	2	4	2	1	1	5	2
AE8			4		1	1			1		1	1			1	1	
AE9	1	1	10		2						2	2		3		5	
AE10		3	1		1				2		2	2	1	2		3	
AE11	5	13	5		4	2	1	3	4	1	4	6	4	3	1	3	1
Sub-total	41	39	48		26	8	1	6	17	3	28	35	9	17	3	48	8
AW1	1	3			1				1		3	2		2		1	
AW2		1	1								1			1		1	1
AW3	2	5	1		3	1		1	1	1	2	2	1	4		5	1
AW4	3	2	1		4				3		2	2	2	2		3	
AW5	1	8	1						2	3	5	5		1		4	1
AW6		8	1		1				1		1	1		1		1	
AW7	4	4	5		1			2	3		2	1	1	2	1	6	1
AW8		5	6													2	
AW9	6	10	17		3	2		2	5	6	11	9	1	7	1	16	9
Sub-total	17	46	33		13	3		5	16	10	27	22	5	20	2	39	13
AU	1	5	1							1	2	2	2	2	1	2	
BU	2	1			1	2			1		1	3		1	1	2	
GRAND TOTAL	92	195	173	1	85	34	4	22	72	25	98	102	43	83	12	172	55

REFERENCE CODES	Livestock in 1988			Basic Human Needs in 1986					Medical Facility in 1986				Schooling in 1986		
Irrigation zone	Veterinary Station	Veterinary Technician	Extension Service Man	Electri-city	Telephone	Post Box	Piped Water	Common Bath	Medical Clinic	Sanitary Office	Physi-cian	Nurse/ Mid-wife	Primary School	Secondary School	Adult School
HWU1							1	1		1			1		
HWU2							1	1					1		
HWU3				2				2					2		
Sub-total				2			2	4		1			4		
HW1				3			1	3					3		2
HW2		1		21		1	4	18	3	5	6	3	17	5	6
HW3			1	19			6	17	2	3	2		17	2	7
HW4				12	1		2	10	1	1		2	12	1	5
HW5				8		1	1	7		2	2		4	2	6
HW6				7			2	5	1	1	1		4	1	2
Sub-total		1	1	70	1	2	16	60	7	12	11	5	57	11	28
Total of HW		1	1	72	1	2	18	64	7	13	11	5	61	11	28
KL1				1				1					1		
KL2				1			1	1							
KL3		1	1	14	2	2	6	12	1	1	2	1	11	4	9
KL4		1	1	17				9		2	1		14	4	8
KL5		1	1	10	1	1	1	6		1		1	7	2	8
KL6		2	1	7	1		2	5		1	1		7		5
Sub-total		5	4	50	4	3	10	34	1	5	4	2	40	10	31
KR2				2				1					1		
KR3			2	8			2	6	1	3	3		10	5	1
KR4		3	1	11			4	9		2	1		10	1	7
KR5		1		5	1	1		3		1	1	2	5	3	5
Sub-total		4	3	26	1	1	6	19	1	8	5	2	26	9	13
HE1	1	1		14		1	7	13	2	4	1		14	4	8
HE2	1			11		1	5	12	1	2			7	2	2
HE3				15			4	13	3	3	2		11	2	1
HE4				17			6	6	1	3			8	2	3
HE5			1	12			9	9		2			10	3	7
Sub-total	2	1	1	69		2	31	53	7	14	3		50	13	19
Total of HE, KL, KR	2	10	8	145	5	6	47	106	9	25	12	4	116	32	63
AE1				5				4			1		3		1
AE2	1			5			1	3				2	4	1	3
AE3				24	3	2	6	21		5	3		21	5	9
AE4				12	1	2	6	12	2	6	5	1	11	4	10
AE5				20		2	4	17	1	5	5	4	12	4	9
AE6		1	1	11				7	2	2	3		10	1	5
AE7		3	3	8	1	1	3	7		1		2	8	1	6
AE8		1	1	4			1	4					2	2	
AE9				12		1		10					10	3	4
AE10				4		1		4					4		4
AE11		4	2	23	6	7	4	10	3		2	3	12	4	11
Sub-total	1	9	7	128	11	16	25	99	8	19	19	12	97	25	62
AW1				4				4	1		1		3	1	2
AW2				2			1	2				1	2	1	
AW3			1	8	1	1	2	8	2	3	3	2	6	3	4
AW4				6			3	5	2	1	2	1	3	3	3
AW5				9				9		1	1	1	8	1	3
AW6				9				6					7	1	1
AW7				13			1	12		3	2	1	10	5	4
AW8				10			7	5	1	1		2	3	1	2
AW9				32	3	2	8	29	3	6	3	6	24	7	17
Sub-total			1	93	4	3	22	80	9	15	12	14	64	23	36
AU				7			5	4					6		1
BU		1		3				2				1	2	1	2
GRAND TOTAL	3	21	17	448	21	27	117	355	33	72	54	36	346	92	192

APPENDIX E. PROJECT PLANNING

APPENDIX E. PROJECT PLANNING

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APPENDIX E. 1 DESIGN

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E. 1. 1 Special Consideration of Groundwater Supply Areas for Secondary Canals

1. Objectives

In order to utilize excess water for the groundwater supply areas, the special consideration is studied in the irrigation capacities of the secondary canals.

2. Basic Conditions

(1) Water Balance

Irrigation water requirements and relevant data are as follows:

Water Balance Data

Mon.	Day	Haraz River (m^3/s) (1)	Water Req. (m^3/s) (2)	(3) = (1) - (2)
Apr.	1-10	23.9	0.2 (-- ℓ/s/ha)	23.7
	11-20	32.6	0.6 (--)	32.0
	21-30	54.3	42.8 (0.794)	11.5
May	1-10	66.6	72.9	negative
	11-20	82.7	70.1 (1.301)	12.6
	21-31	88.6	76.6 (1.421)	12.0
Jun. - Aug.				negative
Sep.	1-10	20.5	15.5 (0.288)	5.0
	11-20	18.3	4.7 (0.087)	13.6

Note, (1) : Average observed discharge at Karehsang station (1956-1982).
(2) : Average planned water demand for the whole surface water supply areas without effective rainfall. (--): negligible.

From the above study, the average water requirement when excess water exists is estimated at 0.8 ℓ/s/ha (=(0.794 + 1.301 + 1.421 + 0.288 + 0.087) /5).

(2) Groundwater Supply Area Ratio

The groundwater supply area ratios (R) (=(Groundwater supply area)/(Surface water supply area)) are calculated under the with project conditions as follows:

Groundwater Supply Area Ratio

R	Zone Name
R>=1.6	AE9,AE10
1.6>R>=1.0	AE4A,AW2
1.0>R>=0.3	HW2A, KL5, KL6B, AW3B, AW5,AW9A,AE3C,AE8,AE11A,KR4

Note) Zones, R less than 0.3, are omitted.

3. Special Consideration

Based on the above data, the irrigation capacities of the secondary canals are specially considered as follows:

(1) Basic Idea

The irrigation capacities of the proposed secondary canals are principally determined as follows:

- The secondary canals have the incident function that the canals can irrigate the groundwater supply areas additionally, whenever it is possible.
- The flow areas in the canals applied for the additional discharges are considered as the 2/3 of freeboard.
- The end points of the secondary canals are not subject to the groundwater supply areas considered herein.

(2) Irrigation Capacity Considering 2/3 of Freeboard (Qq)

Generally speaking, the capacity accrued from using 2/3 freeboard is estimated at about 25% of the irrigation design discharge. Therefore, the capacity in question is as follows:

- Irrigation capacity of secondary canal : 1.7 l/s/ha,
- Capacity in question : $Qq = 1.7 \times 1.25 = 2.1$ l/s/ha.

(3) Potential Ratio (R) Using Capacity (Qq)

The considered capacity is Qq = 2.1 l/s/ha, on the other hand the average water requirement when excess water exists is computed at 0.8 l/s/ha. This means that the secondary canals can irrigate as 2.6 (=2.1/0.8) times areas as the surface water supply areas. Consequently, the maximum potential ratio (R) becomes 1.6 (=(2.1-0.8)/0.8).

(4) Considered Secondary Canal

The zones/canals with R values more than 1.6 are considered specially to enlarge their canal sections. They are AE9 and AE10 zones, however, it is AE10 secondary canal only as AE9 zone has no secondary canal. The new irrigation capacity is computed based on the following irrigation area (As) :

As (ha) = (A1 + A2)/2.6,
Where; Surface water supply area : A1 (ha),
Groundwater supply area : A2 (ha).

E. 1. 2 Suitable Investment Level on Facilities Improvement

1. Objectives

In order to determine the improvement level of the irrigation and drainage systems, most economical investment costs and suitable benefits by the project implementation should be clarified as a reasonable level. Major factors affected to the above mentioned components are summarized as follows:

- Project cost including each category of civil works,
- Operation and maintenance costs, and replacement costs,
- Project implementation plan (cost disbursement plan),
- Incremental benefits.

2. Project Cost

Project cost was preliminarily estimated, and is summarized in the Table E.1.2-1. In the estimates, four alternatives were considered on the systems improvement level as follows (for canal type, refer to Figure E.1.2-1):

Case-1 : Earth canal improvement including provision of turnout, check and drop structures.
(Canal type-III)

Case-2 : Concrete canal improvement for around 1/3 length of the proposed secondary and tertiary canals in the Case-1.
(Canal type-III × 2/3 + canal type-IV × 1/3)

Case-3 : Provision of turnout, check and drop structures only.
(Canal type-II)

Case-4 : Same as Case-2, however saved construction equipment costs for land consolidation works.

3. Other Conditions

1) Project Implementation Plan

The outline of the project implementation plan for each district is indicated in the Table E.1.2-1.

2) Incremental Benefits

The incremental benefits were estimated based on the proposed net production values of major crops, the growth rate of crop production and the proposed cropping patterns. The results are shown in the Table E.1.2-1.

4. Computer Outputs

The economic internal rates of return (EIRR) were calculated based on the cost and benefit flows, which were prepared considering the mentioned conditions. The summary of EIRR is as follows:

EIRR Outputs

(Unit : %)

District	Haraz East	Haraz West	Amol East	Amol West	Overall
Case-1	11.2	9.6	12.1	11.8	11.3
Case-2	9.3	7.6	9.2	9.2	8.9
Case-3	15.2	14.0	12.5	17.6	16.6
Case-4	9.9	10.6	8.6	9.9	10.0

Based on this study, Case-4 is considered as the optimum investment level of the project. In line with this, the improvement level of on-farm facilities (the amount of investment) is considered within the range of Case-4.

E. 1. 3 Design of Turnout

In this section, the two types of turnouts adopted in the study are described, viz. sluice gate type and double orifice gate type (refer to Figure E.1.3-1).

1. Sluice Gate Type

(1) Application

This is common as the type of turnout, and is applicable to almost all kinds of water sources, such as open canals, lakes, reservoirs, regulating ponds, and so on. As this type can not regulate intake quantity satisfactorily, a measuring device is demanded in case of need. If this type is planned to open canals, check structures are to be installed in the canals in order to obtain the required water levels which enable turnouts to take designed discharges.

(2) Structure

The intake structure of this type consists of gate and transition (and screen, if necessary).

A sluice gate is used, and is installed at the entrance of pipe. The gate is made of steel, and is operated manually when the gate size is small. An air hole is required just after the gate.

The transition is designed between the water source (open canal, pond, etc.) and the pipe. The structure of transition is cantilever or retaining wall made of reinforced concrete, and the length is determined in accordance with the site conditions.

(3) Discharge Control

Intake volumes are controlled by gate operation. However, the discharges can not be known accurately. Therefore, a measuring device should be installed in order to perform smooth water management.

(4) Hydraulic Design

The hydraulic design of this type is carried out under the fully-opened-gate condition using the maximum intake discharge. And appropriate head losses should be counted for transition, gate inflow, etc.

2. Double Orifice Gate Type

(1) Application

This type is applicable to the open canals whose water levels can be kept in constant. Therefore, a check structure is indispensable for the application. As this type can measure discharges, no measuring devices are required.

(2) Structure

The major structures of this type consist of two gates and one regulating water tank. The regulating water tank is made of reinforced concrete, and the gates are steel sluice gates. As auxiliary facilities, one gate opening indicator (for orifice gate) and two water level measuring pipes are installed.

The following standard criteria are used in common in the design so as to measure discharges correctly by mitigating the waves and shocks in the regulating water tank:

1) Maximum Opening of Orifice Gate (No. 1 Gate) : Y_1,

$$Y1 < = 0.8\ Y3$$

2) Orifice Submerge Depth: Y_2,

$$Y2 > = Y1$$

3) Minimum Length of Regulating Water Tank: L,

$$2.25\ Y1 < L > 1.75\ Y3, L > 1.0 \quad (Q < = 0.28\ m^3/s),$$
$$L > 2.75\ Y1 \quad (Q > 0.28\ m^3/s)$$

4) Pipe Submerge Depth : Y_4,

$$Y4 = 1.75\ (v^2/2g + 0.08),$$

where, v; velocity in pipe (m/s),
g; acceleration of gravity (m/s^2)

5) Length of Transition : L_2,

$$1.5\ (Y1 + Y2) < L2$$

6) Spacing for Orifice Gate

Before and behind the orifice gate, flat spaces (width Y_1) are necessary.

7) Sluice Gate (No. 2 Gate) and Air Hole

An air hole is needed just after the sluice gate which is circular shape with high water tightness.

(3) Discharge Control

Discharges are regulated by the openings of the orifice gate (square shape), and the No. 2 gate is controlled to maintain the constant differences of water levels, before and behind the orifice gate. The hydraulic design of the gates is carried out using the submerged orifice formula.

The relationship between the openings and discharges of the No. 1 gate is, as follows:

$$Q = CA\sqrt{2gH}$$

Where, Q; discharge (m^3/s)
C; coefficient of discharge, 0.65 - 0.75
A; area of orifice (m^2)
H; difference of water level = 0.05 - 0.06 (m)

E. 1. 4 Design of Check Structure

(1) Application

Check structures are designed for irrigation canals and irrigation-cum-drainage canals in order to mitigate water level fluctuation in canals and to divert water firmly, etc.

(2) Structure

An overflow type stop log gate is designed as a movable weir, and a bypass of fixed weir type is designed at the both sides or one side of a check (refer to Figure E. 1. 4-1).

The width of one stop log is designed to be 1.5 m at maximum, and the maximum height of the stop log is to be about 1.2 m. On the other hand, the salient features of the bypass are as follows:

1) Design Discharge of Bypass (Qb)

The design discharge of bypass (Qb) is considered to be 30% of the design irrigation discharge of the upstream canal.

2) Crest Length of Bypass (Lb)

The total crest length of the bypass (Lb) is calculated based on the following equation:

$Q = LCH^{3/2}$,

where, Q: design discharge of bypass, (= Qb),
L; Lb + Ls, (Ls = total stop log width),
C; coefficient of discharge,
H; depth of flow at crest, standard 0.2 m,

(3) Water Level Control

Generally speaking, water levels and discharges are regulated manually or automatically. In this study, manual gate (stop log) operation type is adopted in principle from the viewpoints of economical operation and similarity to the present type. Then, the check system falls under the constant upstream level type.

(4) Check Water Level (CWS)

The check water level (CWS) is designed to be 0.2 m below the design water level (NWS) which is calculated using the design irrigation discharge. The difference between CWS and NWS equals to the depth of flow at the bypass crest.

(5) Operation

Water level is regulated by the stop log during the irrigation period, and the stop log is removed during the non-irrigation period in principle.

On the other hand, in the case of irrigation-cum-drainage canals, the following discharge is expected during the harvesting period from August to September:

$q = 10.84\ M^{-1/6}$ (ℓ/s/ha; 10-year return period)

As some areas still require irrigation water in this period, the necessity of the stop log operation in this case was studied at the sampled check sites. And the study resulted in no need of stop log operation as follows:

- Drainage less than the bypass capacity can be discharged through the bypass without stop log operation.
- Drainage more than the bypass capacity can overflow over the bypass and stop log without stop log operation. As far as the sample studies were carried out, the water levels of overflows did not exceed the canal heights, viz. within the freeboard. In addition, some ideas can be considered in the detailed design, e.g. deepening the depth of flow at bypass crest and/or lengthening the crest length of bypass, etc.

Sample Studies

Sample Check	Qi	Qd	Qb	Qh	L	Hh	Hc
HE 2 (CP No.1)	1.7	1.8	0.51	< 1.2	3.1	0.36	< 0.52
HE 2 (CP No.2)	0.8	5.8	0.24	< 3.8	3.0 *)	0.79	< 1.04
AE4B (CK No.2)	3.8	2.6	1.14	< 1.8	7.0	0.27	< 0.50
AE6A (CK No.1)	1.7	7.1	0.51	< 4.4	3.1	0.85	< 1.14

Note) Qi : design irrigation discharge (m^3/s),
Qd : design drainage discharge (m^3/s),
Qb : bypass capacity (m^3/s),
Qh : harvesting period discharge (m^3/s),
L : fore mentioned (Lb + Ls) (m),
Hh : crest overflow depth = $(Qh/L \cdot C)^{2/3}$ (m),
Hc : canal room height above the bypass crest including freeboard (m),
*) Some adjustments were made.

E. 1. 5 Secondary Canal Inventory

The 81-route secondary canals were designed and the total length reached at 594.22 km. The inventories of the proposed secondary canals are shown in the Tables E.1.5-1 to E.1.5-3.

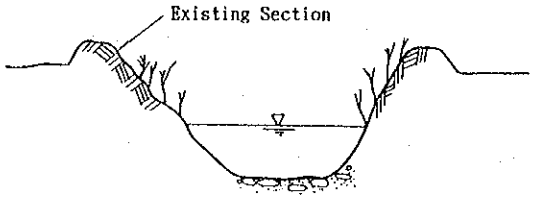
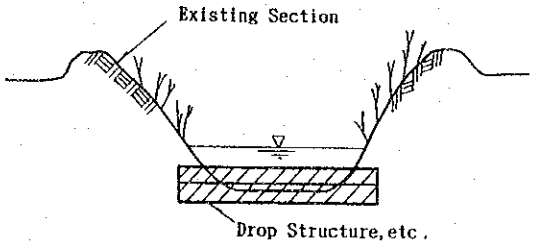
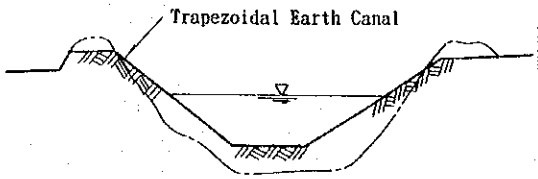
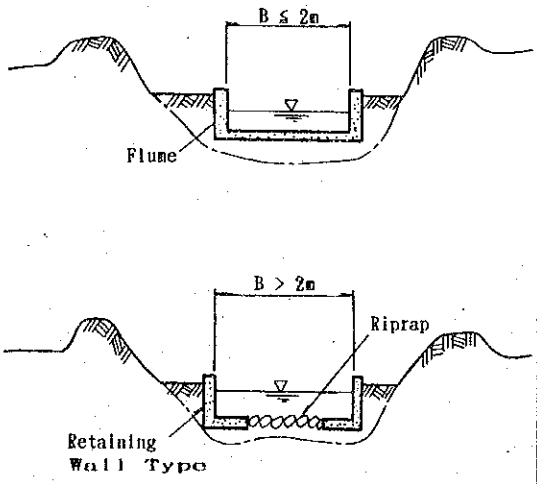
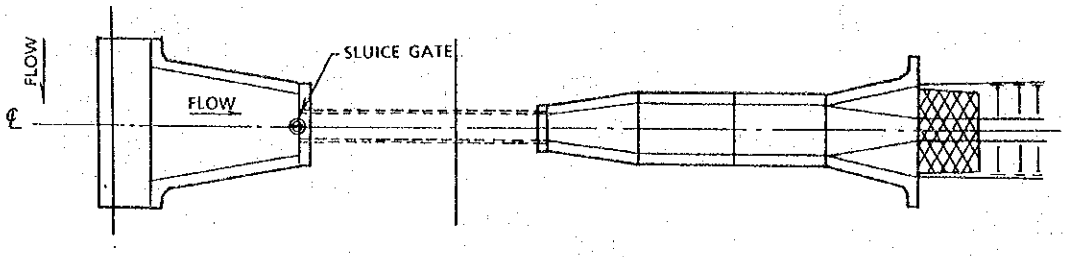
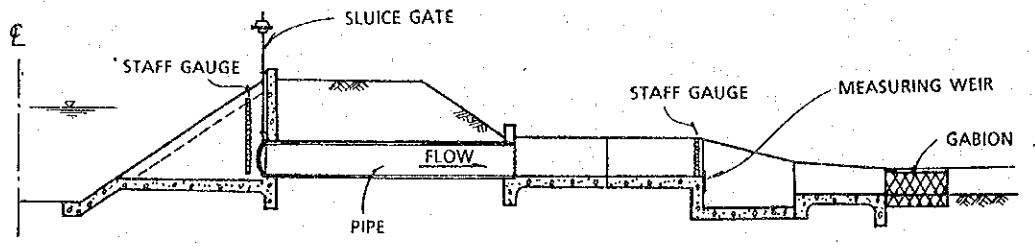
Canal Type	Canal Section
I	
II	
III	
IV	

FIGURE E.1.2-1 CANAL TYPE

SLUICE GATE TYPE

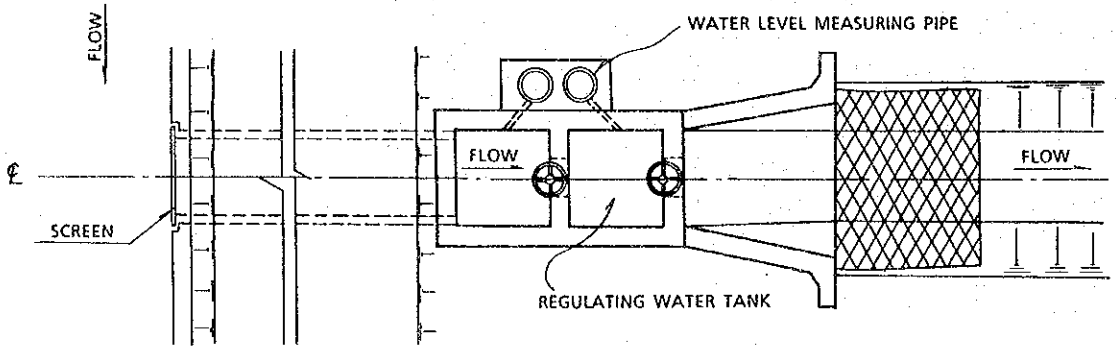


PLAN

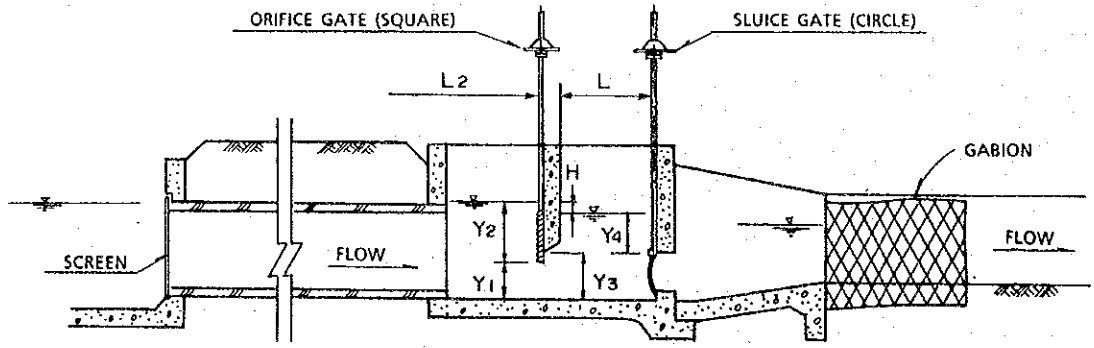


PROFILE

DOUBLE ORIFICE GATE TYPE

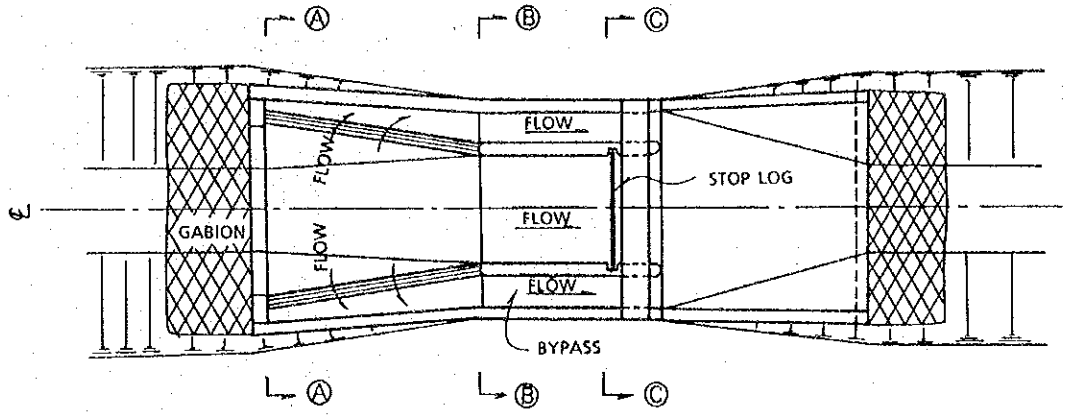


PLAN



PROFILE

FIGURE E.1.3-1 TURNOUT



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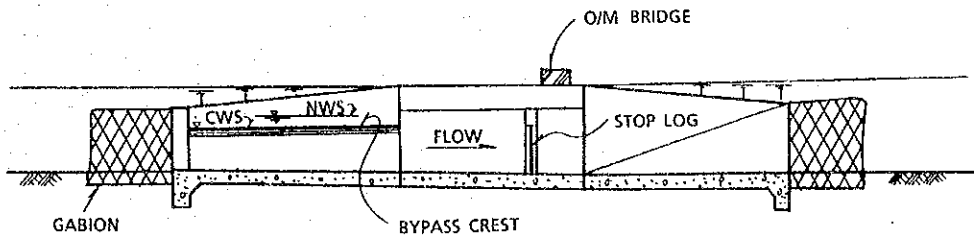


PROFILE

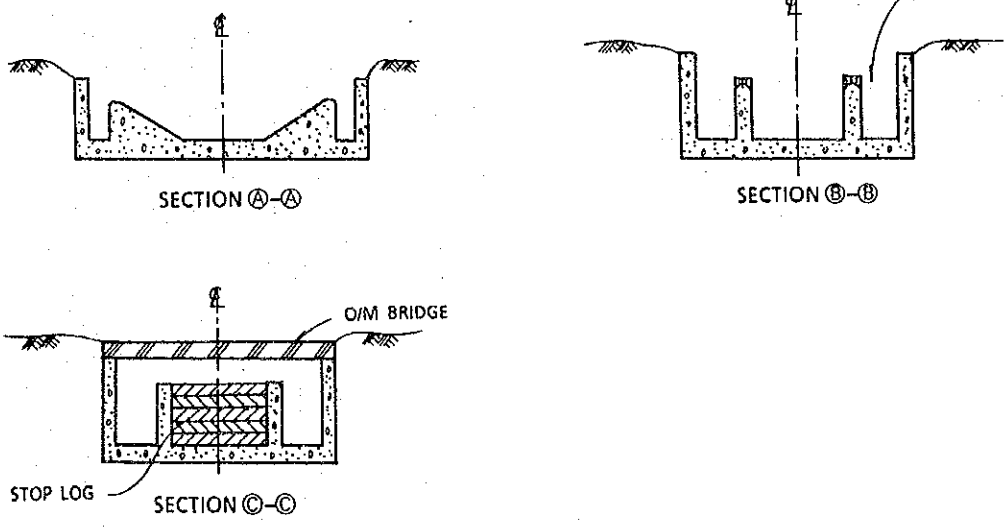


FIGURE E.1.4-1 CHECK STRUCTURE

TABLE E.1.2-1 SUMMARY OF CALCULATION CONDITIONS

(Unit Of Items 1, 2 & 5 : Million Rials in Economic Value)

Items	Haraz East	Haraz West	Amol East	Amol West	Total
1. Capital Cost					
Case-1	171,496	98,867	161,382	122,473	554,218
Case-2	209,409	123,201	216,201	158,861	707,672
Case-3	134,532	75,146	107,947	84,650	402,275
Case-4	181,590	108,153	197,740	144,192	631,675
2. Annual O/M and Replacement Cost					
Case-1	613	353	576	437	1,979
Case-2	748	440	722	567	2,477
Case-3	481	268	386	311	1,446
Case-4	649	386	706	515	2,256
3. Implementation Term					
Project Year	1-13	1-10	3-13	3-13	1-13
Period (Year)	13	10	11	11	13
4. Beneficial Area (ha)					
	25,262	11,239	25,091	18,378	79,970
5. Benefit					
	24,323	11,617	25,376	18,587	79,903

Note) 1. Beneficial Area (ha) : Present paddy fields excluding urban areas.
2. Benefit : Accrued from increase crop productions mainly.

TABLE E.1.5-1 SPECIFICATION OF SECONDARY CANALS (1 OF 3) (Unit: m)

Canal Name	Qmax (m3/s)			Total Length	Irrigation		Irri. cum Drain		Drainage	
	I	I/D	D		Improv.	New	Improv.	New	Improv.	New
HW1	-	-	-	3,900	-	3,900	-	-	-	-
HW2/2B	5.4	6.7	7.6	19,300	4,400	-	10,350	-	4,550	-
HW2A	2.5	-	-	7,800	2,000	5,800	-	-	-	-
HW3	9.2	7.7	7.7	18,900	3,600	600	11,400	-	3,300	-
HW4	5.1	7.3	12.0	14,000	-	5,200	4,900	-	3,200	700
HW5	2.5	2.0	5.2	9,150	-	2,000	2,750	-	4,400	-
HW6	1.2	3.7	5.0	7,350	-	850	750	-	5,750	-
(7-Route: Sub-total)				80,400	10,000	18,350	30,150	0	21,200	700
DHW1	-	-	9.8	1,500	-	-	-	-	-	1,500
DHW1A	-	-	-	2,150	-	-	-	-	2,150	-
DHW7	-	-	4.3	1,500	-	-	-	-	-	1,500
DHW8	-	-	9.7	9,500	-	-	-	-	9,500	-
DHW10A	-	-	4.1	2,250	-	-	-	-	-	2,250
DHW12A	-	-	4.6	3,400	-	-	-	-	-	3,400
DHW19	-	-	3.5	450	-	-	-	-	450	-
(7-Route: Sub-tatal)				20,750	0	0	0	0	12,100	8,650
(HW 14-Route: Total)				101,150	10,000	18,350	30,150	0	33,300	9,350

Note) I: Irrigation canal, I/D: Irrigation-cum-drainage canal,
D: Drainage canal.

TABLE E.1.5-1 SPECIFICATION OF SECONDARY CANALS (2 OF 3) (Unit: m)

Canal Name	Qmax (m3/s) I	I/D	D	Total Length	Irrigation Improv.	Irrigation New	Irri. cum Drain Improv.	Irri. cum Drain New	Drainage Improv.	Drainage New
HE1	3.6	-	-	10,500	2,800	7,700	-	-	-	-
HE2	-	5.8	12.7	17,100	100	-	8,800	-	8,200	-
HE2A	-	-	6.5	3,300	-	-	-	-	1,200	2,100
HE3	-	6.7	8.6	16,900	-	-	12,100	1,300	3,500	-
HE4	3.1	4.9	7.2	16,100	400	-	10,700	-	4,400	600
HE5/5A/5B	4.6	7.0	8.2	25,400	2,800	-	19,800	-	2,800	-
(6-Route:Sub-total)				89,300	6,100	7,700	51,400	1,300	20,100	2,700
DHE2	-	-	3.7	500	-	-	-	-	-	500
DHE4	-	-	3.6	1,800	-	-	-	-	-	1,800
DHE10	-	-	6.0	7,100	-	-	-	-	-	7,100
DHE11	-	-	3.8	1,250	-	-	-	-	1,250	-
DHE12	-	-	9.4	3,600	-	-	-	-	1,800	1,800
DHE12A	-	-	4.3	5,000	-	-	-	-	2,000	3,000
DHE12B	-	-	4.9	3,100	-	-	-	-	500	2,600
DHE13	-	-	9.3	8,600	-	-	-	-	1,000	7,600
DHE16	-	-	5.6	6,100	-	-	-	-	-	6,100
DHE19	-	-	2.9	2,100	-	-	-	-	1,100	1,000
DHE21A	-	-	4.6	3,500	-	-	-	-	1,000	2,500
DHE21B	-	-	3.3	1,400	-	-	-	-	-	1,400
(12-Route:Sub-total)				44,050	0	0	0	0	8,650	35,400
KL2	0.7	-	-	500	-	500	-	-	-	-
KL3	4.0	-	-	9,000	6,300	2,700	-	-	-	-
KL4	2.5	-	-	6,000	3,700	2,300	-	-	-	-
KL5	3.1	-	-	9,900	9,900	-	-	-	-	-
KL6/6B/6A	3.2	-	-	6,700	5,000	1,700	-	-	-	-
(5-Route:Sub-total)				32,100	24,900	7,200	0	0	0	0
KR1				5,900	5,900	-	-	-	-	-
KR2				3,200	3,200	-	-	-	-	-
KR3				4,900	4,900	-	-	-	-	-
KR4				11,300	8,850	-	2,450	-	-	-
KR5				5,000	2,900	2,100	-	-	-	-
(5-Route:Sub-total)				30,300	25,750	2,100	2,450	0	0	0
DKR3				1,500	-	-	-	-	1,500	-
DKR4				600	-	-	-	-	-	600
DKR5				3,500	-	-	-	-	-	3,500
DKR10				2,750	-	-	-	-	2,750	-
DKR14				950	-	-	-	-	450	500
DKR28				1,850	-	-	-	-	1,850	-
(6-Route:Sub-total)				11,150	0	0	0	0	6,550	4,600
(HE 34-Route: Total)				206,900	56,750	17,000	53,850	1,300	35,300	42,700

TABLE E.1.5-1 SPECIFICATION OF SECONDARY CANALS (3 OF 3) (Unit: m)

Canal Name	Qmax (m3/s) I	I/D	D	Total Length	Irrigation Improv.	Irrigation New	Irri. cum Drain Improv.	Irri. cum Drain New	Drainage Improv.	Drainage New
AW1	1.4	-	-	600	-	600	-	-	-	-
AW2	0.4	-	-	800	-	800	-	-	-	-
AW3/3A/3B	2.4	-	-	7,100	5,400	1,700	-	-	-	-
AW4	1.9	6.9	6.9	10,100	-	4,000	2,650	1,050	750	1,650
AW5	2.4	-	-	4,500	4,500	-	-	-	-	-
AW6	1.7	-	-	1,800	-	1,800	-	-	-	-
AW7	3.3	-	-	11,700	11,700	-	-	-	-	-
AW8	0.7	-	-	1,000	-	1,000	-	-	-	-
AW9/9A/9B	7.2	-	-	24,600	13,350	11,250	-	-	-	-
(9-Route:Sub-total)				62,200	34,950	21,150	2,650	1,050	750	1,650
DAW2	-	-	4.0	1,250	-	-	-	-	-	1,250
DAW3/3A	-	-	12.2	6,600	-	-	-	-	5,300	1,300
DAW4	-	-	16.2	6,450	-	-	-	-	3,300	3,150
DAW5/5A	-	-	15.6	12,700	-	-	-	-	900	11,800
DAW6	-	-	15.8	20,520	-	-	-	-	14,870	5,650
DAW8	-	-	7.6	7,300	-	-	-	-	-	7,300
DAW10	-	-	12.0	10,600	-	-	-	-	6,000	4,600
(7-Route:Sub-total)				65,420	0	0	0	0	30,370	35,050
(AW 16-Route: Total)				127,620	34,950	21,150	2,650	1,050	31,120	36,700
AE1	0.6	-	-	2,000	2,000	-	-	-	-	-
AE2	1.3	-	-	3,200	-	3,200	-	-	-	-
AE3A	6.4	16.9	21.1	29,000	4,350	4,950	11,350	500	7,850	-
AE3B	1.6	2.2	9.2	10,300	2,000	1,000	600	-	3,400	3,300
AE3C	0.8	-	-	1,400	-	1,400	-	-	-	-
AE4/4A/4B	4.4	3.8	4.0	15,350	4,400	850	8,100	1,150	-	850
AE5	1.8	-	-	4,900	4,900	-	-	-	-	-
AE6/6A/6B	1.9	7.8	21.3	25,000	7,000	1,600	7,600	1,000	7,800	-
AE7	2.3	7.0	-	11,750	1,900	-	8,350	1,500	-	-
AE8	0.5	-	-	900	900	-	-	-	-	-
AE11	6.8	11.0	11.0	19,350	6,800	2,800	6,050	1,500	-	2,200
(11-Route:Sub-total)				123,150	34,250	15,800	42,050	5,650	19,050	6,350
DAE9	-	-	7.5	5,400	-	-	-	-	1,500	3,900
DAE12B/12C	-	-	9.8	10,500	-	-	-	-	4,000	6,500
DAE13	-	-	8.6	6,400	-	-	-	-	4,900	1,500
DAE14	-	-	15.7	5,500	-	-	-	-	5,500	-
DAE16	-	-	8.4	3,200	-	-	-	-	-	3,200
DAE17	-	-	7.8	4,400	-	-	-	-	1,250	3,150
(6-Route:Sub-total)				35,400	0	0	0	0	17,150	18,250
(AE 17-Route: Total)				158,550	34,250	15,800	42,050	5,650	36,200	24,600
(Entire 81-Route: Total)				594,220	135,950	72,300	128,700	8,000	135,920	113,350

TABLE E.1.5-2 SECONDARY CANAL BY SUB-DISTRICT WISE (1 OF 3) (Unit: m)

Canal Name	Qmax (m3/s)			Total Length	Irrigation		Irri. cum Drain		Drainage	
	I	I/D	D		Improv.	New	Improv.	New	Improv.	New
HW1	-	-	-	3,900	-	3,900	-	-	-	-
HW2/2B	5.4	6.7	7.6	19,300	4,400	-	10,350	-	4,550	-
HW2A	2.5	-	-	7,800	2,000	5,800	-	-	-	-
HW3	9.2	7.7	7.7	18,900	3,600	600	11,400	-	3,300	-
HW4	5.1	7.3	12.0	14,000	-	5,200	4,900	-	3,200	700
HW5	2.5	2.0	5.2	9,150	-	2,000	2,750	-	4,400	-
HW6	1.2	3.7	5.0	7,350	-	850	750	-	5,750	-
(7-Route: Sub-total)				80,400	10,000	18,350	30,150	0	21,200	700
DHW1	-	-	9.8	1,500	-	-	-	-	-	1,500
DHW1A	-	-	-	2,150	-	-	-	-	2,150	-
DHW7	-	-	4.3	1,500	-	-	-	-	-	1,500
DHW8	-	-	9.7	9,500	-	-	-	-	9,500	-
DHW10A	-	-	4.1	2,250	-	-	-	-	-	2,250
DHW12A	-	-	4.6	3,400	-	-	-	-	-	3,400
DHW19	-	-	3.5	450	-	-	-	-	450	-
(7-Route: Sub-tatal)				20,750	0	0	0	0	12,100	8,650
HW(I) 14-Route: Total				101,150	10,000	18,350	30,150	0	33,300	9,350

Note) I: Irrigation canal, I/D: Irrigation-cum-drainage canal,
D: Drainage canal.

TABLE E.1.5-2 SECONDARY CANAL BY SUB-DISTRICT WISE (2 OF 3) (Unit: m)

Canal Name	Qmax (m3/s) I	I/D	D	Total Length	Irrigation Improv.	Irrigation New	Irri. cum Drain Improv.	Irri. cum Drain New	Drainage Improv.	Drainage New
HE1	3.6	-	-	10,500	2,800	7,700	-	-	-	-
HE2	-	5.8	12.7	17,100	100	-	8,800	-	8,200	-
HE2A	-	-	6.5	3,300	-	-	-	-	1,200	2,100
HE3	-	6.7	8.6	16,900	-	-	12,100	1,300	3,500	-
HE4	3.1	4.9	7.2	16,100	400	-	10,700	-	4,400	600
HE5/5A/5B	4.6	7.0	8.2	25,400	2,800	-	19,800	-	2,800	-
(6-Route:Sub-total)				89,300	6,100	7,700	51,400	1,300	20,100	2,700
DHE2	-	-	3.7	500	-	-	-	-	-	500
DHE4	-	-	3.6	1,800	-	-	-	-	-	1,800
DHE10	-	-	6.0	7,100	-	-	-	-	-	7,100
DHE11	-	-	3.8	1,250	-	-	-	-	1,250	-
(4-Route:Sub-total)				10,650	0	0	0	0	1,250	9,400
HE(I) 10-Route: Total				99,950	6,100	7,700	51,400	1,300	21,350	12,100
DHE12	-	-	9.4	3,600	-	-	-	-	1,800	1,800
DHE12A	-	-	4.3	5,000	-	-	-	-	2,000	3,000
DHE12B	-	-	4.9	3,100	-	-	-	-	500	2,600
DHE13	-	-	9.3	8,600	-	-	-	-	1,000	7,600
DHE16	-	-	5.6	6,100	-	-	-	-	-	6,100
DHE19	-	-	2.9	2,100	-	-	-	-	1,100	1,000
DHE21A	-	-	4.6	3,500	-	-	-	-	1,000	2,500
DHE21B	-	-	3.3	1,400	-	-	-	-	-	1,400
(8-Route:Sub-total)				33,400	0	0	0	0	7,400	26,000
KL2	0.7	-	-	500	-	500	-	-	-	-
KL3	4.0	-	-	9,000	6,300	2,700	-	-	-	-
KL4	2.5	-	-	6,000	3,700	2,300	-	-	-	-
KL5	3.1	-	-	9,900	9,900	-	-	-	-	-
KL6/6B/6A	3.2	-	-	6,700	5,000	1,700	-	-	-	-
(5-Route:Sub-total)				32,100	24,900	7,200	0	0	0	0
HE(II) 13-Route: Total				65,500	24,900	7,200	0	0	7,400	26,000
KR1				5,900	5,900	-	-	-	-	-
KR2				3,200	3,200	-	-	-	-	-
KR3				4,900	4,900	-	-	-	-	-
KR4				11,300	8,850	-	2,450	-	-	-
KR5				5,000	2,900	2,100	-	-	-	-
(5-Route:Sub-total)				30,300	25,750	2,100	2,450	0	0	0
DKR3				1,500	-	-	-	-	1,500	-
DKR4				600	-	-	-	-	-	600
DKR5				3,500	-	-	-	-	-	3,500
DKR10				2,750	-	-	-	-	2,750	-
DKR14				950	-	-	-	-	450	500
DKR28				1,850	-	-	-	-	1,850	-
(6-Route:Sub-total)				11,150	0	0	0	0	6,550	4,600
HE(III) 11-Route: Total				41,450	25,750	2,100	2,450	0	6,550	4,600
HE 34-Route: Total				206,900	56,750	17,000	53,850	1,300	35,300	42,700

TABLE E.1.5-2 SECONDARY CANAL BY SUB-DISTRICT WISE (3 OF 3) (Unit: m)

Canal	Qmax (m3/s)			Total	Irrigation		Irri. cum Drain		Drainage	
Name	I	I/D	D	Length	Improv.	New	Improv.	New	Improv.	New
AW1	1.4	-	-	600	-	600	-	-	-	-
AW2	0.4	-	-	800	-	800	-	-	-	-
AW3/3A/3B	2.4	-	-	7,100	5,400	1,700	-	-	-	-
AW4	1.9	6.9	6.9	10,100	-	4,000	2,650	1,050	750	1,650
(4-Route:Sub-total)				18,600	5,400	7,100	2,650	1,050	750	1,650
DAW2	-	-	4.0	1,250	-	-	-	-	-	1,250
DAW3/3A	-	-	12.2	6,600	-	-	-	-	5,300	1,300
DAW4	-	-	16.2	6,450	-	-	-	-	3,300	3,150
(3-Route:Sub-total)				14,300	0	0	0	0	8,600	5,700
AW(I) 7-Route: Total				32,900	5,400	7,100	2,650	1,050	9,350	7,350
AW5	2.4	-	-	4,500	4,500	-	-	-	-	-
AW6	1.7	-	-	1,800	-	1,800	-	-	-	-
AW7	3.3	-	-	11,700	11,700	-	-	-	-	-
AW8	0.7	-	-	1,000	-	1,000	-	-	-	-
AW9/9A/9B	7.2	-	-	24,600	13,350	11,250	-	-	-	-
(5-Route:Sub-total)				43,600	29,550	14,050	0	0	0	0
DAW5/5A	-	-	15.6	12,700	-	-	-	-	900	11,800
DAW6	-	-	15.8	20,520	-	-	-	-	14,870	5,650
DAW8	-	-	7.6	7,300	-	-	-	-	-	7,300
DAW10	-	-	12.0	10,600	-	-	-	-	6,000	4,600
(4-Route:Sub-total)				51,120	0	0	0	0	21,770	29,350
AW(II) 9-Route: Total				94,720	29,550	14,050	0	0	21,770	29,350
AW 16-Route: Total				127,620	34,950	21,150	2,650	1,050	31,120	36,700
AE1	0.6	-	-	2,000	2,000	-	-	-	-	-
AE2	1.3	-	-	3,200	-	3,200	-	-	-	-
AE3A	6.4	16.9	21.1	29,000	4,350	4,950	11,350	500	7,850	-
AE3B	1.6	2.2	9.2	10,300	2,000	1,000	600	-	3,400	3,300
AE3C	0.8	-	-	1,400	-	1,400	-	-	-	-
(5-Route:Sub-total)				45,900	8,350	10,550	11,950	500	11,250	3,300
DAE9	-	-	7.5	5,400	-	-	-	-	1,500	3,900
AE(I) 6-Route: Total				51,300	8,350	10,550	11,950	500	12,750	7,200
AE4/4A/4B	4.4	3.8	4.0	15,350	4,400	850	8,100	1,150	-	850
AE5	1.8	-	-	4,900	4,900	-	-	-	-	-
AE6/6A/6B	1.9	7.8	21.3	25,000	7,000	1,600	7,600	1,000	7,800	-
(3-Route:Sub-total)				45,250	16,300	2,450	15,700	2,150	7,800	850
DAE12B/12C	-	-	9.8	10,500	-	-	-	-	4,000	6,500
DAE13	-	-	8.6	6,400	-	-	-	-	4,900	1,500
(2-Route:Sub-total)				16,900	0	0	0	0	8,900	8,000
AE(II) 5-Route: Total				62,150	16,300	2,450	15,700	2,150	16,700	8,850
AE7	2.3	7.0	-	11,750	1,900	-	8,350	1,500	-	-
AE8	0.5	-	-	900	900	-	-	-	-	-
AE11	6.8	11.0	11.0	19,350	6,800	2,800	6,050	1,500	-	2,200
(3-Route:Sub-total)				32,000	9,600	2,800	14,400	3,000	0	2,200
DAE14	-	-	15.7	5,500	-	-	-	-	5,500	-
DAE16	-	-	8.4	3,200	-	-	-	-	-	3,200
DAE17	-	-	7.8	4,400	-	-	-	-	1,250	3,150
(3-Route:Sub-total)				13,100	0	0	0	0	6,750	6,350
AE(III) 6-Route: Total				45,100	9,600	2,800	14,400	3,000	6,750	8,550
AE 17-Route: Total				158,550	34,250	15,800	42,050	5,650	36,200	24,600
Entire 81-Route: Total				594,220	135,950	72,300	128,700	8,000	135,920	113,350

TABLE E.1.5-3 LIST OF SECONDARY CANAL RELATED FACILITIES

(Unit: place)

District / Sub-District	HW	HE			Sub-total	AW		Sub-total	AE			Sub-total	Total	Remarks
	(I)	(I)	(II)	(III)		(I)	(II)		(I)	(II)	(III)			
1. Check (Type A)	9	10	18	11	39	8	21	29	10	11	12	33	110	
2. Check (Type B)	4	1	0	0	1	1	3	4	4	2	2	8	17	
3. Check/Drop (Type A)	0	3	0	3	6	2	2	4	0	0	3	3	13	
4. Check/Drop (Type B)	15	11	3	5	19	1	2	3	4	2	0	6	43	
5. Check/Drop (Type C)	3	3	1	1	5	0	0	0	1	0	0	1	9	
6. Check/Drop (Type D)	4	2	0	0	2	0	0	0	0	0	0	0	6	
7. Drop (Type A)	23	9	2	20	31	3	8	11	3	4	4	11	76	
8. Drop (Type B)	173	158	1	110	269	4	17	21	10	5	0	15	478	
9. Drop (Type C)	26	9	0	6	15	1	2	3	0	1	0	1	45	
10. Drop (Type D)	51	80	1	19	100	0	1	1	0	0	0	0	152	
11. Bridge (Type A)	27	16	4	5	25	18	23	41	12	13	14	39	132	
12. Bridge (Type B)	27	16	4	5	25	18	23	41	12	13	14	39	132	
13. Bridge (Type C)	99	100	67	43	210	34	97	131	50	64	45	159	599	
14. Turnout (Type A)	18	13	6	0	19	6	16	22	4	13	4	21	80	Double Orifice
15. Turnout (Type B)	15	20	19	0	39	10	19	29	11	9	16	36	119	Double Orifice
16. Turnout (Type C)	8	10	2	21	33	6	18	24	9	7	7	23	88	Sluice Gate
17. Junction (Type C1-1)	3	3	1	0	4	8	8	16	0	4	1	5	28	
18. Junction (Type C1-2)	18	5	3	0	8	8	11	19	11	8	10	29	74	
19. Junction (Type C1-3)	6	8	0	5	13	2	4	6	1	1	3	5	30	
20. Junction (Type C2)	1	0	0	1	1	0	0	0	0	1	0	1	3	
21. Junction (Type S)	33	50	51	26	127	14	37	51	12	22	25	59	270	
22. Siphon (Type A)	2	0	0	0	0	0	1	1	0	0	0	0	3	
23. Siphon (Type B)	0	0	0	0	0	0	0	0	0	0	0	0	0	
24. Cross Culvert (Type A)	0	0	0	0	0	1	3	4	1	0	0	1	5	
25. Cross Culvert (Type B)	4	0	0	0	0	0	0	0	0	0	0	0	4	
26. M.C. Crossing	8	7	4	0	11	0	0	0	0	0	0	0	19	Siphon
27. Aqueduct	1	0	0	12	12	0	3	3	0	0	0	0	16	

E. 1. 6 Planning and Design of Tertiary Canal

1. Definition

This section describes the basic concept and approach, design criteria and standard design adopted for planning and design of the tertiary canal. Some of the items have already been mentioned in detail in the respective appendixes, and are duplicated briefly here.

(1) Proposed Canal System

a) In planning, the canals in the project area are classified as follows.

By the role of the canal into
- Irrigation canal
- Drainage canal
- Irrigation cum drainage canal

By operation & maintenance, and management method into
- Main canal/drain
- Secondary canal
- Tertiary canal
- Fourth canal (irrigation or drainage ditch)
- On-farm ditch

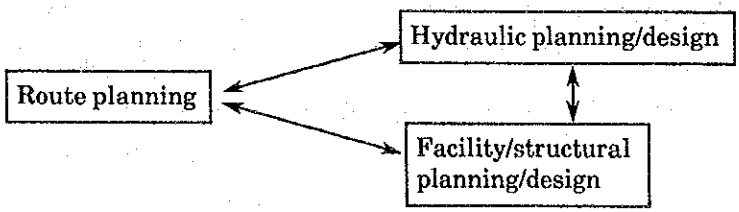
b) The proposed canal system is consisted of

- Conveyance structures
- Regulating structures
- Intake and water measurement structures
- Protective structures

c) The term tertiary canal when used in general will mean both the irrigation and drainage canal. distinction will be made, such as irrigation tertiary canal, drainage tertiary canal, and irrigation cum drainage tertiary canal, whenever necessary to specify the role of the canal.

d) Basic Approach

Route planning, hydraulic planning and facility planning are interrelated and should be planned by feedbacking the results of one to the other, in order to produce a good planning.



(2) Tertiary Canal and the Related Terms

a) A block is an area of approximately 500 ha commanded by a tertiary canal.

b) A unit is an area of approximately 100 ha commanded by a fourth canal.

c) The command area of irrigation and drainage canal is determined by gross paddy area and gross area, respectively. Block very much greater or smaller than 500 ha will be planned as a special case. This happens when the topographical and/or social conditions restrict smooth organization of area in a zone into blocks of 500 ha. For the same reason, a unit can be larger or smaller than 100 ha.

d) A turn-out is a permanent structure diverting water from the secondary canal into the tertiary canal.

e) An off-take, often install with gates and incorporated with check structure, is a permanent structure diverting water from the tertiary into the fourth canal.

f) The irrigation tertiary canal (ITC) conveys water diverted at the turn-out (from the secondary canal) and ends at a terminal irrigation unit. Off-take structures located in the tertiary canal divert

water into the fourth canals to irrigate the units. The secondary canal can be either an irrigation canal or irrigation cum drainage canal. The ITC is connected indirectly, via intake structures, to the farm ponds in the vicinity.

g) The drainage tertiary canal (DTC) starts at a drainage unit, and collects drainage water from other units along its course before draining into the secondary canal, or in some cases directly into the rivers or the Caspian sea. The secondary canal, likewise, can be either a drainage canal or an irrigation cum drainage canal. The DTC is connected indirectly, via intake and spillway structure, to the farm pond in the vicinity to collect and store drainage water and return flow.

h) An irrigation cum drainage tertiary canal (IDTC) is basically a drainage canal which convey irrigation water, return flow and drainage water. The return-flow and drainage water collected during irrigation period are used for irrigation through off-take structures in the downstream. Like the ITC, the IDTC is connected indirectly to the farm ponds.

i) Return flow is available for irrigation and is included when estimating water resource. However, it is omitted in designing canal capacity since it is often very much smaller than the peak design discharge.

j) Surface water irrigated area is the area currently irrigated by water diverted from the existing canals. And is the main factor in the design of canal capacity.

k) Groundwater irrigated area is the area irrigated by groundwater drafted through deep and shallow wells, artesian wells and springs. In this study they are included in the design of canal capacity.

2. Existing Conditions

1) Tertiary Canal

a) The density of existing canal is estimated at about 15m/ha. The command area of these canal ranges from 5 to over 500 ha and the individual canal length from 0.1 km to over 10 km.

b) Some of the tertiary canals function as irrigation cum drainage canals; conveying irrigation water diverted from the secondary canal and collecting return-flow and/or drainage water along its course. The water is either reused for irrigation or drained away at the lower reaches.

c) The existing canal network, evolved over the years, is complex. Though most of the major tertiary canals are named locally, the size and boundary of the command area of each canal are not necessarily accurately known.

d) The routes of these canals were clarified through Terminal Irrigation Block Survey (TIB) conducted in this study.

(2) Appurtenant Structures

a) Diversion Structures

The existing diversion structures, most of them temporary, are constructed by the mirabs or farmers at the beginning of irrigation season.

In the highland region, the invert of the secondary canals are deep, far below the elevation of the surrounding paddy fields and it is difficult to obtain the required diversion head without some form of check structure. Some of the existing canals, especially those irrigating the middle land region, water is diverted at locations very much upstream and convey water through long approach canals.

b) Regulating and Measuring Structures

Water distribution in the Project Area is arbitrated by the Mirabs and the unit 'abdang' (ratio for distribution) in use is ambiguous. In some cases, water diversion is conducted by contracted rectangular weir and measurement is not a common practice. To ensure stable water distribution and efficient water management, some form of measuring device are necessary.

c) Protection and Safety Structures

The existing facility does not provide protection against flood water or rain-storm from flowing into the tertiary canals.

The canals are not protected against sedimentation. The sediment, especially the sand load, is removed by the farmers at the field level. In some of the downstream region, especially in the drainage canal, plugging is becoming a problem.

Most of the existing permanent drop structures (mainly built of concrete, block or stones) are poorly maintained. In some cases, the canals bed and embankments are heavily eroded.

d) Operation and Maintenance Structures

Some of the roads along the larger canals inhibit smooth access by vehicles. And the existing level of farm road and village roads is insufficient for smooth farming, operation & maintenance activities.

(3) Existing Design Criteria/Standard

a) At present there are several design criteria in use in Iran.
For example,

- Soil and concrete design criteria ASSHTO, ASTM, ACI
- Hydraulic and structural design criteria
  Design of small canal structures by United States, Department of the Interior, Bureau of Reclamation

b) The details of hydraulic and structural criteria adopted in Water Resources Development Planning of Talar, Babol and Haraz Watersheds (Haraz Plain Water Supply Project, Design of Irrigation and Drainage Scheme, Phase-1) can be found in HWDP-1 Volume B-2 Report (e.g. p 5-22 to 5-26).

c) To avoid confusion, it is necessary to specify and state clearly the criteria used for planning and design. The detail of design criteria use in this study is given in 1) of (4) "Design Criteria".

3. Route Planning of the Tertiary Canal

(1) Canal Alignment and Integration of Intake

The routes of the tertiary canals are planned as follows.

- The role of canals are planned based on the roles defined above.
- The canal routes are planned using 1/20,000 map containing the contour lines and the existing canal network. These maps were prepared from the NCC maps (National Cartographic Center) and the results of the Terminal Irrigation Block Survey (TIB) conducted in this study.
- The routes of the tertiary canals are planned after careful study of the topography and the existing canal network. The routes are planned in such a way that the tertiary canals irrigate, or drain water from, blocks of approximately 500 ha. In doing so the existing canals, large and small inside a block are integrated into a more or less simpler layout. Also, after land consolidation, most of the smaller existing canals will be 'displaced' by irrigation or drainage ditches.
- The zones, defined for the secondary canals, are cut-up into blocks (less than 500 ha) based on the proposed route of the tertiary canal. The process of grouping the area within the zones into block is conducted after taking into consideration the existing canal routes, topography (contour lines, ridges and valleys, and slope orientation), the existing road, village boundary, ponds (abbandan), land consolidation and canal density.
- The routes are planned principally by adopting the existing ones whenever possible, putting emphasis on those that collect return-flow. However, new routes are planned for cases where better water conveyance and distribution can be expected for irrigation or for better

drainage. For example, by rerouting the irrigation canal along the ridges of rim of the slope and the drainage canal along the valleys. For there cases, the right-of-way for the canal will have to be considered.

- The blocks are then divided into units (about 100 ha) along the tertiary canal to plan the off-take locations and land repotting in land consolidation.
- Also, the blocks are sub-divided into sub-blocks bordered by the irrigation and drainage boundary, as defined by the topography, to facilitate grouping the land into irrigation and drainage area. Note that the blocks are divided into units and sub-blocks for different purposes. And the sub-blocks do not coincide with the units.
- The farm pond in the vicinity are linked indirectly to the proposed tertiary canal whenever possible. The ponds are never planned as a part (i.e. included in the canal route) of a canal.

Generally, topographical undulation play an important role in canal route selection. The irrigation block boundary coincides with the valleys or depression of the topography and therefore is usually the planned location for route of drainage canal. The reverse is true for drainage boundary; since the drainage boundary generally follows the ridges or convex of the topography, the irrigation canal route is generally planned along the drainage boundary, and irrigation cum drainage canal along inflection of a slope.

a) Irrigation Tertiary Canal (ITC)

Irrigation tertiary canals are planned to command an irrigation block (approximately 500 ha of gross paddy area), and ends at a terminal irrigation unit (about 100 ha). Basically each block is irrigated by one tertiary canal. Block irrigated by more than one tertiary canals is planed as special case. The irrigation tertiary canals are generally planned along the ridges of the topography, and they also serve as drainage boundary. Depending on slope orientation, they are planned either to irrigate the area along single or both banks.

The existing canals are given the priority in the route planning. Other alternative routes are considered only when better water conveyance can be expected.

The off-take structures in the tertiary canals are planned in such a manner that each off-take irrigates an irrigation unit of about 100 ha.

In the process of canal route planning some of the canals are planned as irrigation cum drainage canals, depending on water use, the slope orientation and topography.

b) Drainage Tertiary Canal (DTC)

The drainage tertiary canals are planned along the depressions of the topography, and thus also serve as irrigation boundary.

Drainage tertiary canals receive drainage water from a drainage unit (about 100 ha) and along its course collect water from other units. Therefore, a drainage tertiary canal commands a drainage block of approximately 500 ha.

(2) Naming of the Tertiary Canals and Blocks

a) The name of the irrigation tertiary canal consists of two parts. The first part comes from the name of the zone (secondary canal) and the second part from the layout sequence of the tertiary canals from upstream. For example, AE15-T1, AE15-T2, etc. AE15 comes from the secondary canal and T1, T2 are number of the layout sequence.

For blocks irrigated or drained by more than one tertiary canal, "a", "b", "c", will be added, in the clock-wise direction. e.g. AE15-T1a, AE15-T1b.

b) The drainage secondary canals are numbered according to the district and layout sequence in the clock-wise direction. The tertiary canals in each drainage secondary canal are numbered according to the layout sequence from downstream, e.g. DAW2-J3, DAW2-J4. J3 means the third drainage outlet and DAW2 is the name of the drainage secondary canal.

4. Design Criteria and Appurtenant Structures

1) Design Criteria

The hydraulic design criteria for the tertiary canal are basically the same as those for the secondary canal. However, adaptation is made for the small discharge found in the tertiary canal.

- Continuity Equation

  $Q = V1 \times A1 = V2 \times A2$

- The Average Velocity Equation (Manning's formula)

  $V = 1/n \times R^{(2/3)} \times I^{(1/2)}$

  is used in the hydraulic calculation of uniform flow (where the longitudinal gradient, water surface and energy head are parallel).

- Coefficient of Roughness (n)

  In the Manning's formula, n varied only with the conditions of the channel surface. n = 0.030 is adopted in principle for irrigation and irrigation cum drainage canal. n = 0.045 is used for canal with heavy weed growth and stones or pebbles as bed material, and for drainage canal.

- Type and Shape of Cross Section

  Open-type unlined trapezoidal cross-section is adopted as the most economical section. Lined section, not necessarily trapezoidal, will be considered only for hydraulically difficult locations.

  For a Trapezoidal Section

  $$A = b \times h + z \times h^2$$
  $$R = A/P$$
  $$P = b + 2 \times h \times \mathrm{sqrt}(1 + z^2)$$
  $$B = b + 2 \times z \times h$$

  where

  A : cross sectional area
  b : bottom width
  B : water surface width
  h : design water depth
  z : side slope (1 (vertical) : z (horizontal))
  R : hydraulic radius

P : wetted parameter in contact with the channel

- Side Slope (1 vertical : z horizontal)

  For earth canal z ranges from 1.0 to 3.0 depending on soil type. Side slope of 1:1.5 is adopted for this study.

- Freeboard (Fb)

  Adequate freeboard must be provided to guard against sudden rise in the water level due to operation error, intrusion of flood water from rain-storm, changes in canal roughness, etc.

  $$Fb = 0.07 \times d + hv + (0.05 \text{ to } 0.15) >= 0.15 \text{ m}$$

  d : design water depth (m)

  hv : velocity head (m)

  The minimum freeboard is 15 cm. However, the value adopted in planning is determined by the design discharge.

Fb = 0.15 m	for $q <= 1.0$ cu.m/s
Fb = 0.30 m	for 1.0 cu.m/s $< q <= 5.0$ cu.m/s
Fb = 0.40 m	for 5.0 cu.m/s $< q <= 15.0$ cu.m/s

- Longitudinal (invert) Profile

  The invert gradient is designed for maximum canal capacity while ensuring maximum canal stability and most efficient use of head loss; no abnormal flow, no deposition of sand, no aquatic weed growth, no scouring and erosion of canal bed and side.

  The invert are planned, as far as possible, in such a way that the canal bed is situated under the natural ground surface. This does not hold for the 'filled portion' before a check/drop structure. And wherever possible, the normal water surface in the canal is kept at one meter above ground level in the average (from 0.5 m to 1.5 m above ground level) at the diversion point, since in most cases, the area irrigated are located close to the canal.

- Allowable Velocity (Vmin, Vmax)

  Very few natural canal bed/side material can withstand a flow velocity exceeding 1.5m/s. The safe velocity is set between 0.3 m/s (Vmin) to

0.9 m/s (Vmax) for earth irrigation canal. For earth drainage canal 1.5 times of the maximum value, i.e. 0.9 × 1.5 = 1.35 m/s, is adopted for 1/10 probability rain-storm. For the irrigation cum drainage canal, design velocity is checked for the most and the least frequent flow; the maximum value is 0.9 m/s for irrigation and 1.35 m/s for drainage. Near critical flow should be avoided; the design velocity should be less than 2/3 of the critical velocity to ensure hydraulic and water surface stability, and structure safety.

- Energy Head Loss

  Frictional, entrance, transition, bend or curvature, pier or screen or trash rack head loss are the major head losses occur in the tertiary canal. Of the head losses, mainly the frictional head loss is considered in the standard design. 0.3 m head loss is considered in planning.

- Design Discharge

  Irrigation Canal

  2.0 cu.m/s/ha (peak flow in summer irrigating gross paddy area in a block).

  For Drainage Canal,

  15.42M^(-1/6) lit/s/ha (1/10 year probability winter rainfall). However, the Cypress-Creek formula and the 20-40% rule are applied at all time.

- d/b (water depth and bed width) ratio

  Since the best hydraulic cross section (for a trapezoidal section b = 2 × d tan (theta /2), theta is the angle between the horizontal) is not necessary the most economical section, the d/b ratio is set between 1 to 2 for small canal. Larger value of d/b is not adopted because of side slope stability in earth canal.

  For a trapezoidal cross-section with 1:1.5 side slope the best hydraulic section happens when d/b = 1.6. Also, from the construction aspect (e.g. excavating by a backhoe) b = 50 cm is adopted as the minimum bed width value.

- Service Road and Top Berm Width

  Effective width of 4.5 m is adopted for service road. The top berm width of 1 m is proposed for the bank opposite to the service road to reduce seepage and to provide foot passage.

(2) Appurtenant Structures

Generally, for easy and economical operation and maintenance and to reduce construction costs, it is advisable to reduce the number of structures. Since the existing structures in the existing canal network is insufficient to facilitate safe and smooth operation and proper management of water supply and drainage, the following appurtenant structures are proposed.

a) Turn-out Structure

Permanent turn-out structure, with regulating and measuring device are planned in the secondary canal to divert and measure water diverted into the tertiary canal.

b) Off-take Structure

Off-take structures built in the tertiary canal are permanent structure with sluice gate and staff gages to control and measure diversion.

c) Check Structure

Check structure is designed to control the upstream flow as well as to maintain the desired water level for diversion. Check structure is usually incorporated with the off-take structure, since checking-up of water level is only necessary at off-take location.

d) Drop Structure

Drop structures are used in places where the natural slope caused excessive velocity. They may be closely spaced in series to keep flow velocity within the allowable range. Concrete drop structures are proposed. For lined or protected section a maximum drop of 2.5 m to

3.0 m is usually permitted. Vertical drop of 2.0 m is adopted in this study.

e) Spillway Structure

Spillway is provided to drain away excess water resulting from operation error, and to empty the canal for inspection and repair or when bank collapse occurs at downstream. For the irrigation tertiary canal in the study area, spillway structure is usually not necessary for the following reasons:

- The length of the irrigation tertiary canal ranges from a few hundred meters to about 6 km. Operating the turn-out structures will enable inspection and repair work or to cope with emergency.
- The design discharge of tertiary canal is small. A canal with 0.5 m bed width (the smallest design bed width) and 1/500 longitudinal slope (average design slope) will allow a discharge of 0.5 cu.m/s (average design discharge) at a flow velocity of less than 0.7 m/s (less than the allowable velocity).

f) Road Crossing Structure

For $Q < 3.0$ cu.m/s, pipe road crossing is more economical, easily designed and constructed, and cause less road interference during and after construction. For operation and maintenance purpose, the minimum diameter of the pipe should be greater than or equal to 600 mm.

The existing structural survey along the New and Old Amol-Babol road and the coastal road shows that pipe structure is used for small discharge, and except for the few cases, the minimum diameter used is equal to or larger than 600 mm; 800 mm to 1,000 mm being the most popular types. The survey also shows that almost all of the existing pipe crossing structures are poorly maintenance. It is reiterated here that proper maintenance of these structures is a must in order to perpetuate the design capacity. Also, the existing pipe crossing structures must be rehabilitated and adopted in the detail design,

especially in planning land consolidation, before turning to new alternatives.

Simple concrete slab bridge are planned as the crossing structure for drainage tertiary canal where pipe crossing is not advisable.

g) Settling Basin

Since removal of suspended load are already considered at the Haraz and Amol Diversion Dam, only small settling basin will be planned at location after the turn-out or in the head-race to remove suspended load. Exclusion of silt and clay is economically not feasible and is not necessary for water of agricultural use.

h) End Structure

A box-type end structure with drainage outlet is planned at the end of tertiary canal. Water from the end structure is drained either into drainage ditch, tertiary or secondary canal

5. Proposed Level of Improvement

In connection with land consolidation, the following level of improvement is adopted for tertiary canal development.

Structure	Existing	Planned
Conveyance	excavated, unlined	excavated, trapezoidal, unlined. Some existing ones abandoned or unified and systematically ordered and classified
Intake	mostly temporary	permanent structure after unifying and abandoning
Regulating	ditto abbandan	permanent with gates, rehabilitated to increase storage effect
Measuring	staff gages	sluice gate with staff gage
Protective/Safety	mostly temporary	drop, check, gate, settling basin, end structure
O & M	roads, paths	service road

6. Planning and Design Procedure

(1) Design Data

a) Existing Topographical Information From Maps

- Spot (or paddy field) elevation: (1/20,000) maps
- Detail contour lines: NCC (1/20,000) maps

- Bench mark elevation: Bench Mark survey maps (1/20,000)
- Turn-out elevation: Secondary canal survey

b) Area (Block and sub-block level) From Land Use Data

- Gross and paddy (net)
- Groundwater (spring and well) irrigated area

c) Canal Route and Length from Proposed Canal Layout Maps

- Irrigation districts, zones, blocks, sub-blocks,
- Drainage zones, blocks, sub-blocks
- Turn-out locations

  The proposed canal layout maps are prepared after careful and thorough study of the existing canal networks, topography and water use.

d) Existing Irrigation and Drainage Canal Network

- maps (1/20,000) from TIB survey results

e) Canal Materials, Soil Types and Physical Properties

f) Design Criteria

- Hydraulic planning
- Structural design

g) Operation & Maintenance

- Existing situation
- Proposed method and organization

h) Proposed Level of Improvement

(2) Preparation of Block Schematic Flow Diagram

a) Since most of the sub-blocks are 'oblong' in shape in the north-south direction, it is advisable to organized the paddy fields into somewhat 'square' shaped irrigation unit by appropriately organizing the paddy area in the sub-blocks to the respective irrigation unit. This will avoid planning a fourth canal that is unnecessarily long and it is more efficient in the use of available energy head.

b) In organizing the sub-blocks into the units the following points are taken into consideration:

- Existing road (large and paved, shown in NCC maps)
- Shape and direction of the zone/block boundary
- Villages
- Contour lines
- Existing canal, especially those of drainage nature
- The proposed size of unit

c) The gross paddy area and the diversion rate are estimated for each irrigation unit. The location of the off-take in a tertiary canal, usually at the head of the unit, are also determined.

d) These data are tabulated in the form of the schematic flow diagram.

(3) Existing Profile

a) The elevations of all contour lines crossing the proposed tertiary canal are read from the NCC maps. For the steep slope in the highland region and those places where the contour lines are close together and more or less running parallel, they are read at 10 m interval, to an accuracy of 1 m. For the flatter lowland region where the contour lines

are wider apart, they are read at 2 m interval, to an accuracy of 1 decimal place.

b) The distance between the contour lines are measured by a 'curvimeter' to an accuracy of 50 m.

c) These data are plotted to obtain the average longitudinal slope of the ground surface. Average slope is calculated for each 10 m drop in altitude and/or for sections with different slopes.

d) The existing profile are used in designing velocity, locating and designing of drop and check structures.

(4) Hydraulic design

a) Hydraulic design is based on the existing profile. The off-take locations are also read and plotted on the profile. Average slope for the interval between the off-takes are estimated. Hydraulic calculation is conducted separately for the individual Q of the intervals between the off-takes. A combination of standard bed widths and standard longitudinal slopes, ranging from those steeper to those gentler than the existing ones are used. Only the combination that produces a velocity within the permissible velocities and the proposed d/b ratio is adopted in profile design.

b) The profile is designed for each interval by plotting the selected bed width and longitudinal slope combination which give the best hydraulic profile and head distribution throughout the tertiary canal.

7. Standard/Typical Design

a) Hydraulic section
Unlined trapezoidal cross-section (side slope 1.1:5) is adopted as the standard cross-section.

b) The minimum bed width is 50 cm and the increment is 10 cm. Standard bed widths are 50 cm, 60 cm, 70 cm, 80 cm, 90 cm, 100 cm, 110 cm, 120 cm, 130 cm, 140 cm and 150 cm.

c) Standard slope are 1/50, 1/100, 1/200, 1/300, 1/400, 1/500, 1/600, 1/700, 1/800, 1/900, 1/1,000, 1/1,250, 1/1,500, 1/2,000,1/2,500, 1/3,000, 1/3,500, 1/4,000, 1/4,500 and 1/5,000.

d) Four types of drop structure, A-type = 2.0 m, B-type = 1.0 m, C-type = 0.5 m and D-type = 0.25 me are proposed.

TABLE E.1.6-1 SUMMARY OF IRRIGATION CANAL

ZONE	AREA (ha)	DISCHARGE (cu.m/s)	CANAL LENGTH (m)			
			IMPROVE/REPAIR		NEW	TOTAL
			A TYPE	B TYPE	C TYPE	
HARAZ WEST	10,382	20.77	58,200	1,950	30,850	91,000
AMOL WEST	17,463	34.91	83,250	32,600	45,950	161,800
HARAZ EAST	11,019	22.80	60,400	34,150	11,550	106,100
AMOL EAST	23,539	47.06	87,410	55,150	62,200	204,760
KARI LEFT	9,591	19.19	26,650	47,500	19,700	93,850
KARI RIGHT	4,277	8.53	17,400	10,900	9,300	37,600
TOTAL	76,271	153.26	333,310	182,250	179,550	695,110

A TYPE: Existing canal commanding less than 100ha
B TYPE: Existing canal commanding more than 100ha
C TYPE: New canal

TABLE E.1.6-2 TERTIARY IRRIGATION CANAL (HARAZ WEST DISTRICT)

TERTIARY CANAL		AREA (ha)	DISCHARGE (cu.m/s)	CANAL LENGTH (m) IMPROVE/REPAIR A TYPE	IMPROVE/REPAIR B TYPE	NEW C TYPE	TOTAL	ELEVATION(m) START	ELEVATION(m) END	AVERAGE SLOPE
HW1	T1	144	0.29		450	1,150	1,600	153.0	130.0	1/ 70
	T2	77	0.15	400		600	1,000	152.0	132.0	1/ 50
	T3	182	0.36	500		1,900	2,400	152.0	119.0	1/ 73
	T4	220	0.44	1,200		600	1,800	153.0	125.0	1/ 64
	Total	623	1.24	2,100	450	4,250	6,800			
HW2A	T1	201	0.40	200		1,600	1,800	109.0	102.0	1/ 257
	T2	161	0.32	350		1,550	1,900	105.0	89.0	1/ 119
	T3	217	0.43	1,050		250	1,300	93.0	76.0	1/ 76
	T4	1,019	2.04	2,400		4,000	6,400	36.0	4.0	1/ 200
	T4'	(404)	(0.81)			3,100	3,100	20.0	9.0	1/ 282
	T5	293	0.59	2,100			2,100	60.0	42.0	1/ 117
	Total	1,891	3.78	6,100		10,500	16,600			
HW2B	T1	323	0.65	3,400		800	4,200	107.0	70.0	1/ 114
	T2	334	0.67	700	400	1,900	3,000	88.0	64.0	1/ 125
	T3	339	0.68	3,900		500	4,400	62.0	29.0	1/ 133
	T4	314	0.63	1,400		600	2,000	30.0	16.0	1/ 143
	T5	551	1.10	3,700			3,700	16.0	1.4	1/ 253
	Total	1,861	3.73	13,100	400	3,800	17,300			
HW3	T1	247	0.49	1,250		1,600	2,850	170.0	137.0	1/ 86
	T2/UNIT	82	0.16							
	T3,T4	601	1.20	2,500			2,500	146.0	119.0	1/ 93
	T3,T4'	(300)	(0.60)	3,650			3,650	138.0	107.0	1/ 118
	T5/UNIT	35	0.07							
	T6	135	0.28	2,300			2,300	95.0	74.0	1/ 110
	T7/UNIT	60	0.12							
	T8	414	0.83	3,050		1,800	4,850	63.0	17.0	1/ 105
	T9	358	0.72	2,700	100	100	2,900	56.0	39.0	1/ 171
	T10	318	0.64	3,700			3,700	56.0	21.5	1/ 107
	T11/UNIT	100	0.20							
	T12	415	0.83	2,550		400	2,950	21.5	4.8	1/ 177
	T13	119	0.24			1,400	1,400	16.0	8.5	1/ 187
	Total	2,884	5.78	21,700	100	5,300	27,100			
HW4	T1	183	0.37	300		1,300	1,600	86.0	72.0	1/ 114
	T2	312	0.62	1,900			1,900	69.0	53.5	1/ 123
	T3	466	0.93	3,400			3,400	59.0	24.5	1/ 99
	T4	107	0.21			600	600	29.5	27.2	1/ 261
	T5	489	0.98	200		1,850	2,050	215.0	7.8	1/ 10
	T5'	(241)	(0.48)	400		1,200	1,600	19.0	11.5	1/ 213
	Total	1,557	3.11	6,200		4,950	11,150			
HW5	T1	105	0.21			400	400	60.0	56.0	1/ 100
	T2	114	0.23	400			400	51.0	49.5	1/ 267
	T3	175	0.35	1,450		50	1,500	38.5	24.0	1/ 103
	T4	417	0.83	2,800			2,800	26.0	11.0	1/ 187
	Total	811	1.62	4,650		450	5,100			

A TYPE: Existing canal commanding less than 100ha
B TYPE: Existing canal commanding more than 100ha
C TYPE: New canal

HARAZ WEST DISTRICT (2/2)

TERTIARY CANAL		AREA (ha)	DISCHARGE (cu.m/s)	CANAL LENGTH (m) IMPROVE/REPAIR A TYPE	IMPROVE/REPAIR B TYPE	NEW C TYPE	TOTAL	ELEVATION(m) START	ELEVATION(m) END	AVERAGE SLOPE
HW6	T1	219	0.44	800		1,600	2,400	46.4	23.5	1/ 105
	T2	(131)	(0.26)	650			650	42.0	36.4	1/ 116
	T3	536	1.07	2,900	1,000		3,900	47.2	15.8	1/ 124
	Total	755	1.51	4,350	1,000	1,600	6,950			
TOTAL		10,382	20.77	58,200	1,950	30,850	91,000			

A TYPE: Existing canal commanding less than 100ha
B TYPE: Existing canal commanding more than 100ha
C TYPE: New canal

TABLE E.1.6-3 TERTIARY IRRIGATION CANAL (AMOL WEST DISTRICT)

TERTIARY CANAL		AREA (ha)	DISCHARGE (cu.m/s)	CANAL LENGTH (m) IMPROVE/REPAIR A TYPE	IMPROVE/REPAIR B TYPE	NEW C TYPE	TOTAL	ELEVATION(m) START	ELEVATION(m) END	AVERAGE SLOPE
AW1	T1	98	0.20	600			600	-9.0	-10.0	1/ 600
	T2	395	0.79	4,450		600	5,050	-9.0	-20.4	1/ 443
	T3,T4	431	0.86	1,800		400	2,200	-8.7	-13.5	1/ 458
	T4	(214)	(0.43)	1,500		1,000	2,500	-9.4	-13.5	1/ 610
	Total	924	1.85	8,350		2,000	10,350			
AW2	T1	347	0.69	2,850			2,850	-1.4	-11.5	1/ 282
	T2	164	0.33		(3,050)		(3,050)	-8.5	-15.3	1/ 449
	T3	182	0.36	1,250			1,250	-9.5	-11.5	1/ 625
	Total	693	1.38	4,100			4,100			
AW3A	T1	240	0.48			2,300	2,300	-0.8	-6.9	1/ 377
	T2	672	1.34	1,200			1,200	-9.5	-11.4	1/ 632
	T2'	(603)	(1.21)	4,000		800	4,800	-12.7	-21.0	1/ 578
	T3	271	0.54		(3,000)		(3,000)	-9.5	-15.0	1/ 545
	T4,T4'	491	0.98		4,050		4,050	-9.5	-18.8	1/ 435
	T4'	(243)	(0.49)	2,500		200	2,700	-14.0	-20.2	1/ 435
	Total	1,674	3.34	7,700	4,050	3,300	15,050			
AW3B	T1	569	1.14		4,800		4,800	-0.8	-11.2	1/ 462
AW4	T1	296	0.59	1,100		1,650	2,750	6.1	-3.0	1/ 302
	T2	351	0.70	3,350		350	3,700	1.0	-9.8	1/ 343
	T3	130	0.26			550	550	0.0	-1.0	1/ 550
	T4/UNIT	82	0.16							
	T5	508	1.02	1,600		2,400	4,000	-14.5	-20.5	1/ 667
	T5'	(193)	(0.39)	700		800	1,500	-17.8	-20.3	1/ 600
	T6	248	0.50	1,000		1,200	2,200	-17.7	-21.0	1/ 667
	T7/UNIT	11	0.02							
	Total	1,626	3.25	7,750		6,950	14,700			
AW5	T1/UNIT	41	0.08							
	T2	374	0.75			2,600	2,600	0.0	-5.5	1/ 473
	T3	474	0.95	1,900	1,800		3,700	-1.0	-8.5	1/ 493
	T4	463	0.93			2,250	2,250	-8.0	-14.0	1/ 375
	T4'	(177)	(0.35)			600	600	-10.0	-11.5	1/ 400
	T5	629	1.26	1,900		2,900	4,800	-8.0	-20.0	1/ 400
	T5'	(197)	(0.39)	800		2,000	2,800	-12.4	-20.5	1/ 346
	Total	1,981	3.97	4,600	1,800	10,350	16,750			
AW6	T1/UNIT	64	0.13							
	T2	227	0.45	1,600			1,600	14.1	7.5	1/ 242
	T3	658	1.32	2,650		2,000	4,650	10.6	-5.4	1/ 291
	T3'	(265)	(0.53)	1,350		1,150	2,500	5.8	-2.4	1/ 305
	T4	191	0.38	300		1,900	2,200	11.5	3.3	1/ 268
	Total	1,140	2.28	5,900		5,050	10,950			

A TYPE: Existing canal commanding less than 100ha
B TYPE: Existing canal commanding more than 100ha
C TYPE: New canal

AMOL WEST DISTRICT (2/2)

TERTIARY CANAL		AREA (ha)	DISCHARGE (cu.m/s)	CANAL LENGTH (m) IMPROVE/REPAIR A TYPE	IMPROVE/REPAIR B TYPE	NEW C TYPE	TOTAL	ELEVATION(m) START	ELEVATION(m) END	AVERAGE SLOPE
AW7	T1	695	1.39	4,100		2,200	6,300	24.5	-1.3	1/ 244
	T2/UNIT	84	0.17							
	T3	162	0.32		1,750	0	1,750	1.6	-2.5	1/ 427
	T4	289	0.58	2,400		0	2,400	-2.8	-10.2	1/ 324
	T5	200	0.40	2,000		0	2,000	-6.2	-10.4	1/ 476
	T6	212	0.42	2,800		0	2,800	-6.2	-14.0	1/ 359
	T7	284	0.57	0	2,600	0	2,600	-15.5	-21.5	1/ 433
	T8	262	0.52	3,100		0	3,100	-15.7	-21.7	1/ 517
	T9	300	0.60	2,800		0	2,800	-9.7	-15.1	1/ 519
	T10	653	1.31	5,200	1,000	400	6,600	-9.7	-20.0	1/ 641
	T10'	(198)	(0.4)	550		650	1,200	-10.0	-13.2	1/ 375
	Total	3,141	6.28	22,950	5,350	3,250	31,550			
AW8	T1	299	0.60	1,650		200	1,850	50.0	33.0	1/ 109
	T2	179	0.36	1,100		750	1,850	50.0	40.0	1/ 185
	Total	478	0.96	2,750		950	3,700			
AW9	T1	132	0.26	0	200	800	1,000	47.5	45.0	1/ 400
	T2	129	0.26	1,200		0	1,200	26.5	19.4	1/ 169
	T3	501	1.00	1,000	3,800	1,000	5,800	26.5	0.0	1/ 219
	Total	762	1.52	2,200	4,000	1,800	8,000			
AW9A	T1/UNIT	92	0.18							
	T2/UNIT	81	0.16							
	T3	242	0.48	1,600		400	2,000	-1.2	-6.0	1/ 417
	T4	524	1.05	(1400)		(500)	(1900)	-1.4	-4.8	1/ 559
	T4'	(216)	(0.43)	200	1,200	600	2,000	-1.4	-8.4	1/ 286
	T4''	(162)	(0.32)	1,600			1,600	-4.8	-10.0	1/ 308
	T4'''	(113)	(0.23)	2,300			2,300	-4.8	-12.4	1/ 303
	T5/UNIT	84	0.17							
	T6	198	0.40	400		1,400	1,800	-13.7	-17.8	1/ 439
	T7	749	1.50		4,500	600	5,100	-13.5	-21.3	1/ 654
	T7'	(206)	(0.41)		3,000		3,000	-15.5	-18.7	1/ 938
	T7''	(167)	(0.33)	500		600	1,100	-18.2	-20.0	1/ 611
	T8	218	0.44	1,000	2,300	100	3,400	-13.7	-21.5	1/ 436
	Total	2,188	4.38	7,600	11,000	3,700	22,300			
AW9B	T1	131	0.26	400		1,400	1,800	15.1	7.4	1/ 234
	T2/UNIT	71	0.14							
	T3	306	0.61	1,000	500	1,200	2,700	7.1	-1.5	1/ 314
	T4/UNIT	61	0.12							
	T5	370	0.74	2,200		1,600	3,800	1.0	-8.9	1/ 384
	T6	165	0.33	400		400	800	-4.0	-6.7	1/ 296
	T7	184	0.37	1,500			1,500	-8.0	-12.0	1/ 375
	T8	145	0.29			900	900	-10.5	-11.0	1/ 1800
	T9	290	0.58		1,100		1,100	-12.8	-13.8	1/ 1100
	T9'	(115)	(0.23)		(2100)		(2100)	-13.8	-17.1	1/ 636
	T10	422	0.84	3,550		1,100	4,650	-15.3	-21.4	1/ 762
	T11	142	0.28	300		2,000	2,300	-15.3	-19.8	1/ 511
	Total	2,287	4.56	9,350	1,600	8,600	19,550			
TOTAL		17,463	34.91	83,250	32,600	45,950	161,800			

TABLE E.1.6-4 TERTIARY IRRIGATION CANAL (HARAZ EAST DISTRICT)

TERTIARY CANAL		AREA (ha)	DISCHARGE (cu.m/s)	CANAL LENGTH (m) IMPROVE/REPAIR A TYPE	IMPROVE/REPAIR B TYPE	NEW C TYPE	TOTAL	ELEVATION(m) START	ELEVATION(m) END	AVERAGE SLOPE
HE1	T1(L)	167	0.33	1,000	1,000	600	2,600	162.0	148.0	1/ 186
	T1L'#1	(157)	0.31							
	T1(R)	182	0.36	3,900			3,900	162.0	126.0	1/ 108
	T1R' #1	(223)	0.45							
	T2	117	0.23	1,200			1,200	104.0	91.5	1/ 96
	T3	355	0.71	1,800			1,800	86.5	72.0	1/ 124
	T4(L)	533	1.07		5,550		5,550	81.0	36.0	1/ 123
	T4(R)	364	0.73	3,150		1,200	4,350	81.0	48.0	1/ 132
	T5	533	1.07	4,350		400	4,750	73.0	36.0	1/ 128
	T6(L)	290	0.58	1,100		1,200	2,300	74.0	51.0	1/ 100
	T6(R)	280	0.56		1,950		1,950	74.0	60.0	1/ 139
	Total	2,821	6.40	16,500	8,500	3,400	28,400			
HE2	T1	469	0.94	4,300			4,300	160.0	115.0	1/ 96
	T2	617	1.23	3,700		1,200	4,900	103.0	55.0	1/ 102
	T3	439	0.88	4,600		800	5,400	67.0	23.0	1/ 123
	Total	1,525	3.05	12,600		2,000	14,600			
HE3	T1	125	0.25		650	50	700	157.0	142.0	1/ 47
	T2	136	0.27		1,050		1,050	140.0	130.0	1/ 105
	T3	550	1.10		3,500		3,500	126.0	84.0	1/ 83
	T3'	(264)	(0.53)	3,050		350	3,400	120.0	83.0	1/ 92
	T3''	(197)	(0.39)		1,600		1,600	84.0	70.0	1/ 114
	T4	220	0.44	2,950		300	3,250	78.0	47.0	1/ 105
	T5	881	1.76	6,400		300	6,700	50.0	9.0	1/ 163
	T6	145	0.29		950		950	35.0	29.0	1/ 158
	T7	135	0.27	900		800	1,700	24.0	15.0	1/ 189
	Total	2,192	4.38	13,300	7,750	1,800	22,850			
HE4	T1	281	0.56	3,150			3,150	120.0	91.0	1/ 109
	T2	358	0.72	1,650		1,600	3,250	80.0	46.0	1/ 96
	T3/UNIT	98	0.20							
	T4	306	0.61	2,000		600	2,600	40.0	25.0	1/ 173
	T5	749	1.50		4,800		4,800	24.5	4.1	1/ 235
	T5'	(172)	(0.34)	1,350			1,350	19.0	11.5	1/ 180
	Total	1,792	3.59	8,150	4,800	2,200	15,150			
HE5	T1/UNIT	81	0.16							
	T2	279	0.56	1,800			1,800	70.0	58.0	1/ 150
	Total	360	0.72	1,800			1,800			
HE5A	T1	197	0.39	1,450		650	2,100	60.0	46.0	1/ 150
	T2	196	0.39		1,950		1,950	29.0	16.0	1/ 150
	T3/UNIT	86	0.17							
	T4	206	0.41	1,700			1,700	9.0	4.0	1/ 340
	Total	685	1.36	3,150	1,950	650	5,750			

#1: To irrigate Amol urban area
A TYPE: Existing canal commanding less than 100ha
B TYPE: Existing canal commanding more than 100ha
C TYPE: New canal

HARAZ EAST DISTRICT (2/2)

TERTIARY CANAL		AREA (ha)	DISCHARGE (cu.m/s)	CANAL LENGTH (m) IMPROVE/REPAIR A TYPE	IMPROVE/REPAIR B TYPE	NEW C TYPE	TOTAL	ELEVATION(m) START	ELEVATION(m) END	AVERAGE SLOPE
HE5B	T1	415	0.83			1,100	1,100	50.0	44.5	1/ 200
	T1'	(325)	(0.65)	(2200)		(400)	(2600)	44.5	29.0	1/ 168
	T2	113	0.23	100	450	400	950	49.5	42.0	1/ 127
	T3	169	0.34		1,150		1,150	29.0	26.5	1/ 460
	T4/UNIT	81	0.16							
	T5	328	0.66		4,450		4,450	14.5	4.5	1/ 445
	T6	248	0.50	4,800			4,800	14.5	4.0	1/ 457
	T7	290	0.58		5,100		5,100	14.5	2.0	1/ 408
	Total	1,644	3.30	4,900	11,150	1,500	17,550			
TOTAL		11,019	22.80	60,400	34,150	11,550	106,100			

A TYPE: Existing canal commanding less than 100ha
B TYPE: Existing canal commanding more than 100ha
C TYPE: New canal

TABLE E.1.6-5 TERTIARY IRRIGATION CANAL (AMOL EAST DISTRICT)

TERTIARY CANAL		AREA (ha)	DISCHARGE (cu.m/s)	CANAL LENGTH (m) IMPROVE/REPAIR A TYPE	IMPROVE/REPAIR B TYPE	NEW C TYPE	TOTAL	ELEVATION(m) START	ELEVATION(m) END	AVERAGE SLOPE
AE1	T1	319	0.64		3,000		3,000	49.0	22.0	1/ 111
	T2	325	0.65		1,950	1,600	3,550	49.0	22.0	1/ 131
	Total	644	1.29		4,950	1,600	6,550			
AE2	T1	262	0.52			900	900	26.8	20.0	1/ 132
	T2	242	0.48			1,050	1,050	26.8	20.0	1/ 154
	T3	264	0.53	250		1,200	1,450	26.8	16.0	1/ 134
	Total	768	1.53	250		3,150	3,400			
AE3A	T1	193	0.39		1,550		1,550	15.0	7.0	1/ 194
	T2/UNIT	92	0.18							
	T3/UNIT	95	0.19							
	T4	277	0.55	900	1,300		2,200	6.0	-0.5	1/ 338
	T4'	(124)	(0.24)		900		900	6.0	3.8	1/ 409
	T5/UNIT	74	0.15							
	Total	731	1.46	900	3,750		4,650			
AE3Aa	T7	230	0.46	0	1,850		1,850	-6.0	-9.0	1/ 617
	T8	536	1.07	0	7,100		7,100	-6.0	-18.0	1/ 592
	T9 #1	791	1.58	400	5,100		5,500	-13.0	-22.0	1/ 611
	T9'	(136)	(0.27)	1,400		600	2,000	-18.5	-21.5	1/ 667
	Total	1,557	3.11	1,800	14,050	600	16,450			
AE3B	T1/UNIT	88	0.18							
	T2(L)	360	0.72	1,700		1,300	3,000	0.5	-6.8	1/ 411
	T2(R)	456	0.91	3,550		600	4,150	0.5	-8.0	1/ 488
	Total	904	1.81	5,250		1,900	7,150			
AE3Ab	T10/UNIT	86	0.17							
	T11/UNIT	98	0.20							
	T12/UNIT	70	0.14							
	T13	303	0.61	2,000	800	2,300	5,100	-19.1	-23.0	1/ 1308
	Total	557	1.12	2,000	800	2,300	5,100			
AE3C	T1	210	0.42	900			900	15.0	9.8	1/ 173
	T2	385	0.77	1,400	1,250	800	3,450	15.0	4.2	1/ 319
	Total	595	1.19	2,300	1,250	800	4,350			
AE4/4A	T1	574	1.15	3,200		1,200	4,400	14.0	-4.0	1/ 244
AE4B	T1	114	0.23	600		400	1,000	13.5	8.0	1/ 182
	T2	116	0.23		200	800	1,000	13.5	8.0	1/ 182
	T3/UNIT	69	0.14							
	T4	597	1.19	3,100	1,000		4,100	-3.0	-10.5	1/ 547
	T4'	(219)	(0.44)	2,000	1,600		3,600	-8.5	-13.9	1/ 667
	T5	773	1.55	4,400			4,400	-12.3	-18.4	1/ 721
	T5'	(335)	(0.67)	2,000		650	2,650	-20.2	-23.0	1/ 946
	T6	172	0.34	100	1,750		1,850	-13.0	-15.0	1/ 925
	T7	792	1.58	4,000			4,000	-18.0	-23.0	1/ 800
	Total	2,633	5.26	16,200	4,550	1,850	22,600			

A TYPE: Existing canal commanding less than 100ha
B TYPE: Existing canal commanding more than 100ha
C TYPE: New canal

AMOL EAST DISTRICT (2/3)

TERTIARY CANAL		AREA (ha)	DISCHARGE (cu.m/s)	CANAL LENGTH (m) IMPROVE/REPAIR A TYPE	B TYPE	NEW C TYPE	TOTAL	ELEVATION(m) START	END	AVERAGE SLOPE
AE5	T1	203	0.41	1,400			1,400	8.5	4.0	1/ 311
	T2	379	0.76		3,100	1,200	4,300	8.5	-4.0	1/ 344
	T3	187	0.37		600	800	1,400	2.0	-1.8	1/ 368
	T4	134	0.27		1,200		1,200	0.0	-1.5	1/ 800
	T5	449	0.90		2,000		2,000	2.0	-8.0	1/ 200
	T6	288	0.58	2,050			2,050	-7.7	-12.0	1/ 477
	Total	1,640	3.29	3,450	6,900	2,000	12,350			
AE6A	T1/UNIT	74	0.15							
	T2	210	0.42	1,100		600	1,700	4.0	-0.8	1/ 354
	T3	111	0.22	500		300	800	-3.2	-4.8	1/ 500
	T4	244	0.49	1,300		1,500	2,800	-11.8	-15.8	1/ 700
	T5	198	0.40	1,050		850	1,900	-16.0	-19.6	1/ 528
	T6	682	1.36	4,400		2,300	6,700	-16.0	-24.0	1/ 838
	T6'	(260)	(0.52)	500		1,200	1,700	-18.4	-22.4	1/ 425
	Total	1,519	3.04	8,850		6,750	15,600			
AE6B	T1	163	0.33	300		900	1,200	2.4	-1.0	1/ 353
	T2	160	0.32	1,200			1,200	0.0	-3.7	1/ 324
	T3/UNIT	92	0.18							
	T4	222	0.44	700		1,650	2,350	-5.8	-10.2	1/ 534
	T5/UNIT	47	0.09							
	T6	329	0.66	1,860	300	3,150	5,310	-9.0	-15.3	1/ 843
	Total	1,013	2.02	4,060	300	5,700	10,060			
AE7	T1/UNIT	23	0.05							
	T2	200	0.40	1,080		800	1,880	0.0	-2.2	1/ 855
	T3	202	0.40	2,110		750	2,860	-5.7	-9.2	1/ 817
	T4	107	0.21	500		200	700	-6.0	-7.4	1/ 500
	T5	267	0.53	3,000			3,000	-9.4	-13.3	1/ 769
	T6	508	1.02	4,200			4,200	-10.4	-18.0	1/ 553
	T6'	(219)	(0.44)	2,000			2,000	-15.9	-18.1	1/ 909
	T7	548	1.10		4,650		4,650	-19.6	-23.7	1/ 1134
	Total	1,855	3.71	12,890	4,650	1,750	19,290			
AE8	T1	556	1.11	1,900	2,600	1,250	5,750	-2.2	-9.3	1/ 810
	T2/UNIT	45	0.09							
	T3	405	0.81	1,150	2,000		3,150	-7.5	-12.3	1/ 656
	Total	1,006	2.01	3,050	4,600	1,250	8,900			
AE9	T1	182	0.36	1,650			1,650	-4.0	-6.0	1/ 825
	T2	656	1.31	2,900			2,900	-4.0	-5.8	1/ 1611
	T2'	(238)	(0.48)	400		1,000	1,400	-10.0	-12.0	1/ 700
	T3	375	0.75	900			900	-14.2	-14.6	1/ 2250
	T3'	(200)	(0.65)	1,000		900	1,900	-15.2	-17.7	1/ 760
	Total	1,213	2.42	6,850		1,900	8,750			
AE10	T1	563	1.13	600		600	1,200	-5.2	-6.4	1/ 1000
	T1'	(169)	(0.34)	1,200			1,200	-14.4	-16.2	1/ 667
	T2	147	0.29			1,400	1,400	-5.4	-7.5	1/ 667
	T3	402	0.80	2,400		1,300	3,700	-7.2	-11.9	1/ 787
	T3'	(184)	(0.37)			1,400	1,400	-10.0	-11.1	1/ 1273
	Total	1,112	2.22	4,200		4,700	8,900			

AMOL EAST DISTRICT (3/3)

TERTIARY CANAL		AREA (ha)	DISCHARGE (cu.m/s)	CANAL LENGTH (m) IMPROVE/REPAIR A TYPE	IMPROVE/REPAIR B TYPE	NEW C TYPE	TOTAL	ELEVATION(m) START	ELEVATION(m) END	AVERAGE SLOPE
AE11	T1/UNIT	117	0.23							
	T2	326	0.65	1,360		400	1,760	-9.5	-12.0	1/ 704
	Total	443	0.88	1,360		400	1,760			
AE11A	T3	446	0.89		2,150	1,200	3,350	-11.0	-14.5	1/ 957
	T3'	(224)	(0.45)	1,500	600	400	2,500	-11.0	-14.0	1/ 833
	T4	250	0.50		1,200		1,200	-14.0	-15.8	1/ 667
	T4'	(132)	(0.28)			900	900	-16.7	-17.4	1/ 1286
	T5	318	0.64	800		2,200	3,000	-18.6	-21.6	1/ 1000
	Total	1,014	2.03	2,300	3,950	4,700	10,950			
AE11B	T4	111	0.22			700	700	-11.5	-12.0	1/ 1400
	T5/UNIT	99	0.20							
	T6	332	0.66	850		3,400	4,250	-13.0	-19.1	1/ 697
	T9(R)#2	301	0.60	700	600	1,600	2,900	-17.3	-20.5	1/ 906
	T9(L)#3	539	1.08	3,500		1,650	5,150	-17.3	-23.4	1/ 844
	T10	568	1.14	850	2,800	2,400	6,050	-13.5	-21.5	1/ 756
	T11	260	0.52	1,300		1,700	3,000	-14.0	-20.0	1/ 500
	T12	474	0.95	1,300		3,500	4,800	-19.5	-23.4	1/ 1231
	T13	1,077	2.15		2,000	4,700	6,700	-19.6	-22.0	1/ 2792
	Total	3,761	7.52	8,500	5,400	19,650	33,550			
TOTAL		23,539	47.06	87,410	55,150	62,200	204,760			

#1 NOT including	AE3A-2-1	80 ha
	AE3A-2-2	88 ha
#2 NOT including	AE11B-3-1	50 ha
	AE11B-3-2	40 ha
#3 NOT including	AE11B-4-1	40 ha
Total		298 ha

Total area of Amol East District = 23,837 ha

A TYPE: Existing canal commanding less than 100ha
B TYPE: Existing canal commanding more than 100ha
C TYPE: New canal

TABLE E.1.6-6 TERTIARY IRRIGATION CANAL (KARI RUD LEFT BANK AREA)

TERTIARY CANAL		AREA (ha)	DISCHARGE (cu.m/s)	CANAL LENGTH (m) IMPROVE/REPAIR A TYPE	IMPROVE/REPAIR B TYPE	NEW C TYPE	TOTAL	ELEVATION(m) START	ELEVATION(m) END	AVERAGE SLOPE
KL1	T1	155	0.31	1,300	1,200	500	3,000	220.0	170.0	1/ 60
KL2	T1	412	0.82	1,800	1,250	1,000	4,050	115.0	72.0	1/ 94
KL3	T1	550	1.10	600	7,150		7,750	44.0	11.0	1/ 235
	T2	409	0.82		4,450		4,450	44.0	24.0	1/ 223
	T3	550	1.10		5,650	700	6,350	27.5	14.0	1/ 470
	T4	225	0.45	1,600			1,600	22.0	17.0	1/ 320
	T5	249	0.50	2,050		150	2,200	19.0	12.0	1/ 314
	T6	430	0.86		5,200		5,200	12.0	0.7	1/ 460
	Total	2,413	4.83	4,250	22,450	850	27,550			
KL4	T1	453	0.91		5,000	100	5,100	12.5	4.5	1/ 638
	T2	208	0.42		2,200		2,200	13.0	10.5	1/ 880
	T3	249	0.50		2,400	1,000	3,400	13.0	8.0	1/ 680
	T4	194	0.39	450		1,750	2,200	7.0	1.0	1/ 367
	T5	361	0.72		3,250		3,250	7.5	1.0	1/ 500
	T6	492	0.98	1,250	1,100		2,350	6.5	1.0	1/ 427
	T6'	(349)	(0.70)	1,900		2,200	4,100	5.0	-4.5	1/ 432
	Total	1,957	3.92	3,600	13,950	5,050	22,600			
KL5	T1	284	0.57	1,350	1,200	1,400	3,950	11.5	6.0	1/ 718
	T2	201	0.40	1,300		1,150	2,450	9.0	5.5	1/ 700
	T3	383	0.77	2,700		200	2,900	2.0	-4.0	1/ 483
	T4 #1	726	1.45	400	850	1,300	2,550	0.5	-3.0	1/ 729
	T5	581	1.16	800		2,300	3,100	-4.0	-5.3	1/ 2385
	T6	353	0.71		1,200		1,200	-4.0	-5.3	1/ 923
	T6'	(233)	(0.47)	1,200		900	2,100	-4.7	-7.8	1/ 677
	Total	2,528	5.06	7,750	3,250	7,250	18,250			
KL6	T1	286	0.57	1,100	1,600	200	2,900	12.0	9.0	1/ 967
KL6A	T1	190	0.38			2,150	2,150	7.0	2.0	1/ 430
	T2	269	0.54	2,350		300	2,650	7.0	2.0	1/ 530
	Total	459	0.92	2,350		2,450	4,800			
KL6B	T1	228	0.46		1,600	500	2,100	11.0	7.0	1/ 525
	T2 #2	426	0.85	700	2,200	1,400	4,300	8.0	2.0	1/ 717
	T3 #3	727	1.45	3,800		500	4,300	8.0	1.5	1/ 662
	Total	1,381	2.76	4,500	3,800	2,400	10,700			
TOTAL		9,591	19.19	26,650	47,500	19,700	93,850			

#1 including	BUBL-3	420	ha		9,591 ha
#2 including	BU1-1	163	ha	-	1,052 ha
#3 including	BU1-2	107	ha		8,539 ha
	BU2-1	169	ha		
	BU2-2	193	ha		
Total		1,052	ha		

Total area (exculding Babol Urban area) = 8,539 ha

A TYPE: Existing canal commanding less than 100ha
B TYPE: Existing canal commanding more than 100ha
C TYPE: New canal

TABLE E.1.6-7 TERTIARY IRRIGATION CANAL (KARI RUD RIGHT BANK AREA)

TERTIARY CANAL		AREA (ha)	DISCHARGE (cu.m/s)	CANAL LENGTH (m) IMPROVE/REPAIR A TYPE	IMPROVE/REPAIR B TYPE	NEW C TYPE	TOTAL	ELEVATION(m) START	ELEVATION(m) END	AVERAGE SLOPE
KR1		298	0.60		5,200		5,200	210.0	177.0	1/ 158
KR2		365	0.73		3,000		3,000	150.0	120.0	1/ 100
KR3	T3	122	0.24	600			600	70.0	68.0	1/ 300
	T4	102	0.20			600	600	70.0	65.0	1/ 120
	T5	130	0.26	1,100		100	1,200	64.0	55.0	1/ 133
	T6	187	0.37	1,000		200	1,200	60.0	51.0	1/ 133
	T7	170	0.34	500		100	600	50.0	47.0	1/ 200
	Total	711	1.41	3,200		1,000	4,200			
KR4	T1	151	0.30	900		100	1,000	51.0	43.0	1/ 125
	T2	297	0.59	700		1,100	1,800	42.0	32.0	1/ 180
	T3	297	0.59	4,000		1,800	5,800	42.0	32.0	1/ 580
	T4	227	0.45	1,000			1,000	38.0	31.5	1/ 154
	T5	302	0.60	1,600		600	2,200	33.0	26.0	1/ 314
	T6	250	0.50	(1400)		(1000)	(2400)	27.5	23.0	1/ ｲﾌﾞ
	T7	196	0.39	600		600	1,200	27.5	23.0	1/ 267
	T8	228	0.46			1,800	1,800	21.0	18.5	1/ 720
	T9	463	0.93	400	2,700	900	4,000	21.0	13.0	1/ 500
	Total	2,411	4.81	9,200	2,700	6,900	18,800			
KR5		492	0.98	5,000		1,400	6,400	23.5	14.5	1/ 711
TOTAL		4,277	8.53	17,400	10,900	9,300	37,600			

A TYPE: Existing smaller canal after improvement/repair/conservation
B TYPE: Existing larger canal after improvement/repair/conservation
C TYPE: New canal

TABLE E.1.6-8 SUMMARY OF DRAINAGE CANAL

Tertiary canal	AREA (ha)	DISCHARGE (cu.m/s)	CANAL LENGTH (m)			
			IMPROVE/REPAIR		NEW	TOTAL
			A-TYPE	B-TYPE	C-TYPE	
DHW	9,839	59.13	36,050	1,200	47,600	84,850
DAW	18,846	112.26	49,300	27,950	66,200	143,450
DHE	13,733	79.43	38,000	8,700	59,750	106,450
DAE	20,269	117.14	63,350	9,450	69,150	141,950
KARI RIGHT BANK AREA	4,776	49.29	13,450	3,300	8,100	24,850
T O T A L	67,463	417.25	200,150	50,600	250,800	501,550

A TYPE: Existing canal commanding less than 100ha
B TYPE: Existing canal commanding more than 100ha
C TYPE: New canal

TABLE E.1.6-9 TERTIARY DRAINAGE CANAL (HARAZ WEST DISTRICT)

Tertiary canal		AREA (ha)	DISCHARGE (cu.m/s)	CANAL LENGTH (m)			
				IMPROVE/REPAIR		NEW	TOTAL
				A-TYPE	B-TYPE	C-TYPE	
DHW1	J1						
	J2(L)	300	1.79			2,700	2,700
	J3(L)	398	2.26	600		1,900	2,500
	J4						
	J5(L)	247	1.61	1,000		550	1,550
	Total	945	5.66	1,600		5,150	6,750
DHW2							
DHW3							
DHW4							
DHW5							
DHW6							
DHW7	J1(R)	208	1.39	750		800	1,550
	J2	221	1.51	700		1,050	1,750
	J3	377	2.33	800		1,700	2,500
	Total	806	5.23	2,250		3,550	5,800
DHW8	J3(R)	242	1.79	1,800		1,050	2,850
	J4(R)	217	1.48	1,100		150	1,250
	J5(L)	273	1.65	500		800	1,300
	J6(L)						
	J7(R)	179	1.30			900	900
	J8(R)						
	J9(L)						
	J10	400	2.27	2,350		2,900	5,250
	J11	328	1.93			3,500	3,500
	Total	1,639	10.42	5,750		9,300	15,050
DHW9	J5(R)	425	2.48	2,600		1,100	3,700
	J6(R)	184	1.21	1,200		200	1,400
	J8(R)						
	J9(R)						
	J10(R)	550	2.96	1,000		3,150	4,150
	Total	1,159	6.65	4,800		4,450	9,250
DHW10	J3(L)	821	4.14	3,900		1,450	5,350
	J4(R)	357	2.07	1,900		2,000	3,900
	J5(L)	202	1.38	1,100		550	1,650
	J6(R)	120	0.93			200	200
	J9(R)	163	1.17		1,200		1,200
	Total	1,663	9.69	6,900	1,200	4,200	12,300
DHW 11(L)		427	2.40	900		5,350	6,250

A TYPE: Existing canal commanding less than 100ha
B TYPE: Existing canal commanding more than 100ha
C TYPE: New canal

HARAZ WEST DISTRICT (2/2)

Tertiary canal		AREA (ha)	DISCHARGE (cu.m/s)	CANAL LENGTH (m) IMPROVE/REPAIR A-TYPE	IMPROVE/REPAIR B-TYPE	NEW C-TYPE	TOTAL
DHW12	J2(L)	661	3.45	5,600		1,950	7,550
	J3(R)	186	1.21	350		1,000	1,350
	Total	847	4.66	5,950		2,950	8,900
DHW13(L)		229	1.55	1,150		700	1,850
DHW14	J2	411	2.53	2,300		1,650	3,950
DHW15(L)		367	2.11	300		1,650	1,950
DHW16							
DHW17(L)		313	1.85	1,700		400	2,100
DHW18(L)		154	1.03	0		700	700
DHW19	J1(R)	277	1.67	600		3,600	4,200
	J2	395	2.29	800		2,200	3,000
	J2'	207	1.39	1,050		1,750	2,800
	Total	879	5.35	2,450		7,550	10,000
TOTAL		9,839	59.13	36,050	1,200	47,600	84,850

A TYPE: Existing canal commanding less than 100ha
B TYPE: Existing canal commanding more than 100ha
C TYPE: New canal

TABLE E.1.6-10 TERTIARY DRAINAGE CANAL (AMOL WEST DISTRICT)

Tertiary canal		AREA (ha)	DISCHARGE (cu.m/s)	CANAL LENGTH (m)			
				IMPROVE/REPAIR		NEW	TOTAL
				A-TYPE	B-TYPE	C-TYPE	
DAW1							
DAW2	J3	296	1.77	1,000		1,150	2,150
	J4	445	2.48	2,400		1,000	3,400
	Total	741	4.25	3,400		2,150	5,550
DAW3	J6	511	2.79		3,400		3,400
	J7,J8	460	2.55	2,750		1,800	4,550
	J10	526	2.85	600		3,250	3,850
	J11	605	3.21		5,300		5,300
	J11'(L)	133	0.93			1,600	1,600
	Total	2,235	12.33	3,350	8,700	6,650	18,700
DAW4	J2(L)	358	2.10		4,300		4,300
	J3(L)	148	0.99	600			600
	J4(R)	212	1.50	350		400	750
	J6(R)	164	1.08	800			800
	J7	475	2.95		2,700		2,700
	J7'	224	1.43	1,100		1,300	2,400
	Total	1,581	10.05	2,850	7,000	1,700	11,550
DAW4A	J2	320	2.08	3,000			3,000
	J3	348	2.02	200		1,500	1,700
	J4(R)	297	1.95		1,950		1,950
	Total	965	6.05	3,200	1,950	1,500	6,650
DAW4B	J1	680	3.54	4,250			4,250
DAW4C	J2	315	1.86	1,400		2,000	3,400
	J3	335	2.35	1,600			1,600
	Total	650	4.21	3,000		2,000	5,000
TOTAL		3,876	23.85	13,300	8,950	5,200	27,450
DAW5	J2(R)	177	1.26			1,100	1,100
	J4(R)	232	1.62	1,200			1,200
	J5	263	1.77	200		900	1,100
	J6	306	2.07	200		2,800	3,000
	Total	978	6.72	1,600		4,800	6,400
DAW5A	J1(R)	390	2.29	100		2,400	2,500
	J4(R)	260	1.85			2,150	2,150
	J5(R)	257	1.72			1,500	1,500
	J7	530	2.87	1,050		2,800	3,850
	J8	247	1.60			3,400	3,400
	Total	1,684	10.33	1,150		12,250	13,400
TOTAL		2,662	17.05	2,750		17,050	19,800

A TYPE: Existing canal commanding less than 100ha
B TYPE: Existing canal commanding more than 100ha
C TYPE: New canal

AMOL WEST DISTRICT (2/2)

Tertiary canal		AREA (ha)	DISCHARGE (cu.m/s)	CANAL LENGTH (m) IMPROVE/REPAIR A-TYPE	IMPROVE/REPAIR B-TYPE	NEW C-TYPE	TOTAL
DAW6	J5	313	2.15	3,000		600	3,600
	J5'	260	1.76			1,250	1,250
	Total	573	3.91	3,000		1,850	4,850
DAW6A	J3	382	2.26	2,300		600	2,900
	J3'	380	2.25	2,400		500	2,900
	J12	634	3.34		5,700	1,100	6,800
	Total	1,396	7.85	4,700	5,700	2,200	12,600
DAW6B	J3(R)	211	1.37	200		2,000	2,200
	J4,J5	481	2.65	1,800		500	2,300
	J4',J5'	217	1.44	1,200			1,200
	Total	909	5.46	3,200		2,500	5,700
TOTAL		2,878	17.22	10,900	5,700	6,550	23,150
DAW7		401	2.28	2,400		400	2,800
DAW8	J3(L)	339	1.98	600	1,000	400	2,000
	J7	341	2.38			1,600	1,600
	J8	602	3.19	3,100	1,500	2,200	6,800
	Total	1,282	7.55	3,700	2,500	4,200	10,400
DAW9		620	3.31	1,500		2,900	4,400
DAW10	J3(L)	336	2.02			2,800	2,800
	J6(R)	415	2.34	1,300		1,300	2,600
	J8(R)	290	1.76		2,100		2,100
	J9(L)	627	3.74	800		2,600	3,400
	J9'(R)	228	1.58	400		1,000	1,400
	J11	234	1.45	2,100			2,100
	J12	495	2.71	1,400		3,000	4,400
	Total	2,625	15.60	6,000	2,100	10,700	18,800
DAW11							
DAW12(L)		370	2.13	800		2,200	3,000
DAW13							
DAW14(L)		199	1.43	200		1,000	1,200
DAW15(L)		378	2.17	1,000		1,600	2,600
DAW16(L)		579	3.09			5,600	5,600
TOTAL		18,846	112.26	49,300	27,950	66,200	143,450

A TYPE: Existing canal commanding less than 100ha
B TYPE: Existing canal commanding more than 100ha
C TYPE: New canal

TABLE E.1.6-11 TERTIARY DRAINAGE CANAL (HARAZ EAST DISTRICT)

Tertiary canal		AREA (ha)	DISCHARGE (cu.m/s)	CANAL LENGTH (m) IMPROVE/REPAIR A-TYPE	IMPROVE/REPAIR B-TYPE	NEW C-TYPE	TOTAL
DKL1		300	1.79	700		1,800	2,500
DHE1							
DHE2	J1,J2	593	3.15	4,250		1,000	5,250
DHE3							
DHE4	J3,J4	648	3.40			5,550	5,550
DHE5		723	3.72	1,400	2,600	2,400	6,400
DHE6	J2(L)	162	1.07	600		900	1,500
	J5(L)	120	1.20	900			900
	J8(L)	373	2.22	1,900			1,900
	Total	655	4.49	3,400		900	4,300
DHE7	J1(L)	341	1.99		1,100	2,200	3,300
	J2(R)	476	2.65	1,100		2,300	3,400
	J3(L)	345	2.01	600		2,000	2,600
	J9	248	1.53	1,800		200	2,000
	Total	1,410	8.18	3,500	1,100	6,700	11,300
DHE8	J4(L)	427	2.77			3,000	3,000
	J5(L)	294	1.93		3,800		3,800
	Total	721	4.70		3,800	3,000	6,800
DHE9	J3(L)	192	1.32	250		1,100	1,350
	J10(L)	226	1.58			900	900
	Total	418	2.90	250		2,000	2,250
DHE10	J6(L)	478	2.64	5,300		400	5,700
DHE11	J3	333	1.95	1,400		2,300	3,700
	J4	255	1.64			2,750	2,750
	Total	588	3.59	1,400		5,050	6,450
DHE12	J14,J15	558	3.00		800	4,200	5,000
	J20,J21	689	3.57	2,200		2,700	4,900
	J20',J21'(	247	1.67	200		1,600	1,800
	Total	1,494	8.24	2,400	800	8,500	11,700
DHE13	J4(R)	598	3.18	1,200	400	2,800	4,400
	J7(R)	502	2.75			2,900	2,900
	J12,J13	516	3	1,600		200	1,800
	Total	1,616	8.74	2,800	400	5,900	9,100
DHE14(R)		367	2.14	2,000		1,300	3,300
DHE15(R)		249	1.74	900		1,000	1,900
DHE16	J8	511	2.79	200		2,900	3,100
DHE17(R)		393	2.31	400		1,950	2,350
DHE18(R)		207	1.46			1,600	1,600
DHE19	J3,J4	485	2.67	2,900		1,300	4,200
DHE20		180	1.20	1,200		1,200	2,400
DHE21	J2	259	1.71	800		600	1,400
	J2,J3	614	3.25	900		2,700	3,600
	J5,J6	545	2.94	2,800		1,000	3,800
	Total	1,418	7.90	4,500		4,300	8,800
DHE22		279	1.68	500		1,000	1,500
DHE23							
TOTAL		13,733	79.43	38,000	8,700	59,750	106,450

A TYPE: Existing canal commanding less than 100ha
B TYPE: Existing canal commanding more than 100ha
C TYPE: New canal

TABLE E.1.6-12 TERTIARY DRAINAGE CANAL (AMOL EAST DISTRICT)

Tertiary canal		AREA (ha)	DISCHARGE (cu.m/s)	CANAL LENGTH (m)			
				IMPROVE/REPAIR		NEW	TOTAL
				A-TYPE	B-TYPE	C-TYPE	
DAE1(R)		347	2.03	1,200	750	1,400	3,350
DAE2(R)							
DAE3(R)							
DAE4(R)							
DAE5(R)							
DAE6(R)		172	1.26	1,400			1,400
DAE7(R)		605	3.82		2,400		2,400
DAE8(R)							
DAE9	J5	488	2.68	200		4,900	5,100
	J6	480	3.07			3,300	3,300
	Total	968	5.75	200		8,200	8,400
DAE10							
DAE11	J5(R)	191	1.36	1,200		300	1,500
	J5'	557	3.04	1,800		2,100	3,900
	J5''(L)	225	1.60			1,700	1,700
	J7(L)	159	1.05		300	1,300	1,600
	J10(R)	490	2.75	1,600		1,100	2,700
	J11(R)	600	3.19	2,500		2,100	4,600
	J12(L)	294	2.01			1,800	1,800
	J13(R)	207	1.31		400	800	1,200
	J15	348	2.04	2,750		1,300	4,050
	J15'	194	1.32	1,400			1,400
	J16	373	2.14	1,800		1,300	3,100
	J16'	150	1.00	700		900	1,600
	J17(R)	251	1.76	1,200		300	1,500
	Total	4,039	24.57	14,950	700	15,000	30,650
DAE12	J4(L)	324	1.91	800		1,800	2,600
	J5(R)	183	1.20	1,000		800	1,800
	J11(R)	304	1.81			2,100	2,100
	J12(R)	574	3.19	2,200		1,600	3,800
	J12'(R)	128	0.88	600		600	1,200
	J13(L)	615	3.25	4,200		400	4,600
	J14(L)	169	1.24	1,000	600		1,600
	J16,J17	695	3.60			4,800	4,800
	J16',J17'	267	1.81	3,800			3,800
	J21(R)	193	1.28	1,500		650	2,150
	J23	741	3.80		4,100		4,100
	J28(R)	384	2.50	900		1,300	2,200
	J28'(R)	152	1.02			1,100	1,100
	Total	4,729	27.49	16,000	4,700	15,150	35,850

A TYPE: Existing canal commanding less than 100ha
B TYPE: Existing canal commanding more than 100ha
C TYPE: New canal

AMOL EAST DISTRICT (2/2)

Tertiary canal		AREA (ha)	DISCHARGE (cu.m/s)	CANAL LENGTH (m)			
				IMPROVE/REPAIR		NEW	TOTAL
				A-TYPE	B-TYPE	C-TYPE	
DAE13	J7(R)	328	1.93	2,600		300	2,900
	J8	324	2.02	2,000		1,200	3,200
	J8'	614	3.25	1,900	900	2,400	5,200
	Total	1,266	7.20	6,500	900	3,900	11,300
DAE14	J3(R)	418	2.36	1,200		1,400	2,600
	J6(L)	191	1.28	600		400	1,000
	J9(R)	236	1.49	800		600	1,400
	J10(L)	246	1.70			1,600	1,600
	J12(L)	546	2.94	3,200		1,200	4,400
	J13(R)	509	2.78	2,000		1,600	3,600
	J13'(L)	432	2.42	1,400		1,400	2,800
	Total	2,578	14.97	9,200		8,200	17,400
DAE15	J6(R)	729	3.75	3,200			3,200
	J11(L)	333	2.15	1,000		800	1,800
	J12	656	3.43	3,400		800	4,200
	Total	1,718	9.33	7,600		1,600	9,200
DAE16	J4(R)	620	3.27	300		2,700	3,000
	J6(L)	194	1.40	900			900
	J7	338	3.12			2,000	2,000
	J7'	654	0.66			1,700	1,700
	Total	1,806	8.45	1,200		6,400	7,600
DAE17	J5	399	2.36	1,700		1,500	3,200
DAE18(L)							
DAE19	J3	586	3.34	1,200		2,600	3,800
	J3'	206	1.33	800			800
	Total	792	4.67	2,000		2,600	4,600
DAE20	20	424	2.39			4,100	4,100
	20'	224	1.47			1,100	1,100
	Total	648	3.86			5,200	5,200
DAE21(L)							
DAE22(L)							
DAE23(L)							
DAE24(L)		202	1.38	1,400			1,400
DAE25(L)							
TOTAL		20,269	117.14	63,350	9,450	69,150	141,950

A TYPE: Existing canal commanding less than 100ha
B TYPE: Existing canal commanding more than 100ha
C TYPE: New canal

TABLE E.1.6-13 TERTIARY DRAINAGE CANAL (KARI RIGHT BANK AREA)

Tertiary canal	AREA (ha)	DISCHARGE (cu.m/s)	CANAL LENGTH (m)			
			IMPROVE/REPAIR		NEW	TOTAL
			A-TYPE	B-TYPE	C-TYPE	
DKR3	346	8.63	1,350		200	1,550
DKR4	153	2.27	2,100			2,100
DKR9	171	1.12	100	700		800
DKR10	848	15.73		2,600		2,600
DKR11	115	0.8			200	200
DKR14'	179	1.31	800			800
DKR14	518	2.82	1,000		1,400	2,400
DKR16	462	2.72	1,900		900	2,800
DKR17	274	1.86	2,500			2,500
DKR20	284	2.04	900		100	1,000
DKR23	277	1.94	400			400
DKR24	353	2.47			1,000	1,000
DKR25	354	2.46			1,800	1,800
DKR26	173	1.27			1,600	1,600
DKR28	269	1.85	2,400		900	3,300
T O T A L	4776	49.29	13,450	3,300	8,100	24,850

A TYPE: Existing canal commanding less than 100ha
B TYPE: Existing canal commanding more than 100ha
C TYPE: New canal

TABLE E.1.6-14 AVERAGE COMMAND AREA (1/2, 2/2)

DISTRICT		TERTIARY /FOURTH CANAL	DIVERSION POINTS	AREA (ha)	AVERAGE AREA/ CANAL (ha)	AVERAGE AREA/ DIVERSION (ha)
HARAZ WEST	HW1	4	8	623	155.8	77.9
	HW2A	5	17	1,891	378.2	111.2
	HW2B	5	20	1,861	372.2	93.1
	HW3	12	31	2,884	240.3	93.0
	HW4	5	18	1,557	311.4	86.5
	HW5	4	10	811	202.8	81.1
	HW6	2	10	755	377.5	75.5
	Total	37	114	10,382	280.6	91.1

DISTRICT		TERTIARY /FOURTH CANAL	DIVERSION POINTS	AREA (ha)	AVERAGE AREA/ CANAL (ha)	AVERAGE AREA/ DIVERSION (ha)
AMOL WEST	AW1	3	10	924	308.0	92.4
	AW2	3	6	693	231.0	115.5
	AW3A	4	16	1,674	418.5	104.6
	AW3B	1	5	569	569.0	113.8
	AW4	7	21	1,626	232.3	77.4
	AW5	5	19	1,981	396.2	104.3
	AW6	4	14	1,140	285.0	81.4
	AW7	10	33	3,141	314.1	95.2
	AW8	2	4	478	239.0	119.5
	AW9	3	8	762	254.0	95.3
	AW9A	8	30	2,188	273.5	72.9
	AW9B	11	30	2,287	207.9	76.2
	Total	61	196	17,463	286.3	89.1

TABLE E.1.6-15 AVERAGE COMMAND AREA (TERTIARY)

DISTRICT		TERTIARY /FOURTH CANAL	DIVERSION POINTS	AREA (ha)	AVERAGE AREA/ CANAL (ha)	AVERAGE AREA/ DIVERSION (ha)
HARAZ EAST	HE1	9	31	2,821	313.4	91.0
	HE2	3	14	1,525	508.3	108.9
	HE3	7	24	2,192	313.1	91.3
	HE4	5	18	1,792	358.4	99.6
	HE5	2	4	360	180.0	90.0
	HE5A	4	7	685	171.3	97.9
	HE5B	7	19	1,644	234.9	86.5
	Total	37	117	11,019	297.8	94.2

DISTRICT		TERTIARY /FOURTH CANAL	DIVERSION POINTS	AREA (ha)	AVERAGE AREA/ CANAL (ha)	AVERAGE AREA/ DIVERSION (ha)
AMOL EAST	AE1	2	6	644	322.0	107.3
	AE2	3	6	768	256.0	128.0
	AE3A	5	9	731	146.2	81.2
	AE3Aa	3	14	1,557	519.0	111.2
	AE3B	3	9	904	301.3	100.4
	AE3Ab	4	7	557	139.3	79.6
	AE3C	2	5	595	297.5	119.0
	AE4/4A	1	5	574	574.0	114.8
	AE4B	7	27	2,633	376.1	97.5
	AE5	6	16	1,640	273.3	102.5
	AE6A	6	17	1,519	253.2	89.4
	AE6B	6	15	1,013	168.8	67.5
	AE7	7	25	1,855	265.0	74.2
	AE8	3	10	1,006	335.3	100.6
	AE9	3	11	1,213	404.3	110.3
	AE10	3	12	1,112	370.7	92.7
	AE11	2	4	443	221.5	110.8
	AE11A	3	15	1,014	338.0	67.6
	AE11B	9	34	3,761	417.9	110.6
	Total	78	247	23,539	301.8	95.3

AVERAGE COMMAND AREA OF A TERTIARY CANAL AND A UNIT

DISTRICT		TERTIARY /FOURTH CANAL	DIVERSION POINTS	AREA (ha)	AVERAGE AREA/ CANAL (ha)	AVERAGE AREA/ DIVERSION (ha)
KARI RUD LEFT	KL1	1	2	155	155.0	77.5
	KL2	1	5	412	412.0	82.4
	KL3	6	22	2,413	402.2	109.7
	KL4	6	20	1,957	326.2	97.9
	KL5	6	26	2,528	421.3	97.2
	KL6	1	3	286	286.0	95.3
	KL6A	2	5	459	229.5	91.8
	KL6B	3	11	1,381	460.3	125.5
	Total	26	94	9,591	368.9	102.0

DISTRICT		TERTIARY /FOURTH CANAL	DIVERSION POINTS	AREA (ha)	AVERAGE AREA/ CANAL (ha)	AVERAGE AREA/ DIVERSION (ha)
KARI RUD RIGHT	KR1	1	4	298	298.0	74.5
	KR2	1	2	365	365.0	182.5
	KR3	7	12	711	101.6	59.3
	KR4	9	24	2,411	267.9	100.5
	KR5	1	4	492	492.0	123.0
	Total	19	46	4,277	225.1	93.0

TABLE E. 1. 6 - 16 SUMMARY OF NUMBER OF STRUCTURES (IRRIGATION)

ZONE	TYPE OF DROP STRUCTURE				
	A (2.0m)	B (1.0m)	C (0.5m)	D (0.25m)	TOTAL
HARAZ WEST	128	61	64	69	322
AMOL WEST	17	26	45	68	156
HARAZ EAST	137	55	74	70	336
AMOL EAST	15	11	26	46	98
KARI LEFT	30	15	17	35	97
KARI RIGHT	19	6	11	14	50
TOTAL	346	174	237	302	1059