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A GATE OPERATIONS MANUAL FOR LARGE SCALE DIVERSION WEIRS IN THAILAND

by

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ABSTRACT

The manual gives guidelines for the operation of sluice gates at the large diversion weirs in Thailand.

The manual recommends that the depth of water in the sluice channel is continuously monitored when eediment deposition causes the depth to drop below a threshold value then it is time to flush sediment from the sluice channel. The manual includes sets of tables which can be used to calculate a suitable value for the threshold depth at each site.

Duration for sluicing, sluicing during canal cloeuree and sluice gate openings are also covered by the manual.

CONTENTS

1 INTRODUCTION

The purpose of this manual is to give guidelines for the operation of sluice gates at the large diversion weirs in Thailand. The manual is one of the products of a research project undertaken jointly by Hydraulics Research and the Royal Irrigation Department of Thailand, the final report on the research project is Atkinson (1986).

Guidelines on the following aspects of 'the operation of gates at diversion weirs are covered:

(i) When the sluice gates should be opened.

(ii) The duration of sluicing.

(iii) The gate opening required during sluicing.

Present practice is to sluice during periods of high river discharge. However the collaborative research project showed that bed levels in the sluice channel do not drop significantly during sluicing if the river discharge is high, on some occasions bed levels can even rise. The reason is that at larger discharges the high downstream water levels and the large water level drop across the sluice gates cause the water level in the sluice channel to be too high. The high water levels prevent the flow from scouring the sluice channel.

The manual seeks to enable engineers to set the gate operations so that sluicing can be performed at a low river discharge and at the minimum frequency; this ensures that the canal is closed for as short a time as possible during the irrigation season. It is recognised that other considerations apart from sediment control affect the operation of the intake

structures. Therefore the guidelines presented in the manual will not always be applicable.

It is assumed that the canal gates are always fully closed during sluicing, this is recommended, it is also current RID practice. Therefore the manual does not need to give any guidance on the operation of the canal gates.

The kind of site for which the manual has applicability is shown in Figure 1 (a plan view of the Mae Tang diversion weir). Generally, the manual can be used at sites which have the following features:

(i) A sluice channel upstream of the canal intake gates. The channel allows sediment in the flow to settle out before entering the canal; it may be a separate channel, as at Mae Tang, or it may be separated from the river by means of a dividing wall.

(ii) Sluice gates for the flushing of sediment from the sluice channel. It is assumed that the gates can be opened and closed easily enough for a sluicing of only a few hours to be possible.

(iii) The diversion weir may have water abstracted at one or both banks of the river. If water is abstracted at both banks then it is assumed that there is a sluice channel and a set of sluice gates at each bank.

The theoretical background to the manual is presented in the final report of the collaborative research study (Atkinson, 1986). Also Appendix I gives an account of the theory and measurements which were used to produce the tables in the manual.

An example of the use of the manual is presented in Appendix 11.

2 DATA REQUIRED

The following data are required for the use of this manual:

(a) The D_{35} size of the bed material sediment in the sluice channel. (D_{35} is defined as the sediment size at which 35% of the sand sized sediment is finer. Sand sized sediment is defined as the sediment which is retained on a 63 micron sieve.) If possible at least five separate samples should be taken and their D_{35} values averaged. It is best for the individual samples to be taken from different locations in the sluice channel. Also, if possible, samples should be taken on separate occasions, but not immediately before or after a sluicing.

(b) The D_{35} size of the bed material sediment in the main canal. Again five separate samples should be taken and their D_{35} sizes averaged. The samples should be collected from different locations, but always near the centre of the canal cross-section. Samples should not be collected from the first 2km of the canal.

(c) The design slope of the main canal, S_c.

(d) The mean width of the main canal, W_c. For a trapezoidal canal section this is the mean of the bed width and water surface width.

(e) The discharge into the main canal, Q_c.

(f) The water surface width in the sluice channel during normal operation, W_s.

(g) The side slope of the sluice channel (ratio horizontal distance/vertical distance) S_{side}.

(h) A set of measurements of water levels during sluicing (see Chapter 4 for details).

3 DETERMINING WHEN TO OPEN SLUICE GATES

The principal questions to be answered in setting a gate operational strategy at diversion weirs are:

(i) When should the sluice gates be opened? And

(ii) For how long should the gates be left open?

This chapter largely deals with the first question while the second question is discussed in Chapter 4. The following five rules should be sufficient to determine a suitable strategy for gate opening:

(a) Whenever the sluice gates are opened they should be opened fully. At lower discharges the gates can be considered fully open when the bottom of the gate is clear of the water surface.

(b) During any period of canal closure for maintenance the sluice gates should be opened. This prolonged period of sluicing allows drawdown of river bed levels as well as the drawdown of bed levels in the sluice channel. Usually canal maintenance is done during periods of low river discharge, however, if the river discharge is too high then sluicing may not be beneficial. An indication of the maximum allowable discharge for sluicing is the discharge at which water just spills over the weir when the sluice gates are fully open.

(c) During normal operation the timing of sluice gate opening should be determined by the water depth in the sluice channel: when sediment deposition causes the water depth to be reduced below a threshold depth, it is then time to sluice.

It is the depth in the sluice channel and not just the bed level which should determine when to open the sluice gates. This is because it is the depth in the sluice channel which determines the sediment load entering the canal. For example, during periods of higher river discharge the water levels are high and so the depth also is high. As the canal discharge is constant this results in low velocities in the sluice channel and hence a low sediment load entering the canal. It is only after the water levels have dropped that the depth is reduced and the sediment loads entering the canal may become excessive, then would be the time to sluice.

Calculation of threshold depth

The threshold depth in the sluice channel, d_{sluice} is determined using the tables at the back of this manual. Firstly the main canal sediment transporting capacity is obtained using Tables 1(a) to 1(v), the canal's D_{35} sediment size should be used in the tables. If more than one canal takes water from the sluice channel then the minimum of the sediment transporting capacities should be taken. The threshold depth in the sluice channel is then read from Tables 2(a) to 2(k), these tables use the sluice channel D_{35} size. An input to Table 2 is the mean width of the sluice channel which in turn depends on the depth. Therefore the following

trial and error procedure is required to use Table 2:

(i) Choose a sensible value for threshold depth, say 2.0m.

(ii) Calculate the mean width in the sluice channel:

Mean width, $W_m = W_S - \text{depth} \times S_{side}$

where W_S = water surface width in the sluice channel at a typical water level during canal operation.

'side = side slope of the sluice channel.

(iii) Calculate the discharge per metre width in sluice channel, it is

$= Q_c / W_m$

where Q_C = discharge into main canal (total discharge for all canals if there is more than one).

(iv) Use Table 2 to obtain the next estimate for threshold depth, the answer is given in metres. (If the sediment transporting capacity of the canal is greater than 1000ppm, the largest value given, then take the threshold depth for 1000ppm).

(v) If the new estimate for threshold depth is significantly different from the previous

estimate then return to step (ii) above. Otherwise it is the final answer.

Linear interpolation between tables or within tables may be required for the calculation. An example of linear interpolation is given in Appendix **11.**

The theoretical basis for the calculation of threshold depth using the tables is given in Appendix **I.**

Monitoring of depth in sluice channel

A cross-section in the sluice channel upstream of the sluice gates (at about a quarter of the distance from the sluice gates to the sluice channel entrance) should be monitored. The depth at the cross-section could be measured using a pole with depth markings; the depth at about 10 points across the section away from the banks could be measured, and the values averaged. When sediment deposition in the sluice channel causes the depth to be reduced below the threshold value then the sluice gates should be opened.

Once the gate operation strategy described in this manual has been practiced at a weir for two or three deposition and sluicing cycles, then the gate operators would gain an understanding of how frequently the measurement is required for their situation. The required frequency of measurement depends both on the season and on how near the depth is to the threshold depth. Initially the measurement is required weekly.

(d) During the irrigation season the canal may occasionally be closed for a day or so during

periods of high rainfall or for other reasons. Engineers operating the structure will then need to know if it is beneficial to sluice. Sluicing will be beneficial if:

(i) bed levels in the sluice channel are high (ie the water depth is approaching its threshold value) and the river discharge is below the maximum allowable discharge for sluicing (which is described in Section (b) above); or

(ii) the river discharge is less than half the maximum allowable discharge for sluicing.

(e) Some diversion weirs have a sluice channel and canal offtake on both banks; in this case the sluice gates should, wherever possible, be opened together or not opened at all. Therefore, when the depth in the sluice channel is reduced below its threshold value for one offtake then sluicing at both offtakes should be performed. At times when only one canal is in operation, it is not possible to open both sets of sluice gates, so in this case it is advisable not to sluice at all.

Also, the maximum allowable discharge for sluicing when there are two sluice channels is the discharge at which water just spills over the weir when both sets of sluice gates are fully open.

4 DETERMINING THE DURATION OF SLUICING

This chapter seeks to give recommendations on the minimum duration of sluicing. Longer periods of sluicing are possible when a canal closure provides the gate operators with the opportunity. It is not possible to provide tables of recommended minimum sluicing durations because the optimum duration depends on too many variables.

A suitable duration for sluicing can be determined quite easily by measuring water levels during a couple of sluicing operations. Water levels should be measured at three positions in the sluice channel, at a quarter, a half and three quarters of the distance from the sluice channel entrance to the sluice gates. The measurement could be performed by periodically taking a reading of the distance from a fixed point on the bank down to the water surface.

The sluicing measurements should be made when the water depth in the sluice channel before sluicing is at or near its threshold value.

Plotting graphs of measured water level against time should show a steady drop in water levels as the sediment was flushed from the basin, followed by a much slower drop in water levels (or no discernible drop at all). Considerable scatter in the water level measurements is expected due to standing waves in the flow, however the trend described above should still be noted.

A suitable duration for sluicing would be when the steady drop in water levels has ceased. It is

expected that the duration of sluicing would be a few hours rather than days.

5 ACKNOWLEDGEMENTS

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TABLES.

TABLE 1(a): Canal sediment transporting capacities, D_{35} = 0.1mm

TABLE OF CANAL SEDIMENT TRANSPORTING CAPACITIES (in ppm)

D35 sediment size = 0.10 mm

	Discharge per m width of canal (m2/s) :														
Canal Design Slope in cm per km	0.3	0.4	0.5	0.6	0.8	1.0	1.2	1.4	1.6	1.8	2.0	2.5	3.0	3.5	4.0
5	0	0	0	1	2	4	7	11	15	20	26	43	64	89	116
6	0	0	1	2	4	8	14	21	29	38	48	78	113	154	198
7	0	1	2	3	8	15	24	35	48	63	79	125	180	242	310
8	0	1	3	6	14	25	39	55	75	96	120	188	267	356	453
9	1	3	6	10	21	37	58	81	109	139	172	267	376	497	630
10	1	4	9	15	31	54	82	114	151	192	237	363	508	668	842
11	2	6	13	21	44	74	111	154	203	256	314	478	664	870	1093
12	4	9	18	29	59	99	146	202	264	332	406	612	846	1104	1383
13	5	13	24	39	77	128	188	257	335	420	512	767	1056	1373	1714
14	7	17	32	50	99	162	237	322	417	521	633	944	1294	1676	2088
15	10	22	41	64	124	201	292	396	511	636	770	1143	1561	2016	2506
16	12	29	51	80	153	246	355	479	616	765	924	1365	1858	2394	2969
17	16	36	63	98	186	296	426	572	733	908	1095	1611	2186	2811	3479
18	20	44	77	119	223	353	504	675	863	1067	1284	1882	2546	3267	4037
19	25	54	93	142	264	415	591	789	1006	1241	1491	2178	2939	3763	4643
20	30	65	111	168	310	484	687	914	1163	1431	1717	2499	3365	4302	5299
22	43	90	152	228	415	642	905	1198	1517	1861	2226	3223	4321	5506	6766
24	60	122	203	300	539	829	1161	1529	1930	2360	2816	4057	5420	6887	8443
26	80	159	262	385	685	1045	1455	1910	2403	2931	3490	5005	6666	8449	10337
28	104	204	332	484	853	1292	1792	2343	2939	3576	4250	6072	8064	10199	12456
30	132	255	412	598	1043	1572	2170	2829	3541	4299	5099	7261	9619	12141	14803
35	222	418	662	948	1626	2421	3314	4292	5342	6458	7632	10789	14215	17866	21710
40	344	634	990	1403	2371	3498	4756	6126	7593	9147	10778	15146	19869	24887	30159
45	502	908	1402	1970	3291	4819	6515	8355	10320	12394	14568	20374	26630	33262	40215
50	699	1246	1905	2657	4398	6397	8608	10998	13544	16227	19032	26508	34541	43040	51935

TABLE 1(b): Canal sediment transporting capacities, D_{35} = 0.12mm

TABLE OF CANAL SEDIMENT TRANSPORTING CAPACITIES (in ppm)

D35 sediment size = 0.12 mm

Canal Design Slope in cm per km	Discharge per m width of canal (m2/s) : 0.3	0.4	0.5	0.6	0.8	1.0	1.2	1.4	1.6	1.8	2.0	2.5	3.0	3.5	4.0
5	0	0	0	1	2	3	5	8	10	14	17	26	37	48	61
6	0	0	1	2	4	6	10	14	19	24	29	44	61	79	99
7	0	1	2	3	6	11	17	23	30	38	46	68	93	120	148
8	0	1	3	5	10	17	25	34	44	55	67	98	132	169	208
9	1	2	5	8	15	25	36	49	62	77	93	135	180	228	279
10	1	4	7	11	21	34	49	66	84	103	123	177	236	298	362
11	2	5	10	15	29	46	65	86	109	134	159	227	300	377	457
12	3	7	13	20	38	60	84	110	139	169	200	284	373	467	565
13	4	10	18	27	49	75	105	137	172	208	246	348	455	568	685
14	6	13	23	34	61	93	129	168	209	253	298	419	546	679	817
15	8	17	28	42	75	113	156	202	251	302	356	497	646	802	962
16	10	21	35	51	90	136	186	240	297	357	419	583	756	935	1121
17	13	26	42	62	108	160	219	281	347	416	488	676	874	1080	1292
18	16	31	51	73	127	188	255	326	402	481	563	777	1002	1236	1476
19	19	37	60	86	147	217	294	375	461	551	644	886	1140	1403	1673
20	23	44	70	100	170	249	336	428	525	626	730	1002	1287	1582	1883
22	31	59	93	132	221	322	430	546	667	793	922	1259	1611	1973	2344
24	42	78	121	170	280	404	538	680	828	981	1138	1547	1973	2411	2859
26	54	99	153	212	347	498	659	830	1008	1191	1380	1868	2375	2896	3427
28	69	124	189	261	423	602	795	997	1207	1424	1646	2221	2817	3428	4050
30	86	152	229	315	507	718	944	1181	1426	1679	1939	2608	3299	4007	4728
35	137	237	351	477	755	1058	1380	1715	2063	2419	2783	3718	4682	5665	6663
40	204	344	504	678	1059	1472	1907	2360	2827	3305	3791	5039	6320	7623	8944
45	286	476	689	920	1422	1962	2529	3117	3721	4339	4967	6572	8216	9885	11573
50	385	632	907	1204	1844	2530	3247	3988	4749	5524	6311	8320	10371	12451	14553

TABLE 1(c): Canal sediment transporting capacities, D_{35} = 0.14mm

TABLE OF CANAL SEDIMENT TRANSPORTING CAPACITIES (in ppm)

D35 sediment size = 0.14 mm

	Discharge per m width of canal (m2/s) :														
Canal Design Slope in cm per km	0.3	0.4	0.5	0.6	0.8	1.0	1.2	1.4	1.6	1.8	2.0	2.5	3.0	3.5	4.0
5	0	0	0	1	2	3	4	6	8	10	13	19	25	32	39
6	0	0	1	1	3	5	8	11	14	17	21	30	40	51	61
7	0	1	2	3	5	9	13	17	22	27	32	45	59	74	89
8	0	1	3	4	8	13	19	25	31	38	45	63	82	101	121
9	1	2	4	6	12	19	26	34	43	52	61	84	108	133	159
10	1	3	6	9	17	26	35	45	56	67	79	108	139	170	202
11	2	5	8	12	22	33	45	58	72	85	100	136	173	212	250
12	3	7	11	16	29	42	57	73	89	106	123	167	212	257	303
13	4	9	14	21	36	52	70	89	109	129	149	201	254	308	362
14	5	11	18	26	44	64	85	107	130	154	178	238	300	363	426
15	7	14	22	32	53	76	101	127	154	181	209	279	351	423	495
16	9	17	27	38	63	90	119	149	180	211	243	323	405	487	569
17	11	21	32	45	74	105	138	172	207	243	279	370	463	555	648
18	13	25	38	53	86	122	159	198	237	277	318	421	524	628	732
19	16	29	45	62	99	139	182	225	269	314	360	475	590	706	821
20	19	34	52	71	113	158	205	254	303	353	404	531	660	788	916
22	25	45	67	92	144	200	258	317	378	439	500	655	810	965	1119
24	33	58	85	115	179	247	317	388	461	534	607	792	976	1160	1342
26	42	72	106	142	218	299	382	466	552	638	724	941	1157	1372	1585
28	53	89	128	171	261	356	453	552	651	751	852	1103	1353	1601	1848
30	64	107	154	203	309	418	530	644	759	874	989	1277	1564	1848	2129
35	99	161	228	298	445	597	752	908	1064	1221	1378	1769	2155	2538	2916
40	143	227	317	412	607	808	1012	1216	1421	1626	1830	2337	2838	3332	3819
45	195	306	423	545	796	1052	1311	1570	1829	2087	2344	2982	3609	4228	4837
50	257	397	545	697	1010	1328	1648	1968	2287	2605	2920	3701	4469	5224	5967

TABLE 1(d): Canal sediment transporting capacities, D_{35} = 0.16mm

TABLE OF CANAL SEDIMENT TRANSPORTING CAPACITIES (in ppm)

D35 sediment size = 0.16 mm

Discharge per m width of canal (m2/s) :

Canal Design Slope in cm per km	0.3	0.4	0.5	0.6	0.8	1.0	1.2	1.4	1.6	1.8	2.0	2.5	3.0	3.5	4.0
5	0	0	0	1	2	3	4	5	7	9	10	15	19	24	29
6	0	0	1	1	3	5	7	9	12	14	17	23	30	37	43
7	0	1	1	2	5	8	11	14	17	21	24	33	43	52	61
8	0	1	2	4	7	11	15	20	24	29	34	46	58	70	82
9	1	2	4	6	10	16	21	27	33	39	45	60	75	90	105
10	1	3	5	8	14	21	28	35	42	50	57	76	95	113	132
11	2	4	7	11	18	27	35	44	53	62	71	94	117	139	161
12	3	6	10	14	23	33	44	54	65	76	87	114	140	167	193
13	4	8	12	18	29	41	53	65	78	91	104	135	166	197	227
14	5	10	15	22	35	49	63	78	93	107	122	159	195	230	265
15	6	12	19	26	42	58	74	91	108	125	142	184	225	265	304
16	8	15	23	31	49	68	87	106	125	144	163	210	257	302	347
17	10	18	27	36	57	78	100	121	143	165	186	239	291	342	391
18	12	21	31	42	65	89	114	138	162	186	210	269	327	383	439
19	14	25	36	49	75	101	128	155	182	209	236	301	365	427	488
20	16	28	42	55	84	114	144	174	204	233	263	335	405	474	540
22	22	37	53	70	106	142	178	214	250	286	321	407	491	572	651
24	28	47	67	87	130	173	216	259	301	343	384	485	584	679	772
26	35	58	81	106	156	207	257	307	356	405	453	570	684	794	901
28	43	70	98	126	185	243	301	359	416	472	527	661	791	917	1039
30	52	83	116	149	216	283	349	415	479	543	606	758	906	1048	1186
35	79	122	167	212	304	394	483	571	657	742	825	1027	1221	1409	1590
40	111	168	228	287	406	523	638	750	860	969	1075	1331	1578	1815	2045
45	149	222	298	373	522	669	812	952	1088	1222	1353	1670	1974	2266	2548
50	192	284	377	469	652	831	1005	1175	1340	1502	1661	2043	2409	2760	3098

TABLE 1(e): Canal sediment transporting capacities, D_{35} = 0.18mm

TABLE OF CANAL SEDIMENT TRANSPORTING CAPACITIES (in ppm)

D35 sediment size = 0.18 mm

	Discharge per m width of canal (m2/s) :														
Canal Design Slope in cm per km	0.3	0.4	0.5	0.6	0.8	1.0	1.2	1.4	1.6	1.8	2.0	2.5	3.0	3.5	4.0
5	0	0	0	1	1	2	4	5	6	7	9	12	16	19	23
6	0	0	1	1	3	4	6	8	10	12	14	19	24	29	33
7	0	1	1	2	4	7	9	12	15	17	20	27	33	40	46
8	0	1	2	4	7	10	13	17	20	24	27	36	45	53	61
9	1	2	4	5	9	14	18	22	27	31	36	46	57	67	77
10	1	3	5	7	12	18	23	29	34	40	45	58	71	84	96
11	2	4	7	10	16	22	29	36	42	49	55	71	86	101	116
12	3	6	9	12	20	28	36	43	51	59	67	85	103	120	137
13	4	7	11	15	24	34	43	52	61	70	79	100	121	141	160
14	5	9	14	19	29	40	51	61	72	82	92	117	140	163	185
15	6	11	17	23	35	47	59	71	83	95	106	134	161	186	211
16	8	13	20	27	40	54	68	82	95	108	121	152	182	211	238
17	9	16	23	31	47	62	78	93	108	123	137	172	205	237	267
18	11	19	27	36	53	71	88	105	122	138	154	192	229	264	297
19	13	22	31	41	60	80	99	118	136	154	171	214	254	292	329
20	15	25	35	46	68	89	110	131	151	171	190	236	280	322	362
22	20	32	45	58	84	110	135	159	183	207	229	284	335	385	432
24	25	40	55	71	102	132	162	190	218	245	272	335	395	452	507
26	31	49	67	85	121	157	191	224	256	287	317	390	459	524	587
28	38	59	80	101	142	183	222	259	296	332	366	449	526	600	671
30	45	69	93	118	165	211	255	298	339	379	418	511	598	681	760
35	67	99	132	165	228	288	346	402	456	508	559	680	793	900	1002
40	92	135	177	219	300	376	450	520	588	654	717	868	1009	1143	1270
45	122	176	229	281	380	475	565	651	734	814	892	1075	1247	1409	1563
50	155	221	286	349	469	583	691	794	894	989	1081	1300	1504	1697	1879

TABLE 1(f): Canal sediment transporting capacities, D_{35} = 0.2mm

TABLE OF CANAL SEDIMENT TRANSPORTING CAPACITIES (in ppm)

D35 sediment size = 0.20 mm

Discharge per m width of canal (m2/s) :

Canal Design Slope in cm per km	0.3	0.4	0.5	0.6	0.8	1.0	1.2	1.4	1.6	1.8	2.0	2.5	3.0	3.5	4.0
5	0	0	0	1	1	2	3	4	6	7	8	11	13	16	19
6	0	0	1	1	3	4	6	7	9	11	12	16	20	24	27
7	0	1	1	2	4	6	8	11	13	15	17	23	28	33	37
8	0	1	2	4	6	9	12	15	18	20	23	30	36	43	49
9	1	2	3	5	9	12	16	19	23	26	30	38	46	54	61
10	1	3	5	7	11	16	20	25	29	33	37	47	57	66	75
11	2	4	6	9	14	20	25	30	36	41	45	57	68	79	89
12	3	5	8	11	18	24	31	37	43	49	54	68	81	93	105
13	4	7	10	14	22	29	36	44	51	57	64	80	94	108	122
14	5	9	13	17	26	34	43	51	59	67	74	92	109	124	139
15	6	10	15	20	30	40	50	59	68	76	85	105	124	141	158
16	7	12	18	24	35	46	57	67	77	87	96	118	139	159	178
17	9	15	21	27	40	53	64	76	87	98	108	133	156	178	198
18	10	17	24	31	46	59	73	85	97	109	121	148	173	197	220
19	12	20	28	36	51	67	81	95	108	121	134	164	191	217	242
20	14	23	31	40	57	74	90	105	120	134	148	180	210	238	265
22	18	29	39	50	71	90	109	127	144	161	177	214	249	282	313
24	23	36	48	61	85	108	129	150	170	189	208	251	291	329	365
26	28	43	58	72	100	126	151	175	198	220	241	290	336	379	419
28	34	51	68	85	117	146	175	202	227	252	276	331	383	431	476
30	40	60	79	98	134	168	200	230	259	286	313	375	432	486	536
35	59	85	111	135	182	226	267	306	343	379	413	492	565	633	697
40	80	114	147	178	237	292	343	391	437	481	523	621	711	795	874
45	104	146	187	225	297	364	426	484	540	593	643	761	870	970	1065
50	131	182	231	277	363	442	516	585	651	713	773	912	1040	1158	1269

TABLE 1(g): Canal sediment transporting capacities, D_{35} = 0.22mm

TABLE OF CANAL SEDIMENT TRANSPORTING CAPACITIES (in ppm)

D35 sediment size = 0.22 mm

Canal Design Slope in cm per km	Discharge per m width of canal (m2/s) : 0.3	0.4	0.5	0.6	0.8	1.0	1.2	1.4	1.6	1.8	2.0	2.5	3.0	3.5	4.0
5	0	0	0	1	1	2	3	4	5	6	7	10	12	14	16
6	0	0	1	1	3	4	5	7	8	10	11	14	17	20	23
7	0	1	1	2	4	6	8	10	12	14	15	20	24	28	31
8	0	1	2	3	6	8	11	13	16	18	20	26	31	36	40
9	1	2	3	5	8	11	14	17	20	23	26	33	39	45	50
10	1	3	5	7	10	14	18	22	25	29	32	40	48	55	61
11	2	4	6	8	13	18	22	27	31	35	39	48	57	65	73
12	3	5	8	11	16	22	27	32	37	42	46	57	67	76	85
13	3	7	10	13	20	26	32	38	43	49	54	66	77	88	98
14	4	8	12	16	23	30	37	44	50	56	62	76	89	100	111
15	6	10	14	19	27	35	43	51	58	64	71	86	100	113	126
16	7	12	17	22	31	40	49	57	65	73	80	97	113	127	141
17	8	14	19	25	36	46	55	65	73	82	90	108	125	141	156
18	10	16	22	28	40	52	62	72	82	91	100	120	139	156	172
19	11	18	25	32	45	58	69	80	91	100	110	132	152	171	189
20	13	21	29	36	50	64	76	88	100	110	121	145	167	187	206
22	17	26	36	44	61	77	92	106	119	131	143	171	197	220	242
24	21	32	43	54	73	91	108	124	139	154	167	199	228	255	280
26	26	39	51	63	86	107	126	144	161	178	193	229	262	292	320
28	31	46	60	74	99	123	145	165	184	202	220	260	297	330	362
30	37	54	70	85	114	140	164	187	208	229	248	293	333	370	405
35	53	75	96	116	153	186	217	246	273	299	323	380	431	478	521
40	71	100	126	151	196	238	276	312	345	376	406	475	537	594	647
45	92	127	159	189	244	294	340	382	422	460	495	577	651	719	782
50	115	157	195	231	296	355	408	458	505	549	591	686	773	852	925

TABLE 1(h): Canal sediment transporting capacities, D_{35} = 0.24mm

TABLE OF CANAL SEDIMENT TRANSPORTING CAPACITIES (in ppm)

D35 sediment size = 0.24 mm

Canal Design Slope in cm per km	Discharge per m width of canal (m2/s) : 0.3	0.4	0.5	0.6	0.8	1.0	1.2	1.4	1.6	1.8	2.0	2.5	3.0	3.5	4.0
5	0	0	0	1	1	2	3	4	5	6	7	9	11	13	14
6	0	0	1	1	2	4	5	6	8	9	10	13	16	18	21
7	0	1	1	2	4	6	7	9	11	12	14	18	21	24	27
8	0	1	2	3	6	8	10	12	14	16	18	23	27	31	35
9	1	2	3	5	8	10	13	16	18	21	23	29	34	39	43
10	1	3	4	6	10	13	17	20	23	26	29	35	41	47	52
11	2	4	6	8	12	16	20	24	28	31	34	42	49	55	61
12	3	5	7	10	15	20	24	29	33	37	41	49	57	65	71
13	3	6	9	12	18	24	29	34	38	43	47	57	66	74	82
14	4	8	11	15	21	28	34	39	44	49	54	65	75	84	93
15	5	9	13	17	25	32	38	45	51	56	61	74	85	95	104
16	7	11	16	20	29	36	44	51	57	63	69	82	95	106	116
17	8	13	18	23	32	41	49	57	64	70	77	92	105	117	128
18	9	15	21	26	37	46	55	63	71	78	85	101	116	129	141
19	11	17	24	30	41	51	61	70	78	86	94	111	127	141	154
20	13	20	26	33	45	57	67	77	86	94	102	121	138	154	168
22	16	25	33	40	55	68	80	91	102	112	121	143	162	180	196
24	20	30	40	48	65	80	94	107	119	130	141	165	187	207	226
26	25	36	47	57	76	93	109	123	136	149	161	189	213	236	257
28	29	42	55	66	87	107	124	140	155	169	183	213	241	266	289
30	34	49	63	76	100	121	140	158	175	190	205	239	269	297	322
35	49	68	86	102	132	159	184	206	227	247	265	307	345	379	411
40	65	89	111	132	169	202	231	259	284	308	330	381	427	468	506
45	84	113	140	164	208	247	283	315	345	373	400	460	514	562	607
50	104	139	170	199	251	296	338	375	410	443	474	544	606	662	714

TABLE 1(i): Canal sediment transporting capacities, D_{35} = 0.26mm

TABLE OF CANAL SEDIMENT TRANSPORTING CAPACITIES (in ppm)

D35 sediment size = 0.26 mm

Canal Design Slope in cm per km	Discharge per m width of canal (m2/s) : 0.3	0.4	0.5	0.6	0.8	1.0	1.2	1.4	1.6	1.8	2.0	2.5	3.0	3.5	4.0
5	0	0	0	1	1	2	3	4	5	5	6	8	10	12	13
6	0	0	1	1	2	4	5	6	7	8	9	12	14	16	18
7	0	1	1	2	4	5	7	9	10	12	13	16	19	22	24
8	0	1	2	3	5	7	10	11	13	15	17	21	24	28	31
9	1	2	3	4	7	10	12	15	17	19	21	26	30	34	38
10	1	3	4	6	9	12	15	18	21	24	26	32	37	41	45
11	2	4	6	8	12	15	19	22	25	28	31	37	43	49	53
12	2	5	7	10	14	19	23	26	30	33	36	44	50	56	62
13	3	6	9	12	17	22	27	31	35	39	42	50	58	64	71
14	4	7	11	14	20	26	31	35	40	44	48	57	65	73	80
15	5	9	13	16	23	29	35	40	45	50	54	64	73	82	89
16	6	11	15	19	26	33	40	45	51	56	61	72	82	91	99
17	8	13	17	22	30	38	44	51	57	62	68	80	90	100	109
18	9	14	20	25	34	42	49	56	63	69	75	88	99	110	120
19	11	16	22	28	37	46	55	62	69	76	82	96	109	120	130
20	12	19	25	31	41	51	60	68	76	83	89	105	118	130	142
22	15	23	31	37	50	61	71	81	89	97	105	122	138	152	164
24	19	28	37	45	59	72	83	94	104	113	122	141	158	174	188
26	23	34	43	52	69	83	96	108	119	129	139	161	180	197	213
28	28	40	50	60	79	95	109	122	135	146	157	181	202	222	239
30	33	46	58	69	89	107	123	138	151	164	175	202	225	247	266
35	46	63	78	92	118	140	160	178	195	210	225	258	287	313	337
40	61	82	101	118	149	176	200	222	242	260	278	317	352	383	412
45	77	103	125	146	182	214	243	268	292	314	335	381	421	458	491
50	95	125	152	176	218	255	288	318	345	371	394	448	494	536	575

TABLE 1(j): Canal sediment transporting capacities, D_{35} = 0.28mm

TABLE OF CANAL SEDIMENT TRANSPORTING CAPACITIES (in ppm)

D35 sediment size = 0.28 mm

Discharge per m width of canal (m2/s) :

Canal Design Slope in cm per km	0.3	0.4	0.5	0.6	0.8	1.0	1.2	1.4	1.6	1.8	2.0	2.5	3.0	3.5	4.0
5	0	0	0	1	1	2	3	4	4	5	6	8	9	11	12
6	0	0	1	1	2	3	5	6	7	8	9	11	13	15	17
7	0	1	1	2	4	5	7	8	9	11	12	15	18	20	22
8	0	1	2	3	5	7	9	11	13	14	16	19	22	25	28
9	1	2	3	4	7	9	12	14	16	18	20	24	28	31	34
10	1	3	4	6	9	12	15	17	20	22	24	29	33	37	41
11	2	4	5	7	11	15	18	21	23	26	28	34	39	43	47
12	2	5	7	9	14	17	21	24	28	30	33	40	45	50	55
13	3	6	9	11	16	21	25	28	32	35	38	45	52	57	62
14	4	7	10	13	19	24	28	33	37	40	44	51	58	64	70
15	5	9	12	16	22	27	32	37	41	45	49	58	65	72	78
16	6	10	14	18	25	31	37	42	46	51	55	64	72	80	87
17	7	12	16	21	28	35	41	46	52	56	61	71	80	88	95
18	9	14	19	23	31	39	45	51	57	62	67	78	88	96	104
19	10	16	21	26	35	43	50	56	62	68	73	85	95	105	113
20	12	18	24	29	39	47	55	62	68	74	80	92	103	113	122
22	15	22	29	35	46	56	65	73	80	87	93	108	120	131	142
24	18	27	35	42	54	65	75	84	93	100	107	124	138	150	162
26	22	32	41	49	63	75	86	97	106	114	122	140	156	170	183
28	26	37	47	56	72	86	98	109	119	129	138	157	175	190	204
30	31	43	54	64	81	97	110	122	134	144	154	175	194	211	226
35	43	59	72	85	106	125	142	157	171	184	195	222	245	266	284
40	57	76	93	108	134	156	177	195	211	226	240	272	299	324	346
45	72	95	114	132	163	190	213	234	254	271	288	324	356	385	411
50	89	115	138	158	194	225	252	276	298	319	338	380	416	449	478

TABLE 1(k): Canal sediment transporting capacities, D_{35} = 0.3mm

TABLE OF CANAL SEDIMENT TRANSPORTING CAPACITIES (in ppm)

D35 sediment size = 0.30 mm

	Discharge per m width of canal (m2/s) :														
Canal Design Slope in cm per km	0.3	0.4	0.5	0.6	0.8	1.0	1.2	1.4	1.6	1.8	2.0	2.5	3.0	3.5	4.0
5	0	0	0	0	1	2	3	4	4	5	6	7	9	10	11
6	0	0	1	1	2	3	4	5	6	7	8	10	12	14	16
7	0	1	1	2	3	5	6	8	9	10	11	14	16	18	20
8	0	1	2	3	5	7	9	10	12	13	15	18	21	23	26
9	1	2	3	4	7	9	11	13	15	17	18	22	25	28	31
10	1	2	4	6	9	11	14	16	18	20	22	27	30	34	37
11	2	3	5	7	11	14	17	19	22	24	26	31	36	39	43
12	2	5	7	9	13	17	20	23	26	28	31	36	41	45	49
13	3	6	8	11	15	19	23	27	30	33	35	41	47	52	56
14	4	7	10	13	18	23	27	30	34	37	40	47	53	58	63
15	5	8	12	15	21	26	30	34	38	42	45	52	59	65	70
16	6	10	14	17	23	29	34	39	43	47	50	58	65	71	77
17	7	12	16	20	26	33	38	43	47	52	55	64	72	79	85
18	8	13	18	22	30	36	42	47	52	57	61	70	78	86	92
19	10	15	20	25	33	40	46	52	57	62	67	77	85	93	100
20	11	17	22	27	36	44	51	57	62	68	72	83	92	101	108
22	14	21	27	33	43	52	60	67	73	79	84	96	107	116	125
24	18	26	33	39	51	60	69	77	84	91	97	110	122	133	142
26	21	30	38	46	58	69	79	88	96	103	110	125	138	149	160
28	25	35	44	52	67	79	89	99	108	116	123	140	154	167	178
30	30	41	51	60	75	88	100	111	120	129	137	155	171	184	197
35	41	55	68	79	98	114	128	141	153	164	173	195	214	231	246
40	54	71	86	99	122	142	159	174	188	200	212	238	260	280	298
45	68	88	106	122	148	171	191	209	225	239	253	283	309	332	352
50	83	107	127	145	176	202	225	245	263	280	296	330	359	385	409

TABLE 1(1): Canal sediment transporting capacities, D_{35} = 0.35mm

TABLE OF CANAL SEDIMENT TRANSPORTING CAPACITIES (in ppm)

D35 sediment size = 0.35 mm

	Discharge per m width of canal (m2/s) :														
Canal Design Slope in cm per km	0.3	0.4	0.5	0.6	0.8	1.0	1.2	1.4	1.6	1.8	2.0	2.5	3.0	3.5	4.0
5	0	0	0	0	1	2	3	3	4	5	5	7	8	9	10
6	0	0	0	1	2	3	4	5	6	7	8	9	11	12	13
7	0	0	1	2	3	5	6	7	8	9	10	12	14	16	17
8	0	1	2	3	5	6	8	9	11	12	13	16	18	20	21
9	0	1	3	4	6	8	10	12	13	15	16	19	22	24	26
10	1	2	4	5	8	10	12	14	16	18	19	23	26	28	30
11	1	3	5	7	10	13	15	17	19	21	23	27	30	33	35
12	2	4	6	8	12	15	18	20	22	24	26	31	34	37	40
13	3	5	8	10	14	17	20	23	26	28	30	35	39	42	45
14	4	6	9	12	16	20	23	26	29	32	34	39	43	47	50
15	5	8	11	14	19	23	26	30	33	35	38	43	48	52	56
16	6	9	13	16	21	26	30	33	36	39	42	48	53	57	61
17	7	11	14	18	24	29	33	37	40	43	46	53	58	63	67
18	8	12	16	20	26	32	36	40	44	48	51	57	63	68	73
19	9	14	18	22	29	35	40	44	48	52	55	62	69	74	79
20	10	16	20	25	32	38	43	48	52	56	60	67	74	80	85
22	13	19	25	30	38	45	51	56	61	65	69	78	85	91	97
24	16	23	29	35	44	52	58	64	69	74	79	88	96	103	110
26	20	28	34	40	50	59	66	73	79	84	89	99	108	116	123
28	23	32	39	46	57	67	75	82	88	94	99	110	120	129	136
30	27	37	45	52	64	74	83	91	98	104	109	122	132	142	150
35	37	49	59	68	83	95	105	115	123	130	137	152	164	175	185
40	48	63	74	85	102	117	129	140	149	158	166	183	198	210	222
45	61	77	91	103	123	139	154	166	177	187	196	216	232	247	260
50	74	92	108	122	145	163	179	193	206	217	227	250	268	285	299

TABLE 1(m): Canal sediment transporting capacities, D_{35} = 0.4mm

TABLE OF CANAL SEDIMENT TRANSPORTING CAPACITIES (in ppm)

D35 sediment size = 0.40 mm

	Discharge per m width of canal (m2/s) :														
Canal Design Slope in cm per km	0.3	0.4	0.5	0.6	0.8	1.0	1.2	1.4	1.6	1.8	2.0	2.5	3.0	3.5	4.0
5	0	0	0	0	1	2	2	3	4	4	5	6	7	8	9
6	0	0	0	1	2	3	4	5	5	6	7	8	10	11	12
7	0	0	1	2	3	4	5	7	7	8	9	11	13	14	15
8	0	1	2	2	4	6	7	9	10	11	12	14	16	17	19
9	0	1	2	4	6	8	9	11	12	13	14	17	19	21	22
10	1	2	3	5	7	9	11	13	15	16	17	20	22	24	26
11	1	3	5	6	9	12	14	16	17	19	20	23	26	28	30
12	2	4	6	8	11	14	16	18	20	22	23	27	30	32	34
13	2	5	7	9	13	16	19	21	23	25	27	30	33	36	39
14	3	6	9	11	15	18	21	24	26	28	30	34	37	40	43
15	4	7	10	13	17	21	24	27	29	31	33	38	41	45	47
16	5	9	12	14	19	23	27	30	32	35	37	42	45	49	52
17	6	10	13	16	22	26	29	33	36	38	40	45	50	53	56
18	7	11	15	18	24	28	32	36	39	42	44	49	54	58	61
19	8	13	17	20	26	31	35	39	42	45	48	53	58	62	66
20	10	15	19	23	29	34	38	42	46	49	52	58	63	67	71
22	12	18	23	27	34	40	45	49	53	56	59	66	72	76	80
24	15	22	27	32	40	46	51	56	60	64	67	75	81	86	91
26	18	25	31	37	45	52	58	63	68	72	76	84	90	96	101
28	22	29	36	42	51	59	65	71	76	80	84	93	100	106	111
30	25	34	41	47	57	65	72	78	84	88	93	102	110	116	122
35	34	45	53	61	73	83	91	98	104	110	115	126	135	143	150
40	45	57	67	75	89	101	110	119	126	132	138	151	161	170	178
45	55	69	81	91	107	120	131	140	148	156	162	176	188	198	207
50	67	83	96	107	125	139	152	162	171	180	187	203	216	227	237

TABLE 1(n): Canal sediment transporting capacities, D_{35} = 0.45mm

TABLE OF CANAL SEDIMENT TRANSPORTING CAPACITIES (in ppm)

D35 sediment size = 0.45 mm

Discharge per m width of canal (m2/s) :

Canal Design Slope in cm per km	0.3	0.4	0.5	0.6	0.8	1.0	1.2	1.4	1.6	1.8	2.0	2.5	3.0	3.5	4.0
5	0	0	0	0	1	1	2	3	3	4	4	6	6	7	8
6	0	0	0	1	2	3	3	4	5	6	6	8	9	10	11
7	0	0	1	1	3	4	5	6	7	8	9	10	12	13	14
8	0	1	1	2	4	5	7	8	9	10	11	13	14	16	17
9	0	1	2	3	5	7	9	10	11	12	13	15	17	19	20
10	0	2	3	4	7	9	11	12	13	15	16	18	20	22	23
11	1	3	4	6	8	11	13	14	16	17	19	21	23	25	27
12	1	3	5	7	10	13	15	17	18	20	21	24	27	29	30
13	2	4	7	9	12	15	17	19	21	23	24	27	30	32	34
14	3	6	8	10	14	17	19	22	24	25	27	30	33	36	38
15	4	7	9	12	16	19	22	24	26	28	30	34	37	39	42
16	5	8	11	13	18	21	24	27	29	31	33	37	40	43	45
17	6	9	12	15	20	24	27	30	32	34	36	40	44	47	49
18	7	11	14	17	22	26	30	32	35	37	39	44	47	51	53
19	8	12	16	19	24	29	32	35	38	40	43	47	51	54	57
20	9	14	18	21	27	31	35	38	41	44	46	51	55	58	61
22	11	17	21	25	31	36	41	44	47	50	53	58	62	66	69
24	14	20	25	29	36	42	46	50	54	57	60	65	70	74	78
26	17	24	29	34	41	47	52	57	60	64	67	73	78	83	86
28	20	27	33	38	46	53	58	63	67	71	74	81	86	91	95
30	23	31	38	43	52	59	65	70	74	78	81	89	95	100	104
35	32	41	49	55	66	74	81	87	92	96	100	109	116	122	127
40	41	52	61	68	80	90	98	104	110	115	120	129	137	144	150
45	51	64	74	82	96	106	115	122	129	135	140	151	160	167	174
50	62	76	87	96	111	123	133	141	148	155	160	173	183	191	198

TABLE 1(o): Canal sediment transporting capacities, D_{35} = 0.5mm

TABLE OF CANAL SEDIMENT TRANSPORTING CAPACITIES (in ppm)

D35 sediment size = 0.50 mm

	Discharge per m width of canal (m2/s) :														
Canal Design Slope in cm per km	0.3	0.4	0.5	0.6	0.8	1.0	1.2	1.4	1.6	1.8	2.0	2.5	3.0	3.5	4.0
5	0	0	0	0	1	1	2	3	3	4	4	5	6	7	7
6	0	0	0	1	1	2	3	4	5	5	6	7	8	9	10
7	0	0	1	1	2	4	5	6	6	7	8	9	11	12	13
8	0	0	1	2	4	5	6	7	8	9	10	12	13	14	15
9	0	1	2	3	5	7	8	9	10	11	12	14	16	17	18
10	0	1	3	4	6	8	10	11	13	14	15	17	19	20	21
11	1	2	4	5	8	10	12	13	15	16	17	19	21	23	24
12	1	3	5	7	9	12	14	16	17	18	20	22	24	26	28
13	2	4	6	8	11	14	16	18	19	21	22	25	27	29	31
14	2	5	7	9	13	16	18	20	22	23	25	28	30	32	34
15	3	6	9	11	15	18	20	22	24	26	28	31	33	35	37
16	4	7	10	13	17	20	23	25	27	29	30	34	36	39	41
17	5	9	12	14	19	22	25	27	30	31	33	37	40	42	44
18	6	10	13	16	21	24	27	30	32	34	36	40	43	45	47
19	7	11	15	18	23	27	30	32	35	37	39	43	46	49	51
20	8	13	16	20	25	29	32	35	38	40	42	46	49	52	55
22	11	16	20	23	29	34	37	40	43	46	48	52	56	59	62
24	13	19	23	27	34	38	43	46	49	52	54	59	63	66	69
26	16	22	27	31	38	44	48	52	55	58	60	65	70	73	76
28	19	26	31	36	43	49	53	57	61	64	66	72	77	81	84
30	22	29	35	40	48	54	59	63	67	70	73	79	84	88	91
35	30	39	46	51	60	68	73	78	82	86	89	96	102	107	111
40	39	49	57	63	74	82	88	94	99	103	106	114	121	126	131
45	48	59	68	76	87	96	104	110	115	120	124	133	140	146	151
50	58	70	80	88	101	111	119	126	132	137	142	151	159	166	171

TABLE 1(p): Canal sediment transporting capacities, D_{35} = 0.6mm

TABLE OF CANAL SEDIMENT TRANSPORTING CAPACITIES (in ppm)

D35 sediment size = 0.60 mm

Canal Design Slope in cm per km	Discharge per m width of canal (m2/s) : 0.3	0.4	0.5	0.6	0.8	1.0	1.2	1.4	1.6	1.8	2.0	2.5	3.0	3.5	4.0
5	0	0	0	0	0	1	2	2	3	3	4	4	5	6	6
6	0	0	0	0	1	2	3	3	4	5	5	6	7	8	9
7	0	0	0	1	2	3	4	5	6	6	7	8	9	10	11
8	0	0	1	1	3	4	5	6	7	8	9	10	11	12	13
9	0	0	1	2	4	6	7	8	9	10	11	12	14	15	16
10	0	1	2	3	5	7	9	10	11	12	13	15	16	17	18
11	0	2	3	4	7	9	10	12	13	14	15	17	18	20	21
12	1	2	4	6	8	10	12	14	15	16	17	19	21	22	23
13	1	3	5	7	10	12	14	16	17	18	19	22	23	25	26
14	2	4	6	8	11	14	16	18	19	20	22	24	26	27	29
15	2	5	7	9	13	16	18	20	21	23	24	26	28	30	31
16	3	6	9	11	15	17	20	22	23	25	26	29	31	33	34
17	4	7	10	12	16	19	22	24	26	27	29	31	34	35	37
18	5	8	11	14	18	21	24	26	28	29	31	34	36	38	40
19	6	10	13	16	20	23	26	28	30	32	33	36	39	41	42
20	7	11	14	17	22	25	28	30	32	34	36	39	41	44	45
22	9	14	17	21	26	29	32	35	37	39	41	44	47	49	51
24	11	16	21	24	29	34	37	40	42	44	46	50	52	55	57
26	14	19	24	28	33	38	41	44	47	49	51	55	58	61	63
28	16	22	27	31	38	42	46	49	52	54	56	60	64	66	69
30	19	26	31	35	42	47	51	54	57	59	61	66	69	72	75
35	26	34	40	45	52	58	63	66	70	72	75	80	84	87	90
40	34	43	50	55	64	70	75	79	83	86	89	94	99	102	105
45	42	52	60	66	75	82	88	92	96	100	103	109	113	117	121
50	51	62	70	77	87	94	101	106	110	114	117	123	129	133	137

TABLE 1(q): Canal sediment transporting capacities, D_{35} = 0.7mm

TABLE OF CANAL SEDIMENT TRANSPORTING CAPACITIES (in ppm)

D35 sediment size = 0.70 mm

	Discharge per m width of canal (m2/s) :														
Canal Design Slope in cm per km	0.3	0.4	0.5	0.6	0.8	1.0	1.2	1.4	1.6	1.8	2.0	2.5	3.0	3.5	4.0
5	0	0	0	0	0	1	1	2	2	3	3	4	5	5	6
6	0	0	0	0	1	1	2	3	3	4	5	6	6	7	8
7	0	0	0	0	1	2	3	4	5	6	6	7	8	9	10
8	0	0	0	1	2	4	5	6	6	7	8	9	10	11	12
9	0	0	1	2	3	5	6	7	8	9	10	11	12	13	14
10	0	0	1	3	5	6	8	9	10	11	11	13	14	15	16
11	0	1	2	4	6	8	9	10	11	12	13	15	16	17	18
12	0	2	3	5	7	9	11	12	13	14	15	17	18	20	20
13	1	2	4	6	8	11	12	14	15	16	17	19	21	22	23
14	1	3	5	7	10	12	14	16	17	18	19	21	23	24	25
15	2	4	6	8	11	14	16	17	19	20	21	23	25	26	27
16	2	5	7	9	13	15	18	19	21	22	23	25	27	29	30
17	3	6	9	11	14	17	19	21	23	24	25	28	29	31	32
18	4	7	10	12	16	19	21	23	25	26	27	30	32	33	34
19	5	8	11	14	18	21	23	25	27	28	29	32	34	35	37
20	5	9	12	15	19	22	25	27	29	30	31	34	36	38	39
22	7	12	15	18	23	26	29	31	33	34	36	39	41	43	44
24	9	14	18	21	26	30	33	35	37	39	40	43	45	47	49
26	12	17	21	25	30	34	37	39	41	43	45	48	50	52	54
28	14	20	24	28	33	37	41	43	46	47	49	52	55	57	59
30	17	23	27	31	37	41	45	48	50	52	54	57	60	62	64
35	23	30	36	40	47	51	55	58	61	63	65	69	72	74	76
40	30	38	44	49	56	62	66	69	72	75	77	81	84	87	89
45	38	46	53	58	66	72	77	80	84	86	88	93	97	100	102
50	45	55	62	68	77	83	88	92	95	98	100	105	109	112	115

TABLE 1(r): Canal sediment transporting capacities, D_{35} = 0.8mm

TABLE OF CANAL SEDIMENT TRANSPORTING CAPACITIES (in ppm)

D35 sediment size = 0.80 mm

	Discharge per m width of canal (m2/s) :														
Canal Design Slope in cm per km	0.3	0.4	0.5	0.6	0.8	1.0	1.2	1.4	1.6	1.8	2.0	2.5	3.0	3.5	4.0
5	0	0	0	0	0	0	1	1	2	2	3	3	4	5	5
6	0	0	0	0	0	1	2	2	3	3	4	5	6	6	7
7	0	0	0	0	1	2	3	4	4	5	5	6	7	8	9
8	0	0	0	1	2	3	4	5	6	6	7	8	9	10	10
9	0	0	0	1	3	4	5	6	7	8	8	10	11	12	12
10	0	0	1	2	4	5	7	8	9	9	10	12	13	14	14
11	0	0	2	3	5	7	8	9	10	11	12	13	15	15	16
12	0	1	2	4	6	8	9	11	12	13	14	15	16	17	18
13	0	2	3	5	7	9	11	12	13	14	15	17	18	19	20
14	0	2	4	6	9	11	13	14	15	16	17	19	20	21	22
15	1	3	5	7	10	12	14	16	17	18	19	21	22	23	24
16	1	4	6	8	11	14	16	17	19	20	21	23	24	25	26
17	2	5	7	9	13	15	17	19	20	21	23	25	26	27	28
18	3	6	8	11	14	17	19	21	22	23	24	27	28	29	31
19	3	7	10	12	16	18	21	22	24	25	26	28	30	31	33
20	4	8	11	13	17	20	22	24	26	27	28	30	32	34	35
22	6	10	13	16	20	23	26	28	29	31	32	34	36	38	39
24	8	12	16	19	23	27	29	31	33	35	36	38	40	42	43
26	10	15	19	22	27	30	33	35	37	38	40	42	44	46	47
28	12	17	22	25	30	34	36	39	41	42	44	46	49	50	52
30	14	20	24	28	33	37	40	43	45	46	48	51	53	55	56
35	20	27	32	36	42	46	49	52	54	56	58	61	63	65	67
40	27	34	40	44	51	55	59	62	64	66	68	71	74	76	78
45	33	42	48	52	59	65	68	72	74	76	78	82	85	87	89
50	40	49	56	61	69	74	78	81	84	87	89	93	96	98	100

TABLE 1(s): Canal sediment transporting capacities, D_{35} = 0.9mm

TABLE OF CANAL SEDIMENT TRANSPORTING CAPACITIES (in ppm)

D35 sediment size = 0.90 mm

Canal Design Slope in cm per km	Discharge per m width of canal (m2/s) : 0.3	0.4	0.5	0.6	0.8	1.0	1.2	1.4	1.6	1.8	2.0	2.5	3.0	3.5	4.0
5	0	0	0	0	0	0	1	1	1	2	2	3	4	4	5
6	0	0	0	0	0	1	1	2	2	3	3	4	5	6	6
7	0	0	0	0	1	1	2	3	4	4	5	6	7	7	8
8	0	0	0	0	1	2	3	4	5	6	6	7	8	9	9
9	0	0	0	1	2	3	5	5	6	7	8	9	10	11	11
10	0	0	0	1	3	5	6	7	8	8	9	10	11	12	13
11	0	0	1	2	4	6	7	8	9	10	11	12	13	14	15
12	0	0	2	3	5	7	8	10	11	11	12	14	15	16	16
13	0	1	2	4	6	8	10	11	12	13	14	15	16	17	18
14	0	2	3	5	7	9	11	12	14	15	15	17	18	19	20
15	0	2	4	6	9	11	13	14	15	16	17	19	20	21	22
16	1	3	5	7	10	12	14	15	17	18	19	20	22	23	24
17	1	4	6	8	11	14	16	17	18	19	20	22	24	25	26
18	2	5	7	9	13	15	17	19	20	21	22	24	25	26	27
19	2	5	8	10	14	17	19	20	22	23	24	26	27	28	29
20	3	6	9	12	15	18	20	22	23	24	25	27	29	30	31
22	5	8	12	14	18	21	23	25	27	28	29	31	33	34	35
24	6	11	14	17	21	24	26	28	30	31	32	35	36	38	39
26	8	13	17	19	24	27	30	32	33	35	36	38	40	41	42
28	10	15	19	22	27	30	33	35	37	38	39	42	44	45	46
30	12	18	22	25	30	33	36	38	40	42	43	45	47	49	50
35	18	24	29	32	38	42	45	47	49	51	52	55	57	58	60
40	24	31	36	40	46	50	53	56	58	60	61	64	66	68	69
45	30	37	43	47	54	58	62	64	67	69	70	73	76	77	79
50	36	44	50	55	62	67	70	73	76	78	79	83	85	87	89

TABLE 1(t): Canal sediment transporting capacities, D_{35} = 1.0mm

TABLE OF CANAL SEDIMENT TRANSPORTING CAPACITIES (in ppm)

D35 sediment size = 1.00 mm

	Discharge per m width of canal (m2/s) :														
Canal Design Slope in cm per km	0.3	0.4	0.5	0.6	0.8	1.0	1.2	1.4	1.6	1.8	2.0	2.5	3.0	3.5	4.0
5	0	0	0	0	0	0	0	1	1	1	2	3	3	4	4
6	0	0	0	0	0	0	1	2	2	2	3	4	4	5	5
7	0	0	0	0	0	1	2	2	3	4	4	5	6	6	7
8	0	0	0	0	1	2	3	4	4	5	5	6	7	8	9
9	0	0	0	0	2	3	4	5	5	6	7	8	9	9	10
10	0	0	0	1	2	4	5	6	7	7	8	9	10	11	12
11	0	0	1	1	3	5	6	7	8	9	9	11	12	13	13
12	0	0	1	2	4	6	7	8	9	10	11	12	13	14	15
13	0	0	2	3	5	7	9	10	11	12	12	14	15	16	17
14	0	1	2	4	6	8	10	11	12	13	14	15	17	17	18
15	0	1	3	5	8	10	11	13	14	15	15	17	18	19	20
16	0	2	4	6	9	11	13	14	15	16	17	19	20	21	21
17	1	3	5	7	10	12	14	15	17	18	18	20	21	22	23
18	1	4	6	8	11	13	15	17	18	19	20	22	23	24	25
19	2	4	7	9	12	15	17	18	19	21	21	23	25	26	27
20	2	5	8	10	14	16	18	20	21	22	23	25	26	27	28
22	3	7	10	12	16	19	21	23	24	25	26	28	30	31	32
24	5	9	12	15	19	22	24	26	27	28	29	31	33	34	35
26	7	11	15	17	22	25	27	29	30	31	33	35	36	37	38
28	8	13	17	20	24	27	30	32	33	35	36	38	40	41	42
30	10	15	19	22	27	30	33	35	36	38	39	41	43	44	45
35	15	21	26	29	34	38	41	43	44	46	47	50	51	53	54
40	21	27	32	36	41	45	48	51	52	54	55	58	60	61	62
45	26	34	39	43	49	53	56	59	61	62	64	66	68	70	71
50	32	40	46	50	56	61	64	67	69	70	72	75	77	78	80

TABLE 1(u): Canal sediment transporting capacities, D_{35} = 1.5mm

TABLE OF CANAL SEDIMENT TRANSPORTING CAPACITIES (in ppm)

D35 sediment size = 1.50 mm

Canal Design Slope in cm per km	Discharge per m width of canal (m2/s) : 0.3	0.4	0.5	0.6	0.8	1.0	1.2	1.4	1.6	1.8	2.0	2.5	3.0	3.5	4.0
5	0	0	0	0	0	0	0	0	0	0	1	1	2	2	2
6	0	0	0	0	0	0	0	0	1	1	1	2	2	3	3
7	0	0	0	0	0	0	0	1	1	2	2	3	3	4	4
8	0	0	0	0	0	0	1	1	2	2	3	4	4	5	5
9	0	0	0	0	0	1	1	2	3	3	4	5	5	6	6
10	0	0	0	0	0	1	2	3	4	4	5	6	6	7	7
11	0	0	0	0	1	2	3	4	4	5	6	7	7	8	8
12	0	0	0	0	1	3	4	5	5	6	6	8	8	9	10
13	0	0	0	0	2	3	4	5	6	7	7	9	9	10	11
14	0	0	0	1	3	4	5	6	7	8	8	10	11	11	12
15	0	0	0	1	3	5	6	7	8	9	10	11	12	12	13
16	0	0	1	2	4	6	7	8	9	10	11	12	13	13	14
17	0	0	1	3	5	7	8	9	10	11	12	13	14	15	15
18	0	0	2	3	6	8	9	10	11	12	13	14	15	16	16
19	0	1	2	4	6	8	10	11	12	13	14	15	16	17	17
20	0	1	3	5	7	9	11	12	13	14	15	16	17	18	18
22	0	2	4	6	9	11	13	14	15	16	17	18	19	20	21
24	1	3	6	8	11	13	15	16	17	18	19	20	22	22	23
26	1	4	7	9	13	15	17	18	19	20	21	23	24	25	25
28	2	6	9	11	15	17	19	20	22	23	23	25	26	27	27
30	3	7	10	13	16	19	21	23	24	25	26	27	28	29	30
35	6	11	15	17	21	24	26	28	29	30	31	33	34	35	35
40	10	15	19	22	26	29	32	33	35	36	37	38	39	40	41
45	14	19	24	27	31	35	37	39	40	41	42	44	45	46	47
50	18	24	28	32	37	40	42	44	45	47	48	49	51	51	52

TABLE 1(v): Canal sediment transporting capacities, D_{35} = 2.0mm

TABLE OF CANAL SEDIMENT TRANSPORTING CAPACITIES (in ppm)

D35 sediment size = 2.00 mm

Canal Design Slope in cm per km	Discharge per m width of canal (m2/s) : 0.3	0.4	0.5	0.6	0.8	1.0	1.2	1.4	1.6	1.8	2.0	2.5	3.0	3.5	4.0
5	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1
6	0	0	0	0	0	0	0	0	0	0	0	1	1	2	2
7	0	0	0	0	0	0	0	0	0	0	1	1	2	2	3
8	0	0	0	0	0	0	0	0	1	1	1	2	2	3	3
9	0	0	0	0	0	0	0	1	1	2	2	3	3	4	4
10	0	0	0	0	0	0	1	1	2	2	2	3	4	4	5
11	0	0	0	0	0	0	1	2	2	3	3	4	5	5	6
12	0	0	0	0	0	1	2	2	3	3	4	5	5	6	6
13	0	0	0	0	0	1	2	3	3	4	5	5	6	7	7
14	0	0	0	0	1	2	3	3	4	5	5	6	7	8	8
15	0	0	0	0	1	2	3	4	5	5	6	7	8	8	9
16	0	0	0	0	2	3	4	5	6	6	7	8	9	9	10
17	0	0	0	0	2	3	5	5	6	7	7	9	9	10	10
18	0	0	0	1	3	4	5	6	7	8	8	9	10	11	11
19	0	0	0	1	3	5	6	7	8	8	9	10	11	12	12
20	0	0	1	2	4	5	7	8	8	9	10	11	12	12	13
22	0	0	1	3	5	7	8	9	10	11	11	12	13	14	14
24	0	0	2	4	6	8	9	10	11	12	13	14	15	16	16
26	0	1	3	5	7	9	11	12	13	14	14	16	17	17	18
28	0	2	4	6	9	11	12	14	14	15	16	17	18	19	19
30	0	3	5	7	10	12	14	15	16	17	18	19	20	20	21
35	2	5	8	10	14	16	18	19	20	21	22	23	24	24	25
40	4	8	11	14	17	20	21	23	24	25	26	27	28	29	29
45	6	11	14	17	21	23	25	27	28	29	30	31	32	33	33
50	9	14	18	21	25	27	29	31	32	33	34	35	36	37	37

TABLE 2(a): Sluice channel threshold depths (in m), D_{35} = 0.1mm

TABLE OF SLUICE CHANNEL THRESHOLD DEPTHS

D35 sediment size = 0.10 mm

Discharge per m width in sluice channel m2/s	Sediment transporting capacity of canal (ppm) : 10	15	20	30	40	60	80	100	150	200	300	400	600	800	1000
0.20	0.93	0.92	0.91	0.90	0.89	0.88	0.87	0.87	0.85	0.85	0.83	0.83	0.81	0.80	0.80
0.25	1.02	1.01	1.00	0.99	0.98	0.96	0.95	0.94	0.93	0.92	0.90	0.89	0.88	0.87	0.86
0.30	1.11	1.10	1.09	1.07	1.06	1.04	1.03	1.02	1.00	0.99	0.97	0.96	0.94	0.93	0.92
0.35	1.20	1.18	1.17	1.15	1.13	1.11	1.10	1.09	1.07	1.05	1.03	1.02	1.00	0.99	0.97
0.40	1.29	1.26	1.25	1.23	1.21	1.19	1.17	1.16	1.14	1.12	1.10	1.08	1.06	1.04	1.03
0.45	1.37	1.35	1.33	1.30	1.28	1.26	1.24	1.23	1.20	1.18	1.16	1.14	1.12	1.10	1.08
0.50	1.45	1.43	1.41	1.38	1.36	1.33	1.31	1.29	1.27	1.25	1.22	1.20	1.17	1.15	1.14
0.60	1.61	1.58	1.56	1.53	1.50	1.47	1.45	1.43	1.39	1.37	1.34	1.31	1.28	1.26	1.24
0.70	1.77	1.73	1.71	1.67	1.64	1.60	1.58	1.56	1.52	1.49	1.45	1.43	1.39	1.36	1.34
0.80	1.93	1.88	1.85	1.81	1.78	1.74	1.71	1.68	1.64	1.61	1.56	1.54	1.49	1.46	1.44
0.90	2.08	2.03	2.00	1.95	1.91	1.87	1.83	1.80	1.76	1.72	1.68	1.64	1.60	1.56	1.54
1.00	2.23	2.18	2.14	2.08	2.05	1.99	1.96	1.93	1.87	1.84	1.78	1.75	1.70	1.66	1.63
1.10	2.38	2.32	2.28	2.22	2.18	2.12	2.08	2.05	1.99	1.95	1.89	1.85	1.79	1.76	1.73
1.20	2.52	2.46	2.41	2.35	2.31	2.24	2.20	2.16	2.10	2.06	1.99	1.95	1.89	1.85	1.82
1.30	2.67	2.60	2.55	2.48	2.43	2.36	2.32	2.28	2.21	2.16	2.10	2.05	1.99	1.94	1.91
1.40	2.81	2.73	2.68	2.61	2.56	2.48	2.43	2.39	2.32	2.27	2.20	2.15	2.08	2.03	2.00
1.50	2.95	2.87	2.82	2.74	2.68	2.60	2.55	2.51	2.43	2.38	2.30	2.25	2.18	2.13	2.09
1.60	3.09	3.01	2.95	2.86	2.80	2.72	2.66	2.62	2.54	2.48	2.40	2.35	2.27	2.21	2.17
1.80	3.36	3.27	3.20	3.11	3.05	2.96	2.89	2.84	2.75	2.69	2.60	2.54	2.45	2.39	2.34
2.00	3.63	3.53	3.46	3.36	3.29	3.18	3.11	3.06	2.96	2.89	2.79	2.72	2.63	2.56	2.51
2.20	3.90	3.79	3.71	3.60	3.52	3.41	3.33	3.27	3.16	3.09	2.98	2.91	2.80	2.73	2.68
2.40	4.16	4.04	3.96	3.83	3.75	3.63	3.55	3.48	3.36	3.28	3.17	3.09	2.98	2.90	2.84
2.60	4.42	4.29	4.20	4.07	3.98	3.85	3.76	3.69	3.56	3.47	3.35	3.27	3.15	3.07	3.00
2.80	4.68	4.54	4.44	4.30	4.20	4.07	3.97	3.89	3.76	3.66	3.53	3.44	3.32	3.23	3.16
3.00	4.93	4.79	4.68	4.53	4.43	4.28	4.18	4.10	3.95	3.85	3.71	3.62	3.48	3.39	3.32
3.50	5.56	5.39	5.27	5.09	4.97	4.80	4.69	4.59	4.43	4.31	4.15	4.04	3.89	3.78	3.70
4.00	6.17	5.98	5.84	5.65	5.51	5.32	5.18	5.08	4.90	4.77	4.59	4.46	4.29	4.17	4.07

TABLE 2(b): Sluice channel threshold depths (in m), D_{35} = 0.12mm

TABLE OF SLUICE CHANNEL THRESHOLD DEPTHS

D35 sediment size = 0.12 mm

Discharge per m width in sluice channel m2/s	Sediment transporting capacity of canal (ppm) : 10	15	20	30	40	60	80	100	150	200	300	400	600	800	1000
0.20	0.94	0.93	0.92	0.91	0.90	0.88	0.87	0.87	0.85	0.84	0.83	0.82	0.81	0.80	0.79
0.25	1.03	1.02	1.01	0.99	0.98	0.96	0.95	0.94	0.93	0.91	0.90	0.89	0.87	0.86	0.85
0.30	1.12	1.11	1.09	1.07	1.06	1.04	1.03	1.02	1.00	0.98	0.96	0.95	0.93	0.92	0.91
0.35	1.21	1.19	1.17	1.15	1.14	1.11	1.10	1.09	1.06	1.05	1.03	1.01	0.99	0.97	0.96
0.40	1.30	1.27	1.26	1.23	1.21	1.19	1.17	1.16	1.13	1.11	1.09	1.07	1.04	1.03	1.01
0.45	1.38	1.35	1.33	1.31	1.29	1.26	1.24	1.22	1.19	1.17	1.15	1.13	1.10	1.08	1.06
0.50	1.46	1.43	1.41	1.38	1.36	1.33	1.31	1.29	1.26	1.24	1.20	1.18	1.15	1.13	1.12
0.60	1.63	1.59	1.57	1.53	1.50	1.47	1.44	1.42	1.38	1.36	1.32	1.29	1.26	1.23	1.21
0.70	1.79	1.74	1.71	1.67	1.64	1.60	1.57	1.54	1.50	1.47	1.43	1.40	1.36	1.33	1.31
0.80	1.94	1.89	1.86	1.81	1.78	1.73	1.69	1.67	1.62	1.59	1.54	1.50	1.46	1.43	1.40
0.90	2.09	2.04	2.00	1.95	1.91	1.86	1.82	1.79	1.73	1.70	1.64	1.61	1.56	1.52	1.49
1.00	2.24	2.18	2.14	2.08	2.04	1.98	1.94	1.91	1.85	1.81	1.75	1.71	1.65	1.61	1.58
1.10	2.39	2.32	2.28	2.21	2.17	2.10	2.06	2.02	1.96	1.91	1.85	1.81	1.74	1.70	1.67
1.20	2.53	2.46	2.42	2.34	2.29	2.22	2.17	2.13	2.07	2.02	1.95	1.90	1.84	1.79	1.76
1.30	2.68	2.60	2.55	2.47	2.42	2.34	2.29	2.25	2.17	2.12	2.05	2.00	1.93	1.88	1.84
1.40	2.82	2.74	2.68	2.60	2.54	2.46	2.40	2.36	2.28	2.22	2.15	2.09	2.02	1.96	1.92
1.50	2.96	2.87	2.81	2.73	2.66	2.58	2.52	2.47	2.38	2.32	2.24	2.18	2.10	2.05	2.01
1.60	3.10	3.01	2.94	2.85	2.78	2.69	2.63	2.58	2.49	2.42	2.34	2.27	2.19	2.13	2.09
1.80	3.37	3.27	3.20	3.09	3.02	2.92	2.85	2.79	2.69	2.62	2.52	2.45	2.36	2.30	2.25
2.00	3.64	3.53	3.45	3.33	3.25	3.14	3.06	3.00	2.89	2.81	2.71	2.63	2.53	2.46	2.40
2.20	3.90	3.78	3.69	3.57	3.48	3.36	3.27	3.20	3.09	3.00	2.88	2.80	2.69	2.61	2.56
2.40	4.16	4.03	3.94	3.80	3.71	3.57	3.48	3.41	3.28	3.19	3.06	2.97	2.85	2.77	2.71
2.60	4.42	4.28	4.18	4.03	3.93	3.78	3.68	3.61	3.47	3.37	3.23	3.14	3.01	2.92	2.85
2.80	4.68	4.52	4.41	4.26	4.15	3.99	3.89	3.80	3.65	3.55	3.41	3.31	3.17	3.07	3.00
3.00	4.93	4.76	4.65	4.48	4.36	4.20	4.09	4.00	3.84	3.73	3.58	3.47	3.32	3.22	3.14
3.50	5.55	5.36	5.22	5.03	4.89	4.71	4.58	4.47	4.29	4.16	3.99	3.87	3.70	3.59	3.50
4.00	6.15	5.93	5.78	5.56	5.41	5.20	5.05	4.94	4.73	4.59	4.39	4.26	4.07	3.94	3.84

TABLE 2(c): Sluice channel threshold depths (in m), D_{35} = 0.14mm

TABLE OF SLUICE CHANNEL THRESHOLD DEPTHS

D35 sediment size = 0.14 mm

Discharge per m width in sluice channel m2/s	Sediment transporting capacity of canal (ppm) : 10	15	20	30	40	60	80	100	150	200	300	400	600	800	1000
0.20	0.95	0.93	0.92	0.91	0.90	0.89	0.88	0.87	0.85	0.84	0.83	0.82	0.80	0.79	0.78
0.25	1.04	1.02	1.01	0.99	0.98	0.96	0.95	0.94	0.92	0.91	0.89	0.88	0.86	0.85	0.84
0.30	1.13	1.11	1.10	1.08	1.06	1.04	1.03	1.01	0.99	0.98	0.96	0.94	0.92	0.91	0.89
0.35	1.22	1.20	1.18	1.16	1.14	1.11	1.10	1.08	1.06	1.04	1.02	1.00	0.98	0.96	0.95
0.40	1.30	1.28	1.26	1.23	1.21	1.19	1.17	1.15	1.12	1.10	1.08	1.06	1.03	1.01	1.00
0.45	1.39	1.36	1.34	1.31	1.29	1.26	1.23	1.22	1.19	1.16	1.13	1.11	1.08	1.06	1.05
0.50	1.47	1.44	1.42	1.38	1.36	1.33	1.30	1.28	1.25	1.22	1.19	1.17	1.13	1.11	1.09
0.60	1.63	1.60	1.57	1.53	1.50	1.46	1.43	1.41	1.37	1.34	1.30	1.27	1.24	1.21	1.19
0.70	1.79	1.75	1.72	1.67	1.64	1.59	1.56	1.53	1.49	1.45	1.41	1.38	1.33	1.30	1.28
0.80	1.95	1.90	1.86	1.81	1.77	1.72	1.68	1.65	1.60	1.56	1.51	1.48	1.43	1.39	1.37
0.90	2.10	2.04	2.00	1.94	1.90	1.84	1.80	1.77	1.71	1.67	1.61	1.57	1.52	1.48	1.45
1.00	2.25	2.19	2.14	2.08	2.03	1.97	1.92	1.88	1.82	1.78	1.71	1.67	1.61	1.57	1.54
1.10	2.39	2.33	2.28	2.21	2.16	2.09	2.03	2.00	1.93	1.88	1.81	1.76	1.70	1.65	1.62
1.20	2.54	2.46	2.41	2.33	2.28	2.20	2.15	2.11	2.03	1.98	1.91	1.86	1.78	1.74	1.70
1.30	2.68	2.60	2.54	2.46	2.40	2.32	2.26	2.22	2.14	2.08	2.00	1.95	1.87	1.82	1.78
1.40	2.82	2.73	2.67	2.59	2.52	2.43	2.37	2.32	2.24	2.18	2.09	2.03	1.95	1.90	1.85
1.50	2.96	2.87	2.80	2.71	2.64	2.55	2.48	2.43	2.34	2.27	2.18	2.12	2.04	1.98	1.93
1.60	3.10	3.00	2.93	2.83	2.76	2.66	2.59	2.54	2.44	2.37	2.27	2.21	2.12	2.06	2.01
1.80	3.37	3.26	3.18	3.07	2.99	2.88	2.80	2.74	2.63	2.56	2.45	2.38	2.28	2.21	2.16
2.00	3.64	3.51	3.43	3.30	3.22	3.10	3.01	2.94	2.82	2.74	2.63	2.55	2.44	2.36	2.30
2.20	3.90	3.77	3.67	3.53	3.44	3.31	3.21	3.14	3.01	2.92	2.80	2.71	2.59	2.51	2.45
2.40	4.16	4.01	3.91	3.76	3.66	3.52	3.41	3.33	3.20	3.10	2.96	2.87	2.74	2.65	2.58
2.60	4.41	4.25	4.14	3.98	3.87	3.72	3.61	3.53	3.38	3.27	3.13	3.03	2.89	2.79	2.72
2.80	4.66	4.49	4.38	4.21	4.09	3.92	3.80	3.72	3.56	3.44	3.29	3.18	3.04	2.94	2.86
3.00	4.91	4.73	4.60	4.43	4.30	4.12	4.00	3.90	3.73	3.61	3.45	3.34	3.18	3.07	2.99
3.50	5.52	5.31	5.17	4.96	4.81	4.61	4.47	4.36	4.16	4.03	3.84	3.71	3.53	3.41	3.32
4.00	6.11	5.88	5.71	5.48	5.31	5.09	4.93	4.80	4.58	4.43	4.22	4.07	3.87	3.74	3.63

TABLE 2(d): Sluice channel threshold depths (in m), D_{35} = 0.16mm

TABLE OF SLUICE CHANNEL THRESHOLD DEPTHS

D35 sediment size = 0.16 mm

Discharge per m width in sluice channel m2/s	Sediment transporting capacity of canal (ppm) : 10	15	20	30	40	60	80	100	150	200	300	400	600	800	1000
0.20	0.95	0.94	0.93	0.91	0.90	0.89	0.87	0.87	0.85	0.84	0.82	0.81	0.80	0.79	0.78
0.25	1.04	1.03	1.01	1.00	0.98	0.96	0.95	0.94	0.92	0.91	0.89	0.87	0.86	0.84	0.83
0.30	1.13	1.11	1.10	1.08	1.06	1.04	1.02	1.01	0.99	0.97	0.95	0.93	0.91	0.90	0.88
0.35	1.22	1.20	1.18	1.16	1.14	1.11	1.09	1.08	1.05	1.03	1.01	0.99	0.97	0.95	0.93
0.40	1.31	1.28	1.26	1.23	1.21	1.18	1.16	1.15	1.12	1.10	1.07	1.05	1.02	1.00	0.98
0.45	1.39	1.36	1.34	1.31	1.29	1.25	1.23	1.21	1.18	1.16	1.12	1.10	1.07	1.05	1.03
0.50	1.48	1.44	1.42	1.38	1.36	1.32	1.30	1.28	1.24	1.21	1.18	1.15	1.12	1.09	1.07
0.60	1.64	1.60	1.57	1.53	1.50	1.45	1.42	1.40	1.36	1.33	1.28	1.25	1.21	1.19	1.16
0.70	1.80	1.75	1.72	1.67	1.63	1.58	1.55	1.52	1.47	1.44	1.39	1.35	1.31	1.27	1.25
0.80	1.95	1.90	1.86	1.80	1.76	1.71	1.67	1.64	1.58	1.54	1.49	1.45	1.40	1.36	1.33
0.90	2.10	2.04	2.00	1.94	1.89	1.83	1.79	1.75	1.69	1.65	1.59	1.54	1.49	1.45	1.41
1.00	2.25	2.18	2.14	2.07	2.02	1.95	1.90	1.86	1.79	1.75	1.68	1.63	1.57	1.53	1.49
1.10	2.40	2.32	2.27	2.20	2.14	2.07	2.01	1.97	1.90	1.85	1.77	1.72	1.66	1.61	1.57
1.20	2.54	2.46	2.40	2.32	2.26	2.18	2.12	2.08	2.00	1.94	1.87	1.81	1.74	1.69	1.65
1.30	2.68	2.60	2.53	2.45	2.38	2.30	2.23	2.19	2.10	2.04	1.96	1.90	1.82	1.76	1.72
1.40	2.82	2.73	2.66	2.57	2.50	2.41	2.34	2.29	2.20	2.13	2.05	1.98	1.90	1.84	1.80
1.50	2.96	2.86	2.79	2.69	2.62	2.52	2.45	2.39	2.30	2.23	2.13	2.07	1.98	1.91	1.87
1.60	3.10	2.99	2.92	2.81	2.73	2.63	2.55	2.49	2.39	2.32	2.22	2.15	2.05	1.99	1.94
1.80	3.37	3.25	3.16	3.05	2.96	2.84	2.76	2.69	2.58	2.50	2.39	2.31	2.21	2.13	2.08
2.00	3.63	3.50	3.41	3.28	3.18	3.05	2.96	2.89	2.76	2.68	2.55	2.47	2.35	2.28	2.22
2.20	3.89	3.75	3.64	3.50	3.40	3.26	3.16	3.08	2.94	2.85	2.72	2.62	2.50	2.41	2.35
2.40	4.14	3.99	3.88	3.72	3.61	3.46	3.35	3.27	3.12	3.02	2.88	2.78	2.64	2.55	2.48
2.60	4.39	4.23	4.11	3.94	3.82	3.66	3.54	3.45	3.29	3.18	3.03	2.93	2.78	2.68	2.61
2.80	4.64	4.46	4.34	4.16	4.03	3.85	3.73	3.64	3.47	3.35	3.19	3.07	2.92	2.81	2.74
3.00	4.89	4.70	4.56	4.37	4.23	4.05	3.92	3.81	3.63	3.51	3.34	3.22	3.06	2.94	2.86
3.50	5.49	5.27	5.11	4.89	4.74	4.52	4.37	4.25	4.05	3.90	3.71	3.57	3.39	3.26	3.16
4.00	6.07	5.82	5.65	5.40	5.22	4.98	4.81	4.68	4.45	4.29	4.06	3.91	3.71	3.56	3.46

TABLE 2(e): Sluice channel threshold depths (in m), D_{35} = 0.18mm

TABLE OF SLUICE CHANNEL THRESHOLD DEPTHS

D35 sediment size = 0.18 mm

Discharge per m width in sluice channel m2/s	Sediment transporting capacity of canal (ppm) : 10	15	20	30	40	60	80	100	150	200	300	400	600	800	1000
0.20	0.95	0.94	0.93	0.91	0.90	0.89	0.87	0.87	0.85	0.84	0.82	0.81	0.79	0.78	0.77
0.25	1.04	1.03	1.01	1.00	0.98	0.96	0.95	0.94	0.92	0.90	0.88	0.87	0.85	0.84	0.82
0.30	1.14	1.11	1.10	1.08	1.06	1.04	1.02	1.01	0.98	0.97	0.94	0.93	0.90	0.89	0.87
0.35	1.22	1.20	1.18	1.16	1.14	1.11	1.09	1.08	1.05	1.03	1.00	0.98	0.96	0.94	0.92
0.40	1.31	1.28	1.26	1.23	1.21	1.18	1.16	1.14	1.11	1.09	1.06	1.04	1.01	0.98	0.97
0.45	1.40	1.36	1.34	1.31	1.28	1.25	1.22	1.21	1.17	1.15	1.11	1.09	1.05	1.03	1.01
0.50	1.48	1.44	1.42	1.38	1.35	1.32	1.29	1.27	1.23	1.20	1.17	1.14	1.10	1.08	1.06
0.60	1.64	1.60	1.57	1.52	1.49	1.45	1.42	1.39	1.35	1.31	1.27	1.24	1.20	1.17	1.14
0.70	1.80	1.75	1.71	1.66	1.63	1.57	1.54	1.51	1.46	1.42	1.37	1.33	1.28	1.25	1.23
0.80	1.95	1.90	1.86	1.80	1.76	1.70	1.66	1.62	1.56	1.52	1.47	1.43	1.37	1.33	1.31
0.90	2.10	2.04	1.99	1.93	1.88	1.82	1.77	1.73	1.67	1.62	1.56	1.52	1.46	1.41	1.38
1.00	2.25	2.18	2.13	2.06	2.01	1.93	1.88	1.84	1.77	1.72	1.65	1.60	1.54	1.49	1.46
1.10	2.40	2.32	2.26	2.19	2.13	2.05	1.99	1.95	1.87	1.82	1.74	1.69	1.62	1.57	1.53
1.20	2.54	2.46	2.40	2.31	2.25	2.16	2.10	2.06	1.97	1.91	1.83	1.77	1.70	1.64	1.60
1.30	2.68	2.59	2.52	2.43	2.37	2.27	2.21	2.16	2.07	2.01	1.92	1.86	1.77	1.72	1.67
1.40	2.82	2.72	2.65	2.55	2.48	2.38	2.31	2.26	2.16	2.10	2.00	1.94	1.85	1.79	1.74
1.50	2.95	2.85	2.78	2.67	2.60	2.49	2.42	2.36	2.26	2.19	2.09	2.02	1.92	1.86	1.81
1.60	3.09	2.98	2.90	2.79	2.71	2.60	2.52	2.46	2.35	2.27	2.17	2.10	2.00	1.93	1.88
1.80	3.36	3.23	3.15	3.02	2.93	2.81	2.72	2.65	2.53	2.45	2.33	2.25	2.14	2.07	2.01
2.00	3.62	3.48	3.38	3.25	3.15	3.01	2.92	2.84	2.71	2.62	2.49	2.40	2.28	2.20	2.14
2.20	3.88	3.72	3.62	3.47	3.36	3.21	3.11	3.03	2.88	2.78	2.65	2.55	2.42	2.33	2.27
2.40	4.13	3.97	3.85	3.69	3.57	3.41	3.30	3.21	3.05	2.95	2.80	2.70	2.56	2.46	2.39
2.60	4.38	4.20	4.08	3.90	3.78	3.60	3.48	3.39	3.22	3.11	2.95	2.84	2.69	2.59	2.51
2.80	4.62	4.43	4.30	4.11	3.98	3.79	3.66	3.56	3.38	3.26	3.09	2.98	2.82	2.71	2.63
3.00	4.86	4.66	4.52	4.32	4.18	3.98	3.84	3.74	3.54	3.42	3.24	3.11	2.95	2.83	2.74
3.50	5.45	5.22	5.06	4.83	4.67	4.44	4.28	4.16	3.94	3.79	3.59	3.45	3.26	3.13	3.03
4.00	6.03	5.77	5.58	5.32	5.14	4.88	4.70	4.57	4.33	4.16	3.93	3.77	3.56	3.41	3.30

TABLE 2(f): Sluice channel threshold depths (in m), D_{35} = 0.2mm

TABLE OF SLUICE CHANNEL THRESHOLD DEPTHS

D35 sediment size = 0.20 mm

Discharge per m width in sluice channel m2/s	Sediment transporting capacity of canal (ppm) :														
	10	15	20	30	40	60	80	100	150	200	300	400	600	800	1000
0.20	0.95	0.94	0.93	0.91	0.90	0.89	0.87	0.86	0.85	0.83	0.82	0.81	0.79	0.78	0.77
0.25	1.05	1.03	1.02	1.00	0.98	0.96	0.95	0.94	0.92	0.90	0.88	0.86	0.84	0.83	0.82
0.30	1.14	1.12	1.10	1.08	1.06	1.04	1.02	1.01	0.98	0.96	0.94	0.92	0.90	0.88	0.87
0.35	1.23	1.20	1.18	1.16	1.14	1.11	1.09	1.07	1.04	1.02	0.99	0.97	0.95	0.93	0.91
0.40	1.31	1.28	1.26	1.23	1.21	1.18	1.15	1.14	1.10	1.08	1.05	1.03	1.00	0.97	0.96
0.45	1.40	1.36	1.34	1.31	1.28	1.25	1.22	1.20	1.16	1.14	1.10	1.08	1.04	1.02	1.00
0.50	1.48	1.44	1.42	1.38	1.35	1.31	1.28	1.26	1.22	1.19	1.15	1.13	1.09	1.06	1.04
0.60	1.64	1.60	1.57	1.52	1.49	1.44	1.41	1.38	1.33	1.30	1.26	1.22	1.18	1.15	1.13
0.70	1.80	1.75	1.71	1.66	1.62	1.57	1.53	1.50	1.44	1.41	1.35	1.32	1.27	1.23	1.20
0.80	1.95	1.89	1.85	1.79	1.75	1.69	1.64	1.61	1.55	1.51	1.45	1.41	1.35	1.31	1.28
0.90	2.10	2.04	1.99	1.92	1.87	1.81	1.76	1.72	1.65	1.60	1.54	1.49	1.43	1.39	1.35
1.00	2.25	2.18	2.12	2.05	2.00	1.92	1.87	1.83	1.75	1.70	1.63	1.58	1.51	1.46	1.43
1.10	2.39	2.31	2.26	2.18	2.12	2.03	1.98	1.93	1.85	1.79	1.71	1.66	1.59	1.53	1.50
1.20	2.53	2.45	2.39	2.30	2.23	2.15	2.08	2.03	1.95	1.88	1.80	1.74	1.66	1.61	1.56
1.30	2.67	2.58	2.51	2.42	2.35	2.25	2.19	2.13	2.04	1.97	1.88	1.82	1.74	1.68	1.63
1.40	2.81	2.71	2.64	2.54	2.46	2.36	2.29	2.23	2.13	2.06	1.97	1.90	1.81	1.74	1.70
1.50	2.95	2.84	2.76	2.65	2.58	2.47	2.39	2.33	2.22	2.15	2.05	1.98	1.88	1.81	1.76
1.60	3.08	2.97	2.89	2.77	2.69	2.57	2.49	2.43	2.31	2.23	2.13	2.05	1.95	1.88	1.83
1.80	3.35	3.22	3.13	3.00	2.91	2.78	2.68	2.61	2.49	2.40	2.28	2.20	2.09	2.01	1.95
2.00	3.60	3.47	3.36	3.22	3.12	2.98	2.87	2.80	2.66	2.56	2.43	2.34	2.22	2.14	2.07
2.20	3.86	3.71	3.59	3.44	3.33	3.17	3.06	2.98	2.83	2.73	2.58	2.48	2.35	2.26	2.19
2.40	4.11	3.94	3.82	3.65	3.53	3.36	3.24	3.15	2.99	2.88	2.73	2.62	2.48	2.38	2.31
2.60	4.36	4.17	4.04	3.86	3.73	3.55	3.42	3.33	3.15	3.03	2.87	2.76	2.61	2.50	2.42
2.80	4.60	4.40	4.26	4.07	3.93	3.74	3.60	3.50	3.31	3.19	3.01	2.89	2.73	2.62	2.54
3.00	4.84	4.63	4.48	4.27	4.12	3.92	3.77	3.66	3.47	3.33	3.15	3.02	2.85	2.73	2.65
3.50	5.42	5.18	5.01	4.77	4.60	4.36	4.20	4.07	3.85	3.69	3.48	3.34	3.15	3.01	2.91
4.00	5.99	5.72	5.52	5.25	5.06	4.79	4.61	4.47	4.21	4.05	3.81	3.65	3.43	3.28	3.17

TABLE 2(g): Sluice channel threshold depths (in m), D_{35} = 0.22mm

TABLE OF SLUICE CHANNEL THRESHOLD DEPTHS

D35 sediment size = 0.22 mm

Discharge per m width in sluice channel m2/s	Sediment transporting capacity of canal (ppm) : 10	15	20	30	40	60	80	100	150	200	300	400	600	800	1000
0.20	0.95	0.94	0.93	0.91	0.90	0.88	0.87	0.86	0.85	0.83	0.81	0.80	0.78	0.77	0.76
0.25	1.05	1.03	1.02	1.00	0.98	0.96	0.95	0.93	0.91	0.90	0.87	0.86	0.84	0.82	0.81
0.30	1.14	1.12	1.10	1.08	1.06	1.03	1.02	1.00	0.98	0.96	0.93	0.91	0.89	0.87	0.86
0.35	1.23	1.20	1.18	1.15	1.13	1.11	1.08	1.07	1.04	1.02	0.99	0.97	0.94	0.92	0.90
0.40	1.31	1.28	1.26	1.23	1.21	1.17	1.15	1.13	1.10	1.07	1.04	1.02	0.99	0.96	0.95
0.45	1.40	1.36	1.34	1.30	1.28	1.24	1.22	1.19	1.16	1.13	1.09	1.07	1.03	1.01	0.99
0.50	1.48	1.44	1.42	1.38	1.35	1.31	1.28	1.26	1.21	1.18	1.14	1.12	1.08	1.05	1.03
0.60	1.64	1.60	1.56	1.52	1.48	1.44	1.40	1.37	1.32	1.29	1.24	1.21	1.16	1.13	1.11
0.70	1.80	1.75	1.71	1.65	1.61	1.56	1.52	1.49	1.43	1.39	1.34	1.30	1.25	1.21	1.18
0.80	1.95	1.89	1.85	1.79	1.74	1.68	1.63	1.60	1.53	1.49	1.43	1.39	1.33	1.29	1.26
0.90	2.10	2.03	1.98	1.92	1.86	1.79	1.74	1.70	1.63	1.59	1.52	1.47	1.41	1.36	1.33
1.00	2.24	2.17	2.12	2.04	1.99	1.91	1.85	1.81	1.73	1.68	1.60	1.55	1.48	1.43	1.40
1.10	2.39	2.31	2.25	2.16	2.10	2.02	1.96	1.91	1.83	1.77	1.69	1.63	1.56	1.50	1.46
1.20	2.53	2.44	2.38	2.29	2.22	2.13	2.06	2.01	1.92	1.86	1.77	1.71	1.63	1.57	1.53
1.30	2.67	2.57	2.50	2.40	2.33	2.24	2.16	2.11	2.01	1.95	1.85	1.79	1.70	1.64	1.59
1.40	2.80	2.70	2.63	2.52	2.45	2.34	2.26	2.21	2.10	2.03	1.93	1.86	1.77	1.71	1.66
1.50	2.94	2.83	2.75	2.64	2.56	2.44	2.36	2.30	2.19	2.12	2.01	1.94	1.84	1.77	1.72
1.60	3.07	2.96	2.87	2.75	2.67	2.55	2.46	2.40	2.28	2.20	2.09	2.01	1.91	1.84	1.78
1.80	3.34	3.21	3.11	2.98	2.88	2.75	2.65	2.58	2.45	2.36	2.24	2.15	2.04	1.96	1.90
2.00	3.59	3.45	3.34	3.20	3.09	2.94	2.84	2.76	2.62	2.52	2.38	2.29	2.17	2.08	2.02
2.20	3.84	3.68	3.57	3.41	3.29	3.13	3.02	2.93	2.78	2.67	2.53	2.43	2.29	2.20	2.13
2.40	4.09	3.92	3.79	3.63	3.49	3.32	3.20	3.10	2.94	2.82	2.67	2.56	2.41	2.31	2.24
2.60	4.34	4.15	4.01	3.83	3.69	3.50	3.37	3.27	3.10	2.97	2.80	2.69	2.53	2.43	2.35
2.80	4.57	4.37	4.23	4.03	3.88	3.68	3.54	3.44	3.25	3.12	2.94	2.82	2.65	2.54	2.45
3.00	4.81	4.60	4.44	4.23	4.07	3.86	3.71	3.60	3.40	3.26	3.07	2.94	2.77	2.65	2.56
3.50	5.39	5.14	4.96	4.72	4.54	4.30	4.12	4.00	3.77	3.61	3.39	3.24	3.05	2.91	2.81
4.00	5.95	5.67	5.47	5.19	4.99	4.72	4.52	4.38	4.12	3.94	3.70	3.54	3.32	3.17	3.06

TABLE 2(h): Sluice channel threshold depths (in m), D_{35} = 0.24mm

TABLE OF SLUICE CHANNEL THRESHOLD DEPTHS

D35 sediment size = 0.24 mm

Discharge per m width in sluice channel m2/s	Sediment transporting capacity of canal (ppm) : 10	15	20	30	40	60	80	100	150	200	300	400	600	800	1000
0.20	0.95	0.94	0.93	0.91	0.90	0.88	0.87	0.86	0.84	0.83	0.81	0.80	0.78	0.77	0.76
0.25	1.05	1.03	1.02	1.00	0.98	0.96	0.94	0.93	0.91	0.89	0.87	0.86	0.83	0.82	0.81
0.30	1.14	1.12	1.10	1.08	1.06	1.03	1.01	1.00	0.97	0.95	0.93	0.91	0.88	0.87	0.85
0.35	1.23	1.20	1.18	1.15	1.13	1.10	1.08	1.07	1.03	1.01	0.98	0.96	0.93	0.91	0.90
0.40	1.31	1.28	1.26	1.23	1.20	1.17	1.15	1.13	1.09	1.07	1.03	1.01	0.98	0.95	0.94
0.45	1.39	1.36	1.34	1.30	1.28	1.24	1.21	1.19	1.15	1.12	1.09	1.06	1.02	1.00	0.98
0.50	1.48	1.44	1.41	1.37	1.34	1.30	1.27	1.25	1.21	1.18	1.14	1.11	1.07	1.04	1.02
0.60	1.64	1.59	1.56	1.51	1.48	1.43	1.39	1.37	1.32	1.28	1.23	1.20	1.15	1.12	1.09
0.70	1.79	1.74	1.70	1.65	1.61	1.55	1.51	1.48	1.42	1.38	1.32	1.28	1.23	1.20	1.17
0.80	1.95	1.89	1.84	1.78	1.73	1.67	1.62	1.59	1.52	1.48	1.41	1.37	1.31	1.27	1.24
0.90	2.09	2.03	1.98	1.91	1.86	1.78	1.73	1.69	1.62	1.57	1.50	1.45	1.39	1.34	1.31
1.00	2.24	2.17	2.11	2.03	1.98	1.90	1.84	1.79	1.72	1.66	1.58	1.53	1.46	1.41	1.37
1.10	2.38	2.30	2.24	2.15	2.09	2.00	1.94	1.89	1.81	1.75	1.66	1.61	1.53	1.48	1.44
1.20	2.52	2.43	2.37	2.27	2.21	2.11	2.04	1.99	1.90	1.83	1.75	1.68	1.60	1.54	1.50
1.30	2.66	2.56	2.49	2.39	2.32	2.22	2.14	2.09	1.99	1.92	1.82	1.76	1.67	1.61	1.56
1.40	2.80	2.69	2.62	2.51	2.43	2.32	2.24	2.18	2.08	2.00	1.90	1.83	1.74	1.67	1.62
1.50	2.93	2.82	2.74	2.62	2.54	2.42	2.34	2.28	2.16	2.09	1.98	1.90	1.80	1.73	1.68
1.60	3.06	2.94	2.86	2.73	2.65	2.52	2.43	2.37	2.25	2.17	2.05	1.97	1.87	1.80	1.74
1.80	3.32	3.19	3.09	2.95	2.86	2.72	2.62	2.55	2.41	2.32	2.20	2.11	1.99	1.91	1.85
2.00	3.58	3.43	3.32	3.17	3.06	2.91	2.80	2.72	2.58	2.48	2.34	2.24	2.12	2.03	1.97
2.20	3.83	3.67	3.55	3.38	3.26	3.10	2.98	2.89	2.74	2.63	2.48	2.38	2.24	2.14	2.07
2.40	4.07	3.89	3.77	3.59	3.46	3.28	3.16	3.06	2.89	2.77	2.61	2.50	2.36	2.25	2.18
2.60	4.31	4.12	3.99	3.79	3.65	3.46	3.33	3.22	3.04	2.92	2.74	2.63	2.47	2.36	2.28
2.80	4.55	4.35	4.20	3.99	3.84	3.64	3.49	3.38	3.19	3.06	2.87	2.75	2.58	2.47	2.38
3.00	4.79	4.57	4.41	4.19	4.03	3.81	3.66	3.54	3.34	3.19	3.00	2.87	2.69	2.57	2.48
3.50	5.36	5.10	4.92	4.66	4.48	4.23	4.06	3.92	3.69	3.53	3.31	3.16	2.96	2.82	2.72
4.00	5.91	5.62	5.41	5.13	4.92	4.64	4.45	4.30	4.04	3.86	3.61	3.44	3.22	3.07	2.96

TABLE 2(i): Sluice channel threshold depths (in m), D_{35} = 0.26mm

TABLE OF SLUICE CHANNEL THRESHOLD DEPTHS

D35 sediment size = 0.26 mm

Discharge per m width in sluice channel m2/s	Sediment transporting capacity of canal (ppm) :														
	10	15	20	30	40	60	80	100	150	200	300	400	600	800	1000
0.20	0.95	0.94	0.93	0.91	0.90	0.88	0.87	0.86	0.84	0.83	0.81	0.80	0.78	0.76	0.75
0.25	1.05	1.03	1.01	0.99	0.98	0.96	0.94	0.93	0.91	0.89	0.87	0.85	0.83	0.81	0.80
0.30	1.14	1.11	1.10	1.07	1.06	1.03	1.01	1.00	0.97	0.95	0.92	0.90	0.88	0.86	0.85
0.35	1.22	1.20	1.18	1.15	1.13	1.10	1.08	1.06	1.03	1.01	0.98	0.95	0.92	0.90	0.89
0.40	1.31	1.28	1.26	1.23	1.20	1.17	1.14	1.12	1.09	1.06	1.03	1.00	0.97	0.95	0.93
0.45	1.39	1.36	1.34	1.30	1.27	1.23	1.21	1.18	1.15	1.12	1.08	1.05	1.01	0.99	0.97
0.50	1.48	1.44	1.41	1.37	1.34	1.30	1.27	1.24	1.20	1.17	1.13	1.10	1.06	1.03	1.01
0.60	1.64	1.59	1.56	1.51	1.47	1.42	1.39	1.36	1.31	1.27	1.22	1.19	1.14	1.11	1.08
0.70	1.79	1.74	1.70	1.64	1.60	1.54	1.50	1.47	1.41	1.37	1.31	1.27	1.22	1.18	1.15
0.80	1.94	1.88	1.84	1.77	1.73	1.66	1.61	1.58	1.51	1.46	1.40	1.35	1.29	1.25	1.22
0.90	2.09	2.02	1.97	1.90	1.85	1.77	1.72	1.68	1.60	1.55	1.48	1.43	1.37	1.32	1.29
1.00	2.23	2.16	2.10	2.02	1.97	1.88	1.83	1.78	1.70	1.64	1.56	1.51	1.44	1.39	1.35
1.10	2.38	2.29	2.23	2.14	2.08	1.99	1.93	1.88	1.79	1.73	1.64	1.59	1.51	1.45	1.41
1.20	2.52	2.43	2.36	2.26	2.19	2.10	2.03	1.97	1.88	1.81	1.72	1.66	1.58	1.52	1.47
1.30	2.65	2.56	2.48	2.38	2.30	2.20	2.13	2.07	1.97	1.90	1.80	1.73	1.64	1.58	1.53
1.40	2.79	2.68	2.61	2.49	2.41	2.30	2.22	2.16	2.05	1.98	1.87	1.80	1.71	1.64	1.59
1.50	2.92	2.81	2.73	2.61	2.52	2.40	2.32	2.25	2.14	2.06	1.95	1.87	1.77	1.70	1.65
1.60	3.05	2.93	2.84	2.72	2.63	2.50	2.41	2.34	2.22	2.13	2.02	1.94	1.83	1.76	1.71
1.80	3.31	3.18	3.08	2.94	2.84	2.69	2.59	2.52	2.38	2.29	2.16	2.07	1.95	1.87	1.81
2.00	3.56	3.41	3.30	3.15	3.04	2.88	2.77	2.69	2.54	2.44	2.30	2.20	2.07	1.99	1.92
2.20	3.81	3.65	3.53	3.36	3.23	3.07	2.95	2.86	2.69	2.58	2.43	2.33	2.19	2.10	2.02
2.40	4.05	3.87	3.74	3.56	3.43	3.25	3.12	3.02	2.84	2.73	2.56	2.45	2.30	2.20	2.13
2.60	4.29	4.10	3.96	3.76	3.62	3.42	3.28	3.18	2.99	2.87	2.69	2.57	2.41	2.31	2.22
2.80	4.53	4.32	4.17	3.96	3.80	3.59	3.45	3.34	3.14	3.00	2.82	2.69	2.52	2.41	2.32
3.00	4.76	4.54	4.38	4.15	3.99	3.76	3.61	3.49	3.28	3.14	2.94	2.81	2.63	2.51	2.42
3.50	5.33	5.07	4.88	4.62	4.43	4.18	4.00	3.86	3.63	3.46	3.24	3.09	2.89	2.75	2.65
4.00	5.87	5.58	5.37	5.07	4.87	4.58	4.38	4.23	3.96	3.77	3.53	3.36	3.13	2.98	2.87

TABLE 2(j): Sluice channel threshold depths (in m), D_{35} = 0.28mm

TABLE OF SLUICE CHANNEL THRESHOLD DEPTHS

D35 sediment size = 0.28 mm

Discharge per m width in sluice channel m2/s	Sediment transporting capacity of canal (ppm) :														
	10	15	20	30	40	60	80	100	150	200	300	400	600	800	1000
0.20	0.95	0.94	0.93	0.91	0.90	0.88	0.87	0.86	0.84	0.83	0.81	0.79	0.77	0.76	0.75
0.25	1.04	1.03	1.01	0.99	0.98	0.96	0.94	0.93	0.90	0.89	0.86	0.85	0.82	0.81	0.80
0.30	1.13	1.11	1.10	1.07	1.05	1.03	1.01	0.99	0.97	0.95	0.92	0.90	0.87	0.85	0.84
0.35	1.22	1.20	1.18	1.15	1.13	1.10	1.08	1.06	1.03	1.00	0.97	0.95	0.92	0.90	0.88
0.40	1.31	1.28	1.26	1.22	1.20	1.17	1.14	1.12	1.08	1.06	1.02	1.00	0.96	0.94	0.92
0.45	1.39	1.36	1.33	1.30	1.27	1.23	1.20	1.18	1.14	1.11	1.07	1.04	1.01	0.98	0.96
0.50	1.47	1.44	1.41	1.37	1.34	1.29	1.26	1.24	1.19	1.16	1.12	1.09	1.05	1.02	1.00
0.60	1.63	1.59	1.55	1.51	1.47	1.42	1.38	1.35	1.30	1.26	1.21	1.18	1.13	1.09	1.07
0.70	1.79	1.73	1.70	1.64	1.60	1.54	1.49	1.46	1.40	1.36	1.30	1.26	1.20	1.17	1.14
0.80	1.94	1.88	1.83	1.77	1.72	1.65	1.60	1.57	1.50	1.45	1.38	1.34	1.28	1.24	1.20
0.90	2.09	2.02	1.97	1.89	1.84	1.76	1.71	1.67	1.59	1.54	1.47	1.42	1.35	1.30	1.27
1.00	2.23	2.15	2.10	2.02	1.96	1.87	1.81	1.77	1.68	1.63	1.55	1.49	1.42	1.37	1.33
1.10	2.37	2.28	2.22	2.13	2.07	1.98	1.91	1.86	1.77	1.71	1.63	1.57	1.49	1.43	1.39
1.20	2.51	2.42	2.35	2.25	2.18	2.08	2.01	1.96	1.86	1.79	1.70	1.64	1.55	1.49	1.45
1.30	2.64	2.55	2.47	2.37	2.29	2.19	2.11	2.05	1.95	1.88	1.78	1.71	1.62	1.55	1.51
1.40	2.78	2.67	2.59	2.48	2.40	2.29	2.20	2.14	2.03	1.95	1.85	1.78	1.68	1.61	1.56
1.50	2.91	2.80	2.71	2.59	2.51	2.38	2.30	2.23	2.11	2.03	1.92	1.84	1.74	1.67	1.62
1.60	3.04	2.92	2.83	2.70	2.61	2.48	2.39	2.32	2.20	2.11	1.99	1.91	1.80	1.73	1.67
1.80	3.30	3.16	3.06	2.92	2.81	2.67	2.57	2.49	2.35	2.26	2.13	2.04	1.92	1.84	1.78
2.00	3.55	3.40	3.28	3.13	3.01	2.86	2.74	2.66	2.51	2.40	2.26	2.17	2.03	1.95	1.88
2.20	3.80	3.62	3.50	3.33	3.21	3.04	2.91	2.82	2.66	2.54	2.39	2.29	2.15	2.05	1.98
2.40	4.04	3.85	3.72	3.53	3.40	3.21	3.08	2.98	2.81	2.68	2.52	2.41	2.26	2.15	2.08
2.60	4.27	4.07	3.93	3.73	3.58	3.39	3.25	3.14	2.95	2.82	2.64	2.52	2.36	2.25	2.17
2.80	4.51	4.29	4.14	3.92	3.77	3.55	3.40	3.29	3.09	2.95	2.77	2.64	2.47	2.35	2.27
3.00	4.73	4.51	4.34	4.11	3.95	3.72	3.56	3.44	3.23	3.08	2.89	2.75	2.57	2.45	2.36
3.50	5.30	5.03	4.84	4.57	4.39	4.13	3.94	3.81	3.56	3.40	3.17	3.02	2.82	2.68	2.58
4.00	5.84	5.54	5.32	5.02	4.81	4.52	4.31	4.16	3.89	3.70	3.45	3.28	3.05	2.90	2.79

TABLE 2(k): Sluice channel threshold depths (in m), D_{35} = 0.30mm

TABLE OF SLUICE CHANNEL THRESHOLD DEPTHS

D35 sediment size = 0.30 mm

Discharge per m width in sluice channel m2/s	Sediment transporting capacity of canal (ppm) :														
	10	15	20	30	40	60	80	100	150	200	300	400	600	800	1000
0.20	0.95	0.94	0.93	0.91	0.90	0.88	0.87	0.86	0.84	0.82	0.80	0.79	0.77	0.76	0.75
0.25	1.04	1.03	1.01	0.99	0.98	0.96	0.94	0.93	0.90	0.89	0.86	0.84	0.82	0.80	0.79
0.30	1.13	1.11	1.10	1.07	1.05	1.03	1.01	0.99	0.96	0.94	0.92	0.90	0.87	0.85	0.83
0.35	1.22	1.19	1.18	1.15	1.13	1.10	1.07	1.06	1.02	1.00	0.97	0.94	0.91	0.89	0.88
0.40	1.31	1.28	1.25	1.22	1.20	1.16	1.14	1.12	1.08	1.05	1.02	0.99	0.96	0.93	0.91
0.45	1.39	1.36	1.33	1.29	1.27	1.23	1.20	1.18	1.13	1.11	1.07	1.04	1.00	0.97	0.95
0.50	1.47	1.43	1.41	1.36	1.33	1.29	1.26	1.23	1.19	1.16	1.11	1.08	1.04	1.01	0.99
0.60	1.63	1.58	1.55	1.50	1.46	1.41	1.37	1.34	1.29	1.25	1.20	1.17	1.12	1.08	1.06
0.70	1.78	1.73	1.69	1.63	1.59	1.53	1.49	1.45	1.39	1.35	1.29	1.25	1.19	1.15	1.13
0.80	1.93	1.87	1.83	1.76	1.71	1.64	1.59	1.56	1.49	1.44	1.37	1.33	1.26	1.22	1.19
0.90	2.08	2.01	1.96	1.89	1.83	1.75	1.70	1.66	1.58	1.53	1.45	1.40	1.33	1.29	1.25
1.00	2.22	2.14	2.09	2.01	1.95	1.86	1.80	1.75	1.67	1.61	1.53	1.48	1.40	1.35	1.31
1.10	2.36	2.28	2.22	2.13	2.06	1.97	1.90	1.72	1.76	1.70	1.61	1.55	1.47	1.41	1.37
1.20	2.50	2.41	2.34	2.24	2.17	2.07	2.00	1.94	1.84	1.78	1.68	1.62	1.53	1.47	1.43
1.30	2.64	2.54	2.46	2.36	2.28	2.17	2.09	2.03	1.93	1.86	1.75	1.69	1.59	1.53	1.48
1.40	2.77	2.66	2.58	2.47	2.39	2.27	2.19	2.12	2.01	1.93	1.83	1.75	1.65	1.59	1.54
1.50	2.90	2.79	2.70	2.58	2.49	2.37	2.28	2.21	2.09	2.01	1.90	1.82	1.71	1.64	1.59
1.60	3.03	2.91	2.82	2.69	2.59	2.46	2.37	2.30	2.17	2.08	1.96	1.88	1.77	1.70	1.64
1.80	3.29	3.15	3.04	2.90	2.79	2.65	2.55	2.47	2.33	2.23	2.10	2.01	1.89	1.81	1.75
2.00	3.53	3.38	3.27	3.11	2.99	2.83	2.72	2.63	2.48	2.37	2.23	2.13	2.00	1.91	1.85
2.20	3.78	3.61	3.48	3.31	3.18	3.01	2.89	2.79	2.63	2.51	2.35	2.25	2.11	2.01	1.94
2.40	4.02	3.83	3.70	3.51	3.37	3.18	3.05	2.95	2.77	2.64	2.48	2.37	2.21	2.11	2.04
2.60	4.25	4.05	3.91	3.70	3.55	3.35	3.21	3.10	2.91	2.78	2.60	2.48	2.32	2.21	2.13
2.80	4.48	4.27	4.11	3.89	3.73	3.52	3.37	3.25	3.05	2.91	2.72	2.59	2.42	2.30	2.22
3.00	4.71	4.48	4.31	4.08	3.91	3.68	3.52	3.40	3.18	3.03	2.83	2.70	2.52	2.39	2.30
3.50	5.27	5.00	4.80	4.53	4.34	4.08	3.89	3.76	3.51	3.34	3.12	2.96	2.76	2.62	2.52
4.00	5.80	5.50	5.28	4.97	4.76	4.46	4.26	4.10	3.82	3.64	3.39	3.21	2.99	2.84	2.72

FIGURES.

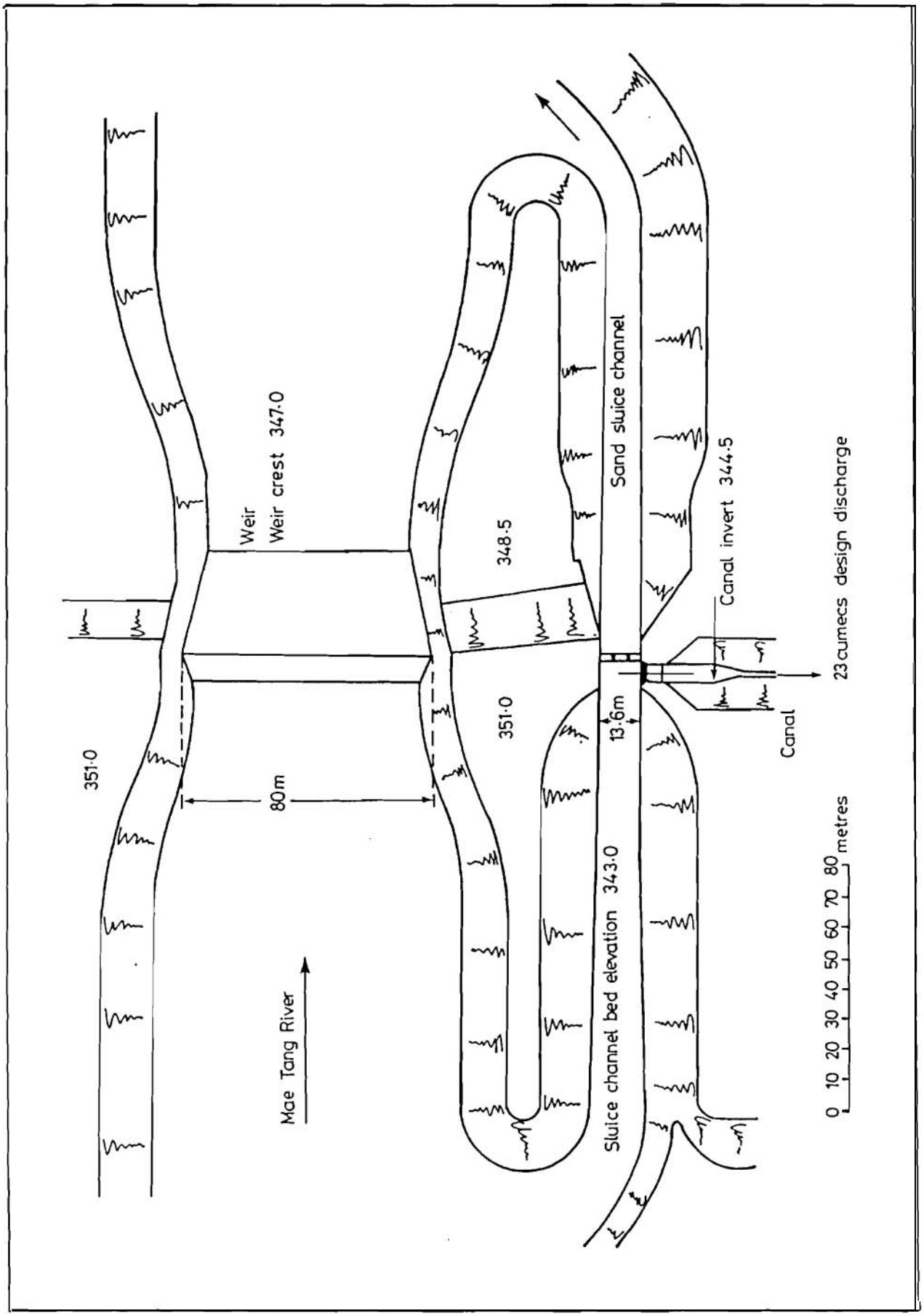

Fig 1 Mae Tang Weir and headworks

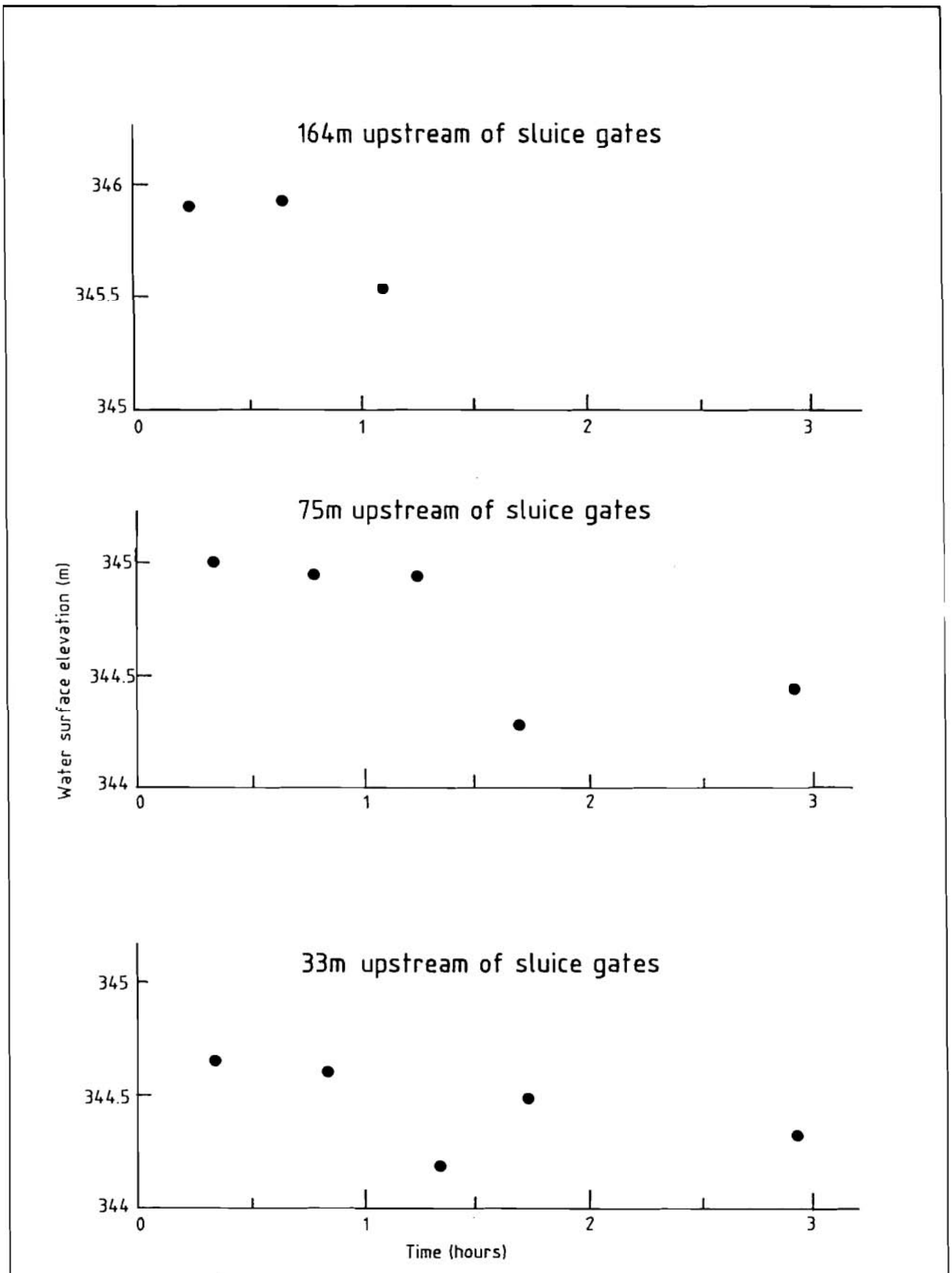

Fig 2 Observed water levels during sluicing at Mae Tang 28.11.86

APPENDICES.

APPENDIX I: Theoretical basis **for** calculation of threshold depth in sluice channel

The depth (and hence the other hydraulic conditions) just upstream of the canal intake gates determine the sediment concentrations entering the canal. As the bed level rises during the deposition phase of sluice channel operation, the depth is reduced and so the velocity of the flow passing into the canal rises. As the velocity increases it can carry more and more sand sized sediment. When the depth in the sluice channel approaches a minimum permissible value (the threshold depth), then the sediment concentration entering the canal reaches its maximum allowable value.

The calculation uses the White et al (1979) method to predict the friction slope in the sluice channel from an initial guess for the flow depth and hence the velocity; and then the Ackers and White (1973) method to predict the sediment transport from these values for depth, velocity and friction slope. The prediction of sediment transport is next compared to the maximum allowable sediment concentration entering the canal, and so a new guess for the depth is made. Eventually the depth is found which exactly produces a sediment transport rate equal to the allowable maximum. The White et al and Ackers and White methods are listed in a compilation of methods for predicting friction and sediment transport in alluvial channels (Sakhuja, 1987), the compilation will be circulated with this manual.

The method just described has been compared with data both from the Mae Tang diversion weir and from a settling reach at the Mataram intake structure in Central Java. The results are summarised in the following table.

	SEDIMENT CONCENTRATION AT DOWNSTREAM END OF SETTLING REACH (ppm)	DEPTH IN SLUICE CHANNEL AT THAT SEDIMENT CONCENTRATION	
		OBSERVED (m)	PREDICTED (m)
Mae Tang, canal discharge = 21m^3/s	200	1.8	1.2
Mae Tang, canal discharge = 17.5m^3/s	200	1.45	1.05
Mataram	100	2.05	1.75

The method consistently underestimates the threshold depth by about 0.4m. The cause of the discrepancy is related to the turbulence introduced to the flow at the entrance to the sluice channel. In the theory just described the methods used to predict both the friction and the sediment transport assume that the flow is steady and uniform down the channel. In this application the sediment is settling out from the flow so the theory only applies if all the excess sediment has settled and the flow is uniform. The turbulence produced at the sluice channel entrance prevents all the sediment from settling. The effect is described in greater detail in the final report on the field measurements (Atkinson, 1986).

Tables presented in this manual (Tables 2(a)-2(k)) give the predicted threshold depths, using the method described above, plus an allowance of 0.5m; this both accounts for the increased turbulence and gives a small margin of safety.

One of the input parameters required for the prediction of threshold depths is the maximum allowable sediment concentration entering the canal. An indication of the approximate value that this maximum allowable concentration may have is the

sediment transporting capacity of the canal. In fact the method which was used to produce the tables takes a sediment concentration of twice the canal's transporting capacity as the maximum allowable value. The sediment loads entering the canal would then be allowed to rise higher than the canal's transporting capacity, but this would be for only a short time at the end of the deposition phase.

Values for the sediment transporting capacity of the main canal are provided in a separate set of tables (Tables 1(a)-1(v)). These tables give predicted transporting capacities from canal slopes, sediment sizes and values for discharge per unit width; again the White et al (1979) and Ackers and White (1973) prediction methods are employed.

APPENDIX 11: Example of using the manual

1. Data

(a) Sluice channel D_{35} = 0.14mm

(b) Canal D_{35} = 0.40mm

(c) Design slope of main canal 24cm per km.

(d) Mean width of main canal 10m.

(e) Canal discharge, Q_c = 16m^3/s.

(f) Water surface width in sluice channel = 19m approximately.

(g) Side slope in sluice channel 1.5 horizontal distance to 1 vertical distance.

(h) Water levels during sluicing. Figure 2.

2 Calculation of sediment transporting capacity of canal

D_{35} = 0.40mm
Discharge per m width = 16.0/10.0 = 1.6m^2/s
Slope = 24cm/km

Using Table 1(m)
Sediment transporting capacity of canal = 60ppm

3 Calculation of threshold depth in sluice channel

For D_{35} = 0.14mm

Initial value for threshold depth in sluice channel = 2.0m
Mean width = 19 - 2.0 x 1.5 = 16m
Discharge per m width = 16/16 = 1.0m^2/s
Table 2(c) gives: depth = 1.97m

Therefore the next try for mean width in sluice channel is:

mean width = 19 - 1.97 x 1.5 = 16.05m

So, discharge per m width = 16.05116 = 1.003m
Table 2(c) again gives: depth = 1.97m

The final answer for threshold depth is therefore 1.97m. When the measured depth in the sluice channel becomes less than 1.97m it is time to open the sluice gates.

4 Examples of linear interpolation in the tables

The example just presented was chosen so that linear interpolation in the use of the tables was avoided. Examples of linear interpolation are given below:

Interpolation in Tables 1(a) - (v)

D_{35} = 0.54mm
Discharge per m width = 2.3m ^{2}/s
Slope = 20cm/km

Starting with Table 1(o):

For D_{35} = 0.5mm and 2.0m^2/s
concentration = 42ppm

For D_{35} = 0.5mm and 2.5m^2/s
concentration = 46ppm

So for D_{35} = 0.5mm and 2.3m^2/s

$$f = \frac{2.3 - 2.0}{2.5 - 2.0} = 0.6, \text{ so}$$

concentration = 0.6 x 46 + (1-0.6) x 42
= 44ppm

Likewise, using Table 1 (p):
For D_{35} = 0.6mm and 2.3m^2/s

$$f = \frac{2.3 - 2.0}{2.5 - 2.0} = 0.6 \text{ and}$$

concentration = 0.6 x 39 + (1-0.6) x 36

= 38ppm

Therefore

For D_{35} = 0.54mm and 2.3m^2/s

$$f = \frac{0.54 - 0.5}{0.6 - 0.5} = 0.4$$

concentration = 0.4 x 38 + (1-0.4) x 44

= 42ppm

Interpolation in Tables 2(a) - (k)

D_{35} = 0.13mm

Sediment transporting capacity of canal = 42ppm

Discharge per m width = 1.05m^2/s

Using Table 2 (b):-

D_{35} = 0.12mm, concentration = 40ppm

(interpolating between values for 1.0m^2/s and 1.1m^2/s)

$$f = \frac{1.05 - 1.0}{1.1 - 1.0} = 0.5$$

depth = 0.5 x 2.17 + 0.5 x 2.04 = 2.11m

D_{35} = 0.12mm, concentration = 60ppm

depth = 0.5 x 2.10 + 0.5 x 1.98 = 2.04m

D_{35} = 0.12mm, concentration = 42ppm

$$f = \frac{42 - 40}{60 - 40} = 0.1$$

depth = 0.1 x 2.04 + (1-0.1) x 2.11 = 2.10m

Then, using Table 2(c)

D_{35} = 0.14mm, concentration = 40ppm

depth = 0.5 x 2.16 + 0.5 x 2.03 = 2.10m

D_{35} = 0.14mm, concentration = 60ppm

depth = 0.5 x 2.09 + 0.5 x 1.97 = 2.03m

D_{35} = 0.14mm, concentration = 42ppm
depth = 0.1 x 2.03 + (1-0.1) x 2.10 = 2.09m

Finally:

D_{35} = 0.13mm
$f = \frac{0.13 - 0.12}{0.14 - 0.12} = 0.5$
depth = 0.5 x 2.09 + 0.5 x 2.10 = 2.10m

5. Duration of sluicing

Measurements of water surface elevation during sluicing at the Mae Tang diversion weir are shown in Figure 2. The scatter in the measurements is considerable but it appears that little sediment was flushed from the sluice channel after about two hours of sluicing. The measurements were made to provide data for a comparison with predictions, more frequent readings of water surface elevation would give a better guide for the optimum duration of sluicings.

This report is one of a series on topics of water resources and irrigation, prepared by Hydraulics Research Limited and funded by the British Overseas Development Administration.

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