Report:	**Liquid**	**Sample ID**	RBH3
JE Lab Job No:	12/4921	**Sample Date**	28/06/2012
Location:	GRAPHENE	**Sample Type**	Ground Water
Client ref:	A076252	**Date of Receipt**	29/06/2012

	LOD	Units	Method No.	TSV		
Dissolved Antimony #	<2	ug/l	TM30/PM14		<	2
Dissolved Arsenic #	<0.9	ug/l	TM30/PM14	7.5		0.9
Dissolved Barium #	<1.8	ug/l	TM30/PM14			34.8
Dissolved Beryllium	<0.5	ug/l	TM30/PM14		<	0.5
Dissolved Boron	<2	ug/l	TM30/PM14	750		109
Dissolved Cadmium #	<0.03	ug/l	TM30/PM14	3.75		0.06
Total Dissolved Chromium #	<0.2	ug/l	TM30/PM14	37.5		0.3
Dissolved Copper #	<3	ug/l	TM30/PM14	1500	<	3
Dissolved Lead #	<0.4	ug/l	TM30/PM14	18.8		1.4
Dissolved Molybdenum #	<0.2	ug/l	TM30/PM14			0.5
Dissolved Nickel #	<0.2	ug/l	TM30/PM14	15		0.9
Dissolved Selenium #	<1.2	ug/l	TM30/PM14	10	<	1.2
Dissolved Zinc #	<1.5	ug/l	TM30/PM14	3750		5.2
Mercury Dissolved by CVAF #	<0.01	ug/l	TM61/PM38	0.75	<	0.01
Sulphate #	<0.05	mg/l	TM38/PM0	188		147.96
Chloride #	<0.3	mg/l	TM38/PM0	188		28.8
Nitrate as NO3 #	<0.2	mg/l	TM38/PM0	42		5.9
Nitrite as NO2 #^	<0.02	mg/l	TM38/PM0		<	0.02
Total Cyanide #	<0.01	mg/l	TM89/PM0	0.05	<	0.01
Ammoniacal Nitrogen as NH3 #	<0.03	mg/l	TM38/PM0	2.9	<	0.03
Ammoniacal Nitrogen as NH4 #	<0.03	mg/l	TM38/PM0	2.9	<	0.03
Total Alkalinity as CaCO3 #^	<1	mg/l	TM75/PM0			236
Dissolved Organic Carbon	<2	mg/l	TM60/PM0			9
pH¹ #	<0.01	pH units	TM73/PM0	<6.5 > 10		7.09
PAH MS						
Naphthalene	<0.01	ug/l	TM4/PM30	2.4	<	0.01
Acenaphthylene	<0.01	ug/l	TM4/PM30		<	0.01
Acenaphthene	<0.01	ug/l	TM4/PM30			0.01
Fluorene	<0.01	ug/l	TM4/PM30			0.01
Phenanthrene	<0.01	ug/l	TM4/PM30			0.02
Anthracene	<0.01	ug/l	TM4/PM30		<	0.01
Fluoranthene	<0.01	ug/l	TM4/PM30	0.1		0.01
Pyrene	<0.01	ug/l	TM4/PM30			0.02
Benzo(a)anthracene	<0.01	ug/l	TM4/PM30			0.01
Chrysene	<0.01	ug/l	TM4/PM30		<	0.01
Benzo(bk)fluoranthene	<0.01	ug/l	TM4/PM30	0.03	<	0.01
Benzo(a)pyrene	<0.01	ug/l	TM4/PM30	0.075		0.01
Indeno(123cd)pyrene	<0.01	ug/l	TM4/PM30		<	0.01
Dibenzo(ah)anthracene	<0.01	ug/l	TM4/PM30		<	0.01
Benzo(ghi)perylene	<0.01	ug/l	TM4/PM30		<	0.01
PAH 16 Total	<0.1	ug/l	TM4/PM30		<	0.1
Benzo(b)fluoranthene	<0.01	ug/l	TM4/PM30		<	0.01
Benzo(k)fluoranthene	<0.01	ug/l	TM4/PM30		<	0.01
PAH Surrogate % Recovery	<0	%	TM4/PM30			120
PETROLEUM HYDROCARBONS						
Methyl Tertiary Butyl Ether #	<1	ug/l	TM15/PM10		<	1
Benzene #	<1	ug/l	TM15/PM10	0.75	<	1
Toluene #	<2	ug/l	TM15/PM10	50.5	<	2
Ethylbenzene #	<2	ug/l	TM15/PM10		<	2
p/m-Xylene #	<3	ug/l	TM15/PM10		<	3
o-Xylene #	<2	ug/l	TM15/PM10		<	2
TPH CWG						
Aliphatic >C5-C6 #	<5	ug/l	TM36/PM12		<	5
Aliphatic >C6-C8 #	<5	ug/l	TM36/PM12		<	5
Aliphatic >C8-C10 #	<5	ug/l	TM36/PM12		<	5
Aliphatic >C10-C12 #	<5	ug/l	TM5/PM30		<	5
Aliphatic >C12-C16 #	<10	ug/l	TM5/PM30		<	10
Aliphatic >C16-C21 #	<10	ug/l	TM5/PM30		<	10
Aliphatic >C21-C35 #	<10	ug/l	TM5/PM30		<	10
Total aliphatics C5-35 #	<10	ug/l	TM5/TM36/PM30		<	10
Aromatic >C5-EC7 #	<5	ug/l	TM36/PM12		<	5
Aromatic >EC7-EC8 #	<5	ug/l	TM36/PM12		<	5
Aromatic >EC8-EC10 #	<5	ug/l	TM36/PM12		<	5
Aromatic >EC10-EC12 #	<5	ug/l	TM5/PM30		<	5
Aromatic>EC12-EC16 #	<10	ug/l	TM5/PM30		<	10
Aromatic >EC16-EC21 #	<10	ug/l	TM5/PM30		<	10
Aromatic >EC21-EC35 #	<10	ug/l	TM5/PM30		<	10
Total aromatics C5-35 #	<10	ug/l	TM5/PM30		<	10
Total aliphatics and aromatics(C5-35) #	<10	ug/l	TM5/TM36/PM30	10	<	10
PHENOLS						
Phenol	<0.5	ug/l	TM26/PM0	7.5	<	0.5

Notes:

TSVs are based on The River Basin Districts Typology, Standards and Groundwater threshold values (Water Framework Directive) (England and Wales) Directions 2010 - Groundwater Drinking Water Protected areas, unless otherwise stated.

TSV based on General Quality of Groundwater body

TSV based on UK Drinking Water Standard

TSV based on Groundwater Impact to Surface Waters

Groundwater Result exceeds TSV

Groundwater Result exceeds TSV due to Detection Limit

- UKAS accredited

SVOC and VOC results awaited.

Appendix F | Archaeological Desk-Based Assessment

NATIONAL GRAPHENE INSTITUTE, BOOTH STREET EAST, MANCHESTER



AN ARCHAEOLOGICAL DESK-BASED ASSESSMENT – OCT 2012

A REPORT FOR THE UNIVERSITY OF MANCHESTER

BY DR PETER ARROWSMITH, ARCHAEOLOGICAL CONSULTANT
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Summary

This report presents the results of an archaeological desk-based assessment of the site of the proposed National Graphene Institute, Booth Street East, Manchester (centred at SJ 8460 9691). This assessment has been carried out on behalf of the University of Manchester in support of the planning application.

The study area was first developed between 1824 and 1831 as part of the growth of Chorlton-upon-Medlock as a suburb of Manchester, and contained a group of buildings mainly erected between that time and the early 1840s. These comprised housing, including a row of single-depth dwellings on the former Lawson Street, and a building at 26 Clifford Street which in the 19th century was variously a villa, a social club with an association with Friedrich Engels, an early example of a Victorian Turkish baths, and a hospital for women and children.

There are no known and potential remains within the study area which are considered to be of national importance, and which therefore merit preservation.

However, the study area potentially contains remains of local significance which merit preservation by record. These comprise remains of the early buildings at 26 Clifford Street, of the workers' housing on Lawson Street and of housing on Clifford Street.

It is recommended that these sites are evaluated by archaeological trial trenching. Should significant remains be found, there may be a requirement for a subsequent programme of recording by archaeological excavation.

The position and number of evaluation trenches should be determined by consultation with the Greater Manchester Archaeological Advisory Service.

1. Introduction

1.1 Background

1.1.1 This report presents the results of an archaeological desk-based assessment to support a planning application for the proposed National Graphene Institute, Booth Street East, Manchester. It has been compiled by Dr Peter Arrowsmith, archaeological consultant, on behalf of the University of Manchester.[1]

1.2 Aim

1.2.1 The aim of the assessment has been, as far as is reasonably possible, to describe the known and potential archaeological remains within the study area, to assess their significance, to identify the impact of the proposed development and to identify any further work which might be required in mitigation.

1.3 Methodology

1.3.1 The assessment has comprised a desk-top study and a site inspection.

1.3.2 Archives and collections consulted for the assessment have included:

- Greater Manchester Historic Environment Record (HER), formerly the Sites and Monuments Record (SMR), held by the Greater Manchester Archaeological Advisory Service
- John Rylands University Library of Manchester
- Manchester City Library

1.3.3 The assessment has been carried out in accordance with the *National Planning Policy Framework* (2012). The significance of the archaeological remains has been assessed using the Secretary of State's criteria for designating Scheduled Monuments.

1.3.4 Norman Redhead, Heritage Management Director (Archaeology), Greater Manchester Archaeological Advisory Service has been consulted on the findings of the report.

1.4 Location, Geology

1.4.1 The study area, centred at SJ 8460 9691, lies on the south side of Manchester city centre, and is bounded by Booth Street East on the north, the former Rumford Street on the east, the former Clifford Street on the south, and

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1. Thanks are due to Stuart Lockwood, The Directorate of Estates, The University of Manchester; Norman Redhead, Heritage Management Director (Archaeology), Dr Andy Myers, Senior Planning Archaeologist, and Lesley Dunkley, Historic Environment Record Officer, Greater Manchester Archaeological Advisory Service.

an unnamed modern street on the west (*Figure 1*). From OS mapping, the study area lies at a height of *c* 38 AOD (Above Ordnance Datum). The study area currently comprises vacant ground which is mostly grass-covered, with belts of trees along the north, east and south sides.

1.4.2 As mapped by the British Geological Survey, the study area lies on the eastern edge of an area of Glaciofluvial Sheet Deposits, of sand and gravel, with the south-east of the study area mapped as Till, or boulder clay. The underlying bedrock is mapped as strata of the Chester Pebble Beds Formation of the Sherwood Sandstone Group and Manchester Marls Formation of the Cumbrian Coast Group, with the West Manchester Fault shown as running north-west to south-east across the centre of the study area.

Recent geotechnical investigations within the study area have revealed made ground up to 2.8m thick, underlain by sand and gravel and, below these, weathered sandstone (WYG Environment 2012) (see Appendix of this report).

1.5 Statutory Sites

1.5.1 The study area contains no sites with statutory protection as a Listed Building, Scheduled Monument or part of a Conservation Area.

2. Archaeological and Historical Background

2.1 Prehistoric and Roman

2.1.1 No prehistoric finds are known from within the study area or its immediate locality. The closest known findspot is that of a stone implement, possibly of Neolithic date, discovered in 1887 in river gravels *c* 0.3km to the north of the study area, at *c* SJ 845 972 (SMR 1373.1.0).

Within the North-West the evidence for prehistoric and native Romano-British activity is often sporadic and based on chance finds, but this evidence does point to settlement and other activity being concentrated on sands and gravels, particularly close to watercourses or wetlands, rather than on the heavier more impermeable boulder clays which form the superficial geology of much of the region. The location of the study area on the edge of a band of sand and gravel and within reasonable proximity to the River Medlock to the north and the Corn Brook (now culverted) to the south places it within an area favourable for early activity. However, given its later development the possibility of any early evidence surviving within the study area can be considered to be slight.

2.1.2 No Roman finds are known from within the study area or its immediate locality. A Greek coin of the Christian period was found in 1922 during excavations *c* 0.5km to the south of the study area at *c* SJ 849 964 (SMR 1372.1.0). If this coin is not a later loss, it may represent ephemeral activity around the Roman fort and civilian settlement at Castlefield, *c* 1.5km to the north-west of the study area.

2.2 Anglo-Saxon to Post-Medieval

2.2.1 Historically the study area lay within the township of Chorlton-upon-Medlock, formerly known as Chorlton Row, and originally as Chorlton (Farrer & Brownbill 1911, 251). The place-name has an Old English derivation, meaning the 'the peasant's **tun** (settlement or farm)'. It has been suggested that in the Anglo-Saxon period this township was originally joined with Chorlton-cum-Hardy, and provided the main peasant settlement in an extensive estate perhaps contiguous with the later Salford Hundred (Kenyon 1991, 107).

2.2.2 The distribution of settlement in the township in the Anglo-Saxon and medieval periods is unknown, but by the post-medieval period, as indicated on Yates's map of the 1770s, it appears to have been concentrated along the line of the Manchester to Stockport road, the present A6. At this period, despite its proximity to the growing town of Manchester, Chorlton Row was scantly populated with only 46 houses and 226 inhabitants recorded in 1774 (Brumhead & Wyke nd, ii).

Laurent's map of 1793 shows that the study area lay within a group of fields which were situated between the Corn Brook and Rusholme Road and which were crossed by a trackway on the line of the later Booth Street (*Figure 2*). Rusholme Road was an early routeway which ran from the Stockport road and which to the west of the study area swung southward to follow the line of

Oxford Road. To the north of this point Oxford Road is shown as a broad thoroughfare on Laurent's map, and had opened in 1790 as a link from St Peter's Square (Brumhead & Wyke nd, ii). The land to the west of Oxford Road is identified on Laurent's map as being in the ownership of Sir Gore Booth, bart. The Gore Booth family were heirs to the estate of Humphrey Booth, the 17th-century Salford merchant and benefactor who is recorded as holding land in Chorlton in the 1630s (Farrer & Brownbill 1911, 208-9 n 50, 254 n 29). This family connection is presumed to have given rise to the name of Booth Street.

2.3 Industrial

2.3.1 Within a generation or so of Yates's survey, the character of Chorlton-upon-Medlock was transformed by the southern spread of the industrial town of Manchester. Shortly after the opening of Oxford Road, the Chorlton Hall estate in the north of the township was bought by Samuel Marsland and his brother Peter, two prominent Stockport cotton manufacturers, and William Cooper and George Duckworth of Manchester (Brumhead & Wyke nd, ii). Their aim was to develop the estate as a suburb of the Manchester, which at this time was growing at an unprecedented rate as a consequence of the upsurge of the cotton industry. The centrepiece of this development was to be a new square, originally known as Grosvenor Square and later as All Saints after the church which was built here in 1819-20. Laurent's map of 1793 shows the proposed square and the surrounding grid-iron of streets superimposed on the then existing field boundaries (*Figure 2*).

In spite of this ambitious town-planning scheme, the initial growth of Chorlton-upon-Medlock was slow, with the population rising to only 675 at the time of the 1801 census, compared with 70,409 for the township of Manchester. By 1821, however, the figure had risen to 8209 (Brumhead & Wyke nd, ii-iii). In 1830-1 Chorlton-upon-Medlock was provided with its own Town Hall and Dispensary, built on the south side of Grosvenor Square. In 1838, as a consequence of its growth in population, the township was included within the boundary of the new municipal borough of Manchester (Farrer & Brownbill 1911, 252).

2.3.2 To the south of the former Chorlton Hall estate, the creation of new streets seems to have been more piecemeal. Johnson's map of 1818-19 (*Figure 3*) shows that the old Brook Street of Laurent's map had been straightened and continued to the south of Rusholme Road to form the present line of Upper Brook Street. Johnson's map also indicates that, to the south of Rusholme Road, two new streets had been laid out between Oxford Road and Upper Brook Street, namely Rosamond Street on the north and Booth Street on the south. However, except for scattered buildings on the north side of Rosamond Street this area was as yet undeveloped. Within a few years, however, as shown on Swire's map of 1824 (*Figure 4*), this situation had changed. A third street, Clifford Street which lay along the southern boundary of the study area, had been added and development had begun to take place to the south of Rosamond Street. This was initially concentrated along Oxford Road and Upper Brook Street, but some development had also begun within the streets between these. It included one building on the north side of Booth Street, lying just to the north of the study area.

Bancks's map of 1831 shows that two new streets had been laid out between,

and parallel to, Oxford Road and Upper Brook Street, comprising Rumford Street on the east and New York Street (later Higher York Street) on the west. These created a new grid-iron of streets, which included a rectangular block between Rumford Street, Clifford Street, New York Street and Booth Street, containing the study area (*Figure 5*). Bancks's map shows this block further divided into two by a narrow central street, named on later mapping as Lawson Street. On the north side of the block, by 1831 a row of eight houses had been built on the south side of Booth Street (**site 1**). These were double-depth houses, each with an outshut and a rear yard which continued to Lawson Street. Because of later road widening, the site of most of these houses is now occupied by Booth Street East but the site of the outshuts of the western six houses lies within the study area (*Figure18*). Large-scale OS mapping of 1849 (*Figure 7*) names the row as Ebenezer Plat Terrace and shows the houses to have had front steps and small lightwells to both front and rear, implying the presence of cellars. At the end of the outshuts there were probably privies with ashpits. On Bancks's map one house is also shown with a rectangular building at the end of its yard, flanked by a narrow passage leading from Lawson Street.

2.3.3 *26 Clifford Street*

On the south side of Lawson Street, Bancks's map shows a rectangular single-depth range, fronted by the circular path or drive (**site 2a**) (*Figure 5*). By 1845 this building had been remodelled as, or replaced by, a larger building with a square footprint with a smaller wing attached at the north-east (**site 2b**) (*Figure 6*). This building, 26 Clifford Street, was fronted by a formal garden area, through which twin curving drives led from Clifford Street to the front door. The large-scale mapping of 1849 (*Figure 7*) shows steps leading to that door and also steps and lightwells to a side elevation, implying that the building was cellared. A photograph of 1971 shows this building to have been two storeys high and three bays wide, with a hipped roof and a chimney stack to each of the two side elevations (Manchester Libraries m69062).

The original use of the building shown at 26 Clifford Street on Banck's map is unknown. The grounds suggest it to have been a villa residence, of which a number were built in the southern part of Chorlton-upon-Medlock in the first part of the 19th century, although its long narrow plan is not typical of such buildings. Its history becomes clearer in the late 1830s, in that by 1838 and probably no earlier than 1836 this was the home of Jeptha Pacey (Pigot 1836; Table 1). He is described at this period as an architect. The 1841 census shows that he was born outside Lancashire and it seems likely that he was the architect of this name who earlier in the 19th century designed a number of Fenland churches. He may also have been responsible for enlarging his house at 26 Clifford Street, to create the building shown on the OS mapping of the 1840s.

The Albert Club

In 1843 the house on Clifford Street was converted into a private social club, named the Albert Club after Queen Victoria's consort. This was founded primarily for Manchester's community of middle-class Germans, involved in the cotton trade, although later about half of its members were English. Facilities at Clifford Street included billiards, a smoking room, a reading room and library, a kitchen and a wine cellar. In 1859 the club moved to larger premises at Dover House, again a former villa, situated at the corner of Oxford

Road and Dover Street. This seems to have offered similar facilities to Clifford Street and was described in 1869 as containing a library, a newsroom and a dining room on the ground floor, with a billiard room, smoking room, card room, committee room and private dining room upstairs. This last building was demolished in 1963 (*Manchester Guardian* 6 Feb 1888; Henderson 1976, 229; Petch 1962; Whitfield 1988, 95-6).

The German members of the Albert Club included Friedrich Engels. He first stayed in Manchester from late 1842 to 1844, revisited the city in 1845 when he was accompanied by Karl Marx, and returned in 1850, making Manchester his home for the next twenty years. Engels is known to have served on the committee of the Albert Club throughout the 1860s and retained his membership of the club after moving from Manchester to London in 1870 (Henderson 1976, 229). According to Moses Baritz, Engels joined the club during his first visit to Manchester in 1842-4, when it was situated on Clifford Street (*Manchester Guardian* 10 Oct 1934).

The Turkish Bath

When the Albert Club moved premises in 1859, 26 Clifford Street was acquired by William Potter and converted into a Turkish baths. Potter originally referred to the premises as the 'Sultan's Bath', although once opened they were variously called 'Turkish Baths', 'Roman and Turkish Baths' and 'Roman or Turkish Baths'. In reality they belonged to the phenomenon of the Victorian Turkish bath, the first of which was constructed in 1856 near Blarney in County Cork. In the following year the first such premises in England opened at Broughton Lane in Manchester with William Potter as the manager. Within a Victorian Turkish bath, patrons passed through progressively hotter rooms heated by dry air, before receiving a massage and body wash and finally relaxing in a cooling-down room. In July 1859 Potter announced that he was 'about to open a suite of baths on the premises recently occupied by the 'Albert Club', Clifford Street...consisting of Turkish Baths, Medicated and Mineral Baths, Electro-chemical Baths, &c'. A contemporary illustration shows how part of the baths was intended to look, and depicts an ornate Turkish-style room with a floor and walls decorated with tiles and with a domed ceiling. It is uncertain to what extent this matched the finished baths, but in 1860 Potter claimed to have spent £2000 on the building, while one local newspaper described it as 'Fitted up with great elegance and comfort, in the Oriental style', and another wrote that the baths 'are so completely Oriental in their character as to look like an Oriental dream'. The rapid rise in the popularity of the Victorian Turkish bath meant that by 1860, in addition to Potter's two establishments, there were at least six others in Manchester. In 1864 the Clifford Street baths were taken over by Matthew Thomas. He attempted to dispose of the property, without success, in 1865 and again in 1867 (Shifrin 2011).

In the late 1860s the premises were described as 'Turkish Baths and Billiard Room', the latter possibly dating back to the days of the Albert Club (Table 1). In June 1868 it was announced that the building had been bought for £1880 to become the new home of the Manchester Southern Hospital for Women and Children. It was reported at the time that the building required 'little alteration to make it ready for the reception of patients' (*Manchester Guardian* 13 June 1868).

The Manchester Southern Hospital

The Manchester Southern Hospital for Women and Children was a charitable hospital serving the southern districts of Manchester and in particularly the crowded industrial townships of Chorlton-upon-Medlock, Ardwick and Hulme. It was originally founded in 1866 with premises on Grosvenor Street, before moving to 26 Clifford Street. By 1870, as well as treating outpatients, the Clifford Street hospital contained eighteen beds, eight for women, and ten for children (*Manchester Guardian* 13 June 1868; 17 Feb 1870; Young 1964, 72-3). In 1904 it was agreed to amalgamate the Southern Hospital with St Mary's. Patients continued to be admitted to Clifford Street until May 1907 (Young 1964, 83).

In about 1910 the building was sold for £1250 to the Salvation Army, under whose ownership it is subsequently described as a 'social work home and institute' (Young 1964, 83; Table 1).

*Table 1: The occupants of 26 Clifford Street (**site 2**), from trade directories and census returns.*

Year/Source	Occupant	Address
1838 Dir	Jeptha Pacey, architect	28 Clifford Street
1841 Census	Jephtha Pacey, architect, family & servants	26 Clifford Street
1841 Dir	Jeptha Pacey, soap boiler, Ducie Soap Works, Charlotte Street, Strangeways	House 28 Clifford Street
1843 Dir	Jeptha Pacey, soap boiler	26 Clifford Street
1845 Dir	Albert Club House, John Brierly steward	26 Clifford Street
1850 Dir	Albert Club House William Clowes steward	20 Clifford Street
1855 Dir	Albert Club	26 Clifford Street
1858 Dir	Albert Club, William Clowes steward	26 Clifford Street
1861 Dir	Roman and Turkish Baths, William Potter bath proprietor	26 Clifford Street
1861 Census	Turkish Baths and House, Willliam Potter turkish baths proprietor	26 Clifford Street
1863 Dir	Roman and Turkish Baths, W Potter	Clifford Street
1865 Dir	Turkish Baths, Thomas Matthew	26 Clifford Street
1869 Dir	Turkish Baths and Billiard Room	26 Clifford Street
1871 Census	Hospital for Women and Children	Clifford Street
1871-2 Dir	Manchester Southern Hospital for Women and Children	26 Clifford Street
1903 Dir	Manchester Southern Hospital for Diseases of Women and Children	26 Clifford Street
1909 Dir	William Mills, caretaker	26 & 28 Clifford Street
1911 Dir	Salvation Army Social Work Home & Institute	26 Clifford Street

OS mapping shows that between 1849 (when it was occupied by the Albert Club) and 1888 (when it was the Manchester Southern Hospital), the building was expanded by the addition of a wing on the west, which from the depiction of lightwells and steps appears to have been cellared (*Figure 8*). The

photograph of 1971 shows that this extension was of two storeys and two bays with a gabled roof, and with a chimney stack against the west elevation; the front elevation included a doorway to the right-hand (eastern) bay. The whole appearance is of a small domestic dwelling (Manchester Libraries m69062). This wing may have been added by William Potter, who was residing at the Turkish bath at the time of the 1861 census, or at a later date for hospital staff.

Between 1888 and 1904 a wing was also added on the east side of the building, to create a single continuous frontage (*Figure 9*). This wing was also of two storeys, with a hipped roof and a chimney stack to the front elevation (Manchester Libraries m69062).

On OS mapping of 1915 26 Clifford Street is described simply as an 'Institute' (*Figure 12*). By 1932 it had been renamed Clifford House, which is described on mapping of 1961 and 1968 as a men's hostel (*Figures 13-15*). The photograph of 1971 shows that the building had remained in the hands of the Salvation Army (Manchester Libraries m69062).

2.3.4 ***Workers Housing, Lawson Street***

OS mapping shows by 1845 the rear of the yards of Ebenezer Plat Terrace was occupied by a continuous row of seven dwellings fronting Lawson Street (**site 3**), built so that each house occupied the width of a single yard (*Figures 6 & 7*). Each of these houses was single-depth with two small or projections to the rear, flanking a tiny yard. On the right-hand side of each house a covered passageway ran through the row to give access the yards of Ebenezer Plat Terrace, presumably for the purposes of removing nightsoil. The small property shown on Lawson Street on Bancks's map has the same arrangement, suggesting that it represented the beginning of the row, by 1831, with the remainder being built perhaps not long after. All seven were built at the latest by 1841 when they were listed in the census (Table 2).

Between 1888 and 1904 the rear projection to the right-hand side of each house, including the inner end of its covered passageway, was removed, leaving a small square building which was presumably a WC (*Figure 9*).

2.3.5 By 1845 the frontages of Rumford Street, to either side of Lawson Street, had been developed with new houses (**site 4**), and others ran along the frontage of Clifford Street to the boundary of the Albert Club House (**site 5**) (*Figure 6*). OS mapping from the 1840s onwards depicts a large yard area to the rear of the last group of houses, which continued in existence until the clearance of the houses themselves in the late 20th century. The large-scale OS map of 1849 shows a pump in the yard's south-west corner, suggesting that there was a well at this location (*Figure 7*).

2.3.6 Between 1849 and 1888 a building, presumed to have been a house, was built at the west end of Ebenezer Plat Terrace (**site 6**). Large-scale mapping shows possible small lightwells against the external elevations of this building, suggesting that it was cellared (*Figure 8*).

2.3.7 OS mapping of 1932 shows no major changes to the buildings in the study area since the early years of the 20th century (*Figure 13*). By 1948, however, the houses of Lawson Street had been removed, as had several of the houses immediately to the east of the study area, on Booth Street East, Rumford

Street and Clifford Street. By 1961 all but one of the remaining houses of Ebenezer Plat Terrace had been demolished, together with another house on Clifford Street (*Figure 14*). Further demolition of houses followed by 1968 (*Figure 15*). Clifford House, 26 Clifford Street, was still standing in 1971 (Manchester Libraries m69062), but OS mapping shows that the entire block between Clifford Street and Booth Street East had been cleared by 1978.

2.3.8 The block is still shown as vacant on OS mapping of 1988 but was subsequently redeveloped with the construction of the H-shaped Lamb Building within the centre of the block (*Figures 16 & 17*). This building did not include a basement (Stuart Lockwood, pers comm). OS mapping shows that the Lamb Building was in turn demolished by 2006-7 and the site again became vacant.

*Table 2: The Lawson Street workers' houses (**site 3**) in the 1841 census.*

Occupants	**Age**	**Occupation**	**Place of Birth**
Uninhabited			
Ann Craven	35	Steam loom weaver	Lancashire
Matthew Craven	29	Card [ ]	"
Elizabeth Craven	15	Female servant	"
Matthew Craven	6	-	"
Sarah Bosom	25	Frame tenter	"
Martha Bosom	16 mths	-	"
Thomas Rockliffe	15	Twist maker	"
John Truman	35	Joiner	"
Elizabeth Truman	35	-	"
William Swindell	30	Grocer	"
Frances Swindell	30	-	"
Thomas Swindell	7	-	"
Jane Swindell	1	-	"
Alice McA[ ]	25	Independent	Ireland
John McA[ ]	1	-	Lancashire
Daniel Ball	40	Coach maker	"
Lydia Ball	30	-	"

3. Gazetteer

For the location of sites, see *Figure 18*.

1) Ebenezer Plat Terrace
SJ 8459 9694

Row of houses built 1824-31. Large-scale OS mapping implies that these were cellared. Only the site of the rear outshuts and privies lies within the study area.

2) 26 Clifford Street
SJ 8459 9690

Originally built 1824-31 (**site 2a**); rebuilt, or remodelled and enlarged, by 1845 (**site 2b**), possibly by architect Jeptha Pacey who lived here in the late 1830s and early 1840s. Converted in 1843 to the Albert Club, a social club for Manchester's German community, in 1859 to a Victorian Turkish bath, and in 1868 to the Manchester Southern Hospital for Women and Children. Enlarged on the west between 1849 and 1888 (**site 2c**) and on the east between 1888 and 1904 (**site 2d**). Demolished in the 1970s. See section 2.3.3 of this report for details of the building's history. Large-scale OS mapping implies that the main building (**site 2b**) and the western wing (**site 2c**) were cellared, and geotechnical investigations found what may be a concrete cellar floor at a depth of 1.8-2.0m (see Appendix, TP3).

3) Workers' Houses, Lawson Street
SJ 8459 9692

Row of seven single-depth houses, built *c* 1831-1841. Each house was built across the rear of the yard of a house of Ebenezer Plat Terrace (**site 1**) and included a covered passage from Lawson Street to that yard. Geotechnical investigations located a brick floor at a depth 2.3-2.5m, located approximately at the rear of these houses, suggesting that they may have been cellared (see Appendix, TP2).

4) Houses, Rumford Street
SJ 8463 9691

Houses built 1831-45 adjoining east end of Ebenezer Plat Terrace (**site 1**). Site lies outside the study area.

5) Houses, Rumford Street and Clifford Street
SJ 8462 9699

Houses with rear outshuts, built 1831-45. Large-scale OS mapping implies that these were cellared and geotechnical investigations found what may be a brick cellar floor at a depth of 1.8-2.0m (see Appendix, TP4). Mapping from the 1840s onwards shows a large yard to the rear of these houses, with a pump indicated at its south-west corner on the 1849 map.

6) House, Booth Street
SJ 8457 9692

House built 1849-88 at west end of Ebenezer Plat Terrace (**site 1**). Large-scale OS mapping implies that this was cellared.

4. Significance of the Remains

4.1 Heritage Assets

4.1.1 The *National Planning Policy Framework* (NPPF) sets out national planning policies on the conservation of the historic environment and in particular on those elements considered to be a heritage asset, ie 'a building, monument, site, place, area or landscape identified as having a degree of significance meriting consideration in planning decisions' (NPPF, Annex 2 p 52).

Heritage assets are deemed to be of significance because of their heritage interest. That interest may be archaeological, ie 'if it holds, or potentially may hold, evidence of past human activity worthy of expert investigation at some point'; architectural; artistic or historic. The significance of a heritage asset derives not only from its physical presence but also from its setting (NPPF, Annex 2 p 50, 52, 56).

Under the NPPF, planning applications should include a description of the significance of any heritage assets affected, including any contribution made by their setting, with the level of detail being proportionate to the asset's importance. Where an application site includes or has the potential to include heritage assets of archaeological interest there is a requirement for developers to provide an appropriate desk-based assessment and, where necessary, field evaluation (NPPF, p 30, para 128).

4.2 Site Assessment

4.2.1 The significance of the heritage asset has been assessed using the Secretary of State's criteria for the scheduling of monuments, namely: period, rarity, documentation, group value, survival/condition, fragility/vulnerability, diversity, and potential.

Period

The study area was first developed between 1824 and 1831 as part of the growth of Chorlton-upon-Medlock as a suburb of Manchester, and contained a group of buildings mainly erected between that time and the early 1840s. These comprised housing, including a row of single-depth dwellings on the former Lawson Street, and a building at 26 Clifford Street which in the 19th century was variously a villa, a social club with an association with Friedrich Engels, an early example of a Victorian Turkish bath, and a charitable hospital for women and children.

Rarity

Remains of early housing could be considered to be local rarity, depending upon the extent of survival of remains. The row of houses on Lawson Street are of particular interest, in being built within the yards of existing houses and incorporating covered passageways allowing access to those yards. Remains of the early to mid 19th-century buildings at 26 Clifford Street, might also be of local rarity, in particular any remains relating to its use as a Turkish bath.

Documentation

The general development of the study area can be traced reasonably well through the readily available cartographic and documentary sources. Other details could undoubtedly be learned from further more detailed research, but it is considered unlikely that these would significantly alter the outline given in this report.

Group Value

Remains of workers' houses might add to the small but growing body of archaeological evidence for such sites, derived from excavations in Manchester and other industrial towns within the region.

Survival/Condition

The extent and condition of surviving below-ground remains within the study area is at present unknown. Geotechnical investigations have found made ground across the study area to depths varying between 1.7m and 2.8m (see Appendix). OS mapping implies that a number of the buildings within the study area contained cellarage, and evidence of possible cellars floors has been found by test pitting. The Lamb Building which stood recently within the study area did not include a basement.

Fragility/Vulnerability

See section 5 below.

Diversity

The diversity of any surviving remains is at present known but the known sites relate principally to the development of the study area in the 19th century.

Potential

It is not anticipated that the study area contains any remains other than as outlined in this report.

4.3 Significance

4.3.1 On the above criteria, there are no known or potential remains within the study area which are considered to be of national significance. However, the study area may contain remains of local significance, these being remains relating to the early to mid 19th-century buildings at 26 Clifford Street, and of neighbouring housing of the same period.

5. Impact of the Development

5.1 The archaeological impact of development on a site can be assessed as follows.

Direct:
Involving damage to the remains. This can be further refined by assessing what proportion of the remains is likely to be destroyed.

Indirect:
Involving changes to the condition or setting of the remains as a consequence of the development.

The following direct impacts have been identified.

5.2 **Impact**

5.2.1 Under the proposed development, the National Graphene Institute will occupy the study area and will include a basement across the footprint of the building. Any below-ground remains within the study area will be removed by groundworks for construction.

6. Recommendations

6.1 The *National Planning Policy Framework* instructs that in the case of heritage assets which either have designated status or are non-designated but are of a significance demonstrably comparable with a Scheduled Monument, ie of national importance, the general assumption should be in favour of conservation.

Where the loss of the whole or a part of a heritage asset's significance is justified by a development, the developer should be required first to record that asset and advance understanding of its significance, in a manner proportionate to their importance and the impact (NPPF, p 32 para 141).

The following recommendations are based upon consultation with Norman Redhead, Heritage Management Director (Archaeology), Greater Manchester Archaeological Advisory Service.

6.2 There are no known and potential remains within the study area which are considered to be of national importance, and which therefore merit preservation.

6.3 However, the study area potentially contains remains of local significance which merit preservation by record. These comprise remains of the early buildings at 26 Clifford Street (**sites 2a-b**), of the workers' housing on Lawson Street (**site 3**) and the housing on Clifford Street (**site 5**).

It is recommended that these sites are evaluated by archaeological trial trenching. Should significant remains be found, there may be a requirement for a subsequent programme of recording by archaeological excavation.

The position and number of evaluation trenches should be determined by consultation with the Greater Manchester Archaeological Advisory Service.

Appendix: Summary of Geotechnical Investigations

The following section summarizes the results of recent geotechnical investigations within the study area (WYG 2012), and relates these to the historic mapping. See also *Figure 19*.

RBH1 Made ground, including brick, concrete and steel, to 2.8m; above sand and gravel. On site of rear of mid 19th-century house (**site 6**), which OS mapping implies to have been cellared.

RBH2 Made ground, including brick and concrete, to 1.2m; brown sandy soil with gravels to 2.8m; above brown sand and gravel. On site of yard of *c* 1830 Ebenezer Plat Terrace (**site 1**).

RBH3 Made ground, including brick, to 2.8m. On site of gardens to front of 26 Clifford Street (**site 2**).

CP1 Made ground, including brick and concrete, to 0.6m; sand, including ceramic and brick, to 1.7m; above sand. On site of large yard to rear of *c* 1840 housing (**site 5**), and against the footprint of the Lamb Building.

CP2 Made ground, including brick and concrete, to 1.7m; sand. On site of Lawson Street.

TP1 Made ground, including brick and concrete, to 2.7m; above sand and gravel. On the site of yard of *c* 1830 Ebenezer Plat Terrace (**site 1**) and against rear of workers housing on Lawson Street (**site 3**).

TP2 Made ground including brick and concrete, to 2.3m; made ground comprising bricks (interpreted as basement floor) to 2.5m; above sand and gravel. On site of rear of workers housing on Lawson Street (**site 3**), and against/within footprint of the Lamb Building.

TP3 Made ground to 1.8m; concrete slab to 2.0m; made ground, red sand and gravel of brick, to 2.7m; above gravelly sand. On site of 26 Clifford Street (**site 2b**), and within footprint of the Lamb Building.

TP4 Made ground, including brick and concrete, to 0.5m; sandstone slabs to 0.6m; made ground, sand with occasional brick, to 1.8m; and bricks (interpreted as basement floor) to 2.0m; above sand and gravel. On site of rear of *c* 1840 housing on Clifford Street (**site 5**), which OS mapping implies to have been cellared.

TP5 Made ground, including brick and concrete, to 1.5m; sand (reworked natural), to 2.0m; above sand. On site of gardens to front of 2 Clifford Street (**site 2**).

WS2 Made ground, including brick, concrete and plastic, to 1.3m; made ground, including brick, to 1.9m; above sand. On site of mid 19th-century house (**site 6**), which OS mapping implies to have been cellared.

WS3 Made ground, including brick, concrete and plastic, to 1.1m; possibly reworked sand to 3.2m; above sand. On site of rear yard/outshut of *c* 1830 Ebenezer Plat Terrace (**site 1**).

WS4 Made ground, including brick, concrete and plastic, to 1.2m; made ground, sand, to 1.9m; made ground, brick cobble, to 2.0m; possibly reworked sand to 3.6m; above sand. On site of rear yard/outshut of *c* 1830 Ebenezer Plat Terrace (**site 1**).

WS5 Made ground, including brick, concrete and plastic, to 1.8m; made ground, brick cobble, to 1.9m; possibly reworked sand to 3.6m; above sand. On site of yard/passageway to rear of *c* 1830 Ebenezer Plat Terrace (**site 1**).

WS6 Made ground, including brick, concrete and plastic, to 1.65m; possibly reworked sand to 3.2m; above sand. On site of Lawson Street.

WS7 Made ground, including brick and concrete, to 1.5m; made ground, sand, to 2.2m; above sand. On site of rear yard of *c* 1840 houses on Clifford Street (**site 5**), which OS mapping implies to have been cellared.

WS8 Made ground, including brick and plastic to 2.2m; above sand. On/adjacent to site of *c* 1840s houses of Clifford Street (**site 5**), which OS mapping implies to have been cellared.

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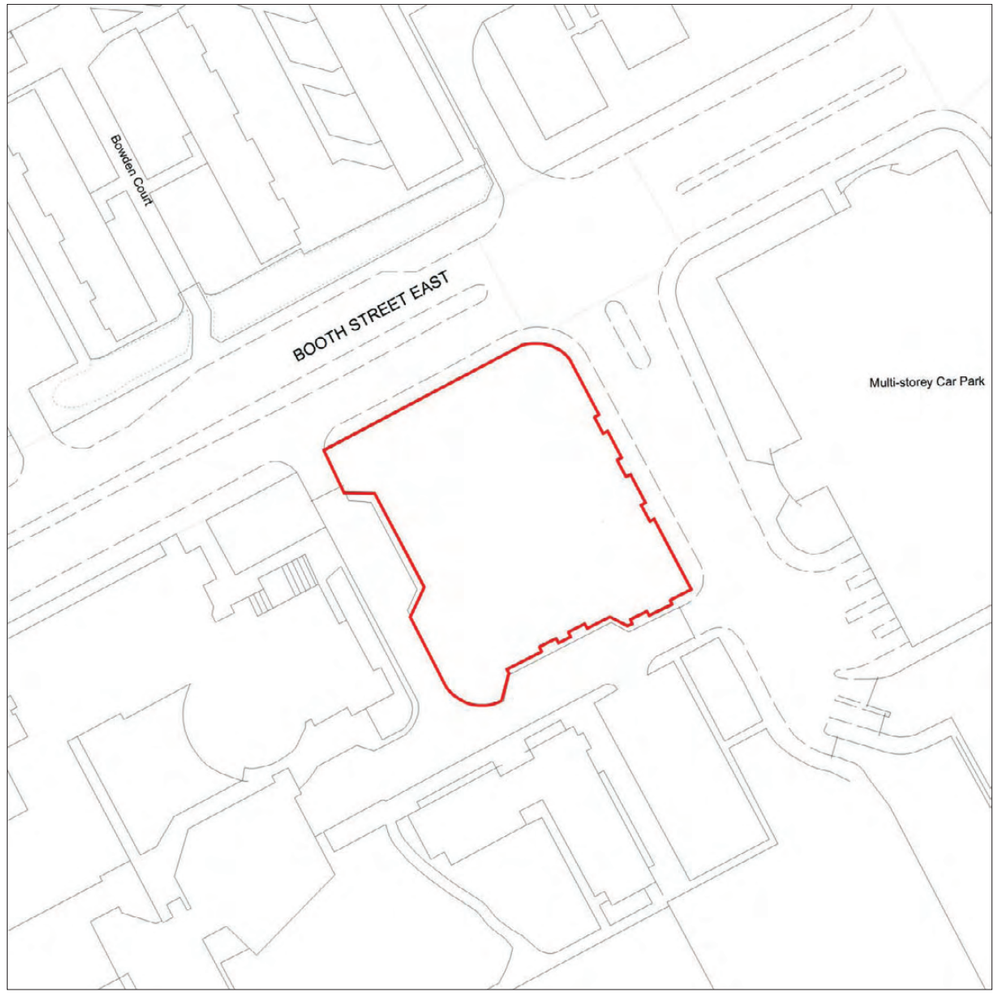

Figure 1: National Graphene Institute, Booth Street East, archaeological assessment, location of the study area. Scale 1:1000.

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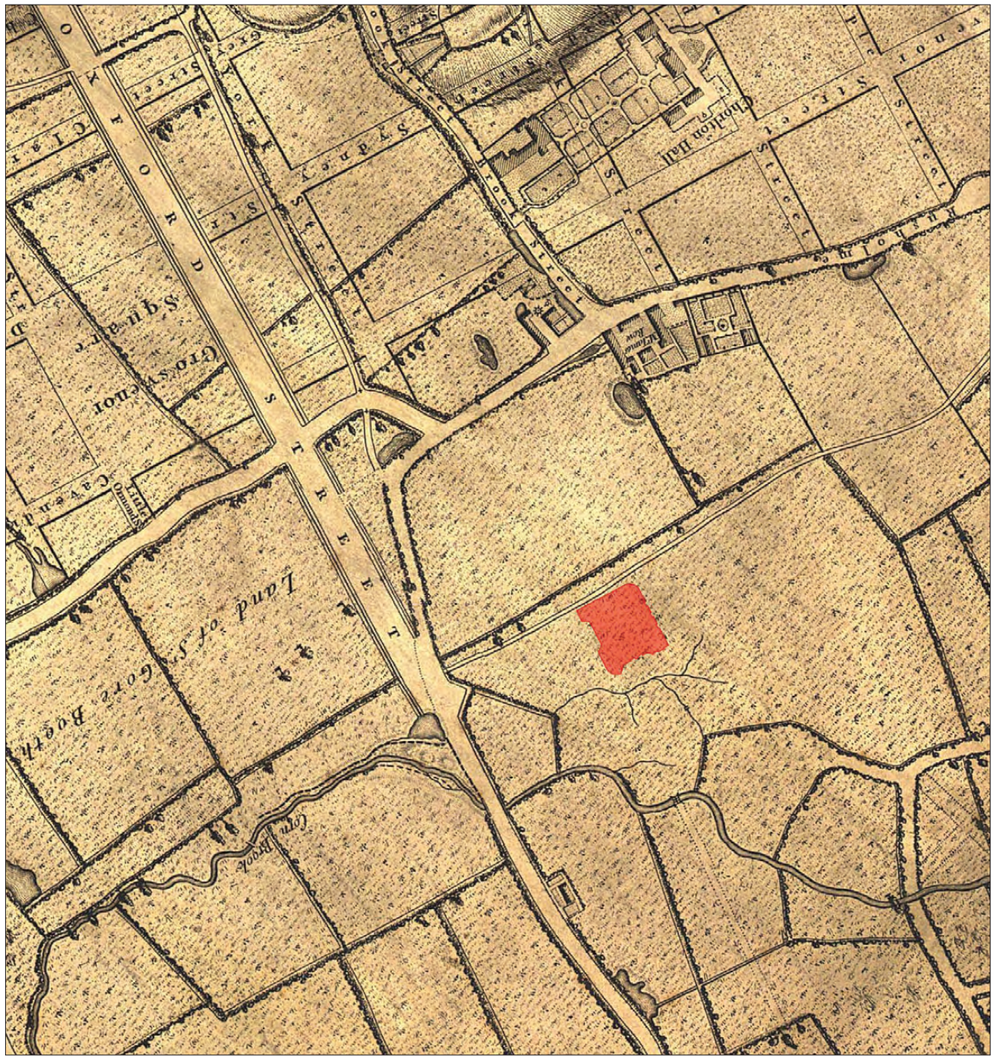

Figure 2: Detail of Laurent's map 1793, with the study area shaded. Scale 1:4000.

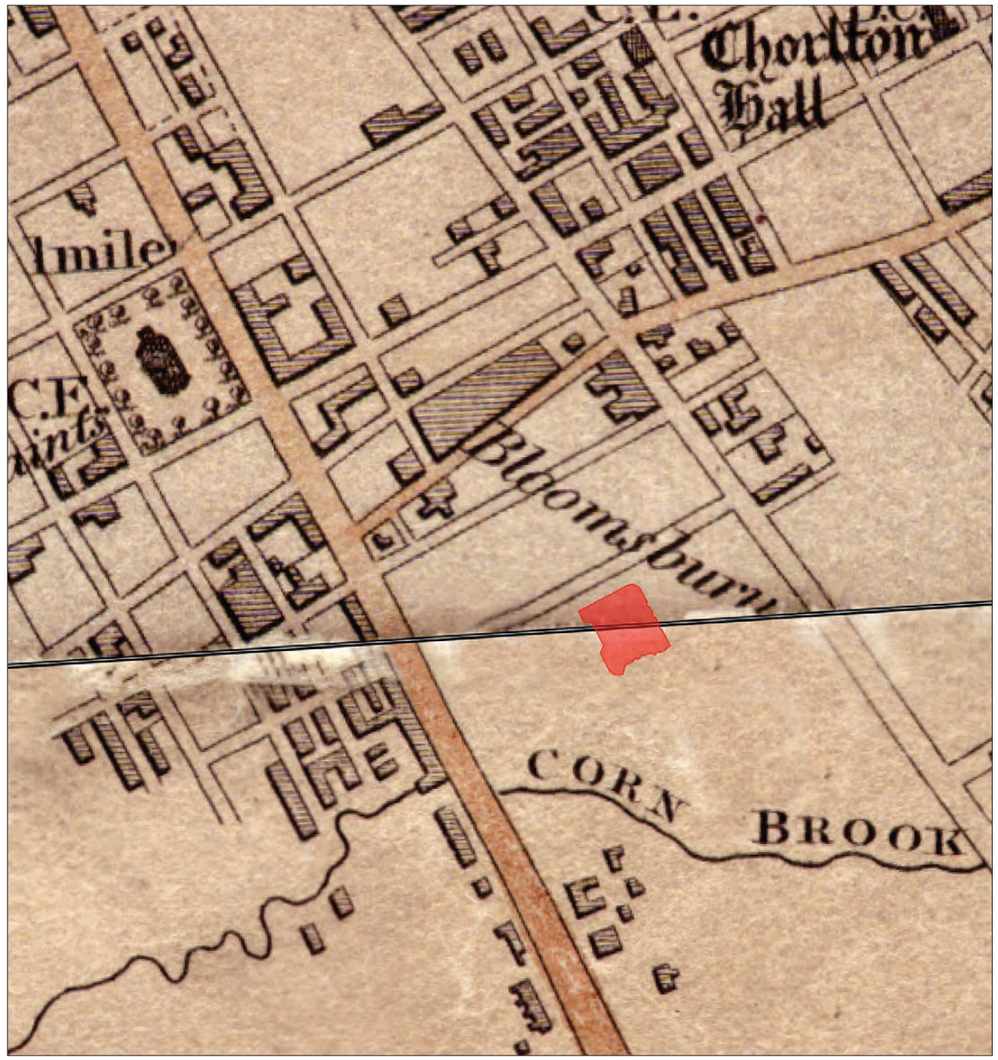

Figure 3: Detail of Johnson's map surveyed 1818-19, with the study area shaded. Scale 1:4000.



Figure 4: Detail of Swire's map 1824, with the study area shaded. Scale 1:4000.

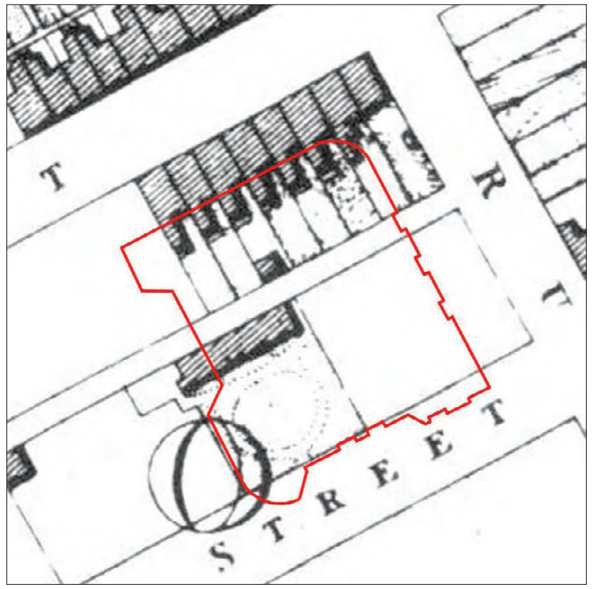

Figure 5: Detail of Bancks's map of 1831, with the study area outlined. Scale 1:1000.



Figure 6: Detail of OS 6in to 1 mile mapping surveyed 1845, with the study area outlined. Scale 1:1000.



Figure 7: Detail of OS 5ft to 1 mile mapping surveyed 1849, with the study area outlined. Scale 1:500.



Figure 8: Detail of OS 10ft to 1 mile mapping surveyed 1888, with the study area outlined. Scale 1:500.



Figure 9: Detail of OS 10ft to 1 mile mapping surveyed 1904, with the study area outlined. Scale 1:500.

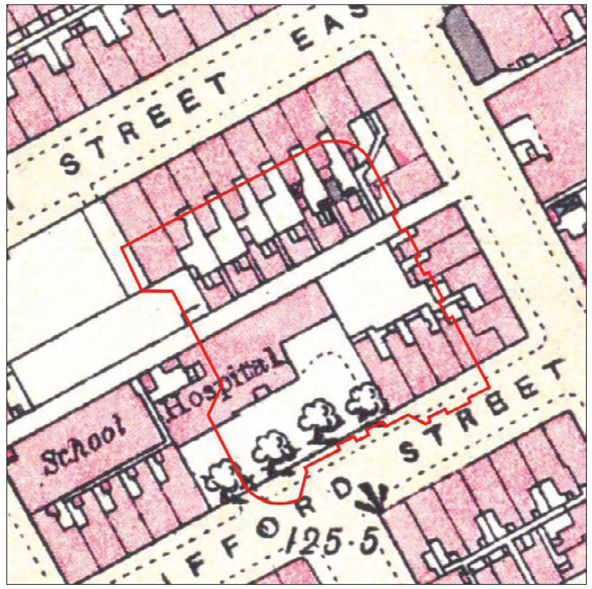

Figure 10: Detail of OS 1:2500 mapping surveyed 1888-9, with the study area outlined. Scale 1:1000.



Figure 11: Detail of OS 1:2500 mapping surveyed 1905, with the study area outlined. Scale 1:1000.



Figure 12: Detail of OS 1:2500 mapping surveyed 1915, with the study area outlined. Scale 1:1000.

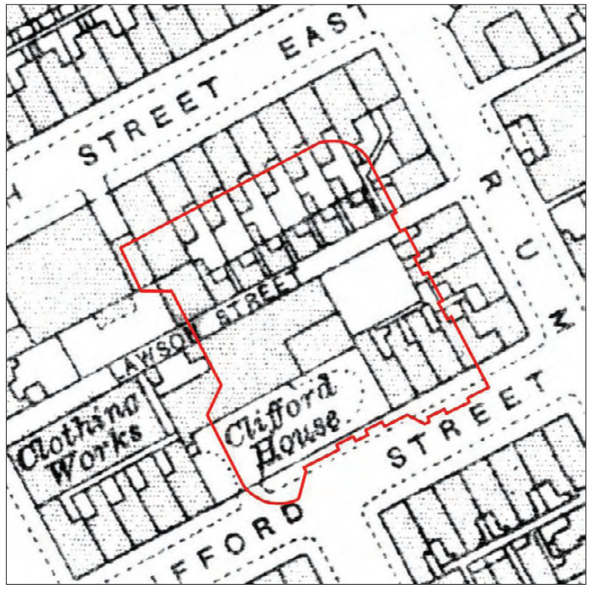

Figure 13: Detail of OS 1:2500 mapping surveyed 1932, with the study area outlined. Scale 1:1000.

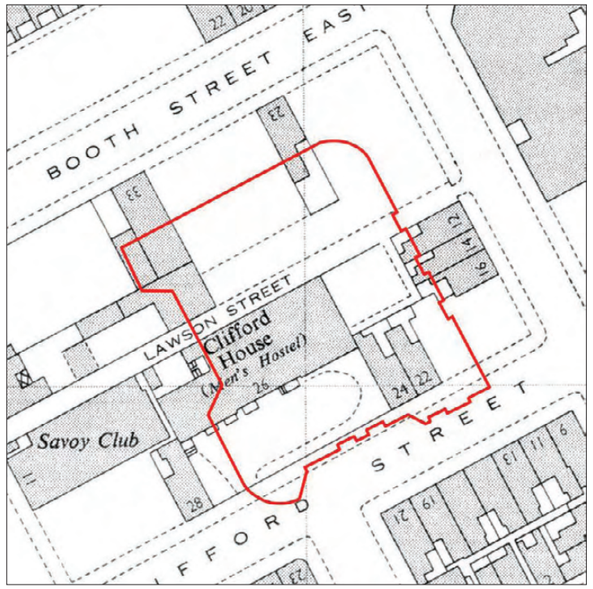

Figure 14: Detail of OS 1:1250 mapping surveyed 1961, with the study area outlined. Scale 1:1000.

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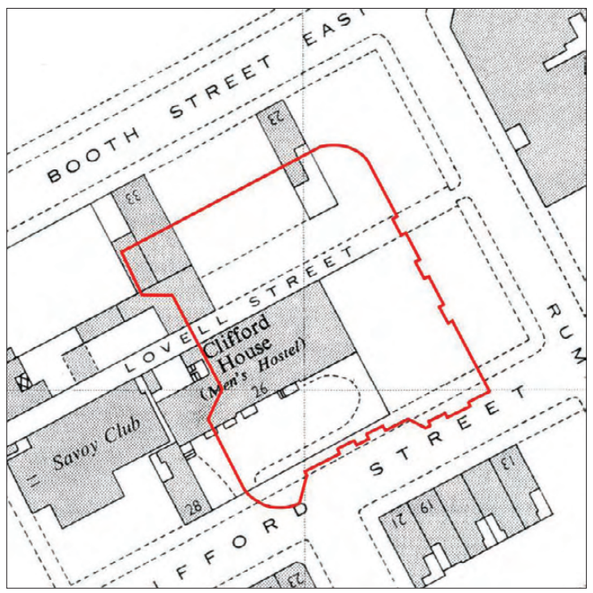

Figure 15: Detail of OS 1:1250 mapping surveyed 1968, with the study area outlined. Scale 1:1000.

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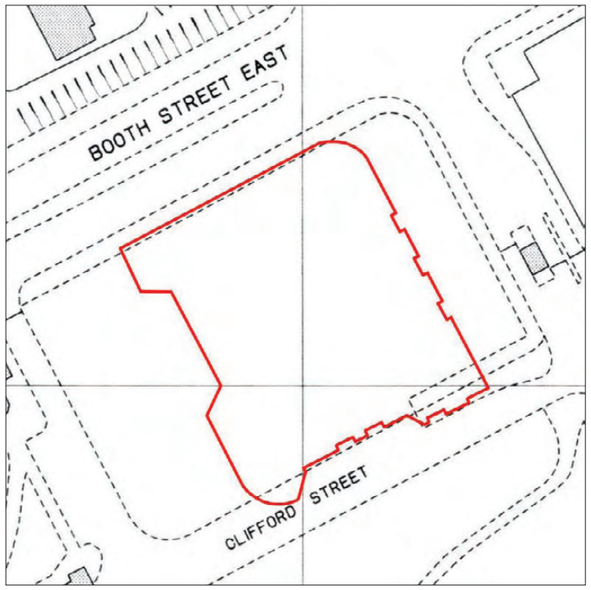

Figure 16: Detail of OS 1:1250 mapping surveyed 1988, with the study area outlined. Scale 1:1000.
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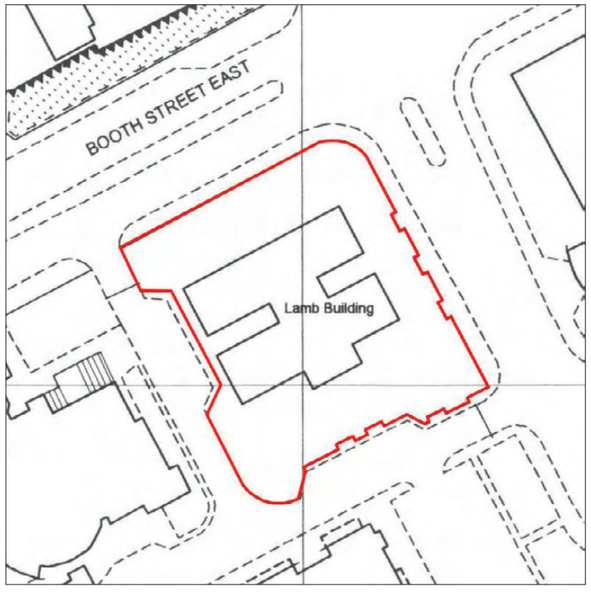

Figure 17: Detail of OS 1:1250 mapping issued 2007, with the study area outlined. Scale 1:1000.
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Figure 18: Location of sites identified. Scale 1:500.
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Figure 19: Location of geotechnical investigations. The site of the Lamb Building is outlined in purple. Scale 1:500.

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Appendix G | Flood Risk Assessment

Intended for
University of Manchester

Project no.
61020221

Date
20 August 2012

GRAPHENE INNOVATION HUB

FLOOD RISK ASSESSMENT

Revision History

Revision	Date	Purpose / Status	Document Ref.	Comments
-	20.08.2012	Issued for comment		

Prepared By	Reviewed By	Approved By
		
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GRAPHENE INNOVATION HUB
FLOOD RISK ASSESSMENT

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3. Assessment of New Development 7
4. Conclusions 12

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Table 2.2 – Flooding Sources at the Graphene Innovation Hub
Table 3.3 – Post-development Surface Water Runoff Rates

FIGURES

Figure 1 – Site Location Plan
Figure 2 – Proposed Site Layout

APPENDICES

Appendix A – Peak Runoff Calculations
Appendix B – EA Detailed Flood Data

1. INTRODUCTION

1.1. General

1.1.1. Ramboll has been appointed by the University of Manchester to undertake a Flood Risk Assessment (FRA) to support the development of the Graphene Innovation Hub within the University of Manchester Campus.

1.1.2. The information used to prepare this report includes:

- A topographical site survey by Survey Operations (Drawing No. 12D046/001, May 2012);
- A Utility Mapping Survey by 40 Seven (Drawing No. FS104, Sheet 2 of 16, Rev 15.0, November 2006);
- A Proposed Site Plan by Jestico and Whiles (Drawing No. 2469-GA-000 Rev P02, July 2012);
- British Geological Survey (BGS) maps;
- Manchester City, Salford City and Trafford Councils Level 2 Hybrid Strategic Flood Risk Assessment (SFRA) (JBA Consulting, March 2011);
- National Planning Policy Framework (NPPF): Flood Risk; and
- The Environment Agency's (EA) online database of indicative floodplain and hydrogeological maps and detailed flood data for the site.

1.1.3. Ramboll cannot accept liability for the accuracy or otherwise of any information derived from third party sources.

1.2. Scope and Objectives

1.2.1. This document considers the risks of various sources of flooding to the site and the consequent risk of flooding to downstream receptors (such as people, property, habitats, infrastructure and statutory sites) from the proposed development, as a result of surface water runoff. A comparison is made between the current situation and the proposed future development.

1.2.2. This FRA has been carried out in accordance with the National Planning Policy Framework (NPPF). It is to be used to assist the Local Planning Authority (LPA) and EA, when considering the flooding issues of the proposed development, as part of a planning application. An FRA is required for the site as it has been identified as being potentially at risk of flooding.

1.2.3. This report provides the following information:

i. An assessment of the flood risk to the site based upon flood data and the flood maps provided by the EA and SFRA and;
ii. An assessment of the impact of the new development in terms of surface runoff;
iii. Proposals for measures to mitigate the generation of surface water runoff from the proposed development; and
iv. Proposals to mitigate any residual flood risks to the development (if any).

GRAPHENE INNOVATION HUB
FLOOD RISK ASSESSMENT

2. SITE CONTEXT

2.1. Site Location and Surrounding Use

2.1.1. The site is situated off Booth East Street, Manchester, M13 9PL, at National Grid Reference (384597, 396914). The site has a total area of approximately 0.25ha, and was previously occupied by a temporary building. The site is situated within the University of Manchester campus, with university buildings immediately adjacent to the site. The topography is relatively flat, with levels varying between approximately 37.58m AOD and 38.31m AOD. Figure 1 below shows the site location plan, with the site boundary denoted by the red line.



Figure 1: Site Location Plan

2.2. Geological Setting

2.2.1. The British Geological Survey (BGS) geological map for the area, Sheet 085 (Manchester) 1:50,000 series Solid and Drift Edition shows the site to be underlain by Permian mudstones (including Middle and Upper Marls, Eden and St Bees Shales) and Diamicton Till. In addition to this, made ground Is likely to be present on site as a result of the demolition of the previous building and infill to the basement.

2.3. Hydrological Setting

2.3.1. The River Medlock is situated approximately 550m to the north of the site, with the nearest section of the river to the site culverted. The River Irwell is situated approximately 2km to the north west of the site, the River Irk is situated approximately 2.5km to the north of the site and the River Gore is situated approximately 2.3km to the south east of the site. There are no watercourses situated within the site.

2.3.2. Gorton Lower Reservoir and Gorton Upper Reservoir are situated approximately 6km to the east of the site and Audenshaw Reservoir is situated approximately 6.7km to the east of the site.

2.4. Hydrogeological Setting

2.4.1. The EA has developed Groundwater Source Protection Zones (SPZ) to assist in the assessment of risk to groundwater supplies taken from an abstraction point. The site lies within SPZ3 – Source Catchment Protection Zone. Definitions for the zone types are provided below based on the EA website:

- SPZ1 – Inner Protection Zone: "Defined as the 50 day travel time from any point below the water table to the source. This zone has a minimum radius of 50 metres."

- SPZ2 – Outer Protection Zone: "Defined by a 400 day travel time from a point below the water table. The previous methodology gave an option to define SPZ2 as the minimum recharge area required to support 25 per cent of the protected yield. This option is no longer available in defining new SPZs and instead this zone has a minimum radius of 250 or 500 metres around the source, depending on the size of the abstraction."

- SPZ3 – Source Catchment Protection Zone: "Defined as the area around a source within which all groundwater recharge is presumed to be discharged at the source. In confined aquifers, the source catchment may be displaced some distance from the source. For heavily exploited aquifers, the final Source Catchment Protection Zone can be defined as the whole aquifer recharge area where the ratio of groundwater abstraction to aquifer recharge (average recharge multiplied by outcrop area) is >0.75. There is still the need to define individual source protection areas to assist operators in catchment management."

- Former Zone of Special Interest: "A fourth zone SPZ4 or 'Zone of Special Interest' was previously defined for some sources. SPZ4 usually represented a surface water catchment which drains into the aquifer feeding the groundwater supply (i.e. catchment draining to a disappearing stream). In the future this zone will be incorporated into one of the other zones, SPZ 1, 2 or 3, whichever is appropriate in the particular case, or become a safeguard zone."

2.4.2. The EA website also shows aquifers and provides designations which are in line with the Water Framework Directive and are based on maps produced by the BGS. The geology beneath the site is designated as a Principal Aquifer in the bedrock. Definitions for the aquifer types are provided below based on the EA website:

- Principal Aquifer: "These are layers of rock or drift deposits that have high intergranular and/or fracture permeability - meaning they usually provide a high level of water storage. They may support water supply and/or river base flow on a strategic scale. In most cases, principal aquifers are aquifers previously designated as major aquifer."

- Secondary A aquifer: "permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers."

- Secondary B aquifer: "predominantly lower permeability layers which may store and yield limited amounts of groundwater due to localised features such as fissures, thin permeable horizons and weathering. These are generally the water-bearing parts of the former non-aquifers."

- Secondary 'undifferentiated' aquifer: "it has not been possible to attribute either category A or B to a rock type. In most cases, this means that the layer in question has previously been designated as both minor and non-aquifer in different locations due to the variable characteristics of the rock type."

2.5. Existing Drainage Regime & Surface Water Runoff

2.5.1. The site has an area of approximately 0.25ha. The temporary building previously situated on site had a total impermeable area of approximately 0.067ha.

2.5.2. Existing peak runoff rates have therefore been calculated using the Modified Rational Method for various return periods based on this impermeable area. Table 3.2 summarises the existing peak runoff rates for the site. Calculations are provided in Appendix A.

Table 2.1 –Existing Peak Runoff Rates

Return Period (years)	1-in-2	1-in-10	1-in-30	1-in-100
Existing Peak Runoff Rates (l/s)	6	9	11	14

2.5.3. A Utility Mapping Survey by 40Seven shows a 150mm diameter private sewer connection by gravity from the temporary building into drainage to situated in the private road (part of the University of Manchester campus) to the of the site. It is most likely that discharge from the temporary building was unrestricted.

2.6. Existing Flood Risk

Fluvial and Tidal

2.6.1. The EA indicative floodplain maps identify areas in England and Wales at risk of flooding by allocating them into flood risk zones.

2.6.2. The flood risk zones shown on the flood maps are defined in Table 2 of the Technical Guidance to the NPPF:

Zone 1: Low Probability

According to the NPPF, land in this zone is considered to have less than 1-in-1000 annual probability of river or sea flooding in any year. This is < 0.1%.

Zone 2: Medium Probability

According to the NPPF, land in this zone is considered to have between a 1-in-100 and 1-in-1000 annual probability of river flooding in any year (between 1% and 0.1%) or between a 1 in 200 and 1 in 1000 annual probability of sea flooding in any year (0.5%-0.1%).

Zone 3a: High Probability

According to the NPPF, land in this zone is considered to have a 1 in 100 or greater annual probability of river flooding in any year (>1%) or a 1 in 200 or greater annual probability of flooding from the sea in any year (>0.5%).

Zone 3b: The Functional Floodplain

According to the NPPF, land in this zone is used for water flow or storage in times of flood. This flood zone should be identified by a Strategic Flood Risk Assessment (SFRA). It is considered to have a 1 in 20 or greater chance of river flooding in any year which is > 5%. Another probability however can also be agreed between the LPA and the E.A.

2.6.3. The EA detailed flood map and flood levels have been purchased for the site and are included in Appendix B. Although the EA flood map suggests that the site is situated on the edge of Flood Zone 2, the floodplain outlines shown on these maps utilise high level and relatively coarse survey data. Comparison of the flood levels provided with the topographical survey levels demonstrates that the site is situated above the 1-in-1000 year flood level and therefore at low risk of flooding, in Flood Zone 1.

Surface Water and Sewer Drainage Risk

2.6.4. The SFRA Figure SS 4.3 (Surface Water Flooding Risk Assessment – Current Scenario) and Section and Figure SS 4.4 (Surface Water Flooding Risk Assessment Future Scenario) show surface water flood risk within the study area based upon the number of properties at risk of flooding. The figures show that the site is situated in an area where no properties have been identified to be at risk of surface water flooding, both at present and in the future scenario. Therefore surface water and sewer flood risk to the site is considered to be low.

Groundwater Flood Risk

2.6.5. The SFRA Figure GW 2.1 (Groundwater Flooding) shows that the site is not at risk of groundwater flooding or situated in an area of shallow groundwater. Therefore groundwater flood risk to the site is considered to be low.

Artificial Water Bodies

2.6.6. The EA's indicative reservoir flood risk maps show that the site is at risk of reservoir flooding, the closest reservoirs to the site are situated approximately 6km away, as detailed in Section 2.3. Reservoirs are carefully regulated by law and require stringent monitoring and management. Therefore the residual flood risks from reservoir flooding remain very low. There are no artificial water bodies in the proximity of the site. Therefore flood risk to the site from artificial sources is considered to be low.

Flood Risk Summary

2.6.7. Based on the assessment of flooding sources above, the flood risk summary for the site is presented in Table 2.2 below.

GRAPHENE INNOVATION HUB
FLOOD RISK ASSESSMENT

Table 2.2 – Flooding Sources at the Graphene Innovation Hub

	High	Medium	Low	
Tidal/ Fluvial			X	Comparison of levels on site with EA flood levels shows site to be situated above the floodplain, in Flood Zone 1.
Surface Water and Drainage Flood Risk			X	SFRA shows site to be situated in an area at low risk of surface water flooding.
Groundwater			X	SFRA shows site to be situated in an area at low risk of groundwater flooding.
Reservoirs, canals and other artificial sources			X	Site at risk of reservoir flooding, however residual risks are considered to be low.

3. ASSESSMENT OF NEW DEVELOPMENT

3.1. Development Proposals

3.1.1. It is proposed to construct a new building on site, the footprint of which will cover the entire site area. The proposed building will have three floors as well as a basement. The proposed site layout is shown in Figure 2, at the rear of this report.

3.2. Flood Risk Vulnerability

3.2.1. The NPPF seeks to direct new development to areas at lower risk of flooding through the sequential test. According to Table 2 (Flood Risk Vulnerability Classification) in the Technical Guidance to the NPPF, buildings used for educational purposes are classified as "More Vulnerable" to flooding. The Technical Guidance to the NPPF Table 3 (Flood Risk Vulnerability and Flood Zone "Compatibility") states that "More Vulnerable" development is appropriate in Flood Zones 1 and 2. Therefore the sequential tested is passed and the exception test is not required.

3.3. Occupant Safety and Management of Residual Flood Risks

3.3.1. As discussed in Section 2.6, site levels show the building to be situated above the flood level. Therefore the development is deemed to be safe for occupants and there are no residual flood risks.

3.4. Floodplain Volume and Flood Routing

3.4.1. As discussed in Section 2.6, site levels show the building to be situated above the floodplain. Therefore floodplain compensation measures or flood routing measures are not required in this instance.

3.5. Surface Water Runoff

3.5.1. As the proposed building footprint will cover the entire site area, the proposed development will result in an increase in impermeable area within the site, from approximately 0.067ha, to 0.25ha. In addition to this, the NPPF identifies that rainfall intensities will increase in the future as a result of the predicted effects of climate change, resulting in an increase in surface water runoff. Therefore, this needs to be accounted for when designing new drainage systems.

3.5.2. Table 3.1 summarises the predicted change in peak flows for the proposed development compared to the existing situation. The critical storm duration for runoff is 15 minutes. In accordance with Table 5 of the Technical Guidance to the NPPF, an allowance for increases in rainfall intensity of 30% has been included in the post-development peak runoff rates. Calculations are provided in Appendix A.

Table 3.1 – Post-development Surface Water Runoff Rates

Return Period (years)	1-in-2	1-in-10	1-in-30	1-in-100
Peak Runoff for a 15minute storm duration (l/s)	28	43	52	67
Increase Compared to Existing Situation (l/s)	22	34	41	53

GRAPHENE INNOVATION HUB
FLOOD RISK ASSESSMENT

3.5.3. To ensure that downstream flood risk does not increase as a result of the development, attenuation of the surface water runoff will need to be incorporated into the proposed drainage strategy for the site. Various attenuation options in the form of Sustainable Drainage Systems (SuDS) are discussed in the following section.

3.6. Assessment of Attenuation Options

3.6.1. For sustainable management of surface water run-off from a new development, the use of SuDS is recommended. SuDS options available for attenuating surface water run-off on site are discussed below:

i. *Permeable or porous surfaces:* Either a block paving system which consists of interlocking paving blocks or a porous asphalt concrete surface that allows water to infiltrate through to an underlying gap-graded sub-base. From the sub-base, run-off can infiltrate directly into the ground, or where this not appropriate, can be stored in a tanked system before being discharged elsewhere. As the proposed building footprint will cover the entire site, this is not a feasible option for the development.

ii. *Tank/Cellular Storage:* A method involving storage tanks or plastic crates installed below ground level that can be used to provide large volumes of storage prior to infiltration or discharge. Tank/cellular storage has the advantage of having a 95% voids ratio allowing it to attenuate significantly larger volumes than a traditional granular soakaway or storage area of the same volume. This is a feasible option for the development provided a storage tank is able to be accommodated beneath the proposed building.

iii. *Swales:* A grassland depression usually shallower and wider than a conventional ditch. Swales convey surface water run-off from the drained surface into a storage or infiltration system, or let the surface water infiltrate directly and provide storage for peak surface water runoff flows. As the proposed building footprint will cover the entire site, this is not a feasible option for the development.

iv. *Green Roofs:* Planted roof areas which provide a degree of rainfall storage and attenuation for small return period storms. Well maintained green roofs are able to decrease the volume of surface water runoff by up to 40% in low return period storms. For large storm events sheet runoff is still likely to occur and the use of another primary attenuation feature such as permeable paving would still be required. This is unlikely to be a feasible option for the site given the requirements for mechanical plant on the roof of the proposed building.

v. *Rainwater Harvesting:* The use of rainwater harvesting for grey-water use within the buildings would decrease the volume and rate of surface water runoff from the remaining roof areas. This is a good example of sustainability and will reduce the roof runoff in low return period events, however it cannot be considered to reduce peak flows off site since the drainage strategy has to assume that the rainwater tank is full and therefore overflowing. Whilst recommended for the development, this is not considered in the calculations for attenuation.

vi. *Detention Basins:* Surface storage basins are normally dry and can provide attenuation of surface water run-off in peak storm conditions. As the proposed building footprint will cover the entire site, this is not a feasible option for the development.

3.6.2. On the basis of the various options discussed above, there are various SuDS options that could provide surface water attenuation for the new development. The proposed surface water drainage strategy is discussed in the following section.

3.7. Surface Water Drainage Strategy

3.7.1. The SFRA states that surface water runoff from development on brownfield sites should be attenuated to 50% of existing peak runoff rates for up to the 1-in-100 year return period (including an allowance for the predicted increase in surface water runoff due to climate change).

3.7.2. Based on the existing peak runoff rates provided in Table 2.1, the existing peak runoff rate for a 1-in-100 year return period is 14l/s, therefore the peak allowable discharge rate for the proposed development is 7l/s. On this basis, the estimated storage volume required would be in the range of 76-120m^3.

3.7.3. It is therefore proposed to provide attenuation storage in the form of a tank situated beneath the proposed building. This could also be utilised for rainwater harvesting.

3.7.4. Detailed drainage design will need to be undertaken as the scheme progresses, however on this basis there will be no increase in flood risk to downstream receptors as a result of the development.

3.8. Water Quality

3.8.1. Chapter 5 of CIRIA 697: The SUDS Manual discusses treatment train options for water quality management of surface water runoff. The site is low risk, with no vehicle usage, and would require one treatment train component. This could take the form of an appropriate filter.

3.9. Foul Drainage Strategy

3.9.1. It is proposed to discharge foul drainage from the site into the private sewers situated adjacent to the site, as for previous development on site.

3.10. BREEAM Credits

3.10.1. BREEAM New Construction (2011) is a sustainability assessment tool which can be applied to new developments to set environmental targets.

3.10.2. Five credits are available if the criteria of Pol 3 (surface water runoff) are satisfied. These are divided into three parts: flood risk (two available credits); surface water runoff (two available credits); and minimising watercourse pollution (one available credit).

3.10.3. Two credits are available for flood risk where the following criteria can be satisfied:

- The assessed development is situated in an area at low annual probability of flooding; and
- A site specific FRA confirms that the assessed development is at low risk of flooding from all sources.

3.10.4. On the basis of the assessment of flood risk to the site from all sources in Section 2.6, both credits can be achieved in this instance.

3.10.5. One credit is available for surface water runoff where the following criteria can be satisfied:

- Where drainage measures are specified to ensure that the peak rate of run-off from the site to the watercourses (natural or municipal) is no greater for the developed site than it was for the pre-development site. This should comply at the 1 year and 100 year return period events; and
- Calculations include an allowance for climate change; this should be made in accordance with current best practice planning guidance.

3.10.6. As discussed in Section 3.7, the proposed drainage strategy has been designed to restrict runoff from the site for up to the 1-in-100 year return period to 50% of existing peak runoff rates. Calculations have included an allowance for increases in rainfall intensity of 30% in accordance with the NPPF. Therefore peak runoff rates will be reduced compared to the existing situation and this credit can be achieved in this instance.

3.10.7. A second credit is available for surface water runoff where the following criteria can be satisfied:

- Where flooding of property will not occur in the event of local drainage system failure (caused either by extreme rainfall or a lack of maintenance); and
- The post development run-off volume, over the development lifetime, is no greater than it would have been prior to the assessed site's development. Any additional predicted volume of run-off for the 1-in-100 year six hour storm event must be pre-vented from leaving the site by using infiltration or other SuDS techniques.

3.10.8. If the above two criteria are unable to be achieved, then the second credit for surface water runoff can only be achieved if it can be justified why this is not a viable option for the development and it can be shown that the post-development peak runoff rate is reduced to a limiting discharge. The limiting discharge is defined as the following and the option with the highest flow rate must be achieved:

- The pre development 1-in-1 year peak flow rate OR
- The mean annual flow rate Qbar OR
- 2l/s/ha

3.10.9. For either option above calculations need to include an allowance for climate change in accordance with current best practice planning guidance.

3.10.10. The drainage and external levels on site will be designed to ensure that failure of the existing private drainage system will not cause the new building to be flooded. However, due to ground conditions on site and limited available space, disposal of surface water using infiltration techniques is not possible in this instance. Although some reduction in surface water runoff volume can be achieved through rainwater harvesting, due to the building population, the recycled water consumption is unlikely to be high enough to meet the reduction in volume criteria detailed above. It is also unlikely that there will be sufficient space on site for the required attenuation volume to meet the required limiting discharge. Further detailed drainage design is required in order to determine whether this credit is attainable, however based on the information available at present, one credit is achievable for surface water runoff.

3.10.11. One credit is available for minimising watercourse pollution where the following criteria can be satisfied:

- There is no discharge from the developed site for rainfall up to 5mm;
- Specification of SUDs or source control systems such as permeable surfaces or infiltration trenches where runoff drains are in areas with a relatively low risk source of watercourse pollution;
- Specification of oil/petrol separators (or equivalent system) in surface water drainage systems, where there is a high risk of contamination or spillage of substances such as petrol and oil;
- All water pollution prevention systems have been designed and detailed in accordance with the recommendations of Pollution Prevention Guideline 37 and where applicable the SUDS manual;
- A comprehensive and up-to-date drainage plan of the site will be made available for the building/site occupiers;
- Where the building has chemical/liquid gas storage areas, shut-off valves are fitted to the site drainage system to prevent the escape of chemicals to natural watercourses (in the event of a spillage or bunding failure);
- Where present, all external storage and delivery areas designed and detailed in accordance with the recommendations of the EA's publication Pollution Prevention Pays Guidance.

3.10.12. On the basis that a rainwater harvesting tank is installed on site, assuming the tank is empty, sufficient volume will be available to prevent rainfall discharging from the site for up to 5mm. There is no known pollution risk from the site as the building covers the entire site area and therefore there will be no vehicular areas, external storage or delivery areas within the site and there will be no chemical/ liquid gas storage areas within the building. A record of the site drainage plan will be included as part of the building operation and maintenance manuals. Therefore, all of the above criteria are either met or not applicable to the development. On this basis, it is likely that one credit can be achieved for minimising watercourse pollution.

3.10.13. In summary, four credits may be achieved against Pol 3, although the two surface water credits available and one watercourse pollution credit available will need further review as the detailed drainage design progresses.

GRAPHENE INNOVATION HUB
FLOOD RISK ASSESSMENT

4. CONCLUSIONS

4.1.1. The conclusions of this Flood Risk Assessment are as follows:

4.1.2. The site has a total area of approximately 0.25ha and has been previously occupied by a temporary building. It is proposed to construct a new building on site, the footprint of which will cover the entire site area.

4.1.3. Although the EA flood maps show the site to be situated in Flood Zone 2, comparison of the topographical site levels with detailed EA flood levels demonstrates the site to be above the 1-in-1000 year flood level, at low risk of flooding. Flood risk from all other sources has been assessed and all residual risks were found to the low.

4.1.4. Following development, the impermeable site area will increase, resulting in an increase in surface water runoff.

4.1.5. It is proposed to throttle runoff from the proposed development to 50% of existing peak runoff rates, in accordance with guidance detailed in the SFRA. It is proposed to provide attenuation in the form of tanked storage situated beneath the new building. It is also proposed to use rainwater harvesting on site.

4.1.6. It is likely that 4 BREEAM credits can be achieved under New Construction (2011) Pol 3 surface water runoff, although this will need to be further reviewed as the detailed drainage design progresses.

4.1.7. Detailed drainage design will need to be progressed as the scheme is developed in more detail, however on the basis of this report, no further FRA is considered to be necessary for this scheme.

FIGURES

Figure 1 – Site Locatin Plan (Page 2 of report)

Figure 2 – Proposed Site Layout

GRAPHENE INNOVATION HUB
FLOOD RISK ASSESSMENT

Figure 2 – Proposed Site Layout

DO NOT SCALE THIS DRAWING ALL DIMENSIONS MUST BE CHECKED ON SITE
INFORM THE ARCHITECT OF ANY DISCREPANCIES PRIOR TO CONSTRUCTION

KEY PLAN

NOTES

BOWDEN COURT

JAMES CHADWICK BUILDING

BOOTH STREET EAST

AA 0V-100

BB 0V-100

MAIN ENTRANCE

NATIONAL GRAPHENE INSTITUTE

MULTI-STOREY CAR PARK

LOADING

STAFF ENTRANCE

CRAWFORD HOUSE

CAR PARK

PROSPECT HOUSE

ST. PETER'S HOUSE CHURCH AND CHAPLAINCY

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CLIENT
THE UNIVERSITY OF MANCHESTER

PROJECT
NATIONAL GRAPHENE INSITUTE
MANCHESTER

DRAWING TITLE
PROPOSED SITE PLAN

SCALE 1:500 A3 SHEET

STATUS
PRELIMINARY

DRAWING NO 2469–GA–000 REV P02

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APPENDICES

Appendix A – Peak Runoff Calculations

Appendix B – EA Detailed Flood Data

GRAPHENE INNOVATION HUB
FLOOD RISK ASSESSMENT

Appendix A – Peak Runoff Calculations

Graphene Innovation Hub **61020221** **1 in 2 year storm event**
SG **Aug-12**

Total Depth of rainfall - The Manual Method According to the Wallingford Procedure

i) M5-60 = 18 mm, r = 0.35 *From Wallingford Procedure Maps*

ii) **M5-D = Z1 (M5-60)** *Read Z1 from Figure 6.3b for appropriate r value*

Storm Duration	Total Rainfall	Z1	Z2
M5-15	9.9 mm	0.55	0.790
M5-30	14.22 mm	0.79	0.798
M5-60	18 mm	1.00	0.806
M5-120	21.96 mm	1.22	0.814
M5-240	25.74 mm	1.43	0.821
M5-360	29.34 mm	1.63	0.829
M5-600	33.3 mm	1.85	0.833
M5-1440	44.1 mm	2.45	0.844

iii) **MT-D = Z2 (M5-D)** *Interpolate Z2 from Table 6.2*

Storm Duration	Total Rainfall	Total Rainfall + 30% CC	Intensity	Intensity + CC
M2-15	7.8 mm	10.2 mm	31.3	40.7
M2-30	11.4 mm	14.8 mm	22.7	29.5
M2-60	14.5 mm	18.9 mm	14.5	18.9
M2-120	17.9 mm	23.2 mm	8.9	11.6
M2-240	21.1 mm	27.5 mm	5.3	6.9
M2-360	24.3 mm	31.6 mm	4.1	5.3
M2-600	27.7 mm	36.1 mm	2.8	3.6
M2-1440	37.2 mm	48.4 mm	1.6	2.0

Impermeable Area	
0.067 ha	Existing
0.250 ha	Proposed

Peak run-off calculated using Modified Rational Method
Peak Run-off -- Qp = 3.61CviA (l/s)

Storm Event	Existing Peak Runoff (l/s)	Post-Development Peak Runoff (inc CC) (l/s)	Increase over existing (l/s)
M2-15	6	28	22
M2-30	4	20	16
M2-60	3	13	10
M2-120	2	8	6
M2-240	1	5	4
M2-360	1	4	3
M2-600	1	2	2
M2-1440	0	1	1

Graphene Innovation Hub **61020221** **1 in 10 year storm event**
SG **Aug-12**

Total Depth of rainfall - The Manual Method According to the Wallingford Procedure

i) M5-60 = 18 mm, r = 0.35 *From Wallingford Procedure Maps*

ii) **M5-D = Z1 (M5-60)** *Read Z1 from Figure 6.3b for appropriate r value*

Storm Duration	Total Rainfall	Z1	Z2
M5-15	9.9 mm	0.55	1.220
M5-30	14.22 mm	0.79	1.237
M5-60	18 mm	1.00	1.240
M5-120	21.96 mm	1.22	1.240
M5-240	25.74 mm	1.43	1.237
M5-360	29.34 mm	1.63	1.223
M5-600	33.3 mm	1.85	1.210
M5-1440	44.1 mm	2.45	1.182

iii) **MT-D = Z2 (M5-D)** *Interpolate Z2 from Table 6.2*

Storm Duration	Total Rainfall	Total Rainfall + 30% CC	Intensity	Intensity + CC
M10-15	12.1 mm	15.7 mm	48.3	62.8
M10-30	17.6 mm	22.9 mm	35.2	45.7
M10-60	22.3 mm	29.0 mm	22.3	29.0
M10-120	27.2 mm	35.4 mm	13.6	17.7
M10-240	31.8 mm	41.4 mm	8.0	10.3
M10-360	35.9 mm	46.6 mm	6.0	7.8
M10-600	40.3 mm	52.4 mm	4.0	5.2
M10-1440	52.1 mm	67.8 mm	2.2	2.8

Impermeable Area	
0.067 ha	Existing
0.250 ha	Proposed

Peak run-off calculated using Modified Rational Method
Peak Run-off -- Qp = 3.61CviA (l/s)

Storm Event	Existing Peak Runoff (l/s)	Post-Development Peak Runoff (inc CC) (l/s)	Increase over existing (l/s)
M10-15	9	43	34
M10-30	6	31	25
M10-60	4	20	16
M10-120	2	12	10
M10-240	1	7	6
M10-360	1	5	4
M10-600	1	4	3
M10-1440	0	2	2

Graphene Innovation Hub **61020221** **1 in 30 year storm event**
SG **Aug-12**

Total Depth of rainfall - The Manual Method According to the Wallingford Procedure

i) M5-60 = 18 mm, r = 0.35 *From Wallingford Procedure Maps*

ii) **M5-D = Z1 (M5-60)** *Read Z1 from Figure 6.3b for appropriate r value*

Storm Duration	Total Rainfall	Z1	Z2
M5-15	9.9 mm	0.55	1.490
M5-30	14.22 mm	0.79	1.521
M5-60	18 mm	1.00	1.537
M5-120	21.96 mm	1.22	1.539
M5-240	25.74 mm	1.43	1.530
M5-360	29.34 mm	1.63	1.516
M5-600	33.3 mm	1.85	1.498
M5-1440	44.1 mm	2.45	1.448

iii) **MT-D = Z2 (M5-D)** *Interpolate Z2 from Table 6.2*

Storm Duration	Total Rainfall	Total Rainfall + 30% CC	Intensity	Intensity + CC
M30-15	14.8 mm	19.2 mm	59.0	76.7
M30-30	21.6 mm	28.1 mm	43.3	56.2
M30-60	27.7 mm	36.0 mm	27.7	36.0
M30-120	33.8 mm	43.9 mm	16.9	22.0
M30-240	39.4 mm	51.2 mm	9.8	12.8
M30-360	44.5 mm	57.8 mm	7.4	9.6
M30-600	49.9 mm	64.8 mm	5.0	6.5
M30-1440	63.8 mm	83.0 mm	2.7	3.5

Impermeable Area	
0.067 ha	Existing
0.250 ha	Proposed

Peak run-off calculated using Modified Rational Method
Peak Run-off -- Qp = 3.61CviA (l/s)

Storm Event	Existing Peak Runoff (l/s)	Post-Development Peak Runoff (inc CC) (l/s)	Increase over existing (l/s)
M30-15	11	52	41
M30-30	8	38	30
M30-60	5	24	19
M30-120	3	15	12
M30-240	2	9	7
M30-360	1	7	5
M30-600	1	4	3
M30-1440	0	2	2

Graphene Innovation Hub **61020221** **1 in 100 year storm event**
SG **Aug-12**

Total Depth of rainfall - The Manual Method According to the Wallingford Procedure

i) M5-60 = 18 mm, r = 0.35 *From Wallingford Procedure Maps*

ii) **M5-D = Z1 (M5-60)** *Read Z1 from Figure 6.3b for appropriate r value*

Storm Duration	Total Rainfall	Z1	Z2
M5-15	9.9 mm	0.55	1.910
M5-30	14.22 mm	0.79	1.978
M5-60	18 mm	1.00	2.014
M5-120	21.96 mm	1.22	2.022
M5-240	25.74 mm	1.43	2.004
M5-360	29.34 mm	1.63	1.975
M5-600	33.3 mm	1.85	1.944
M5-1440	44.1 mm	2.45	1.857

iii) **MT-D = Z2 (M5-D)** *Interpolate Z2 from Table 6.2*

Storm Duration	Total Rainfall	Total Rainfall + 30% CC	Intensity	Intensity + CC
M100-15	18.9 mm	24.6 mm	75.6	98.3
M100-30	28.1 mm	36.6 mm	56.2	73.1
M100-60	36.3 mm	47.1 mm	36.3	47.1
M100-120	44.4 mm	57.7 mm	22.2	28.9
M100-240	51.6 mm	67.1 mm	12.9	16.8
M100-360	58.0 mm	75.3 mm	9.7	12.6
M100-600	64.7 mm	84.1 mm	6.5	8.4
M100-1440	81.9 mm	106.5 mm	3.4	4.4

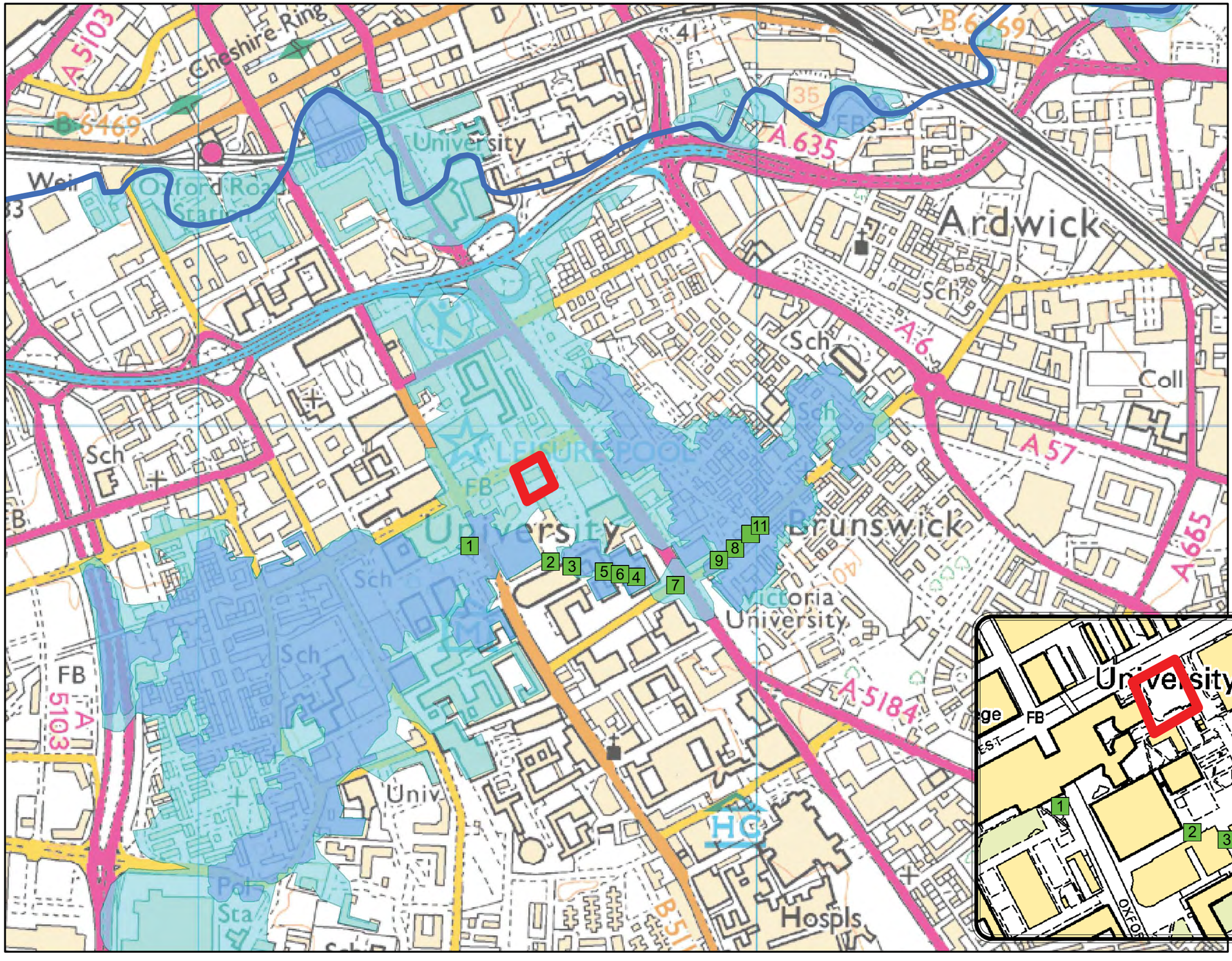
Impermeable Area	
0.067 ha	Existing
0.250 ha	Proposed

Peak run-off calculated using Modified Rational Method
Peak Run-off -- Qp = 3.61CviA (l/s)

Storm Event	Existing Peak Runoff (l/s)	Post-Development Peak Runoff (inc CC) (l/s)	Increase over existing(l/s)
M100-15	14	67	53
M100-30	10	49	39
M100-60	7	32	25
M100-120	4	20	16
M100-240	2	11	9
M100-360	2	8	7
M100-600	1	6	5
M100-1440	1	3	2

Appendix B – EA Detailed Flood Data

Detailed map centred on Booth East Street, Manchester. Created on 31st July 2012 [Ref. PRRWAR4472]



Environment Agency

Scale 1:10,000

N

Legend

- Water Level Flows
- Main River
- Site
- Flood Zone 3
- Flood Zone 2

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					Undefended									
Map Reference	Model Node Reference	Easting	Northing	Data	50 % AEP (1 in 2 year)	20 % AEP (1 in 5 year)	10 % AEP (1 in 10 year)	4 % AEP (1 in 25 year)	2 % AEP (1 in 50 year)	1.33 % AEP (1 in 75 year)	1 % AEP (1 in 100 year)	1 % AEP (1 in 100 year) + Climate Change*	0.5 % AEP (1 in 200 year)	0.1 % AEP (1 in 1000 year)
1	ea013_Model_CORN02_00026	384487	396785	Modelled Water Level (m aod)	35.3	35.52	36.21	36.71	36.78	36.8	36.82	36.85	36.84	36.96
				Modelled Flow (cumecs)	5.67	7.27	8.29	8.62	8.72	8.75	8.78	8.82	8.82	8.27
2	ea013_Model_CORN02_00028	384632	396757	Modelled Water Level (m aod)	35.87	36.04	36.49	37.08	37.16	37.19	37.21	37.26	37.26	37.45
				Modelled Flow (cumecs)	5.46	7.02	8.14	8.57	8.69	8.76	8.79	8.86	8.88	8.94
3	ea013_Model_CORN02_00029	384670	396749	Modelled Water Level (m aod)	36.04	36.24	36.69	37.42	37.49	37.53	37.55	37.59	37.59	37.77
				Modelled Flow (cumecs)	5.36	6.89	8.01	8.38	8.44	8.46	8.47	8.47	8.49	8.33
4	ea013_Model_CORN02_00030	384785	396730	Modelled Water Level (m aod)	36.52	36.8	37.3	38.33	38.39	38.43	38.45	38.49	38.48	38.64
				Modelled Flow (cumecs)	5.31	6.84	8.02	8.4	8.45	8.47	8.48	8.48	8.49	8.34
5	ea013_Model_CORN02_00031	384728	396739	Modelled Water Level (m aod)	36.26	36.53	37.03	37.92	37.99	38.02	38.04	38.08	38.08	38.21
				Modelled Flow (cumecs)	5.36	6.89	8.05	8.45	8.53	8.56	8.58	8.62	8.62	8.5
6	ea013_Model_CORN02_00032	384757	396734	Modelled Water Level (m aod)	36.33	36.6	37.1	38.01	38.08	38.12	38.14	38.18	38.17	38.31
				Modelled Flow (cumecs)	5.31	6.84	8	8.36	8.4	8.41	8.42	8.41	8.42	8.31
7	ea013_Model_CORN02_00033	384856	396715	Modelled Water Level (m aod)	36.84	37.07	37.52	38.59	38.66	38.69	38.71	38.76	38.76	38.94
				Modelled Flow (cumecs)	5.32	6.85	8.04	8.45	8.5	8.51	8.53	8.54	8.55	8.43
8	ea013_Model_CORN02_00034	384963	396781	Modelled Water Level (m aod)	37.36	37.59	37.94	39.15	39.19	39.21	39.22	39.25	39.25	39.36
				Modelled Flow (cumecs)	4.96	6.41	7.58	8.01	8.05	8.06	8.07	8.06	8.09	7.87
9	ea013_Model_CORN02_00035	384933	396759	Modelled Water Level (m aod)	37.18	37.38	37.74	38.87	38.93	38.96	38.97	39.01	39.01	39.16
				Modelled Flow (cumecs)	4.99	6.44	7.6	7.99	8.02	8.02	8.02	7.99	8.03	7.94
10	ea013_Model_CORN02_00036	384990	396806	Modelled Water Level (m aod)	37.52	37.76	38.12	39.36	39.38	39.39	39.4	39.41	39.41	39.48
				Modelled Flow (cumecs)	4.87	6.29	7.46	7.87	7.88	7.88	7.88	7.84	7.88	7.68
11	ea013_Model_CORN02_00037	385008	396821	Modelled Water Level (m aod)	37.56	37.8	38.17	39.42	39.45	39.46	39.46	39.48	39.48	39.53
				Modelled Flow (cumecs)	4.87	6.29	7.47	7.89	7.91	7.91	7.91	7.87	7.91	7.79

Source: Cornbrook Model, 2009

Notes:

AEP - Annual Exceedence Probability
m aod - metres above ordnance datum
cumecs - cubic metres per second
*Climate Change Scenario - 20% increase in flow

Appendix H | Natura 2000 Site Declaration

ANNEX IIB
DECLARATION BY THE AUTHORITY RESPONSIBLE FOR NATURA 2000 SITES

Responsible Authority: Natural England

[Nb. In Great Britain the provisions of the Council Directive 92/43/EEC (the Habitats Directive) are implemented through the Conservation (Natural Habitats &c) Regulations 1994, as amended. Natural England are not the permitting authority and are therefore not the competent authority in the meaning of the Conservation (Natural Habitats &c) Regulations 1994, as amended. However this advice is offered in respect of Natural England's advisory role under Regulation 48 of the Conservation (Natural Habitats &c) Regulations 1994,as amended (Article 6(3) of the Habitats Directive).]

Having examined the project application: Proposed Graphene Innovation hub (multi-story research building)

Which is to be located at: Within University of Manchester Campus off Booth Street East, Manchester

(Grid Reference 384604,396911)

Declares that the project is not likely to have significant effects on a *NATURA 2000* site on the following grounds:

- There will be no direct impact on any NATURA 2000 sites as the closest (Rochdale Canal SAC) is located 6km north east of the application site, which is located within the urban context of central Manchester.

- Emissions or discharges are unlikely to cause adverse indirect effects on any NATURA 2000 sites due to their scale, the urban context of the site and as the closest NATURA 2000 site is located at a sufficient distance not to represent a significant effect.

Therefore Natural England's advice, to the competent authority under Regulation 48 (Article 6(3) of the Habitats Directive), is that this project is unlikely to have a significant effect and that an Appropriate Assessment should not be required.

Therefore an appropriate assessment required by Article 6 (3) was not deemed necessary.

A map at scale of 1:100.000 (or the nearest possible scale) is attached, indicating the location of the project as well as the *NATURA 2000* sites concerned, if any.

Date (dd/mm/yyyy): 26/09/2012

Signed: J Lunt

Name: JULIE LUNT

Position: HEAD OF LEGAL SERVICES

Organisation: Natural England

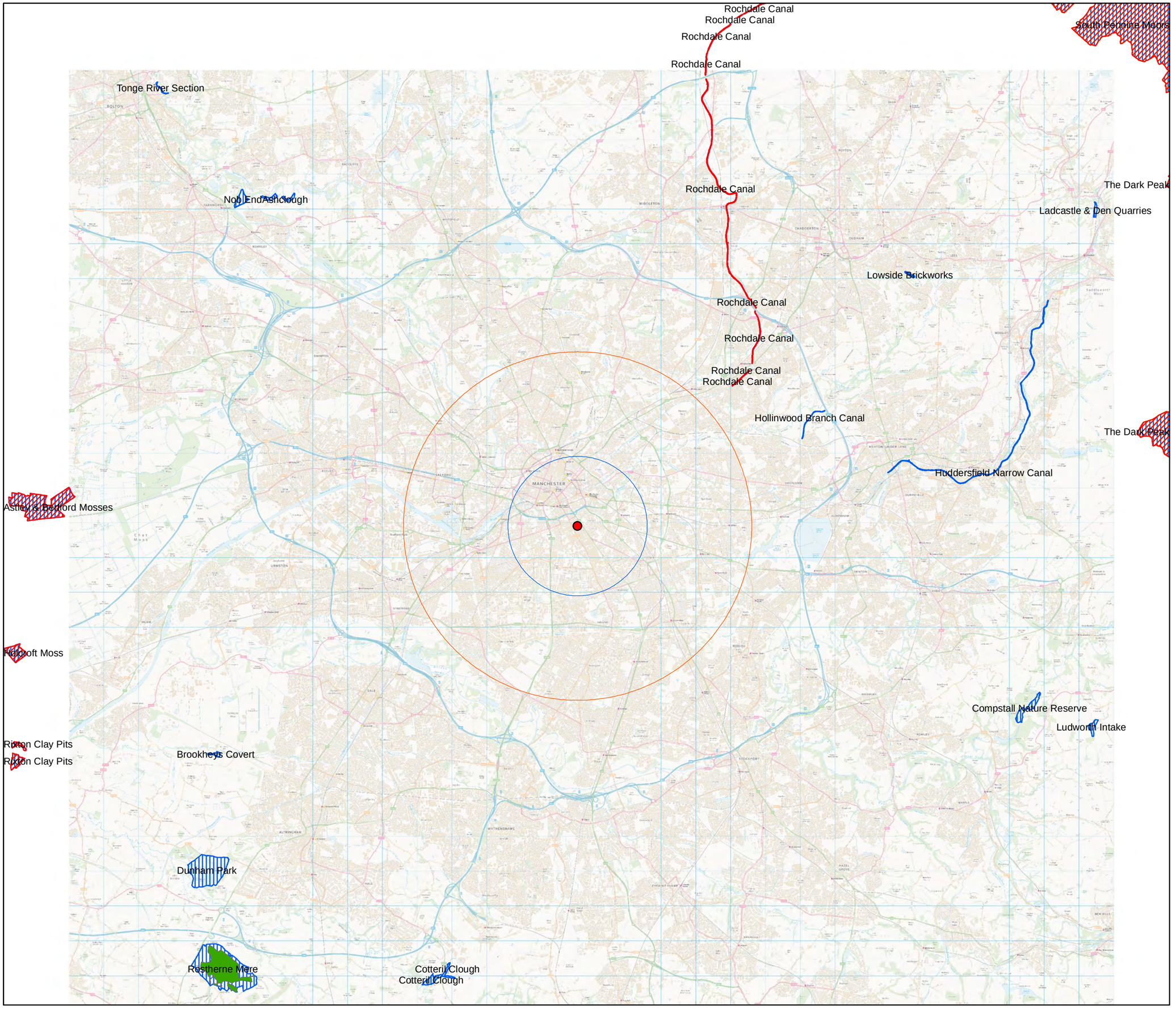
(Authority responsible for monitoring *NATURA 2000* sites)

Official Seal:

NATURAL ENGLAND

1256

Appendix J | Natura 2000 Designated Site Map



Legend

- SAC
- SPA
- Ramsar
- SSSI
- Site Location
- Site Location Buffer 2km Radius
- Site Location Buffer 5km Radius

Designated Site shapefiles downloaded from the Natural England Website on 09/08/2012

1:100,000

Contains Ordinance Survey data © Crown copyright and database right 2010.

N

Client

University of Manchester

Project Title

University of Manchester Graphene Innovation Hub

Project Number

61020221

Figure Title

Designated Sites

RAMBOLL
Tel: 0121 230 1650
Fax: 0121 230 1675
birmingham@ramboll.co.uk
www.ramboll.co.uk

Date	Prepared By
26/09/12	CB
Figure No.	**Revision**
Figure 1	-

Appendix K | Ecological Walkover Survey Letter

RAMBOLL

BUILDINGS

Stuart Lockwood
The University of Manchester
The Directorate of Estates
Capital Projects Group

Dear Stuart

Date 26/07/2012

NATIONAL GRAPHENE INSTITUTE

Please be advised that an ecological walkover survey of the proposed site for the National Graphene Institute was carried out on the 20th July 2012.

A full report will be produced in due course, but the following is a summary of our findings: We did not encounter any major/urgent concerns with regards to ecology on site. There were no invasive weeds and no protected species observed. The only precaution we would highlight is that there is the potential for nesting birds to be present within the trees on site and that any works to these trees should be carried out outside the bird nesting season which runs from the beginning of March to end of August.

Should you have any queries regarding the above please do not hesitate to contact me.

Yours sincerely

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Ref HPS/PAE/20221

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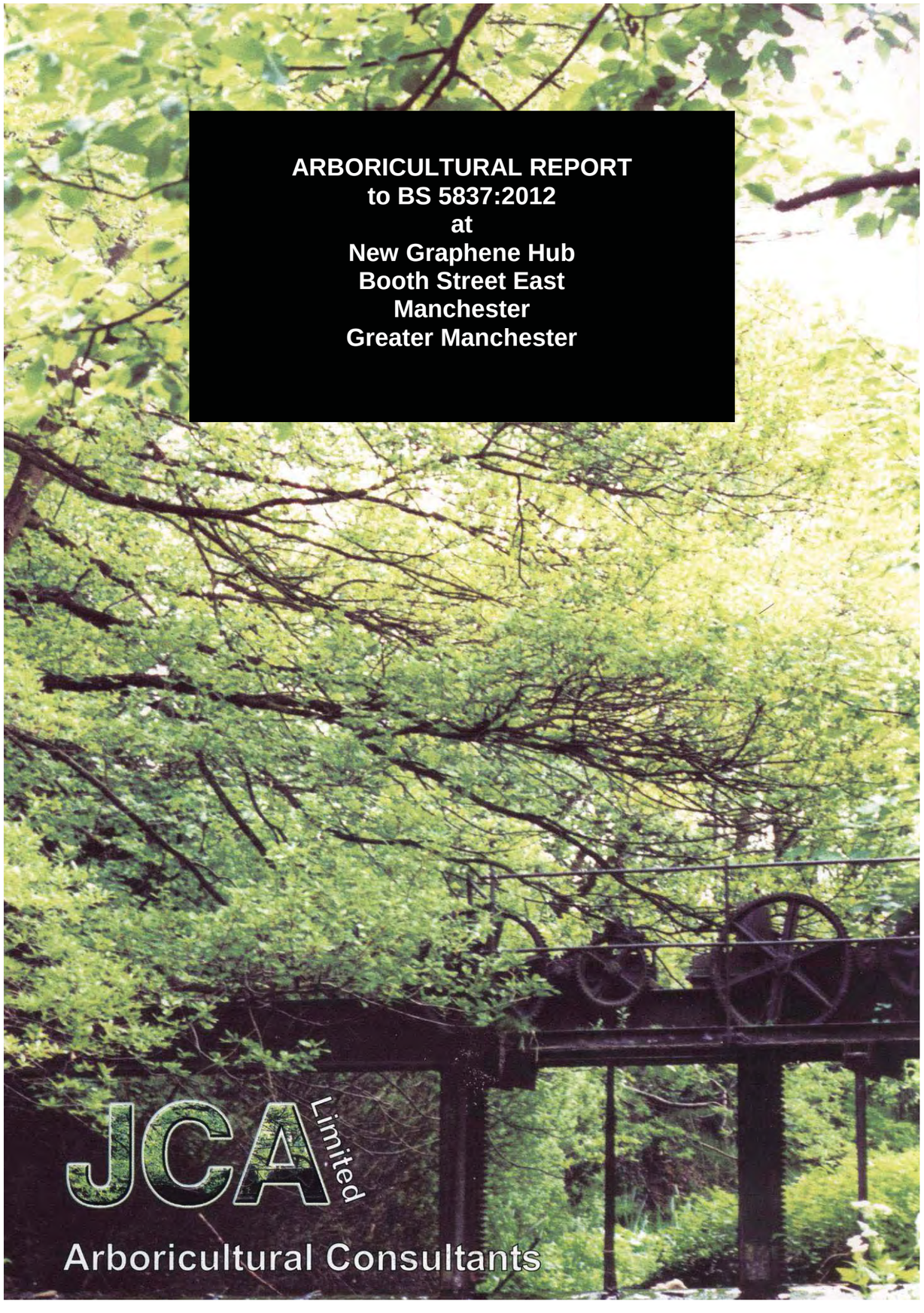
Appendix L | Arboricultural Report



ARBORICULTURAL REPORT
to BS 5837:2012
at
New Graphene Hub
Booth Street East
Manchester
Greater Manchester

Client:
The University of Manchester

Client Address:
4th Floor
Beyer Building
Oxford Road
Manchester
M13 9PL

Client Contact:
0161 306 4878

JCA Ref:
10610/PH

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1. Introduction

1.1 Purpose of the Report

1.1.1 A report is required at **New Graphene Hub, on Booth Street East, Manchester,** to provide detailed, independent, arboricultural advice on the trees present, in the context of potential development.

1.2 Terms of Reference

1.2.1 I am instructed by **The University of Manchester** to visit the site and prepare my findings in a report.

1.2.2 For this purpose I have been supplied with a topographical survey, Drawing Name: **Graphene site plan. DWG**

1.3 Scope of the Report

1.3.1 This report is compiled in accordance with *BS 5837:2012 Trees in relation to design, demolition and construction - Recommendations.*

1.3.2 Preliminary recommendations are given with a view to the long-term management of a sustainable tree cover.

1.3.3 Where applicable trees outside the site boundary, but close enough to be affected by the proposed development, are included.

1.4 Survey Details

1.4.1 The survey took place during the month of May 2012.

1.4.2 The survey was conducted by Phil Humeniuk.

1.4.3 Inspection was made at ground level. Further investigation, such as climbed inspections or decay detection surveys, may be recommended where appropriate.

1.4.4 Measurements were obtained using clinometers, specialist tapes and electronic distometers. Where this was not possible measurements were estimated.

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2. Site Description

2.1 Land Use

2.1.1 The site is currently an open area of amenity grassland.

2.2 Topography

2.2.1 The site is approximately level.

2.3 Treescape

2.3.1 The site is situated in central Manchester and is surrounded by mature street trees.

2.3.2 The trees on this site have a moderate impact on the local treescape.

2.4 Visual Amenity Value

2.4.1 The trees on site collectively provide a reasonable visual amenity to the surrounding area. Occasional specimens have a high amenity value.

2.5 Age Class Mix

2.5.1 The trees surveyed ranged in age from young to mature. However, the trees were predominantly semi-mature and early-mature.

2.6 Species Diversity

2.6.1 Species surveyed include Apple, Ash, Aspen, Alder, Cherry, Elm, Poplar, Rowan and Willow. The predominant species were Poplar and Aspen.

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3. Status of the Trees

3.1 A check was made on 24th April 2012 with: ***Manchester City Council.***

3.2 We are informed that there is no Tree Preservation Order in force and that the site is not within a Conservation Area.

4. Tree Descriptions and Recommendations

4.1 Full details of all individual trees surveyed are recorded in the tables at **Appendix 1**, a full explanation of the tables can be found at **Appendix 2**. Please refer also to the Tree Constraints Plan at **Appendix 6** for tree locations.

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5. Discussion

5.1 Tree Condition & Recommended Works

5.1.1 The tree survey revealed a total of 45 items of vegetation (43 individual trees and 2 groups of trees). Of these, 14 trees and 1 group was identified as retention category 'B', 28 trees and 1 group was identified as retention category 'C' and 1 tree was identified as retention category 'U'. Please refer to **Appendix 2** for retention category and definition criteria.

5.1.2 **One tree** (**T45**) was identified as retention category 'U'. This tree requires removal for arboricultural reasons regardless of any on site development, detailed below:

- **T45** has no long term future and been recommended for removal to prevent it from becoming dangerous; its removal is of **moderate priority**.

5.1.3 Tree pruning works are recommended for reasons of public safety, as detailed at **Appendix 1**. Attention is drawn to **T10**, **T11, T12, T13, T14, T15, T16, T18, T28, T36, T39, T41** and **T43**. The recommended work should be carried out as a matter of **high priority.**

5.1.4 **G26, T27** and **T30** were noted to have structural or physiological defects, as detailed at **Appendix 1.** Although these trees were considered to be in an acceptable condition at the time of the inspection, the defects observed may lead to their early demise or render them unsafe in the future. As such, it is recommended that these trees be monitored (re-inspected) on an annual basis to assess if their condition is still acceptable.

5.1.5 Those trees which overhang the public footpaths or public highways, detailed at **Appendix 1**, shall require future maintenance in order to maintain clearance heights for vehicular or pedestrian traffic. These heights should be 5.6m above a road and 2.5m above a footpath.

5.1.6 The species and age diversity of existing trees on site is poor and a proposed development would improve this by incorporating a Tree Planting Scheme which introduces younger ornamental trees of a variety of suitable native species suitable for growing within the built environment.

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5.2 Potential Arboricultural Implications & Design Advice

5.2.1 The details of the proposed development are not known at present. However, the following comments can be made about the site in terms of its tree cover in relation to a potential development.

5.2.2 During development the part of the tree most commonly under threat, and most commonly ignored, is the rooting system. When trees are damaged, particularly the roots, their long-term health and stability can be affected. Most development activity can have an impact on the future condition and safety of a tree, and therefore careful planning and management of tree protection should ensure a continued sustainable tree cover with minimal stress to existing trees.

5.2.3 The majority of trees recommended for retention are situated close to the site boundary. This offers a potential window for development within the centre of the site. However, development within this site is limited without the removal of some trees, many of the trees are of poor quality (retention category 'C') and could be replaced as part of a post development landscaping scheme

5.2.4 Two tarmac entrances already exist offering vehicular access to this site. If these can be retained it will minimise disturbance to tree roots.

5.2.5 In order to ensure that the retained trees on site are properly protected during the development phase, the tree rooting zones are to be considered. For the purpose of development the rooting zone of the tree is known as the Root Protection Area or RPA. The RPA of each tree or group is marked on the Tree Constraints Plan at **Appendix 6** and represents the rooting zone which, where possible, should remain undisturbed. The protection of retained trees can therefore be achieved by creating a **Construction Exclusion Zone** (**CEZ**) based on the RPAs.

5.2.6 Damage caused by any construction activity such as demolition, soil stripping, and provision of services needs to be considered at the design stage. Care should be taken to avoid damage to tree roots when existing structures such as tarmac surfaces are removed within a RPA.

5.2.7 The laying of access roads, driveways, parking areas or any other hard surfaces planned in proximity to retained trees needs to be considered. There are many solutions available to construct hard surfaces over RPA's without causing damage to trees.

5.2.8 Boundary walls or other light structures can be constructed without damage to roots through the use of piled foundations rather than the more traditional strip foundations.

5.2.9 The location of drainage and utilities within the RPA can be achieved if need be, using special techniques and supervision.

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5.2.10 The position of the site compound is a major consideration. It is recommended that this, which typically includes the site office, facilities, toilets, storage of materials and parking, is located away from trees and outside the RPA.

5.2.11 Consideration must be given to movement of both vehicle and pedestrian traffic. If possible traffic should be diverted away from the RPA's. If this is not possible a range of temporary surfaces are available to distribute the weight of traffic and allow the roots to receive moisture and air.

5.2.12 Generally, the alteration of ground levels within the RPA is not acceptable, however, should ground levels need to be lowered in areas adjacent to trees or within the minimum distance recommended, appropriate measures should be taken to minimise the detrimental effects on the trees and their root systems. With regards to raising levels, it is necessary to maintain adequate supplies of moisture and oxygen through the soil to the tree roots. Therefore, no material should be placed within the RPA without arboricultural advice.

5.2.13 The shade that will be cast by the retained trees must also be considered. Where buildings are to be positioned within the shade cast area of trees, these should be designed in order to maximise light levels. If required, JCA can provide a shade cast prediction plan.

5.2.14 Many development sites contain areas of nature conservation interest. Trees and hedgerows, in particular, provide an important habitat for birds, bats, invertebrates and fungi and appropriate attention needs to be paid to preserving habitats throughout the development process. JCA can provide ecological and bat surveys where required.

5.2.15 Where a landscape planting scheme is proposed, consideration must be made at the planning stage as to where this is to be implemented on site. Such locations should be protected in order to prevent soil compaction and/or contamination and should therefore form part of the Construction Exclusion Zone. JCA can provide Tree Planting Schemes where required.

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6. Conclusions

6.1 The trees surveyed were generally found to be in fair condition.

6.2 One tree has been recommended for removal for arboricultural reasons. This is discussed in **Section 5.1.2** and detailed at **Appendix 1**.

6.3 Thirteen trees have been recommended for pruning works for reasons of public safety and to ensure their long term health. These are discussed in **Section 5.1.3** and detailed at **Appendix 1**.

6.4 All development work carried out in close proximity to trees should be done so in a manner sympathetic to their needs. Otherwise the condition of the trees may deteriorate in the months and years following the development, leading to a loss of amenity and potentially hazardous trees.

6.5 Care should be taken at the design stage to ensure that the retained trees are protected. The protection of retained trees can be achieved by the creation of a Construction Exclusion Zone based on the Root Protection Area of a tree. The Root Protection Area of each tree or group is marked on the Tree Constraints Plan at **Appendix 6**.

6.6 The proposed development should be accompanied by an Arboricultural Method Statement (AMS) detailing the specific protection measures necessary for each tree. This should specify fencing standards and positions (the creation of the Construction Exclusion Zone), acceptable construction techniques and necessary tree works.

6.7 Upon instruction JCA Limited are able to provide a comprehensive Arboricultural Method Statement in order to ensure the continued health of trees throughout the proposed development. We are also able to provide tree planting schemes and organise tree works.

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Appendix 1: Tree Descriptions and Recommendations

Appendices

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Tree Ref.	Age Species *Latin Name*	Height (m)	Crown Height (m)	Height (m) & Direction of Lowest Branch	Diameter (cm)	Crown Spread N W E S	Observations	Recommendations	Physiological Condition	Structural Condition	Amenity Value	Life Expectancy (yrs)	Retention Category
T 1	Semi-mature Bird Cherry *Prunus padus*	8	3	3 N	25	3 3 3 2.5	Single stemmed and vertical with a balanced crown. Overhanging the footpath. No evidence of previous pruning. No major visible defects.	No action required.	GOOD	GOOD	HIGH	40+	B
T 2	Semi-mature Bird Cherry *Prunus padus*	8	4	4 N	22	2.5 3.5 3.5 4	Single stemmed and vertical with a balanced crown. No evidence of previous pruning. No major visible defects.	No action required.	GOOD	GOOD	MOD	40+	B
T 3	Young Cherry sp. *Prunus sp.*	2.5	1.5	1.5 N	<10	1 1 1 1	Single stemmed and vertical with a balanced crown and a weeping habit. No evidence of previous pruning. No major visible defects.	No action required.	GOOD	GOOD	MOD	40+	C
T 4	Young Cherry sp. *Prunus sp.*	2.5	1.5	1.5 N	<10	1 1 1 1	Single stemmed and vertical with a balanced crown and a weeping habit. No evidence of previous pruning. No major visible defects.	No action required.	GOOD	GOOD	MOD	40+	C
T 5	Young Cherry sp. *Prunus sp.*	3	2	2 N	<10	1.5 1.5 1.5 1.5	Single stemmed and vertical with a balanced crown and a weeping habit. No evidence of previous pruning. No major visible defects.	No action required.	GOOD	GOOD	MOD	40+	C
T 6	Young Rowan *Sorbus aucuparia*	4.5	3	3 N	7	1 1 1 1	Single stemmed and vertical with a balanced crown. No evidence of previous pruning. No major visible defects.	No action required.	GOOD	GOOD	MOD	40+	C
T 7	Young Rowan *Sorbus aucuparia*	4.5	3.5	3.5 N	9	1 1 1 1	Single stemmed and vertical with a balanced crown. No evidence of previous pruning. No major visible defects.	No action required.	GOOD	GOOD	MOD	40+	B
T 8	Young Rowan *Sorbus aucuparia*	4.5	3	3 N	9	1.5 1.5 1.5 1.5	Single stemmed and vertical with a balanced crown. No evidence of previous pruning. No major visible defects.	No action required.	GOOD	GOOD	MOD	40+	B
T 9	Semi-mature Lombardy Poplar *Populus nigra 'Italica'*	16	4	4 N	54	3 2.5 2 1	Single stemmed and vertical with a slightly unbalanced crown. Overhanging the footpath. No evidence of previous pruning. Minor deadwood observed.	No action required.	GOOD	GOOD	HIGH	40+	B
T 10	Semi-mature Lombardy Poplar *Populus nigra 'Italica'*	16	4	4 N	44	1.5 1 1 1	Single stemmed and vertical with a slightly unbalanced crown. Overhanging the footpath. No evidence of previous pruning. Minor deadwood observed.	Crown clean.	FAIR	GOOD	HIGH	40+	C

Appendix 1 *Tree Descriptions and Recommendations* *Ref:10610/PH*

Tree Ref.	Age Species *Latin Name*	Height (m)	Crown Height (m)	Height (m) & Direction of Lowest Branch	Diameter (cm)	Crown Spread N W E S	Observations	Recommendations	Physiological Condition	Structural Condition	Amenity Value	Life Expectancy (yrs)	Retention Category
T 11	Semi-mature Lombardy Poplar *Populus nigra 'Italica'*	16	4	4 N	37	2 1 1 1	Single stemmed and vertical with an unbalanced crown. Overhanging the footpath. No evidence of previous pruning. Deadwood observed. In an acceptable condition at present.	Crown clean.	GOOD	GOOD	HIGH	40+	C
T 12	Semi-mature Lombardy Poplar *Populus nigra 'Italica'*	16	5	5 N	33	2 0.5 1.5 0.5	Single stemmed and vertical with an unbalanced crown. Overhanging the footpath. No evidence of previous pruning. Deadwood observed.	Crown clean.	FAIR	GOOD	HIGH	40+	C
T 13	Semi-mature Lombardy Poplar *Populus nigra 'Italica'*	16	4	4 N	46	4 1 3 1	Single stemmed and vertical with an unbalanced crown. Overhanging the footpath. No evidence of previous pruning. Deadwood observed.	Crown clean.	GOOD	GOOD	HIGH	40+	C
T 14	Semi-mature Lombardy Poplar *Populus nigra 'Italica'*	16	4	4 N	39	3 1 1 1	Single stemmed and vertical with an unbalanced sparse crown. Overhanging the footpath. No evidence of previous pruning. Deadwood observed.	Crown clean.	GOOD	GOOD	HIGH	40+	C
T 15	Semi-mature Lombardy Poplar *Populus nigra 'Italica'*	16	4	4 N	34	1 1 1 0	Single stemmed and vertical with an unbalanced, sparse crown. Overhanging the footpath. No evidence of previous pruning. Deadwood observed.	Crown clean.	FAIR	FAIR	HIGH	20-40	C
T 16	Semi-mature Lombardy Poplar *Populus nigra 'Italica'*	16	3	3 N	44	3.5 1.5 2 1	Single stemmed and vertical with an unbalanced crown. Overhanging the footpath. No evidence of previous pruning. Deadwood observed.	Crown clean.	GOOD	GOOD	HIGH	40+	B
T 17	Early-mature Aspen *Populus tremula*	15	7	7 N	47	4.5 3 7.5 5	Single stemmed and vertical with an unbalanced crown. Overhanging the footpath and the road. Occasional pruning wounds (healing slowly).	No action required.	GOOD	GOOD	HIGH	40+	B
T 18	Early-mature Aspen *Populus tremula*	15	35	8 N	35	2 2 6 6	Single stemmed with a slight lean to the east and an unbalanced crown. No evidence of previous pruning. Minor deadwood observed.	Crown clean.	GOOD	GOOD	HIGH	40+	B
T 19	Early-mature Aspen *Populus tremula*	15	29	9 S	29	2 2.5 7 3	Single stemmed and vertical with an unbalanced crown. No evidence of previous pruning. In an acceptable condition at present.	No action required.	GOOD	GOOD	HIGH	40+	B
T 20	Early-mature Aspen *Populus tremula*	15	31	9 SW	31	0 0 6 3	Single stemmed and vertical with a kinked stem and a one sided crown. Minor wounds observed to the stem (healing well). Occasional pruning wounds noted. In an acceptable condition at present.	No action required.	FAIR	FAIR	HIGH	40+	C

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Tree Ref.	Age Species *Latin Name*	Height (m)	Crown Height (m)	Height (m) & Direction of Lowest Branch	Diameter (cm)	Crown Spread N W E S	Observations	Recommendations	Physiological Condition	Structural Condition	Amenity Value	Life Expectancy (yrs)	Retention Category
T 21	Early-mature Aspen *Populus tremula*	15	10	10 SE	36	2 2 7 2	Single stemmed and vertical with a kinked stem and unbalanced crown. Occasional pruning wounds-healing slowly. In an acceptable condition at present.	No action required.	GOOD	GOOD	HIGH	40+	C
T 22	Young Apple sp. *Malus sp.*	4.5	2	2 N	11	1.5 1.5 1.5 1.5	Single stemmed and vertical with a balanced crown. Multiple pruning wounds (healing slowly). In an acceptable condition at present.	No action required.	GOOD	GOOD	MOD	40+	C
T 23	Early-mature Aspen *Populus tremula*	15	10	10 S	33	2.5 2 5 4.5	Single stemmed and vertical with a kinked stem and an unbalanced crown. Occasional pruning wounds noted (healing slowly). In an acceptable condition at present.	No action required.	FAIR	GOOD	HIGH	40+	C
T 24	Early-mature Aspen *Populus tremula*	16	9	9 SE	52	4 4 9.5 9	Single stemmed and leaning to the east with an unbalanced crown. Multiple pruning wounds (healing slowly). In an acceptable condition at present.	No action required.	GOOD	FAIR	HIGH	40+	C
T 25	Early-mature Aspen *Populus tremula*	16	9	9 SW	50	4 7.5 7 10	Single stemmed and vertical with an unbalanced crown. No evidence of previous pruning. In an acceptable condition at present. No major visible defects.	No action required.	GOOD	GOOD	HIGH	40+	B
G 26	Young Italian Alder *Alnus cordata*	7-9	Ave 4	4 N	<10 to 13	See plan	Single stemmed and vertical with slightly unbalanced crowns. Occasional pruning wounds (healing slowly). The majority have strimmer damage at their bases (healing slowly).	Re-inspect annually.	FAIR	GOOD	MOD	40+	C
T 27	Semi-mature Italian Alder *Alnus cordata*	8	4	4 S	20	2.5 2.5 2.5 3	Single stemmed and vertical with a slightly unbalanced crown. No evidence of previous pruning. Strimmer damage at the base of the stem. In an acceptable condition at present.	Re-inspect annually.	GOOD	GOOD	MOD	40+	B
T 28	Mature Weeping Willow *Salix x sepulcralis*	12	2	2 W	71	6.5 7 5.5 8	Single stemmed and vertical with a slightly unbalanced crown. Overhanging the footpath and the road. Good branch junctions throughout. Occasional pruning wounds (healing well). Minor deadwood observed.	Crown clean.	GOOD	GOOD	HIGH	40+	B
T 29	Early-mature Poplar sp *Populus sp*	13	3	3 S	47	7.5 4.5 4.5 3.5	Single stemmed and leaning to the north with an unbalanced crown. No evidence of previous pruning. Minor deadwood observed. In an acceptable condition at present.	No action required.	GOOD	GOOD	HIGH	40+	C

Appendix 1 *Tree Descriptions and Recommendations* *Ref:10610/PH*

Tree Ref.	Age Species *Latin Name*	Height (m)	Crown Height (m)	Height (m) & Direction of Lowest Branch	Diameter (cm)	Crown Spread N W E S	Observations	Recommendations	Physiological Condition	Structural Condition	Amenity Value	Life Expectancy (yrs)	Retention Category
T 30	Early-mature Poplar sp. *Populus sp.*	12	5	5 S	37	5.5 4 4 4	Previously twin stemmed but now single stemmed. Vertical with a slight lean and a reasonably balanced crown. A large wound at 0.5m is healing slowly. Occasional pruning wounds noted (healing slowly). In an acceptable condition at present.	Re-inspect annually.	FAIR	FAIR	MOD	10-20	C
T 31	Semi-mature Lombardy Poplar *Populus nigra 'Italica'*	15	4	4 SE	36	1 1 1 1	Single stemmed and vertical with a sparse balanced crown. No evidence of previous pruning. No major visible defects.	No action required.	GOOD	GOOD	MOD	40+	C
T 32	Semi-mature Lombardy Poplar *Populus nigra 'Italica'*	15	6	6 N	35	1 1 1 1	Single stemmed and vertical with a balanced crown. No evidence of previous pruning. No major visible defects.	No action required.	GOOD	GOOD	MOD	40+	C
T 33	Semi-mature Lombardy Poplar *Populus nigra 'Italica'*	15	3	3 S	46	1 1 1 1.5	Single stemmed and vertical with a balanced crown. No evidence of previous pruning. No major visible defects.	No action required.	GOOD	GOOD	MOD	40+	C
T 34	Early-mature Aspen *Populus tremula*	14	7	7 S	53	5.5 4.5 5 3	Single stemmed and vertical with an unbalanced crown. No evidence of previous pruning. No major visible defects.	No action required.	GOOD	GOOD	HIGH	40+	B
T 35	Young Aspen *Populus tremula*	8	7	7 N	15	1 2 2 1	Single stemmed and vertical with a slightly unbalanced crown. No evidence of previous pruning. Deadwood observed. No major visible defects.	No action required.	GOOD	GOOD	MOD	40+	C
T 36	Early-mature Lombardy Poplar *Populus nigra 'Italica'*	15	6	6 S	50	1 1 1 2	Single stemmed and vertical with an unbalanced, sparse crown. No evidence of previous pruning. Exposed roots at the base. Deadwood observed in the upper crown.	Crown clean.	FAIR	GOOD	MOD	10-20	C
T 37	Semi-mature Ash *Fraxinus excelsior*	9	4	4 E	22	1.5 1 3.5 3	Single stemmed and vertical with an unbalanced crown. Overhanging the road. No evidence of previous pruning. No major visible defects.	No action required.	GOOD	GOOD	LOW	40+	C
T 38	Semi-mature Cherry sp. *Prunus sp.*	9	3	3 S	22	1 2.5 2 3.5	Single stemmed and vertical with an unbalanced crown. Overhanging the road. No evidence of previous pruning. No major visible defects.	No action required.	GOOD	GOOD	LOW	40+	B
T 39	Semi-mature Lombardy Poplar *Populus nigra 'Italica'*	14	7	7 N	42	1 0.5 0.5 0.5	Single stemmed and vertical with an unbalanced, sparse crown. No evidence of previous pruning. Deadwood observed.	Crown clean.	POOR	FAIR	LOW	20-40	C

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Tree Ref.	Age Species *Latin Name*	Height (m)	Crown Height (m)	Height (m) & Direction of Lowest Branch	Diameter (cm)	Crown Spread N W E S	Observations	Recommendations	Physiological Condition	Structural Condition	Amenity Value	Life Expectancy (yrs)	Retention Category
G 40	Semi-mature Elm sp. *Ulmus sp.*	To 10	4	4 S	29	1.5 6 7 8.5	Two specimens - both single stemmed and vertical with unbalanced crowns. Overhanging the road. No evidence of previous pruning.	No action required.	GOOD	GOOD	MOD	40+	B
T 41	Early-mature Lombardy Poplar *Populus nigra 'Italica'*	15	8	8 N	59	2 1 1 2	Single stemmed and vertical with an unbalanced crown. No evidence of previous pruning. Deadwood observed.	Crown clean.	FAIR	GOOD	LOW	40+	C
T 42	Semi-mature Cherry sp. *Prunus sp.*	5.5	4	4 S	12	0 3 1 4	Single stemmed and vertical with a one sided crown. Overhanging the road. No evidence of previous pruning. No major visible defects.	No action required.	GOOD	GOOD	LOW	40+	C
T 43	Early-mature Lombardy Poplar *Populus nigra 'Italica'*	16	7	7 W	65	2 3.5 1 2	Single stemmed and vertical with an unbalanced crown. Overhanging the road. No evidence of previous pruning. Deadwood observed. No major visible defects.	Crown clean.	GOOD	GOOD	MOD	40+	C
T 44	Young Aspen *Populus tremula*	8	4	4 W	20	2.5 4.5 2 4.5	Single stemmed and vertical with a kinked stem and a slightly unbalanced crown. No evidence of previous pruning. In an acceptable condition at present.	No action required.	GOOD	FAIR	LOW	40+	C
T 45	Early-mature Lombardy Poplar *Populus nigra 'Italica'*	15	5	4 NW	57	2 2.5 1 2.5	Single stemmed and vertical with an unbalanced crown. A major cavity was noted to the stem at 1m on the west side along with a major cavity to the buttress with internal decay on the east side. No evidence of previous pruning. Limited long term future.	Remove to ground level.	FAIR	FAIR	LOW	10-20	U

Appendix 2: Explanation of Tree Descriptions

A2.1 Measurements

A2.1.1 *HEIGHT* of the tree is measured from the stem base in metres. Where the ground has a significant slope the higher ground is selected.

A2.1.2 *CROWN HEIGHT* is an indication of the average height at which the crown begins. Also recorded is the height of the first significant branch and the direction of growth.

A2.1.3 *STEM DIAMETER* is measured at 1.5 metres above (higher) ground level. Where the tree is multi-stemmed below a height of 1.5 metres, the diameter is measured at the narrowest point below the fork.

A2.1.4 *CROWN SPREAD* is measured from the centre of the stem base to the tips of the branches in all four cardinal points.

A2.2 Evaluations

A2.2.1 *AGE CLASS* of the tree is described as young, semi-mature, early-mature, mature, or over-mature.

A2.2.2 *PHYSIOLOGICAL CONDITION* is classed as good, fair, poor, or dead. This is an indication of the health of the tree and takes into account vigour, presence of disease and dieback.

A2.2.3 *STRUCTURAL CONDITION* is classed as good, fair or poor. This is an indication of the structural integrity of the tree and takes into account significant wounds, decay and quality of branch junctions.

A2.2.4 *LIFE EXPECTANCY* is classed as; less than 10 years, 10-20 years, 20-40 years, or more than 40 years. This is an indication of the number of years before removal of the tree is likely to be required.

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A2.3 Retention Categories

A2.3.1 ***A (marked green on the plan) = trees of high quality; retention most desirable.***

These trees are of high quality and value with a good life expectancy. They may be further sub-divided as follows:

A1) Particularly good examples; perhaps rare or unusual species, or forming an essential part of arboricultural features e.g. avenues.

A2) Groups of trees having a significant landscape impact or with excellent screening properties, or those softening the effect of existing structures.

A3) Those having significant conservation or historical value e.g. veteran trees.

A2.3.2 ***B (marked in blue on the plan) = trees of moderate quality; retention desirable.***

These trees are of moderate quality and value with a significant life expectancy. They may be further sub-divided as follows:

B1) Trees that might be included in the high category but because of their numbers or slightly impaired condition, are downgraded in favour of the better individuals.

B2) Groups of trees forming distinct landscape features, thereby attracting a higher collective rating than they might as individuals.

B3) Trees with clearly identifiable conservation or other cultural benefits.

A2.3.3 ***C (marked in grey on the plan) = trees of low quality but which could be retained.***

These trees are of low quality and value, and are in adequate condition to remain until new planting could be established. They may be further sub-divided as follows:

C1) Trees not qualifying in higher categories.

C2) Groups of trees which do not form a distinct landscape feature.

C3) Trees with very limited conservation or other cultural benefits.

A2.3.4 ***U (marked in red on the plan) = unsuitable for retention: trees for removal.***

These trees are in such a condition that any existing value would be lost within 10 years. This may be due to any of the following:

1) Failure is likely due to serious, irredeemable, structural defects.
2) The trees are considered to be hazardous.
3). Diseases are present which may affect the health of adjacent trees.
4) They are in serious, overall decline or are already dead.
5) They are of low quality and suppressing adjacent trees of better quality.
6) Removal of other category U trees will render them exposed and unstable.

These trees should be removed or treated in such a way as to make them safe where they have high ecological value, such as in a woodland setting.

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Appendix 3: General Guidelines

A3.1 All work must be to BS 3998: 2010 - '*Recommendations for tree work'*.

A3.2 Staff carrying out the work must be qualified, experienced and ideally be Arboricultural Association approved contractors. They should be covered by adequate public liability insurance.

A3.3 This report is based upon a visual inspection. The consultant shall not be responsible for events which happen after this time due to factors which were not apparent at the time, and the acceptance of this report constitutes an agreement with the guidelines and the terms listed in this report.

A3.4 Any defects seen by a contractor or the employer that were not apparent to the consultant must be brought to the consultant's attention immediately.

A3.5 No liability can be accepted by JCA Limited in respect of the trees unless the recommendations of this report are carried out under the supervision of JCA and within JCA's timescale.

A3.6 It is advisable to have trees inspected by an arboricultural consultant regularly. In this instance it is recommended that these inspections are made every year.

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Appendix 4: Glossary of Terms & Abbreviations

Arboriculture The cultivation of trees in order to produce individual specimens of the greatest ornament, for shelter or any primary purpose other than the production of timber.

Canker Disease damaged area of a tree, usually caused by fungus or bacteria.

Co-dominant Stem A stem which has grown in direct competition to the main stem and which has formed a substantial size influencing the appearance of the tree.

Crown Lift The removal of the lowest branches, usually to a given height. It allows more residual light and greater clearance underneath for vehicles, etc.

Crown reduce The reduction of a tree's height or spread while preserving its natural shape.

Crown thin The removal of some of the density of a tree's crown**,** usually 5-25% allowing more light through its canopy and reducing wind resistance.

Deadwood Either dead branches, or a procedure involving the removal of dead, dying and diseased branches.

Dieback Where branches are beginning to show signs of death usually at the tips in the crown.

Epicormic shoots Small branches that grow in uncharacteristic clusters around the base or the stem of a tree, usually as a result of bad pruning or some other stress factor.

Formative pruning The trimming of a tree to remove weaknesses and irregularities which may lead to problems. The formative pruning operation is aimed at reducing the potential for future weaknesses or problems within the tree's crown.

Included bark Where the bark on two adjoining branches or stems is growing tight together, forming a joint with limited physical strength.

Pollarding A method of tree management in which the main trunk of the tree is cut at about 4m, and the resulting branches are then cropped on a regular basis.

Remedial pruning The removal of old stubs, deadwood, epicormic growth, rubbing or crossing branches and other unwanted items from the tree's crown. Sometimes referred to as crown cleaning.

RPA Root Protection Area – The theoretical rooting area of a tree as defined in BS5837: 2005 *Trees in relation to construction*.

Topping Topping is a form of pruning that removes terminal growth leaving a 'stub' cut end. Topping causes serious health problems to a tree.

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Appendix 5: Author Qualifications

Principal Consultant and Managing Director

Jonathan Cocking F.R.E.S., Tech. Cert. (Arbor.A), PDipArb (RFS) FArborA CBiol MSB. MICFor. Jonathan is a Registered Consultant and Fellow of the Arboricultural Association and sits on its Professional Committee. He has 31 years experience in the Arboricultural profession and served for eight years as Senior Arboriculturist with a large local authority before establishing JCA in 1997. He has since developed JCA's portfolio of services and its extensive client base. Jonathan is a Chartered Biologist, a Chartered Arboriculturalist and an Expert Witness with much experience of litigation work.

Technical Coordinator

Toby Thwaites *BSc (Hons), HND (Arboriculture).* Toby joined JCA in 1998 after graduating in Ecology at the University of Huddersfield and has since graduated in Arboriculture at the University of Lancashire. A former JCA team leader and Consulting Arboriculturist, Toby was promoted to Technical Coordinator and now oversees all office and on-site activities at JCA and is on hand to offer technical support and advice.

Consulting Staff: Arboriculture

Andrew Bagshaw *FdSc (Arboriculture).* Andrew joined JCA in 2005 having gained several years experience in tree surgery and landscaping. He is trained in aerial rescue and is JCA's principal first aid person. Andrew has obtained a foundation degree in Arboriculture at the University of Lancashire, is QTRA qualified and is a JCA team leader who manages an office of Consulting Arboriculturists.

Adam Winson *Chartered Arboriculturist, MSc, BSc (Hons), ND, MICFor, AIEEM.* Adam has extensive experience in arboriculture, having worked with trees for over 15 years. In 2010 Adam obtained an MSc in Arboriculture and Urban Forestry (with distinction), also gaining the top student award. Adam has had articles published in industry magazines including original research in a peer reviewed UK Forestry Commission publication in 2012.

Robert Godwin *BA (Hons), MSc (Arboriculture and Urban Forestry), MArborA.* Robert is a Professional Member of the Arboricultural Association and a Professional Associate of the Institute of Chartered Foresters. He has a degree in Landscape Planning & Management and has several years experience as a Consulting Arboriculturist. Robert has recently obtained an MSc in Arboriculture and Urban Forestry.

Victoria Black *FdSc (Arboriculture).* Victoria has been with JCA since 2002 building her knowledge of the Arboricultural business. She has recently obtained her foundation degree in Arboriculture at the University of Lancashire.

Andrew Bussey Andrew joined JCA having spent 12 years doing tree surgery for various private companies and a Local Authority. He has various NPTC qualifications, is QTRA qualified and is currently studying for his Arboricultural Technicians Certificate.

Toby Parsons *Cert. Arb. (RFS), Tech. Cert. (Arbor.A).* Toby joined JCA after spending 6 years working as a senior climber for various Arboricultural contractors in the East Midlands and the South-West. He has gained the Level 2 Certificate in Arboriculture (RFS), an Arboricultural Technicians Certificate and is QTRA qualified.

Phil Humeniuk *FdSc (Arboriculture), MicFor.* Phil has recently joined JCA having spent 3 years working for various tree surgery companies and as a Tree Officer for a Local Authority. He obtained his foundation degree in Arboriculture at the University of Central Lancashire and is qualified in LANTRA's Professional Tree Inspection

Consulting Staff: Ecology

Christopher Shaw *BSc (Hons).* Chris is our in-house Ecologist, and joined JCA in 2010 after achieving a First Class degree in Biology at the University of Leeds. Prior to joining JCA, Chris has volunteered with a number of organisations including the Yorkshire Wildlife Trust, BTCV and a local Ecological Consultancy. He is currently undertaking a 'Certificate in Ecological Consultancy Course' with Acorn Ecology. Chris is actively involved in building JCA's portfolio of ecological services.

Administrative Staff

Sue Guest Administrative Team Leader.
Sally Whitwam Administrative Assistant.
Simeon Haigh *BSc (Hons).* IT Officer.
Catherine Cocking Accounts Manager.
Yasmin Hussain Administrative Assistant.
Liz Bone Trainee Administrative Assistant

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Appendix 6: Tree Constraints Plan

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I hope that this report provides all the necessary information, but should any further advice be needed please do not hesitate to contact the author.

Signed

Phil Humeniuk

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For and on behalf of:-

Jonathan Cocking *F.R.E.S., Tech. Cert. (Arbor.A), PDipArb (RFS) FArborA CBiol MSB. MICFor.*

21st May 2012

For and on behalf of ***JCA Ltd***

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Root Protection Area: RPA

THE ROOT PROTECTION AREA (RPA) INDICATES THE LIKELY ROOTING ZONE OF A TREE. THE RPA SHOULD IDEALLY REMAIN UNDISTURBED IF A TREE IS TO BE RETAINED.

THE DEVELOPMENT PROPOSALS SHOULD THEREFORE BE DESIGNED TO AVOID THE RPA OF ANY TREE WHICH IS TO BE RETAINED.

IF IT IS NECESSARY FOR THE DEVELOPMENT TO ENCROACH INTO THE RPA OF A TREE WHICH IS TO BE RETAINED THEN SPECIALIST CONSTRUCTION TECHNIQUES AND MATERIALS MUST BE CONSIDERED.

Appendix 6: Tree Constraints Plan

TITLE:
New Graphene Hub, University of Manchester.
JCA Ref: 10610/PH.

SCALE : 1:200	PAPER SIZE : A1

SURVEYED BY: PH	DRAWN BY: TT	APPROVED BY: PH

BRITISH STANDARD 5837:2012: 4.5 RETENTION CATEGORIES

Detailed definitions of these catagories are at Appendix 2 of our report. N.B. These categories do not necessarily represent or correspond to recommendations for action made in this report.

	CATEGORY A: 'RETENTION MOST DESIRABLE'
	CATEGORY B: 'RETENTION DESIRABLE'
	CATEGORY C: 'TREE WHICH COULD BE RETAINED'
	CATEGORY U: 'TREE FOR REMOVAL'
	ROOT PROTECTION AREA
	CENTRE OF TREE/SHRUB
	CENTRE OF TREE/SHRUB TO BE REMOVED

JCA Limited
Arboricultural & Forestry Consultants

Appendix M | BREEAM Pre-Assessment

BREEAM Pre-Assessment

BREEAM

During August 2012 a BREEAM pre-assessment was undertaken to determine the potential score the National Graphene Institute (NGI) building could achieve. The building is required by Manchester City Council planning authority to achieve a BREEAM Very good rating. However the University of Manchester has the aspiration for achieving a minimum of 65% within the Very Good rating.

BREEAM Rating	% Score
Unclassified	< 30
Pass	≥ 30
Good	≥ 45
Very Good	≥ 55
Excellent	≥ 70
Outstanding	≥ 85

Scope

The pre-assessment has been undertaken following the most recent version of the BREEAM 2011 New Construction scheme manual (SD5073:2.0). The pre-assessment assesses the development using the design stage criteria. The proposed NGI project will be assessed as a new build under the BREEAM criteria.

Minimum Standards

In addition to the minimum percentage score required to achieve a BREEAM rating, there are minimum standards applicable to the rating level which must be complied with.

BREEAM Credit	VERY GOOD	EXCELLENT
Man 01 - Sustainable Procurement	1	1
Man 02 - Responsible Construction Practices	-	1
Man 04 - Stakeholder Participation	-	1 (Building User Information)
Hea 01 – Visual Comfort	Criterion 1 only	Criterion 1 only
Hea 04 - Water Quality	Criterion 1 only	Criterion 1 only
Ene 01 - Reduction of CO_2 Emissions	-	6
Ene 02 - Energy Monitoring	1 (First sub-metering credit)	1 (First sub-metering credit)
Ene 04 - Low or Zero Carbon Technologies	-	1
Wat 01 - Water Consumption	1	1
Wat 02 - Water Monitoring	Criterion 1 only	Criterion 1 only
Mat 03 – Responsible Sourcing	Criterion 3 only	Criterion 3 only
Wst 01 – Construction Waste Management	-	-
Wst 03 - Operational Waste	-	1
Le3 - Mitigating Ecological Impact	1	1

Pre-Assessment Score

At this stage, using the information and commitments provided from the design team, the proposed development could potentially achieve a BREEAM Very Good rating of 69.72%. This is looking at the project at its current status of design, without making any major changes. The pre-assessment includes assumptions that the project team will fulfil the minimum standards that are fundamental to achieving a BREEAM Very Good rating.

The table below presents the number of credits attained for each section.

Section	Available	Current
Management	22	18
Health & Wellbeing	16	9
Energy	32	19
Transport	11	10
Water	9	5
Materials	13	9
Waste	6	4
Land Use & Ecology	10	7
Pollution	13	9
Innovation	15	2
Total	**147**	**73**
Current:	**69.72%**	

Management

Man 01 Sustainable Procurement
Aim: To ensure delivery of a functional and sustainable asset designed and built in accordance with performance expectations.
5 out of 8 credits targeted.

Man 02 Responsible Construction Practices
Aim: To recognise and encourage construction sites which are managed in an environmentally and socially considerate, responsible and accountable manner.
2out of 2 credits targeted.

Man 03 Construction Site Impacts
Aim: To recognise and encourage construction sites managed in an environmentally sound manner in terms of resource use, energy consumption and pollution.
5 out 5 credits targeted.

Man 04 Stakeholder Participation
Aim: To design, plan and deliver accessible functional and inclusive buildings in consultation with current and future building users and other stakeholders.
3 out of 4 credits targeted.

Man 05 Life Cycle Cost and Service Planning
Aim: To recognise and encourage life cycle costing and service life planning in order to improve design, specification and through-life maintenance and operation.
3 out of 3 credits targeted.

Health & Wellbeing

Hea 01 Visual Comfort
Aim: To ensure daylighting, artificial lighting and occupant controls are considered at the design stage to ensure best practice visual performance and comfort for building occupants.

BREEAM Pre-Assessment

1 out of 4 credits targeted.

Hea 02 Indoor Air Quality
Aim: To recognise and encourage a healthy internal environment through the specification and installation of appropriate ventilation, equipment and finishes.
3 out of 5 credits targeted.

Hea 03 Thermal Comfort
Aim: To ensure that appropriate thermal comfort levels are achieved through design, and controls are selected to maintain a thermally comfortable environment for occupants within the building.
2 out of 2 credits targeted.

Hea 04 Water Quality
Aim: To minimise the risk of water contamination in building services and ensure the provision of clean, fresh sources of water for building users.
1 out 1 credits targeted.

Hea 05 Acoustic Performance
Aim: To ensure the buildings' acoustic performance including sound insulation meet the appropriate standards for its purpose.
1 out 2 credits targeted.

Hea 06 Safety and Security
Aim: To recognise and encourage effective design measures that promote low risk, safe and secure access to and use of the building.
1 out 2 credits targeted.

Energy

Ene 01 Reduction of CO_2 Emissions
Aim: To recognise and encourage buildings designed to minimise operational energy demand, consumption and CO2 emissions.
4 out of 15 credits targeted.

Ene 02 Energy Monitoring
Aim: To recognise and encourage the installation of energy sub-metering that facilitates the monitoring of operational energy consumption.
2 out of 2 credits targeted.

Ene 03 External Lighting
Aim: To recognise and encourage the specification of energy-efficient light fittings for external areas of the development.
1 out of 1 credits targeted.

Ene 04 Low and Zero Carbon Technologies
Aim: To reduce carbon emissions and atmospheric pollution by encouraging local energy generation from renewable sources to supply a significant proportion of the energy demand.
4 out 5 credits targeted.

Ene 06 Energy Efficient Transportation Systems
Aim: To recognise and encourage the specification of energy-efficient transportation systems.
2 out 2 credits targeted.

Ene 07 Energy Efficient Laboratory Systems
Aim: To recognise and encourage laboratory areas that are designed to minimise the CO2 emissions associated with their operational energy consumption.
4 out 5 credits targeted.

Ene 08 Energy Efficient Equipment
Aim: To recognise and encourage procurement of energy-efficient equipment to ensure optimum performance and energy savings in operation.
2 out 2 credits targeted.

Transport

Tra 01 Public Transport Accessibility
Aim: To recognise and encourage development in proximity of good public transport networks, thereby helping to reduce transport-related pollution and congestion.
4 out 5 credits targeted.

Tra 02 Proximity to Amenities
Aim: To encourage and reward a building that is located in close proximity to local amenities, thereby reducing the need for extended travel or multiple trips.
1 out of 1 credits targeted.

Tra 03 Cyclist Facilities
Aim: To encourage building users to cycle by ensuring adequate provision of cyclist facilities.
2 out of 2 credits targeted.

Tra 04 Maximum Car Parking Capacity
Aim: To encourage the use of alternative means of transport to the building other than the private car, thereby helping to reduce transport related emissions and traffic congestion associated with the building's operation.
2 out of 2 credits targeted.

Tra 05 Travel Plan
Aim: To recognise the consideration given to accommodating a range of travel options for building users, thereby encouraging the reduction of user reliance on forms of travel that have the highest environmental impact.
1 out of 1 credits targeted.

Water

Wat 01 Water Consumption
Aim: To reduce the consumption of potable water for sanitary use in new buildings from all sources through the use of water efficient components and water recycling systems.
2 out 5 credits awarded.

Wat 02 Water Monitoring
Aim: To ensure water consumption can be monitored and managed and therefore encourage reductions in water consumption.
1 out of 1 credits targeted.

Wat 03 Leak Detection
Aim: To reduce the impact of water leaks that may otherwise go undetected.
2 out of 2 credits targeted.

Wat 04 Water Efficient Equipment
Aim: To reduce unregulated water consumption by encouraging specification of water efficient equipment.
0 out 1 credit targeted.

Materials

Mat 01 Life Cycle Impacts
Aim: To recognise and encourage the use of construction materials with a low environmental impact (including embodied carbon) over the full life cycle of the building.
4 out of 6 credits targeted.

Mat 02 Hard Landscaping and Boundary Protection
Aim: To recognise and encourage the specification of materials for boundary protection and external hard surfaces that have a low environmental impact, taking account of the full life cycle of materials used.
0 out 1 credit targeted.

Mat 03 Responsible Sourcing of Materials
Aim: To recognise and encourage the specification of responsibly sourced materials for key building elements.
2 out of 3 credits targeted.

Mat 04 Insulation
Aim: To recognise and encourage the use of thermal insulation which has a low embodied environmental impact relative to its thermal properties and has been responsibly sourced.
2 out of 2 credits targeted.

Mat 05 Designing for Robustness
Aim: To recognise and encourage adequate protection of exposed elements of the building and landscape, therefore minimising the frequency of replacement and maximising materials optimisation.
1 out 1 credits targeted.

Waste

Wst 01 Construction Waste Management
Aim: To promote resource efficiency via the effective management and reduction of construction waste.
3 out of 4 credits targeted.

Wst 02 Recycled Aggregates
Aim: To recognise and encourage the use of recycled and secondary aggregates, thereby reducing the demand for virgin material and optimising material efficiency in construction.
0 out of 1 credit targeted.

Wst 03 Operational Waste
Aim: To recognise and encourage the provision of dedicated storage facilities for a building's operational-related recyclable waste streams, so that this waste is diverted from landfill or incineration.
1 out 1 credits targeted.

Land Use and Ecology

LE 01 Site Selection
Aim: To encourage the use of previously developed and/or contaminated land and avoid land which has not been previously disturbed.
1 out of 1 credit targeted.

LE 02 Ecological Value of Site and Protection of Ecological Features
Aim: To encourage development on land that already has limited value to wildlife and to protect existing ecological features from substantial damage during site preparation and completion of construction works.
1 out of 1 credit targeted.

LE 03 Mitigating Ecological Impact
Aim: To minimise the impact of a building development on existing site ecology.
1 out of 2 credits targeted.

LE 04 Enhancing Site Ecology
Aim: To recognise and encourage actions taken to maintain and enhance the ecological value of the site as a result of development.
2 out of 3 credits targeted.

LE 05 Long Term Impact on Biodiversity
Aim: To minimise the long term impact of the development on the site and the surrounding area's biodiversity.
2 out of 2 credits targeted.

Pollution

Pol 01 Impact of Refrigerants
Aim: To reduce the level of greenhouse gas emissions arising from the leakage of refrigerants from building systems.
1 out of 3 credits targeted.

Pol 02 NOx Emissions
Aim: To encourage the supply of heat and/or coolth from a system that minimises NOx emissions, and therefore reduces pollution of the local environment.
2 out of 3 credits targeted.

Pol 03 Surface Water Run Off
Aim: To avoid, reduce and delay the discharge of rainfall to public sewers and watercourses, therefore minimising the risk of localised flooding on and off site, watercourse pollution and other environmental damage.
4 out of 5 credits targeted.

Pol 04 Reduction of Night Time Light Pollution
Aim: To ensure that external lighting is concentrated in the appropriate areas and that upward lighting is minimised, reducing unnecessary light pollution, energy consumption and nuisance to neighbouring properties.
1 out of 1 credit targeted.

Pol 05 Noise Attenuation
Aim: To reduce the likelihood of noise from the new development affecting nearby noise-sensitive buildings.
1 out 1 credit targeted.

Potential Score

There are a number of credits that are not included within the current pre-assessment but have been indicated by the design team as potentially feasible. Further investigation is required by the design team to confirm the inclusion of these credits within the current score. These credits account for 17.17% and if included would increase the current score 72.95% a BREEAM Excellent rating.

Section		Available	Current	Potential	Comments
Water					
Wat 01	Water Consumption	5	2	1	40% water consumption improvement (Criterion 1 - 6)
	Water score totals:	9	5	1	
Materials					
Mat 01	Life Cycle Impacts	6	2	2	Attain 10 Mat 01 points (Criterion 1 -3)
Mat 03	Responsible Sourcing of Materials	3	1	1	Attain 36% of Mat 03 points (Criterion 1 - 2)
	Materials score totals:	13	9	3	
Land Use & Ecology					
LE 04	Enhancing Site Ecology	3	1	1	Increase ecological value of site by 6 species (Criterion 3 - 5)
	Land Use & Ecology score totals:	10	7	1	
Pollution					
Innovation					
Man 02	Responsible Construction Practices	1	1	0	
Hea 01	Visual Comfort	1	0	0	
Ene 01	Reduction of CO2 Emissions	5	0	0	
Ene 04	Low or Zero Carbon Technologies	1	0	0	
Wat 01	Water Consumption	1	0	0	
Mat 01	Life Cycle Impacts	1	0	0	
Mat 03	Responsible Sourcing of Materials	1	0	0	
Wst 01	Construction Waste Management	1	1	0	
Wst 02	Recycled Aggregates	1	0	0	
	Innovation score totals:	14	2	0	
	OVERALL SCORE TOTALS:	**114**	**8**	**10**	

BREEAM Pre-Assessment

Summary

The BREEAM 2011 New Construction pre-assessment has identified that the proposed NGI project could achieve a BREEAM 'VERY GOOD' rating of 69.72%. This is based on the information provided by the design team at this stage. A number of credits have been identified as potentially achievable equating to 6.86% or a total of 76.58%, an Excellent rating, however due to the ENE01 minimum standard not able to be achieved the potential rating still remains as Very Good. Further investigation is needed by the design team to determine whether these credits can be included in the current targeted score. This is based on the project team providing all of the necessary information to support the assessment throughout the Design and Post-Construction stages.

Appendix N | Sustainable Travel Plan

The University of Manchester

Sustainable Travel Plan 2012 – 2015

Document control box	
Title:	**Sustainable Travel Plan 2012 – 2015**
Date approved:	TBC
Approving body:	Director of Estates and Facilities via Environmental Sustainability Strategy Group
Implementation date:	September 2012
Version:	Three
Next review date:	January 2014
Owner:	Andrew Hough, Sustainable Travel Planner

1. Executive Summary

This latest *University Sustainable Travel Plan* builds upon previous versions by increasing its scope to cover travel in a broader sense. Previously the strategy focused almost entirely on staff commuter journeys and has achieved significant success (section 8). However, it is the intention of this document to also incorporate student commuter travel, business travel and fleet vehicles. There are two key reasons for doing this. Firstly, it seems sensible to provide a high level strategy encompassing all the main aspects of travel and secondly, the introduction of Scope 3 carbon emissions reporting across the sector (section 2). With the additional aspects of travel, the main aim is to better understand our current position before then looking to produce meaningful targets going forward, such has been done with staff commuter travel.

Travel is a far reaching subject area affecting every staff member, student and visitor. Through ten key aims (section 6) and a detailed delivery plan (section 9), the aim is to provide focus and direction until 2015. Many of the measures and initiatives contained can only be taken forward with support from Directorates, Faculties and colleagues from across the University, and the success of the Sustainable Travel Plan is very dependent upon this cross University action to promote and adopt more sustainable travel options.

2. Strategic Context

The University's *Strategic Plan 2020* has a clear focus on sustainability. Each of its three core goals, relating to research, higher learning and social responsibility include an explicit commitment to sustainability. In addition, one of its eight enabling strategies focuses exclusively on environmental sustainability with the stated aim of making environmental sustainability a key priority across the full range of our activities.

The University has already set a challenging target of 40% reduction in its carbon footprint by 2020 (based on a 2007/2008 baseline). To achieve this, a significant commitment to carbon reduction has already been made. This is largely contained in the University's *Carbon Management Plan 2009 - 2015*[1] *(CMP).* The remit of the *CMP* is restricted largely to reducing Scope 1 and Scope 2 emissions[2]. However, and of real importance with regards to travel, the Higher Education Funding Council for England (HEFCE) is placing requirements on universities regarding the measurement and monitoring of Scope 3 emissions (indirect emissions, namely travel, waste, water and procurement). Guidance with regards to travel has been published providing a sector wide methodology[3]. The University will be required to measure and report its Scope 3 travel emissions from 2012/13, accounting for business travel emissions, as well as emissions from the staff and student commute.

Scope 3 emissions from travel provide a key driver for this document as travel will, over time, become embedded in the University's carbon footprint and associated targets. This is reflected in the Environmental Sustainability Plan (ESP) which aims to go beyond the CMP and bring together all areas of environmental sustainability. The ESP sets out objectives and targets with regards to sustainable travel and it is beneath this strategy that this document sits.

3. Additional Key Drivers

As stated above, environmental sustainability is the key driver for this document but there are many other key drivers for the production and implementation of a Sustainable Travel Plan (STP), namely:

- **Social Responsibility**
  As stated in the Strategic Vision 2020 under Social Responsibility: 'The University will be a sustainable and socially responsible institution, minimising the impact of its own activities on the environment.'
- **Reputation**
  Being seen as a University that actively promotes environmental sustainability can help with recruitment and retention of both staff and students, with many applicants now giving serious consideration to an organisation's environmental credentials.
- **Managing car park demand**
  Provision and promotion of information on alternative, more sustainable travel options will assist in reducing the number of cars accessing the site lowering demand for University car parks. This presents opportunities for more efficient use of land and more efficient car park management, particularly with regard to the Estates Master Plan and associated campus developments[4]
- **Local and regional sustainable transport schemes**[5]
  Greater Manchester is to set to benefit from a range of sustainable travel schemes over the coming years which will improve bus (Cross City Bus), train (The Northern Hub), tram (Metrolink expansion) and cycle (Local Sustainable Transport Fund) access to the University and provide a more pleasant environment through the removal of general traffic on the south campus section of Oxford Road.
- **Reducing expenditure**
  Encouraging sustainable travel and video conferencing for business trips can, in many cases, reduce University costs.
- **Reducing congestion and improving air quality**
  Reducing the numbers travelling by car reduces congestion on local roads and streets, helps improve journey efficiency and improves the air quality and environment for local residents, staff and students.
- **Promoting healthy living**
  By encouraging greater levels of cycling, walking and public transport use staff and students benefit from the associated health benefits. The University also benefits from having a healthier workforce.

4. Vision

The University's Environmental Sustainability vision is:
'To transform The University of Manchester into a low carbon institution, whilst educating our students and delivering leading research, to address the global challenge of sustainability.'

The Sustainable Travel Plan's vision is:
'To embed a culture of sustainable travel whereby staff and students understand the impact of their travel habits and choose to walk, cycle, use public transport, car share or video conference whenever feasible.'

5. Current Estimate of Total Carbon Emissions from Travel

This section outlines the current situation regarding the calculation of the University's carbon emissions from travel.

Scope 1 travel emissions

In terms of direct carbon emissions (Scopes 1 and 2), fleet vehicles are the only aspect of travel that fit into this category.

- **Fleet Vehicles** As part of the Carbon Management Plan (CMP) fleet emissions for 2009/10 were calculated as **344 tonnes** (including University's proportion of the Oxford Road Link bus)

Scope 3 travel emissions

The University intends to calculate its travel related carbon emissions based on HEFCE Scope 3 emissions guidance. However, work has already been undertaken to begin to better understand the University's affect upon the environment with regard to indirect emissions from travel.

- **The Staff Commute** In 2010, as part of the staff travel survey, a carbon footprint for annual commuting was calculated as **8,037 tonnes** of CO_2[6] for the academic year 2009/10
- **The Student Commute** In order to begin to understand the affect of student commuting in terms of carbon, a first estimate has been made which suggests an annual figure of **6,661 tonnes**
- **Business Travel** As part of the Carbon Management Plan (CMP), business travel emissions for 2009/10 were calculated as **12,328 tonnes**

Travel Carbon Emissions Summary

There is no doubt that there will be inaccuracies in this data. However, it is important to make an initial estimate based on available data in order to highlight issues with data collection and to start to understand the contribution travel (from Scopes 1 and 3) makes to the University's

[1] http://www.sustainability.manchester.ac.uk/campus/energy/cmanagement

[2] Scope 1 and 2 emissions are those under the direct control of the University e.g. gas, electricity, and in transport terms, University fleet vehicles.

[3] http://www.hefce.ac.uk/pubs/hefce/2012/12_02/12_02.pdf

[4] http://www.staffnet.manchester.ac.uk/news/display/?id=8848

[5] www.tfgm.com

[6] http://www.sustainability.manchester.ac.uk/campus/travel/surveys

overall emissions. The combination of staff and student commute, business and fleet emissions totals **27,370 tonnes**. The University's 2009/10 total carbon footprint was calculated to be **123,115 tonnes** (not including procurement, which is yet to be calculated). Therefore travel (Scopes 1 and 3) comprises around **22%** of overall carbon emissions. This is not insignificant but is only a guide at this stage.

However, this is a useful starting point to help begin to understand the scale of the issue and it is one of the key aims of this document that data recording accuracy improves, in line with sector guidance, to further understand the full impact of travel with regards to the University's overall carbon footprint. Indeed, the University may well choose to go beyond the limits of sector guidance as it is aware that there is additional travel undertaken connected to the University which could potentially contribute to its overall emissions e.g. student travel, particularly international students, from their home to the University.

6. Aims

In line with the ESP, there are ten key aims that this document sets out to achieve in order to increase the use of sustainable travel across the University, namely;

1. Introduce a new Staff Car Parking Policy focussed on reducing emissions, equality of access and encouraging more flexible travel arrangements.
2. Establish an overall travel carbon emissions baseline based on HEFCE Guidance.
3. Systematically introduce a business travel booking system which enables the full measurement of the carbon impact of travel
4. Systematically introduce a travel expenses system to enable full measurement of the carbon impact of travel.
5. Reduce carbon emissions from business travel by encouraging sustainable travel use and by discouraging unnecessary or carbon intensive travel.
6. Promote videoconferencing as a sustainable and viable alternative option to travel.
7. Encourage cycling as a viable option for both staff and students through the introduction and implement of a suite of initiatives.
8. Work with local and regional transport bodies and operators to improve public transport access and viability for staff, students and visitors.
9. Reduce carbon emissions from fleet vehicles by investing in low emitting vehicles and improve the efficiency of their use.
10. Actively inform visitors of sustainable transport options and encourage their use.

7. Aims Outlined

The University will aim to achieve all of the aims outlined and the accompanying Delivery Plan sets out in more detail how and by when this will be achieved. In this section, each of the aims are outlined with the key objectives and targets included.

1. Introduce a new Staff Car Parking Policy focussed on reducing emissions, equality of access and encouraging more flexible travel arrangements.

Since the introduction of a Travel Plan in 2000 the University has successfully reduced the numbers of staff commuting by car from 56% to 37% in 2010[7]. Currently, allocation of car parking permits is on a first come, first served basis with a salary banded charging structure. A Working Group has been set up to investigate future options for the car park policy with the intention of creating a system that aims to compliment the STP and ESP with regard to further reducing Scope 3 emissions and promoting the use of sustainable travel. In addition, the aim is to provide a system that is equitable and one which supports the differing transport circumstances affecting staff at the University.

Objectives and targets:

- Produce an options paper for the Senior Leadership Team
- Based on the option selected, begin a phased implementation in September 2013

2. Establish an overall travel carbon emissions baseline based on HEFCE guidance.

[7] Staff travel survey data: http://www.sustainability.manchester.ac.uk/campus/travel/surveys

Based on HEFCE transport guidance on Scope 3 emissions, the University will baseline its emissions from both business and commuter travel. Internal work with related departments will need to take place to better understand current provision of data. There is also a need to collate carbon data from the University's fleet vehicles, in line with Scope 1 guidance. Once a baseline is established the University will, as a matter of course, provide data and information for the Higher Education Statistics Agency (HESA) controlled Estates Management Statistics (EMS) submission from 2012/13 and beyond. Over time the quality of this data will be improved through better systems and a greater understanding of the need to capture it.

Objectives and targets:

- Calculate annual fleet vehicle emissions from data available and agree a system for future collection.
- Use business travel expenses information to calculate carbon emissions from individual modes of travel for 2012/13 EMS submission and then annually.
- Capture data from University used Travel Management Companies (TMCs) in order to calculate carbon emissions for 2012/13 EMS submission and then annually.
- Investigate whether any business travel currently takes place outside the expenses and TMCs systems.
- Carry out staff and student sample surveys in order to calculate commuter travel carbon emissions for 2012/13 EMS submission and then survey biennially.

3. Systematically introduce a business travel booking system which improves the measurement of the carbon impact of travel.

Currently, there are a vast range of Travel Management Companies used for the booking of advanced business travel, as well as a variety of other methods. Consequently the availability of the necessary data for carbon calculations is problematic. The University has a preferred supplier agreement with Egencia who have the ability to capture and report on the carbon emissions from staff booked business travel. It is the intention of the University to roll out and encourage the use of the system across all Schools and Directorates in order to improve the quality of data available. Currently (April 2012), all Faculties have the system in place, with Professional and Support Services (PSS) set to implement by June 2012. The system will also improve the efficiency of travel bookings, reduce the associated cost and be better able to trace employees in terms of risk management.

Objectives and targets:

- Support and encourage the use of the Egencia system across all Schools and Directorates
- Work with Egencia to provide carbon reporting that fulfils the University's reporting obligations

4. Systematically introduce a travel expenses system to enable full measurement of the carbon impact of travel.

The University is improving the efficiency of procedures for claiming expenses and availability of this data will enable an accurate calculation of carbon emissions from business travel. It is the intention to improve this process further with the introduction of an online expenses claim system and, as a consequence, carbon data collection will be improved.

Objectives and targets:

- Support the introduction of the new expenses system from the perspective of carbon data collection and ensure that it fulfils the University's reporting obligations.

5. Reduce carbon emissions from business travel by encouraging sustainable travel use, video conferencing (see section 6 below) and restricting unnecessary or carbon intensive travel.

In addition to monitoring usage, which in itself may well help reduce carbon emissions, there is also a need to improve internal procedures and practices with regard to business travel. There are a number of ways this can be done, with some changes requiring a culture change. The intention is to reduce carbon emissions from business travel, which in turn may well provide financial savings for the University.

Objectives and targets:

- An audit of University mileage claim rates and due consideration to using them to promote sustainable travel i.e. introducing a cycle mileage rate and car share rate
- A line manager authorisation procedure for advance travel bookings, as currently provided by Egencia
- Implementing a no domestic flight policy and encouraging train use
- Providing company/pool travel passes for local business travel
- Providing pool bikes for short distance journeys
- Implementing an onsite car club or providing low emitting pool cars
- Providing eco driver training to staff to reduce emissions emitted whilst driving on University business

6. Promote videoconferencing as a sustainable and viable alternative option to travel.

The use of videoconferencing has an important role to play in reducing carbon emissions by completely removing the need to travel. The University currently has three suites available free of charge with full IT support[8]. There are many other 'local' facilities within Faculties and Directorates and, there is the ability to videoconference from an individual's work station. The STP will aim to support IT Services and the Media Services Unit in the further promotion and roll out of videoconferencing as an important way to reduce carbon emissions, improve working practices and reduce financial expenditure.

Objectives and targets:

- Increase the promotion and awareness of videoconferencing and the facilities available across the University
- Audit current facilities and usage and introduce monitoring in order to capture utilisation and consequential carbon savings.
- Investigate the potential for increasing the level of facilities at the University.

7. Implement initiatives and actively encourage cycling as a viable option for commuter journeys of both staff and students.

The University has had real success with encouraging staff to cycle through a variety of measures[9] and has seen a trebling of those using a cycle as their main mode of travel, from 4% in 1999 to 13% in 2010[10]. The University is keen to maintain this momentum and to achieve similar success within the student body, once student cycling rates are benchmarked as part of the Scope 3 data collection.

Objectives and targets:

- Increase the number of staff cycling to work to 15% of staff by 2015 and set targets for student cycling, based on survey results.
- Increase *sheffield* stand cycle parking capacity by 500 (250 stands) by 2015
- Install 3 new secure cycle shelters in addition to current provision over the lifetime of this document
- Reduce the number of cycle thefts by 30% by 2014/15, against 2010/11 figures
- Increase shower and changing provision by around 30% (32 showers to 42) over the next three years using a combination of retrofitting and facilities in new developments
- Improve consultation processes between Project Managers and cyclists in order to make sure new cycle facility provision is as fit for purpose as possible
- Support the Directorate for the Student Experience, the Student Union and other student engaged bodies in the promotion of cycling to future and current students
- Work productively with external cycling related organisations so as to improve access to the University for all cyclists

8. Work with local and regional transport bodies and operators to improve public transport access and viability for staff, students and visitors.

In terms of sustainable travel, public transport is the most viable option for the majority of staff and students. The 2010 staff travel survey showed that 39% used bus, train or tram for their commuter journey. As yet, student public transport use has not been ascertained.

There is no doubt that the ability to increase usage levels is not something the University can achieve in isolation. Being based centrally within a large city means access to public transport options is good but there is still a real need for improvement to public transport access, quality, ticketing and a need to further tackle congestion[11]. In order to make significant strides forward, investment in local and regional infrastructure is needed, along with improvements in service provision and this remains a significant challenge for the City and the region. The University will continue to both lobby and, as appropriate, support the City in improving public transport choices that will directly benefit staff, students and visitors, as well as build positive relationships with local public transport operators.

Objectives and targets:

- Support planned regional and local schemes that promote the use of sustainable travel, such as; the Bus Priority Package, the Northern Hub, Metrolink's expansion and the Local Sustainable Transport Fund[12]
- Support the implementation of smart ticketing within Greater Manchester, particularly with regard to supporting flexible travel habits, occasional use and part time staff
- Work with partner organisations within the Corridor to actively represent the views of staff and students with public transport bodies and transport operators with a view to improving the viability of public transport
- Access the potential to increase the opportunities to purchase tickets on site, the range of tickets available and at a discounted price

9. Reduce the carbon emissions from fleet vehicles by investing in low emitting vehicles and improve the efficiency of their use.

[8] http://www.sustainability.manchester.ac.uk/campus/travel/videoconferencing

[9] http://www.sustainability.manchester.ac.uk/campus/travel/cycling

[10] http://www.sustainability.manchester.ac.uk/campus/travel/surveys

[11] www.sustainability.manchester.ac.uk/campus/travel/surveys

[12] www.tfgm.com

The University has around 100 fleet vehicles covering a wide range of services. In order to help support the reduction of carbon emissions and create a more pleasant environment to work and study, the University will, where viable, invest in low emitting vehicles and encourage more fuel efficient driver behaviour. Such vehicles and behaviour will also showcase the positive stance the University has on environmental sustainability.

Objectives and targets:

- The University will carry out a free Energy Saving Trust Green Fleet Review in order to better understand its current arrangements and future options
- A biodiesel trial using used cooking oil from University refectories will take place in a select number of fleet vehicles
- Low emitting vehicle criteria will be added to vehicle procurement processes and a menu of vehicle type options produced to inform decisions
- Staff driving fleet vehicles will be provided with environmental driver training designed to improve driving efficiency and reduce both carbon emissions and fuel costs
- The potential to provide a shuttle bus service between the Manchester campuses and Jodrell Bank will be investigated

10. Actively inform visitors of sustainable transport options and encourage their use.

First impressions are crucial and the first journey to a new destination creates one of the key starting points of a person's perception. In order to showcase the University's environmental sustainability credentials it is important that new visitors are provided with information that highlights this. In addition, a reduction in visitor car use improves the local environment in terms of emissions, air quality and congestion, as well as reducing car parking demand.

Objectives and targets:

- All University travel information, both printed and online, displays travel directions in a sustainable travel order as a matter of course

8. Targets

8.1 Measuring Success

There are a number of ways that the Sustainable Travel Plan's success will be measured. Carbon emissions will be the key to this but there are other ways in which progress can be determined, such as travel surveys, initiative take up, facility usage monitoring and investment in new facilities.

More detail on how each of the four key areas will be monitored and targets set is outlined below:

8.2 Staff Commuter Travel

Why target a reduction in car travel?

As stated throughout this document, a reduction in car usage for all types of trips is being targeted. Table 1 below refers to the results of the 2010 staff commute travel survey and can be used to illustrate why this is the case. As can be seen, nearly 68% of carbon emissions are as a result of staff driving a car on their own, despite them only making up 30% of all travel modes. The average per person tonnage highlights this point further, with single occupancy car drivers producing five times as much carbon as bus users and three times as much as train travellers. Of course, there has to be a place for car use in the transport mix as there are circumstances and situations where driving is the only viable option, plus the efficiency and level of emissions from vehicles is improving all the time. However, the aim of the STP is to help support and encourage alternative travel modes and more selective use of car travel.

Table 1: The percentage of total carbon emissions resulting from each mode of travel and the average per person emissions for each mode

Mode	Percentage of Respondents	Percentage of Total Emissions	Average Per Person Emissions (tonnes CO_2 per year)
Single Occupancy Car	30.3	67.8	1.48
Car share	6.5	5.7	0.58
Motorbike	1	1.4	0.93
Moped/Scooter	0.1	0.1	0.37
Train	19.4	14.4	0.49
Bus	17.5	8.6	0.33
Tram	1.9	0.6	0.21

Bicycle	13.3	0	0
On Foot	8.7	0	0
Other	1.4	1.4	0.66

The 'Mode Split'

Staff commuter travel is where the majority of previous monitoring and targeting has taken place. Traditionally the key measure of success has been the so called 'mode split' from staff travel surveys which shows the main mode of travel used by staff for their journey to and from the University. Table 2 below outlines the results of the three previous surveys[13] and shows some encouraging trends.

Table 2: Comparison of the 'modal split' from the 1999, 2005 and 2010 staff travel surveys.

Mode	2010	2005	1999***
	Percent.	Percent.*	Percent.
Car, as driver on own**	30.3	36.3	51
Car share**** as driver	4	N/A	N/A
Car share**** as passenger	2.5	2.7	4.5
Motorbike	1	0.9	N/A
Moped/Scooter	0.1	N/A	N/A
Train	19.4	19.3	14.5
Bus	17.5	21.3	16
Tram	1.9	2.6	3.5
Bicycle	13.3	8.4	4
On Foot	8.7	6.5	5
Other	1.4	0.1	1.5
Number of respondents	3763	1610	N/A

*Percentages for the 2005 survey sum to 98.1, the remaining 1.9% of respondents gave invalid responses to the question.

**In the 1999 and 2005 surveys, those travelling to work by car as a driver on their own were not separated from those driving in with a passenger.

***The 1999 figures are an average of the UMIST and Victoria University of Manchester modal splits.

****For the 2010 survey only, Car sharing was defined as '*Two or more University staff in the vehicle for the main part of the journey*'.

Previous Targets

Table 3: Mode Split Targets from 2006 – 11 Travel Plan

Mode	Percentage
Car driver on own	35%
Car Sharing	5%
Public Transport	43%
Cycling	10%
Walking	7%

As can be seen from Table 2, the 'Car driver on own' 35% target has been surpassed, with 30% travelling this way. Also of particular note is the 63% increase in cycling from 8.4% to 13.3%. Public transport use did not meet the target but this is, in the main, due to increases in walking and cycling and is therefore positive from a carbon and health perspective.

Future targets

[13] http://www.sustainability.manchester.ac.uk/campus/travel/surveys

As mentioned, it is the intention to produce a carbon footprint for staff commuter travel in line with HEFCE guidance in 2012. This will then be incorporated into the relevant University environmental sustainability policies to produce a specific carbon reduction target. However, based on previous work undertaken, Table 4 below shows future mode split targets and associated carbon emissions.

Table 4: Staff commute mode split targets and resultant carbon emissions

	2010 survey results		2015 target		Carbon Emissions with New Mode Split
	No. of staff	Percentage %	No. of staff	Percentage %	Tonnes CO_2 per year
Car as driver on own	3482	30.3	2873	25	4261
Car share	747	6.5	1034	9	601
Motorbike	115	1	115	1	106
Moped/Scooter	11	0.1	57	0.5	21
Train	2229	19.4	2413	21	1192
Bus	2011	17.5	2068	18	675
Tram	218	1.9	287	2.5	61
Bicycle	1528	13.3	1724	15	0
On foot	1000	8.7	804	7	0
Other	161	1.4	115	1	76
Total Emissions					**6993**

Other ways in which success will be measured:

- Take up levels of schemes and initiatives
- Usage of sustainable travel facilities
- Car park monitoring data

8.3 Student Commuter Travel

Currently there is no robust data available with regards to student commuting habits. An initial baseline survey will take place in 2013 as part of Scope 3 calculations and in line with HEFCE guidance. This benchmarking of current habits will then allow targets for mode splits to be set. Carbon targets will also be established, as part of University environmental sustainability policies.

Other ways in which success will be measured:

- Take up levels of schemes and initiatives
- Usage of sustainable travel facilities

8.4 Flexible Travel and Commuting

Despite the mode split being a useful gauge to determine the success of the STP, there is an important issue with regards to flexible travel which involves commuters (both staff and students) using a variety of modes of travel dependent on daily circumstances. As outlined elsewhere in this document this is a key aim and is seen as a realistic way of altering behaviour and achieving increased rates of sustainable travel usage. Therefore this will not be reflected in mode split results which only cater for the 'main mode' of travel. However, the HEFCE guidance on commuter travel monitoring does allow for flexible travel habits and therefore data will become more accurate and the presentation of results will improve.

8.5 Business Travel

Currently there is no robust carbon data available with regards to business travel habits. As part of Scope 3 monitoring, and in line with HEFCE guidance, the aim will be to capture appropriate business travel data from August 2012. This measurement of carbon emissions will then allow targets to be set in line with University environmental sustainability policies.

Other ways in which success will be measured:

- Levels of expenditure on all business travel combined and specific modes of travel
- Usage of video conferencing facilities
- Usage of schemes and initiatives designed to encourage sustainable business travel

8.6 Fleet Vehicles

As outlined in the carbon section, fleet vehicle Scope 1 emissions were calculated as part of the Carbon Management Plan for the year 2007/08. As part of the STP this will be recalculated to establish progress since and to allow for the production of targets for this individual area.

Other ways in which success will be measured:

- The types of fleet vehicles purchased and leased
- Numbers taking part in eco-driving lessons
- Implementation of schemes and initiatives designed to reduce carbon emissions

9. Delivery Plans

In order to achieve the aims and targets described in this document three detailed delivery plans are attached, namely:

- Planned Internal Measures - Those that are budgeted for and/or have been agreed
- Potential Internal Measures - Those that are not yet budgeted for and/or agreed but will be actively pursued
- External Partnerships – Projects, schemes, issues and initiatives that are not directly influenced by the University but that the University needs to be actively involved in in order to increase the use of sustainable travel

In order to implement a successful STP, support from individuals, Schools and Directorates is required, as well as from external partners. The lead responsibilities in the delivery plans reflect this and their support is most valued. It may well also be the case that new opportunities and/or unforeseen barriers arise during the lifetime of this document, as well as potential new buildings and public realm schemes as part of the Estates Master Plan. The STP will therefore be updated annually to reflect changes in circumstances.

Appendix O | CH2M Hill Report

Report

Planning Support Information

Prepared for

National Graphene Institute (NGI)

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21 November 2012

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