Woolton Road, Liverpool

Flood Risk Assessment & Drainage Strategy

April 2016

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w1637-160422-FRA

DOCUMENT VERIFICATION RECORD

CLIENT:

Redrow Homes Limited

SCHEME:

Flood Risk Assessment and Drainage Strategy for a development at land off Woolton Road, Liverpool, L18 9UZ. The purpose of this report is to support the Planning Application.

INSTRUCTION:

The instruction to carry out this Flood Risk Assessment and Drainage Strategy was received from Mr Steve Cole of Redrow Homes Limited.

REPORT FORMAT:

This Flood Risk Assessment report has been prepared in accordance with the National Planning Policy Framework (NPPF) and the associated Planning Practice Guidance (NPPG) document: Flood Risk and Coastal Change.

ISSUE HISTORY:

Issue Date	Comment
20/08/2014	First issue
22/04/2016	Second issue – New Masterplan

DOCUMENT REVIEW & APPROVAL

Prepared by	Jordan Jones BSc (Hons)
Reviewed by	Johanne Williams LLB (Hons) PGDip
Approved by	Aled Williams BSc (Hons)

Waterco Document Reference Number.....w1637-160422-FRA

Contents

Appendices

Supporting Documents:

National Planning Policy Framework (March 2012)

Liverpool City Council Strategic Flood Risk Assessment (January 2008)

Liverpool City Council Preliminary Flood Risk Assessment (June 2011)

Abbreviations

AEP	*Annual Exceedance Probability*
CCA	*Climate Change Allowance*
EA	*Environment Agency*
LLFA	*Lead Local Flood Authority*
LiDAR	*Light Detection and Ranging*
LCC	*Liverpool City Council*
m AOD	*metres Above Ordnance Datum*
NPPF	*National Planning Policy Framework*
NPPG	*National Planning Practice Guidance*
PFRA	*Preliminary Flood Risk Assessment*
SFRA	*Strategic Flood Risk Assessment*
UU	*United Utilities*

1 Development Description and Location

1.1 This Flood Risk Assessment (FRA) has been prepared in support of a Planning Application for a residential development at Woolton Road, Liverpool, L18 9UZ (National Grid reference: 341301E 385980N). A location plan and an aerial image are included in Appendix A.

1.2 The existing site is predominantly greenfield, with a Pavilion located near to the southern boundary. The site covers an area of approximately 13.5ha and is bordered by Ye Priory Court (road), Allerton Priory and Allerton Park Golf Course to the north, Allerton Tower Park to the east, Woolton Road and Clarke Gardens to the south, and Allerton Road and residential properties to the west.

1.3 The proposed development is for 160 units with associated driveways, access roads, and public open space. A proposed masterplan is included in Appendix B.

1.4 The proposed residential development is considered to be 'more vulnerable' in accordance with Table 2 of the NPPG.

1.5 In accordance with NPPF the risk-based 'Sequential Test' should be applied to steer new development into areas of lower probabilities of flooding. The site is located outside of the extreme flood extent on the EA 'Flood Map for Planning (Rivers and Sea)' in Appendix C and is considered to be Flood Zone 1. The site is assessed as having a less than 1 in 1000 annual probability of flooding (<0.1%). Therefore, it is considered that this development passes the Sequential Test. 'More vulnerable' development is considered acceptable in Flood Zone 1 and the Exception Test does not need to be applied.

1.6 In accordance with NPPF a FRA is required as the development site is greater than 1ha.

2 Scope of Site Specific Flood Risk Assessment

2.1 The potential sources of flooding considered in the following sections are: Fluvial - from rivers and streams; Tidal; Pluvial – from rainfall on the surface; Rising Groundwater; Overwhelmed Sewers and Drainage Systems; Reservoirs, Canals, Lakes and Artificial sources.

2.2 An Envirocheck Flood Report (Appendix D) has been obtained to inform the assessment. Historical research has also been undertaken and the Liverpool City Council (LCC) SFRA (January 2008) and LCC PFRA (June 2011) have been reviewed for site specific information.

2.3 From 6th April 2015, LCC as a Lead Local Flood Authority (LLFA) is a statutory consultee for major planning applications in relation to surface water drainage. A pre-application enquiry was submitted to LCC on 23rd July 2014 to check on any site specific requirements. A response was received on 6th August 2014 and is included in Appendix E. LCC have stated that sustainable drainage methods should be implemented where possible, and a soils report, including ground percolation test results carried out in accordance with BRE 365, will need to be provided with the FRA when the report is submitted for approval. LCC have been re-consulted in April 2016 and have confirmed that the previous comments regarding the use of SUDS techniques and the need for ground investigations still apply.

3 Fluvial and Tidal Risk

3.1 The site is located within the River Mersey catchment. The nearest watercourse is an unnamed land drain located approximately 275m east of the site. There is also an unnamed land drain located approximately 810m south-west of the site. The River Mersey is located approximately 2.5km south-west of the site. There are no other watercourses within the vicinity of the site.

3.2 The SFRA ‘Historical Flooding Areas’ map (Appendix F) shows that there are no recorded incidents of fluvial flooding at or near to the site. The site lies outside of the 0.1% annual probability flood extent on the EA ‘Flood Map for Planning (Rivers and Sea)’ and is therefore at low risk of fluvial flooding.

3.3 The SFRA ‘Tidal Flood Risk Zones’ map (Appendix F) shows that the site is located outside of the EA tidal flood risk zone. The site is situated at a minimum of approximately 45m AOD

and is significantly above sea level. Therefore, it can be concluded that there is no risk from tidal flooding.

4 Pluvial Risk

4.1 Pluvial flooding is defined as local flooding in areas not normally associated with natural or manmade watercourses that results from rainfall generated overland flow, before the runoff enters any watercourse or sewer. It is usually associated with high intensity rainfall events, but can also occur with lower intensity rainfall or melting snow, where the ground is saturated, frozen or developed resulting in overland flow and ponding in depressions in the topography. Pluvial flooding is unpredictable, to the extent that localised heavy rainfall can occur anywhere without warning. However, flow paths and depths can be determined by consideration of contours and relative levels.

4.2 The PFRA states that 'in July 2010 Liverpool experienced a high intensity rainfall event in which 257 properties suffered internal flooding attributed to surface water'. During this event, flooding was recorded in the Allerton Road area (L18 postcode). However, there are no records of this flooding affecting the site.

4.3 The EA 'Risk of Flooding from Surface Water' map (Appendix C) shows that the site is at very low risk of surface water flooding meaning it has a less than 0.1% annual probability of occurrence. The LCC flood mapping (Appendix E) shows that surface water flooding is minimal in extent for both the 1 in 30 and 1 in 200 year events. The majority of the site is shown to be flood free.

4.4 Any potential surface water flooding arising at or near to the site would be directed west, away from the site, following the local topography. It can therefore be concluded that the risk of pluvial flooding is low.

5 Risk of Rising Groundwater

5.1 Groundwater flooding occurs when water levels underneath the ground rise above normal levels. Prolonged heavy rainfall soaks into the ground and can cause the ground to become saturated. This results in rising groundwater levels which leads to flooding above ground.

5.2 The Envirocheck report gives details of BGS groundwater flooding data based on underlying geological conditions. The BGS flooding dataset indicates that the site is located in an area with limited potential for groundwater flooding to occur.

5.3 The PFRA 'Areas Susceptible to Groundwater Flooding' map (Appendix F) shows that the site is not within an area susceptible to groundwater flooding. It can therefore be concluded that the risk of groundwater flooding is low.

6 Sewer Flooding

6.1 Flooding from sewers can occur when a sewer is overwhelmed by heavy rainfall, becomes blocked, is damaged or is of inadequate capacity. This is mostly applicable to combined and surface water sewers.

6.2 The United Utilities (UU) sewer plan (Appendix G) shows that there are no public sewers crossing through the site. The UU sewer plan shows that there is a public combined sewer system within private access roads to the north and east, a 225mm public combined sewer in Woolton Road to the south and a 225mm public combined sewer narrowing to a 150mm sewer to the west in Allerton Road. There is also a 375mm public surface water sewer located approximately 275m east of the site. This sewer is not shown on the UU asset plan however is confirmed through correspondence with UU.

6.3 The SFRA 'Historical Sewer Flooding' map (Appendix F) shows that one property has been affected by sewer flooding within the sites postcode sector (L18 9). However, there are no recorded incidents of sewer flooding affecting the site. Any potential flooding arising from an exceedance event of the public sewers would be contained within the highways and directed west, away from the site, following the local topography. It can therefore be concluded that the risk of sewer flooding is low.

7 Risk from Reservoirs, Canals, Lakes and Artificial Sources

7.1 The site is not shown to be at risk of flooding from reservoirs on the EA 'Risk of Flooding from Reservoirs' map included in Appendix C. There are no canals within the vicinity of the site. Therefore, the probability of flooding from artificial sources can be considered to be low.

8 Flood Risk Management Measures

8.1 The site is shown to be at low risk of flooding from all sources, therefore no flood protection measures are considered necessary for the proposed properties.

8.2 In accordance with Building Regulations, finished floor levels of the properties should be set 150mm above surrounding ground levels.

9 Surface Water Management

9.1 The existing site is predominantly greenfield with the exception of a pavilion located along the southern border of the site. It is assumed that there is currently no positive drainage from the greenfield parts of the site.

9.2 The proposed development will increase the impermeable area of the site by approximately 28% through the introduction of buildings and roads.

9.3 The additional impermeable area will result in increased runoff rates and volumes. In order to ensure no increase in surface water runoff as a result of the development, the runoff rate will be controlled and sustainable drainage systems used to accommodate the 1 in 100 year plus climate change allowance storm event.

Overall Design Philosophy

9.4 Paragraph 080 of the NPPG: Flood Risk and Coastal Change sets out the following hierarchy of drainage options: into the ground (infiltration); to a surface water body; to a surface water sewer, highway drain or another drainage system; to a combined sewer.

Disposal via Infiltration Techniques

9.5 The Cranfield University ‘Soilscape’ mapping identifies that the site is underlain by ‘naturally wet, sandy and loamy soils’. Therefore, the use of soakaways may not be a practical option for this site.

9.6 As per the LCC correspondence (Appendix E) a soil report including ground percolation test results will need to be submitted with the FRA for approval. The percolation tests should be carried out in accordance with the BRE 365 specification to determine the suitability of soakaways.

9.7 Soakaways will need to be located a minimum of 5m away from buildings and adopted roads.

Discharge to Watercourse / Sewer

9.8 Where soakaways are not suitable, discharge to watercourse is the next consideration. The nearest watercourse is an unnamed land drain located approximately 275m east of the site. A connection to this land drain would require crossing third party land. It is understood that there is a 375mm public surface water sewer east of the site which discharges to the land drain. A connection to the land drain could therefore be made via the existing public surface water sewer. A connection to the sewer through third party land could be requisitioned by UU. A connection to the public sewer avoids creating a new outfall structure on the unnamed land drain.

9.9 A developer enquiry was submitted to UU to establish if a connection to the public surface water sewer network would be accepted in principle. A response is included in Appendix G. UU have confirmed that connection to the 375mm public surface water sewer is acceptable in principle.

9.10 It is considered likely that a pumped connection would be required.

9.11 In order to ensure no increase in flood risk elsewhere, discharge to the public surface water sewer should be restricted to the greenfield runoff rate. The estimated greenfield QBAR runoff rate is 68 l/s (see MicroDrainage greenfield runoff calculations in Appendix H).

Surface Water Storage

9.12 In order to achieve a discharge rate of 68 l/s attenuation storage will be required. An attenuation storage estimate has been undertaken using MicroDrainage (see Appendix I). An estimated storage volume of 1720m³ will be required to accommodate surface water runoff up to the 1 in 100 year plus 30% climate change allowance event. The attenuation estimate is based on storage within a tank or pond structure, hydro-brake flow control, a design head of 1m and an impervious drainage area of 37,800m² (28% of the site area) which accounts for all buildings and roads.

9.13 The attenuation volumes are provided for indicative purposes only and should be verified when undertaking the detailed drainage design.

Pumped Solution

9.14 In accordance with Sewers for Adoption 7th Edition section D4.5, for surface water pumping stations, 125m³ of storage should be provided per hectare of impermeable surface draining to

the pumping station. This equates to approximately 472.5m³ for this site. The attenuation storage provided for the 1 in 100 plus climate change event (1720m³) therefore provides sufficient storage to accommodate for a pump failure.

9.15 Provision of standby pumps, an automated pump exercise regime and a pump failure alarm system would limit the risk of pump failure.

Sustainable Drainage Systems

9.16 Attenuation storage should be provided in the form of Sustainable Drainage Systems (SuDS) where practical. The following SuDS options have been considered:

Soakaways

9.17 As described above, the use of soakaways should be determined by carrying out infiltration tests in accordance with the BRE 365 specification.

Swales, detention basins and ponds

9.18 Storage could be provided in the form of a pond, basin or swale. However, an open surface water attenuation feature such as a pond or swale in a residential area presents a safety risk; the hazards and appropriate mitigation should be considered at the detailed design stage. The current masterplan identifies space for open water features (SuDS) in the lower western / south-western extents of the site.

Rainwater Harvesting

9.19 The attenuation benefits provided through the use of rainwater harvesting are considered to be limited, and would only be realised when the tanks were not full. However, rainwater harvesting techniques could be incorporated within the final design.

Porous / Permeable Paving

9.20 The site will include access roads and private driveways which may be suitable for the use of permeable paving. Storage could be provided within the sub-grade material prior to controlled discharge to the public surface water sewer (or via infiltration if ground conditions allow).

Underground Attenuation Tanks

9.21 Storage could be provided within an underground attenuation tank (modular storage) or oversized pipes. An attenuation tank would need to be located in the lower western / south-western extent of the site to ensure gravity drainage.

Concept Drainage Strategy

9.22 Surface water runoff from building areas and roads will be directed to SuDS in the lower western / south-western extent of the site. Provision for open water features such as ponds or basins is shown on the Masterplan (Appendix B). Attenuation storage will be provided up to the 1 in 100 year plus 30% climate change allowance event. Discharge will be to the 375mm public surface water sewer to the east of the site at a controlled greenfield QBAR rate of 68 l/s.

Exceedance Event

9.23 Storage will be provided for the 1 in 100 year plus climate change event. Storm events in excess of the 1 in 100 year plus climate change event should be permitted to produce shallow depth flooding within open space adjacent to attenuation features.

Surface Water Treatment

9.24 In accordance with the CIRIA C753 publication 'The SuDS Manual' (2015), residential roofs have a 'very low' pollution hazard level, with low traffic roads classified as having a 'low' pollution hazard level. Table 1 below shows the pollution hazard indices for each land use.

Table 1 – Pollution Hazard Indices

Land Use	Pollution Hazard Level	Total Suspended Solids (TSS)	Metals	Hydrocarbons
Residential Roofs	Very Low	0.2	0.2	0.05
Low traffic Roads	Low	0.5	0.4	0.4

Table extract taken from the CIRIA C753 publication 'The SuDS Manual' Table 26.2

** Indices values range from 0-1.*

9.25 Where practical, runoff from roofs and roads will be directed to an above ground attenuation feature such as a pond or basin. There is also potential for the use of permeable paving. Table 2 overleaf demonstrates that a pond or basin and permeable paving provide sufficient treatment.

Table 2 – SuDS Mitigation Indices

	Mitigation Indices		
Land Use	**Total Suspended Solids (TSS)**	**Metals**	**Hydrocarbons**
Detention Basin	0.5	0.5	0.6
Pond	0.7	0.7	0.5
Permeable Pavement	0.7	0.6	0.7

Table extract taken from the CIRIA C753 publication 'The SuDS Manual' Table 26.2

9.26 It can be concluded that the inclusion of a detention basin, pond and / or permeable paving will provide sufficient treatment. Where attenuation is provided in a below ground system (tank storage), treatment will need to be provided by a hydrodynamic separator.

Maintenance

9.27 Maintenance of communal drainage features such as a pond, basin, permeable paving or an underground attenuation tank will be the responsibility of the site owner. Maintenance of a shared surface water drainage system can be arranged through appointment of a site management company.

9.28 Maintenance of ponds / basins includes:

- Regular monitoring
- Removal of litter and debris
- Regular maintenance of surrounding vegetation

9.29 Maintenance of permeable paving includes:

- Regular jetting to unclog voids

9.30 Maintenance of underground attenuation tanks includes:

- Removal of sediment from silt traps / separators

10 Foul Drainage

10.1 As shown on the UU sewer plan, there is a public combined sewer system adjacent to the site in Woolton Road and Allerton Road.

10.2 A developer enquiry was submitted to UU in order to establish foul discharge to the public combined sewer system in principle. A response is included in Appendix G. UU have stated that foul flows would be allowed to discharge freely into the nearest available public sewage system. It would be practical for the developer to discharge foul flows either into the 225mm public combined sewer in Woolton Road or the 225mm public combined sewer in Allerton Road. A gravity connection to the 225mm public combined sewer in Allerton Road appears feasible.

10.3 Foul sewers will be adopted by UU who will be responsible for their maintenance.

11 Summary and Conclusions

11.1 The proposed residential development at Woolton Road, Liverpool, L18 9UZ is located in Flood Zone 1, as identified on the Environment Agency Flood map for Planning – an area at low risk of fluvial and tidal flooding.

11.2 The existing site is predominantly greenfield. The proposed development is for 160 properties with associated driveways, access roads and landscaping.

11.3 All potential sources of flooding have been assessed. It can be concluded that the site is at low risk from all sources and no specific flood mitigation measures are considered necessary.

11.4 The proposed development increases the impermeable area of the site by approximately 28% through the introduction of new buildings, highways and driveways. Surface water runoff calculations have shown that this results in increased surface water runoff rates and volumes.

11.5 The most practical option for surface water discharge from the site is connection to the 375mm public surface water sewer to the east of the site. A connection to this sewer would need to be requisitioned by UU and a pumped solution would be required.

11.6 In order to ensure the development does not increase flood risk elsewhere, surface water discharge from the site will be restricted to the greenfield QBAR rate of 68 l/s.

11.7 Attenuation storage will be provided in the form of ponds, swales, attenuation tanks and / or oversized pipes. As shown on the Masterplan, provision for above ground drainage features such as ponds and basins has been made in the lower western / south-western extent of the site.

11.8 Foul flows from the site will be discharged into the public combined sewer system either in Woolton Road or Allerton Road. Foul discharge has been agreed in principle with UU and gravity drainage appears feasible.

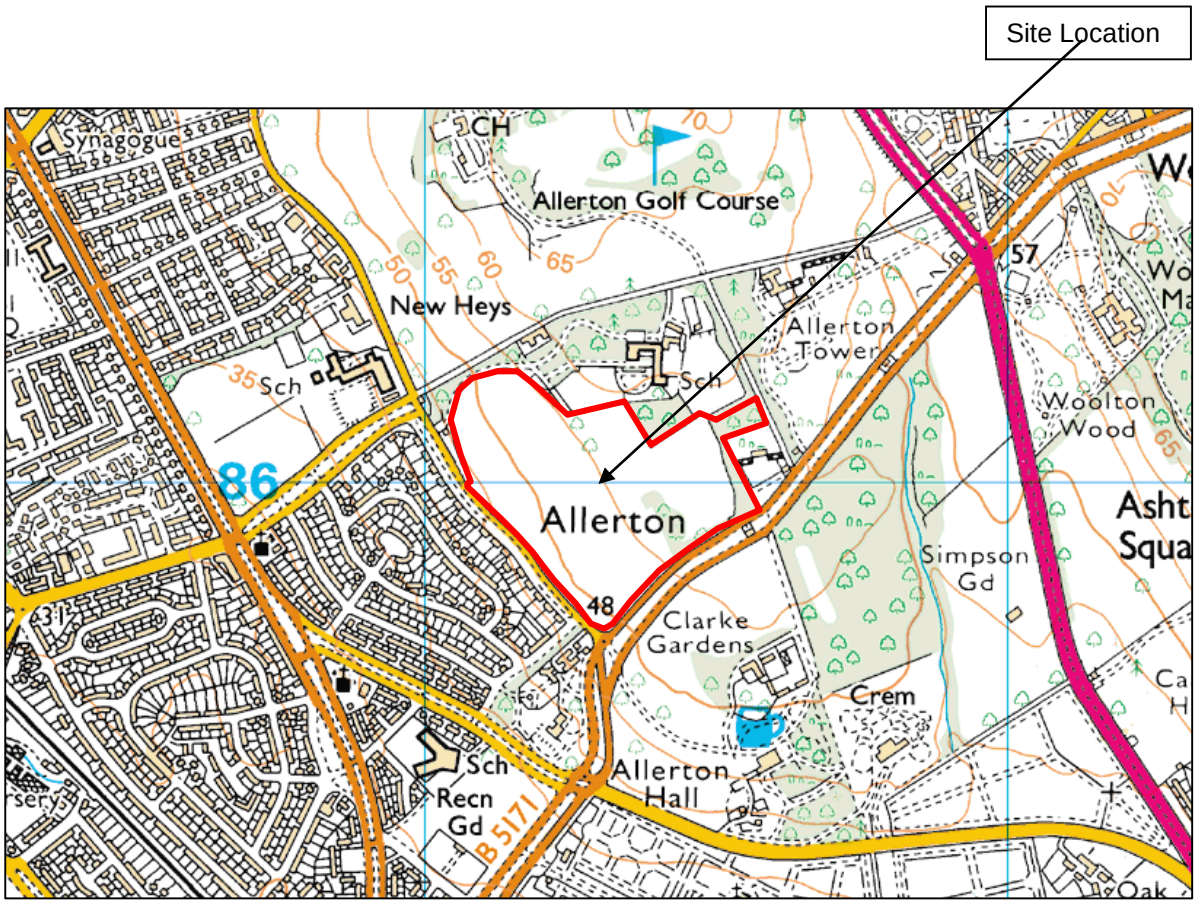
12 Recommendations

12.1 Finished floor levels should be set a minimum of 150mm above surrounding ground levels in accordance with Building Regulations.

12.2 Infiltration tests in accordance with the BRE 365 specification should be carried out to determine the feasibility of soakaways.

12.3 This Flood Risk Assessment should be submitted to the Planning Authority in support of the Planning Application.

Appendix A – Location Plan and Aerial Image



Site Location Plan

(Source: Streetmap)

Aerial Photograph

(Source: Google)

Appendix B – Masterplan

IN ACCORDANCE WITH THE REQUIREMENTS OF THE CDM REGULATIONS 2007 THE FOLLOWING SIGNIFICANT RESIDUAL HAZARDS HAVE NOT BEEN DESIGNED OUT OF THIS PROJECT AND MUST BE TAKEN INTO CONSIDERATION BY CONTRACTORS PLANNING TO UNDERTAKE THE WORKS SHOWN ON THIS DRAWING.

N

REV.	DATE	NOTES	INIT.
REV.F	050711	Updated	RSL
REV.G	171110	Site boundry amended	RSL
REV.E	051110	Site boundry amended	RSL
REV.D	201010	Site boundry amended	RSL
REV.C	240810	Site boundry amended	RSL
REV.B	240810	Site boundry added	RSL
REV.a	031209	sURVEY BOUNDRY ADDED	RSL

PROJECT

EQUESTRIAN CENTER, ALLERTON
LIVERPOOL STABLING &
EQUESTRIAN CENTERS LTD

DRAWING TITLE

EXISTING LOCATION PLAN

STATUS

DATE	DRAWN	CHECK	SCALE @ A1
19.09.08	ATT		1:1250

PROJECT NUMBER	UNIT / BLOCK	CI / SFB CODE	TYPE & NUMBER	REVISION LETTER
DRAWING NO. 8630			01	G

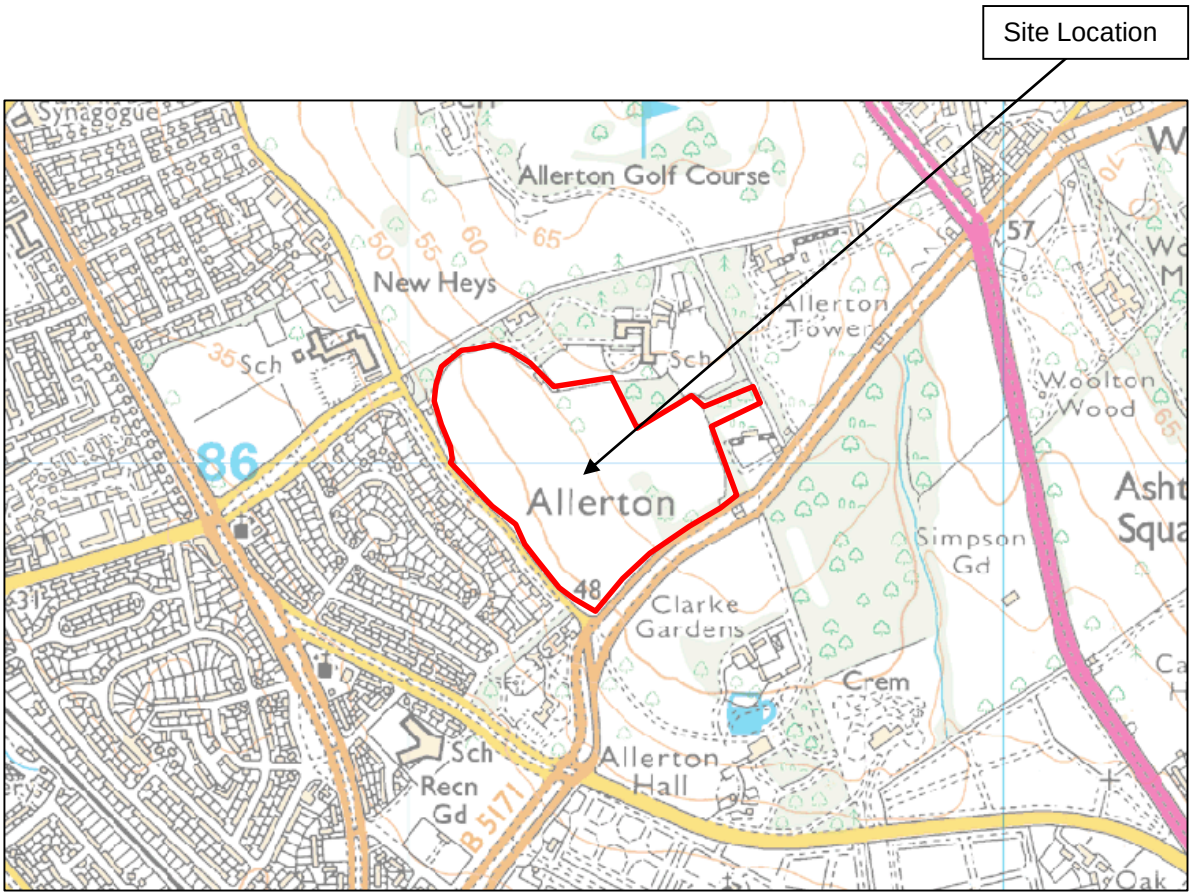
Site Location Plans	L	GA Plans	P	Elevations	E
Sections	S	Details	D	Prefix; Colour	C

MANCHESTER LONDON GLASGOW MACCLESFIELD

105 MANCHESTER ROAD
BURY
LANCASHIRE

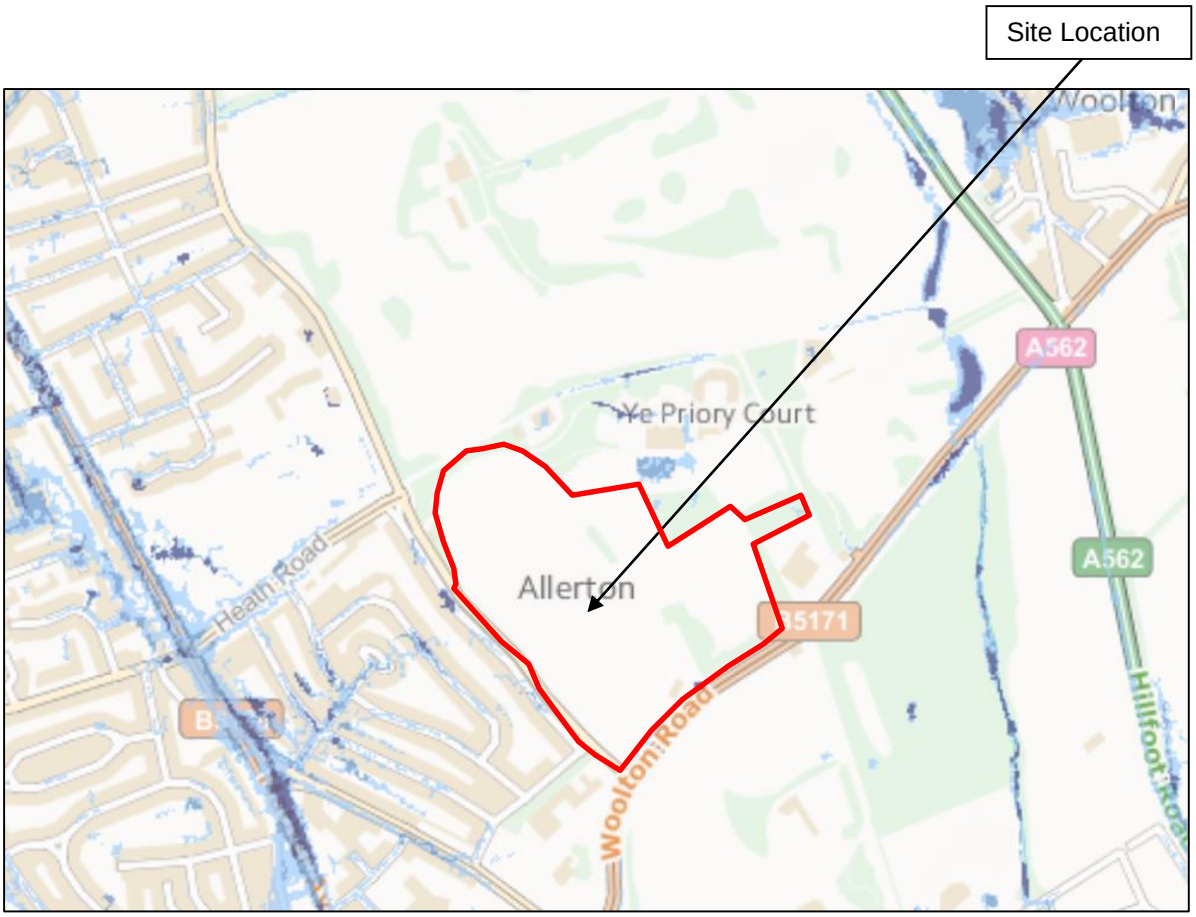

PRIORY.
ALLERTON RD.
WHITEHALL RD.

Appendix C – Environment Agency Flood Maps



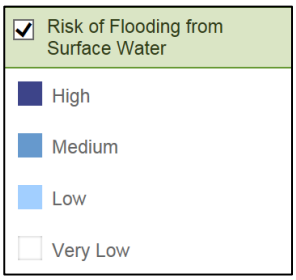
Environment Agency Flood Map for Planning (Rivers and Sea)

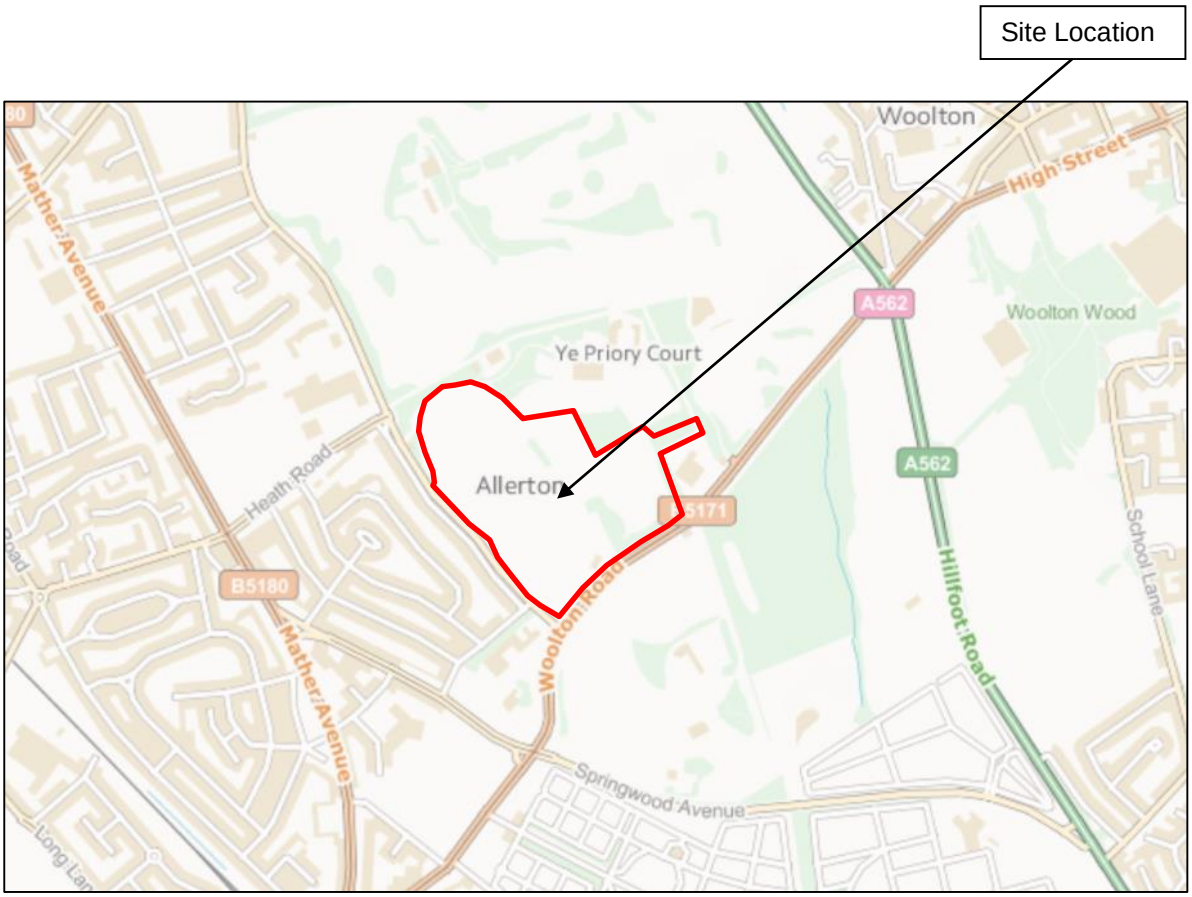
(April 2016)



Environment Agency Risk of Flooding from Surface Water

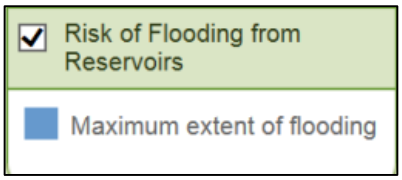
(April 2016)



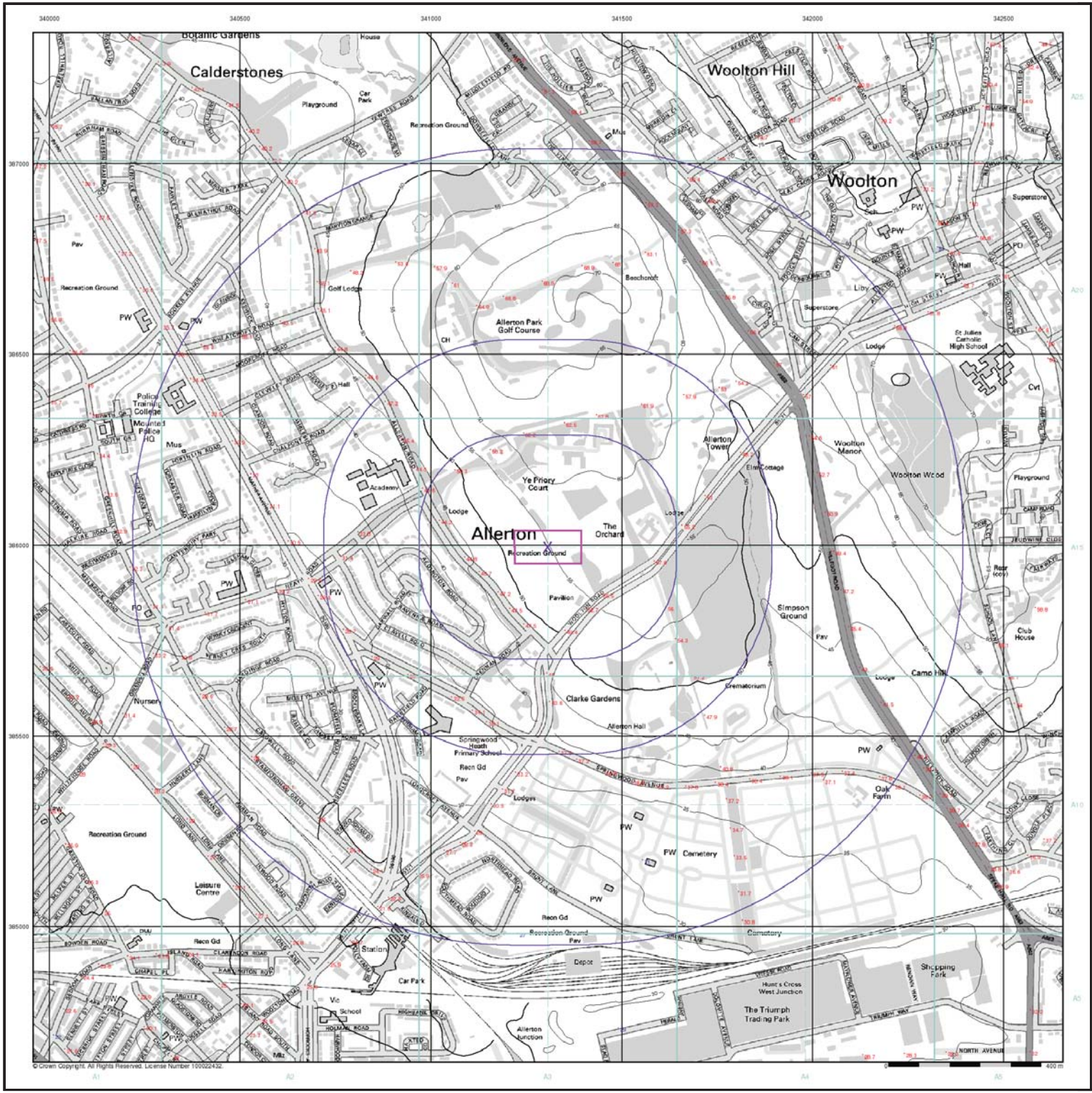


Environment Agency Risk of Flooding from Reservoirs

(April 2016)



Appendix D – Envirocheck Report



Envirocheck® Flood

EA Flood Data Map (1:10,000)

General

- Specified Site
- Specified Buffer(s)
- Bearing Reference Point

Environment Agency Flood Data

- Extreme Flooding from Rivers or Sea without Defences (Zone 2)
- Flooding from Rivers or Sea without Defences (Zone 3)
- Area Benefiting from Flood Defence
- Flood Water Storage Areas
- Flood Defence

Contours (height in metres)

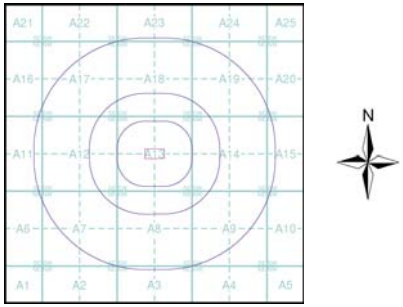
Standard Contour — 105 — 100 — 95

Index Contour

*167.8 Spot Height

*45.8 Air Height

EA Flood Data Map - Slice A



Order Details

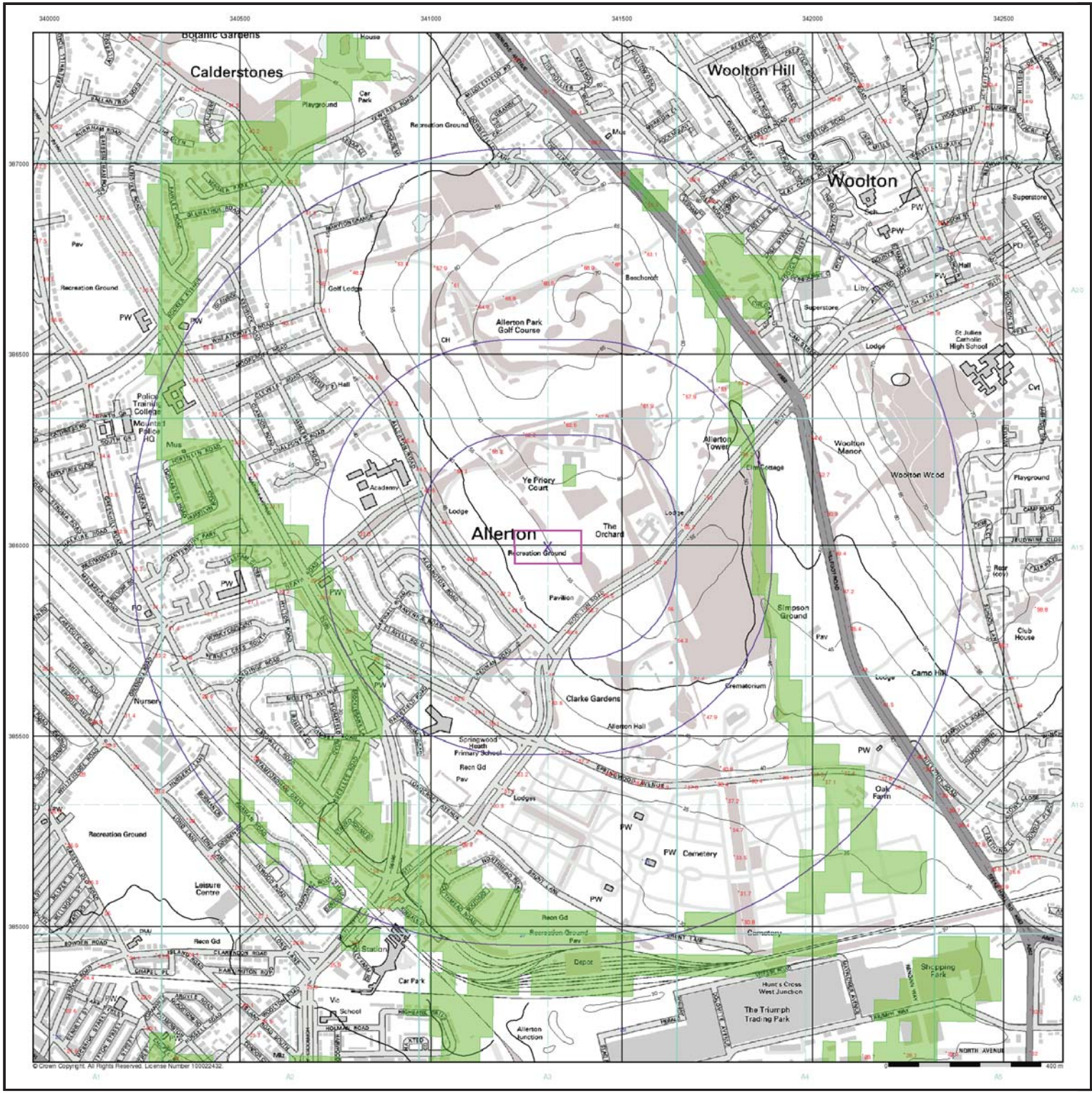
Order Number:	58661660_1_1
Customer Ref:	w1637-240714
National Grid Reference:	341310, 386000
Slice:	A
Site Area (Ha):	1.52
Search Buffer (m):	1000

Site Details

Site at 341300, 385980

Landmark® Information Group

Tel: 0844 844 9952
Fax: 0844 844 9951
Web: www.envirocheck.co.uk



Envirocheck® Flood

RMS 75 year Return Flood Map (1:10,000)

General

- Specified Site
- Specified Buffer(s)
- Bearing Reference Point

RMS 75 year Return Flood Data

Flood Depth (mm)	Flood Type: Defended Flood	Flood Type: Undefended Flood	Pluvial & Minor River Flood (flood depth n/a)
0 - 200			
201 - 500			
501 - 2000			
2001 +			

Contours (height in metres)

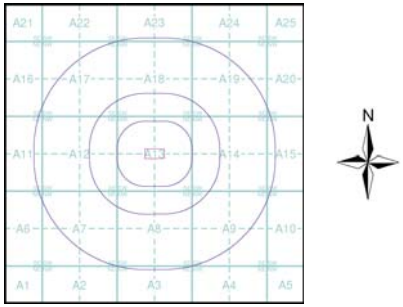
Standard Contour — 105 — 100 — 95

Index Contour

*167.3 Spot Height

*45.8 Air Height

RMS 75 year Return Flood Map - Slice A



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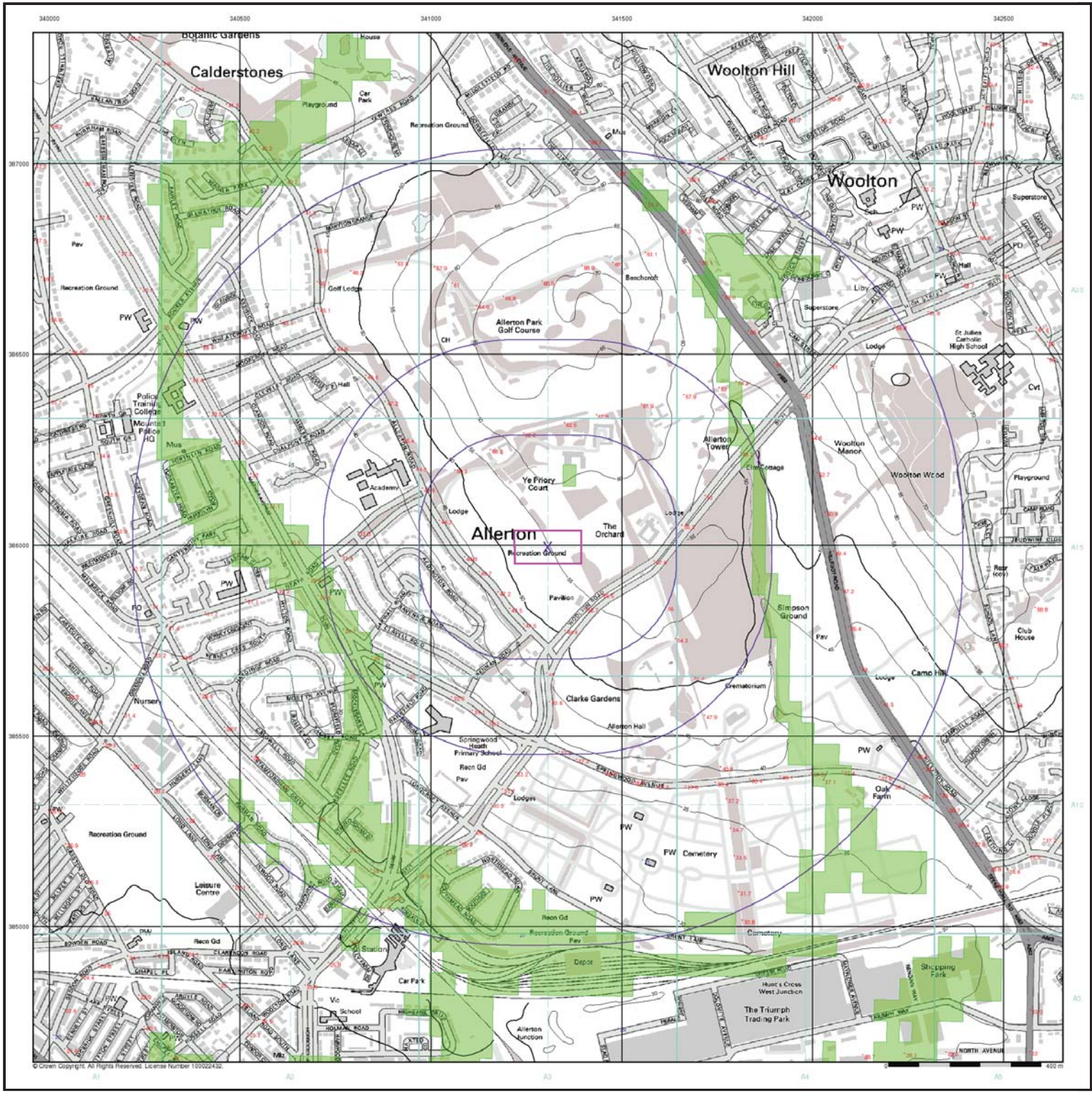


Envirocheck® Flood

RMS 100 year Return Flood Map (1:10,000)

General

- Specified Site
- Specified Buffer(s)
- Bearing Reference Point

RMS 100 year Return Flood Data

Flood Depth (mm)	Flood Type: Defended Flood	Flood Type: Undefended Flood	Pluvial & Minor River Flood (flood depth n/a)
0 - 200			
201 - 500			
501 - 2000			
2001 +			

Contours (height in metres)

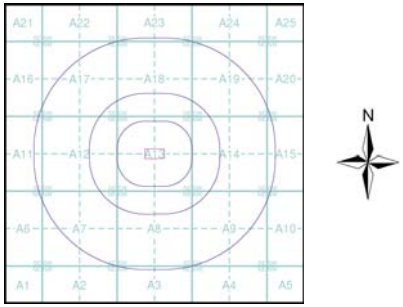
Standard Contour — 105 — 100 — 95

Index Contour

*167.3 Spot Height

*45.8 Air Height

RMS 100 year Return Flood Map - Slice A



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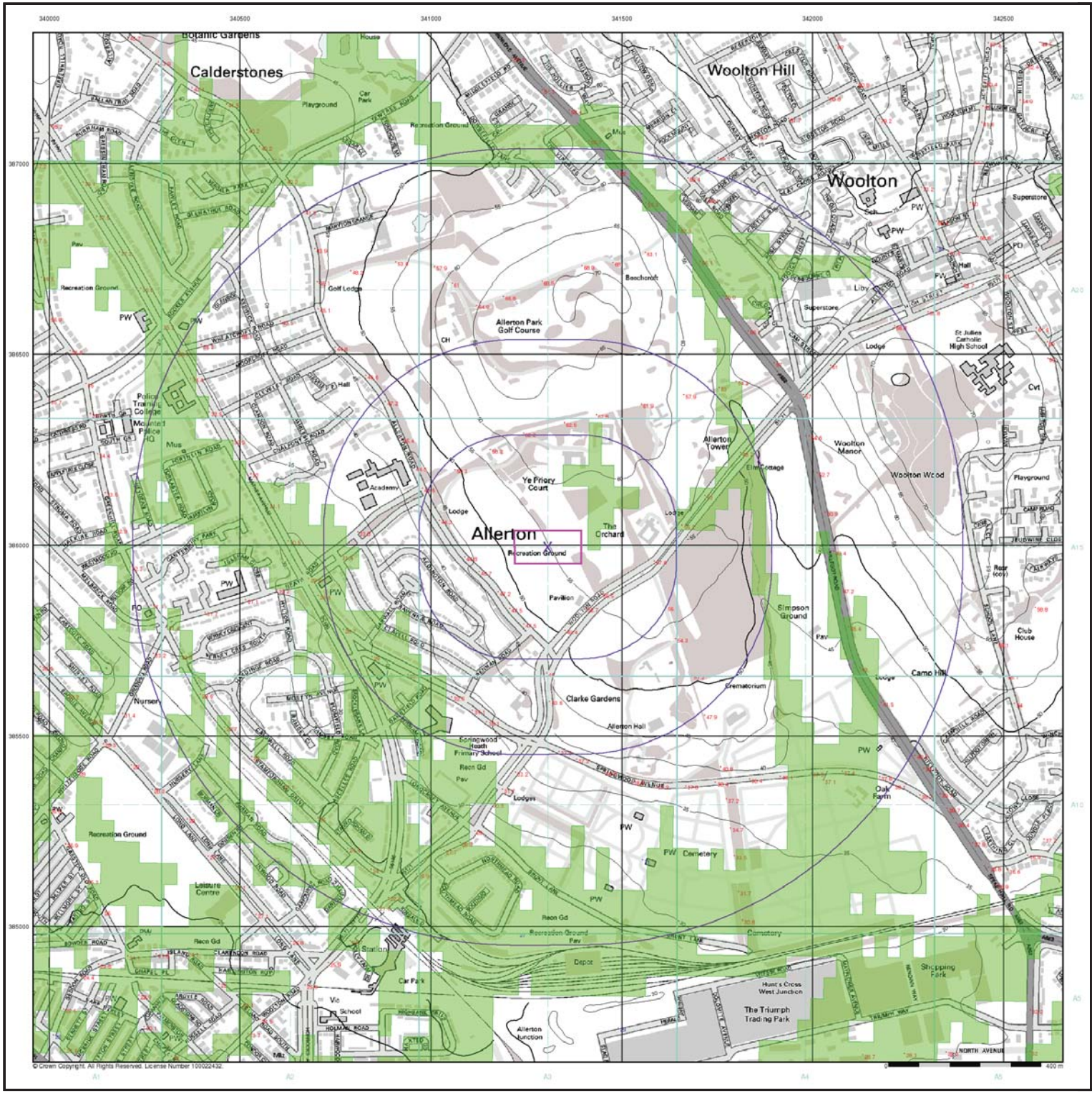
Fax: 0844 844 9951
Web: www.envirocheck.co.uk



Envirocheck® Flood

RMS 1000 year Return Flood Map (1:10,000)

General

- Specified Site
- Specified Buffer(s)
- Bearing Reference Point

RMS 1000 year Return Flood Data

Flood Depth (mm)	Flood Type: Defended Flood	Flood Type: Undefended Flood	Pluvial & Minor River Flood (flood depth n/a)
0 - 200			
201 - 500			
501 - 2000			
2001 +			

Contours (height in metres)

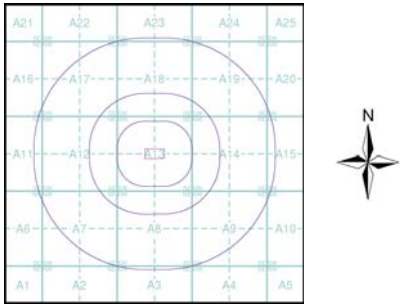
Standard Contour — 105 — 100 — 95

Index Contour

*167.3 Spot Height

*45.8 Air Height

RMS 1000 year Return Flood Map - Slice A



Order Details

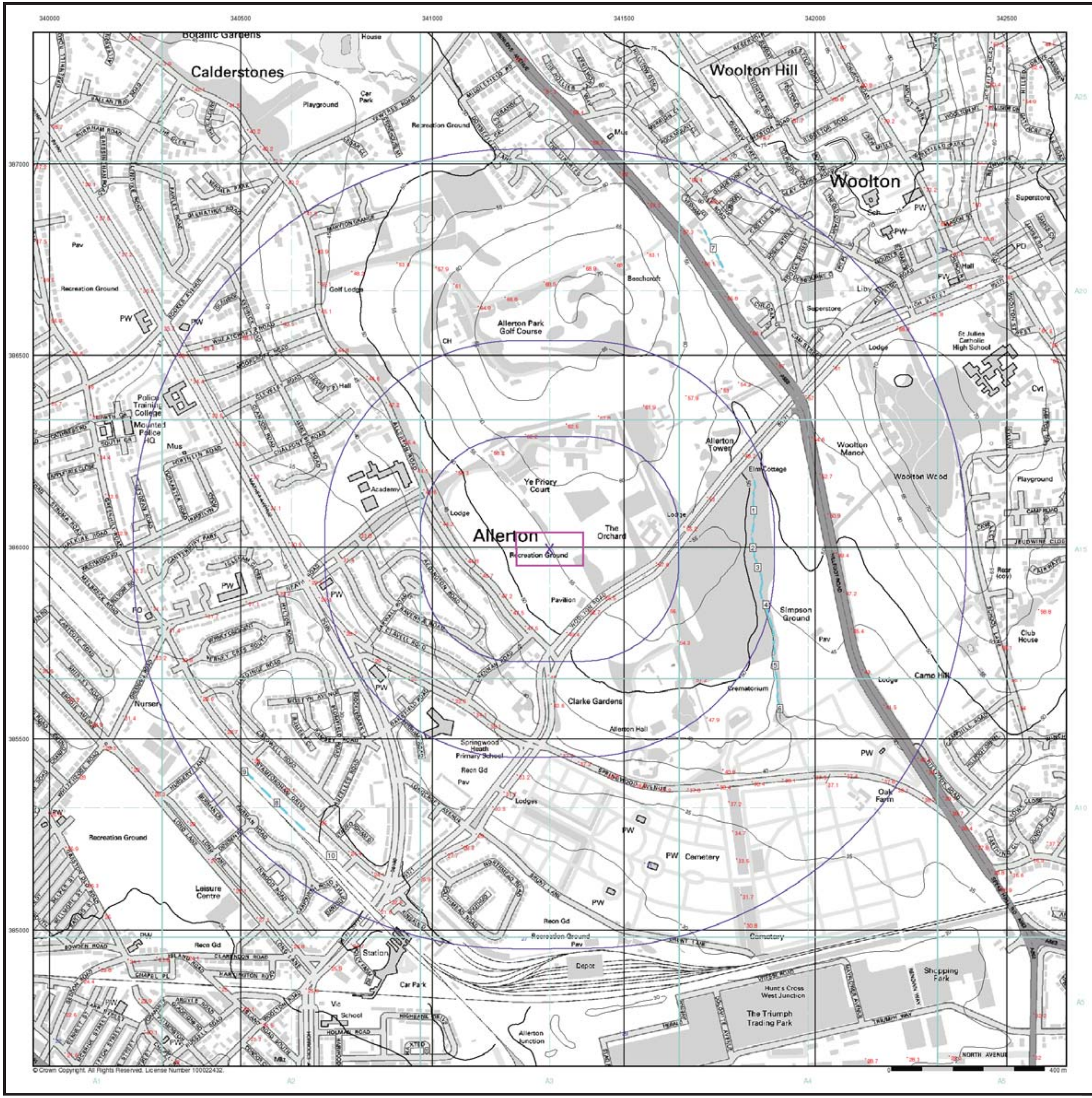
Order Number:	58661660_1_1
Customer Ref:	w1637-240714
National Grid Reference:	341310, 386000
Slice:	A
Site Area (Ha):	1.52
Search Buffer (m):	1000

Site Details

Site at 341300, 385980

Landmark® Information Group

Tel: 0844 844 9952
Fax: 0844 844 9951
Web: www.envirocheck.co.uk



Envirocheck® Flood

EA Detailed River Network Map (1:10,000)

General

- Specified Site
- Specified Buffer(s)
- X Bearing Reference Point
- Map ID

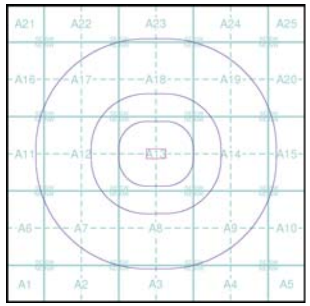
EA Detailed River Network Data

Primary River	Extended Culvert (greater than 50m)
Secondary River	Underground River (inferred)
Tertiary River	Underground River (local knowledge)
Canal	Downstream of High Water Mark
Canal Tunnel	Downstream of Seaward Extension
Undefined River	Not assigned River feature
Lake/Reservoir	
Source	Not assigned River feature
Junction	Pseudo Node (general)
Sink	Pseudo Node (High Water Mark)
Non-interactive Node	Pseudo Node (OS MasterMap polygon boundary)
Offline Drainage Feature	

Contours (height in metres)

- Standard Contour — 105
- Index Contour — 100, 95
- 167.3 Spot Height
- 45.8 Air Height

EA Detailed River Network Map - Slice A



N

Order Details

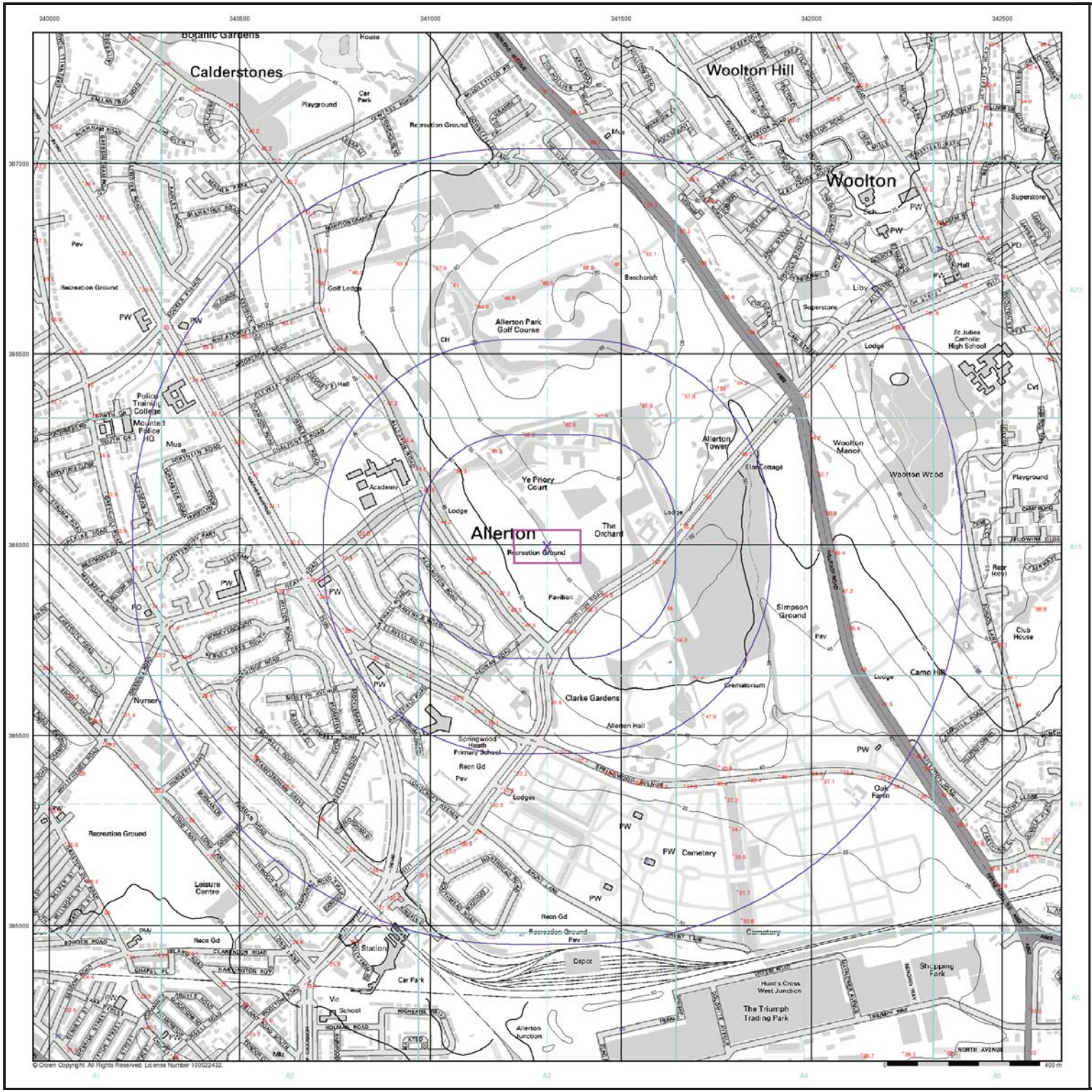
Order Number:	58661660_1_1
Customer Ref:	w1637-240714
National Grid Reference:	341310, 386000
Slice:	A
Site Area (Ha):	1.52
Search Buffer (m):	1000

Site Details

Site at 341300, 385980

Landmark Information Group

Tel: 0844 844 9952
Fax: 0844 844 9951
Web: www.envirocheck.co.uk



Envirocheck® Flood

EA Historic Flood Map (1:10,000)

General

- Specified Site
- Specified Buffer(s)
- Bearing Reference Point
- Map ID

EA Historic Flood Events Data

- Channel Capacity Exceeded (no raised defences)
- Groundwater/High Water Table
- Local Drainage/Surface Water
- Mechanical Failure
- Obstruction/Blockage - Bridge
- Obstruction/Blockage - Channel
- Obstruction/Blockage - Culvert
- Obstruction/Blockage - Debris Screen
- Operational Failure/ Breach of Defence
- Other
- Overtopping of Defences
- Unknown
- Historical Flood Liabilities

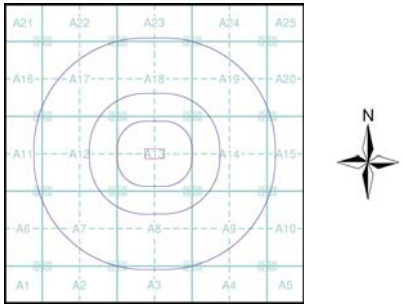
Contours (height in metres)

Standard Contour — 105 — Index Contour — 100 — 95

167.3 Spot Height

45.8 Air Height

EA Historic Flood Map - Slice A



Order Details

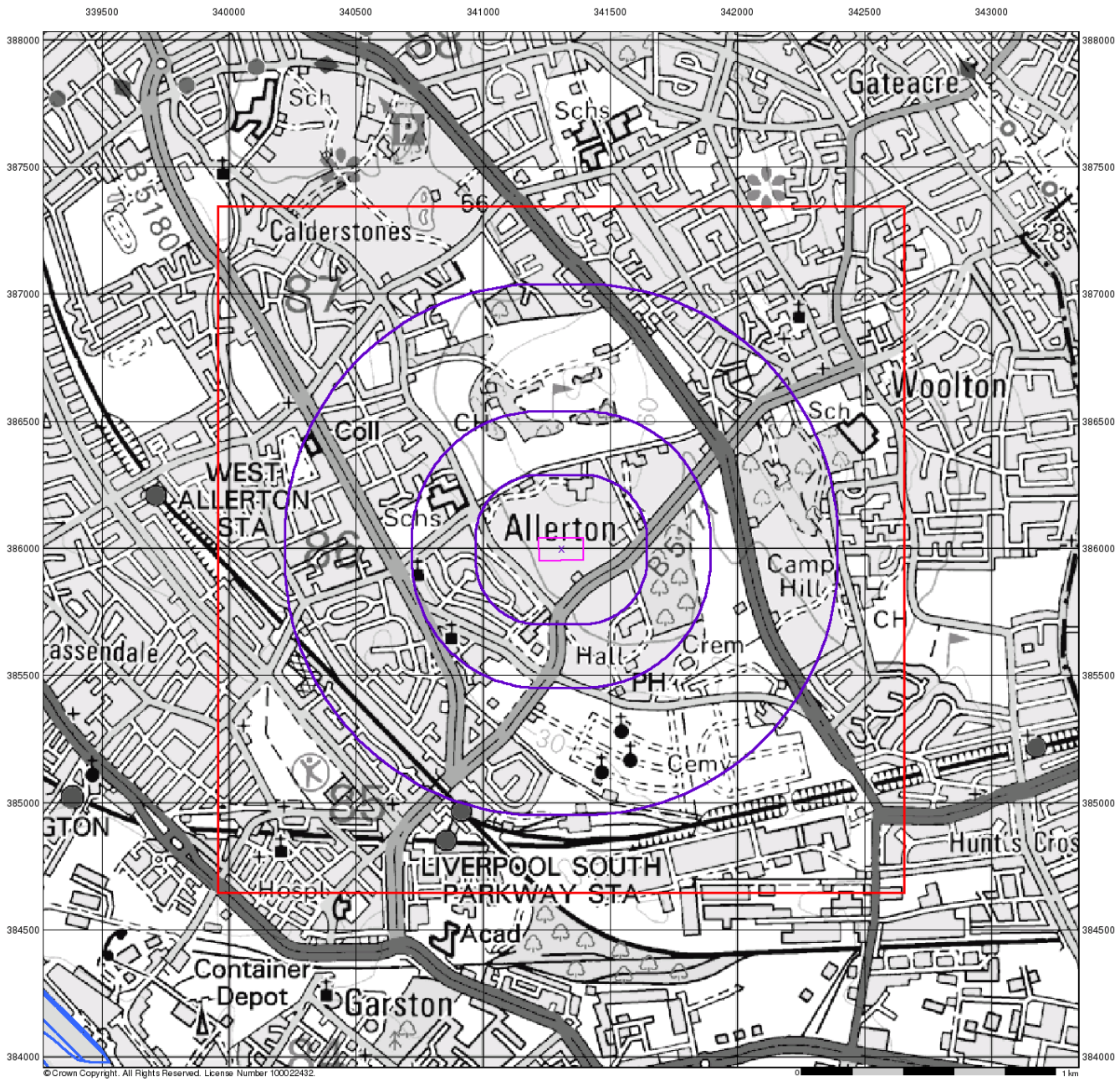
Order Number:	58661660_1_1
Customer Ref:	w1637-240714
National Grid Reference:	341310, 386000
Slice:	A
Site Area (Ha):	1.52
Search Buffer (m):	1000

Site Details

Site at 341300, 385980

Landmark® Information Group

Tel: 0844 844 9952
Fax: 0844 844 9951
Web: www.envirocheck.co.uk



Envirocheck® Flood

BGS Flood Data (1:50,000)

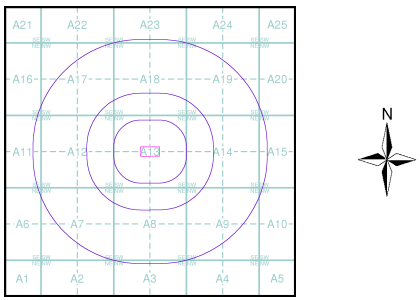
General

Specified Site | Specified Buffer(s) | Bearing Reference Point
Slice | Map ID

BGS Geological Indicators of Flooding

- Coastal
- Inland
- Bodies of Water

BGS Flood Data Map - Slice A



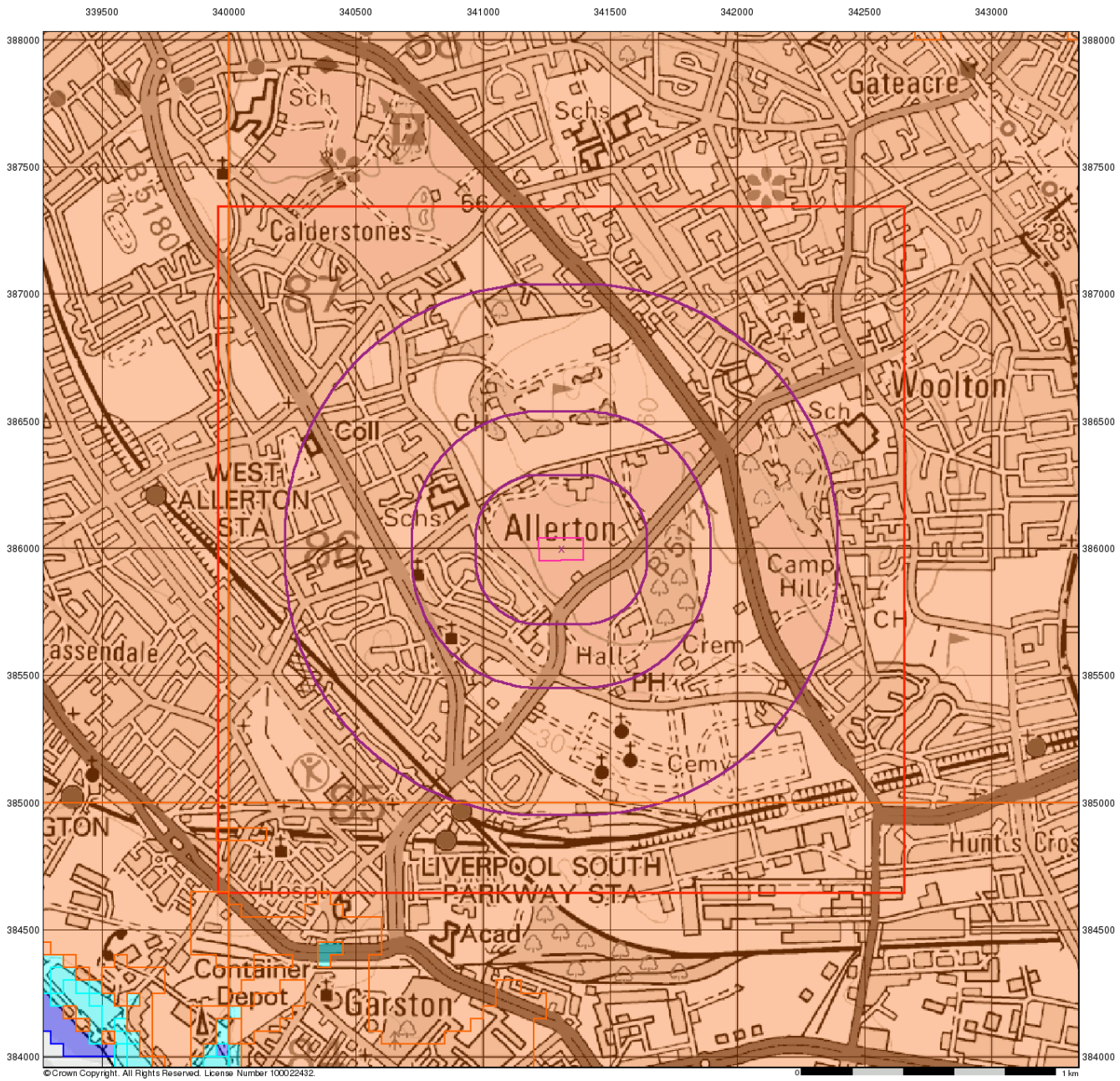
Order Details

Order Number:	58661660_1_1
Customer Ref:	w1637-240714
National Grid Reference:	341310, 386000
Slice:	A
Site Area (Ha):	1.52
Search Buffer (m):	1000

Site Details

Site at 341300, 385980

Landmark® Information Group
Tel: 0844 844 9952
Fax: 0844 844 9951
Web: www.envirocheck.co.uk



Envirocheck® Flood

BGS Flood Data (1:50,000)

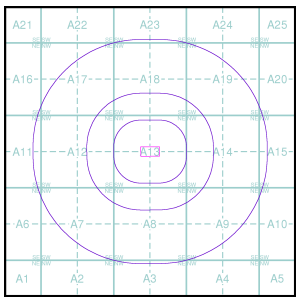
General

Specified Site | Specified Buffer(s) | Bearing Reference Point
Slice | Map ID

BGS Groundwater Flooding Susceptibility

- Potential for Groundwater Flooding to Occur at Surface
- Potential for Groundwater Flooding of Property Situated Below Ground Level
- Limited Potential for Groundwater Flooding to Occur

BGS Flood Data Map - Slice A



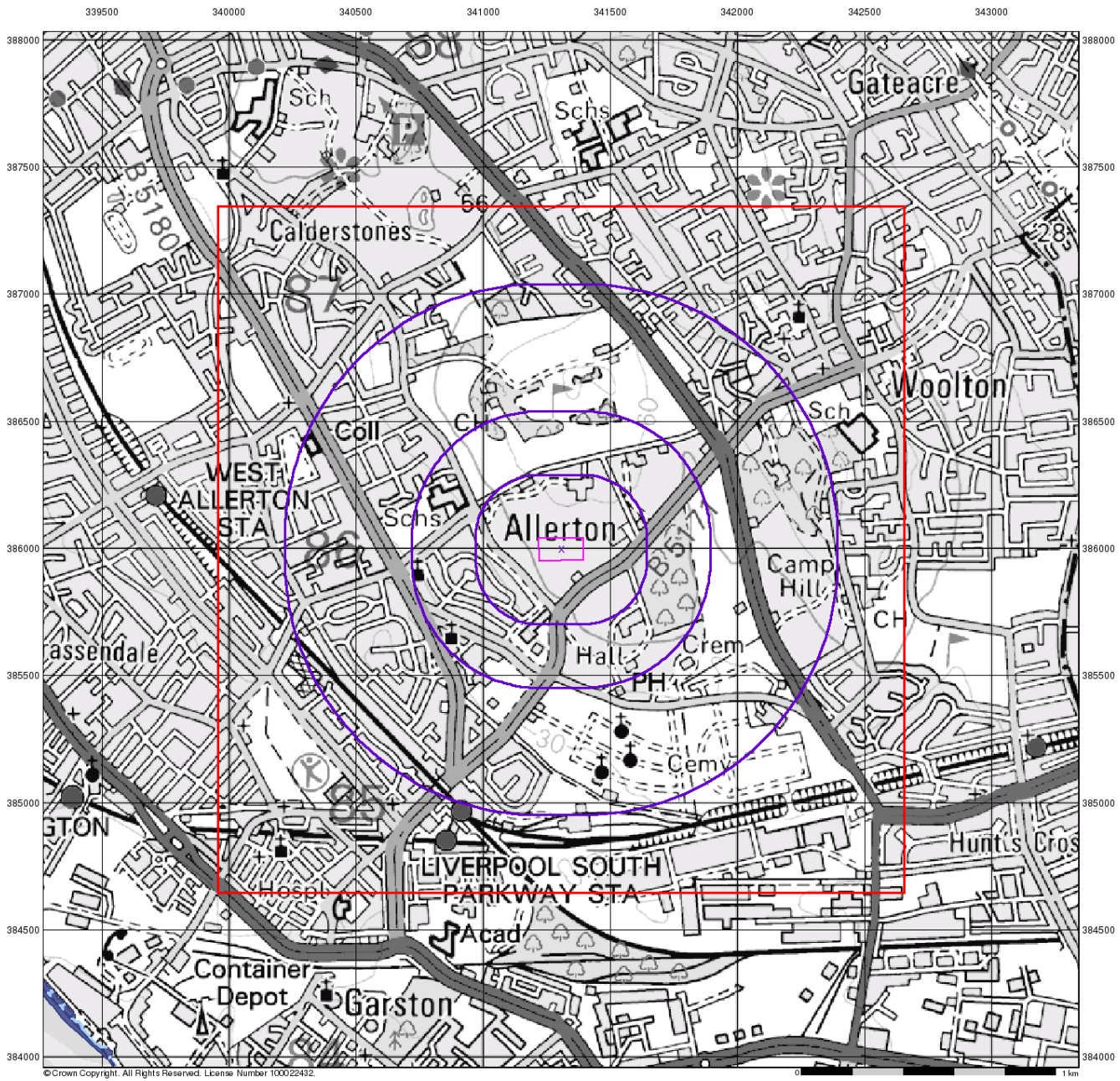
Order Details

Order Number:	58661660_1_1
Customer Ref:	w1637-240714
National Grid Reference:	341310, 386000
Slice:	A
Site Area (Ha):	1.52
Search Buffer (m):	1000

Site Details

Site at 341300, 385980

Landmark® Information Group
Tel: 0844 844 9952
Fax: 0844 844 9951
Web: www.envirocheck.co.uk



Envirocheck® Flood

EA NaFRA Data (1:50,000)

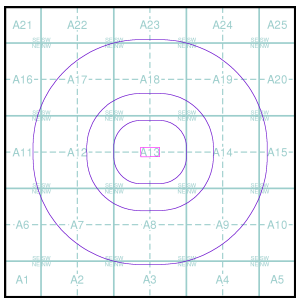
General

Specified Site | Specified Buffer(s) | Bearing Reference Point | Slice | Map ID

National Flood Risk Assessment (NaFRA)

- High Risk
- Medium Risk
- Low Risk
- Very Low Risk

EA NaFRA Data Map - Slice A



Order Details

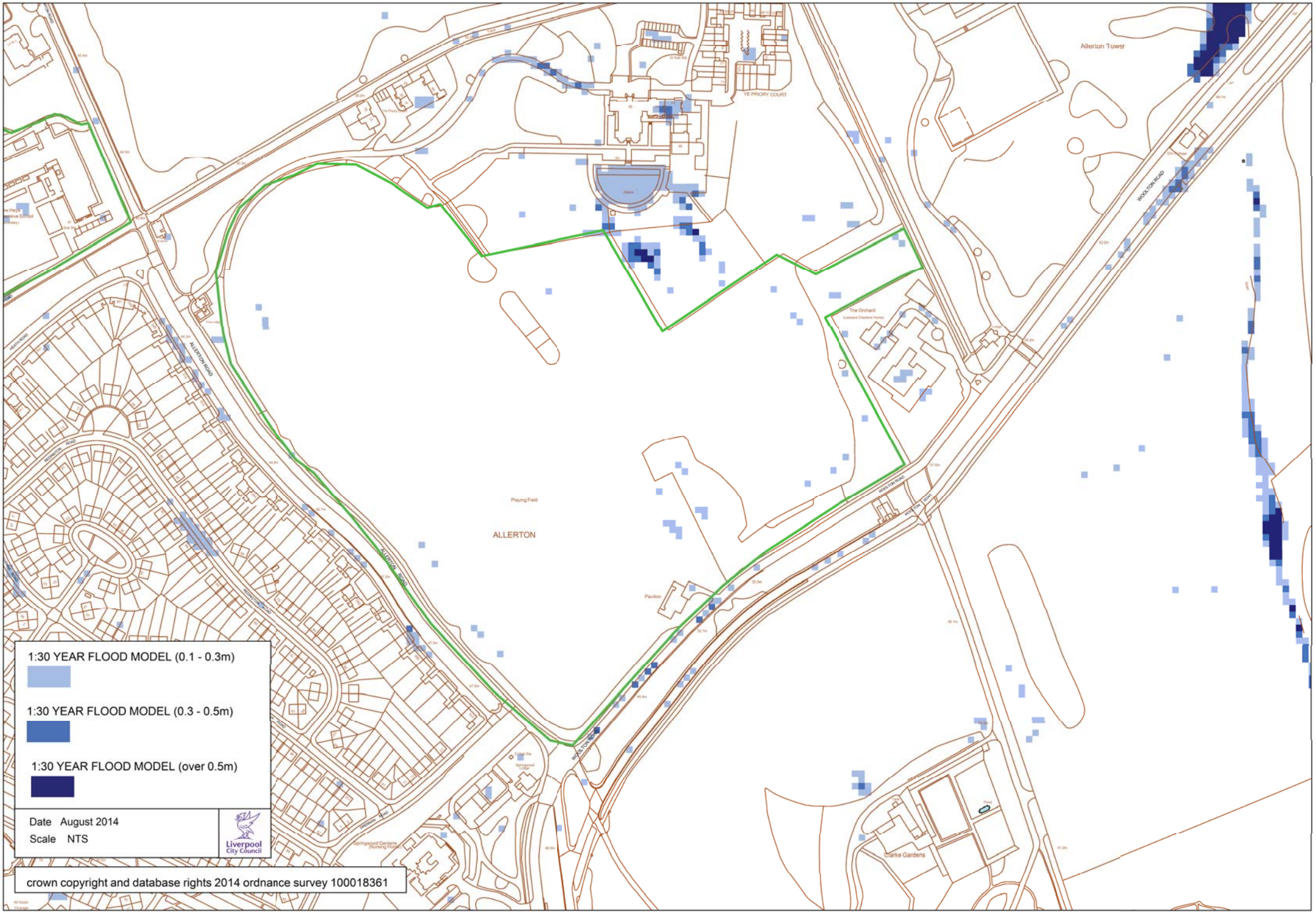
Order Number:	58661660_1_1
Customer Ref:	w1637-240714
National Grid Reference:	341310, 386000
Slice:	A
Site Area (Ha):	1.52
Search Buffer (m):	1000

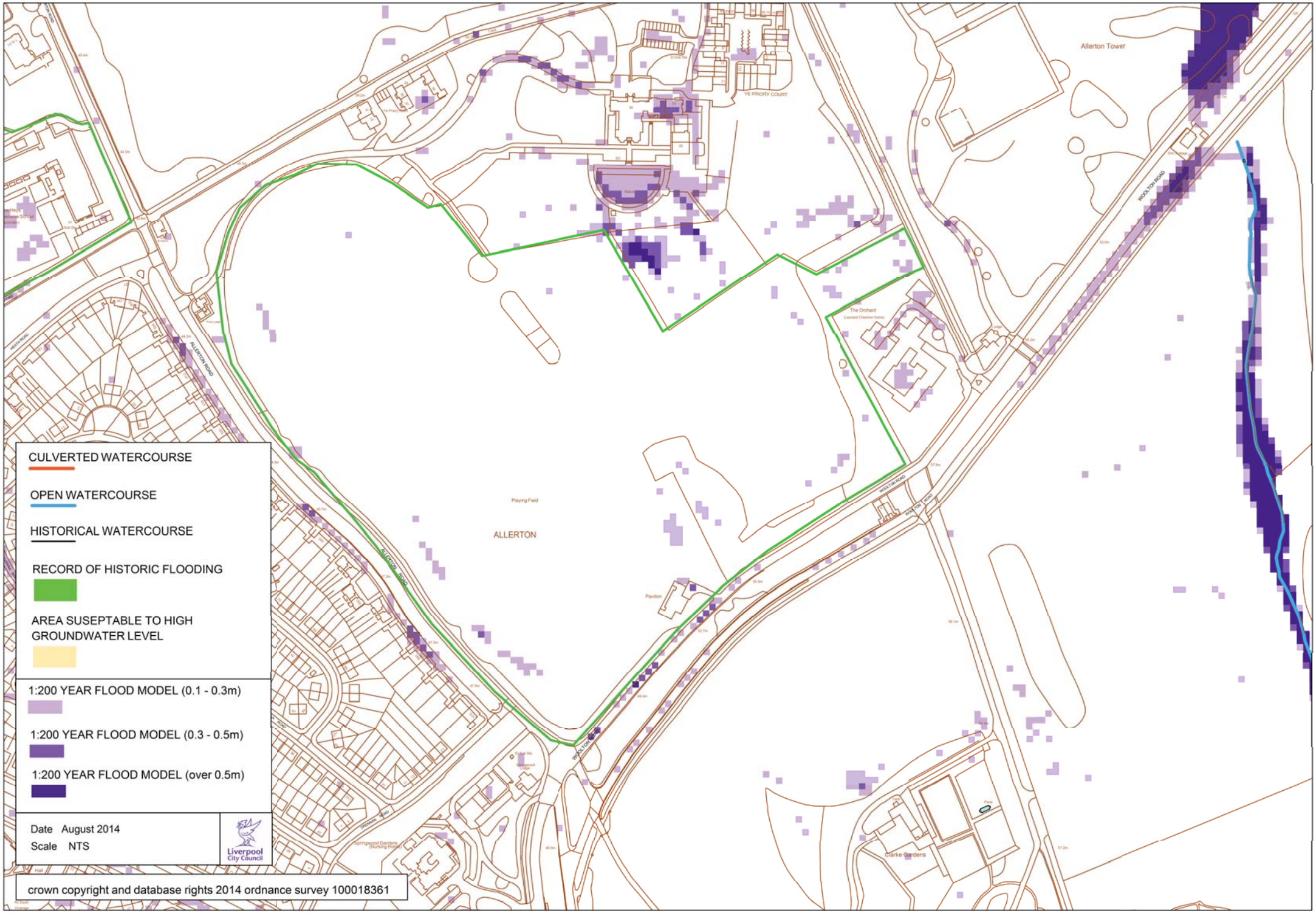
Site Details

Site at 341300, 385980

Landmark® Information Group
Tel: 0844 844 9952
Fax: 0844 844 9951
Web: www.envirocheck.co.uk

Appendix E – Liverpool City Council Maps and Correspondence


1:30 YEAR FLOOD MODEL (0.1 - 0.3m)
1:30 YEAR FLOOD MODEL (0.3 - 0.5m)
1:30 YEAR FLOOD MODEL (over 0.5m)
Date August 2014
Scale NTS
Liverpool City Council
ALLERTON
YE PRIORY COURT
Allerton Tower
WOOLTON ROAD
ALLERTON ROAD
Playing Field
Pavilion
The Orchard
Clarke Gardens
crown copyright and database rights 2014 ordnance survey 100018361


CULVERTED WATERCOURSE
OPEN WATERCOURSE
HISTORICAL WATERCOURSE
RECORD OF HISTORIC FLOODING
AREA SUSEPTABLE TO HIGH GROUNDWATER LEVEL
1:200 YEAR FLOOD MODEL (0.1 - 0.3m)
1:200 YEAR FLOOD MODEL (0.3 - 0.5m)
1:200 YEAR FLOOD MODEL (over 0.5m)
Date August 2014
Scale NTS
Liverpool City Council
crown copyright and database rights 2014 ordnance survey 100018361
ALLERTON
Allerton Tower
YE PRIORY COURT
The Orchard
Playing Field
Pavilion
Clarke Gardens
ALLERTON ROAD
WOOLTON ROAD

Jordan Jones

From: Jordan Jones
Sent: 06 August 2014 17:47
To: Angharad Llewelyn
Subject: FW: Woolton Road, Liverpool
Attachments: Woolton Rd 1-30yr model.pdf; Woolton Rd 1-200yr model & flooding.pdf; Liverpool City Council Data Disclaimer.doc

Categories: Information received

From: Jackson, David
Sent: 06 August 2014 17:44:38 (UTC) Dublin, Edinburgh, Lisbon, London
To: Jordan Jones
Subject: Woolton Road, Liverpool

Jordan

I am currently assisting Laura Gilmore (LCC) with regards to requests for drainage information for development sites

Please find attached the following -

* Surface water flooding (1 in 30 and 1 in 200 yr)
* Groundwater flooding
* Information on Ordinary watercourses in the area (culverted or open watercourse)
* Historic flooding

In line with NPPF (National Planning Policy Framework) the development of a site should look towards the use of SUDS techniques as a method of reducing the run off from the site, as a result of the development. Government policy strongly encourages a hierarchical approach to the use of sustainable drainage systems in new developments and infiltration methods for private drainage should be used where possible.

Ground Investigations should be carried out to BRE 365 to determine if infiltration drainage methods are practicable and suitable for the sites. A soils report including ground percolation test results and recommendations will need to be submitted within the FRA for approval, although any detailed soakaway design information is not required at this stage. If this proves that infiltration drainage is not a viable option, then a positive piped system of surface water run off disposal will need to be provided.

Any soakaway design and the sub ground strata of the sloping site areas shall be considered so as not to cause flooding to any adjoining third party land.

If you require any further information then please contact myself or Laura

Thanks

DAVE JACKSON

Engineer | Consulting

Amey

t: 0151 728 1666 ext 67244 | **e:** david.jackson3@amey.co.uk

Johanne Williams

From: Jackson, David <David.Jackson3@amey.co.uk>
Sent: 19 April 2016 11:11
To: Jordan Jones
Subject: WOOLTON ROAD. LIVERPOOL
Attachments: LCC BROWNFIELD-GREENFIELD-FRA ADVICE.docx

Categories: Information received

Jordan

The advice regarding the drainage requirements for planning applications has been developed since your last enquiry for this site. I have attached LCC guidance note for your information. For this development the previously supplied comments regarding the use of SUDS techniques and the need for ground investigations will still apply.

If you need any further information please contact me

Thanks

DAVE JACKSON

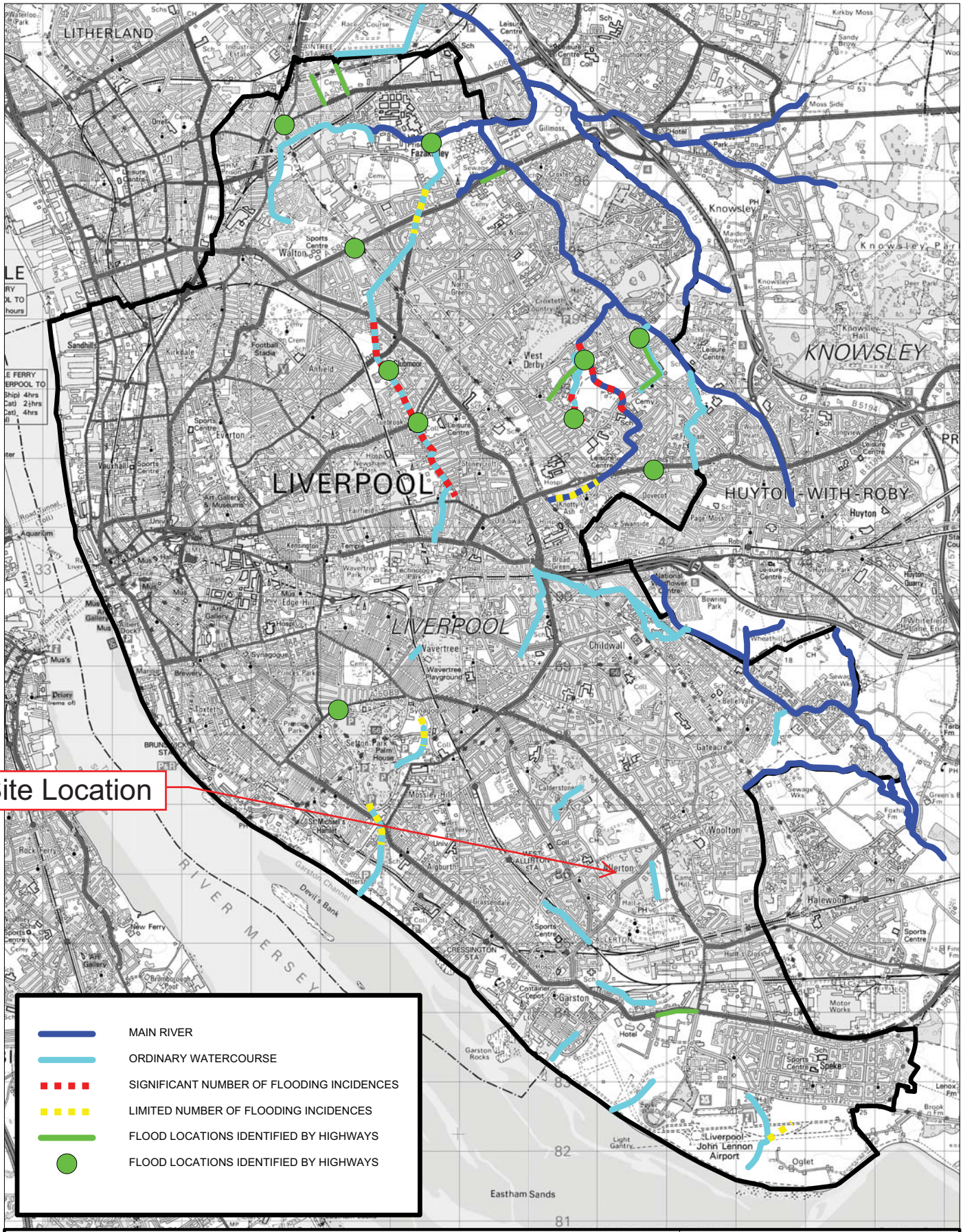
Engineer | Consulting

Amey

t: 0151 498 6825 **l m:** 0780 9313978 | **e:** david.jackson3@amey.co.uk

Unit 3 | Matchworks | 142 Speke Road | Garston | Liverpool | L19 2PH

Appendix F – SFRA and PFRA Maps



MAP 6: HISTORICAL FLOODING AREAS

N
W E
S

Date: 7/6/2007

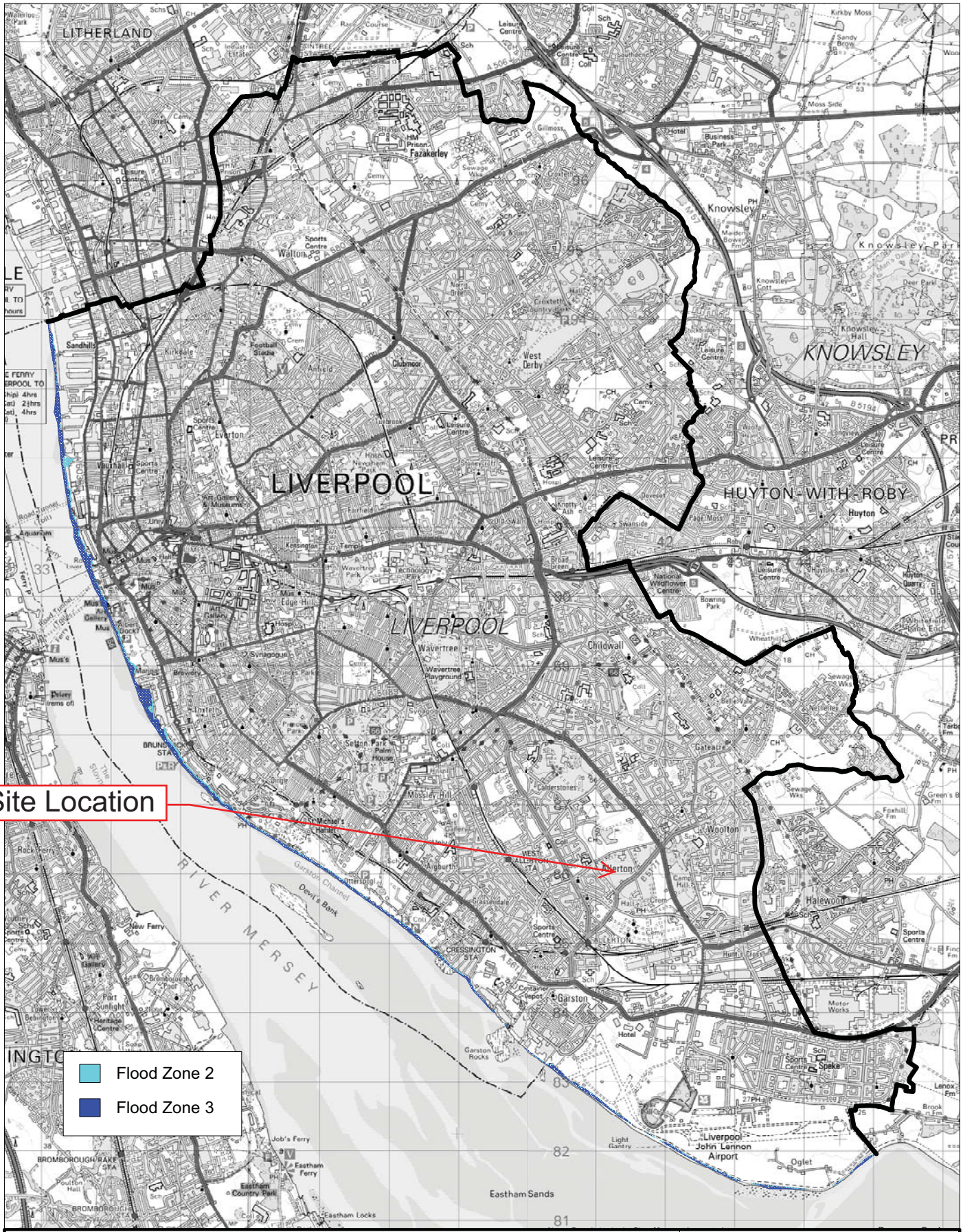
Scale: 1: 75,000

Planning & Building Control, 4th Floor, Millennium House, 60 Victoria Street
Liverpool, L1 6JH Tel: 0151 233 5685 Fax: 0151 233 4290

Status:

FINAL

The City of Liverpool



MAP 4a: Environment Agency Flood Risk Zones Tidal Flood Risk

N
W E
S

Date: 31/5/2007

Scale: 1: 75,000

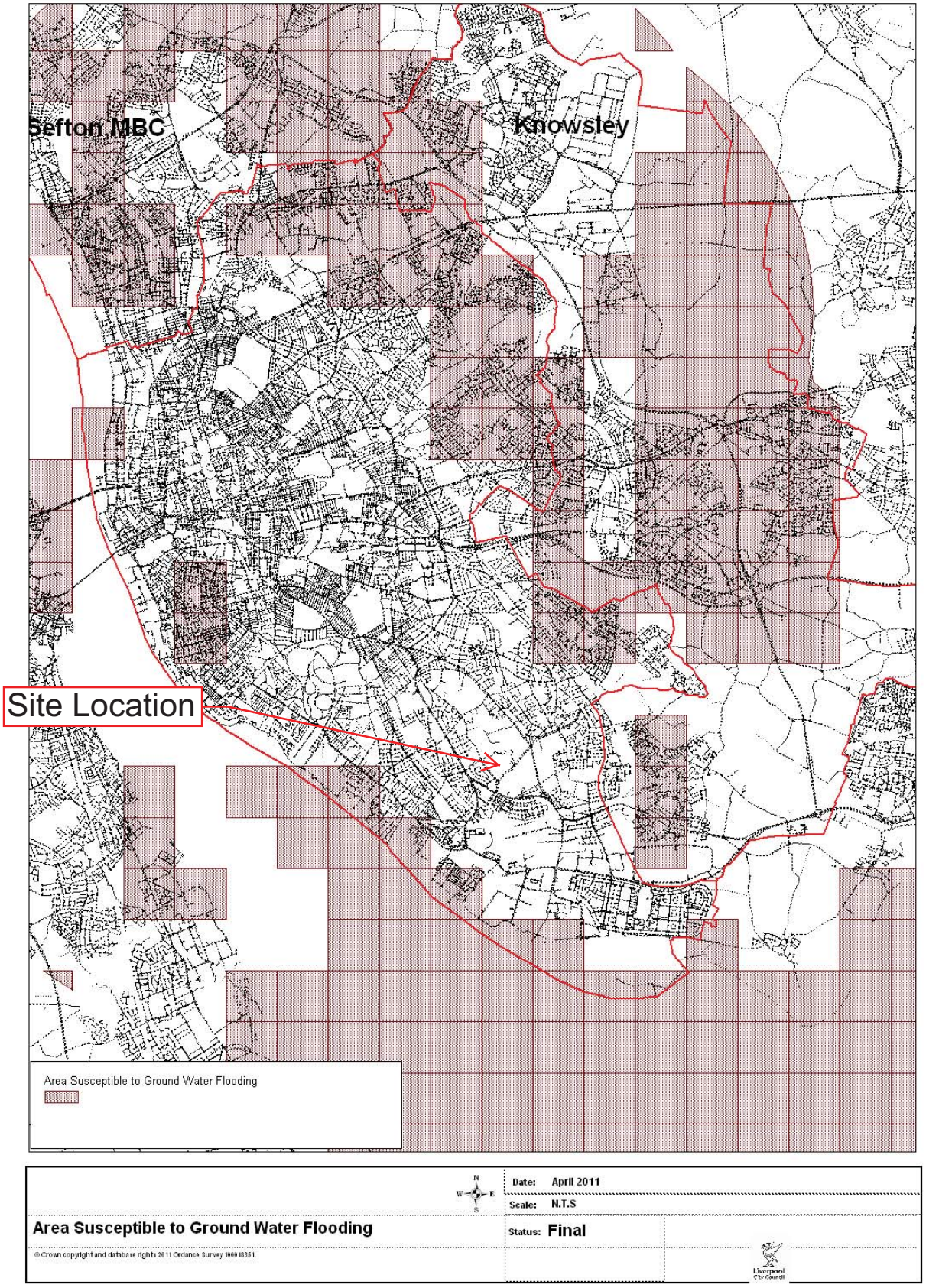
Planning & Building Control, 4th Floor, Millennium House, 60 Victoria Street
Liverpool, L1 6JH Tel: 0151 233 5685 Fax: 0151 233 4290

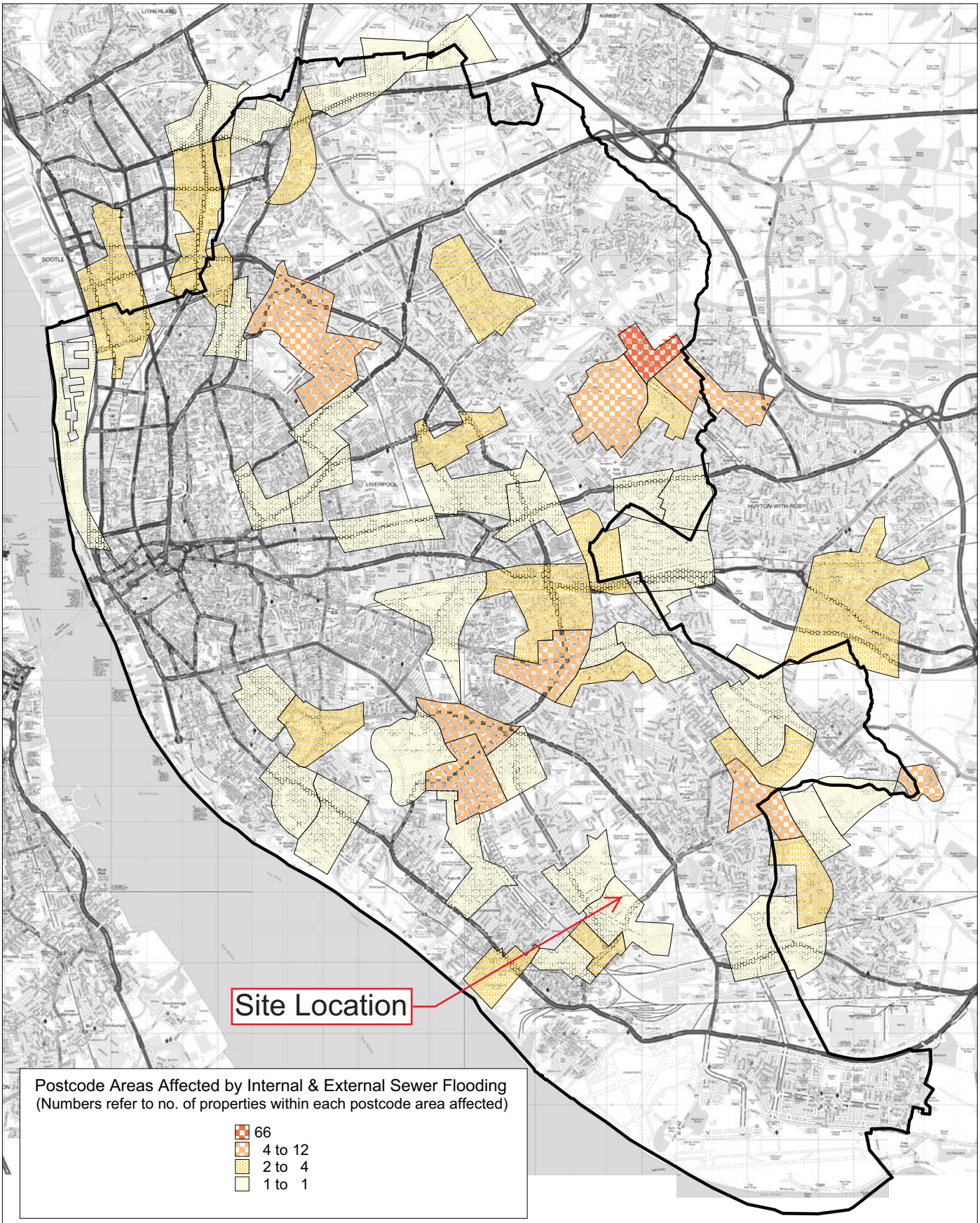
Status:

FINAL

The City of Liverpool

Figure 5.2.3 Areas Susceptible to Groundwater Flooding (AStGF)





MAP 8:
Historical Sewer Flooding

N
W E
S

Date: 05/10/2006

Scale: 1: 75,000

Planning & Building Control, 4th Floor, Millennium House, 60 Victoria Street
Liverpool, L1 6JH Tel: 0151 233 5685 Fax: 0151 233 4290

Status:

FINAL

The City of Liverpool

Appendix G – United Utilities Sewer Plan and Correspondence

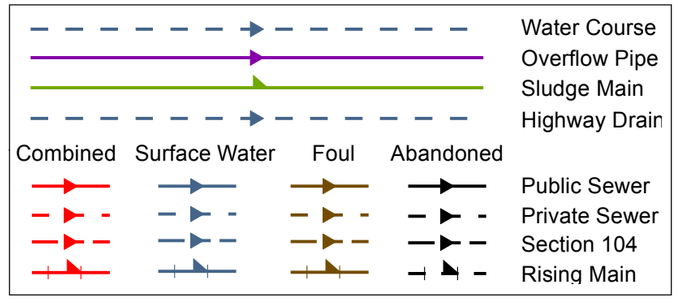
Extract from Map of Public Sewers

The position of underground apparatus shown on this plan is approximate only and is given in accordance with the best information currently available.

The actual positions may be different from those shown on the plan and private pipes, sewers or drains may not be recorded.

United Utilities will not accept any liability for any damage caused by the actual positions being different from those shown.

LEGEND



W1637-140724

Printed By : LE

Date: 28/07/2014

DO NOT SCALE

Approximate Scale: 1:5000

United Utilities
helping life flow smoothly

Johanne Williams

From: Lunt, John <John.Lunt@uuplc.co.uk>
Sent: 22 April 2016 11:11
To: Aled Williams
Cc: Wastewater Developer Services
Subject: RE: (UU ref: DE0209) : w1637 - Woolton Road, Liverpool - Development Advice

Hi Aled,

Please note the 225mm sewer you've mentioned is in fact a "Highway Drain" and not a public sewer so you would need to approach the local authority in the first instance to ascertain if it could be used at all.

The proposed discharge rate of 68 l/s communicating with the 375mm public surface water sewer would be acceptable in principle to UU.

Regards,

John

From: Aled Williams [mailto:Aled.Williams@waterco.co.uk]
Sent: 21 April 2016 16:45
To: Lunt, John <John.Lunt@uuplc.co.uk>
Subject: RE: (UU ref: DE0209) : w1637 - Woolton Road, Liverpool - Development Advice

Hi John,

Thanks for this. The asset plans we have (attached) don't quite cover the 375mm sewer to the east. I was looking at the 225mm sewer to the south.

We will have to pump to achieve discharge to the 375mm sewer / watercourse. This may be an option and I assume would be acceptable to UU at a rate of 68 l/s (greenfield runoff calcs attached)?

Would discharge or partial discharge to the 225mm surface water sewer at a restricted rate be an option so that gravity drainage can be achieved? I understand if acceptable this would likely need to be at a lower rate.

Kind Regards,

Aled Williams

T: 01824 702220 | **E:** Aled.Williams@waterco.co.uk | **W:** www.waterco.co.uk

waterco consultants

Specialists of choice for water, drainage and flood risk assessment

Head Office	Regional	International
Ruthin, Denbighshire	Hanover St, Manchester	Hyderabad, India
(+44) 1824 702220	(+44) 161 214 0850	(+91) 406536060

From: Lunt, John [mailto:John.Lunt@uuplc.co.uk]
Sent: 21 April 2016 16:14
To: Aled Williams
Subject: RE: (UU ref: DE0209) : w1637 - Woolton Road, Liverpool - Development Advice

Hi Aled,

The previous response by UU was for the surface water flows to be directed towards the watercourse and or the public surface water sewer approx. 450m to the East of the site, of which the sewer here is a 375mm surface water sewer?

Regards,

John

From: Aled Williams [mailto:Aled.Williams@waterco.co.uk]
Sent: 21 April 2016 15:50
To: Lunt, John <John.Lunt@uuplc.co.uk>
Subject: (UU ref: DE0209) : w1637 - Woolton Road, Liverpool - Development Advice

Hi John,

I called earlier regarding a development site at Woolton Road, Liverpool (please see attached the original email from my colleague Jordan).

The previous UU response stated that a connection could be made to the surface water sewer at the greenfield rate (this appears the only practical option to achieve gravity discharge). The greenfield QBAR rate is 68 l/s and the receiving sewer appears to be 225mm. There is a concern that the 225mm sewer will not have capacity to deal with this flow rate.

As such, in your response, please could you advise if UU will have a maximum pass forward flow rate from the site to the 225mm sewer.

Thank you in advance,

Kind Regards,

Aled Williams

T: 01824 702220 | **E:** Aled.Williams@waterco.co.uk | **W:** www.waterco.co.uk

waterco consultants

Specialists of choice for water, drainage and flood risk assessment

Head Office	Regional	International
Ruthin, Denbighshire	Hanover St, Manchester	Hyderabad, India
(+44) 1824 702220	(+44) 161 214 0850	(+91) 406536060

Jordan Jones

From: Lunt, John <John.Lunt@uuplc.co.uk>
Sent: 06 August 2014 09:04
To: Jordan Jones
Cc: Wastewater Developer Services
Subject: (UU ref: DE0209) : w1637 - Woolton Road, Liverpool - Development Advice

Categories: Information received

Hi Jordan,

In reply, I can confirm that UU will require the site to be designed and served using a total separate drainage system with the foul water flows emanating from the site being allowed to discharge freely into the nearest available public sewerage system.

The surface water flows generated from the site should be directed towards the public surface water sewer and or watercourse located approx. 450m to the East along Woolton Road.

If I can be of any further assistance at all then please don't hesitate to get in touch.

Regards,

John Lunt
Developer Query Engineer
DDI – 01925 679411

From: Jordan Jones [mailto:jordan.jones@waterco.co.uk]
Sent: 22 July 2014 10:08
To: Wastewater Developer Services
Subject: w1637 - Woolton Road, Liverpool - Development Advice

Dear Sir / Madam,

Please find attached the completed pre-development enquiry form with relevant attachments.

If you require any further information please do not hesitate to contact me.

Kind Regards,

Jordan Jones

waterco consultants

Waterco Ltd, Lon Parcwr Business Park, Ruthin LL15 1NJ
01824 702220 - www.waterco.co.uk - jordan.jones@waterco.co.uk

Specialising in Water, Drainage and Flood Risk

Appendix H – Greenfield Runoff Calculations

ICP SUDS Mean Annual Flood

Input

Return Period (years)	100	Soil	0.450
Area (ha)	13.500	Urban	0.000
SAAR (mm)	790	Region Number	Region 10

Results	**l/s**
QBAR Rural	68.3
QBAR Urban	68.3
Q100 years	142.1
Q1 year	59.4
Q30 years	115.8
Q100 years	142.1

Appendix I – Storm Water Storage 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	9.487	0.487	66.1	838.1	O K
30 min Summer	9.630	0.630	66.1	1082.9	O K
60 min Summer	9.761	0.761	66.1	1309.5	Flood Risk
120 min Summer	9.858	0.858	66.1	1475.0	Flood Risk
180 min Summer	9.877	0.877	66.1	1507.9	Flood Risk
240 min Summer	9.874	0.874	66.1	1502.6	Flood Risk
360 min Summer	9.854	0.854	66.1	1468.6	Flood Risk
480 min Summer	9.827	0.827	66.1	1421.8	Flood Risk
600 min Summer	9.792	0.792	66.1	1362.8	Flood Risk
720 min Summer	9.755	0.755	66.1	1298.0	Flood Risk
960 min Summer	9.680	0.680	66.1	1168.8	O K
1440 min Summer	9.546	0.546	66.1	939.6	O K
2160 min Summer	9.404	0.404	65.6	695.3	O K
2880 min Summer	9.321	0.321	63.8	552.5	O K
4320 min Summer	9.257	0.257	51.1	442.7	O K
5760 min Summer	9.224	0.224	41.8	385.2	O K
7200 min Summer	9.202	0.202	35.6	346.8	O K
8640 min Summer	9.185	0.185	31.1	318.2	O K
10080 min Summer	9.172	0.172	27.6	296.0	O K
15 min Winter	9.549	0.549	66.1	943.5	O K
30 min Winter	9.711	0.711	66.1	1222.7	Flood Risk

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	126.178	0.0	868.9	25
30 min Summer	82.868	0.0	1147.2	39
60 min Summer	51.848	0.0	1461.0	66
120 min Summer	31.345	0.0	1767.6	124
180 min Summer	23.041	0.0	1949.5	178
240 min Summer	18.411	0.0	2077.3	204
360 min Summer	13.368	0.0	2262.7	268
480 min Summer	10.654	0.0	2404.5	336
600 min Summer	8.928	0.0	2518.6	404
720 min Summer	7.724	0.0	2614.6	470
960 min Summer	6.141	0.0	2771.0	598
1440 min Summer	4.438	0.0	3000.0	848
2160 min Summer	3.202	0.0	3264.8	1196
2880 min Summer	2.538	0.0	3447.3	1532
4320 min Summer	1.826	0.0	3709.8	2248
5760 min Summer	1.444	0.0	3929.3	2944
7200 min Summer	1.203	0.0	4092.2	3680
8640 min Summer	1.036	0.0	4225.0	4408
10080 min Summer	0.913	0.0	4333.4	5144
15 min Winter	126.178	0.0	975.5	25
30 min Winter	82.868	0.0	1287.2	39

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
60 min Winter	9.862	0.862	66.1	1483.1	Flood Risk
120 min Winter	9.972	0.972	66.1	1672.0	Flood Risk
180 min Winter	9.998	0.998	66.2	1717.1	Flood Risk
240 min Winter	9.991	0.991	66.1	1705.4	Flood Risk
360 min Winter	9.960	0.960	66.1	1650.9	Flood Risk
480 min Winter	9.920	0.920	66.1	1582.4	Flood Risk
600 min Winter	9.872	0.872	66.1	1500.0	Flood Risk
720 min Winter	9.819	0.819	66.1	1408.3	Flood Risk
960 min Winter	9.699	0.699	66.1	1202.3	O K
1440 min Winter	9.499	0.499	66.1	858.5	O K
2160 min Winter	9.323	0.323	63.9	555.5	O K
2880 min Winter	9.268	0.268	54.0	461.6	O K
4320 min Winter	9.217	0.217	39.8	372.6	O K
5760 min Winter	9.188	0.188	31.8	322.7	O K
7200 min Winter	9.168	0.168	26.5	289.8	O K
8640 min Winter	9.154	0.154	22.9	265.7	O K
10080 min Winter	9.144	0.144	20.3	247.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
60 min Winter	51.848	0.0	1637.1	66
120 min Winter	31.345	0.0	1980.5	122
180 min Winter	23.041	0.0	2184.2	176
240 min Winter	18.411	0.0	2327.4	228
360 min Winter	13.368	0.0	2535.1	284
480 min Winter	10.654	0.0	2693.9	360
600 min Winter	8.928	0.0	2821.7	438
720 min Winter	7.724	0.0	2929.2	514
960 min Winter	6.141	0.0	3104.8	648
1440 min Winter	4.438	0.0	3362.3	890
2160 min Winter	3.202	0.0	3657.0	1196
2880 min Winter	2.538	0.0	3861.8	1532
4320 min Winter	1.826	0.0	4157.7	2252
5760 min Winter	1.444	0.0	4400.9	2992
7200 min Winter	1.203	0.0	4583.5	3688
8640 min Winter	1.036	0.0	4733.0	4416
10080 min Winter	0.913	0.0	4856.6	5144

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)	19.700	Shortest Storm (mins)	15
Ratio R	0.400	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+30

Time Area Diagram

Total Area (ha) 3.780

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	4	1.260	4	8	1.260	8	12	1.260

Model Details

Storage is Online Cover Level (m) 10.000

Tank or Pond Structure

Invert Level (m) 9.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	1720.0	1.000	1720.0

Hydro-Brake Optimum® Outflow Control

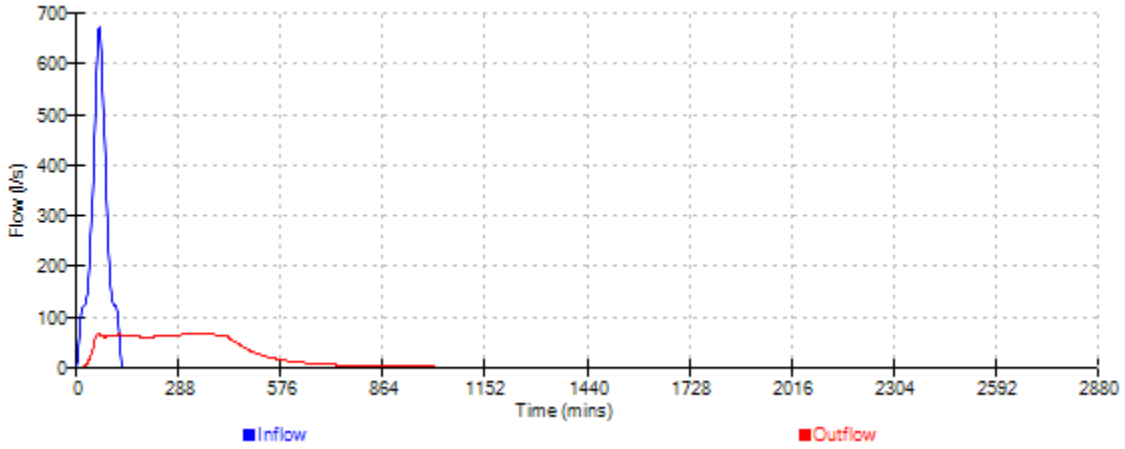
Unit Reference	MD-SHE-0331-6800-1000-6800
Design Head (m)	1.000
Design Flow (l/s)	68.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Diameter (mm)	331
Invert Level (m)	8.995
Minimum Outlet Pipe Diameter (mm)	375
Suggested Manhole Diameter (mm)	2100

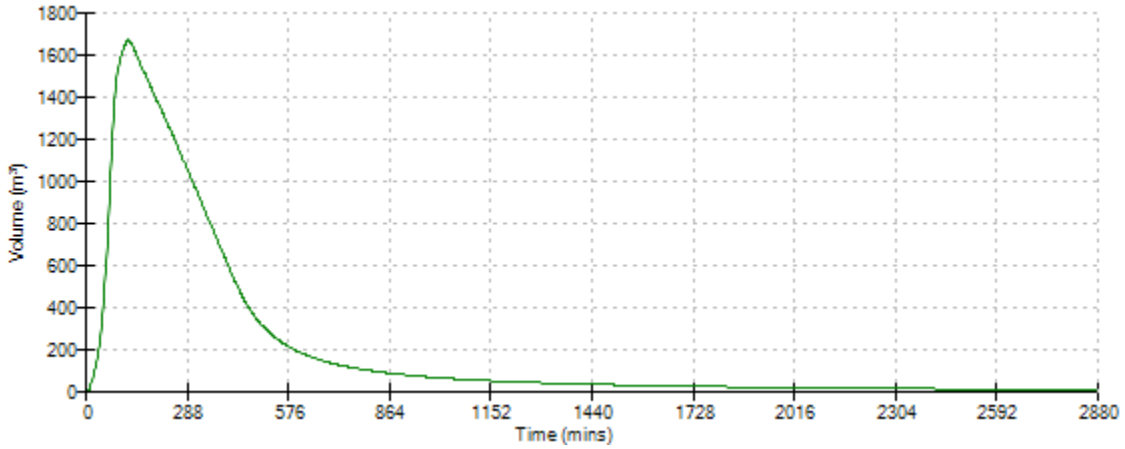
Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	66.1
Flush-Flo™	0.488	66.1
Kick-Flo®	0.809	59.7
Mean Flow over Head Range	-	52.1

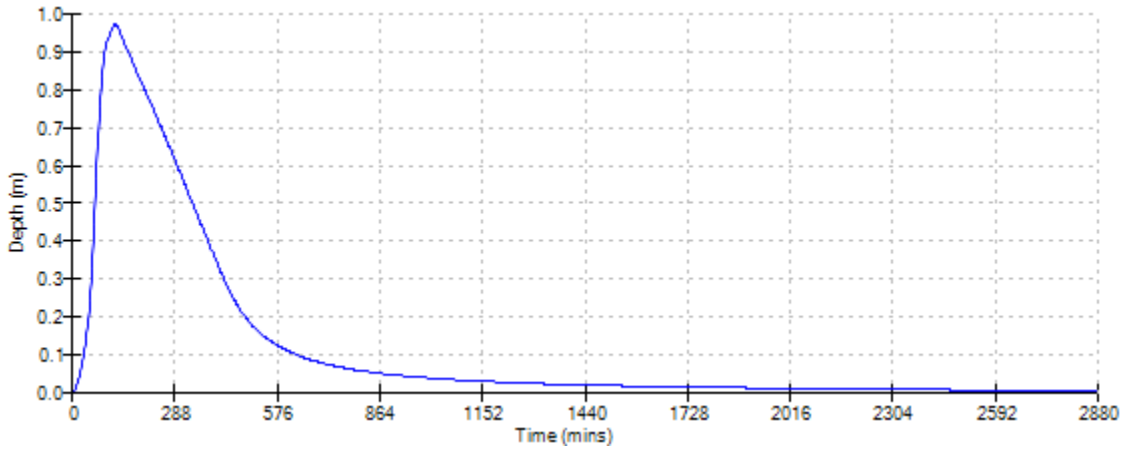
The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake Optimum® as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	9.8	1.200	72.2	3.000	112.7	7.000	170.5
0.200	33.8	1.400	77.8	3.500	121.5	7.500	176.4
0.300	60.4	1.600	83.0	4.000	129.7	8.000	182.0
0.400	65.5	1.800	87.9	4.500	137.4	8.500	187.5
0.500	66.1	2.000	92.5	5.000	144.6	9.000	192.9
0.600	65.3	2.200	96.9	5.500	151.5	9.500	198.0
0.800	60.2	2.400	101.1	6.000	158.1		
1.000	66.1	2.600	105.1	6.500	164.4		

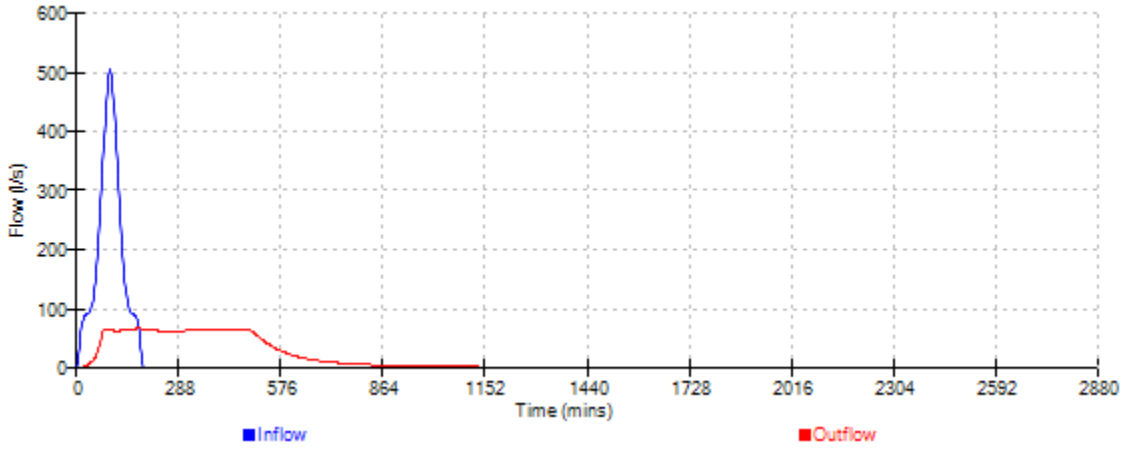
Event: 120 min Winter

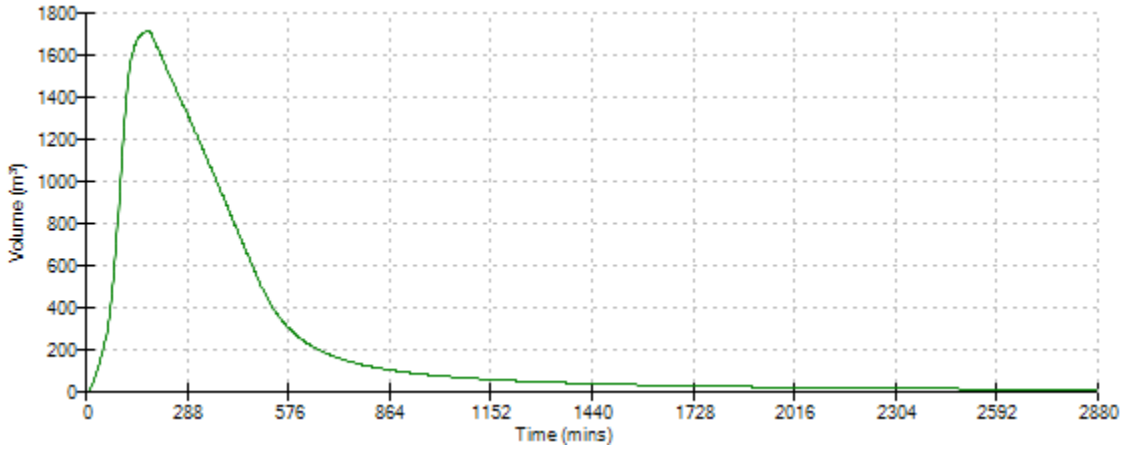


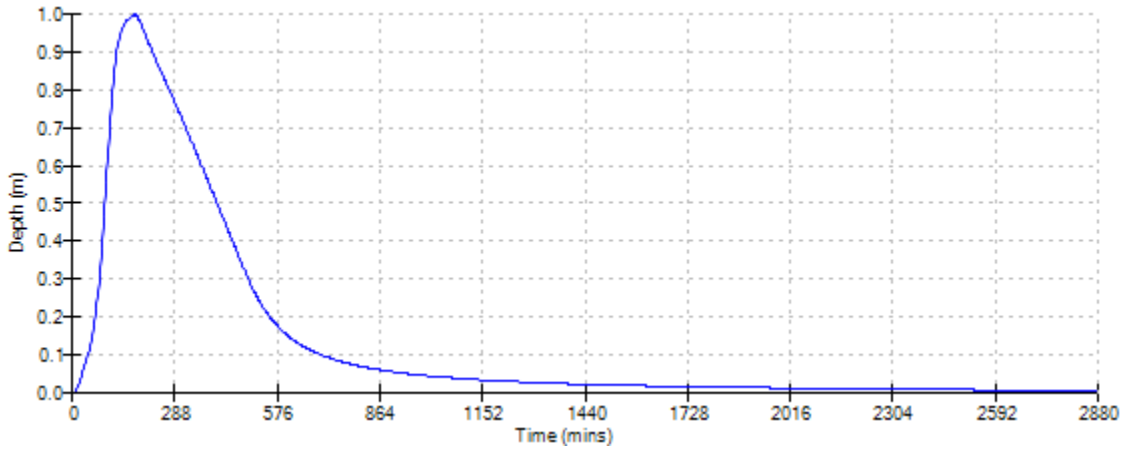




Event: 180 min Winter







Event: 240 min Winter