APPENDIX FRA 6

Calculations

APPENDIX FRA 6.1

Flood Relief Channel Diversion

White Young Green

White Young Green

Project No A012564

Calculation Sheet No 1 A

Office

Division

Project Title WEST SOUTHALL

Prepared by RCB

Work Section FLOOD RELIEF CHANNEL DIVERSION

Date JUNE 2008

1 The new pumpline access entails crossings of the Yeading Brook & Flood Relief Channel (FRC)

2 The EA have requested that the length of culvert for the FRC be kept to a minimum

3 The previous approved solution entailed

1) FRC Diversion mainly open channel 3.5 bed width, 1:3 Ave side slopes

2) 25 m long culvert on FRC 5.5 m wide x 3.7 m High

3) Bridge over Yeading Brook span = 17.5 m.

4 The access road has now been re-aligned. This gives an opportunity to combine the FRC channel with the Brook and provide a larger clear span bridge.

White Young Green

Project No	A012564
Calculation Sheet No	2A
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Date	

Project Title: WEST SOUTHALL

Work Section: FRC DIVERSION

5 EA have indicated general principle to be acceptable but require a 2 stage channel. also EA have new Flood data.

6 New proposal

a) Diversion channel
- main channel 2.0 m bed 1:3 slopes
- high flow shelf approx 2 m wide 0.6 m above main invert.

b) Wider span Bridge

b) Widen Yeading Brook downstream of confluence. as (a) above.

c) reduce back to existing section at hard banked area by Railway Bridge.

7 Hecras

a) Local reach modelled using top survey data. Flows Taken from EA data (Halcrow 2004)

White Young Green

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Project Title: WEST SOUTHALL

Work Section: FRC DIVERSION

b) channel roughness = n = 0.027
Out of bank n = 0.125
gave good fit to EA DATA — sht 4A

c) Diversion added (no Bridge)
⇒ 0.02 m increase for Q_{20}
0.05 m increase for $Q_{100+20\%}$ — sht 5A

D) Bridge added to model.
Further increase of 0.01 m. — sht 6A

4 For cross section locations
see sht 9

HEC-RAS Plan: P1YB River: yeading Reach: yupper

Reach	River Sta	Profile	Q Total (m3/s)	Min Ch El (m)	W.S. Elev (m)	Crit W.S. (m)	E.G. Elev (m)	E.G. Slope (m/m)	Vel Chnl (m/s)	Flow Area (m2)	Top Width (m)	Froude # Chl	from EA model W.S elev m	
yupper	90	PF 1	12.58	24.05	26.73		26.76	0.000349	0.84	26.6	33.06	0.19	**26.74**	Q_{20}
yupper	90	PF 2	15.98	24.05	27.02		27.06	0.000312	0.87	38.28	45.15	0.19	**27.03**	Q_{100}
yupper	90	PF 3	17.71	24.05	27.21		27.24	0.000269	0.85	47.2	50.17	0.18	**27.22**	$Q_{100+20\%}$
yupper	80	PF 1	12.58	24.51	26.69		26.73	0.000446	0.87	22.34	53.11	0.22		
yupper	80	PF 2	15.98	24.51	26.99		27.03	0.000345	0.84	39.43	57.98	0.2		
yupper	80	PF 3	17.71	24.51	27.19		27.22	0.000276	0.79	50.93	59.94	0.18		
yupper	70	PF 1	12.58	24.45	26.67		26.71	0.000406	0.86	33.63	68.16	0.21		
yupper	70	PF 2	15.98	24.45	26.99		27.01	0.000284	0.8	60.07	98.43	0.18		
yupper	70	PF 3	17.71	24.45	27.18		27.2	0.00021	0.73	79.77	101.04	0.16		
yupper	60	PF 1	12.58	24.3	26.67		26.7	0.000308	0.76	30.25	78.92	0.19		
yupper	60	PF 2	15.98	24.3	26.98		27	0.000217	0.72	57.09	87.72	0.16		
yupper	60	PF 3	17.71	24.3	27.18		27.2	0.000166	0.67	74.7	90.43	0.14		
yupper	50	PF 1	12.58	24.62	26.66		26.69	0.000302	0.75	35.69	61.5	0.18		
yupper	50	PF 2	15.98	24.62	26.98		27	0.000222	0.72	55.1	61.5	0.16		
yupper	50	PF 3	17.71	24.62	27.18		27.19	0.000177	0.68	67.29	61.5	0.15		
yupper	40	PF 1	12.58	24.69	26.62		26.66	0.000446	0.89	20.68	27.55	0.22		
yupper	40	PF 2	15.98	24.69	26.94		26.98	0.000358	0.9	29.48	27.92	0.21		
yupper	40	PF 3	17.71	24.69	27.14		27.18	0.000299	0.88	35.11	28.16	0.19		
yupper	30	PF 1	12.58	24.08	26.62		26.64	0.000135	0.62	33.79	26.38	0.13	**26.65**	Q_{20}
yupper	30	PF 2	15.98	24.08	26.94		26.96	0.000134	0.67	42.21	26.87	0.13	**26.97**	Q_{100}
yupper	30	PF 3	17.71	24.08	27.14		27.16	0.000125	0.68	47.63	27.18	0.13	**27.18**	$Q_{100+20\%}$
yupper	20	PF 1	12.58	24.1	26.62		26.63	0.000101	0.43	37.33	31.54	0.11		
yupper	20	PF 2	15.98	24.1	26.94		26.95	0.000084	0.44	47.51	32.43	0.1		
yupper	20	PF 3	17.71	24.1	27.14		27.15	0.000072	0.44	54.1	33	0.1		
yupper	10	PF 1	12.58	24.57	26.58	25.34	26.62	0.000392	0.94	15.55	10	0.22	**26.58**	Q_{20}
yupper	10	PF 2	15.98	24.57	26.89	25.47	26.94	0.0004	1.03	18.75	10.66	0.22	**26.89**	Q_{100}
yupper	10	PF 3	17.71	24.57	27.09	25.52	27.14	0.000378	1.04	20.92	11.1	0.21	**27.09**	$Q_{100+20\%}$

WEST SOUTHALL
YEADING BROOK AT PUMP LANE
HECRAS CALIBRATION

HEC-RAS Plan: two stage

Reach	River Sta	Profile	Q Total (m3/s)	Min Ch El (m)	W.S. Elev (m)	Crit W.S. (m)	E.G. Elev (m)	E.G. Slope (m/m)	Vel Chnl (m/s)	Flow Area (m2)	Top Width (m)	Froude # Chl
yupper	90	Q20	12.58	24.05	26.75		26.78	0.000337	0.83	27.15	33.84	0.19
yupper	90	Q100	15.98	24.05	27.06		27.09	0.000289	0.85	39.89	43.55	0.18
yupper	90	Q100+20%	17.71	24.05	27.26		27.29	0.000244	0.83	48.74	44.58	0.17
yupper	80	Q20	12.58	24.51	26.71		26.74	0.000426	0.86	23.34	53.61	0.22
yupper	80	Q100	15.98	24.51	27.04		27.07	0.000315	0.81	41.84	58.61	0.19
yupper	80	Q100+20%	17.71	24.51	27.24		27.27	0.000246	0.76	54.23	59.99	0.17
yupper	70	Q20	12.58	24.22	26.72		26.73	0.000054	0.34	49.23	71.92	0.08
yupper	70	Q100	15.98	24.22	27.05		27.05	0.000032	0.29	78.58	99.29	0.07
yupper	70	Q100+20%	17.71	24.22	27.26		27.26	0.000022	0.26	99.24	101.99	0.06
floodchan	130	Q20	12.58	24.32	26.71		26.75	0.000256	0.87	20.15	15.48	0.18
floodchan	130	Q100	15.98	24.32	27.03		27.07	0.000253	0.95	25.5	21.75	0.18
floodchan	130	Q100+20%	17.71	24.32	27.24		27.28	0.000234	0.96	29.27	27.22	0.18
floodchan	120	Q20	12.58	24.3	26.72		26.74	0.000109	0.54	27.66	18.49	0.13
floodchan	120	Q100	15.98	24.3	27.05		27.06	0.000103	0.57	33.92	25.1	0.13
floodchan	120	Q100+20%	17.71	24.3	27.25		27.27	0.000094	0.56	38.11	30.86	0.12
floodchan	110	Q20	6.15	24.28	26.73		26.73	0.000022	0.23	45.27	59.85	0.06
floodchan	110	Q100	7.74	24.28	27.05		27.06	0.000017	0.22	66.52	70.47	0.05
floodchan	110	Q100+20%	8.94	24.28	27.26		27.26	0.000015	0.22	81.32	73.03	0.05
floodchan	100	Q20	6.15	24.25	26.73		26.73	0.00002	0.22	35.73	52.39	0.06
floodchan	100	Q100	7.74	24.25	27.05		27.06	0.000015	0.22	55.29	69.8	0.05
floodchan	100	Q100+20%	8.94	24.25	27.26		27.26	0.000013	0.22	69.57	69.8	0.05
floodchan	70	Q20	6.15	24.22	26.73		26.73	0.000012	0.16	52.88	72.21	0.04
floodchan	70	Q100	7.74	24.22	27.05		27.05	0.000007	0.14	82.2	99.32	0.03
floodchan	70	Q100+20%	8.94	24.22	27.26		27.26	0.000005	0.13	102.8	102.02	0.03
ylower	70	Q20	12.58	24.22	26.72		26.73	0.000049	0.32	52.63	71.95	0.08
ylower	70	Q100	15.98	24.22	27.05		27.05	0.00003	0.28	81.96	99.29	0.06
ylower	70	Q100+20%	17.71	24.22	27.26		27.26	0.00002	0.25	102.63	102	0.05
ylower	60	Q20	12.58	24.2	26.72		26.73	0.000081	0.4	42.39	84.11	0.1
ylower	60	Q100	15.98	24.2	27.05		27.05	0.000042	0.33	70.93	88.63	0.07
ylower	60	Q100+20%	17.71	24.2	27.26		27.26	0.000028	0.29	89.47	91.45	0.06
ylower	50	Q20	12.58	24.17	26.71		26.72	0.000085	0.44	49.63	61.5	0.1
ylower	50	Q100	15.98	24.17	27.04		27.05	0.000069	0.44	69.8	61.5	0.1
ylower	50	Q100+20%	17.71	24.17	27.25		27.26	0.000059	0.44	82.46	61.5	0.09

WEST SOUTHALL
YEADING BROOK AT PUMP LANE
TWO STAGE DIVERSION CHANNEL

HEC-RAS Plan: two stage

Reach	River Sta	Profile	Q Total (m3/s)	Min Ch El (m)	W.S. Elev (m)	Crit W.S. (m)	E.G. Elev (m)	E.G. Slope (m/m)	Vel Chnl (m/s)	Flow Area (m2)	Top Width (m)	Froude # Chl
ylower	40	Q20	12.58	24.15	26.71		26.72	0.000091	0.45	32.83	27.65	0.11
ylower	40	Q100	15.98	24.15	27.04		27.05	0.000081	0.48	41.94	28.04	0.11
ylower	40	Q100+20%	17.71	24.15	27.24		27.25	0.000071	0.48	47.72	28.28	0.1
ylower	35	Q20	12.58	24.06	26.71		26.71	0.000069	0.36	37.68	33.79	0.09
ylower	35	Q100	15.98	24.06	27.04		27.04	0.000057	0.38	49.02	35.27	0.09
ylower	35	Q100+20%	17.71	24.06	27.24		27.25	0.000049	0.37	56.39	36.2	0.08
ylower	30	Q20	18.73	24.08	26.67		26.71	0.000276	0.9	35.1	26.46	0.18
ylower	30	Q100	23.72	24.08	27		27.04	0.000272	0.97	43.75	26.96	0.19
ylower	30	Q100+20%	26.65	24.08	27.2		27.24	0.00026	0.99	49.3	27.27	0.18
ylower	20	Q20	18.73	24.1	26.67		26.69	0.0002	0.61	38.91	31.68	0.16
ylower	20	Q100	23.72	24.1	27		27.02	0.000165	0.63	49.44	32.6	0.15
ylower	20	Q100+20%	26.65	24.1	27.21		27.23	0.000146	0.64	56.24	33.18	0.14
ylower	10	Q20	18.73	24.57	26.58	25.56	26.68	0.000234	1.4	15.55	10	0.32
ylower	10	Q100	23.72	24.57	26.89	25.72	27.01	0.000237	1.52	18.75	10.66	0.32
ylower	10	Q100+20%	26.65	24.57	27.09	25.8	27.21	0.00023	1.57	20.92	11.1	0.32

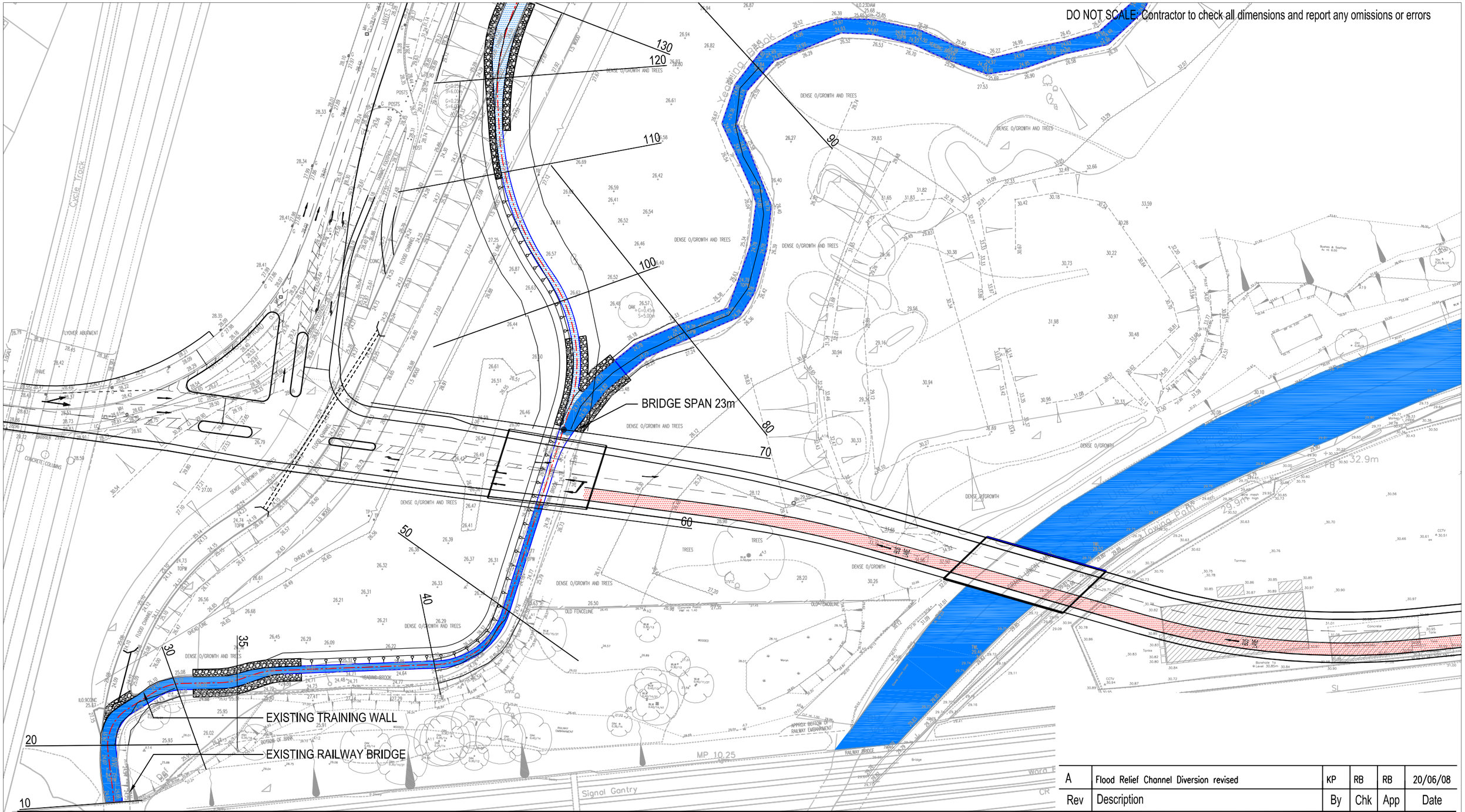
HEC-RAS Plan: Plan 01

Reach	River Sta	Profile	Q Total (m3/s)	Min Ch El (m)	W.S. Elev (m)	Crit W.S. (m)	E.G. Elev (m)	E.G. Slope (m/m)	Vel Chnl (m/s)	Flow Area (m2)	Top Width (m)	Froude # Chl
yupper	90	Q20	12.58	24.05	26.75		26.78	0.00033	0.82	27.47	34.27	0.19
yupper	90	Q100	15.98	24.05	27.07		27.1	0.000283	0.84	40.59	46.5	0.18
yupper	90	Q100+20%	17.71	24.05	27.27		27.3	0.000239	0.82	50.49	51.89	0.17
yupper	80	Q20	12.58	24.51	26.72		26.75	0.000415	0.85	23.89	53.76	0.21
yupper	80	Q100	15.98	24.51	27.05		27.08	0.000306	0.8	42.58	58.8	0.19
yupper	80	Q100+20%	17.71	24.51	27.26		27.28	0.000239	0.75	54.99	60.01	0.17
yupper	70	Q20	12.58	24.22	26.73		26.74	0.000053	0.33	49.95	72.68	0.08
yupper	70	Q100	15.98	24.22	27.06		27.07	0.000031	0.29	79.79	99.45	0.06
yupper	70	Q100+20%	17.71	24.22	27.27		27.27	0.000021	0.26	100.51	102.16	0.05
floodchan	130	Q20	12.58	24.32	26.72		26.76	0.000252	0.87	20.31	15.55	0.18
floodchan	130	Q100	15.98	24.32	27.04		27.09	0.000248	0.94	26.19	22.1	0.18
floodchan	130	Q100+20%	17.71	24.32	27.25		27.29	0.000228	0.95	31.26	27.59	0.18
floodchan	120	Q20	12.58	24.3	26.73		26.75	0.000107	0.54	27.86	18.54	0.13
floodchan	120	Q100	15.98	24.3	27.06		27.07	0.000101	0.56	34.18	25.46	0.13
floodchan	120	Q100+20%	17.71	24.3	27.26		27.28	0.000092	0.56	38.38	31.23	0.12
floodchan	110	Q20	6.15	24.28	26.74		26.74	0.000033	0.28	29.21	42.3	0.07
floodchan	110	Q100	7.74	24.28	27.07		27.07	0.000028	0.28	44.69	51.99	0.07
floodchan	110	Q100+20%	8.94	24.28	27.27		27.27	0.000026	0.29	55.61	53.6	0.07
floodchan	100	Q20	6.15	24.25	26.74		26.74	0.000021	0.22	32.17	37.47	0.06
floodchan	100	Q100	7.74	24.25	27.07		27.07	0.000018	0.23	44.48	37.47	0.05
floodchan	100	Q100+20%	8.94	24.25	27.27		27.27	0.000017	0.23	52.14	37.47	0.05
floodchan	70	Q20	6.15	24.22	26.74		26.74	0.000011	0.16	53.24	68.33	0.04
floodchan	70	Q100	7.74	24.22	27.07		27.07	0.000007	0.14	77.76	78.08	0.03
floodchan	70	Q100+20%	8.94	24.22	27.27		27.27	0.000005	0.13	94.02	80.78	0.03
ylower	70	Q20	12.58	24.22	26.73	25.06	26.74	0.000053	0.33	49.95	72.68	0.08
ylower	70	Q100	15.98	24.22	27.06	25.18	27.07	0.000031	0.29	79.79	99.45	0.06
ylower	70	Q100+20%	17.71	24.22	27.27	25.24	27.27	0.000021	0.26	100.51	102.16	0.05
ylower	65	Bridge										
ylower	60	Q20	12.58	24.2	26.73		26.73	0.000094	0.43	34.65	41.92	0.11
ylower	60	Q100	15.98	24.2	27.06		27.06	0.000066	0.4	49.22	46.43	0.09
ylower	60	Q100+20%	17.71	24.2	27.26		27.27	0.000051	0.37	59.07	49.25	0.08

HEC-RAS Plan: Plan 01

Reach	River Sta	Profile	Q Total (m3/s)	Min Ch El (m)	W.S. Elev (m)	Crit W.S. (m)	E.G. Elev (m)	E.G. Slope (m/m)	Vel Chnl (m/s)	Flow Area (m2)	Top Width (m)	Froude # Chl
ylower	50	Q20	12.58	24.17	26.71		26.73	0.000147	0.62	34.26	30.5	0.14
ylower	50	Q100	15.98	24.17	27.04		27.06	0.000133	0.65	44.24	30.5	0.14
ylower	50	Q100+20%	17.71	24.17	27.24		27.26	0.000118	0.65	50.51	30.5	0.13
ylower	40	Q20	12.58	24.15	26.7		26.73	0.000166	0.64	23.05	12.64	0.15
ylower	40	Q100	15.98	24.15	27.03		27.05	0.000159	0.7	27.22	13.03	0.15
ylower	40	Q100+20%	17.71	24.15	27.23		27.26	0.000146	0.71	29.91	13.27	0.15
ylower	35	Q20	12.58	24.06	26.7		26.71	0.000124	0.61	31.42	21.74	0.13
ylower	35	Q100	15.98	24.06	27.02		27.04	0.000122	0.66	38.74	23.21	0.13
ylower	35	Q100+20%	17.71	24.06	27.23		27.25	0.000113	0.67	43.61	24.13	0.13
ylower	30	Q20	18.73	24.08	26.67		26.71	0.000276	0.9	35.1	26.46	0.18
ylower	30	Q100	23.72	24.08	27		27.04	0.000272	0.97	43.75	26.96	0.19
ylower	30	Q100+20%	26.65	24.08	27.2		27.24	0.00026	0.99	49.3	27.27	0.18
ylower	20	Q20	18.73	24.1	26.67		26.69	0.0002	0.61	38.91	31.68	0.16
ylower	20	Q100	23.72	24.1	27		27.02	0.000165	0.63	49.44	32.6	0.15
ylower	20	Q100+20%	26.65	24.1	27.21		27.23	0.000146	0.64	56.24	33.18	0.14
ylower	10	Q20	18.73	24.57	26.58	25.56	26.68	0.000234	1.4	15.55	10	0.32
ylower	10	Q100	23.72	24.57	26.89	25.72	27.01	0.000237	1.52	18.75	10.66	0.32
ylower	10	Q100+20%	26.65	24.57	27.09	25.8	27.21	0.00023	1.57	20.92	11.1	0.32

DO NOT SCALE: Contractor to check all dimensions and report any omissions or errors



Rev	Description	By	Chk	App	Date
A	Flood Relief Channel Diversion revised	KP	RB	RB	20/06/08

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Civil Structural Mechanical Electrical Process Rail Traffic Environmental Project Management

Project:
WEST SOUTHALL
YEADING BROOK
FLOOD RISK ASSESSMENT

Client:

Drawing Title:
CROSS SECTIONS FOR
LOCAL HECRAS MODEL

Scale at A3	Drawn By	Date	Checked By	Date	Approved By	Date
1:1000	*DW*	*07/03/08*	*R.C.B.*	*07/03/08*	*R.C.B.*	*07/03/08*

Project No.	Office	Discipline	Drawing No.	Revision
A012564	28	C	SK107	A

APPENDIX FRA 6.2

Surface Water Attenuation

White Young Green

Project No	A0 12564
Calculation Sheet No	1
Office	
Division	
Project Title	WEST SOUTHALL
Prepared by	RCB
Work Section	SW ATTENUATION – PUMP LANE
Date	7/1/07

USING IOH FIGURES FOR DISCHARGE

Q_{BAR} = 16 l/s/ha

Q_{100} = 24 l/s/ha (sht 15)

New impermeable area = 4600 m²

Hence discharge @ 50mm/hr = 66 l/s.

For permitted discharge of 24/s/ha

at 1:100yr ≈ 11.5 l/s.

Use Top portion of old outfall channel. say 54 m × 5.5m bed width + 1:3 side slopes

– Using 100ϕ ×10 m Thrttle pipe (sht 3)

= storage required = 145 m³ at 0.513 m³ depth.

peak flow = 11.4 @ 1:100yr.

For 100 yr + 30% rainfall (sht 6)

storage 261 m³

@ depth 0.644 m

peak flow 12.6 l/s.

White Young Green

White Young Green

Project No	AO12564
Calculation Sheet No	2
Office	
Division	

Project Title	West southall.	Prepared by	R.C.B
Work Section	S.W. Attenuation – Pump Lane.	Date	7/1/07

or using MOS profile hydro brake.

- 147 mm dia (sht 9)

for 1:100 yr. storage = 193 m³

at depth = 0.509 m

peak flow = 10.3 l/s

for 1:100 yr + 30% rainfall. (sht 13)

storage = 262 m³

at depth = 0.652 m

peak flow = 10.9 l/s

White Young Green
Brigantine House
27-31 Cumberland Street
Bristol BS2 8NL

West Southall
Pump Lane Link Road
Attenuation

Date Jan 07
File pump lane 2007.SRC
Micro Drainage

Designed By RCB
Checked By
Source Control W.10.3

Summary of Results for 100 year Return Period

Storm Duration (mins)	Maximum Control (l/s)	Maximum Overflow (l/s)	Maximum Outflow (l/s)	Maximum Water Level (m OD)	Maximum Depth (m)	Overflow Volume (m^3)	Maximum Volume (m^3)	Status
30 Summer	10.4	0.0	10.4	25.5273	0.4272	0.0	156.4	O K
60 Summer	10.7	0.0	10.7	25.5538	0.4537	0.0	168.1	O K
120 Summer	10.8	0.0	10.8	25.5603	0.4602	0.0	171.0	O K
180 Summer	10.7	0.0	10.7	25.5553	0.4552	0.0	168.7	O K
240 Summer	10.7	0.0	10.7	25.5488	0.4487	0.0	165.9	O K
360 Summer	10.5	0.0	10.5	25.5323	0.4322	0.0	158.7	O K
480 Summer	10.2	0.0	10.2	25.5143	0.4142	0.0	150.8	O K
600 Summer	10.0	0.0	10.0	25.4958	0.3957	0.0	142.9	O K
720 Summer	9.8	0.0	9.8	25.4778	0.3777	0.0	135.2	O K
960 Summer	9.3	0.0	9.3	25.4453	0.3452	0.0	121.9	O K
1440 Summer	8.6	0.0	8.6	25.3913	0.2912	0.0	100.2	O K
30 Winter	10.9	0.0	10.9	25.5717	0.4717	0.0	176.1	O K
60 Winter	11.3	0.0	11.3	25.6023	0.5022	0.0	190.0	O K
120 Winter	11.4	0.0	11.4	25.6128	0.5127	0.0	195.0	O K
180 Winter	11.3	0.0	11.3	25.6038	0.5037	0.0	190.8	O K
240 Winter	11.2	0.0	11.2	25.5948	0.4947	0.0	186.6	O K
360 Winter	10.9	0.0	10.9	25.5713	0.4712	0.0	175.8	O K
480 Winter	10.6	0.0	10.6	25.5442	0.4442	0.0	163.9	O K
600 Winter	10.3	0.0	10.3	25.5173	0.4172	0.0	152.2	O K
720 Winter	10.0	0.0	10.0	25.4917	0.3917	0.0	141.1	O K
960 Winter	9.4	0.0	9.4	25.4463	0.3462	0.0	122.1	O K
1440 Winter	8.3	0.0	8.3	25.3718	0.2717	0.0	92.7	O K

Storm Duration (mins)	Rain (mm/hr)	Time-Peak (mins)
30 Summer	94.04	35
60 Summer	53.46	64
120 Summer	30.38	116
180 Summer	21.83	144
240 Summer	17.27	176
360 Summer	12.41	244
480 Summer	9.82	312
600 Summer	8.18	380
720 Summer	7.05	446
960 Summer	5.60	578
1440 Summer	4.05	828
30 Winter	94.04	35
60 Winter	53.46	62
120 Winter	30.38	118
180 Winter	21.83	150
240 Winter	17.27	186
360 Winter	12.41	264
480 Winter	9.82	338
600 Winter	8.18	408
720 Winter	7.05	478
960 Winter	5.60	612
1440 Winter	4.05	868

Rainfall Details

Region	FEH Rainfall Model
Return Period (years)	100
Site Location	511550 179950 TQ 11550 79950
C (1km)	-0.025
D1 (1km)	0.300
D2 (1km)	0.315
D3 (1km)	0.233
E (1km)	0.308
F (1km)	2.562
Cv (Summer)	0.750
Cv (Winter)	0.840
Shortest Storm (mins)	30
Longest Storm (mins)	1440
Summer Storms	Yes
Winter Storms	Yes
Climate Change %	+0

Time / Area Diagram

Total Area (ha) = 0.480

Time from:	(mins) to:	Area (ha)	Time from:	(mins) to:	Area (ha)
0	4	0.240	4	8	0.240

Tank/Pond Details

Invert Level (m) 25.100 Ground Level (m) 26.500

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.00	297.0	0.60	491.0	1.20	621.0	1.80	621.0	2.40	621.0
0.10	329.0	0.70	524.0	1.30	621.0	1.90	621.0	2.50	621.0
0.20	362.0	0.80	556.0	1.40	621.0	2.00	621.0		
0.30	394.0	0.90	589.0	1.50	621.0	2.10	621.0		
0.40	427.0	1.00	621.0	1.60	621.0	2.20	621.0		
0.50	459.0	1.10	621.0	1.70	621.0	2.30	621.0		

Pipe Outflow Control

Pipe Diameter (m)	0.100	Roughness (mm)	0.600	Invert Level (m)	25.100
Slope (1:x)	100.0	Entry Loss Coef	0.500		
Length (m)	10.000	Coef of Contraction	0.600		

Weir / Flume Overflow Control

Discharge Coef 0.544 Width (m) 1.000 Crest Level (m) 26.000

White Young Green
Brigantine House
27-31 Cumberland Street
Bristol BS2 8NL

Date Jan 07	West Southall
File pump lane 2007.SRC	Pump Lane Link Road
Micro Drainage	Attenuation
	Designed By RCB
	Checked By
	Source Control W.10.3

Summary of Results for 100 year Return Period (+30%)

Storm Duration (mins)	Maximum Control (l/s)	Maximum Overflow (l/s)	Maximum Outflow (l/s)	Maximum Water Level (m OD)	Maximum Depth (m)	Overflow Volume (m^3)	Maximum Volume (m^3)	Status
30 Summer	11.6	0.0	11.6	25.6348	0.5347	0.0	205.2	O K
60 Summer	12.0	0.0	12.0	25.6703	0.5702	0.0	222.0	O K
120 Summer	12.2	0.0	12.2	25.6843	0.5843	0.0	228.8	O K
180 Summer	12.1	0.0	12.1	25.6783	0.5783	0.0	226.0	O K
240 Summer	12.0	0.0	12.0	25.6713	0.5712	0.0	222.6	O K
360 Summer	11.9	0.0	11.9	25.6543	0.5542	0.0	214.4	O K
480 Summer	11.6	0.0	11.6	25.6348	0.5347	0.0	205.1	O K
600 Summer	11.4	0.0	11.4	25.6148	0.5147	0.0	195.7	O K
720 Summer	11.2	0.0	11.2	25.5942	0.4942	0.0	186.4	O K
960 Summer	10.8	0.0	10.8	25.5582	0.4582	0.0	170.2	O K
1440 Summer	10.0	0.0	10.0	25.4953	0.3952	0.0	142.7	O K
30 Winter	12.2	0.0	12.2	25.6888	0.5888	0.0	230.9	O K
60 Winter	12.6	0.0	12.6	25.7288	0.6288	0.0	250.7	O K
120 Winter	12.8	0.0	12.8	25.7483	0.6483	0.0	260.7	O K
180 Winter	12.8	0.0	12.8	25.7423	0.6423	0.0	257.5	O K
240 Winter	12.7	0.0	12.7	25.7313	0.6313	0.0	252.0	O K
360 Winter	12.4	0.0	12.4	25.7078	0.6078	0.0	240.4	O K
480 Winter	12.1	0.0	12.1	25.6803	0.5803	0.0	226.7	O K
600 Winter	11.8	0.0	11.8	25.6513	0.5512	0.0	212.9	O K
720 Winter	11.5	0.0	11.5	25.6228	0.5227	0.0	199.4	O K
960 Winter	10.9	0.0	10.9	25.5712	0.4712	0.0	175.8	O K
1440 Winter	9.8	0.0	9.8	25.4833	0.3832	0.0	137.5	O K

Storm Duration (mins)	Rain (mm/hr)	Time-Peak (mins)
30 Summer	94.04	36
60 Summer	53.46	64
120 Summer	30.38	120
180 Summer	21.83	154
240 Summer	17.27	184
360 Summer	12.41	250
480 Summer	9.82	318
600 Summer	8.18	386
720 Summer	7.05	454
960 Summer	5.60	588
1440 Summer	4.05	842
30 Winter	94.04	35
60 Winter	53.46	64
120 Winter	30.38	118
180 Winter	21.83	170
240 Winter	17.27	194
360 Winter	12.41	270
480 Winter	9.82	344
600 Winter	8.18	418
720 Winter	7.05	490
960 Winter	5.60	628
1440 Winter	4.05	894

Rainfall Details

Region	FEH Rainfall Model
Return Period (years)	100
Site Location	511550 179950 TQ 11550 79950
C (1km)	-0.025
D1 (1km)	0.300
D2 (1km)	0.315
D3 (1km)	0.233
E (1km)	0.308
F (1km)	2.562
Cv (Summer)	0.750
Cv (Winter)	0.840
Shortest Storm (mins)	30
Longest Storm (mins)	1440
Summer Storms	Yes
Winter Storms	Yes
Climate Change %	+30

Time / Area Diagram

Total Area (ha) = 0.480

Time from:	(mins) to:	Area (ha)	Time from:	(mins) to:	Area (ha)
0	4	0.240	4	8	0.240

Tank/Pond Details

Invert Level (m) 25.100 Ground Level (m) 26.500

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.00	297.0	0.60	491.0	1.20	621.0	1.80	621.0	2.40	621.0
0.10	329.0	0.70	524.0	1.30	621.0	1.90	621.0	2.50	621.0
0.20	362.0	0.80	556.0	1.40	621.0	2.00	621.0		
0.30	394.0	0.90	589.0	1.50	621.0	2.10	621.0		
0.40	427.0	1.00	621.0	1.60	621.0	2.20	621.0		
0.50	459.0	1.10	621.0	1.70	621.0	2.30	621.0		

Pipe Outflow Control

Pipe Diameter (m)	0.100	Roughness (mm)	0.600	Invert Level (m)	25.100
Slope (1:x)	100.0	Entry Loss Coef	0.500		
Length (m)	10.000	Coef of Contraction	0.600		

Weir / Flume Overflow Control

Discharge Coef 0.544 Width (m) 1.000 Crest Level (m) 26.000

White Young Green		Page 1
Brigantine House	West Southall	
27-31 Cumberland Street	Pump Lane Link Road	
Bristol BS2 8NL	Attenuation	
Date Jan 07	Designed By RCB	
File pump lane 2007.SRC	Checked By	
Micro Drainage	Source Control W.10.3	

Summary of Results for 100 year Return Period

Storm Duration (mins)	Maximum Control (l/s)	Maximum Overflow (l/s)	Maximum Outflow (l/s)	Maximum Water Level (m OD)	Maximum Depth (m)	Overflow Volume (m^3)	Maximum Volume (m^3)	Status
30 Summer	10.3	0.0	10.3	25.5238	0.4237	0.0	155.0	O K
60 Summer	10.3	0.0	10.3	25.5493	0.4492	0.0	166.2	O K
120 Summer	10.3	0.0	10.3	25.5538	0.4537	0.0	168.1	O K
180 Summer	10.3	0.0	10.3	25.5443	0.4442	0.0	164.0	O K
240 Summer	10.3	0.0	10.3	25.5348	0.4347	0.0	159.6	O K
360 Summer	10.3	0.0	10.3	25.5123	0.4122	0.0	149.9	O K
480 Summer	10.3	0.0	10.3	25.4883	0.3882	0.0	139.7	O K
600 Summer	10.3	0.0	10.3	25.4643	0.3642	0.0	129.7	O K
720 Summer	10.3	0.0	10.3	25.4418	0.3417	0.0	120.3	O K
960 Summer	10.3	0.0	10.3	25.4023	0.3022	0.0	104.5	O K
1440 Summer	9.8	0.0	9.8	25.3428	0.2427	0.0	81.7	O K
30 Winter	10.3	0.0	10.3	25.5693	0.4692	0.0	175.1	O K
60 Winter	10.3	0.0	10.3	25.5993	0.4992	0.0	188.6	O K
120 Winter	10.3	0.0	10.3	25.6093	0.5092	0.0	193.2	O K
180 Winter	10.3	0.0	10.3	25.5972	0.4972	0.0	187.8	O K
240 Winter	10.3	0.0	10.3	25.5832	0.4832	0.0	181.4	O K
360 Winter	10.3	0.0	10.3	25.5522	0.4522	0.0	167.4	O K
480 Winter	10.3	0.0	10.3	25.5178	0.4177	0.0	152.3	O K
600 Winter	10.3	0.0	10.3	25.4828	0.3827	0.0	137.3	O K
720 Winter	10.3	0.0	10.3	25.4488	0.3487	0.0	123.3	O K
960 Winter	10.3	0.0	10.3	25.3918	0.2917	0.0	100.5	O K
1440 Winter	9.5	0.0	9.5	25.3123	0.2122	0.0	70.4	O K

Storm Duration (mins)	Rain (mm/hr)	Time-Peak (mins)
30 Summer	94.04	35
60 Summer	53.46	64
120 Summer	30.38	120
180 Summer	21.83	146
240 Summer	17.27	178
360 Summer	12.41	244
480 Summer	9.82	312
600 Summer	8.18	378
720 Summer	7.05	442
960 Summer	5.60	568
1440 Summer	4.05	810
30 Winter	94.04	35
60 Winter	53.46	64
120 Winter	30.38	118
180 Winter	21.83	170
240 Winter	17.27	190
360 Winter	12.41	266
480 Winter	9.82	340
600 Winter	8.18	408
720 Winter	7.05	474
960 Winter	5.60	598
1440 Winter	4.05	828

Rainfall Details

Region	FEH Rainfall Model
Return Period (years)	100
Site Location	511550 179950 TQ 11550 79950
C (1km)	-0.025
D1 (1km)	0.300
D2 (1km)	0.315
D3 (1km)	0.233
E (1km)	0.308
F (1km)	2.562
Cv (Summer)	0.750
Cv (Winter)	0.840
Shortest Storm (mins)	30
Longest Storm (mins)	1440
Summer Storms	Yes
Winter Storms	Yes
Climate Change %	+0

Time / Area Diagram

Total Area (ha) = 0.480

Time from:	(mins) to:	Area (ha)	Time from:	(mins) to:	Area (ha)
0	4	0.240	4	8	0.240

Tank/Pond Details

Invert Level (m) 25.100 Ground Level (m) 26.500

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.00	297.0	0.60	491.0	1.20	621.0	1.80	621.0	2.40	621.0
0.10	329.0	0.70	524.0	1.30	621.0	1.90	621.0	2.50	621.0
0.20	362.0	0.80	556.0	1.40	621.0	2.00	621.0		
0.30	394.0	0.90	589.0	1.50	621.0	2.10	621.0		
0.40	427.0	1.00	621.0	1.60	621.0	2.20	621.0		
0.50	459.0	1.10	621.0	1.70	621.0	2.30	621.0		

Hydro-Brake Outflow Control

Design Head (m) 0.750 Hydro-Brake Type MD5 Invert Level (m) 25.100
Design Flow (l/s) 11.5 Diameter (mm) 147

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.10	4.9	0.80	11.7	2.00	18.3	4.00	25.9	7.00	34.3
0.20	9.3	1.00	13.0	2.20	19.2	4.50	27.5	7.50	35.5
0.30	10.3	1.20	14.2	2.40	20.1	5.00	29.0	8.00	36.6
0.40	10.2	1.40	15.3	2.60	20.9	5.50	30.4	8.50	37.8
0.50	10.3	1.60	16.4	3.00	22.4	6.00	31.7	9.00	38.9
0.60	10.6	1.80	17.4	3.50	24.2	6.50	33.0	9.50	39.9

Weir / Flume Overflow Control

Discharge Coef 0.544 Width (m) 1.000 Crest Level (m) 26.000

White Young Green		Page 1
Brigantine House 27-31 Cumberland Street Bristol BS2 8NL	West Southall Pump Lane Link Road Attenuation	Micro Drainage
Date Jan 07 File pump lane 2007.SRC	Designed By RCB Checked By	
Micro Drainage	Source Control W.10.3	

Summary of Results for 100 year Return Period (+30%)

Storm Duration (mins)	Maximum Control (l/s)	Maximum Overflow (l/s)	Maximum Outflow (l/s)	Maximum Water Level (m OD)	Maximum Depth (m)	Overflow Volume (m^3)	Maximum Volume (m^3)	Status
30 Summer	10.4	0.0	10.4	25.6343	0.5342	0.0	204.8	O K
60 Summer	10.5	0.0	10.5	25.6703	0.5702	0.0	222.0	O K
120 Summer	10.6	0.0	10.6	25.6863	0.5863	0.0	229.7	O K
180 Summer	10.5	0.0	10.5	25.6783	0.5783	0.0	225.8	O K
240 Summer	10.5	0.0	10.5	25.6678	0.5677	0.0	220.8	O K
360 Summer	10.4	0.0	10.4	25.6458	0.5457	0.0	210.3	O K
480 Summer	10.3	0.0	10.3	25.6218	0.5217	0.0	199.1	O K
600 Summer	10.3	0.0	10.3	25.5977	0.4977	0.0	187.9	O K
720 Summer	10.3	0.0	10.3	25.5732	0.4732	0.0	176.9	O K
960 Summer	10.3	0.0	10.3	25.5293	0.4292	0.0	157.3	O K
1440 Summer	10.3	0.0	10.3	25.4498	0.3497	0.0	123.7	O K
30 Winter	10.6	0.0	10.6	25.6888	0.5888	0.0	230.9	O K
60 Winter	10.8	0.0	10.8	25.7298	0.6298	0.0	251.3	O K
120 Winter	10.9	0.0	10.9	25.7518	0.6518	0.0	262.3	O K
180 Winter	10.9	0.0	10.9	25.7473	0.6473	0.0	260.0	O K
240 Winter	10.8	0.0	10.8	25.7328	0.6328	0.0	252.7	O K
360 Winter	10.6	0.0	10.6	25.7043	0.6043	0.0	238.7	O K
480 Winter	10.5	0.0	10.5	25.6723	0.5722	0.0	223.1	O K
600 Winter	10.4	0.0	10.4	25.6388	0.5387	0.0	207.0	O K
720 Winter	10.3	0.0	10.3	25.6042	0.5042	0.0	190.9	O K
960 Winter	10.3	0.0	10.3	25.5382	0.4382	0.0	161.2	O K
1440 Winter	10.3	0.0	10.3	25.4208	0.3207	0.0	111.9	O K

Storm Duration (mins)	Rain (mm/hr)	Time-Peak (mins)
30 Summer	94.04	36
60 Summer	53.46	64
120 Summer	30.38	122
180 Summer	21.83	166
240 Summer	17.27	194
360 Summer	12.41	258
480 Summer	9.82	326
600 Summer	8.18	392
720 Summer	7.05	460
960 Summer	5.60	592
1440 Summer	4.05	840
30 Winter	94.04	36
60 Winter	53.46	64
120 Winter	30.38	120
180 Winter	21.83	174
240 Winter	17.27	222
360 Winter	12.41	278
480 Winter	9.82	354
600 Winter	8.18	428
720 Winter	7.05	500
960 Winter	5.60	636
1440 Winter	4.05	880

Rainfall Details

Region	FEH Rainfall Model
Return Period (years)	100
Site Location	511550 179950 TQ 11550 79950
C (1km)	-0.025
D1 (1km)	0.300
D2 (1km)	0.315
D3 (1km)	0.233
E (1km)	0.308
F (1km)	2.562
Cv (Summer)	0.750
Cv (Winter)	0.840
Shortest Storm (mins)	30
Longest Storm (mins)	1440
Summer Storms	Yes
Winter Storms	Yes
Climate Change %	+30

Time / Area Diagram

Total Area (ha) = 0.480

Time from:	(mins) to:	Area (ha)	Time from:	(mins) to:	Area (ha)
0	4	0.240	4	8	0.240

Tank/Pond Details

Invert Level (m) 25.100 Ground Level (m) 26.500

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.00	297.0	0.60	491.0	1.20	621.0	1.80	621.0	2.40	621.0
0.10	329.0	0.70	524.0	1.30	621.0	1.90	621.0	2.50	621.0
0.20	362.0	0.80	556.0	1.40	621.0	2.00	621.0		
0.30	394.0	0.90	589.0	1.50	621.0	2.10	621.0		
0.40	427.0	1.00	621.0	1.60	621.0	2.20	621.0		
0.50	459.0	1.10	621.0	1.70	621.0	2.30	621.0		

Hydro-Brake Outflow Control

Design Head (m) 0.750 Hydro-Brake Type MD5 Invert Level (m) 25.100
Design Flow (l/s) 11.5 Diameter (mm) 147

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.10	4.9	0.80	11.7	2.00	18.3	4.00	25.9	7.00	34.3
0.20	9.3	1.00	13.0	2.20	19.2	4.50	27.5	7.50	35.5
0.30	10.3	1.20	14.2	2.40	20.1	5.00	29.0	8.00	36.6
0.40	10.2	1.40	15.3	2.60	20.9	5.50	30.4	8.50	37.8
0.50	10.3	1.60	16.4	3.00	22.4	6.00	31.7	9.00	38.9
0.60	10.6	1.80	17.4	3.50	24.2	6.50	33.0	9.50	39.9

Weir / Flume Overflow Control

Discharge Coef 0.544 Width (m) 1.000 Crest Level (m) 26.000

White Young Green		Page 1
Portland Square 22-24 Portland House Bristol BS2 8RZ		Micro Drainage
Date File	Designed By Checked By	
CADS	Source Control W.9.4	

IoH 124 Mean Annual Flood

Input

Return Period (years)	100	Soil	0.500
Area (Ha)	1.000	Urban	0.000
SAAR (mm)	641.000	Region Number	6.000

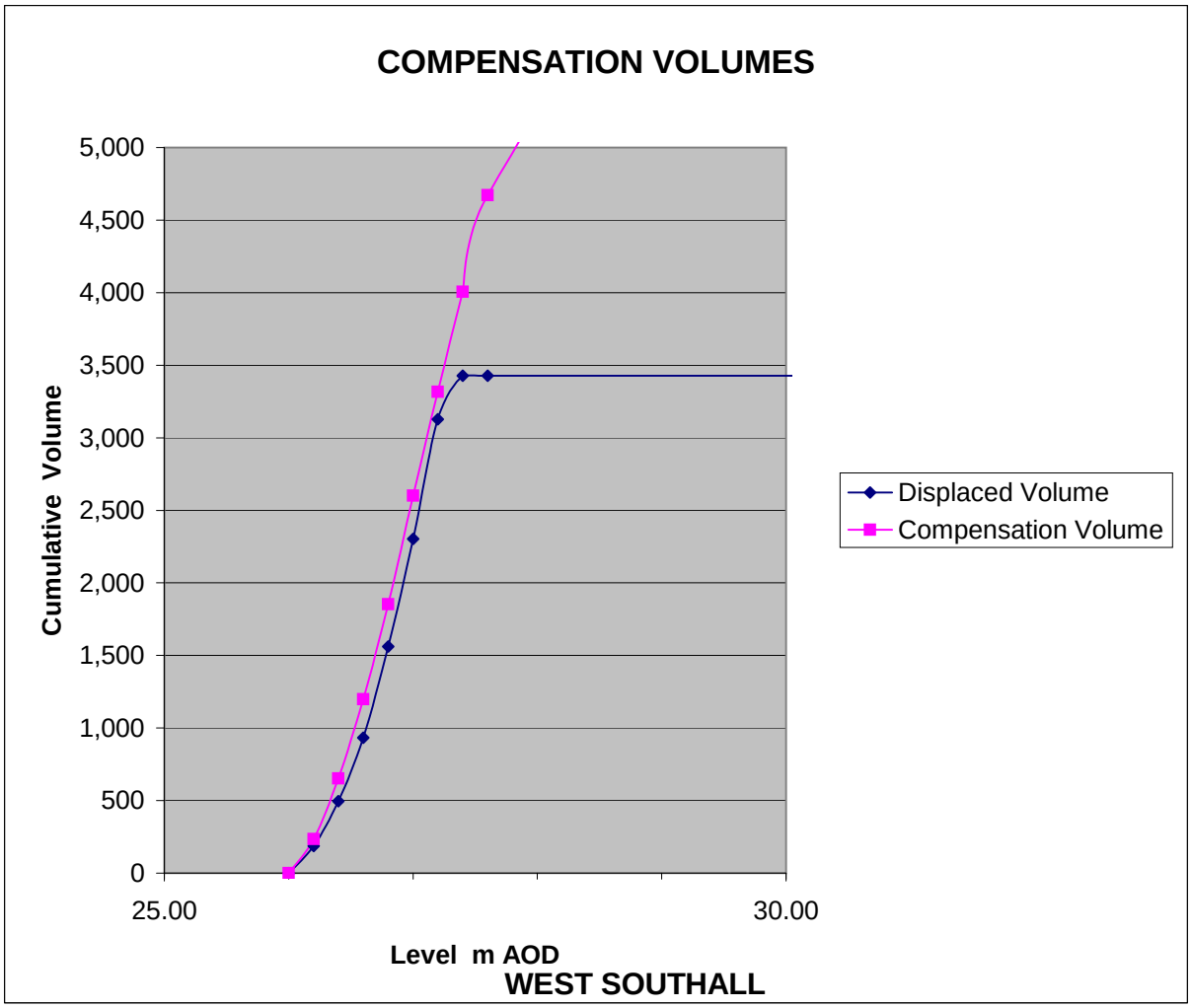
Results

QBAR Rural (m3/s)	0.008	Q 100 years (m3/s)	0.024
QBAR Urban (m3/s)	0.008		

APPENDIX FRA 6.3

Compensation Volumes

level	Incremental		Cumulative		
	Displacement volume	Compensation Volume	Displacement volume	Compensation Volume	
m AOD	m^3	m^3	m^3	m^3	
33.00	0	7,627	3,427	12,298	
27.60	0	665	3,427	4,671	
27.40	300	690	3,427	4,006	$Q_{100+20\%}$ = 27.27
27.20	824	715	3,127	3,316	
27.00	741	747	2,303	2,601	Q_{100} = 27.06
26.80	630	655	1,562	1,854	
26.60	437	546	932	1,199	
26.40	308	418	495	653	
26.20	187	235	187	235	
26.00	0	0	0	0	

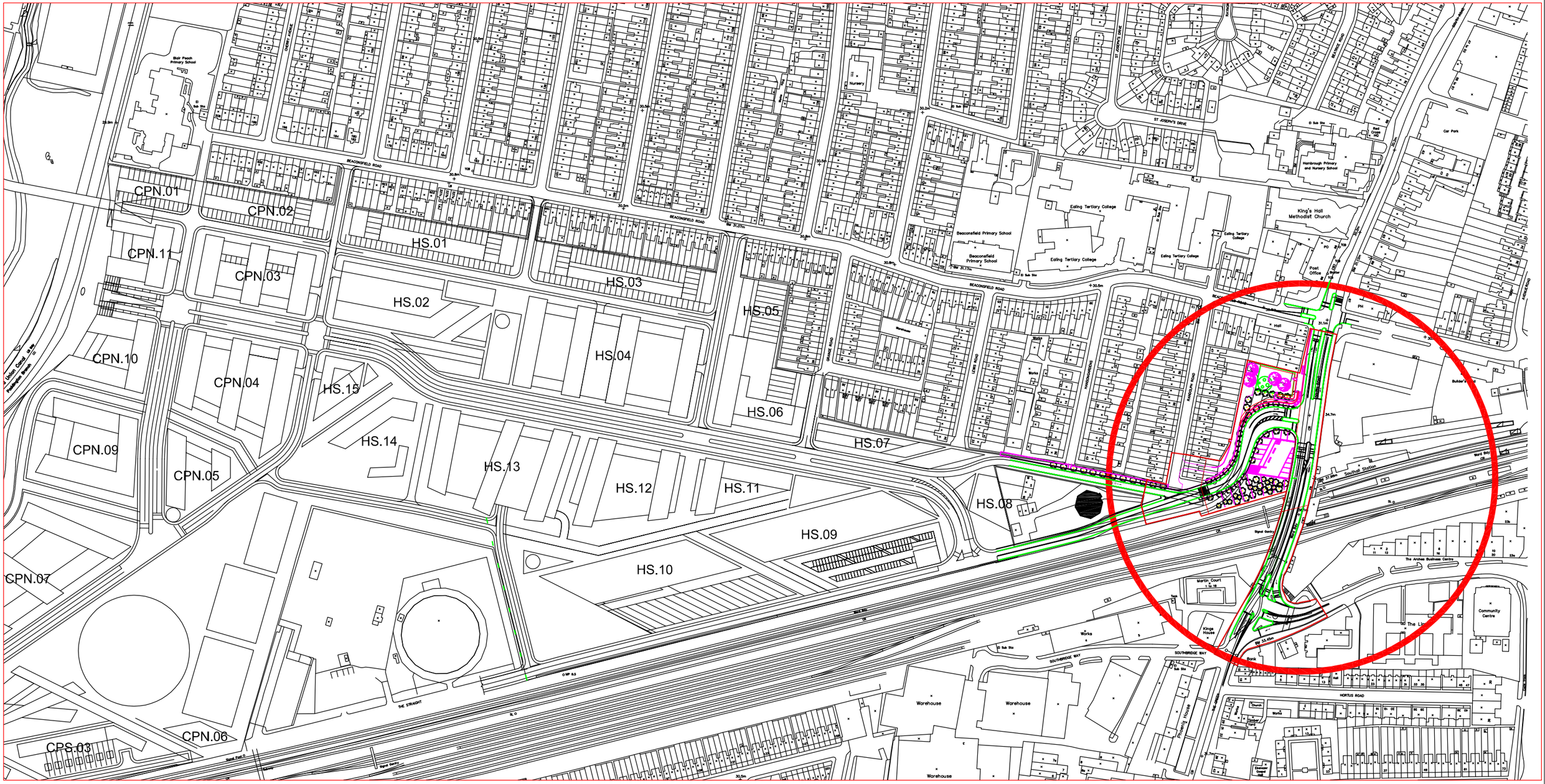


WEST SOUTHALL
PUMPLANE LINK ROAD
COMPENSATION STORAGE VOLUMES

APPENDIX FRA-E A

Location Plan

DO NOT SCALE: Contractor to check all dimensions and report any omissions or errors



Rev	Description	By	Chk	App	Date

Brigantine House
27-31Cumberland Street
Bristol
BS2 8NL

Tel: 0117 924 4144
Fax: 0117 924 4145
e-mail:
bristol@wyg.com

White Young Green

Consulting Engineers

Civil Structural Mechanical Electrical Process Rail Traffic Environmental Project Management

Project:

WEST SOUTHALL
EASTERN ACCESS
FLOOD RISK ASSESSMENT

Drawing Title:

LOCATION PLAN

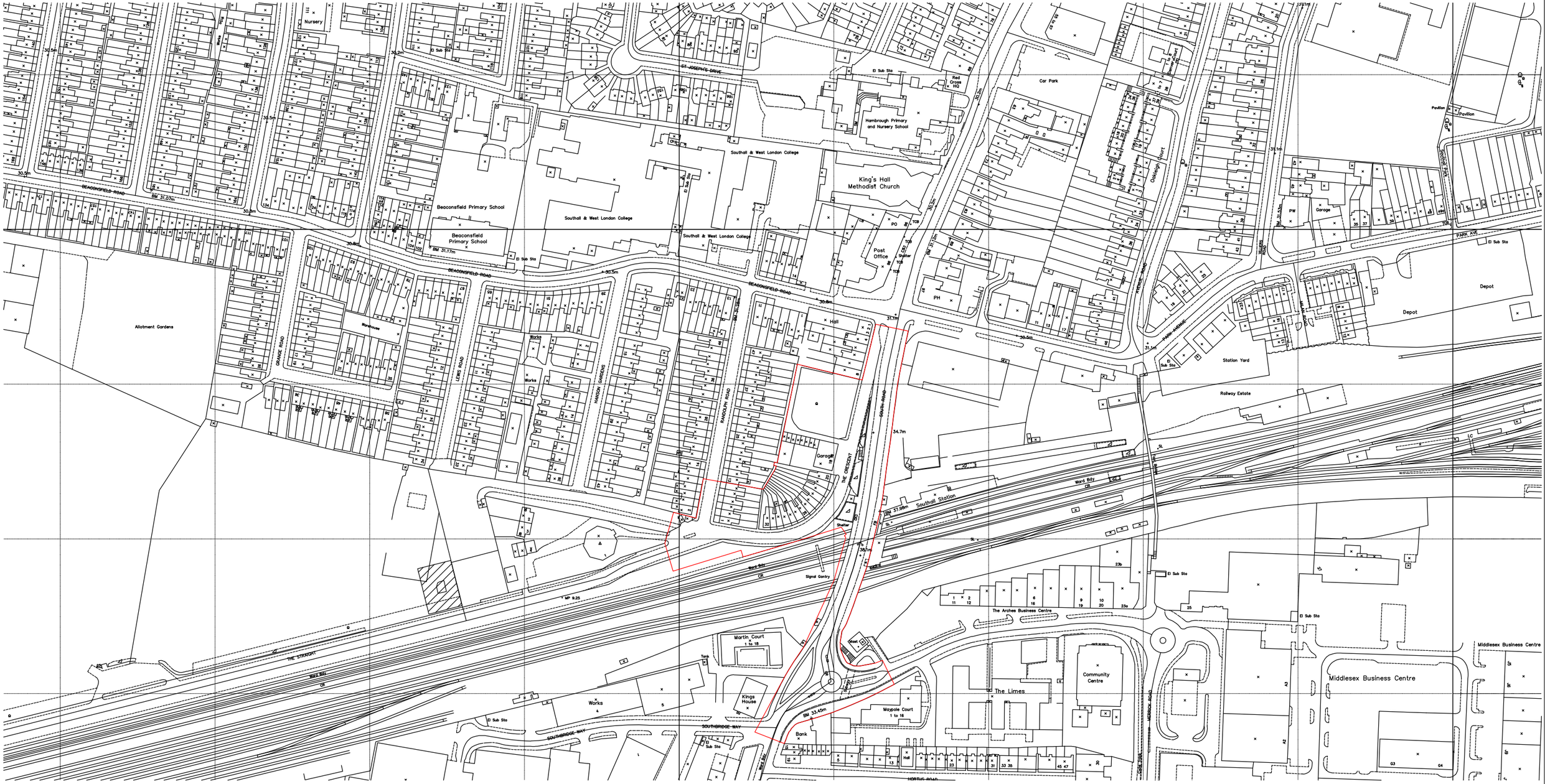
Scale at A3	Drawn By	Date	Checked By	Date	Approved By	Date
NTS	RB	16/9/2008				

Project No.	Office	Discipline	Drawing No.	Revision
A012564-E	28	C	APPENDIX FRA-E A	

APPENDIX FRA-E B

Existing Site Plan

DO NOT SCALE: Contractor to check all dimensions and report any omissions or errors



Rev	Description	By	Chk	App	Date

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White Young Green

Consulting Engineers

Civil Structural Mechanical Electrical Process Rail Traffic Environmental Project Management

Project:

WEST SOUTHALL
EASTERN ACCESS / THE CRESCENT
FLOOD RISK ASSESSMENT

Drawing Title:

EXISTING SITE OS PLAN
APPROXIMATE RED LINE BOUNDARY AREA

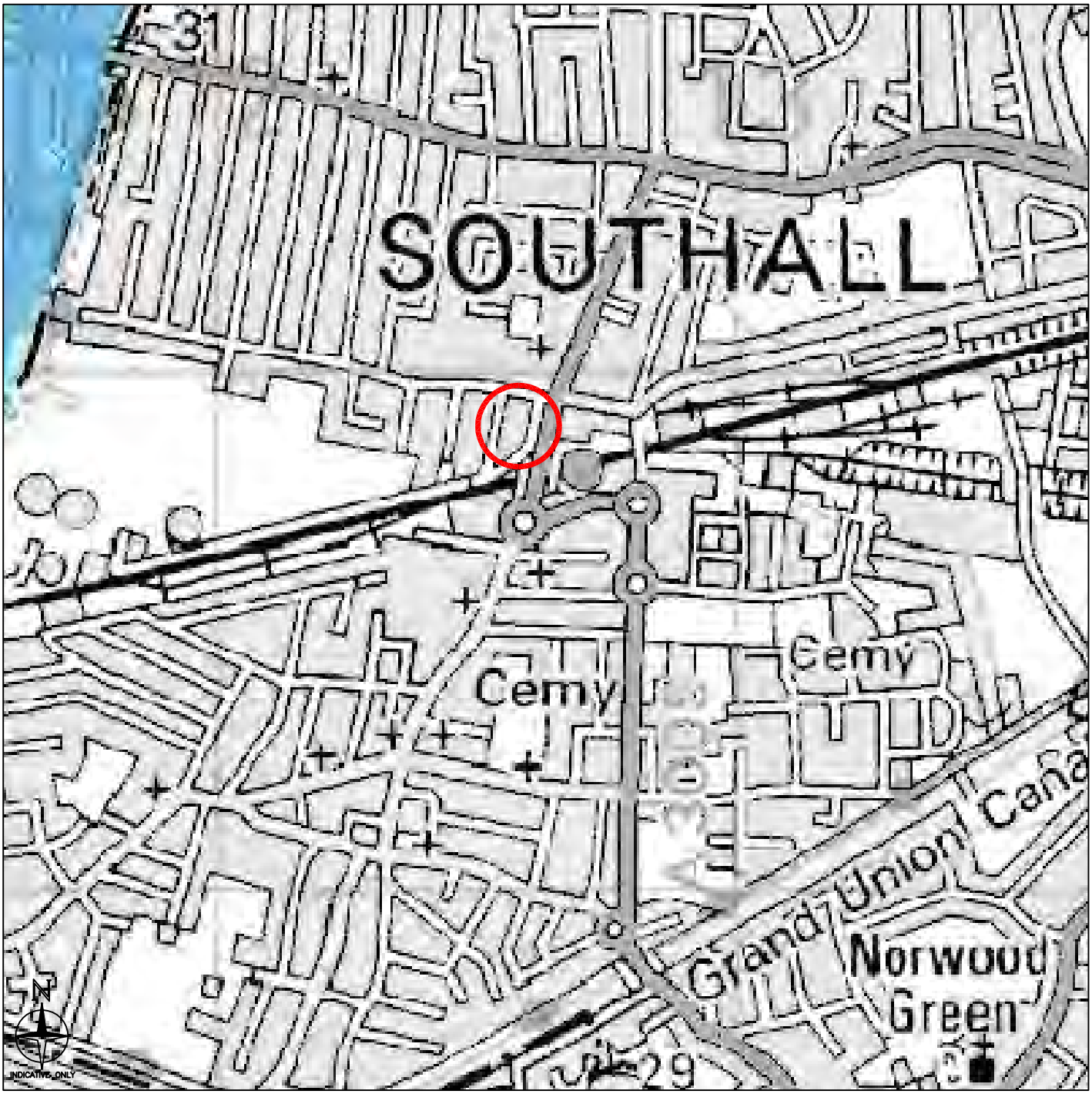
Scale at A3	Drawn By	Date	Checked By	Date	Approved By	Date
NTS	RB	16/9/2008				

Project No.	Office	Discipline	Drawing No.	Revision
A012564-E	28	C	APPENDIX FRA-E B	

APPENDIX FRA-E C

Flood Zone Map

DO NOT SCALE: Contractor to check all dimensions and report any omissions or errors



Rev	Description	By	Chk	App	Date

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White Young Green

Consulting Engineers

Civil Structural Mechanical Electrical Process Rail Traffic Environmental Project Management

Project:
WEST SOUTHALL
EASTERN ACCESS - THE CRESCENT
FLOOD RISK ASSESSMENT

Drawing Title:
ENVIRONMENT AGENCY
FLOOD ZONE MAP

Scale at A4	Drawn By	Date	Checked By	Date	Approved By	Date
NTS	CC	18/03/2008				

Project No.	Office	Discipline	Drawing No.	Revision
A012564-E	28	C	APPENDIX FRA-E C	

APPENDIX FRA-E D

Thames Water Sewer Plans

ALS/ALS Standard/2005_248039

The position of the apparatus shown on this plan is given without obligation and warranty, and the accuracy cannot be guaranteed. Service pipes are not shown but their presence should be anticipated. No liability of any kind whatsoever is accepted by Thames Water for any error or omission. The actual position of mains and services must be verified and established on site before any works are undertaken.

100 metre intervals

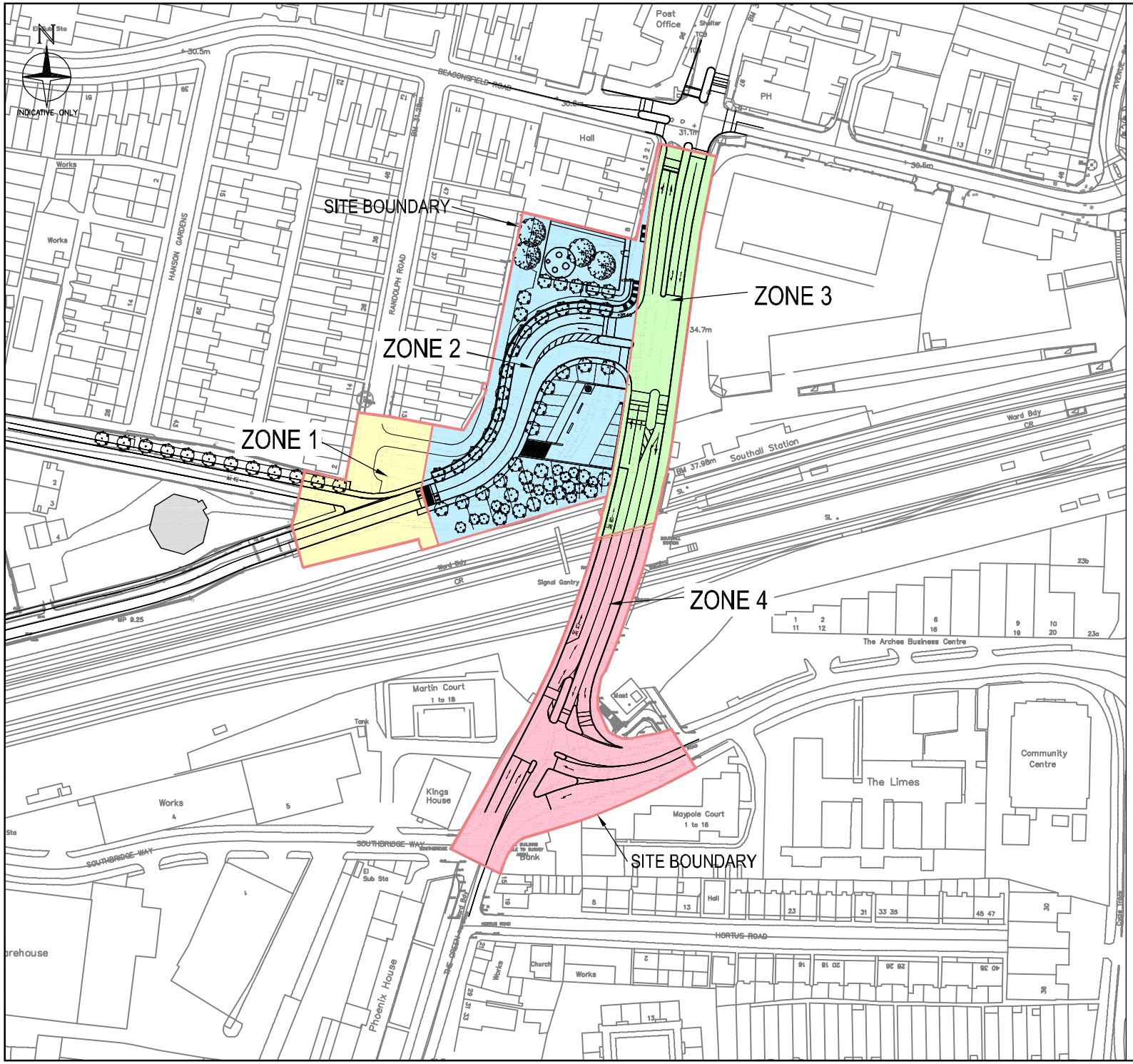
EAGLE hardcopy facility - Normal Map.
The plot is centred on (512626 , 179935), which is in TQ1279NE. Printed on 24 November 2005 at 9:58:24 by OARTHURS.

Comments:
SEWER

APPENDIX FRA-E E

Drainage Schematic

FILENAME : N:\PROJECTS\A012501 - A013000\A012564\ACAD\CIVILS\HISTORY\A012564_APPENDIX FRA-E-E SHEET 1 OF 3_R0.DWG | PLOTTED BY : BRETT.EAMER | PLOTTED DATE : 18 September 2008 14:25:02



REV	DESCRIPTION	BY	CHK	APP	DATE

Client:

BRIGANTINE HOUSE
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BRISTOL
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e-mail: bristol@wyg.com

White Young Green

Project:

WEST SOUTHALL
YEADING BROOK
FLOOD RISK ASSESSMENT

Drawing Title:

EASTERN ACCESS
DRAINAGE SCHEMATIC
SHEET 1 OF 3

Scale	@A4	Drawn	Date	Checked	Date	Approved	Date
1:500		B.C.E	17/09/08	R.C.B.	17/09/08	R.C.B.	17/09/08

Project No.	Office	Type	Drawing No.	Revision
A012564	28	C	APPENDIX FRA-E-E	-

SHEET SIZE : A4 PORTRAIT

N

INDICATIVE ONLY

DIVERT SW TO TW REQUIREMENTS AND MAINTAIN EXISTING CONNECTIONS.

NEW SITE DRAINAGE.

225Ø DRAIN TO EXISTING SWS.

225Ø

25m x 100Ø THROTTLE PIPE.

84m² x 1.8m DEEP ATTENUATION TANK.

DRAIN TO SWALES EITHER SIDE, IF POSSIBLE.

DRAIN VIA EXISTING SEWER IN RANDOLPH ROAD.

SEE DRAWING NO. A012564 APPENDIX FRA-E-E SHT 3 OF 3

LEGEND

- NEW SURFACE WATER DRAINAGE.
- EXISTING PUBLIC SURFACE WATER SEWER.
- EXISTING PUBLIC FOUL WATER SEWER.
- EXISTING PUBLIC SURFACE WATER SEWER TO BE ABANDONED.
- EXISTING PUBLIC FOUL WATER SEWER TO BE ABANDONED. (SUBJECT TO SURVEY AND TW AGREEMENT).

REV	DESCRIPTION	BY	CHK	APP	DATE

Client:

BRIGANTINE HOUSE
27-31 CUMBERLAND STREET
BRISTOL
BS2 8NL

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White Young Green

Project:

WEST SOUTHAL
YEADING BROOK
FLOOD RISK ASSESSMENT

Drawing Title:

EASTERN ACCESS
DRAINAGE SCHEMATIC
SHEET 2 OF 3

Scale @ A3	Drawn	Date	Checked	Date	Approved	Date
1:1000	B.C.E	17/09/08	R.C.B.	17/09/08	R.C.B.	17/09/08

Project No.	Office	Type	Drawing No.	Revision
A012564	28	C	APPENDIX FRA-E-E	-

SHEET SIZE : A3 LANDSCAPE

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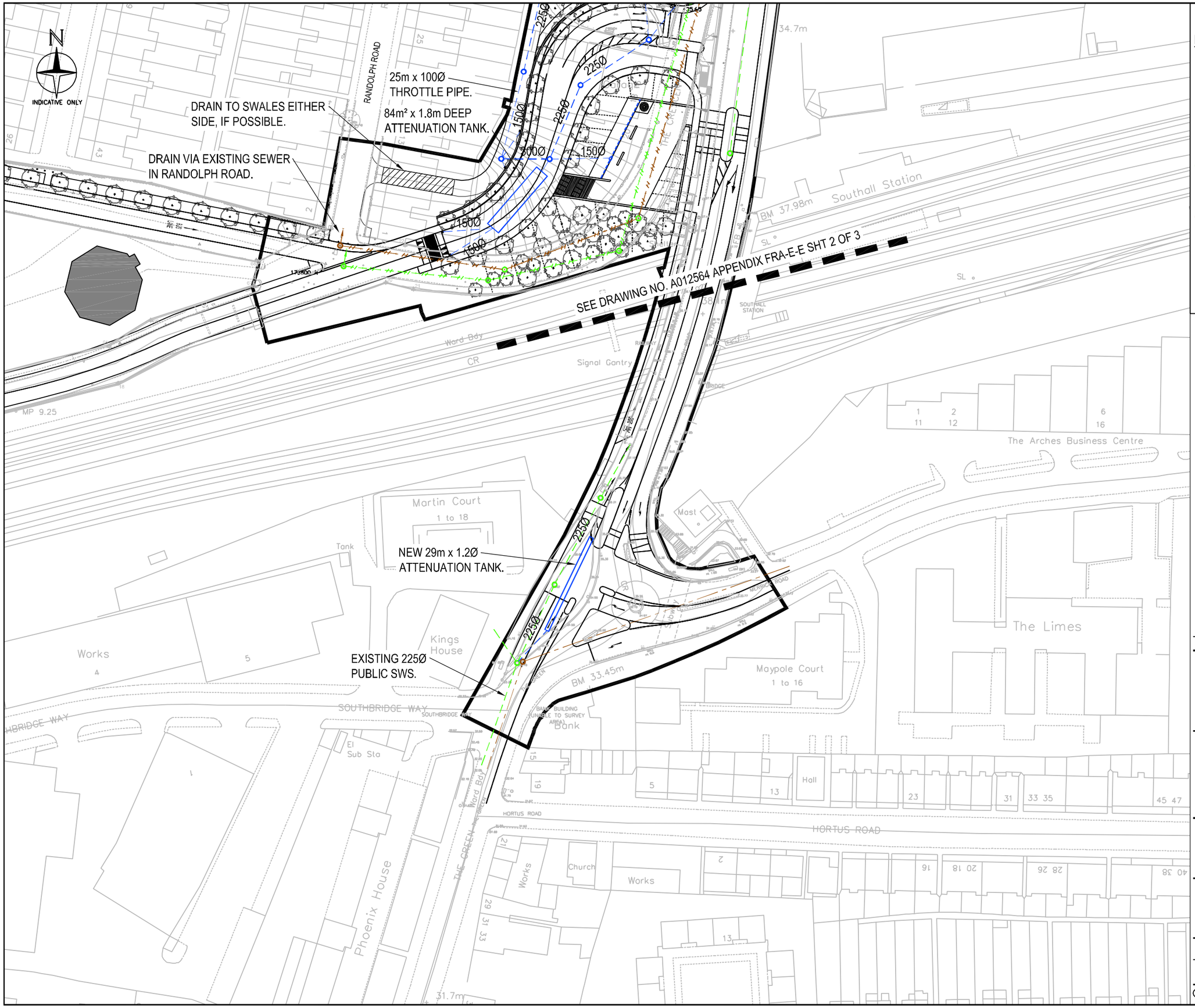

LEGEND

- NEW SURFACE WATER DRAINAGE.
- EXISTING PUBLIC SURFACE WATER SEWER.
- EXISTING PUBLIC FOUL WATER SEWER.
- EXISTING PUBLIC SURFACE WATER SEWER TO BE ABANDONED.
- EXISTING PUBLIC FOUL WATER SEWER TO BE ABANDONED. (SUBJECT TO SURVEY AND TW AGREEMENT).

REV	DESCRIPTION	BY	CHK	APP	DATE

Client:

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White Young Green

Project:
WEST SOUTHAL
YEADING BROOK
FLOOD RISK ASSESSMENT

Drawing Title:
EASTERN ACCESS
DRAINAGE SCHEMATIC
SHEET 3 OF 3

Scale @ A3	Drawn	Date	Checked	Date	Approved	Date
1:1000	B.C.E	17/09/08	R.C.B.	17/09/08	R.C.B.	17/09/08

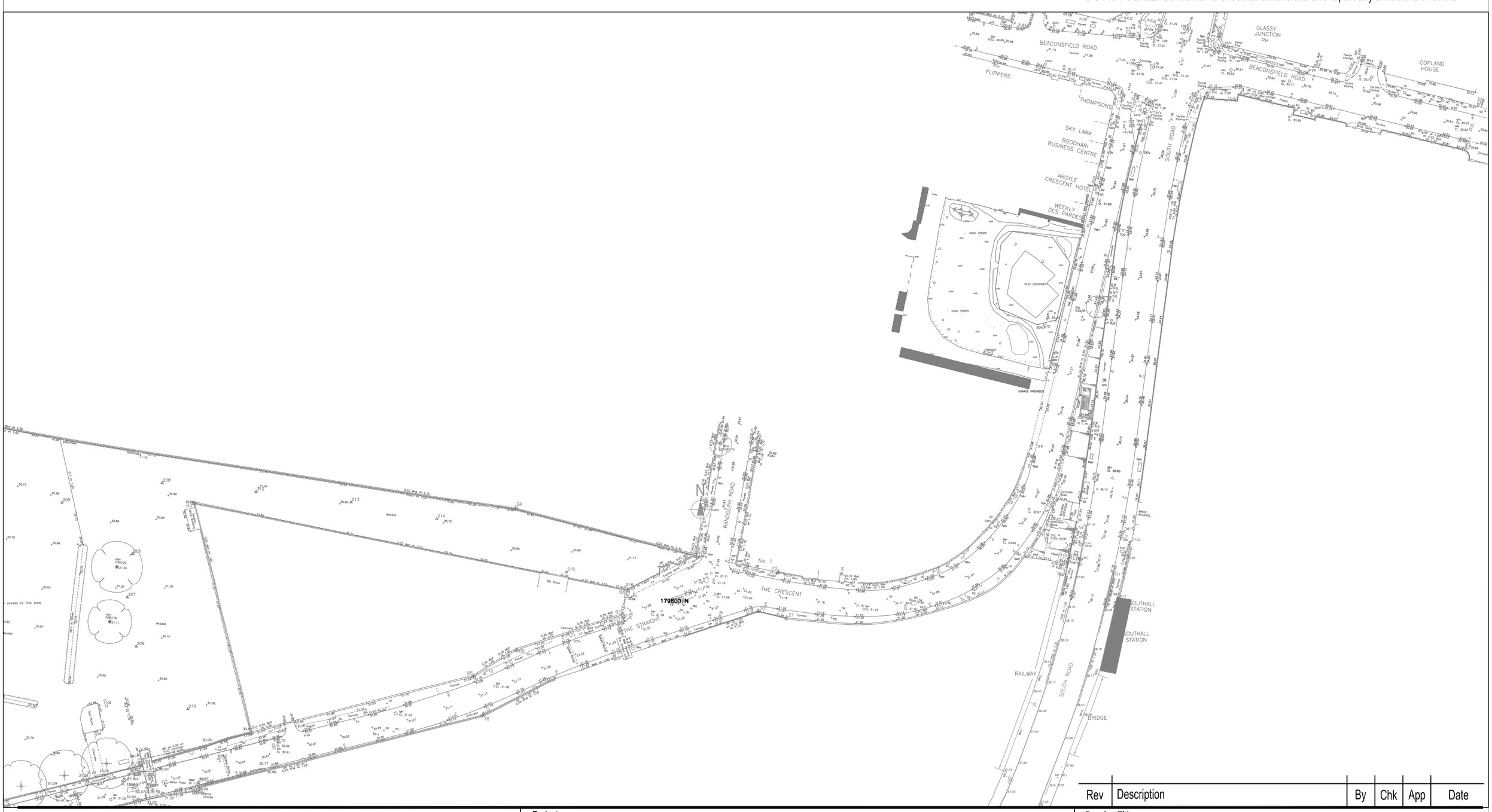
Project No.	Office	Type	Drawing No.	Revision
A012564	28	C	APPENDIX FRA-E-E	-

SHEET SIZE : A3 LANDSCAPE

APPENDIX FRA-E F

Topographic Survey

DO NOT SCALE: Contractor to check all dimensions and report any omissions or errors



Rev	Description	By	Chk	App	Date

Brigantine House
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White Young Green

Consulting Engineers

Civil Structural Mechanical Electrical Process Rail Traffic Environmental Project Management

Project:
WEST SOUTHALL
YEADING BROOK
FLOOD RISK ASSESSMENT

Client:

Drawing Title:
EASTERN ACCESS
TOPOGRAPHICAL SURVEY

Scale at A3	Drawn By	Date	Checked By	Date	Approved By	Date
1:1000	KP	23/06/08	R.C.B.	23/06/08	R.C.B.	23/06/08

Project No.	Office	Discipline	Drawing No.	Revision
A012564	28	C	APPENDIX F	-

APPENDIX FRA-E G

Calculations

Calculation *Cover Sheet*

Brigantine House
27-31 Cumberland street
Bristol
BS2 8NL
Tel: 0117 9244144
Fax: 0117 9244145

White Young Green

Office :	Bristol	Prepared by:	RCB
Division:	C & S	Date:	Sept 08
Project No :	A0112564		
Project Title :	West Southall – East Access		
Client :	National Grid Property Holdings		

Contents :

Design Philosophy :

Establish undeveloped green field run off rates using IOH 124 method (from Micro drainage programme)
Provide attenuation to undeveloped greenfield rate for any increase in impermeable area (zone 4)
Where practical reduce new development to undeveloped Greenfield rates as per EA request (Zone 2)

(Continue on separate sheet if necessary)

Status : Preliminary ✓ Working ☐

Checked by : RCB Date : Sept 08 Approved by : Date :

Revisions :

Rev	Date	Description	Checked	Approved	Pages Revised

White Young Green
Brigantine House
27-31 Cumberland Street
Bristol BS2 8NL
Date 21/8/08
File
Micro Drainage

West Southall
East Access

Designed By RCB
Checked By
Source Control W.11.2

Micro Drainage

IH 124 Mean Annual Flood

Input

Return Period (years)	100	Soil	0.300
Area (Ha)	1.195	Urban	0.000
SAAR (mm)	641.000	Region Number	6

Results **l/s**

QBAR Rural	9.0
QBAR Urban	9.0
Q 100 years	26.6
Q 1 year	7.6
Q 2 years	7.9
Q 5 years	11.5
Q 10 years	14.5
Q 20 years	18.0
Q 25 years	19.3
Q 30 years	20.3
Q 50 years	23.5
Q 100 years	26.6
Q 200 years	33.7
Q 250 years	35.3
Q 1000 years	46.3

White Young Green

Consulting Engineers and Project Managers

White Young Green Consulting Engineers

Project No A012564-E

Calculation Sheet No 2

Office

Division

Project Title WEST SOUTHALL

Work Section EAST ACCESS

Prepared by R.L.B

Date Sept 06

North of Railway. - Existing

Impermeable	m²	
South Road.	2585	
The Cresent	1421	
The straight Junction	1037	
Play Area	294	
Garage	796	
Residential - The Cresent	845	
Residential - Randolph Rd	444	7472
Permeable		
Play Area	1474	
Back Gardens	651	
Front Gardens	211	
South strip	455	
The straight Junc.	104	
Embankment	316	
Misc.	86	3301
Total,		10647.

White Young Green

Consulting Engineers and Project Managers

White Young Green
Consulting Engineers

Project No A012564-E
Calculation Sheet No 3
Office
Division

Project Title WEST SOUTHALL
Work Section EAST ACCESS

Prepared by RCB
Date Sept 06

North of Railway – Proposed

	m²	
Impermeable		
South Road	2610	
(remainder of the crescent	120	
Upper Access	1236	
Lower Access	560	
The Straight Junction	1026	
Residents access	649	
Plazza	467	
stairs to Plazza	73	6735
Permeable.		
Play space	607	
North area	430	
Access Road Border	190	
Plazza West	447	
Plazza East	119	
Southern strip	1540	
Southern Block	323	
Southern by rest	160	
Misc. footpaths etc draining to landscape	222	4036
Total		10,773

White Young Green

Consulting Engineers and Project Managers

White Young Green Consulting Engineers

Project No A012564-E

Calculation Sheet No 4

Office

Division

Project Title WEST SOUTHALL

Work Section EAST ACCESS.

Prepared by RCB

Date sept 06

Effective Proposed Catchment Areas.

Zone	Location	Imp m^2	Perm m^2	Total m^2
1	Randolph Road.	1026	615	1641
2	New Access/ The Crescent	3099	3201	6300
3	South Road (N)	2744	—	2744
4	South Road (S)	4000	—	4000

For Zone 2 to Match IDH 124 flows

1:2yr = 6.6 l/s/ha ⇒ 42 l/s

1:30yr = 17.0 l/s/ha ⇒ 10.7 l/s

1:100yr = 23.9 l/s/ha ⇒ 15.1 l/s.

White Young Green
Brigantine House
27-31 Cumberland Street
Bristol BS2 8NL
Date sept 08
File throttle pipe.src
Micro Drainage

West Southall
East Access
Zone 2
Designed By RCB
Checked By
Source Control W.11.2

Micro Drainage

Summary of Results for 100 year Return Period (+30%)

Storm Duration (mins)	Maximum Control (l/s)	Maximum Overflow (l/s)	Maximum Outflow (l/s)	Maximum Water Level (m OD)	Maximum Depth (m)	Overflow Volume (m³)	Maximum Volume (m³)	Status
15 Summer	13.8	0.0	13.8	30.6322	1.3622	0.0	114.4	O K
30 Summer	13.6	0.0	13.6	30.7602	1.4902	0.0	125.2	O K
60 Summer	13.9	0.0	13.9	30.8232	1.5532	0.0	130.5	O K
120 Summer	13.8	0.0	13.8	30.7987	1.5287	0.0	128.4	O K
180 Summer	13.6	0.0	13.6	30.7542	1.4842	0.0	124.7	O K
240 Summer	13.4	0.0	13.4	30.7002	1.4302	0.0	120.1	O K
360 Summer	12.8	0.0	12.8	30.5858	1.3157	0.0	110.5	O K
480 Summer	12.3	0.0	12.3	30.4783	1.2083	0.0	101.5	O K
600 Summer	11.8	0.0	11.8	30.3833	1.1133	0.0	93.5	O K
720 Summer	11.3	0.0	11.3	30.2993	1.0293	0.0	86.4	O K
960 Summer	10.4	0.0	10.4	30.1463	0.8763	0.0	73.6	O K
1440 Summer	9.0	0.0	9.0	29.9313	0.6613	0.0	55.5	O K
2160 Summer	7.5	0.0	7.5	29.7339	0.4632	0.0	38.9	O K
2880 Summer	6.4	0.0	6.4	29.6136	0.3437	0.0	28.8	O K
4320 Summer	4.9	0.0	4.9	29.4763	0.2062	0.0	17.3	O K
5760 Summer	4.0	0.0	4.0	29.4099	0.1398	0.0	11.7	O K
7200 Summer	3.4	0.0	3.4	29.3648	0.0948	0.0	8.0	O K
8640 Summer	2.9	0.0	2.9	29.3363	0.0663	0.0	7.2	O K
10080 Summer	2.6	0.0	2.6	29.3498	0.0797	0.0	6.7	O K
15 Winter	13.8	0.0	13.8	30.9022	1.5522	0.0	128.7	O K
30 Winter	14.5	0.0	14.5	30.9537	1.6037	0.0	141.4	FLOOD RISK
60 Winter	14.9	0.0	14.9	31.0392	1.7692	0.0	148.6	FLOOD RISK
120 Winter	14.7	0.0	14.7	31.0047	1.7347	0.0	145.7	FLOOD RISK
180 Winter	14.4	0.0	14.4	30.9407	1.6707	0.0	140.4	FLOOD RISK
240 Winter	14.1	0.0	14.1	30.8607	1.5907	0.0	133.6	O K
360 Winter	13.3	0.0	13.3	30.6832	1.4232	0.0	119.5	O K
480 Winter	12.6	0.0	12.6	30.5395	1.2693	0.0	106.6	O K

Storm Duration (mins)	Rain (mm/hr)	Time-Peak (mins)
15 Summer	211.48	18
30 Summer	121.66	32
60 Summer	69.99	60
120 Summer	40.27	92
180 Summer	29.14	126
240 Summer	23.17	160
360 Summer	16.77	228
480 Summer	13.33	296
600 Summer	11.15	362
720 Summer	9.64	426
960 Summer	7.59	550
1440 Summer	5.42	794
2160 Summer	3.86	1152
2880 Summer	3.04	1504
4320 Summer	2.13	2208
5760 Summer	1.65	2944
7200 Summer	1.36	3672
8640 Summer	1.16	4368
10080 Summer	1.01	5104
15 Winter	211.48	18
30 Winter	121.66	32
60 Winter	69.99	60
120 Winter	40.27	96
180 Winter	29.14	134
240 Winter	23.17	172
360 Winter	16.77	246
480 Winter	13.33	316

White Young Green
Brigantine House
27-31 Cumberland Street
Bristol BS2 8NL
Date sept 08
File throttle pipe.src
Micro Drainage

West Southall
East Access
Zone 2
Designed By RCB
Checked By
Source Control W.11.2

Micro Drainage

Summary of Results for 100 year Return Period (+30%)

Storm Duration (mins)	Maximum Control (l/s)	Maximum Overflow (l/s)	Maximum Outflow (l/s)	Maximum Water Level (m OD)	Maximum Depth (m)	Overflow Volume (m³)	Maximum Volume (m³)	Status
600 Winter	11.9	0.0	11.9	30.4049	1.1346	0.0	95.3	O K
720 Winter	11.2	0.0	11.2	30.2888	1.0186	0.0	85.6	O K
960 Winter	10.1	0.0	10.1	30.0903	0.8203	0.0	68.9	O K
1440 Winter	8.3	0.0	8.3	29.9298	0.5597	0.0	46.9	O K
2160 Winter	6.5	0.0	6.5	29.6178	0.3477	0.0	29.2	O K
2880 Winter	5.3	0.0	5.3	29.5079	0.2372	0.0	19.9	O K
4320 Winter	3.8	0.0	3.8	29.3983	0.1283	0.0	10.8	O K
5760 Winter	3.0	0.0	3.0	29.3578	0.0878	0.0	7.4	O K
7200 Winter	2.5	0.0	2.5	29.3483	0.0783	0.0	6.6	O K
8640 Winter	2.1	0.0	2.1	29.3398	0.0698	0.0	5.8	O K
10080 Winter	1.9	0.0	1.9	29.3333	0.0632	0.0	5.3	O K

Storm Duration (mins)	Rain (mm/hr)	Time-Peak (mins)
600 Winter	11.15	394
720 Winter	9.64	450
960 Winter	7.59	578
1440 Winter	5.42	822
2160 Winter	3.86	1198
2880 Winter	3.04	1528
4320 Winter	2.13	2248
5760 Winter	1.65	2872
7200 Winter	1.36	3624
8640 Winter	1.16	4406
10080 Winter	1.01	5088

Rainfall Details

Region	FEH Rainfall Model
Return Period (years)	100
Site Location	510550 179250 TQ 10550 79250
C (1km)	-0.026
D1 (1km)	0.302
D2 (1km)	0.287
D3 (1km)	0.240
E (1km)	0.310
F (1km)	2.560
Cv (Summer)	0.750
Cv (Winter)	0.840
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Summer Storms	Yes
Winter Storms	Yes
Climate Change %	+50

Time / Area Diagram

Total Area (ha) = 0.310

Time (mins) from:	to:	Area (ha)
0	4	0.310

White Young Green
Brigantine House
27-31 Cumberland Street
Bristol BS2 8NL

Date sept 08
File throttle pipe.src
Micro Drainage

West Southall
East Access
Zone 2
Designed By RCB
Checked By
Source Control W.11.2

Tank/Pond Details

Invert Level (m) 28.270 Ground Level (m) 31.100

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.00	84.0	0.50	84.0	1.00	84.0	1.50	84.0	2.00	84.0	2.50	84.0
0.10	84.0	0.60	84.0	1.10	84.0	1.60	84.0	2.10	84.0		
0.20	84.0	0.70	84.0	1.20	84.0	1.70	84.0	2.20	84.0		
0.30	84.0	0.80	84.0	1.30	84.0	1.80	84.0	2.30	84.0		
0.40	84.0	0.90	84.0	1.40	84.0	1.90	84.0	2.40	84.0		

Pipe Outflow Control

Pipe Diameter (m)	0.100	Roughness (mm)	0.600	Invert Level (m)	29.270
Slope (1:x)	272.0	Entry Loss Coef	0.500		
Length (m)	25.000	Coef of Contraction	0.600		

Weir / Flume Overflow Control

Discharge Coef 0.544 Width (m) 1.000 Crest Level (m) 31.060

White Young Green Brigantine House 27-31 Cumberland Street Bristol BS2 8NL	West Southall East Access Zone 2	Page 1
Date sept 08 File throttle pipe.src	Designed By RCB Checked By	
Micro Drainage	Source Control W.11.2	

Summary of Results for 2 year Return Period

Storm Duration (mins)	Maximum Control (l/s)	Maximum Overflow (l/s)	Maximum Outflow (l/s)	Maximum Water Level (m OD)	Maximum Depth (m)	Overflow Volume (m³)	Maximum Volume (m³)	Status
15 Summer	5.9	0.0	5.9	29.5243	0.2542	0.0	21.4	O K
30 Summer	5.9	0.0	5.9	29.5583	0.2882	0.0	24.0	O K
60 Summer	6.1	0.0	6.1	29.5773	0.3072	0.0	25.8	O K
120 Summer	6.1	0.0	6.1	29.5838	0.3137	0.0	26.3	O K
180 Summer	6.0	0.0	6.0	29.5743	0.3042	0.0	25.6	O K
240 Summer	5.9	0.0	5.9	29.5608	0.2907	0.0	24.4	O K
360 Summer	5.6	0.0	5.6	29.5318	0.2617	0.0	22.0	O K
480 Summer	5.3	0.0	5.3	29.5053	0.2352	0.0	19.8	O K
600 Summer	5.0	0.0	5.0	29.4833	0.2132	0.0	17.9	O K
720 Summer	4.8	0.0	4.8	29.4638	0.1937	0.0	16.3	O K
960 Summer	4.3	0.0	4.3	29.4313	0.1613	0.0	13.5	O K
1440 Summer	3.7	0.0	3.7	29.3883	0.1183	0.0	9.9	O K
2160 Summer	3.1	0.0	3.1	29.3598	0.0899	0.0	7.5	O K
2880 Summer	2.6	0.0	2.6	29.3498	0.0797	0.0	6.7	O K
4320 Summer	1.9	0.0	1.9	29.3343	0.0642	0.0	5.4	O K
5760 Summer	1.5	0.0	1.5	29.3263	0.0562	0.0	4.7	O K
7200 Summer	1.3	0.0	1.3	29.3223	0.0522	0.0	4.4	O K
8640 Summer	1.1	0.0	1.1	29.3193	0.0492	0.0	4.1	O K
10080 Summer	1.0	0.0	1.0	29.3168	0.0467	0.0	3.9	O K
15 Winter	5.9	0.0	5.9	29.5563	0.2862	0.0	24.0	O K
30 Winter	6.3	0.0	6.3	29.5943	0.3242	0.0	27.2	O K
60 Winter	6.4	0.0	6.4	29.6143	0.3442	0.0	28.9	O K
120 Winter	6.4	0.0	6.4	29.6128	0.3427	0.0	28.8	O K
180 Winter	6.2	0.0	6.2	29.5928	0.3227	0.0	27.1	O K
240 Winter	6.0	0.0	6.0	29.5693	0.2992	0.0	25.2	O K
360 Winter	5.5	0.0	5.5	29.5248	0.2547	0.0	21.4	O K
480 Winter	5.1	0.0	5.1	29.4878	0.2177	0.0	18.3	O K

Storm Duration (mins)	Rain (mm/hr)	Time-Peak (mins)
15 Summer	42.09	17
30 Summer	25.98	30
60 Summer	16.04	46
120 Summer	9.90	80
180 Summer	7.46	114
240 Summer	6.11	148
360 Summer	4.61	212
480 Summer	3.77	276
600 Summer	3.23	338
720 Summer	2.84	398
960 Summer	2.30	520
1440 Summer	1.71	754
2160 Summer	1.27	1100
2880 Summer	1.03	1468
4320 Summer	0.75	2200
5760 Summer	0.60	2936
7200 Summer	0.51	3624
8640 Summer	0.44	4368
10080 Summer	0.39	5136
15 Winter	42.09	17
30 Winter	25.98	30
60 Winter	16.04	48
120 Winter	9.90	86
180 Winter	7.46	122
240 Winter	6.11	158
360 Winter	4.61	224
480 Winter	3.77	288

White Young Green		Page 1
Brigantine House 27-31 Cumberland Street Bristol BS2 8NL	West Southall East Access Zone 2	Micro Drainage
Date sept 08 File throttle pipe.src Micro Drainage	Designed By RCB Checked By Source Control W.11.2	

Summary of Results for 30 year Return Period

Storm Duration (mins)	Maximum Control (l/s)	Maximum Overflow (l/s)	Maximum Outflow (l/s)	Maximum Water Level (m OD)	Maximum Depth (m)	Overflow Volume (m³)	Maximum Volume (m³)	Status
15 Summer	9.1	0.0	9.1	29.9408	0.6728	0.0	56.4	O K
30 Summer	9.5	0.0	9.5	30.0083	0.7383	0.0	62.0	O K
60 Summer	9.7	0.0	9.7	30.0348	0.7648	0.0	64.2	O K
120 Summer	9.7	0.0	9.7	30.0298	0.7598	0.0	63.8	O K
180 Summer	9.5	0.0	9.5	30.0038	0.7338	0.0	61.6	O K
240 Summer	9.3	0.0	9.3	29.9713	0.7013	0.0	58.9	O K
360 Summer	8.9	0.0	8.9	29.9053	0.6353	0.0	53.3	O K
480 Summer	8.4	0.0	8.4	29.8458	0.5757	0.0	48.4	O K
600 Summer	8.0	0.0	8.0	29.7943	0.5242	0.0	44.0	O K
720 Summer	7.6	0.0	7.6	29.7492	0.4792	0.0	40.3	O K
960 Summer	7.0	0.0	7.0	29.6703	0.4002	0.0	33.6	O K
1440 Summer	5.9	0.0	5.9	29.5633	0.2932	0.0	24.6	O K
2160 Summer	4.8	0.0	4.8	29.4638	0.1937	0.0	16.8	O K
2880 Summer	4.1	0.0	4.1	29.4168	0.1468	0.0	12.3	O K
4320 Summer	3.3	0.0	3.3	29.3618	0.0918	0.0	7.7	O K
5760 Summer	2.5	0.0	2.5	29.3493	0.0792	0.0	6.7	O K
7200 Summer	2.1	0.0	2.1	29.3393	0.0692	0.0	5.8	O K
8640 Summer	1.8	0.0	1.8	29.3323	0.0622	0.0	5.2	O K
10080 Summer	1.6	0.0	1.6	29.3278	0.0577	0.0	4.8	O K
15 Winter	9.7	0.0	9.7	30.0258	0.7558	0.0	63.5	O K
30 Winter	10.2	0.0	10.2	30.1063	0.8363	0.0	70.3	O K
60 Winter	10.4	0.0	10.4	30.1418	0.8718	0.0	73.2	O K
120 Winter	10.3	0.0	10.3	30.1248	0.8548	0.0	71.8	O K
180 Winter	10.0	0.0	10.0	30.0818	0.8118	0.0	68.2	O K
240 Winter	9.7	0.0	9.7	30.0308	0.7608	0.0	63.9	O K
360 Winter	9.0	0.0	9.0	29.9323	0.6623	0.0	55.6	O K
480 Winter	8.4	0.0	8.4	29.8473	0.5772	0.0	48.5	O K

Storm Duration (mins)	Rain (mm/hr)	Time-Peak (mins)
15 Summer	106.81	17
30 Summer	62.81	31
60 Summer	36.93	52
120 Summer	21.72	86
180 Summer	15.92	120
240 Summer	12.77	154
360 Summer	9.36	222
480 Summer	7.51	286
600 Summer	6.33	350
720 Summer	5.51	412
960 Summer	4.37	538
1440 Summer	3.16	780
2160 Summer	2.28	1128
2880 Summer	1.82	1498
4320 Summer	1.29	2200
5760 Summer	1.01	2936
7200 Summer	0.83	3672
8640 Summer	0.71	4400
10080 Summer	0.63	5136
15 Winter	106.81	17
30 Winter	62.81	31
60 Winter	36.93	58
120 Winter	21.72	92
180 Winter	15.92	130
240 Winter	12.77	166
360 Winter	9.36	236
480 Winter	7.51	304

White Young Greer		Page 1
Brigantine House	West Southall	
27-31 Cumberland Street	East Access	
Bristol BS2 8NL	Zone 4- new imp area	
Date sept 08	Designed By rcb	
File south of railway.src	Checked By	
Micro Drainage	Source Control W.11.2	

Summary of Results for 100 year Return Period (+30%)

Storm Duration (mins)	Maximum Control (l/s)	Maximum Overflow (l/s)	Maximum Outflow (l/s)	Maximum Water Level (m OD)	Maximum Depth (m)	Overflow Volume (m³)	Maximum Volume (m³)	Status
15 Summer	0.8	0.0	0.8	0.4092	0.4092	0.0	20.5	O K
30 Summer	0.9	0.0	0.9	0.4627	0.4627	0.0	23.1	O K
60 Summer	0.9	0.0	0.9	0.5142	0.5142	0.0	25.7	O K
120 Summer	1.0	0.0	1.0	0.5532	0.5532	0.0	27.7	O K
180 Summer	1.0	0.0	1.0	0.5627	0.5627	0.0	28.1	O K
240 Summer	1.0	0.0	1.0	0.5612	0.5612	0.0	28.1	O K
360 Summer	1.0	0.0	1.0	0.5552	0.5552	0.0	27.8	O K
480 Summer	1.0	0.0	1.0	0.5467	0.5467	0.0	27.3	O K
600 Summer	0.9	0.0	0.9	0.5352	0.5352	0.0	26.8	O K
720 Summer	0.9	0.0	0.9	0.5232	0.5232	0.0	26.2	O K
960 Summer	0.9	0.0	0.9	0.4907	0.4907	0.0	24.5	O K
1440 Summer	0.8	0.0	0.8	0.4332	0.4332	0.0	21.7	O K
2160 Summer	0.8	0.0	0.8	0.3637	0.3637	0.0	18.2	O K
2880 Summer	0.7	0.0	0.7	0.3107	0.3107	0.0	15.5	O K
4320 Summer	0.6	0.0	0.6	0.2302	0.2302	0.0	11.5	O K
5760 Summer	0.5	0.0	0.5	0.1782	0.1782	0.0	8.9	O K
7200 Summer	0.5	0.0	0.5	0.1428	0.1428	0.0	7.1	O K
8640 Summer	0.4	0.0	0.4	0.1173	0.1173	0.0	5.9	O K
10080 Summer	0.4	0.0	0.4	0.0993	0.0993	0.0	5.0	O K
15 Winter	0.9	0.0	0.9	0.4592	0.4592	0.0	23.0	O K
30 Winter	0.9	0.0	0.9	0.5197	0.5197	0.0	26.0	O K
60 Winter	1.0	0.0	1.0	0.5787	0.5787	0.0	28.9	O K
120 Winter	1.0	0.0	1.0	0.6263	0.6263	0.0	31.3	O K
180 Winter	1.0	0.0	1.0	0.6408	0.6408	0.0	32.0	O K
240 Winter	1.0	0.0	1.0	0.6413	0.6413	0.0	32.1	O K
360 Winter	1.0	0.0	1.0	0.6298	0.6298	0.0	31.5	O K
480 Winter	1.0	0.0	1.0	0.6168	0.6169	0.0	30.8	O K

Storm Duration (mins)	Rain (mm/hr)	Time-Peak (mins)
15 Summer	211.48	19
30 Summer	121.66	33
60 Summer	69.99	62
120 Summer	40.27	122
180 Summer	29.14	180
240 Summer	23.17	214
360 Summer	16.77	274
480 Summer	13.33	340
600 Summer	11.15	408
720 Summer	9.64	479
960 Summer	7.59	616
1440 Summer	5.42	882
2160 Summer	3.86	1276
2880 Summer	3.04	1844
4320 Summer	2.13	2980
5760 Summer	1.65	3112
7200 Summer	1.36	3824
8640 Summer	1.16	4504
10080 Summer	1.01	5248
15 Winter	211.48	18
30 Winter	121.66	32
60 Winter	69.99	62
120 Winter	40.27	118
180 Winter	29.14	176
240 Winter	23.17	228
360 Winter	16.77	286
480 Winter	13.33	364

White Young Green
Brigantine House
27-31 Cumberland Street
Bristol BS2 8NL
Date sept 08
File south of railway.src
Micro Drainage

West Southall
East Access
Zone 4- new imp area
Designed By rcb
Checked By
Source Control W.11.2

Summary of Results for 100 year Return Period (+30%)

Storm Duration (mins)	Maximum Control (l/s)	Maximum Overflow (l/s)	Maximum Outflow (l/s)	Maximum Water Level (m OD)	Maximum Depth (m)	Overflow Volume (m³)	Maximum Volume (m³)	Status
600 Winter	1.0	0.0	1.0	0.6003	0.6003	0.0	30.0	O K
720 Winter	1.0	0.0	1.0	0.5819	0.5819	0.0	29.1	O K
960 Winter	0.9	0.0	0.9	0.5362	0.5362	0.0	26.8	O K
1440 Winter	0.9	0.0	0.9	0.4547	0.4547	0.0	22.7	O K
2160 Winter	0.8	0.0	0.8	0.3602	0.3602	0.0	18.0	O K
2880 Winter	0.7	0.0	0.7	0.2917	0.2917	0.0	14.6	O K
4320 Winter	0.6	0.0	0.6	0.1952	0.1952	0.0	9.8	O K
5760 Winter	0.5	0.0	0.5	0.1398	0.1398	0.0	7.0	O K
7200 Winter	0.4	0.0	0.4	0.1053	0.1053	0.0	5.3	O K
8640 Winter	0.3	0.0	0.3	0.0833	0.0833	0.0	4.2	O K
10080 Winter	0.3	0.0	0.3	0.0678	0.0678	0.0	3.4	O K

Storm Duration (mins)	Rain (mm/hr)	Time-Peak (mins)
600 Winter	11.15	440
720 Winter	9.64	514
960 Winter	7.59	664
1440 Winter	5.42	940
2160 Winter	3.86	1344
2880 Winter	3.04	1728
4320 Winter	2.13	2464
5760 Winter	1.65	3176
7200 Winter	1.36	3888
8640 Winter	1.16	4584
10080 Winter	1.01	5248

White Young Green		
Brigantine House	West Southall	
27-31 Cumberland Street	East Access	
Bristol BS2 8NL	Zone 4- new imp area	
Date sept 08	Designed By rcb	
File south of railway.src	Checked By	
Micro Drainage	Source Control W.11.2	

Rainfall Details

Region	FSR Rainfall Model
Return Period (years)	100
Site Location	310550 179250 TQ 10550 79250
C (1km)	-0.026
D1 (1km)	0.322
D2 (1km)	0.287
D3 (1km)	0.249
E (1km)	0.319
F (1km)	2.560
Cv (Summer)	0.750
Cv (Winter)	0.840
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Summer Storms	Yes
Winter Storms	Yes
Climate Change %	+30

Time / Area Diagram

Total Area (ha) = 0.053

Time (mins) from:	to:	Area (ha)
0	4	0.053

White Young Green		Page 4
Brigantine House	West Southall	
27-31 Cumberland Street	East Access	
Bristol BS2 8NL	Zone 4- new imp area	
Date sept 08	Designed By rcb	
File south of railway.src	Checked By	
Micro Drainage	Source Control W.11.2	

Tank/Pond Details

Invert Level (m) 0.000 Ground Level (m) 2.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.00	50.0	0.50	50.0	1.00	50.0	1.50	50.0	2.00	50.0	2.50	50.0
0.10	50.0	0.60	50.0	1.10	50.0	1.60	50.0	2.10	50.0		
0.20	50.0	0.70	50.0	1.20	50.0	1.70	50.0	2.20	50.0		
0.30	50.0	0.80	50.0	1.30	50.0	1.80	50.0	2.30	50.0		
0.40	50.0	0.90	50.0	1.40	50.0	1.90	50.0	2.40	50.0		

Orifice Outflow Control

Diameter (m) 0.025 Invert Level (m) 0.000
Discharge Coefficient 0.600

Weir / Flume Overflow Control

Discharge Coef 0.544 Width (m) 1.000 Crest Level (m) 1.000

APPENDIX A – Topographic Survey

GENERAL NOTES:
1. THIS DRAWING IS BASED ON A LANDFORM TOPOGRAPHICAL SURVEY DATED APRIL 1999 AND UPDATED BY AWORTH LAND SURVEYS IN 2004.
2. THE INFORMATION SHOWN ON THIS DRAWING IS TO ORDNANCE DATUM.
3. THE INFORMATION SHOWN ON THIS DRAWING IS SUBJECT TO CONDITIONS RECORDED BY THE SURVEYORS AT THE TIME OF THE SURVEY WITHIN THE CONTEXT OF THE BRIEF PROVIDED.

Survey Notes:
4) DRAINAGE – Invert levels, pipe sizes and pipe connections have been surveyed by visual inspection only, and therefore the complete accuracy of this information cannot be guaranteed.
5) TREES – Sizes and species are indicative only, with the mean spread drawn to scale.
6) Survey is based on a local grid related to OS National Grid by GPS.

BOUNDARY NOTES:
7. DETAIL SHOWN GREY WAS SURVEYED BY LANDFORM.
8. BOUNDARY POINTS SHOWN THUS 31 HAVE BEEN SURVEYED BY AWORTH.
9. BOUNDARY POINTS SHOWN THUS 47 HAVE BEEN POSITIONED BY AWORTH TO EXISTING LINEWORK SURVEYED BY LANDFORM.

LEVELLING NOTES:
ALL LEVELS ARE BASED ON OSBMS
10) VALUE 37.98m, SITUATED ON NW FACE PILLAR, E SIDE OF SOUTH ROAD, N OF SOUTHALL TRAIN STATION.
11) VALUE 33.45m, SITUATED ON N FACE, NE ANGLE, TACK & CO SOLICITORS, E SIDE OF THE GREEN.
12) VALUE 30.32m, SITUATED ON NW FACE BRICK PILLAR, S SIDE GRAND UNION CANAL, 175M SW OF WEIR.
13) VALUE 31.09m, SITUATED ON E FACE, NE ANGLE, 205 BEACONSFIELD ROAD.

Rev	Description	By	Chk	App	Date
A	LATEST (DEC. 2004) TOPO INFORMATION ADDED	DJB	JA	DMF	07.01.05

FOR INFORMATION

Client:
SecondSite Property

White Young Green Environmental Ltd.
Yeoman House
63 Croydon Road
London SE20 7TS
Tel: 020 8659 9959
Fax: 020 8676 9968
e-mail: enviro.london@wyg.com

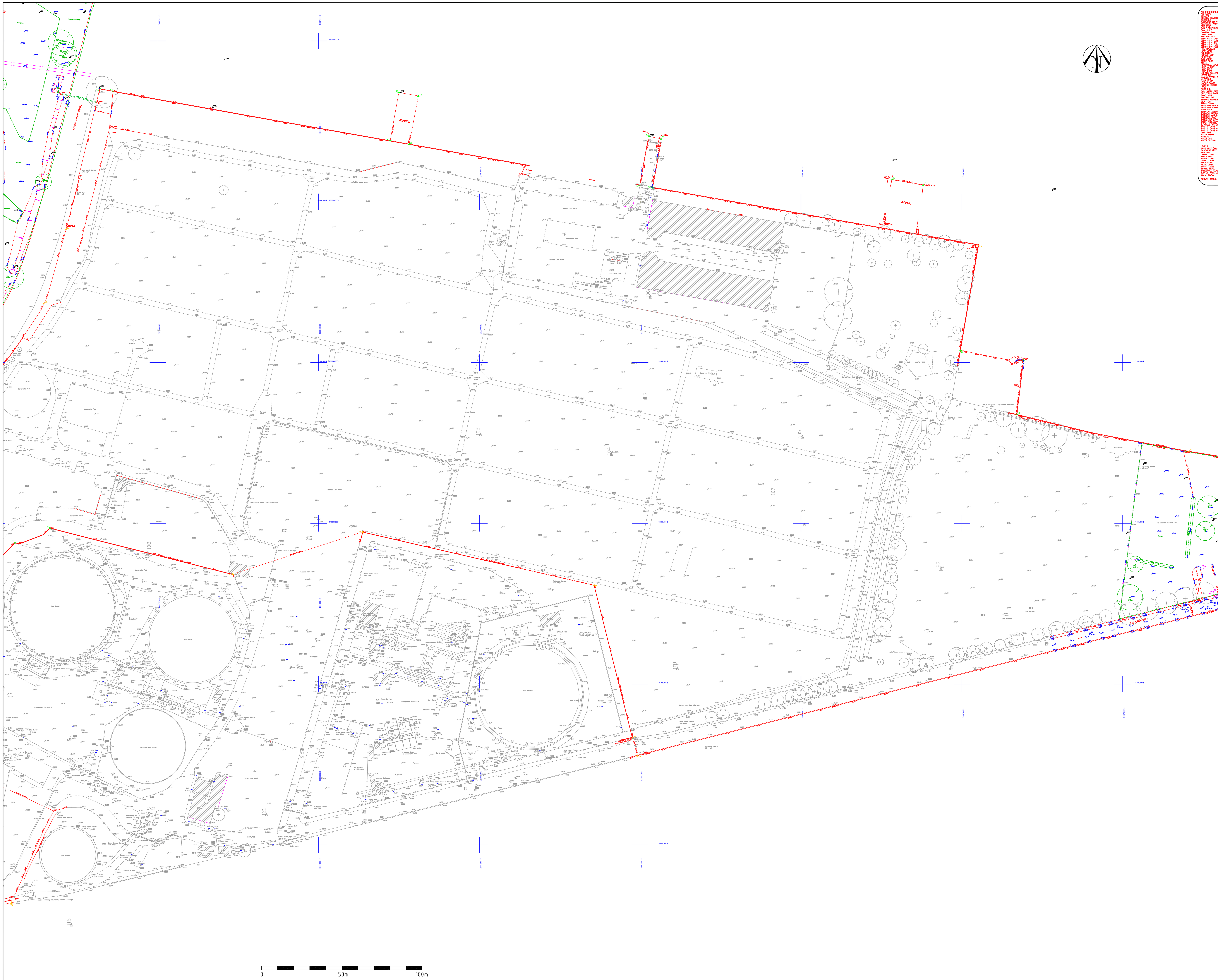
Environmental Consultancy
Civil Structural Mechanical Electrical Process Rail Traffic Environmental Project Management

Project:
SOUTHALL GASWORKS
SOUTHALL

Drawing Title:
TOPOGRAPHICAL SURVEY
WESTERN AREA

Scale at A0	Drawn By	Date	Checked By	Date	Approved By	Date
1 : 750	D. J. B.	OCT. 2003	G. M.	OCT. 2003	J. A.	OCT. 2003

Project No.	Office	Type	Drawing No.	Revision
E0357	40	ENV	800W	A



GENERAL NOTES:
1. THIS DRAWING IS BASED ON A LANDFORM TOPOGRAPHICAL SURVEY DATED APRIL 1999 AND UPDATED BY AWORTH LAND SURVEYS IN 2004.
2. THE INFORMATION SHOWN ON THIS DRAWING IS TO ORDNANCE DATUM.
3. THE INFORMATION SHOWN ON THIS DRAWING IS SUBJECT TO CONDITIONS RECORDED BY THE SURVEYORS AT THE TIME OF THE SURVEY WITHIN THE CONTEXT OF THE BRIEF PROVIDED.

Survey Notes:
4) DRAINAGE – Invert levels, pipe sizes and pipe connections have been surveyed by visual inspection only, and therefore the complete accuracy of this information cannot be guaranteed.
5) TREES – Sizes and species are indicative only, with the mean spread drawn to scale.
6) Survey is based on a local grid related to OS National Grid by GPS.

BOUNDARY NOTES:
7. DETAIL SHOWN GREY WAS SURVEYED BY LANDFORM.
8. BOUNDARY POINTS SHOWN THUS 31 HAVE BEEN SURVEYED BY AWORTH.
9. BOUNDARY POINTS SHOWN THUS 47 HAVE BEEN POSITIONED BY AWORTH TO EXISTING LINEWORK SURVEYED BY LANDFORM.

LEVELLING NOTES:
ALL LEVELS ARE BASED ON OSBMS
10) VALUE 37.98m, SITUATED ON NW FACE PILLAR, E SIDE OF SOUTH ROAD, N OF SOUTHALL TRAIN STATION.
11) VALUE 33.45m, SITUATED ON N FACE, NE ANGLE, TACK & CO SOLICITORS, E SIDE OF THE GREEN.
12) VALUE 30.32m, SITUATED ON NW FACE BRICK PILLAR, S SIDE GRAND UNION CANAL,175M SW OF WEIR.
13) VALUE 31.09m, SITUATED ON E FACE, NE ANGLE, 205 BEACONSFIELD ROAD.

TREE LEGEND

ALDER	ALD	MAPLE	MPL
ASH	ASH	OAK	OAK
ASPEN	ASP	PINE	PNE
BEECH	BCH	POPLAR	POP
CEDAR	CED	PRUNUS	PRU
CHERRY	CHY	RHODODENDRONS	RDN
CONIFER (UNKNOWN)	CON	ROWAN	RWN
CYPRESS	CYP	SALLOW	SLW
DECIDUOUS (UNKNOWN)	DEC	SAPLING	SAP
DEAD	DED	SWEET CHESTNUT	SCH
ELDERBERRY	ELD	SILVER BIRCH	SIB
ELM	ELM	SPRUCE	SPR
EUCALYPTUS	EUC	SPECIES UNKNOWN	SPU
FIR	FIR	SYCAMORE	SYC
FRUIT	FRT	TREE OF HEAVEN	TOH
HAWTHORN	HAW	WHITEBEAM	WBM
HAZEL	HZL	WILLOW	WLW
HORNBEAM	HBM	WALNUT	WNT
HORSE CHESTNUT	HCH	YEW	YEW

Rev	Description	By	Chk	App	Date
A	LATEST (DEC. 2004) TOPO INFORMATION ADDED	DJB	JA	DMF	07.01.05

FOR INFORMATION

Client:
SecondSite Property

White Young Green Environmental Ltd.
Yeoman House
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London SE20 7TS
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Environmental Consultancy
Civil Structural Mechanical Electrical Process Rail Traffic Environmental Project Management

Project:
SOUTHALL GASWORKS
SOUTHALL

Drawing Title:
TOPOGRAPHICAL SURVEY
EASTERN AREA

Scale at A0	Drawn By	Date	Checked By	Date	Approved By	Date
1 : 750	D. J. B.	OCT. 2003	G. M.	OCT. 2003	J. A.	OCT. 2003

Project No.	Office	Type	Drawing No.	Revision
E0357	40	ENV	800E	A

APPENDIX B – Communications with the Environment Agency

Our Ref : NE/2005/012428-2/1
Your Ref : BEW/AD/130505LT/A17014

Date : 26 April 2005

White Green Young
Yeoman House
63 Croydon Road
London
SE20 7TS

FAO: Brian Wilkins

Dear Sir,

SUBMISSION OF SURFACE WATER FLOOD RISK ASSESSMENT (FRA).

SOUTHALL GASWORKS REDEVELOPMENT, SOUTHALL, EALING, UB2

Thank you for your letter dated 13 April 2005, which was received on 14 April 2005. You are asked to quote our reference in any correspondence. The Environment Agency has the following comments:

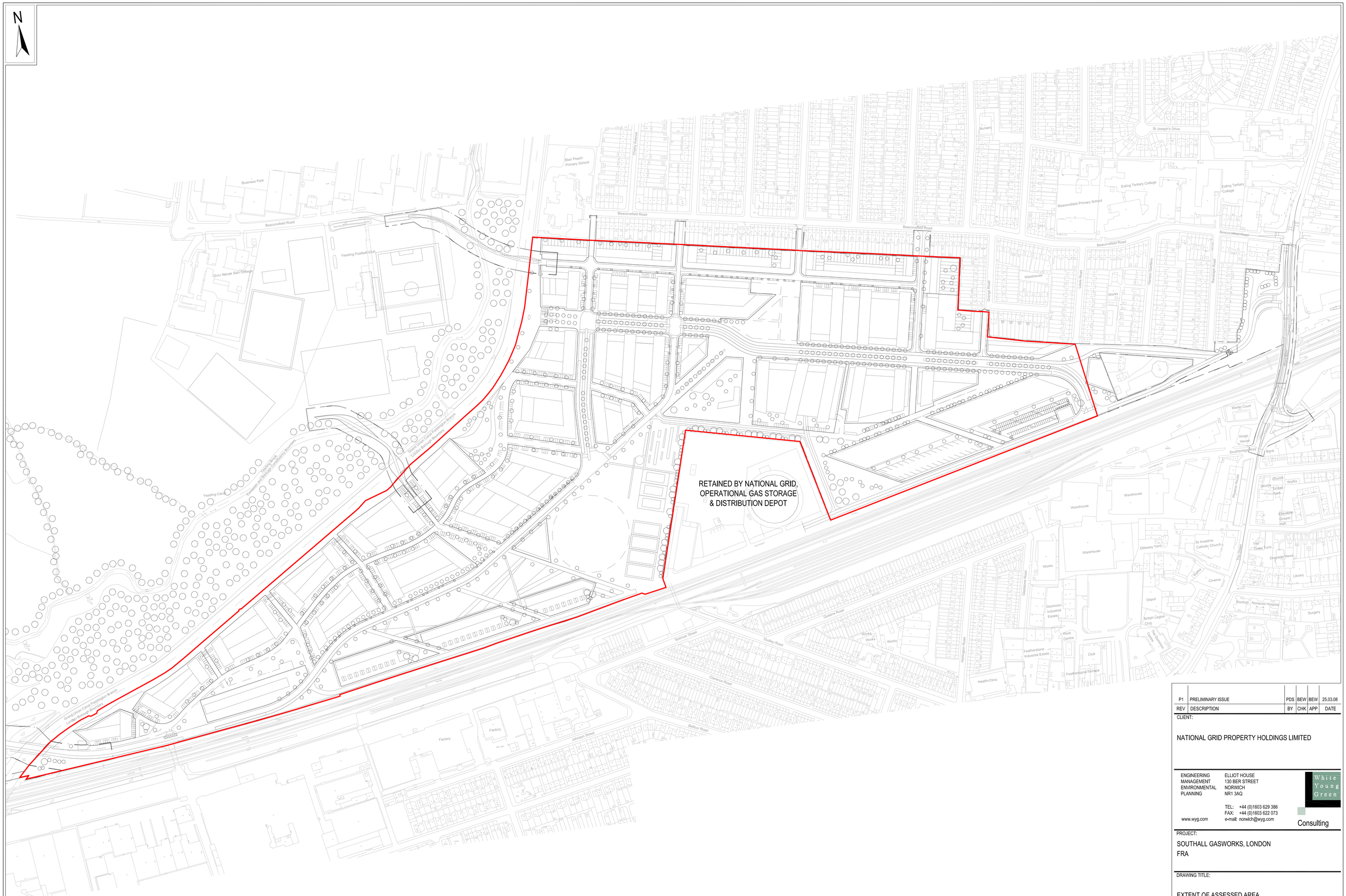
The proposals awithin the FRA are acceptable because the discharge has been restricted to greenfield rate and 1 in 100 year attenuation has been provided. Whilst these proposals are acceptable we would like to see the inclusion of more sustainable drainage techniques in the final design. We would also prefer to see surface waters disposed off into the Yeading Brook through one single outfall rather than two outfalls.

I trust this is satisfactory but if you have any queries, please contact me.

Yours faithfully

LINDA CRUSE
Planning Liaison Officer
Tel: 01707 632407
Fax: 01707 632515
Email: linda.cruse@environment-agency.gov.uk

APPENDIX C – Thames Water Asset Records



REV	DESCRIPTION	BY	CHK	APP	DATE
P1	PRELIMINARY ISSUE	PDS	BEW	BEW	25.03.08

CLIENT:

NATIONAL GRID PROPERTY HOLDINGS LIMITED

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White Young Green
Consulting

PROJECT:

SOUTHALL GASWORKS, LONDON
FRA

DRAWING TITLE:

EXTENT OF ASSESSED AREA

SCALE @ A0	DRAWN	DATE	CHECKED	DATE	APPROVED	DATE
1:1500	PDS	MAR 08	BEW	MAR 08	BEW	MAR 08

PROJECT No.	OFFICE	TYPE	DRAWING No.	REVISION
A17014	3201	C	APP 01	P1

SHEET SIZE : A0 LANDSCAPE

APPENDIX D – Allowable Run-off Rate Calculations

IH 124 Mean Annual Flood

Input

Return Period (years)	100	Soil	0.300
Area (Ha)	34.000	Urban	0.000
SAAR (mm)	639.000	Region Number	6

Results l/s

QBAR	Rural	58.1
QBAR	Urban	58.1
Q 100	years	185.4
Q 1	year	49.4
Q 2	years	51.2
Q 5	years	74.4
Q 10	years	94.1
Q 20	years	116.4
Q 25	years	124.8
Q 30	years	131.7
Q 50	years	152.2
Q 100	years	185.4
Q 200	years	217.9
Q 250	years	228.4
Q 1000	years	299.8

≡ 1.71 l/s/Ha

APPENDIX E – Proposed Development

West Southall illustrative landscape

SOUTHALL GASWORKS

Landscape Masterplan - 30 September 2007

Scale 1:1250

LOVEJOY

APPENDIX F – Foul Impact Study Report

SEWER IMPACT STUDY

Asset Management

X4503 – 128

PROPOSED DEVELOPMENT AT SOUTHALL GAS WORK

FOUL WATER SYSTEM

Thames Water Utilities

Gainsborough House / Blake House
Manor Farm Road
Reading
Berkshire
RG2 0JN

Author	: Norman Yong
Date	: 1 March 2005
Checked by	: Geof Brown
Date	: 9 March 2005
Approved by	: Paul Eccleston
Date	: 15 March 2005
Issue	: 1

Contents

1.0 Introduction

The following report was commissioned by Developer Services Waste on behalf of White Young Green Consulting to investigate the capacity within the existing public foul water system and to ascertain the impact of the proposed development on the public sewerage system.

The scope of the study includes:

- The production of a detailed hydraulic model for the local foul water system.
- The incorporation of the detailed foul model to the existing Mogden macro model.
- Flow surveys in the foul water system.
- Verification of the foul water model.
- The assessment of the impact of additional flows on the existing sewerage system using the verified model.
- Proposal of solutions to any adverse affects of the development.

2.0 Background

The site is located within the Mogden STW Catchment.

The boundary of the proposed development is highlighted in Figure 1 below. The proposed development would consist of approximately 4,052 housing units. The Developer has indicated that their estimated foul flow for the whole development is 32.4l/s.

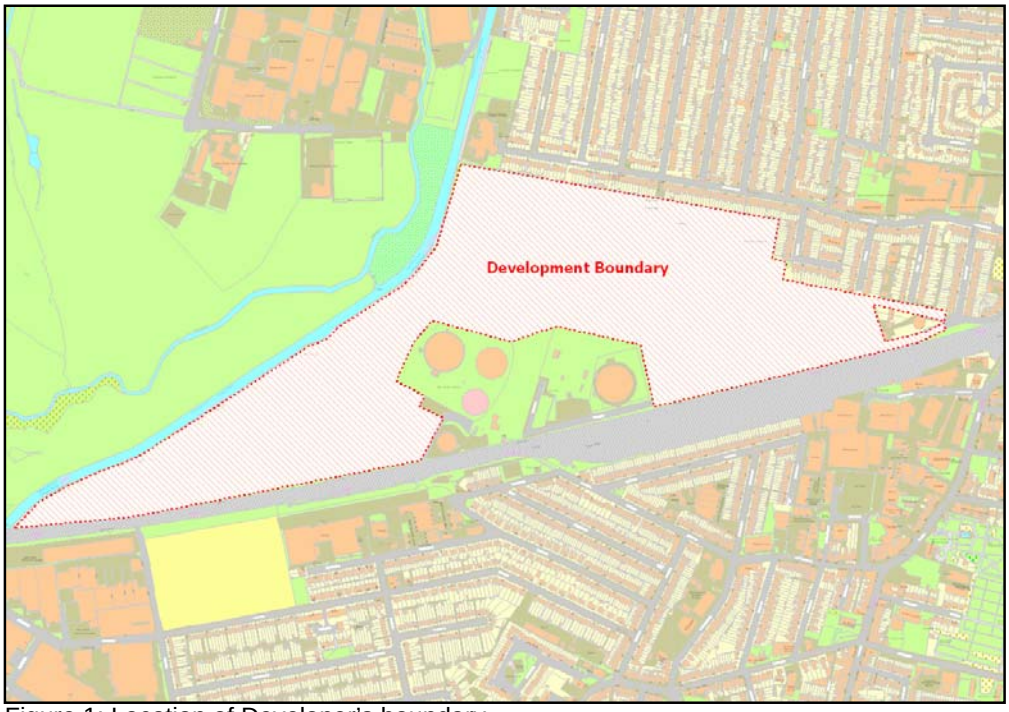


Figure 1: Location of Developer's boundary.

Based on sewer for adoption (4000l/dwelling/day), it is estimated that the design flow for the development is approximately 194 l/s.

3.0 Existing sewerage system

The layout of the proposed development indicates that the flows from the development would naturally connect to existing manhole TQ11791402. This manhole is located on the southwest section of the development. The existing sewer along here is 600mm in diameter and discharges to the Crane Valley Trunk Sewer. The 600mm diameter sewer downstream of manhole TQ11791402 has a pipe full capacity of 272l/s. An alternate point of connection for the proposed development would be at Southall Gas Works compound at manhole TQ11798702. The 225mm diameter sewer downstream of manhole TQ11798702 has a pipe full capacity of 38l/s. Flows from the Mogden Catchment are treated at Mogden STW.

An assessment of the sewerage system in this area revealed an existing 775m of 1500mm diameter tank sewer (Refer to Figure 2) upstream of manhole TQ11791402 along Western Road.

Figure 2: Location of 1500mm diameter tank sewer.

An assessment of Thames Water sewer flooding history database (SFHD) highlighted 10 known flooding incidents between January 2000 and December 2004. These are flooding incidents within the detailed model that discharge to manhole TQ11791402. An assessment of the flooding incidents indicated that they were caused by blockages of the sewers that restricted the use of toilets.

Figure 3 shows the locations of the recorded flooding incidents highlighted in red.

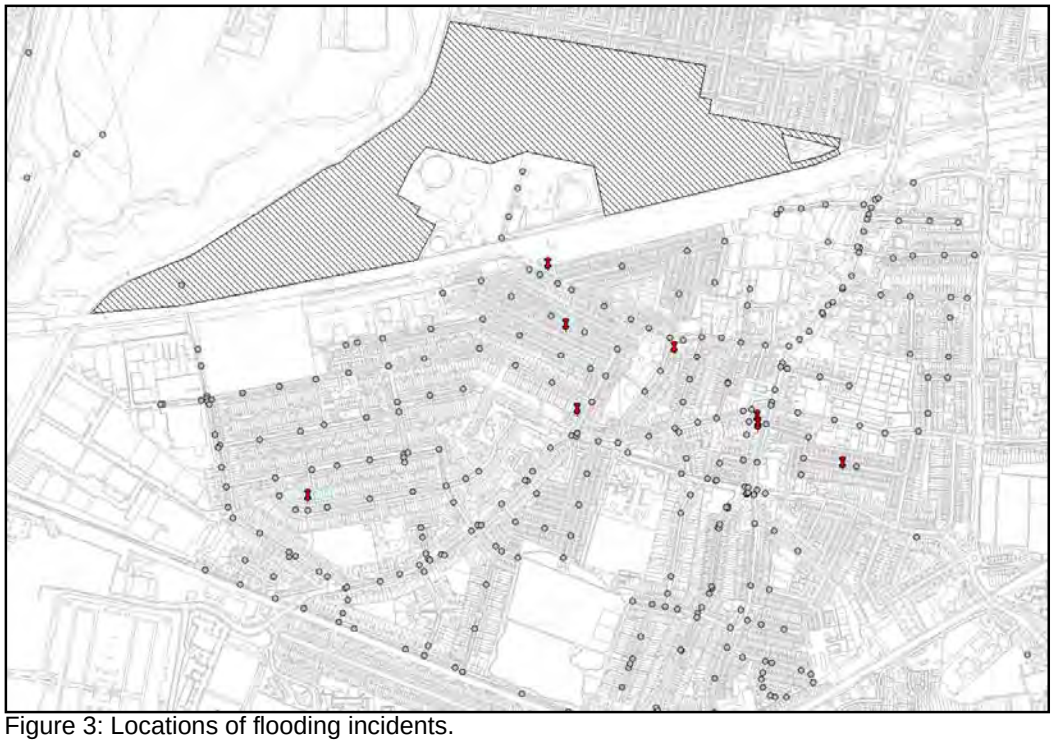


Figure 3: Locations of flooding incidents.

4.0 Thames Water Drainage Requirements

It is necessary to provide separate foul and surface water drainage systems and to ensure that each system is connected to an appropriate drainage system.

The development should caused no detriment to the system in a 1 in 15 year FEH critical duration storm.

5.0 Sewer Impact Assessment

5.1 Model Build

The asset information has been obtained from Thames Water's GIS system and is assumed to be correct. In the model build, where level data is missing it has been interpolated. The detailed model for use in assessing the impact of the proposed development flow is a 305nodes model with a catchment area of 142ha. Population based on address count of 2.5 person per household was calculated to be 10,740.

5.2 Model Verification

The verification of the model was carried out using data from a short-term flow survey, commissioned as part of this study. The flow survey was carried out between 30th November 2004 and 19th January 2005 and consisted of 2 rain gauges and 3 flow monitors.

Rainfall events on the 17th, 28th December 2004 and 8th January 2005 were selected for verification of the model. All three events had a return period of less than 1 in 1 year based on Flooding Estimation Handbook (FEH) software estimation.

With regards to the foul system, the flow survey indicated the likely presence of a large amount of silt in the network. As such, a large amount of sediment was included to calibrate the hydraulic model. These sediments were modelled downstream of flow monitors FM6 and FM7.

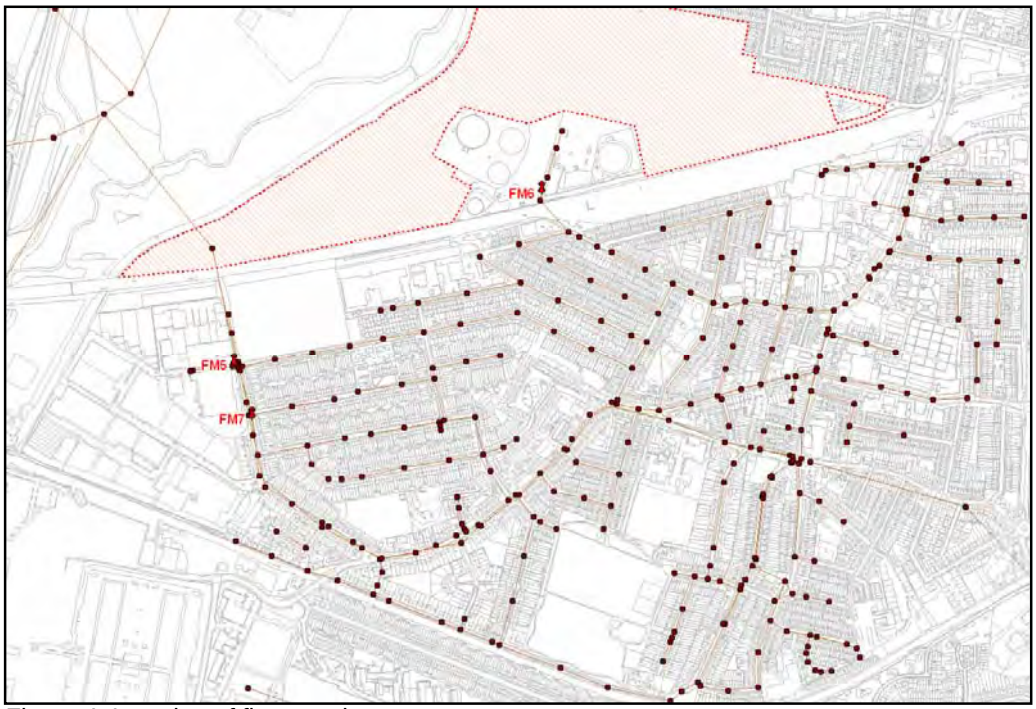


Figure 4: Location of flow monitors.

The calibration for DWF required the population in the model to be increase by a factor of 2. This was due to the observed flow survey data on the volume of flows discharging through flow monitor FM7. As such, the original calculated population based on address count increased to a total of approximately 23,500. Infiltration was discounted as the observed flow survey data did not record any abnormal base flow.

For the DWF verification, the model shows an over prediction on the depth hydrograph in comparison to the observed depth. For the storm events verification, the model shows good fit for the observed storm events.

The verification results are shown on Appendix A.

The verified model was then investigated for hydraulic performance and solutions investigated to mitigate the effects of the proposed flows.

5.3 Return Period Analysis

As is current best practice the Flooding Estimation Handbook (FEH) storm profiles were used for analysis of the network. The critical storm duration (the duration producing the greatest number of flooded nodes) was found to be 30 minutes and 60 minutes (the greatest flood volume within the detailed model).

The existing calibrated foul sewerage network in the detailed model was found to flood in a 1 in 2 year return period storm of 30 minutes critical duration. This is the calibrated model with a large amount of sediment modelled. Figure 5 shows the

flooded nodes (Flood volume >25m^3). Flooding was occurring at locations with no known flooding incident recorded in Thames Water SFHD database. It is also likely that during intense short duration rainfall events, inflows to the sewers are restricted by the capacity of the road gullies.

It is possible that any flooding from the foul sewers would drain into the adjacent storm sewerage system and not flood any properties.

Figure 5: 1 in 2 year return period storm. Flooded nodes highlighted in blue.

The flooded nodes could also be attributed to incorrect distribution of impermeable areas within the contributing areas of the detailed model than what is perceived in reality. In calibrating the model, 140mm of sediment was modelled downstream of FM7 and this would likely cause the model to predict flooding upstream. It was necessary to increase the population by a factor of 2 globally within the detailed model during calibration of the model. This would have the likely impact of inducing flooding at sewer branches to the main drainage of the detailed model.

The relatively few flow monitors on site and no impermeable area survey meant that it is difficult to effectively calibrate every sub catchments of the detailed model. As such, without a detailed flow survey, judgement should be used in understanding the flooded areas predicted by the model.

5.4 Impact Assessment

The impact has been assessed based on the proposed design flow of 194.4 l/s (6 x 32.4 l/s). From the location of the proposed development, flows were assumed to discharge to existing manhole TQ11791402. The hydraulic analysis identified that the existing sewers downstream of manhole TQ11791402 have sufficient capacity to accept the additional proposed design flow in DWF condition.

During design storm condition, there was a small increase in the flood volume. The table below listed the total flood volumes from the existing system and the proposed development.

Reference	2 year return period (m^3)	5 year return period (m^3)	15 year return period (m^3)
Existing system without silt	877	1997	3833
Existing system with silt	890	1999	3833
Existing system with development & silt	878	2000	3846
Existing system with development & without silt	878	1993	3835

Alternate location for the connection of the proposed flow at manhole TQ11798702 was not appropriate due to insufficient capacity of the existing 225mm diameter sewer. Manhole TQ11798702 is located at Southall Gas Works compound.

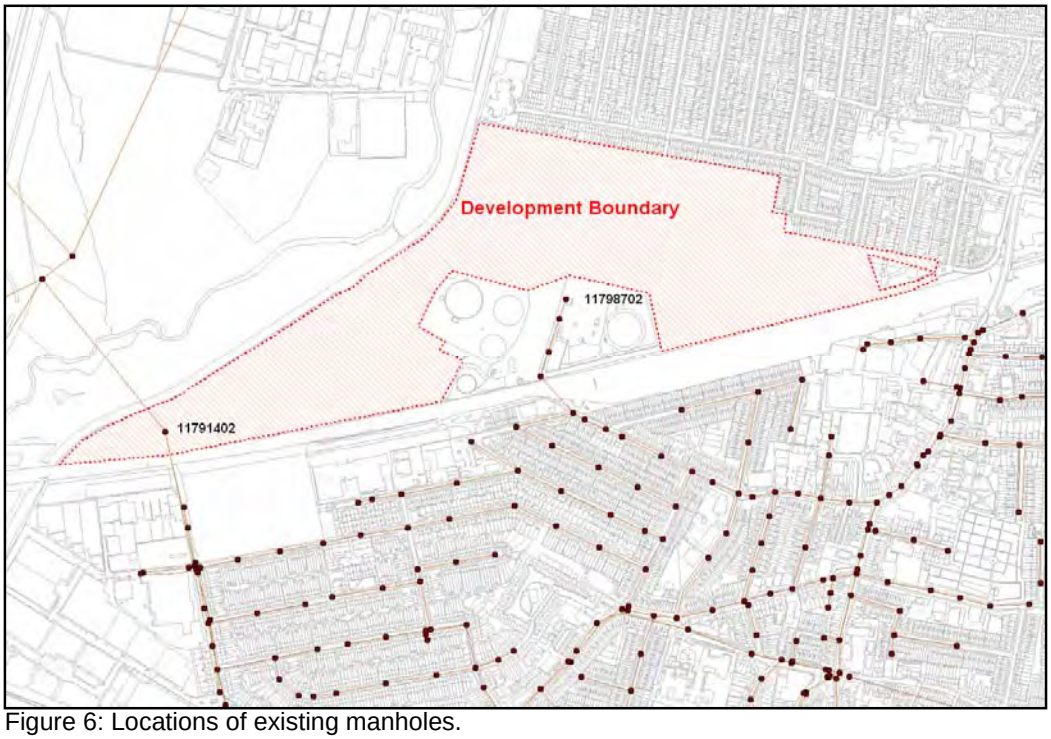


Figure 6: Locations of existing manholes.

An analysis of the trunk sewers downstream of the model was carried out with a typical design storm event of 15 year 360mins duration. The table below listed the changes in surcharge levels in the trunk sewers downstream and upstream of the proposed connection point.

Infoworks Node id	Existing situation	Existing situation + development
10-157	16.679	16.819
10-155	18.260	18.510
10-150	19.980	20.360
10-146	20.330	20.709
10-140	22.302	22.630

6.0 Conclusion

It can be concluded that the existing system has the capacity to cater for the increase in DWF from the proposed development.

The hydraulic analysis of the system using design storm events does highlight hydraulic deficiency in the system during storm events. As such, the developer should ensure that no storm flows discharges directly or indirectly into the existing foul system.

7.0 Recommendations

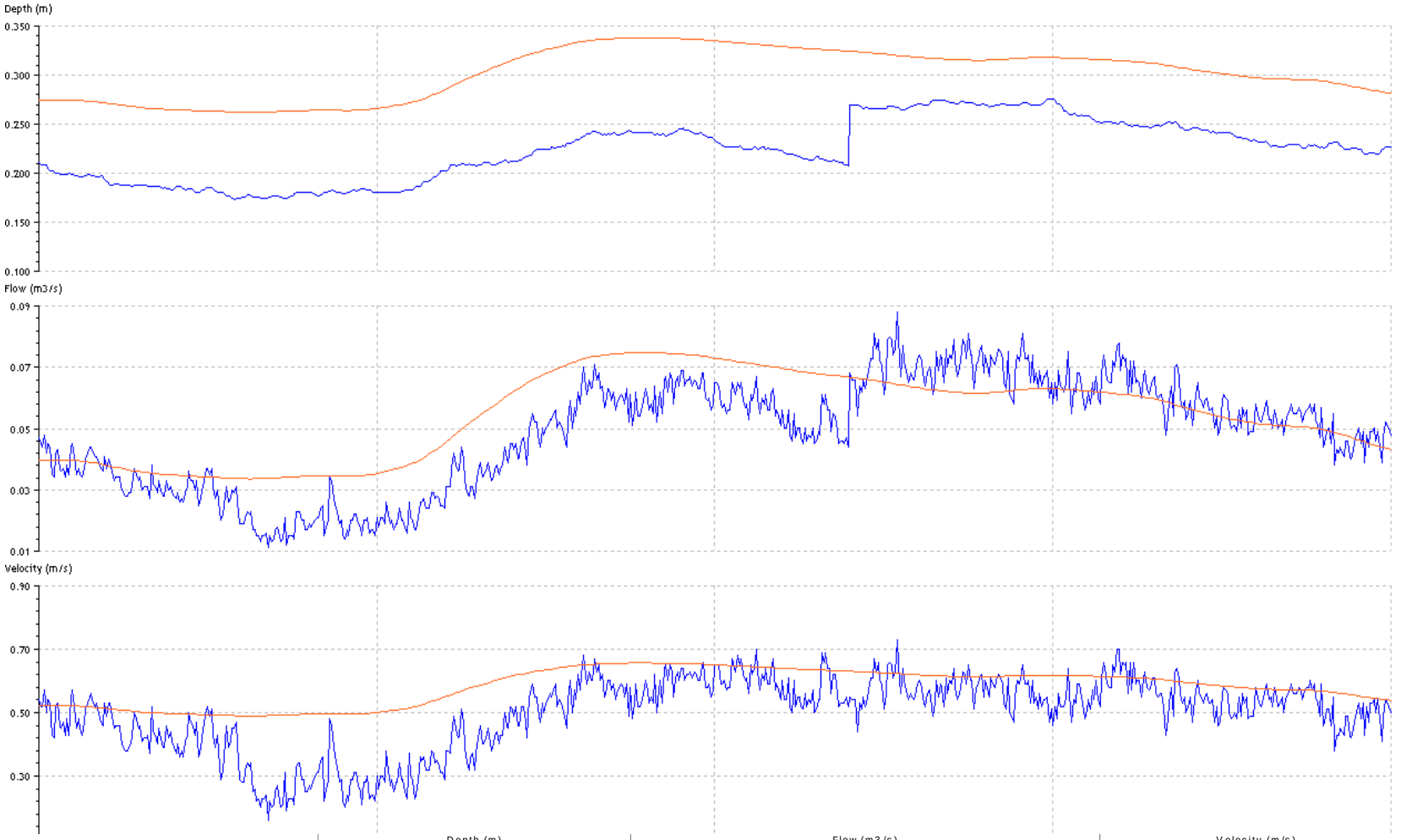
It is recommended that the additional foul flows from the proposed development be allowed to connect to the public sewers at manhole TQ11791402.

The above are recommendations to Thames Water Utilities, Developer Services Waste and may be altered/added to based on local operational knowledge of the system.

Appendix A – Verification Results

Flow Survey: >Impact Studies>Flow Survey-DWF (25Dec2004)c (2/10/2005 9:16:34 AM)
Sim: >Impact Studies>Run Group-Southall Gas Work (DWF)>DWF (25 Dec 2004)>DWF (3/4/2005 5:55:15 PM)
Graph Template: >Impact Studies>Graph Template-Southall Gas Work (25Dec2004)c (2/10/2005 1:32:27 PM)

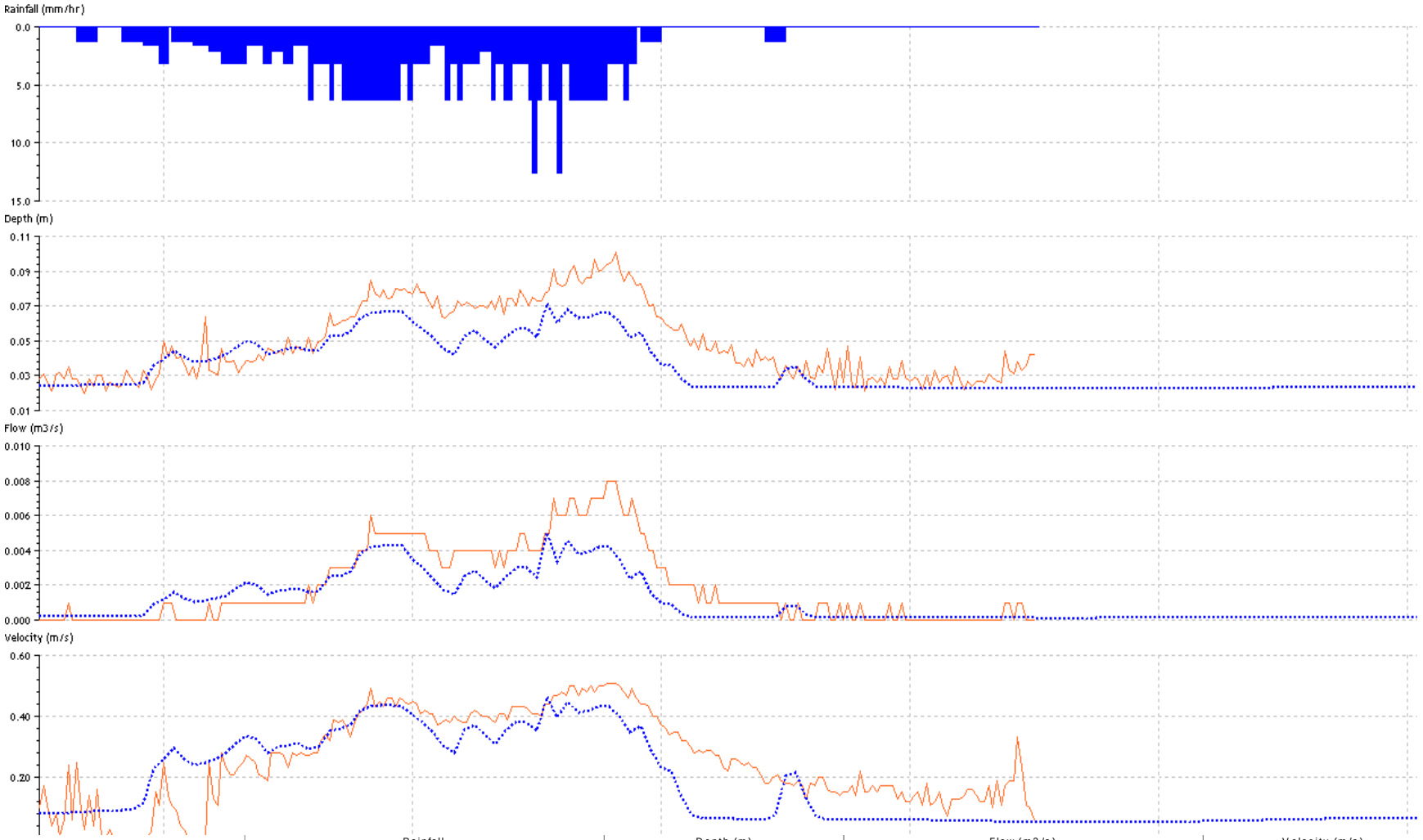
Flow Survey Location (Obs.) M07, Model Location (Pred.) D/S 11791002.1



	Depth (m)		Flow (m3/s)			Velocity (m/s)	
	Min	Max	Min	Max	Volume (m3)	Min	Max
Obs.	0.173	0.276	0.011	0.088	4204.980	0.160	0.730
...Work (DWF)>DWF (25 Dec 2004)>DWF	0.262	0.338	0.034	0.075	4703.566	0.490	0.657

Flow Survey: >Impact Studies>Flow Survey-Storm1 (17Dec2004)c (2/10/2005 1:38:04 PM)
Sim: >Impact Studies>Run Group-Southall Gas Work (Storm)c>Southall Storm1>Rain (3/4/2005 6:35:52 PM)
Graph Template: >Impact Studies>Graph Template-Southall-Storm1 (17Dec2004)c (2/10/2005 1:46:40 PM)

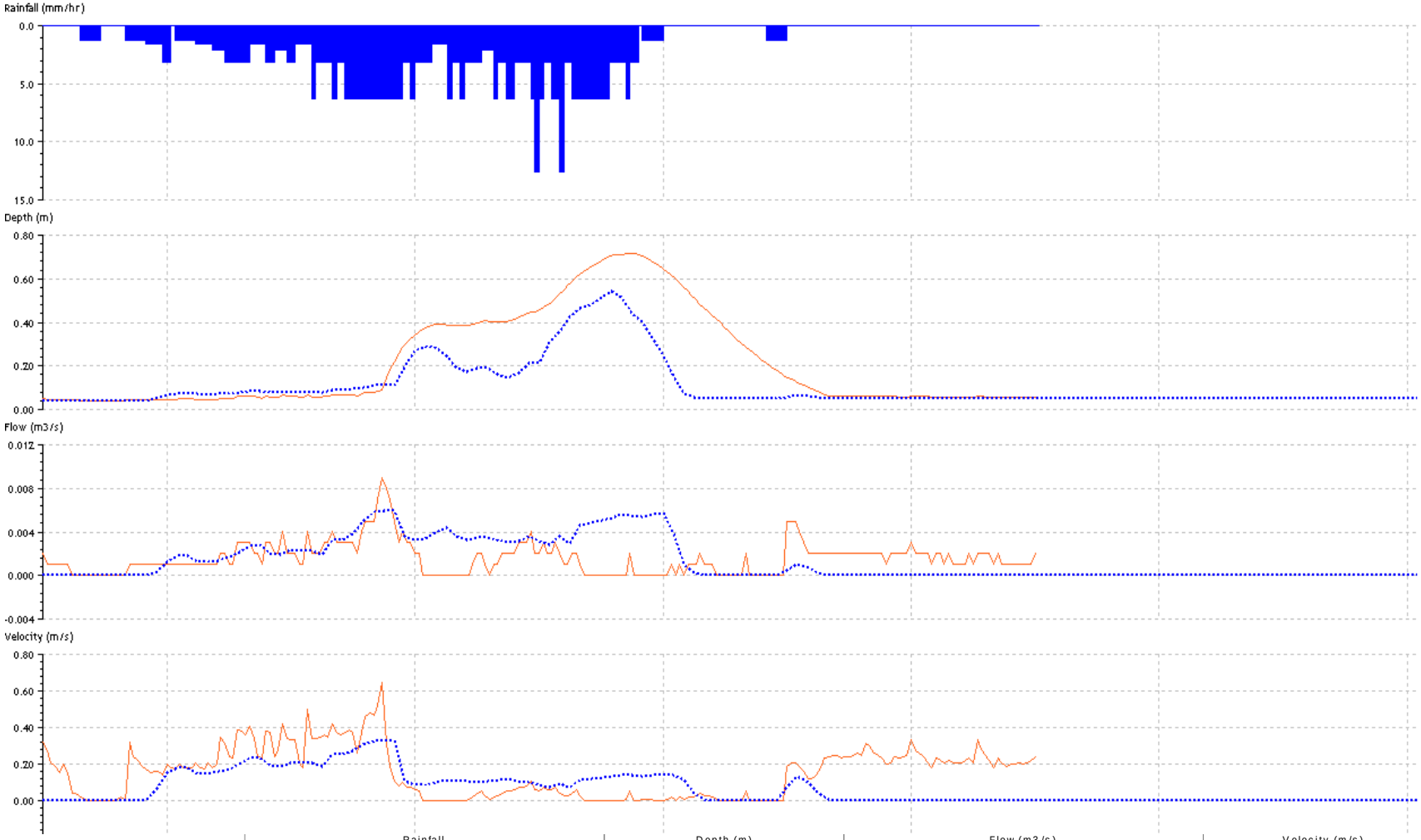
Flow Survey Location (Obs.) M05, Model Location (Pred.) U/S 11791204.1, Rainfall Profile: 1



	Rainfall			Depth (m)		Flow (m3/s)			Velocity (m/s)	
	Depth (mm)	Peak (mm/hr)	Average (mm/hr)	Min	Max	Min	Max	Volume (m3)	Min	Max
Rain	0.004	12.600	1.975							
Obs.				0.020	0.101	0.000	0.008	57.120	0.000	0.510
...orm)c>Southall Storm1>Rain				0.022	0.071	0.000	0.005	42.382	0.050	0.463

Flow Survey: >Impact Studies>Flow Survey-Storm1 (17Dec2004)c (2/10/2005 1:38:04 PM)
Sim: >Impact Studies>Run Group-Southall Gas Work (Storm)c>Southall Storm1>Rain (3/4/2005 6:35:52 PM)
Graph Template: >Impact Studies>Graph Template-Southall-Storm1 (17Dec2004)c (2/10/2005 1:46:40 PM)

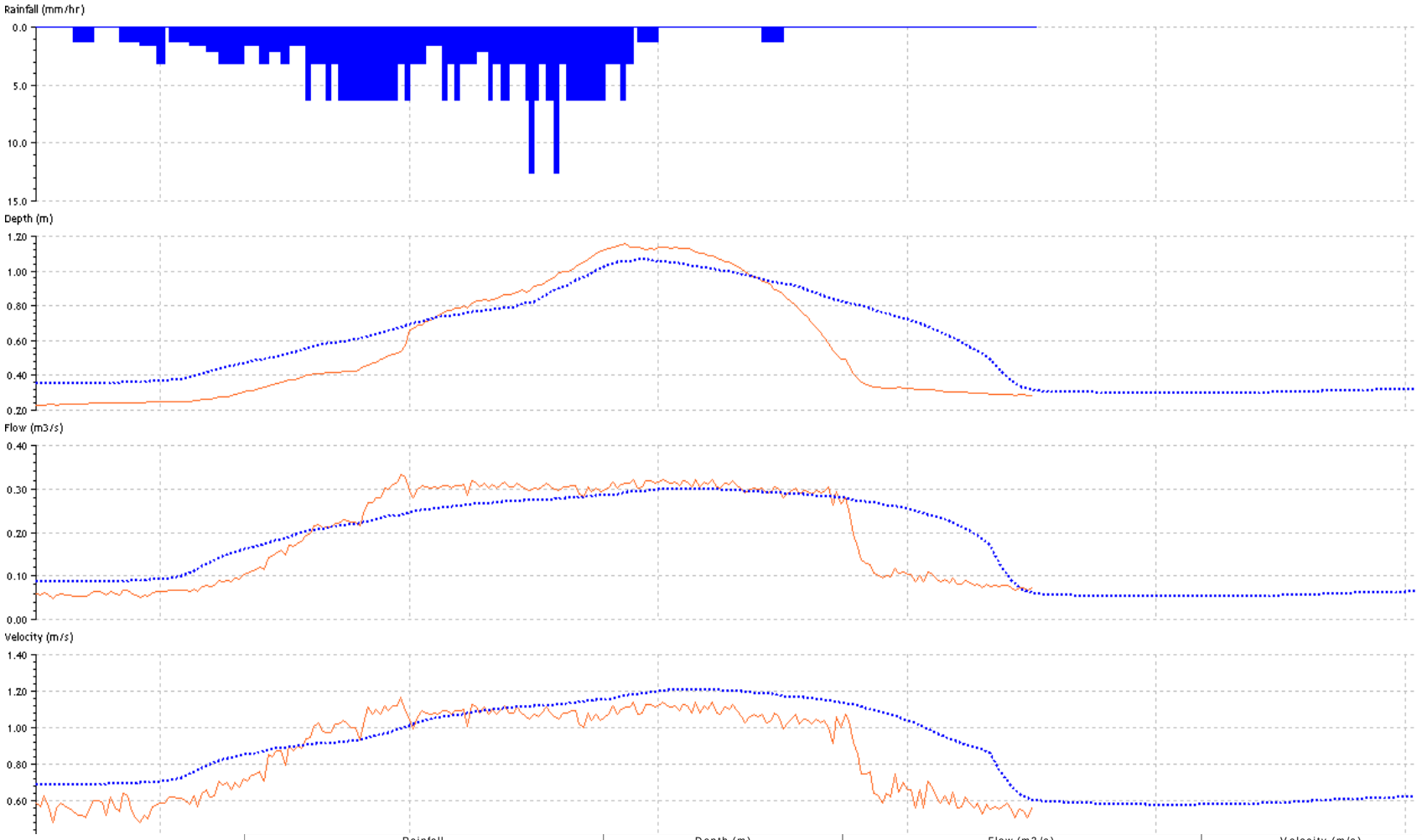
Flow Survey Location (Obs.) M06, Model Location (Pred.) D/S 11797602.1, Rainfall Profile: 1



	Rainfall			Depth (m)		Flow (m3/s)			Velocity (m/s)	
	Depth (mm)	Peak (mm/hr)	Average (mm/hr)	Min	Max	Min	Max	Volume (m3)	Min	Max
Rain	0.004	12.600	1.975							
Obs.				0.041	0.718	0.000	0.009	43.920	0.000	0.650
...orm)c>Southall Storm1>Rain				0.041	0.542	-0.000	0.006	53.426	-0.000	0.331

Observed / Predicted Plot Produced by nyong (3/8/2005 11:00:41 AM) Page 3 of 3
Flow Survey: >Impact Studies>Flow Survey-Storm1 (17Dec2004)c (2/10/2005 1:38:04 PM)
Sim: >Impact Studies>Run Group-Southall Gas Work (Storm)c>Southall Storm1>Rain (3/4/2005 6:35:52 PM)
Graph Template: >Impact Studies>Graph Template-Southall-Storm1 (17Dec2004)c (2/10/2005 1:46:40 PM)

Flow Survey Location (Obs.) M07, Model Location (Pred.) D/S 11791002.1, Rainfall Profile: 1



	Rainfall			Depth (m)		Flow (m3/s)			Velocity (m/s)	
	Depth (mm)	Peak (mm/hr)	Average (mm/hr)	Min	Max	Min	Max	Volume (m3)	Min	Max
Rain	0.004	12.600	1.975							
Obs.				0.231	1.159	0.048	0.333	5773.080	0.480	1.170
...orm)c>Southall Storm1>Rain				0.298	1.069	0.052	0.300	6916.644	0.576	1.210

APPENDIX G – Preliminary Phasing/Above Ground Storage Areas

N

PHASE	APPROXIMATE FLOOD STORAGE AREAS (m²)
1	7918
2	4264
3	3002
4	6954
5	10675
6	3424
7	29461
8	2885
9	2893
10	9648
11	3010
12	2635
13	4091

REV	DESCRIPTION	BY	CHK	APP	DATE
P1	PRELIMINARY ISSUE	PDS	RM	BEW	17.09.08

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White Young Green

Project:

SOUTHALL GASWORKS
LONDON

Drawing Title:

AREAS AVAILABLE FOR FLOODING

Scale @ A0	Drawn	Date	Checked	Date	Approved	Date
1:1500	PDS	SEP 08	RM	SEP 08	BEW	SEP 08

Project No.	Office	Type	Drawing No.	Revision
A17014	3201	C	600	P1

SHEET SIZE : A0 LANDSCAPE

APPENDIX H – Storage Calculation/Above Ground Storage Depths

Phase No.	Approx Net Area (ha)	Assumed 80% Impermeable (ha)	Greenfield Runoff Rate (IH 124 Method)		Approx Attenuation Volume Required			Approx Area Available For Above Ground Storage (m2)	Approx Mean Flood Depth (m)
			1 in 30 Year (l/s)	1 in 100 Year +CC (l/s)	1 in 30 Year (m3)	1 in 100 Year +CC (m3)	Difference (m3)		
1	5.8	4.6	18.0	25.3	1484.9	2626.3	1141.4	7918.04	0.14
2	1.9	1.5	5.9	8.3	483.9	855.0	371.1	4264.41	0.09
3	2.8	2.2	8.7	12.2	707.7	1253.3	545.6	3002.43	0.18
4	1.8	1.4	5.6	7.8	448.9	796.6	347.7	6954.40	0.05
5	3.9	3.1	12.1	17.0	1001.5	1771.3	769.8	10675.39	0.07
6	1.9	1.5	5.9	8.3	483.4	855	371.6	3424.45	0.11
7	5.0	4.0	15.5	21.8	1295.3	2289.2	993.9	29461.47	0.03
8	1.8	1.4	5.6	7.8	448.9	796.6	347.7	2884.59	0.12
9	1.2	1.0	3.7	5.2	328.6	579.1	250.5	2893.45	0.09
10	3.7	3.0	11.5	16.1	974.8	1723.7	748.9	9647.77	0.08
11	1.5	1.2	4.6	6.5	389.9	687.9	298.0	3009.85	0.10
12	1.3	1.0	4.0	5.7	320.5	565.5	245.0	2635.27	0.09
13	1.2	1.0	3.7	5.2	328.6	579.1	250.5	4090.73	0.06
Total	33.8	27.0	104.6	147.4	8696.9	15378.6	6681.7	90862.25	0.07

- During storm events up to the critical 1 in 30 year, storage will be provided using one or more of the following methods:

  - Adopted large diameter pipes/box culverts
  - Private geo-cellular/steel tanks
  - Wetland features (phase 10 only)

  Consideration must be given during the detail drainage submission of all phases to the use of:

  - Green roofs (assumed zero storage)
  - Rain water harvesting (assumed zero storage)

- During storm events between the critical 1 in 30 year and 1 in 100 year plus climate change, storage will be provided using one or more of the following methods:

  - Permeable paving (sub base storage) where land use is deemed appropriate
  - Above ground storage (controlled flooding)
  - Lined swales (where land is available following detailed design)
  - Dry detention basins (where land is available following detailed design)
  - Private geo-cellular/steel tanks (should lined swales/dry detention basin be proven not to be feasible as a first option due to site density)
  - Wetland features (phase 10 only)

The exact SUDs methods used will depend on which phase of the development is being constructed and how dense the proposed layout is for that particular phase once the detail layout and level design has been completed. The proposed mean flood depths stated above are approximate only and have been base on available land within each phase which could be use for one or more of the SUDs solutions stated above for storm events between 1 in 30 year and 1 in 100 year plus climate change event. Therefore the mean flood depths above actually represent the worst case scenario of above ground controlled flooding. This is because some of this storage may be placed below ground (e.g. Permeable Paving) or within structure with deeper storage depth than stated above such as lined Swales or detention basins (approx 1m deep).

Ref: A17014_3201_C_001
PHASED STORAGE REQUIREMENTS AND FLOOD DEPTH