R J Fillingham
Associates Ltd
Flood Risk & Drainage Consultants

LAND OFF BREINTON LEE, HEREFORD

PROPOSED FOUL & SURFACE WATER DRAINAGE STRATEGY

November 2012

Mr M Wakeley

Rev A – April 2013

1.0 Introduction

1.1 This Proposed Foul & Surface Water Drainage Strategy report has been prepared by R J Fillingham Associates Ltd. on behalf of Mr M. Wakeley in respect of the proposed residential development of land located off Breinton Lee, Hereford.

1.2 This report has been prepared in consultation with Martin Jackson at Local Government Amey.

1.3 It is intended that the drainage strategy described within this report is used in support of an outline planning application for the residential development of the site and should form the basis for the detailed drainage design.

2.0 Site Description

2.1 The site is Greenfield with a gross area of approx. 0.84 ha. It is located directly off Breinton Lee, Kings Acre Road, Hereford. The site boundary is indicated on an OS based location plan included within Appendix A.

2.2 The site consists of a mix of open pasture/meadow and lightly wooded areas. Two small drainage ditches run along the southern and western boundaries.

2.3 The site is bound to the north and east by the Breinton Lee gated residential development and to the south and west by open arable fields.

2.4 A topographical survey of the site has been carried out, relative to OS Datum. The survey confirms that the site is gently undulating with no

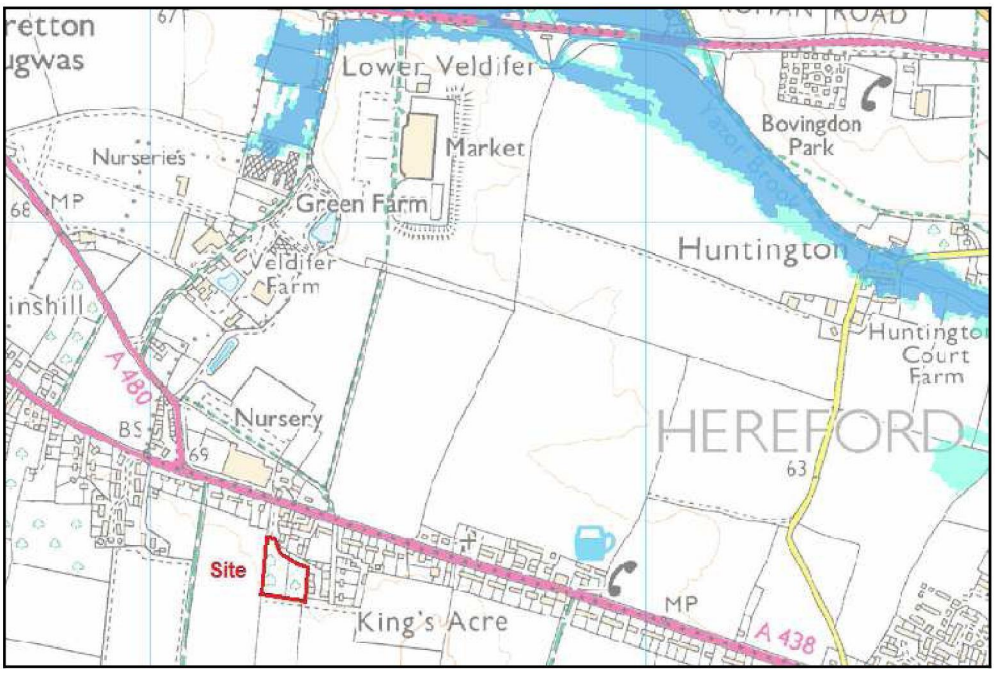
predominant falls. A copy of the topographical survey is included within Appendix B.

3.0 Existing Drainage

3.1 An extract of the public sewer records has been obtained from Welsh Water and is included within Appendix C. The records confirm that the nearest public foul sewer to the site is located within Breinton Lee. There are no public surface water sewers indicated on the records within the vicinity of the site.

3.2 Being Greenfield, there is no positive foul or surface water drainage associated with the site.

3.3 The site falls within the local catchment of the Yazor Brook, located approx. 1km to the north, and the wider catchment of the River Wye. The site is indicated on the Environment Agency mapping as being located within Flood Zone 1 and therefore at the lowest probability (<0.1%) of fluvial flooding.



3.4 Whilst there are no predominant falls across the site itself, it is likely that the two ditches that bound the site to the south and west serve any Greenfield run-off.

3.5 The southern ditch runs east to west where it joins the western ditch which runs south to north. The western ditch is then culverted along the boundary of No. 343 Kings Acre Road and Breinton Lee. It is understood that the ditch was culverted to facilitate the construction of No. 343. The culvert connects into a catchpit manhole located at the edge of public highway verge. From this manhole, the surface water discharge from the ditch and nearby road gullies is conveyed across the Breinton Lee junction and then Kings Acre Road via a 225mm diameter pipe to an outfall that discharges to a ditch running between Nos. 304 and 306a Kings Acre Road. This existing surface water drainage arrangement is shown on the plan included within Appendix E.

3.6 We understand that the southern ditch was originally dug in 2000 in an attempt to relieve flooding to the gardens of properties on the Breinton Lee development, allegedly due to excess standing water running off the field to the south. We understand, however, that there is some question as to whether this flooding is being caused or exacerbated by the ineffective operation of the soakaways serving the development.

3.7 From a site inspection, all pipework from the culvert inlet to the outfall on the northern side of Kings Acre Road appears to be significantly blocked with silt and debris, including the road gullies at the junction of Breinton Lee with Kings Acre Road and what appears to be a new road gully located in the public footway at the point of the vehicular access to Nos. 343 – 347 Kings Acre Road.

3.8 The top of the pipe at the outfall on the northern side of Kings Acre Road is only just visible on the photograph below, taken on

Wednesday 6 March 2013. The condition of the culvert and receiving drainage system would appear to indicate a general lack of maintenance over recent years.

3.9 It should be noted, however, that the effective operation of the existing site ditches and the downstream surface water drainage system ultimately depends upon the condition of the receiving ditch that runs between Nos. 304 and 306a King's Acre Road, and beyond. This ditch also appears to have had little maintenance with its capacity apparently currently being severely restricted.

4.0 Existing Surface Water Flooding

4.1 We have been made aware of the existing surface water flooding problems that have been experienced by the properties on the Breinton Lee development and also several properties off King's Acre Road.

King's Acre Road

4.2 From our site investigations, it is apparent that the primary cause of flooding to properties to the south of Kings Acre Road has been ineffective highway drainage. As previously stated the road gullies on Kings Acre Road, in and around the junction with Breinton Lee, have all been found to be significantly blocked with debris. These properties are set at a lower level relative to the highway such that in times of any significant rainfall, water runs off the highway, bypassing the gullies, and into their driveways and gardens. Should any water manage to drain through the gullies, the receiving drainage system has also been found to be totally blocked, with its outfall being barely visible.

4.3 This flooding problem appears to be further exacerbated by the catchpit manhole outside No. 343 King's Acre Road being partially open, thus allowing any surface water backed up within the drainage system to surcharge onto the verge and gardens.

Breinton Lee/The Site

4.4 Whilst the land to the south does rise, the slope is gentle and therefore unlikely to give rise to flash overland run-off. From the photographic evidence of previous flooding events, it would appear that surface water is unable to drain freely into the local sub-strata during, and immediately after, heavy or prolonged rainfall events, leading to standing water. This standing water has been evident on the field immediately to the south of the development as well as the gardens of

the properties in Breinton Lee and the site itself. With no suitable outlet, it appears that standing water has built up to a significant degree on several occasions.

4.5 We understand that the digging of the ditch along the south of site, after the flooding experienced in 2000 mitigated the problem for some time and again in 2009 when the ditch was re-profiled. The effectiveness of this ditch more latterly has clearly been limited due to the ineffective receiving surface water drainage system in King's Acre Road.

4.6 It should be noted that the properties on the Breinton Lee estate are served by soakaways and that the effectiveness of these soakaways has been bought into question, given the clayey nature of the sub-strata. The poor performance of these soakaways could be a significant contributing factor to flooding of these properties.

5.0 Proposed Development

5.1 It is proposed to develop the site to accommodate up to 16 No. residential units. A concept layout for the proposed development is included within Appendix D.

6.0 Proposed Foul Drainage

6.1 Based on a proposed residential development of 16 units, the peak foul discharge generated will be approx. 0.74 l/s.

6.2 It is proposed to connect the foul discharge from the development to the public foul sewer within Breinton Lee. Welsh Water has confirmed that there is sufficient spare capacity within the public foul sewer network.

6.3 Based on the invert levels quoted on the sewer record extract and the existing site levels, a gravity discharge from the development will be feasible.

7.0 Proposed Surface Water Drainage

7.1 Based on the current concept layout, it is estimated that approx. 0.288 ha (34%) of the site will potentially become impermeable in the post development scenario.

7.2 An initial desk top assessment of ground conditions suggests that proprietary infiltration SUDS techniques, such as soakaways, will not be feasible on this site. The standing water and resultant flooding experienced locally may well be testament to this assessment.

7.3 On the basis that infiltration SUDS are not viable and that there are no public surface water sewers within the vicinity, the only remaining option for surface water drainage is a positive outfall to be the ditches that bound the south and west of the site.

7.4 It is therefore proposed to make a restricted surface water discharge from the site to the ditches with the balance of flows being attenuated on site, up to the 1 in 100 year climate change event.

7.5 Due to the shallow nature of the ditches relative to the site and the flat nature of the site, the depth of any gravity outfall will be limited, thus requiring any on site attenuation structure/s to be very shallow in nature.

7.6 Due to the level restrictions, it is initially proposed that attenuation is accommodated within 2 No. shallow balancing ponds, Pond A and Pond B. Preliminary calculations have been prepared using the Micro

Drainage software package to provide an indicative design for the ponds, based on the following design criteria.

- Max. Discharge – 5 l/s for each pond
- Pond A Contributing Area – 0.180 ha
- Pond B Contributing Area – 0.108 ha
- Design Event – 1 in 100 year, plus a 30% allowance for climate change.
- Pond A Overall Depth – 1.0m (0.7m effective)
- Pond B Overall Depth – 0.8m (0.5m effective)
- Bank Slopes – 1 in 3

This gives a maximum plan area of 183m2 for Pond A and 127m2 and for Pond B.

7.7 It is proposed to locate Pond A to the north western corner of the site, with a restricted discharge to the western ditch, and the smaller Pond B in the open space just to the north of Plot 10, with a restricted discharge to the southern ditch, as indicated on the Concept Layout Plan.

7.8 Whilst proprietary infiltration SUDS techniques may not be viable, permeable paving may still prove to be feasible. A variety of permeable paving solutions are available such as, pervious block paving, pervious tarmac, grasscrete, unbound aggregates, etc. Any use of permeable paving would, of course, reduce the attenuation requirements.

7.9 Consideration should also be given to incorporating water butts on rain water pipes, with their overflows draining to soakaways. Whilst the use of water butts will not reduce the design criteria of the attenuation structures, they will assist in maximising the re-use of non-potable water within the garden and amenity areas.

7.10 The proposed surface water drainage system will be subject to detailed design in accordance with the appropriate relevant guidance provided by CIRIA and to the approval the Local Planning Authority (LPA) and all other relevant authorities.

7.11 The site lies within a groundwater Source Protection Zone (SPZ) 3 which is classified as being the overall aquifer catchment protection zone. The proposed surface water drainage system should therefore be designed in accordance with all relevant Environment Agency Pollution Prevention Guidance (PPG) with only clean roof water run-off being permitted to drain directly to the ground. Trapped gullies should be used as a minimum to serve run-off from the access road.

7.12 The maintenance responsibility for the proposed balancing ponds should be agreed with the Environment Agency and LPA. Should the ponds not be adopted then it will be necessary to appoint an appropriate estate management company.

8.0 Proposed Flood Mitigation Measures

8.1 In an attempt to alleviate the flooding problems experience by the properties to the south the King's Acre Road, the client has arranged and funded the jetting out of the culvert running between Breinton Lee and No. 343 King's Acre Road and the receiving highway surface water drainage system in King's Acre Road. All pipework has then been CCTV surveyed to ascertain its condition. A copy of the survey reports is included within Appendix H. In summary, the survey has revealed a number of defects with the drainage system but, most significantly, key deficiencies with the culvert running along the boundary of No.343 King's Acre Road which will require rectifying to ensure the effective operation of the drainage system.

8.2 It should be noted that the cleaning and survey work has been carried out as a gesture of goodwill. The responsibility for the maintenance of this pipework does not lie with our client. The culvert is the joint riparian responsibility of No.343 King's Acre Road and I E Deveopments. The pipework within King's Acre Road is the responsibility of the Highway Authority.

8.3 To help alleviate the flooding experienced by properties on the Breinton Lee estate, it is proposed to re-profile the existing ditches bounding the site and extend the existing southern ditch for a length of approx. 50m in an easterly direction, to the rear of Nos. 3 and 4 Breinton Lee. The new ditches will provide greater storage capacity and, allied with a clear unrestricted outfall, should prove to be more effective in draining any standing water from the adjoining field. A grill/screen will also be fitted across the inlet of the receiving culvert to help prevent any debris from entering the downstream drainage system. The proposed ditch works are indicated on the drawings included within Appendix F.

9.0 Summary

Proposed Foul Drainage

9.1 It is proposed to connect the foul drainage from the development to the public foul sewer located within Breinton Lee via a new gravity connection.

9.2 Welsh Water has confirmed that there is sufficient capacity within the public foul sewer network to serve the foul flows from the development.

Proposed Surface Water Drainage

9.3 An attenuation based surface water drainage system is proposed for the new development.

9.4 It is proposed to make 2 No. restricted surface water discharges of 5 l/s to the ditches that bound the site with the balance of flows being attenuated on site within 2 No. balancing ponds, up to the 1 in 100 year climate change event. Discharge rates will be restricted by the use of 'hydrobrake' vortex flow control devices. Such a drainage system should ensure that existing flooding problems are not worsened.

Proposed Flood Mitigation

9.5 The existing drainage ditches that bound the site will be re-profiled and extended to assist with the drainage of any excess surface water run-off from the field to the south of the site. A grill/screen will be fitted over the downstream culvert inlet to help prevent debris entering the drainage system. To ensure their future effective operation, the on-going maintenance of the ditches should be included within the maintenance regime required for the proposed on site balancing ponds.

9.6 The culvert and piped drainage system downstream of the ditches has been cleared of all debris and the pipework CCTV surveyed at the client's expense. The structural defects idenfified in the survey report will need to be actioned by either the Highway Authority or the relevant riparian owners, under the direction of the LPA as the land drainage authority, in order to ensure the effective operation of the drainage system.

9.7 The continued effective operation of the site ditches and downstream drainage system will, however, be dependant upon there being a clear unrestricted outfall and the integrity of the receiving ditch. It is therefore strongly recommended that the downstream ditch, running between Nos. 304 and 306a Kings Acre Road is cleared/re-profiled by the riparian owners, under the direction of the LPA, as the land

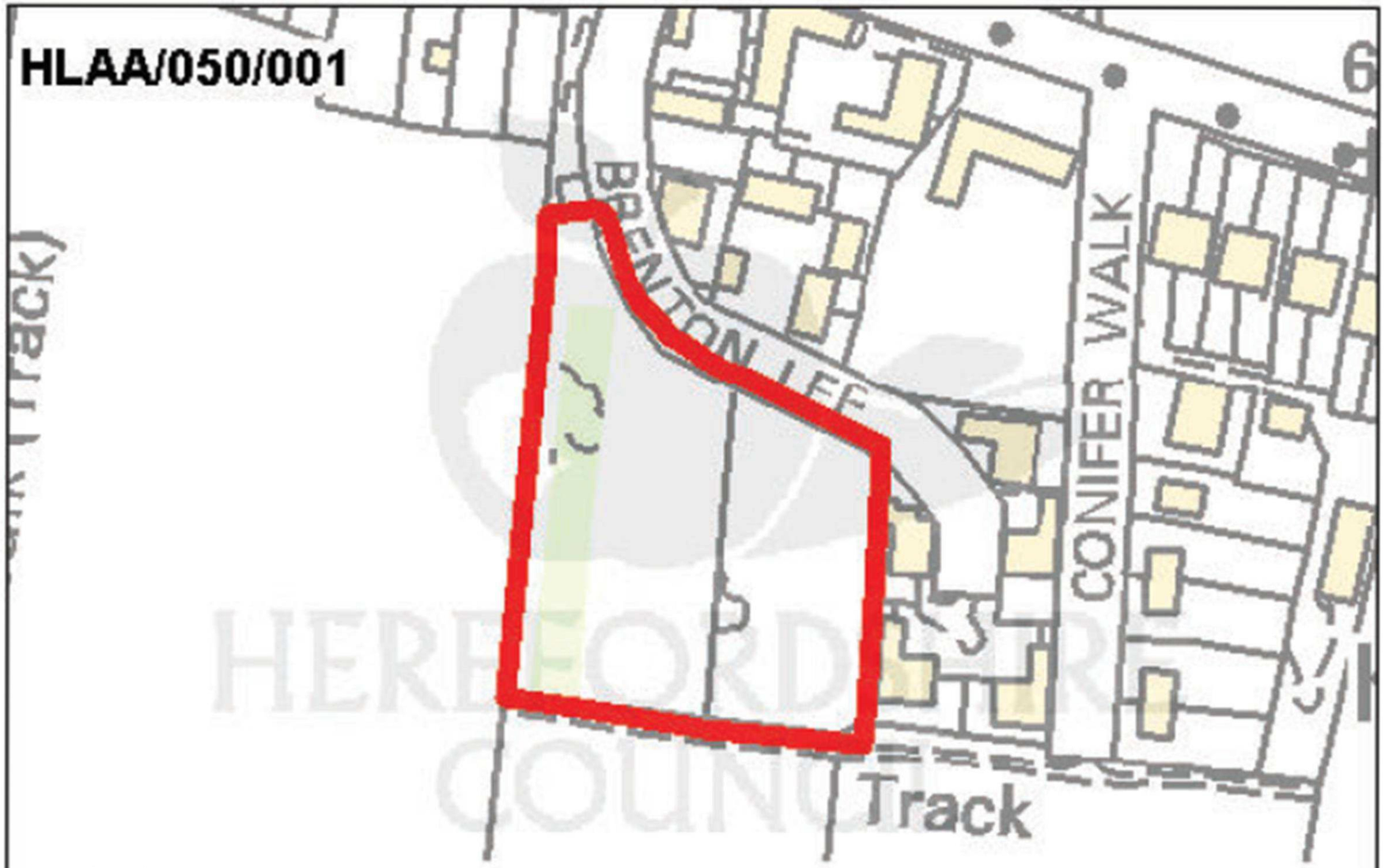
drainage authority, at the earliest possible opportunity in order to prevent the system from blocking up again.

9.8 The implementation of the above mitigation measures should ensure that the existing flooding problems are alleviated as far as can reasonably be expected.

APPENDIX A

Site Location Plan

Site Address: Land at Kings Acre, Breinton Lee, Hereford



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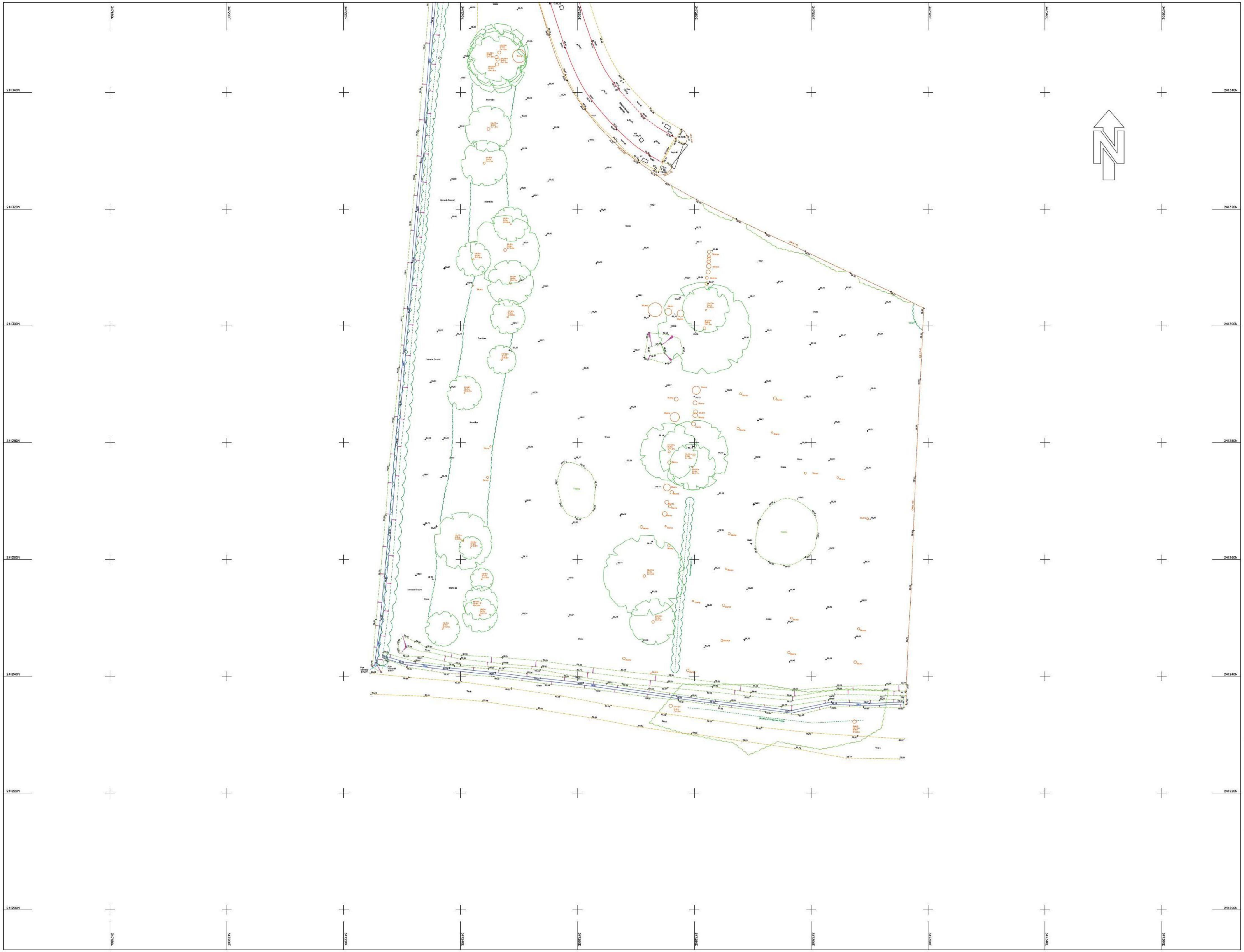
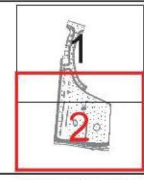
APPENDIX B

Topographical Survey



SHEET LAYOUT



TOPOGRAPHICAL LEGEND

- Building
- Building Canopy
- Building Overhead
- Surface Edge
- Road Edge
- Road Kerb Channel
- Banking
- Fence
- Wall
- Structure
- Structure Overhead
- Structure Underground
- Vegetation Extents
- Drainage Channel
- Scar
- Above Ground Pipe
- Overhead Pipe
- Overhead Electricity
- Overhead Telecom
- Railway Track
- Contour Line

ABBREVIATIONS

AC	Asbestos Cement	NM	Node Marker
ACU	Air Conditioning Unit	NP	Name Plate
AD	Assumed Direction	NPV	No Pipes Visible
AR	Assumed Route	OSA	Off Survey Area
AV	Air Valve	P	Post
BB	Belisha Beacon	PBM	Permanent Bench Mark
BD	Back Drop	PE	Polyethylene
BdL	Bed Level	PGM	Permanent Ground Marker
BH	Borehole	PL	Plastic
Bk	Brick	P/L	Palisade Fence
BL	Basement Light	PM	Parking Meter
BO	Bollard	P/R	Post and Rail Fence
BR	Brick	PU	Pump
BS	Bus Stop	PVC	Polyvinylchloride
BT	British Telecom Cover	P/W	Post and Wire Fence
BTS	British Telecom Box	PZ	Piezometer
BW	Brick Wall	RE	Rodding Eye
B/W	Barbed Wire Fence	RI	Riser
Cam	Camera	RL	Rail Level
CAT	Catenary Level	RP	Reflector Post
C/B	Close Boarded Fence	RS	Road Sign
CC	Control Cabinet	RWP	Rain Water Pipe
CH	Chainage	R/W	Retaining Wall
ChL	Channel Level	S	Stump
CI	Cast Iron	SA	Survey Abandoned
CI	Corrugated Iron Fence	S/A	Soakaway
CL	Cover Level	SC	Speed Camera
C/L	Chain Link Fence	S/F	Safety Fence
Co	Concrete	SI	Spun Iron
CP	Catch Pit	SL	Soffit Level
CpL	Coping Level	SP	Sign Post
CrB	Crash Barrier	Spr	Spring
CTV	Cable TV	S/R	Steel Railings
CUL	Culvert	SS	Structure Support
CW	Concrete Wall	ST	Stop Tap
DI	Ductile Iron	Stn	Survey Station
dil	Dilapidated	SV	Sluice Valve
dis	Disused	SVP	Soil Vent Pipe
DS	Downstream	SW	Stone Wall
DSW	Dry Stone Wall	Tac	Tactile Paving
EB	Electricity Box	TBM	Temporary Bench Mark
EC	Electricity Cover	TC	Telecom Cover
E/F	Electric Fence	TCB	Telephone Call Box
EOT	End of Trace	TCP	Telephone Call Post
EP	Electricity Pole	TFR	Taken From Records
ER	Earth Rod	TH	Trial Hole / Pit
FC	Fuel Cover	ThL	Threshold Level
FFL	Finished Floor Level	Tk	Tank
FH	Fire Hydrant	TOW	Top Of Wall
FO	Fibre Optic Cover	TP	Telegraph Pole
FS	Flag Staff	TS	Traffic Signals
G	Gully	U/S	Upstream
GPRI	Ground Penetrating Radar Inconclusive	UTGA	Unable to Gain Access
GV	Gas Valve	UTL	Unable to Locate
HR	Hand Rail	UTR	Unable to Raise
IC	Inspection Cover	UTS	Unable to Survey
IL	Invert Level	UTT	Unable to Trace
I/R	Iron Rail Fence	VC	Vitrified Clay
KO	Kerb Outlet	VDP	Vehicle Detector Pads
LB	Letter Box	VP	Vent Pipe
LC	Lighting Column	VR	Vapour Recovery
LH	Lamp Hole	VTP	Vertical Pipe
LOR	Loss Of Reflection	W	Water Cover
LOS	Loss Of Signal	WL	Water Level
MB	Mooring Bollard	WM	Water Meter
M/C	Multiple Cables	WM	Wire Mesh Fence
MH	Manhole Cover	WO	Water Wash Out
Mkr	Marker Post	WS	Window Sample
MP	Mile Post/Stone	WV	Wheel Valve
NFI	No Further Information		

REV.	DETAILS	BY	DATE

GRID: OS NATIONAL AS DEFINED BY CONNECTION TO LEICA SMARTNET

DATUM: OS DATUM AS DEFINED BY GPS CONNECTION TO LEICA SMARTNET

THE SURVEY ASSOCIATION

40SEVEN

An ICEX Water & Wastewater Business

LEEDS · LONDON · WORCESTER

CLIENT:

Mr. M. WAKELEY
THE OLD PANNIERS
52 HIGH STREET
YELVERTOFT NN6 6LQ

PROJECT TITLE:

BREINTON LEE
TOPOGRAPHICAL SURVEY

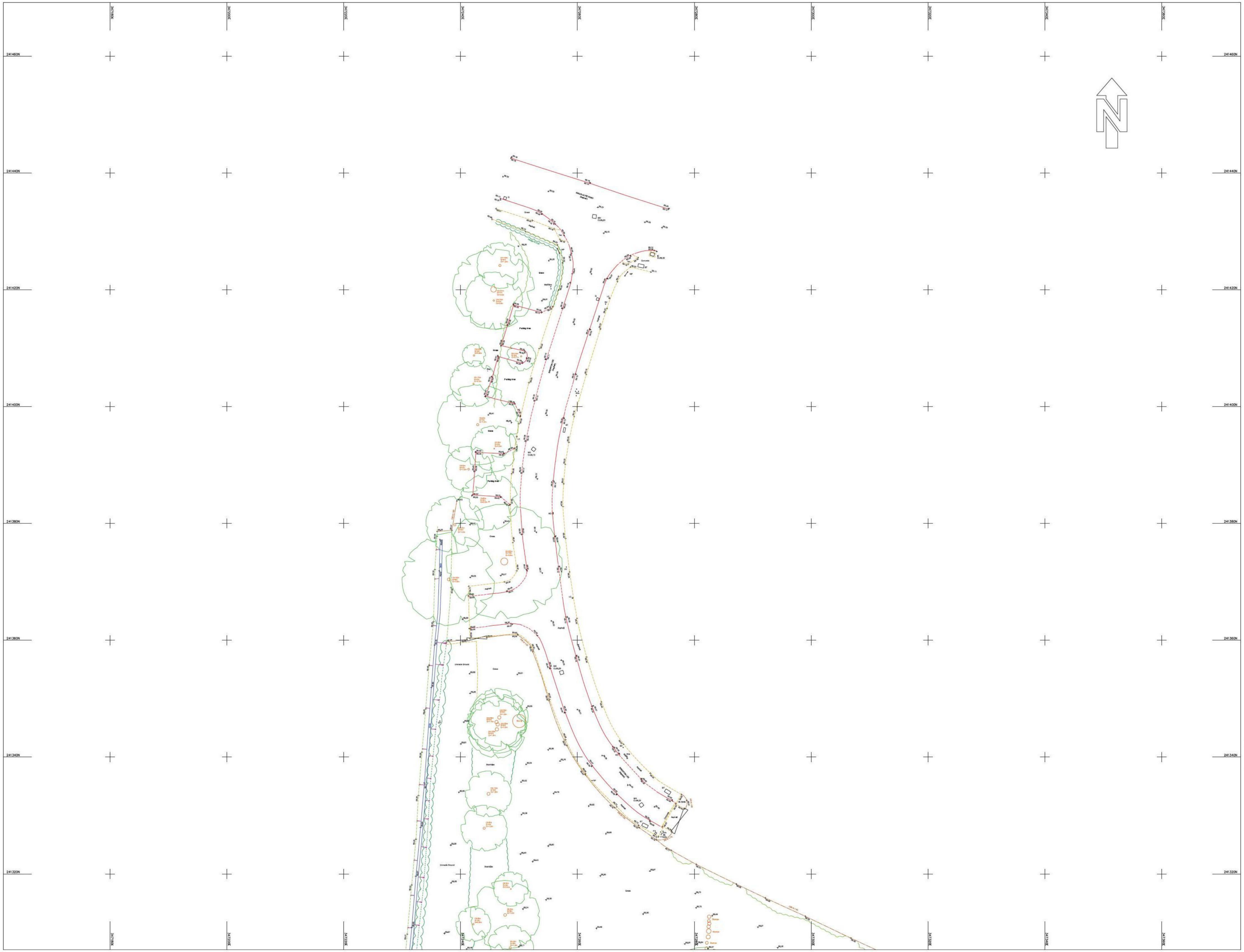
DRAWING TITLE:

BREINTON LEE

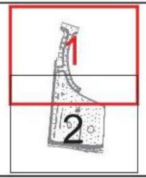
SURVEYED BY:	DRAWN BY:	APPROVED BY:
I.H.	N.C.	S.H.H.

SCALE:	SURVEY DATE:	
1:200 @ A0	05/2012	

DRAWING NUMBER:	SHEET NUMBER:	REV:
56817-P	56817-P-02	



SHEET LAYOUT



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ABBREVIATIONS

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An IDEX Water & Wastewater Business

CLIENT:

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52 HIGH STREET
YELVERTOFT NN6 6LQ

PROJECT TITLE:

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TOPOGRAPHICAL SURVEY

DRAWING TITLE:

BREINTON LEE

SURVEYED BY:	DRAWN BY:	APPROVED BY:
I.H.	N.C.	S.H.H.

SCALE:	SURVEY DATE:	
1:200 @ A0	05/2012	
DRAWING NUMBER:	SHEET NUMBER:	REV:
56817-P	56817-P-01	

APPENDIX C

Public Sewer Records Extract (Welsh Water)

Dŵr Cymru
Welsh Water

Land off Breinton Lee, Hereford

N
W E
S

LEGEND(Representative of most common features)

Waste network:

	Foul chamber		Outfall
	Surface water chamber	LH	Lamphole
	Combined chamber		Storm Overflow
CO	Combined sewer overflow		Rising main
SPC	Special purpose chamber		Gravity sewer
	Treatment works		Private sewer
	Pumping station	S 104	Private sewer subject to Sect. 104 adoption agreement
			Private Sewer Transfer
			Lateral Drain
			Inspection Chamber

NB: Sewer symbol colour indicates the type.
RED - Combined
GREEN - Surface Water
BROWN - Foul
Purple - Former S24 sewers (for indicative purposes only)

Notes:

Dwr Cymru Cyf gives this information as to the position of its underground apparatus by way of general guidance only on the strict understanding that it is based on the best information available and no warranty as to its correctness is relied upon in the event of excavations or other works made in the vicinity of the Company's apparatus and any onus of locating the apparatus before carrying out any excavations rests entirely on you. It must be understood that the furnishing of the information is entirely without prejudice to the provision of the New Roads and Streetworks Act 1991 and of the Company's right to be compensated for any damage to its apparatus.

Service pipes are not generally shown but their presence should be anticipated.

EXACT LOCATIONS OF ALL APPARATUS TO BE DETERMINED ON SITE.

Map Ref:	347329,241279
Map scale:	1:1,250
Printed by:	np
Printed on:	26.09.2012

APPENDIX D

Proposed Development Concept Layout (Foxley Tagg)

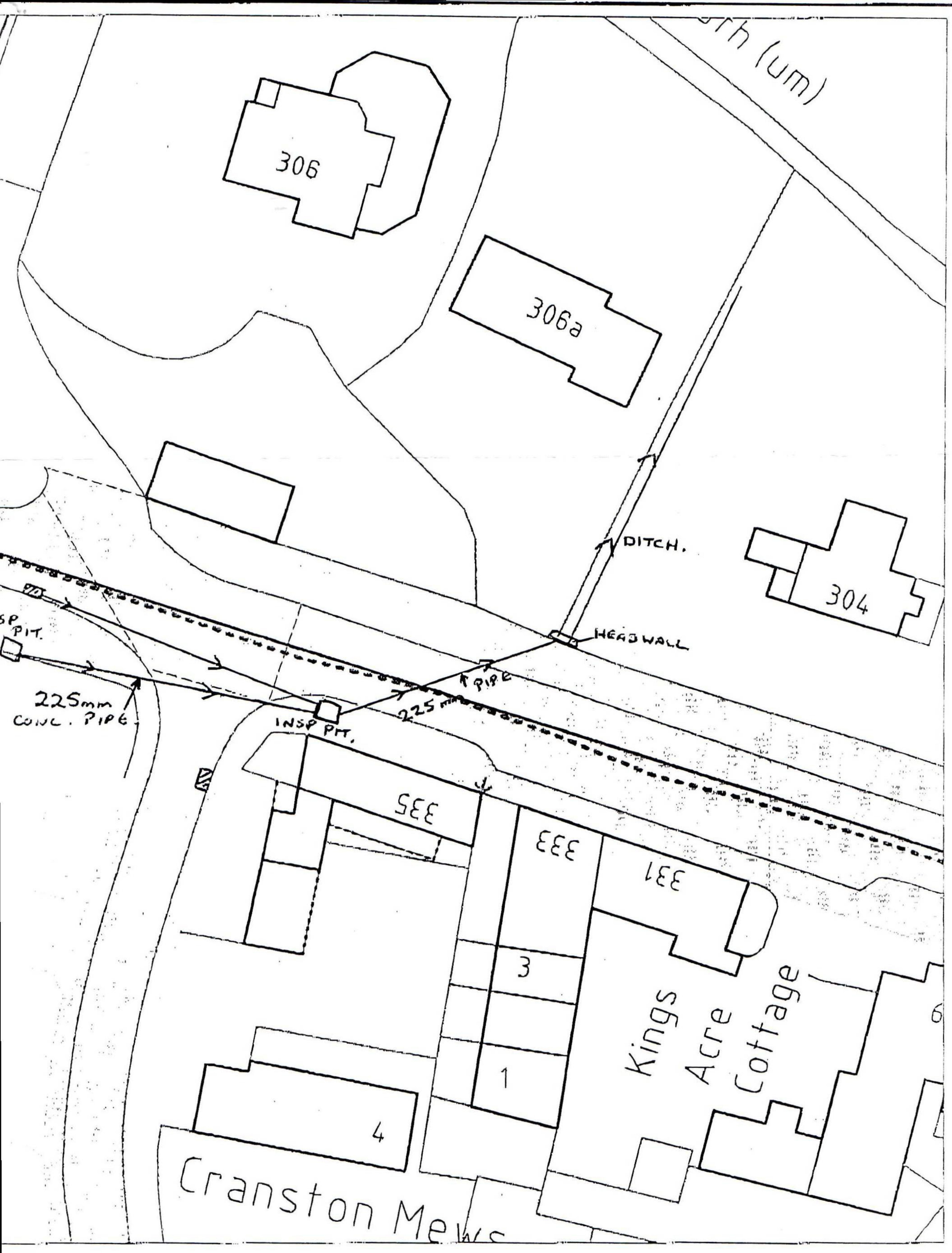
FOXLEY TAGG PLANNING LIMITED

Land at Breinton Lee		
1:500	@ A3	FTP/705/05/A
April 2013		
Concept Layout		

N

APPENDIX E

Existing Surface Water Drainage



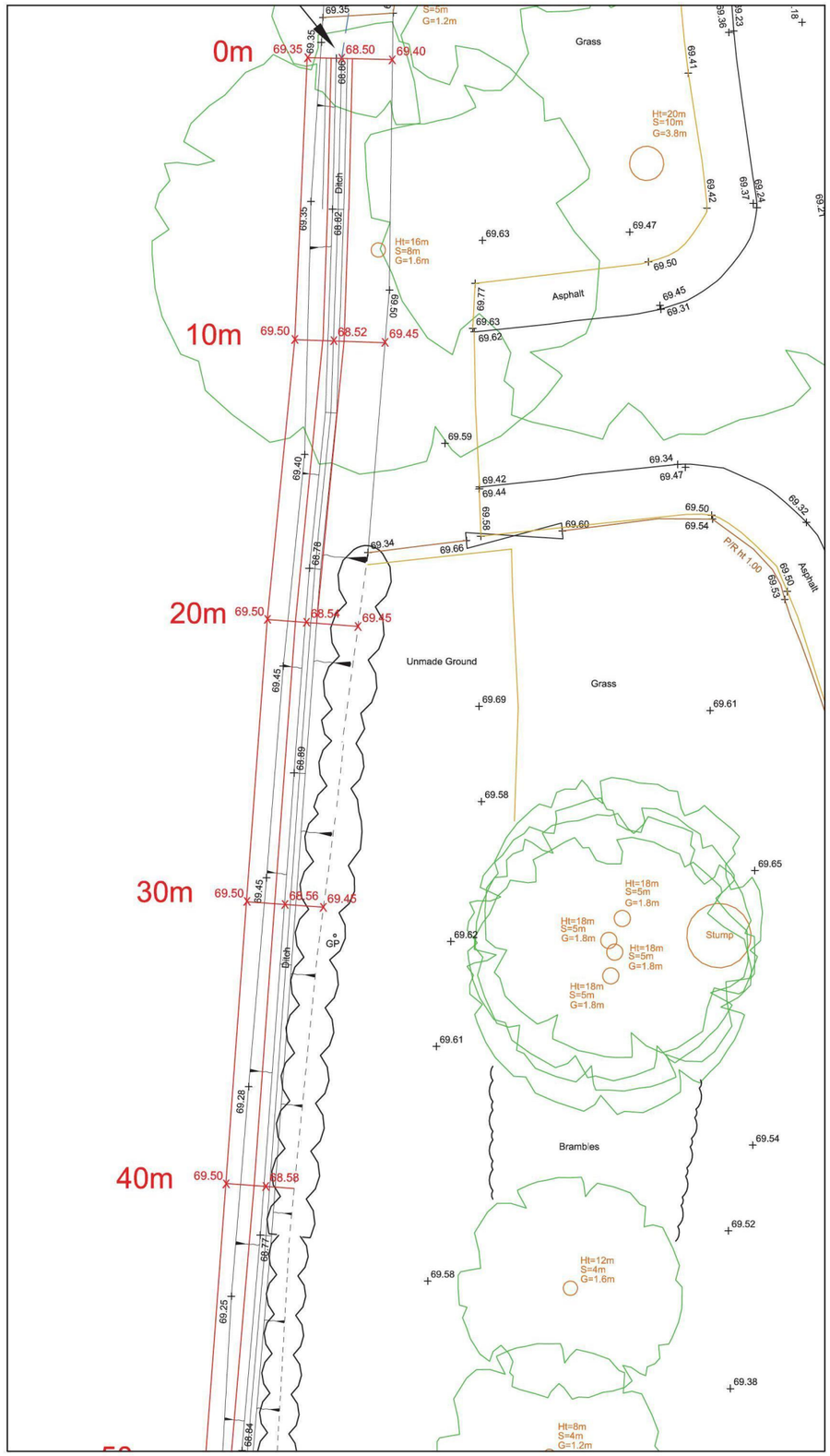
LOCATION

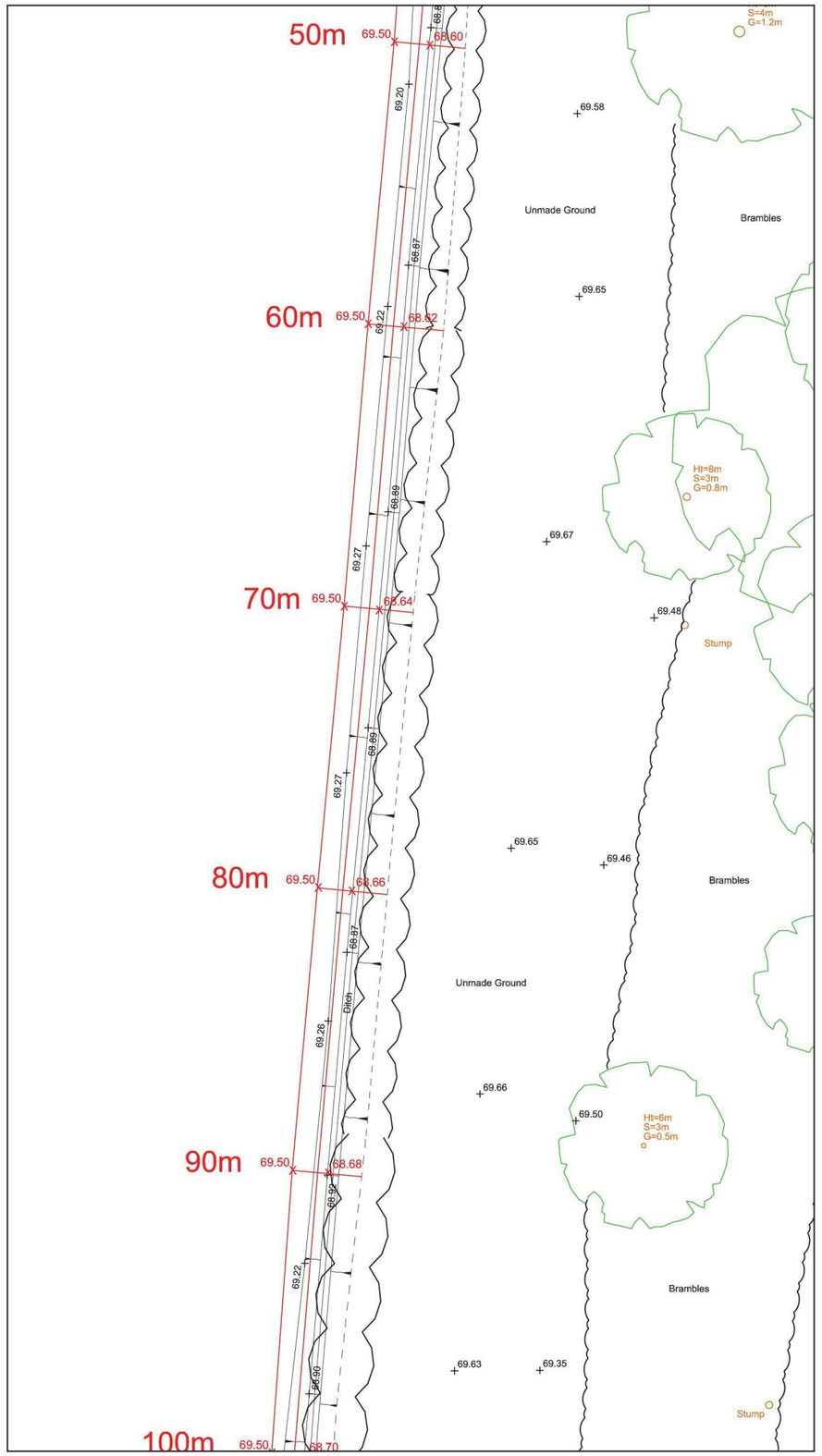
SCALE 1:
STREET REFERENCE
POSTCODE

Herefordshire Council,
Highways and Transportation,
Unit 3, Thorn Business Park, Rotherwas,
Hereford. HR2 6JT.
Tel: 01432 260000
Fax: 01432 261983

APPENDIX F

Proposed Ditch Improvement Works





NOTES

1. Do not scale from this drawing.
2. This drawing should be read in conjunction with Dwg. Nos. 13-010-02, 03 & 04.
3. Proposed ditch channel to be at a gradient of 1:500.
4. The south/north ditch is to be re-graded to the western side only, as indicated, in order to retain the existing hedgerow. The eastern bank slopes will therefore remain as existing.
5. The east/west ditch extension details are subject to the extension of the topogrpahical survey.
6. All excavated material to remain on site and should be spread on either bank side or within the site boundary, as appropriate.
6. Any queries or descrepancies relating to this drawing should be referred to the engineer prior to carrying out any work.

Rev	Amendment	Drawn	Check'd	Appr'd	Date

R J Fillingham Associates Ltd

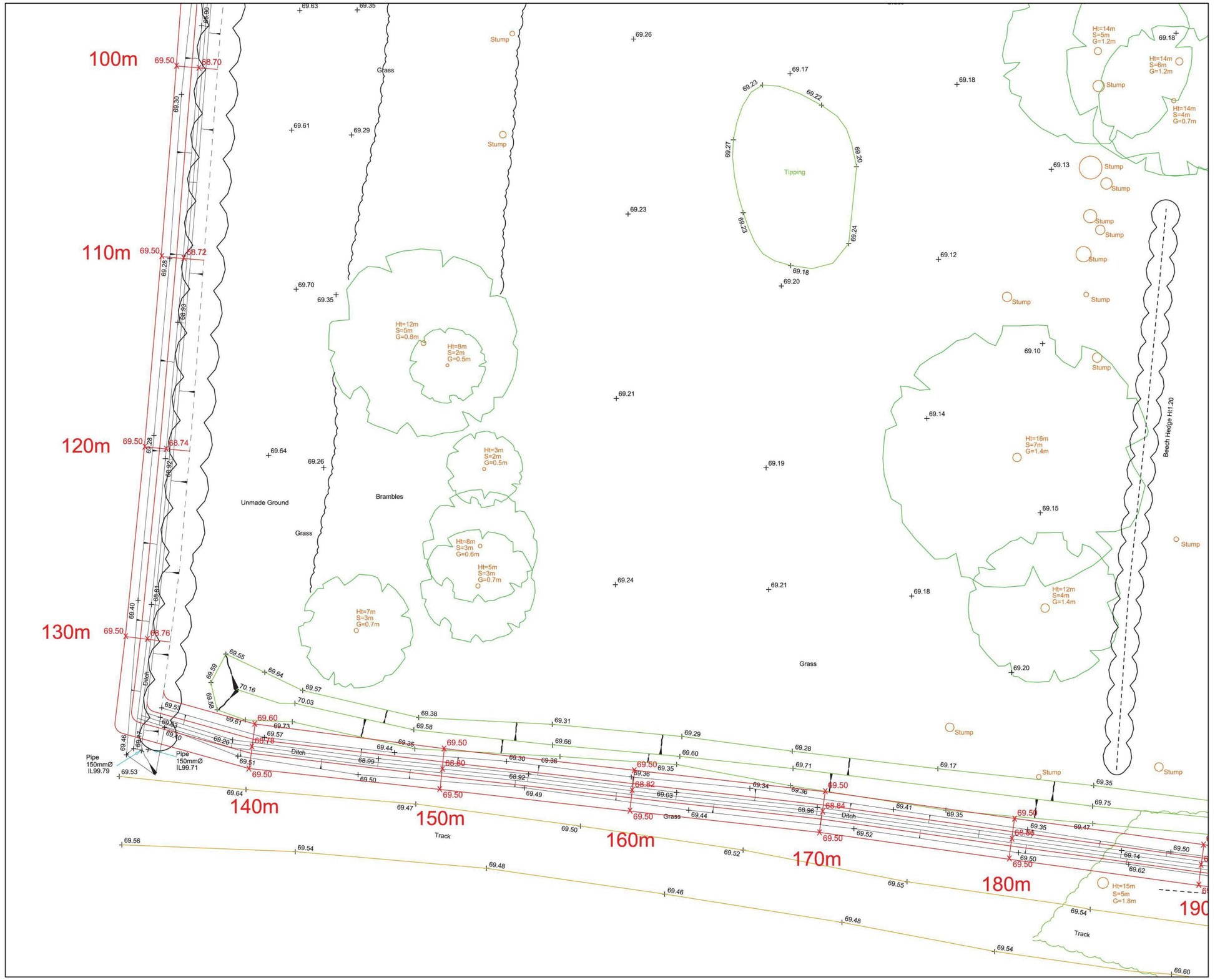
Flood Risk & Drainage Consultants

MR M WAKELEY

BREINTON LEE
HEREFORD

PROPOSED DITCH IMPROVEMENT WORKS PLAN
(1 of 3)

Drawn	Checked	Approved
RS	RJF	RJF
Date: Mar 2013	Date: Mar 2013	Date: Mar 2013
Scale: 1:200 @ A3	Status: APPROVAL	Rev
Dwg No.: 13-010-01		



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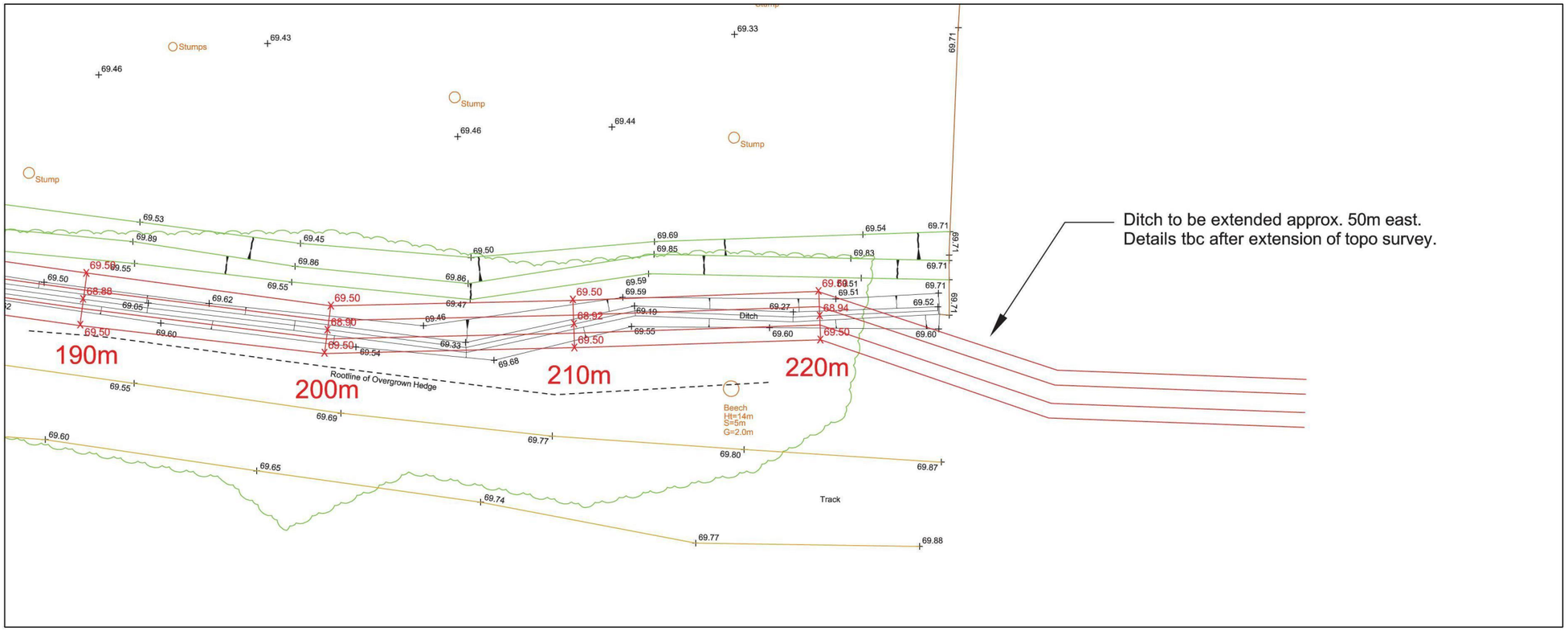
MR M WAKELEY

BREINTON LEE
HEREFORD

PROPOSED DITCH IMPROVEMENT WORKS PLAN (2 of 3)

Drawn	Checked	Approved
RS	RJF	RJF
Date: Mar 2013	Date: Mar 2013	Date: Mar 2013
Scale: 1:200 @ A3	Status: APPROVAL	Rev
Dwg No.: 13-010-02		



be extended approx. 50m east.
bc after extension of topo survey.

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2. This drawing should be read in conjunction with Dwg. Nos. 13-010-01, 02 & 04.
3. Proposed ditch channel to be at a gradient of 1:500.
4. The south/north ditch is to be re-graded to the western side only, as indicated, in order to retain the existing hedgerow. The eastern bank slopes will therefore remain as existing.
5. The east/west ditch extension details are subject to the extension of the topogrpahical survey.
6. All excavated material to remain on site and should be spread on either bank side or within the site boundary, as appropriate.
6. Any queries or descrepancies relating to this drawing should be referred to the engineer prior to carrying out any work.

Rev	Amendment	Drawn	Check'd	Appr'd	Date

R J Fillingham Associates Ltd
Flood Risk & Drainage Consultants

MR M WAKELEY

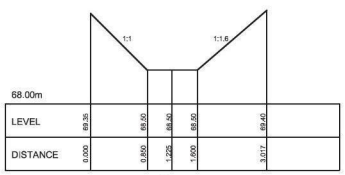
BREINTON LEE
HEREFORD

PROPOSED DITCH
IMPROVEMENT WORKS PLAN
(3 of 3)

Drawn	Checked	Approved
RS	RJF	RJF
Date Mar 2013	Date Mar 2013	Date Mar 2013

Scale	Status	Rev
1:200 @ A3	APPROVAL	

Dwg No. 13-010-03



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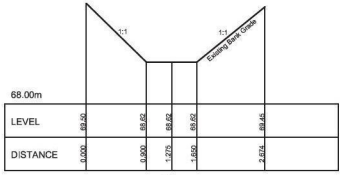

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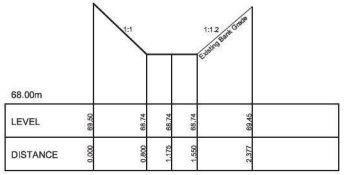

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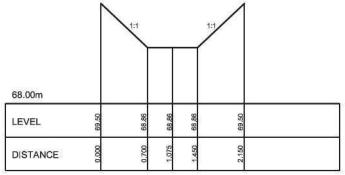

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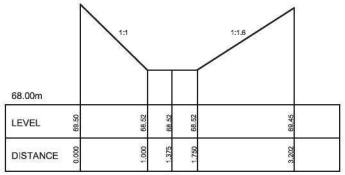

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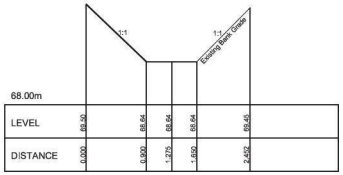

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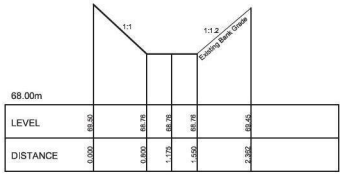

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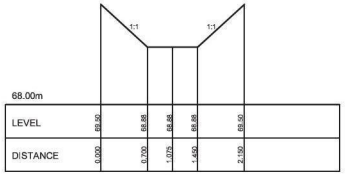

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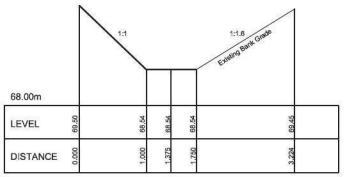

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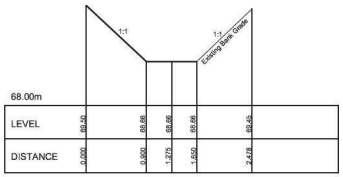

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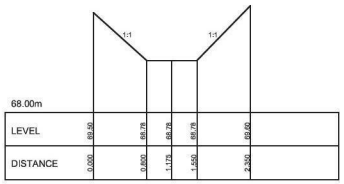

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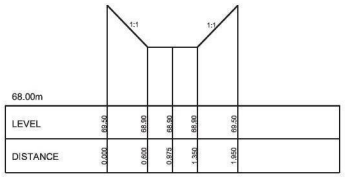

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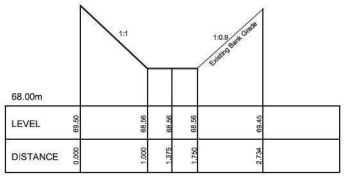

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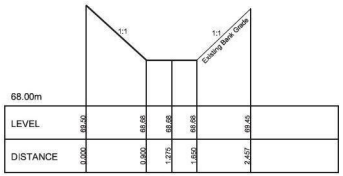

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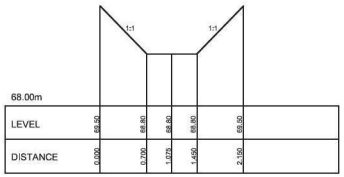

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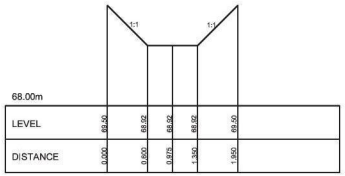

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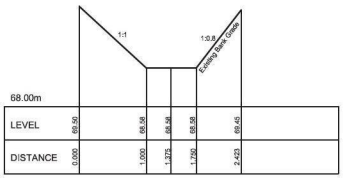

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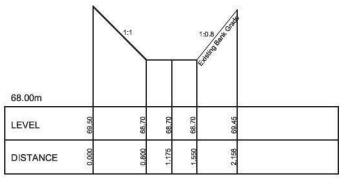

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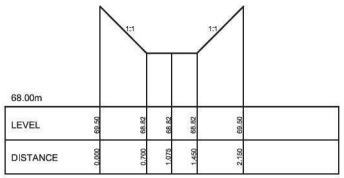

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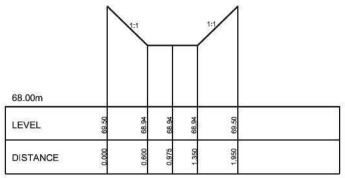

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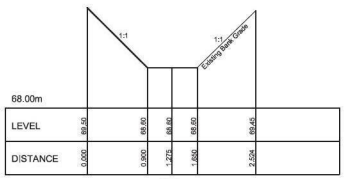

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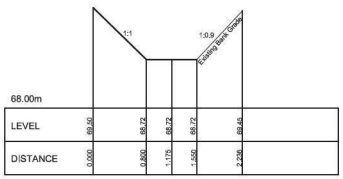

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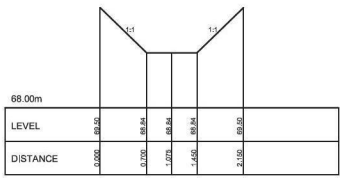


170m

NOTES

1. Do not scale from this drawing.
2. This drawing should be read in conjunction with Dwg. Nos. 13-010-01, 02 & 03.
3. Proposed ditch channel to be at a gradient of 1:500.
4. The south/north ditch is to be re-graded to the western side only, as indicated, in order to retain the existing hedgerow. The eastern bank slopes will therefore remain as existing.
5. The east/west ditch extension details are subject to the extension of the topogrpahical survey.
6. All excavated material to remain on site and should be spread on either bank side or within the site boundary, as appropriate.
6. Any queries or descrepancies relating to this drawing should be referred to the engineer prior to carrying out any work.

Rev	Amendment	Drawn	Check'd	Appr'd	Date

R J Fillingham Associates Ltd

Flood Risk & Drainage Consultants

MR M WAKELEY

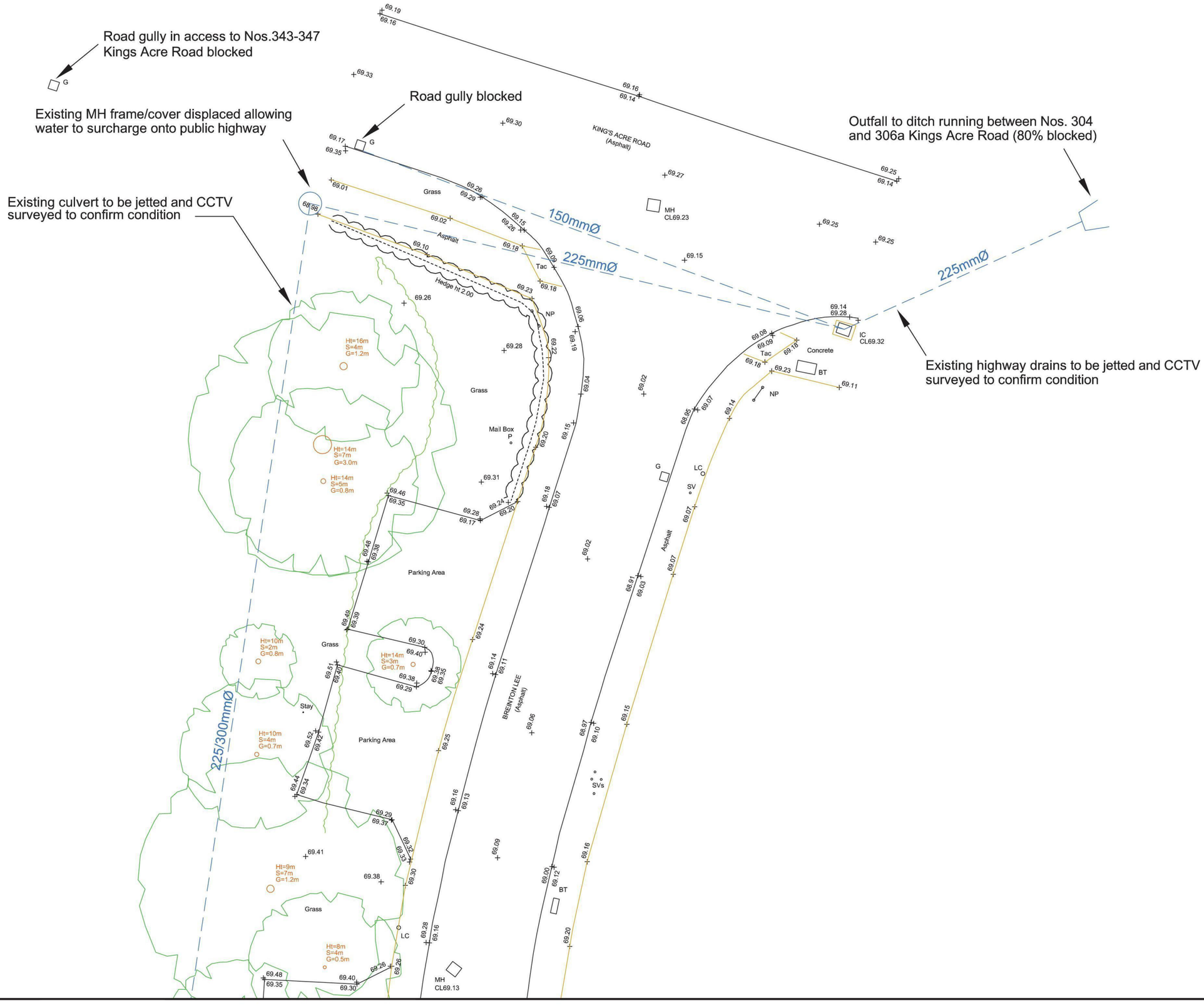
BREINTON LEE
HEREFORD

PROPOSED
DITCH CROSS SECTIONS

Drawn	Checked	Approved
RS	RJF	RJF
Date: Mar 2013	Date: Mar 2013	Date: Mar 2013

Scale: 1:100 @ A3 | Status: APPROVAL | Rev

Dwg. No. 13-010-04



NOTES

1. Do not scale from this drawing.
2. Initial inspection of existing surface water drainage in and around the junction of Breinton Lee confirms several blocked road gullies and a blocked outfall.
3. Scope of drainage remedial works to be carried out by others to be determined by CCTV survey.

Rev	Amendment	Drawn	Check'd	Appr'd	Date

R J Fillingham Associates Ltd

Flood Risk & Drainage Consultants

MR M WAKELEY

BREINTON LEE
HEREFORD

EXISTING
SURFACE WATER DRAINAGE

Drawn: RS	Checked: RJF	Approved: RJF	
Date: Mar 2013	Date: Mar 2013	Date: Mar 2013	
Scale: 1:200 @ A3	Status: APPROVAL		Rev
Dwg No.: 13-010-05			

APPENDIX G

Preliminary Attenuation Calculations

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

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	69.138	0.438	4.6	40.3	O K
30 min Summer	69.228	0.528	4.6	51.0	O K
60 min Summer	69.290	0.590	4.6	58.9	O K
120 min Summer	69.309	0.609	4.7	61.4	O K
180 min Summer	69.302	0.602	4.7	60.5	O K
240 min Summer	69.288	0.588	4.6	58.6	O K
360 min Summer	69.255	0.555	4.6	54.3	O K
480 min Summer	69.221	0.521	4.6	50.1	O K
600 min Summer	69.188	0.488	4.6	46.1	O K
720 min Summer	69.155	0.455	4.6	42.3	O K
960 min Summer	69.091	0.391	4.6	35.1	O K
1440 min Summer	68.952	0.252	4.6	20.9	O K
2160 min Summer	68.853	0.153	4.3	11.9	O K
2880 min Summer	68.826	0.126	3.6	9.7	O K
4320 min Summer	68.800	0.100	2.7	7.6	O K
5760 min Summer	68.787	0.087	2.1	6.6	O K
7200 min Summer	68.779	0.079	1.8	5.9	O K
8640 min Summer	68.773	0.073	1.5	5.4	O K
10080 min Summer	68.768	0.068	1.4	5.1	O K

Storm Event	Rain (mm/hr)	Time-Peak (mins)
15 min Summer	128.285	18
30 min Summer	84.226	32
60 min Summer	52.662	62
120 min Summer	31.800	106
180 min Summer	23.353	136
240 min Summer	18.644	170
360 min Summer	13.543	238
480 min Summer	10.792	308
600 min Summer	9.043	376
720 min Summer	7.823	442
960 min Summer	6.219	576
1440 min Summer	4.493	808
2160 min Summer	3.241	1120
2880 min Summer	2.568	1468
4320 min Summer	1.847	2204
5760 min Summer	1.461	2936
7200 min Summer	1.217	3656
8640 min Summer	1.048	4384
10080 min Summer	0.923	5136

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

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Winter	69.182	0.482	4.6	45.4	O K
30 min Winter	69.280	0.580	4.6	57.6	O K
60 min Winter	69.351	0.651	4.9	67.1	O K
120 min Winter	69.377	0.677	5.0	70.8	O K
180 min Winter	69.366	0.666	4.9	69.3	O K
240 min Winter	69.348	0.648	4.9	66.8	O K
360 min Winter	69.303	0.603	4.7	60.6	O K
480 min Winter	69.255	0.555	4.6	54.4	O K
600 min Winter	69.207	0.507	4.6	48.4	O K
720 min Winter	69.159	0.459	4.6	42.7	O K
960 min Winter	69.056	0.356	4.6	31.3	O K
1440 min Winter	68.863	0.163	4.5	12.9	O K
2160 min Winter	68.819	0.119	3.4	9.1	O K
2880 min Winter	68.801	0.101	2.7	7.7	O K
4320 min Winter	68.783	0.083	2.0	6.2	O K
5760 min Winter	68.773	0.073	1.5	5.4	O K
7200 min Winter	68.766	0.066	1.3	4.9	O K
8640 min Winter	68.761	0.061	1.1	4.6	O K
10080 min Winter	68.758	0.058	1.0	4.3	O K

Storm Event	Rain (mm/hr)	Time-Peak (mins)
15 min Winter	128.285	18
30 min Winter	84.226	32
60 min Winter	52.662	60
120 min Winter	31.800	114
180 min Winter	23.353	144
240 min Winter	18.644	182
360 min Winter	13.543	258
480 min Winter	10.792	334
600 min Winter	9.043	406
720 min Winter	7.823	476
960 min Winter	6.219	616
1440 min Winter	4.493	778
2160 min Winter	3.241	1116
2880 min Winter	2.568	1472
4320 min Winter	1.847	2204
5760 min Winter	1.461	2936
7200 min Winter	1.217	3592
8640 min Winter	1.048	4408
10080 min Winter	0.923	5128

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.000	Shortest Storm (mins)	15
Ratio R	0.400	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+30

Time / Area Diagram

Total Area (ha) 0.180

Time (mins)	Area (ha)
0-4	0.180

Model Details

Storage is Online Cover Level (m) 69.700

Tank or Pond Structure

Invert Level (m) 68.700

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	71.5	0.700	144.1	1.400	183.1	2.100	183.1
0.100	80.4	0.800	156.5	1.500	183.1	2.200	183.1
0.200	89.6	0.900	169.5	1.600	183.1	2.300	183.1
0.300	99.6	1.000	183.1	1.700	183.1	2.400	183.1
0.400	110.0	1.100	183.1	1.800	183.1	2.500	183.1
0.500	120.7	1.200	183.1	1.900	183.1		
0.600	132.2	1.300	183.1	2.000	183.1		

Hydro-Brake® Outflow Control

Design Head (m) 0.700 Hydro-Brake® Type Md4 Invert Level (m) 68.700
Design Flow (l/s) 5.0 Diameter (mm) 88

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	2.7	1.200	6.6	3.000	10.5	7.000	16.0
0.200	4.5	1.400	7.1	3.500	11.3	7.500	16.5
0.300	3.8	1.600	7.6	4.000	12.1	8.000	17.1
0.400	3.9	1.800	8.1	4.500	12.8	8.500	17.6
0.500	4.3	2.000	8.5	5.000	13.5	9.000	18.1
0.600	4.7	2.200	9.0	5.500	14.2	9.500	18.6
0.800	5.4	2.400	9.3	6.000	14.8		
1.000	6.0	2.600	9.7	6.500	15.4		

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

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	69.280	0.330	4.1	23.2	O K
30 min Summer	69.343	0.393	4.5	28.6	O K
60 min Summer	69.375	0.425	4.7	31.5	O K
120 min Summer	69.378	0.428	4.7	31.8	O K
180 min Summer	69.363	0.413	4.6	30.4	O K
240 min Summer	69.343	0.393	4.5	28.6	O K
360 min Summer	69.303	0.353	4.3	25.1	O K
480 min Summer	69.265	0.315	4.1	22.0	O K
600 min Summer	69.231	0.281	3.9	19.2	O K
720 min Summer	69.198	0.248	3.9	16.7	O K
960 min Summer	69.133	0.183	3.9	11.9	O K
1440 min Summer	69.074	0.124	3.5	7.8	O K
2160 min Summer	69.044	0.094	2.8	5.8	O K
2880 min Summer	69.030	0.080	2.2	4.9	O K
4320 min Summer	69.015	0.065	1.6	3.9	O K
5760 min Summer	69.007	0.057	1.3	3.4	O K
7200 min Summer	69.001	0.051	1.1	3.1	O K
8640 min Summer	68.997	0.047	0.9	2.8	O K
10080 min Summer	68.994	0.044	0.8	2.6	O K

Storm Event	Rain (mm/hr)	Time-Peak (mins)
15 min Summer	128.285	17
30 min Summer	84.226	31
60 min Summer	52.662	54
120 min Summer	31.800	86
180 min Summer	23.353	120
240 min Summer	18.644	156
360 min Summer	13.543	222
480 min Summer	10.792	288
600 min Summer	9.043	352
720 min Summer	7.823	416
960 min Summer	6.219	528
1440 min Summer	4.493	750
2160 min Summer	3.241	1104
2880 min Summer	2.568	1468
4320 min Summer	1.847	2196
5760 min Summer	1.461	2928
7200 min Summer	1.217	3664
8640 min Summer	1.048	4376
10080 min Summer	0.923	5104

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

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Winter	69.315	0.365	4.4	26.2	O K
30 min Winter	69.385	0.435	4.8	32.5	O K
60 min Winter	69.423	0.473	5.0	36.0	O K
120 min Winter	69.422	0.472	5.0	36.0	O K
180 min Winter	69.400	0.450	4.8	33.9	O K
240 min Winter	69.371	0.421	4.7	31.2	O K
360 min Winter	69.313	0.363	4.3	26.0	O K
480 min Winter	69.259	0.309	4.0	21.5	O K
600 min Winter	69.207	0.257	3.9	17.4	O K
720 min Winter	69.151	0.201	3.9	13.1	O K
960 min Winter	69.085	0.135	3.7	8.5	O K
1440 min Winter	69.046	0.096	2.8	5.9	O K
2160 min Winter	69.026	0.076	2.1	4.6	O K
2880 min Winter	69.015	0.065	1.6	3.9	O K
4320 min Winter	69.004	0.054	1.2	3.2	O K
5760 min Winter	68.997	0.047	0.9	2.8	O K
7200 min Winter	68.993	0.043	0.8	2.5	O K
8640 min Winter	68.990	0.040	0.7	2.4	O K
10080 min Winter	68.987	0.037	0.6	2.2	O K

Storm Event	Rain (mm/hr)	Time-Peak (mins)
15 min Winter	128.285	17
30 min Winter	84.226	31
60 min Winter	52.662	58
120 min Winter	31.800	92
180 min Winter	23.353	130
240 min Winter	18.644	168
360 min Winter	13.543	238
480 min Winter	10.792	308
600 min Winter	9.043	374
720 min Winter	7.823	432
960 min Winter	6.219	522
1440 min Winter	4.493	750
2160 min Winter	3.241	1104
2880 min Winter	2.568	1468
4320 min Winter	1.847	2204
5760 min Winter	1.461	2864
7200 min Winter	1.217	3672
8640 min Winter	1.048	4392
10080 min Winter	0.923	5136

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.000	Shortest Storm (mins)	15
Ratio R	0.400	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+30

Time / Area Diagram

Total Area (ha) 0.108

Time (mins)	Area (ha)
0-4	0.108

Model Details

Storage is Online Cover Level (m) 69.750

Tank or Pond Structure

Invert Level (m) 68.950

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	58.1	0.700	117.0	1.400	127.2	2.100	127.2
0.100	65.4	0.800	127.2	1.500	127.2	2.200	127.2
0.200	72.8	0.900	127.2	1.600	127.2	2.300	127.2
0.300	80.8	1.000	127.2	1.700	127.2	2.400	127.2
0.400	89.4	1.100	127.2	1.800	127.2	2.500	127.2
0.500	98.0	1.200	127.2	1.900	127.2		
0.600	107.4	1.300	127.2	2.000	127.2		

Hydro-Brake® Outflow Control

Design Head (m) 0.500 Hydro-Brake® Type Md3 Invert Level (m) 68.950
Design Flow (l/s) 5.0 Diameter (mm) 86

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	2.9	1.200	7.8	3.000	12.4	7.000	18.9
0.200	3.6	1.400	8.5	3.500	13.4	7.500	19.6
0.300	3.9	1.600	9.0	4.000	14.3	8.000	20.2
0.400	4.5	1.800	9.6	4.500	15.2	8.500	20.9
0.500	5.1	2.000	10.1	5.000	16.0	9.000	21.5
0.600	5.5	2.200	10.6	5.500	16.8	9.500	22.1
0.800	6.4	2.400	11.1	6.000	17.5		
1.000	7.2	2.600	11.5	6.500	18.2		