Updated 10/03/2022
Ref:21038

DA 8/2021/21907/1 – Lot 201, DP 1099068
1026 & 1044 Lovedale Road, Allandale

CULVERT SIZING UNDER ACCESS ROAD TO PROPOSED SOLAR FARM

FLOW

Q = CIA/360 where Q is in m^3/s (cumecs) and A is in ha

Catchment Area (A) = 90ha = $0.9km^2$ – See Appendix A

The catchment area extends beyond the Hunter Valley Expressway.
There is twin 1800mmØ RCP culvert under the expressway.
As a conservative measure it has assumed this will not impede flows to the proposed access road for the solar fame.

Time of Concentration $t_c = 0.76A^{0.38}$ where A is in km^2

$t_c = 0.76 \times 0.9^{0.38} = 0.73$ hours = 44 minutes

$I_{1\%}$ for 44 minutes = 87.4, from BOM rainfall data – See Appendix B

Assume $C_{10} = 0.45$ (Cessnock City Council specification for a rural catchment)
$C_{100} = 0.45 \times 1.2 = 0.54$

C = 0.54
I = 87.4
A = 70

Q = CIA/360 = (0.54x87.4x90)/360
Q = 11.8 cumecs

Total flow to the proposed culvert, under the proposed access road, to the proposed solar farm is 11.8 cumecs for the 1% AEP event.

Box Culvert Design

Assume 1800 x 1800 box culvert, 10m long at 0.5% grade.

Inlet Control

HW = headwater, depth of water from invert of culvert
D = internal height of culvert (1.8m)
B = internal base width of culvert (1.8m)
Q = flow ($11.8m^3/s$)
Q/B = 11.8/1.8 = 6.56
HW/D = 1.55 from inlet control graph – See Appendix C
HW = 2.79.
The Finished road level will be 2.79m + freeboard (say 0.3m) above the inlet invert of the box culvert.
Refer to Appendix D for sections.

https://ingeniir.com/stormwater/manningspipe

BOX CULVERT SIZING

Flow Volume: 11.925m^3/s

Flow Velocity: 3.834m/s

Pipe Size: 1.8x1.8m

Flow Depth: 96%

Maximum Flow Volume: 12.537m^3/s

Maximum Flow Velocity: 3.869m/s

Input

Pipe Shape

Rectangular

Diameter (m)

1.8 Culvert width — m

Depth (m)

1.8 Culvert height

Pipe Material

Concrete or FRC

Roughness (n)

0.013

Pipe Slope (%)

0.5 — %

Design Flow Rate (m^3/s)

11.8

STANDARD BOX CULVERT SIZES

Table 2 – Large box culvert size range

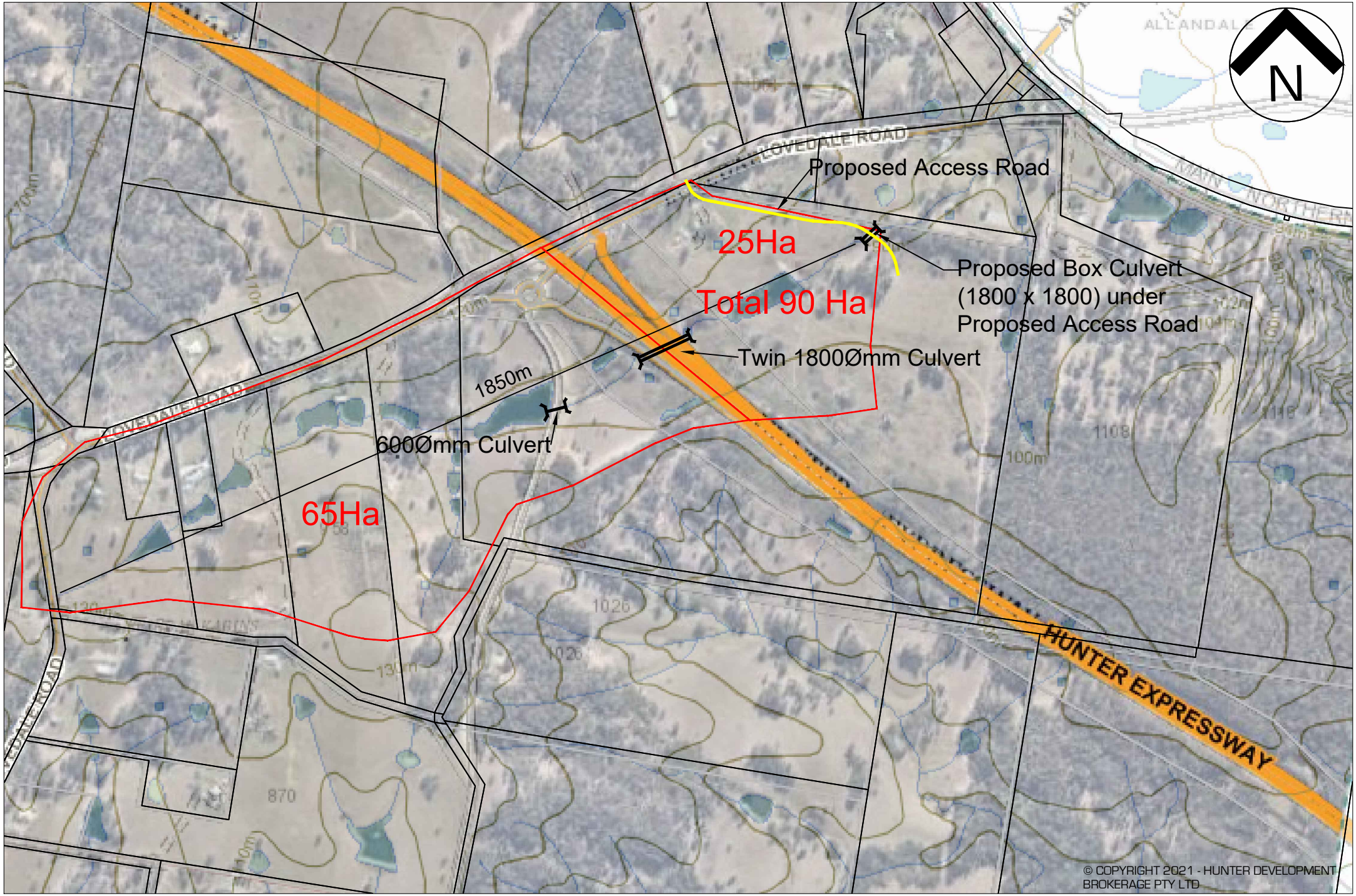
Leg height (mm)	Span (mm)							
	1,500	1,800	2,100	2,400	2,700	3,000	3,300	3,600
600	■	■	■					
900	■	■	■	■	■			
1,200	■	■	■	■	■	■	■	■
1,500	■	■	■	■	■	■	■	■
1,800		■	■	■	■	■	■	■
2,100			■	■	■	■	■	■
2,400				■	■	■	■	■
2,700					■	■	■	■
3,000						■	■	■
3,600								■

Notes:

1. Nominal standard sizes are shown as: ■
2. Box culverts are generally available in standard lengths of 1.22 m and 2.46 m (or 1.2 m and 2.4 m in QLD).
3. The Humes large box culvert size range includes those sizes greater than 1,200 mm span and up to 4,200 mm span covered by Australian Standard 1597 Part 2.
4. In many cases Humes has the facility to manufacture larger span and leg heights beyond those indicated in the Australian Standards. Our design team can customise culvert designs to suit various applications and site conditions.

- Not typically supplied.

Appendix A – Catchment



REF: 21038
DATE: 10.03.2022

200 100 0 200 400 600 800 1000

SCALE IN METRES ON ORIGINAL DRAWING AT REDUCTION RATIO 1:10,000

CATCHMENT PLAN

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Appendix B – Rainfall Data

Australian Government
Bureau of Meteorology

Location

Label: 1044 Lovedale Road Allandale

Latitude: -32.7148 [Nearest grid cell: 32.7125 (S)]

Longitude: 151.4113 [Nearest grid cell: 151.4125 (E)]

IFD Design Rainfall Intensity (mm/h)

Issued: 18 February 2022

Rainfall intensity for Durations, Exceedance per Year (EY), and Annual Exceedance Probabilities (AEP).
FAQ for New ARR probability terminology

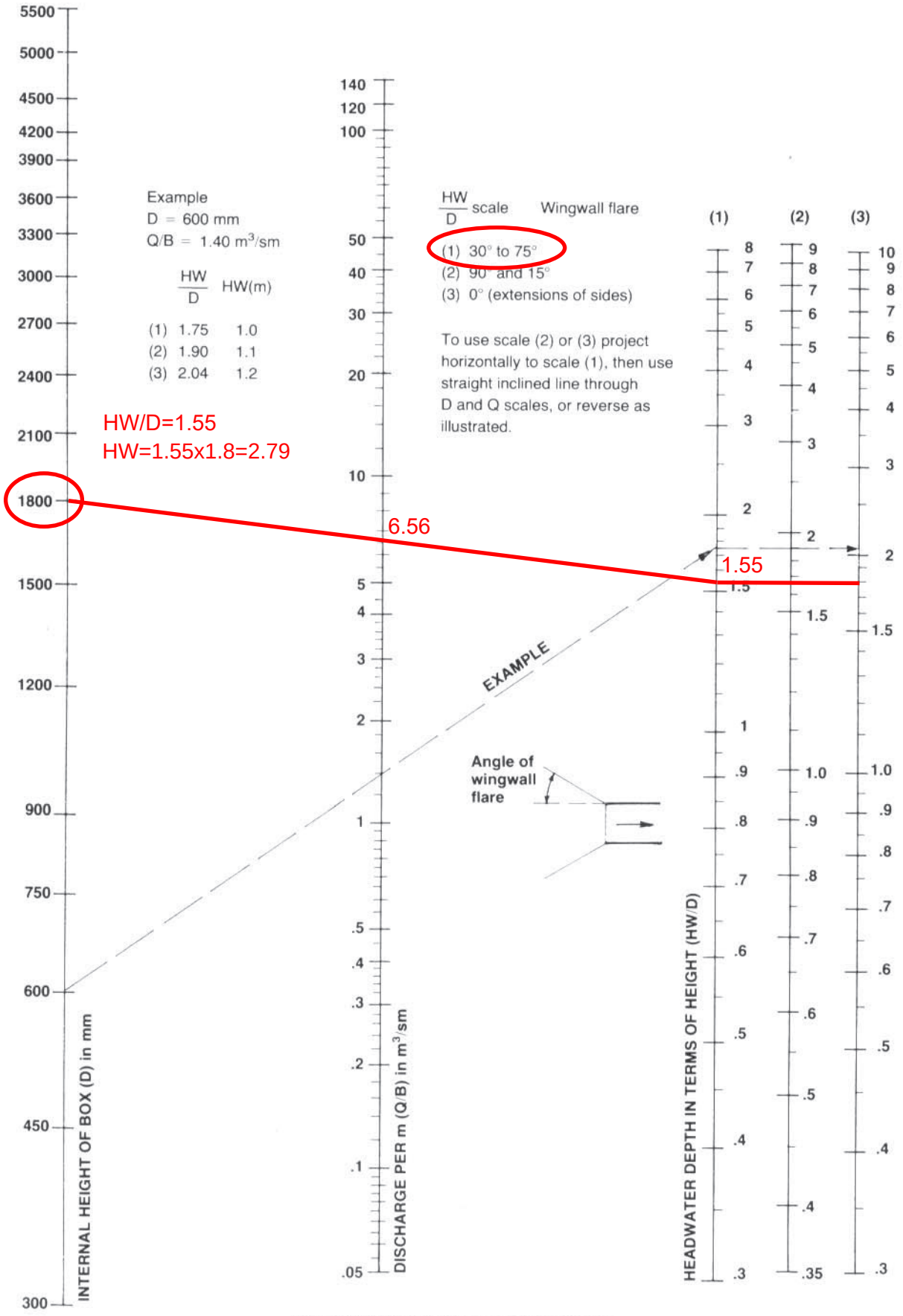
	Annual Exceedance Probability (AEP)						
Duration	**63.2%**	**50%#**	**20%***	**10%**	**5%**	**2%**	**1%**
1 min	113	129	181	219	258	314	361
2 min	94.2	107	148	178	209	250	281
3 min	87.4	99.1	138	166	195	234	265
4 min	82.4	93.5	130	157	185	223	254
5 min	78.1	88.7	124	150	176	214	244
10 min	62.2	70.8	99.3	120	142	174	200
15 min	52.0	59.1	82.9	101	119	146	168
20 min	44.8	50.9	71.5	86.6	102	125	144
25 min	39.6	45.0	63.0	76.3	90.1	110	126
30 min	35.5	40.4	56.5	68.3	80.7	98.2	113
44 min	28.0	31.7	44.3	53.5	63.0	76.4	87.4
45 min	27.6	31.3	43.6	52.7	62.1	75.3	86.0
1 hour	22.8	25.9	36.0	43.4	51.1	61.8	70.4
1.5 hour	17.3	19.7	27.3	32.9	38.6	46.6	53.0
2 hour	14.3	16.2	22.5	27.0	31.7	38.2	43.4
3 hour	10.8	12.3	17.1	20.6	24.1	29.1	33.1
4.5 hour	8.28	9.40	13.1	15.8	18.6	22.5	25.6
6 hour	6.87	7.81	10.9	13.2	15.6	18.9	21.6
9 hour	5.32	6.06	8.54	10.4	12.2	14.9	17.2
12 hour	4.45	5.08	7.19	8.75	10.4	12.7	14.7
18 hour	3.46	3.96	5.66	6.93	8.27	10.2	11.8
24 hour	2.89	3.32	4.77	5.86	7.01	8.65	10.0
30 hour	2.51	2.88	4.16	5.12	6.15	7.59	8.78
36 hour	2.23	2.56	3.71	4.58	5.51	6.79	7.85
48 hour	1.84	2.12	3.07	3.80	4.58	5.64	6.51
72 hour	1.37	1.59	2.31	2.85	3.44	4.21	4.83
96 hour	1.10	1.27	1.85	2.28	2.74	3.33	3.81

120 hour	0.917	1.06	1.54	1.89	2.26	2.74	3.12
144 hour	0.785	0.906	1.31	1.60	1.91	2.30	2.63
168 hour	0.684	0.790	1.14	1.39	1.64	1.98	2.25

Note:
The 50% AEP IFD **does not** correspond to the 2 year Average Recurrence Interval (ARI) IFD. Rather it corresponds to the 1.44 ARI.
* The 20% AEP IFD **does not** correspond to the 5 year Average Recurrence Interval (ARI) IFD. Rather it corresponds to the 4.48 ARI.

This page was created at **13:19 on Friday 18 February 2022 (AEDT)**

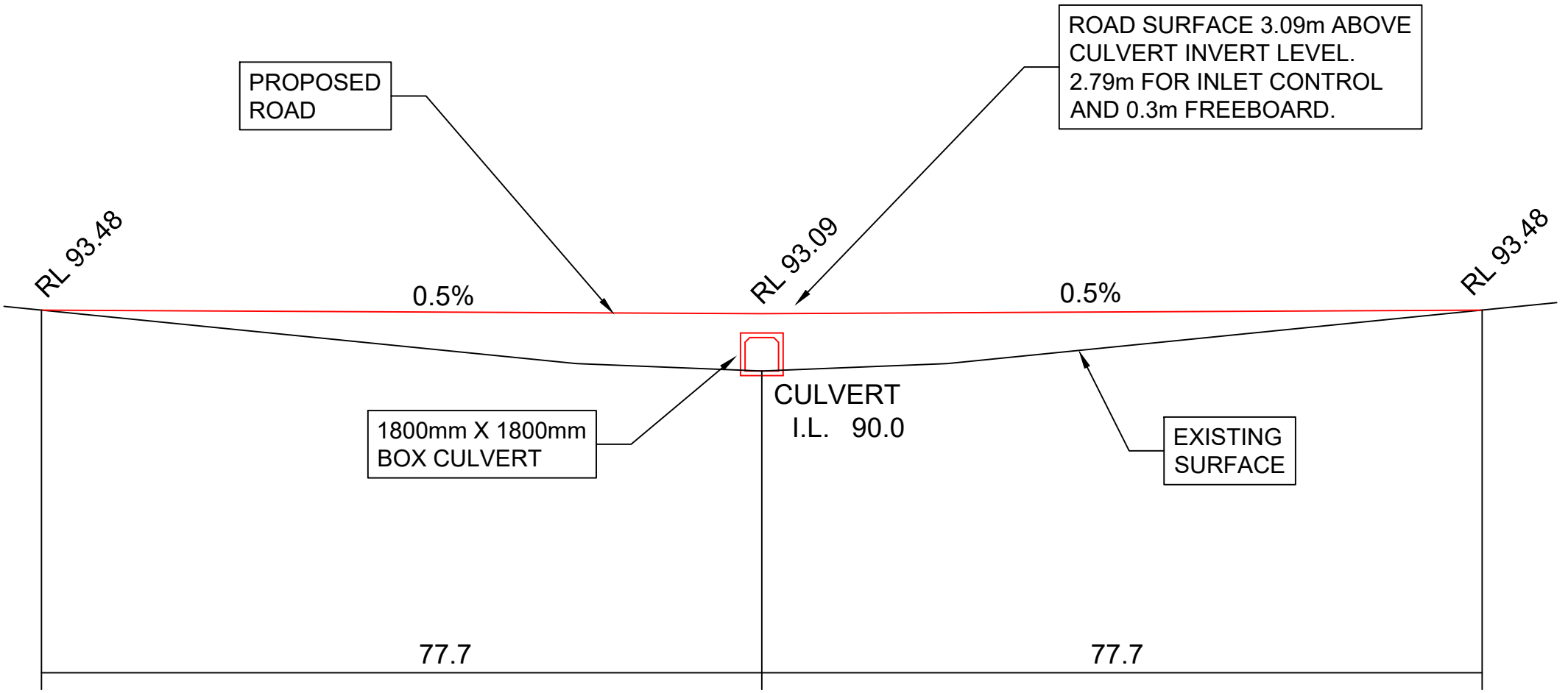
Appendix C – Inlet Control



HEADWATER DEPTH FOR BOX CULVERTS WITH INLET CONTROL

FIGURE 3.4
ADAPTED FROM [3.4]

Appendix D – Sections



CONCEPT ROAD LONGITUDINAL SECTION

EXISTING SURFACE LEVEL INTERPOLATED FROM SIX MAPS
FINAL DESIGN SUBJECT TO SITE SURVEY LEVELS

REF: 21038
DATE: 10.03.2022

6 3 0 6 12 18 24 30

SCALE IN METRES ON ORIGINAL DRAWING AT REDUCTION RATIO 1:300

CULVET SECTIONS 1 OF 2

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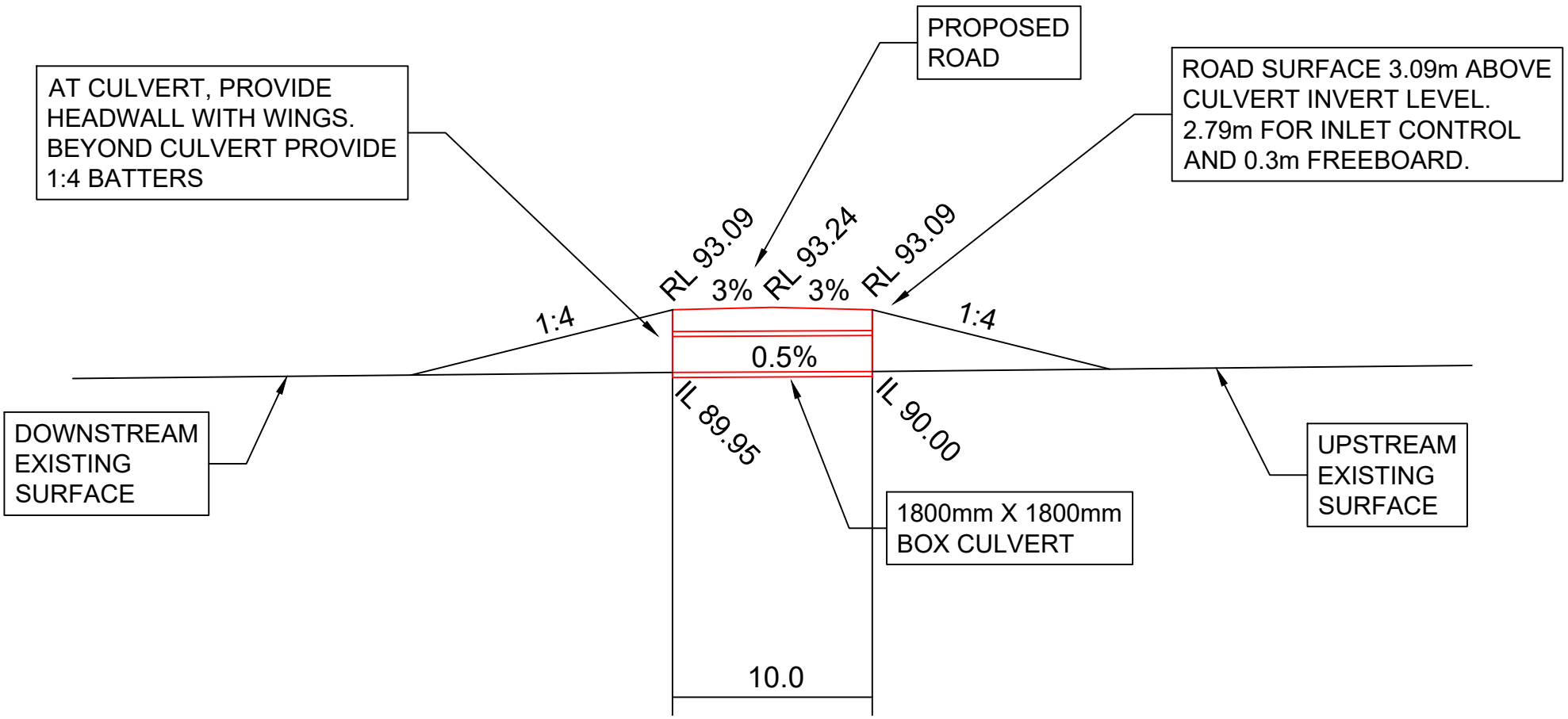

CONCEPT ROAD CROSS SECTION

EXISTING SURFACE LEVEL INTERPOLATED FROM SIX MAPS
FINAL DESIGN SUBJECT TO SITE SURVEY LEVELS

REF: 21038
DATE: 10.03.2022

6 3 0 6 12 18 24 30

SCALE IN METRES ON ORIGINAL DRAWING AT REDUCTION RATIO 1:300

CULVET SECTIONS 2 OF 2

hdb