

Appendix A.10.6

Hydraulic Calculations

A.10.6

1 Radius of influence

A calculation of the radius of influence upon groundwater at each location where dewatering is proposed has been calculated using a simplified analytical approach detailed in CIRIA (Construction Industry Research and Information Association) Report No 113, 'Control of groundwater for temporary works' (SH Somerville, 1986).

The following equation is presented for estimating radius of influence (R_o) for given drawdown (h) and hydraulic conductivity (k):

$$R_o = 3000 h\sqrt{K} \quad (\text{Sichart equation})$$

Where,

R_o = Radius of influence (m)

h = Drawdown (m)

k = Hydraulic conductivity (m/sec)

The calculation is performed for each 100m chainage of the proposed road development, which is presented in **Table 1** below.

Ch.	Ground level mOD	Construct Dewater. level mOD	Operat. Dewatering level mOD	Embank./ Cutting/ Tunnel	Depth of cutting m BGL	Construction Phase Drawdown		Operation Phase Drawdown	
						Vertical m	Radius from design footprint m	Vertical m	Radius from design footprint m
0	10.9	7.9	7.9	Embankment	0.0	1.7	10.7	1.7	10.7
100	12.8	9.7	9.7	Cutting	0.1	2.2	13.9	2.2	13.9
200	17.5	13.8	13.8	Cutting	0.7	2.8	18.2	2.8	18.2
300	21.9	18.3	18.3	Cutting	0.6	2.7	17.5	2.7	17.5
400	27.0	22.8	22.8	Cutting	1.3	3.1	20.2	3.1	20.2
500	30.8	27.3	27.3	Cutting	0.6	2.2	14.4	2.2	14.4
600	31.8	28.8	28.8	Embankment	0.0	2.0	13.1	2.0	13.1
700	33.8	30.8	30.8	Embankment	0.0	2.0	12.7	2.0	12.7
800	37.6	34.6	34.6	Embankment	0.0	2.6	17.0	2.6	17.0
900	38.8	35.8	35.8	Embankment	0.0	2.8	18.0	2.8	18.0
1000	40.0	37.0	37.0	Embankment	0.0	2.0	13.0	2.0	13.0
1100	41.6	38.6	38.6	Embankment	0.0	2.4	15.3	2.4	15.3
1200	47.2	43.3	43.3	Cutting	0.9	2.0	12.8	2.0	12.8
1300	47.9	44.9	44.9	Embankment	0.0	2.5	15.9	2.5	15.9
1400	49.8	46.8	46.8	Embankment	0.0	2.2	14.2	2.2	14.2
1500	49.2	46.2	46.2	Embankment	0.0	1.9	12.3	1.9	12.3
1600	53.0	50.0	50.0	Embankment	0.0	1.0	6.5	1.0	6.5
1700	56.9	52.9	52.9	Cutting	1.0	2.9	18.6	2.9	18.6
1800	57.4	54.4	54.4	Embankment	0.0	2.4	15.3	2.4	15.3
1900	57.9	54.9	54.9	Embankment	0.0	1.9	12.3	1.9	12.3
2000	56.4	53.4	53.4	Embankment	0.0	2.4	15.5	2.4	15.5
2100	52.8	49.8	49.8	Embankment	0.0	1.0	6.2	1.0	6.2
2200	50.9	47.9	47.9	Embankment	0.0	1.9	12.5	1.9	12.5
2300	51.9	48.9	48.9	Embankment	0.0	2.1	13.7	2.1	13.7
2400	50.1	46.9	46.9	Cutting	0.2	2.1	13.4	2.1	13.4
2500	48.2	44.7	44.7	Cutting	0.4	1.6	10.2	1.6	10.2
2600	48.9	42.8	42.8	Cutting	3.1	2.5	16.1	2.5	16.1
2700	43.3	40.3	40.3	Embankment	0.0	2.4	15.2	2.4	15.2
2800	41.1	38.1	38.1	Embankment	0.0	1.9	12.0	1.9	12.0
2900	40.5	37.5	37.5	Embankment	0.0	2.3	14.7	2.3	14.7
3000	40.0	37.0	37.0	Embankment	0.0	2.6	16.9	2.6	16.9
3100	39.2	36.2	36.2	Embankment	0.0	2.9	18.5	2.9	18.5
3200	39.3	33.3	33.3	Cutting	3.0	5.1	32.8	5.1	32.8
3300	37.1	30.1	30.1	Cutting	4.0	6.6	42.6	6.6	42.6
3400	36.8	28.8	28.8	Cutting	5.0	7.3	47.2	7.3	47.2
3500	36.5	27.6	27.6	Cutting	5.9	7.4	47.9	7.4	47.9
3600	34.8	26.4	26.4	Cutting	5.4	7.5	48.6	7.5	48.6
3700	32.9	25.2	25.2	Cutting	4.7	6.5	42.1	6.5	42.1
3800	31.6	24.0	24.0	Cutting	4.6	7.1	45.9	7.1	45.9
3900	26.4	22.8	22.8	Cutting	0.6	0.6	4.1	0.6	4.1
4000	22.6	19.6	19.6	Embankment	0.0	1.0	6.7	1.0	6.7
4100	23.2	20.2	20.2	Embankment	0.0	2.0	13.0	2.0	13.0
4200	25.1	22.1	22.1	Embankment	0.0	2.5	16.4	2.5	16.4
4300	30.5	27.5	27.5	Embankment	0.0	2.8	17.8	2.8	17.8
4400	38.4	33.6	33.6	Cutting	1.8	1.6	10.6	1.6	10.6
4500	36.7	33.7	33.7	Embankment	0.0	2.9	18.5	2.9	18.5
4600	42.0	37.7	37.7	Cutting	1.3	3.7	23.9	3.7	23.9

Ch.	Ground level mOD	Construct Dewater. level mOD	Operat. Dewatering level mOD	Embank./ Cutting/ Tunnel	Depth of cutting m BGL	Construction Phase Drawdown		Operation Phase Drawdown	
						Vertical m	Radius from design footprint m	Vertical m	Radius from design footprint m
4700	43.3	40.8	40.8	Embankment	0.0	1.5	9.8	1.5	9.8
4800	45.4	42.4	42.4	Embankment	0.0	1.2	8.0	1.2	8.0
4900	45.5	42.5	42.5	Embankment	0.0	1.1	7.3	1.1	7.3
5000	47.3	44.3	44.3	Embankment	0.0	2.5	16.2	2.5	16.2
5100	49.9	46.9	46.9	Embankment	0.0	1.6	10.4	1.6	10.4
5200	55.5	52.5	52.5	Cutting	1.3	0.0	0.0	0.0	0.0
5300	59.0	53.3	53.3	Cutting	2.7	1.5	9.9	1.5	9.9
5400	59.5	54.7	54.7	Cutting	1.8	3.1	19.8	3.1	19.8
5500	63.9	55.6	55.6	Cutting	5.3	4.9	31.7	4.9	31.7
5600	59.4	56.5	56.5	Embankment	0.0	1.5	9.5	1.5	9.5
5700	59.5	56.5	56.5	Embankment	0.0	1.4	9.1	1.4	9.1
5800	56.7	53.7	53.7	Embankment	0.0	2.8	18.1	2.8	18.1
5900	57.4	54.4	54.4	Cutting	0.0	1.6	10.3	1.6	10.3
6000	54.5	51.5	51.5	Embankment	0.0	1.8	11.7	1.8	11.7
6100	56.3	53.3	53.3	Embankment	0.0	0.8	5.3	0.8	5.3
6200	53.0	50.0	50.0	Embankment	0.0	2.0	12.8	2.0	12.8
6300	57.2	54.2	54.2	Embankment	0.0	0.8	5.4	0.8	5.4
6400	54.8	51.8	51.8	Embankment	0.0	1.2	7.8	1.2	7.8
6500	59.7	56.7	56.7	Embankment	0.0	0.0	0.0	0.0	0.0
6600	60.2	57.2	57.2	Embankment	0.0	1.6	10.2	1.6	10.2
6700	58.8	55.8	55.8	Embankment	0.0	2.5	16.0	2.5	16.0
6800	59.6	56.2	56.2	Cutting	0.3	0.0	0.0	0.0	0.0
6900	55.6	52.6	52.6	Embankment	0.0	1.5	9.7	1.5	9.7
7000	60.3	57.3	57.3	Embankment	0.0	2.4	15.8	2.4	15.8
7100	61.6	58.6	58.6	Embankment	0.0	2.3	14.5	2.3	14.5
7200	58.9	55.9	55.9	Embankment	0.0	2.0	12.6	2.0	12.6
7300	61.5	58.5	58.5	Embankment	0.0	0.1	0.5	0.1	0.5
7400	63.9	60.9	60.9	Embankment	0.0	0.1	0.4	0.1	0.4
7500	63.1	60.1	60.1	Embankment	0.0	2.2	14.0	2.2	14.0
7600	64.1	61.1	61.1	Embankment	0.0	1.8	11.5	1.8	11.5
7700	69.2	62.9	62.9	Cutting	3.3	3.1	20.1	3.1	20.1
7800	68.9	60.1	60.1	Cutting	5.8	9.0	58.0	9.0	58.0
7900	73.8	56.5	56.5	Cutting	14.4	11.6	74.8	11.6	74.8
8000	67.0	52.5	52.5	Cutting	11.5	11.5	74.1	11.5	74.1
8100	59.3	48.5	48.5	Cutting	7.9	7.5	48.4	7.5	48.4
8200	50.8	44.5	44.5	Cutting	3.3	3.8	24.6	3.8	24.6
8300	42.4	39.4	39.4	Embankment	0.0	0.0	0.0	0.0	0.0
8400	32.3	29.3	29.3	Embankment	0.0	0.0	0.0	0.0	0.0
8500	27.6	24.6	24.6	Embankment	0.0	0.0	0.0	0.0	0.0
8600	23.9	20.9	20.9	Embankment	0.0	2.1	13.6	2.1	13.6
8700	25.1	22.1	22.1	Embankment	0.0	0.9	5.8	0.9	5.8
8800	27.0	24.0	24.0	Embankment	0.0	0.0	0.0	0.0	0.0
8900	14.8	11.8	11.8	Embankment	0.0	2.7	98.7	2.7	98.7
9000	15.7	12.7	12.7	Embankment	0.0	3.0	110.7	3.0	110.7
9100	16.4	13.4	13.4	Embankment	0.0	1.0	38.0	1.0	38.0
9200	10.6	7.6	7.6	Embankment	0.0	2.6	94.2	2.6	94.2
9300	5.9	2.9	2.9	Embankment	0.0	3.4	0.0	3.4	0.0

Ch.	Ground level mOD	Construct Dewater. level mOD	Operat. Dewatering level mOD	Embank./ Cutting/ Tunnel	Depth of cutting m BGL	Construction Phase Drawdown		Operation Phase Drawdown	
						Vertical m	Radius from design footprint m	Vertical m	Radius from design footprint m
9400	6.0	3.0	3.0	Embankment	0.0	3.3	0.0	3.3	0.0
9500	13.3	10.3	10.3	Embankment	0.0	1.0	34.9	1.0	34.9
9600	12.9	9.9	9.9	Embankment	0.0	1.3	46.6	1.3	46.6
9700	16.6	13.6	13.6	Embankment	0.0	0.0	0.0	0.0	0.0
9800	9.7	6.7	6.7	Embankment	0.0	0.0	0.0	0.0	0.0
9900	11.9	8.9	8.9	Embankment	0.0	0.3	10.1	0.3	10.1
10000	19.5	16.5	16.5	Embankment	0.0	0.0	0.0	0.0	0.0
10100	20.0	17.0	17.0	Embankment	0.0	0.0	0.0	0.0	0.0
10200	22.9	19.9	19.9	Embankment	0.0	0.0	0.0	0.0	0.0
10300	10.8	7.8	7.8	Embankment	0.0	0.4	13.9	0.4	13.9
10400	18.1	15.1	15.1	Embankment	0.0	0.0	0.0	0.0	0.0
10500	14.4	11.4	11.4	Embankment	0.0	0.0	0.0	0.0	0.0
10600	16.5	13.5	13.5	Embankment	0.0	0.0	0.0	0.0	0.0
10700	14.0	11.0	11.0	Embankment	0.0	0.0	0.0	0.0	0.0
10800	14.2	10.0	14.2	Cutting	1.3	0.0	0.0	0.0	0.0
10900	21.5	9.8	21.5	Cutting	8.7	0.0	0.0	0.0	0.0
11000	23.9	10.6	23.9	Cutting	10.3	0.0	0.0	0.0	0.0
11100	27.9	11.5	27.9	Cutting	13.5	0.0	0.0	0.0	0.0
11200	32.6	12.3	32.6	Tunnel	17.3	0.0	0.0	0.0	0.0
11300	39.8	13.1	39.8	Tunnel	23.7	0.0	0.0	0.0	0.0
11400	24.2	13.9	24.2	Tunnel	7.3	0.0	0.0	0.0	0.0
11500	15.3	12.3	15.3	Embankment	0.0	0.0	0.0	0.0	0.0
11600	12.2	9.2	12.2	Embankment	0.0	0.0	0.0	0.0	0.0
11700	14.8	20.6	14.8	Embankment	0.0	0.0	0.0	0.0	0.0
11800	50.9	23.3	23.3	Cutting	24.6	0.0	0.0	0.0	0.0
11900	34.9	25.0	25.0	Cutting	7.0	0.0	0.0	0.0	0.0
12000	25.7	22.7	22.7	Embankment	0.0	0.0	0.0	0.0	0.0
12100	23.5	20.5	20.5	Embankment	0.0	0.0	0.0	0.0	0.0
12200	21.0	18.0	18.0	Embankment	0.0	0.0	0.0	0.0	0.0
12300	14.1	11.1	11.1	Embankment	0.0	0.0	0.0	0.0	0.0
12400	11.1	8.1	8.1	Embankment	0.0	0.0	0.0	0.0	0.0
12500	22.0	19.0	19.0	Embankment	0.0	0.0	0.0	0.0	0.0
12600	28.3	21.6	21.6	Cutting	3.7	0.0	0.0	0.0	0.0
12700	31.4	20.8	20.8	Cutting	7.6	0.0	0.0	0.0	0.0
12800	28.2	20.1	20.1	Cutting	5.1	0.0	0.0	0.0	0.0
12900	23.6	19.4	19.4	Cutting	1.2	0.0	0.0	0.0	0.0
13000	18.1	15.1	15.1	Embankment	0.0	0.0	0.0	0.0	0.0
13100	28.4	19.8	19.8	Cutting	5.6	3.0	110.6	3.0	110.6
13200	35.7	20.7	20.7	Cutting	12.0	2.9	106.9	2.9	106.9
13300	35.1	21.6	21.6	Cutting	10.5	2.5	92.2	2.5	92.2
13400	34.4	22.5	22.5	Cutting	8.9	3.1	114.2	3.1	114.2
13500	32.4	23.4	23.4	Cutting	6.0	2.5	92.2	2.5	92.2
13600	30.3	24.1	24.1	Cutting	3.2	1.7	61.7	1.7	61.7
13700	21.6	18.6	18.6	Embankment	0.0	0.0	0.0	0.0	0.0
13800	16.9	13.9	13.9	Embankment	0.0	0.0	0.0	0.0	0.0
13900	18.7	15.7	15.7	Embankment	0.0	0.0	0.0	0.0	0.0
14000	18.3	15.3	15.3	Embankment	0.0	0.0	0.0	0.0	0.0

Ch.	Ground level mOD	Construct Dewater. level mOD	Operat. Dewatering level mOD	Embank./ Cutting/ Tunnel	Depth of cutting m BGL	Construction Phase Drawdown		Operation Phase Drawdown	
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14100	30.8	27.8	27.8	Embankment	0.0	0.0	0.0	0.0	0.0
14200	46.7	35.6	35.6	Cutting	8.1	0.0	0.0	0.0	0.0
14300	54.8	39.5	39.5	Cutting	12.3	0.0	0.0	0.0	0.0
14400	56.9	42.5	56.9	Cutting	11.4	0.0	0.0	0.0	0.0
14500	57.5	44.5	57.5	Cutting	10.0	0.0	0.0	0.0	0.0
14600	57.5	45.6	57.5	Cutting	9.0	0.0	0.0	0.0	0.0
14700	57.3	45.6	57.3	Cutting	8.7	0.0	0.0	0.0	0.0
14800	56.8	44.6	56.8	Cutting	9.1	0.0	0.0	0.0	0.0
14900	54.2	42.9	54.2	Cutting	8.3	1.6	6.3	0.0	0.0
15000	53.3	41.7	53.3	Tunnel	8.6	2.7	10.6	0.0	0.0
15100	53.2	41.0	53.2	Tunnel	9.2	3.3	13.0	0.0	0.0
15200	52.0	40.3	52.0	Cutting	8.7	3.9	15.3	0.0	0.0
15300	48.8	40.7	48.8	Cutting	5.1	3.4	13.4	0.0	0.0
15400	46.7	42.8	46.7	Cutting	0.9	1.3	4.9	0.0	0.0
15500	47.0	44.0	47.0	Embankment	0.0	0.0	0.0	0.0	0.0
15600	46.0	43.0	46.0	Embankment	0.0	0.8	3.1	0.0	0.0
15700	43.6	40.6	43.6	Embankment	0.0	1.9	7.3	0.0	0.0
15800	42.7	39.7	42.7	Embankment	0.0	1.8	7.1	0.0	0.0
15900	41.7	38.7	41.7	Embankment	0.0	1.2	4.8	0.0	0.0
16000	41.8	38.8	41.8	Embankment	0.0	0.5	1.8	0.0	0.0
16100	41.3	38.3	41.3	Embankment	0.0	0.5	2.1	0.0	0.0
16200	41.5	38.3	38.3	Cutting	0.2	0.3	1.2	0.3	1.2
16300	39.9	34.7	34.7	Cutting	2.2	1.3	5.1	1.3	5.1
16400	36.5	32.0	32.0	Cutting	1.5	0.9	3.4	0.9	3.4
16500	33.8	30.3	30.3	Cutting	0.6	0.0	0.0	0.0	0.0
16600	34.8	29.4	29.4	Cutting	2.4	0.0	0.0	0.0	0.0
16700	36.7	29.3	29.3	Cutting	4.4	0.0	0.0	0.0	0.0
16800	38.9	29.1	29.1	Cutting	6.8	0.0	0.0	0.0	0.0
16900	32.7	28.7	28.7	Cutting	1.0	0.0	0.0	0.0	0.0
17000	32.4	28.3	28.3	Cutting	1.1	0.0	0.0	0.0	0.0
17100	32.5	27.7	27.7	Cutting	1.8	0.0	0.0	0.0	0.0
17200	33.1	26.9	26.9	Cutting	3.2	0.0	0.0	0.0	0.0
17300	29.1	26.0	26.0	Cutting	0.1	0.0	0.0	0.0	0.0
17400	28.0	25.0	25.0	Cutting	0.1	0.0	0.0	0.0	0.0
17500	27.1	23.8	23.8	Cutting	0.3	0.0	0.0	0.0	0.0