Report on surveys of the presence of mercury vapour in :

Rutherford Building (ex-Coupland 1)
Psychology Annex
Manchester Museum

& other selected buildings at the University of Manchester

Aug 2008 – March 2009

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Contents

Introduction

1. In June 2008, senior managers at the University of Manchester received a report by John Churcher, Don O'Boyle and Neil Todd, entitled "Possible health risks due to ionising radiation in the Rutherford Building (formerly Coupland Building 1) at the University of Manchester"[1]. Whilst the focus of this report is very much on radiation hazards, it also refers to the authors' observation of mercury in the sub-floor spaces in rooms included in the first phase of refurbishment in 2001 (ie rooms 2.057/8, then known as 2.62/3). See, for example, their report, pages 11 & 26.

2. The University Safety Advisor was asked to survey relevant buildings for current concentrations of mercury vapour, to compare measurements with those in other buildings on campus, to develop risk assessments[2] and to make appropriate recommendations.

3. The geographical scope of the main part of the survey was defined by plans prepared and agreed by the Head of Compliance and Risk, Dr David Barker, and the Deputy Director of Estates, Mr Trevor Humphreys. The plans are included in Appendices F-H but basically include:

   - the whole of what is now known as the Rutherford Building, extensively refurbished in 2003/4, and currently occupied by Student Recruitment, Admissions & International Development Division (SRAIDD)
   - parts of Coupland 1 Annex (the "1912 Annex"), currently occupied by the School of Psychological Sciences, and
   - parts of the Manchester Museum which abut the Rutherford Building, or were known or suspected to have been used by Rutherford and colleagues in the early 1900s.

   The location of other measurements was determined by Dr Taylor and Ms Davidge, based on their knowledge of scientific work across the campus.

4. Casella Winton undertook a survey of the presence of mercury residues in what is now called the Rutherford Building[3], prior to the 2nd phase of refurbishment of this building in 2004. High levels of mercury vapour were found in sub-floor voids (5 rooms were classed then as "severely contaminated"; 8 as "significantly contaminated"). Decontamination was undertaken as part of the refurbishment schedule, although measurements taken as part of this work indicate that remediation was not effective in rooms 2.057/2.058.

5. Measurements of mercury vapour were undertaken in Manchester Museum between 2006-early 2008. The complete report is reproduced in Appendix L as background information, although the measurements were taken for reasons unassociated with the Churcher et al report.

[1] Available at http://drop.io/rutherfordbuilding
[2] in compliance with the Management of Health & Safety at Work Regulations 1999, and the Control of Substances Hazardous to Health Regulations 2004
[3] Project no FLIX0010, final report received by University Estates, 2 Feb 2004

General Method

6. Real time measurements of mercury vapour were made using equipment described in the following section, and compared primarily with the Occupational Exposure Standard (OES) for inorganic mercury, last published in 2002. This was 25 μg/m^3, an average concentration time-weighted over 8 hours (ie equivalent to exposure to a steady concentration of 25 μg/m^3 for 8 hours, or 50 μg/m^3 for 4 hours, or 12.5 μg/m^3 for 16 hours, etc). This OES was not changed in the 2003 supplement to EH40[4]. No short term exposure limit was specified at that time, although clearly higher concentrations would be undesirable.

7. The OES for mercury has been withdrawn, pending implementation of the EU's 3rd listing of Indicative Occupational Exposure Limit Values (IOELVs), which will contain a draft Workplace Exposure Limit[5] (WEL) for inorganic mercury. Until that is determined, safety practitioners rely on the general principles of control specified in the Control of Substances Hazardous to Health Regulations[6]. Informal discussions with HSE specialists at their International Chemicals Unit suggests that the draft Directive containing the proposed IOELV for inorganic mercury will be published in early 2009, and will be 20 μg/m^3. This will then be subject to consultation with industry before final publication as a WEL, expected 18 months later [7].

8. Real time measurements give a snapshot of concentrations, not a concentration averaged over the working day. Nevertheless, they provide a useful indication of whether a problem might exist and whether more comprehensive measurements need to be instigated.

9. Measurements were taken at ground level, 1m and 1.5m above ground level. These approximate to a likely worst case (mercury vapour is denser than air), and sitting and standing breathing zones for the room occupants. In addition to the levels recorded, a general sweep of each room was carried out paying particular attention to gaps around pipework and cabling, between walls and floor surfaces, and similar openings. Any localised high readings were also recorded.

10. Appendix A includes a chronological listing of all the dates on which buildings were visited and mercury vapour concentrations measured, together with the main findings in each case.

11. Room numbering conventions have changed over the years. Throughout this report, the convention familiar to current occupiers has been used. In some key places, the convention used by Churcher et al has been included in brackets.

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[4] EH40 List of Approved Workplace Exposure Limits, now at http://www.hse.gov.uk/coshh/table1.pdf

[5] In 2005, HSE changed the nomenclature (and some of the rationale for determining them) from Occupational Exposure Standards (OESs) and Maximum Exposure Limits (MELs) to Workplace Exposure Limits (WELs).

[6] Statutory Instrument 2002 No. 2677

[7] Per com, Richard Peterson, 9 Jan 2009, and http://www.hse.gov.uk/aboutus/meetings/iacs/acts/090708/paper04.pdf

Instrumentation

12. Two different types of meters were used for these measurements. The Mercury Vapour Indicator (MVI) is a robust instrument routinely used by safety personnel at the University to check for contamination after breakages and spillages (typically, broken thermometers). However, its mode of detecting mercury vapour means that the reading can be influenced by the presence of confounding substances. A second instrument, the Mercury Analyser RA-915+, was hired to overcome this problem in specific areas where confounders were known or suspected to exist. The analyser is highly specific to mercury vapour. A comparison of key features of the two instruments is given below.

	Mercury Vapour Indicator (MVI)	**Mercury Analyser RA-915+**
Serial No(s)	Measurements 4 Aug – 11 Sept, hire instrument from ShawCity SN W270308-2. Post mid-Sept, HSS ShawCity instrument SN 8069019.	Instrument hired from Spectronic Analytical Instruments, Leeds. ID no 496/2004
Method of analysis	Ultraviolet absorption photometry	Differential Zeeman atomic absorption spectrometry
Interferences	Substances with greater absorption of UV light than air. Known substances include: vapour of various hydrocarbons (naphthalene?) water vapour, sulphur compounds and particles e.g. smoke.	None. Measurement is Hg specific at a wavelength of 254nm
Hg Detection range	Range 1 = 0-2000 $\mu g.m^{-3}$ or Range 2 = 0-200 $\mu g.m^{-3}$	0-20,000 $ng.m^{-3}$ or 0-200,000 $ng.m^{-3}$ in High Concentration mode
Detection limit	10 $\mu g.m^{-3}$ (deduced from description of: repeatability = 5% of Full Scale Deflection)	2 $ng.m^{-3}$
Drift	Less than 5 $\mu g.m^{-3}$ per hour. It is therefore possible to obtain negative readings.	None.

13. The Mercury Analyser RA-915+ was set to measure the mean mercury concentration of three 10 second periods and each of these values were recorded. Where the readings were effectively the same, their average was recorded as a single value.

Rutherford Building

A dynamic risk assessment was carried out whenever mercury vapour measurements were made, in the sense that action would have been taken immediately in the event of finding concentrations in breathing zones in excess of the last published Occupational Exposure Standard, 25 μg/m^3. None were found. The first documented risk assessment for occupiers was performed in November 2008, based on the readings obtained up to that date. This assessment was revised in January 2009, following work to seal gaps in the floor/wall junctions in Room 2.057 which resulted in increased concentrations of mercury vapour in Room 2.058. Both assessments are reproduced in full in Appendix I, but the main findings and recommendations are given below.

Summary of visits, main events and key findings

Date	Building / positions	Main findings
2 Sept 2008	Rutherford Building, see plans in Appendix F for measurement positions 1-39	Insignificant concentrations except in Rooms 2.057 & 2.058. In 2.057, at 1.0m (sitting person) height, concentrations 2.7 – 4.5 μg/m^3; lower in Room 2.058. But, higher concentrations measured at ground levels, especially near wall/floor junction between rooms, and external wall. Probe pushed behind cupboard unit.
3 Sept 2008	Rutherford Building,	Visit confirmed localised high concentrations behind cupboard unit in Room 2.057.
Specification of work in 2.057 agreed with Estates and contractors, to take up part-floor under existing cupboard unit along party wall (bare floorboards), check for remnants of contaminated material, and remove as much as possible.		
24 Oct 2008	Rutherford, Room 2.057	Continuous monitoring (for mercury and radiation) during work to lift floorboards along party wall to 2.058. For mercury, max at ~1m height in room was 5 μg/m^3. At ground level, up to 11 μg/m^3. Between joints (under floor), concentrations ranged from 200-300 μg/m^3. After work, levels at ground level generally < 5 μg/m^3 but higher around external corner.
28 Oct 2008	Rutherford Building, Room 2.057	Working position 5.6 μg/m^3, higher at ground level and wall/floor junction.
Results discussed with occupant. Although they indicated that concentrations at breathing zone were approx 20% of the presumed WEL, the snapshot measurements could miss transient peaks and would not represent variations during the day. Occupant advised that he could attend Occ Health for purposes of biological monitoring, and that further remedial work would be discussed with Estates. Estates project agreed to empty room of all furniture, cover all floor with board, apply generous sealant to all wall/floor junctions, and re-carpet entire room.		
4 Nov 2008	Tunnel between Rutherford Building & Beyer Building	Concentrations between 1.2 – 1.9 μg/m^3.

Nov 2008	Risk assessment based on measurements to date, with main findings and recommendations as follows: In most rooms, the mercury vapour levels are insignificant, and well below presumed exposure limits averaged over an 8 hour working day[8]. In room 2.057, levels at typical breathing zone positions are 20% of the presumed WEL, but nevertheless higher than the rest of the building. However, it is known that occupational exposure concentrations are under discussion and are likely to be reduced. It is prudent therefore (and a legal requirement) to reduce exposure to mercury vapour to as low a level as reasonably practicable. For these reasons, the following recommendations are made: 1. Room 2.057 should be fully covered and carpeted with special attention being paid to sealing wall/floor junctions and floorboard junctions (not tongue & grooved). 2. The occupant(s) should be offered biological monitoring through Occ Health 3. Regular monitoring should be carried out (eg at least annually) 4. Before any refurbishment, maintenance or repair work involving penetration or disturbance to any structural element is carried out, specific and local mercury vapour monitoring should be carried out and a specific risk assessment made. 5. Further consideration should be given to whether it is reasonably practicable to locate the sources of mercury contamination and eliminate or reduce them, bearing in mind the building refurbishment work that has already been carried out to remove contaminated floor plugging material. Complete assessment at Appendix I.	
6 Jan 2009	Rutherford Building, Room 2.057. Measurement positions 1-6, 13 & 14.	Room emptied of furniture, pending work by Estates to seal wall/floor junction. Heating on. Breathing zone position up to 1.6 µg/m^3 but higher at ground floor.
7 Jan 2009	Rutherford Building, Rooms 2.057 & 2.058 (positions shown on plan) and Room 1.057.	AM – work in progress in Room 2.057. Concentration in occupant's approx breathing zone at desk up to 25.7 µg/m^3, and had risen to 10 µg/m^3 at approx 1m height, in Room 2.058. Concentrations in room underneath, 1.057, ranged from 1.0 to 2.4 µg/m^3. PM – no work in progress. Plywood sheet nailed to bare floorboards (existing sheet and carpet remaining in place). Some flexible sealant applied, but to parts of the room only. Transient concentrations up to 70 µg/m^3 found at ground level in Room 2.057. In Room 2.058, increased concentrations found. At hole in skirting near external wall where radiation pipes traverse between 2.057 & 2.058, levels peaking at up to 1000 µg/m^3 but more typically up to

[8] See para 6 above

		400 µg/m^3, very variable. Concentrations dropped markedly with distance from the hole in the skirting, but reached up to 23 µg/m^3 at breathing zone positions of 3 occupants.
8 Jan 2009	Rutherford Building, Room 2.058.	Revisited to check if readings taken 7 Jan had been temporarily affected by general disturbance to air flows caused by building works. Breathing zone concentrations had dropped to under 20 µg/m^3, but remained high at hole in skirting board (up to 200 µg/m^3). Strong evidence that work in room 2.057 on 7th Jan had resulted in increased mercury vapour concentrations in room 2.058. Exposures at these elevated levels believed to have started the day before (ie during the 7th), not previously.
9 Jan 2009	Rutherford Building, Room 2.058.	Readings at breathing zones remained undesirably high (but less than the presumed WEL) at between 13-16 µg/m^3, and higher at hole in skirting board.
12 Jan 2009	Rutherford Building, Rooms 2.057 and 2.058	Measurements made by Andrew Easterbrook, HSL alongside measurements using University's own meter. Good correlation noted. Results similar to those recorded for 9 Jan 2009.
	Risk assessment revised to take into account measurements during and after work in Room 2.057. Recommendation made as follows: The concentrations in the breathing zones of the 3 occupants [of room 2.058] are close enough to the old OES to warrant their removal from the room, pending further investigations and remedial work to reduce/eliminate mercury vapour.	
13-14 Jan 2009	Initial report received from HSL, with recommendation that both 2.057 (2.62) and 2.058 (2.63) be taken out of use, pending further investigations into why 2001 remediation appears to have failed in this location. Email from Dr Barker, Head of Compliance & Risk initiating relocation of staff currently in Room 2.058 (2.057 already vacated).	
27 Jan 2009	Meeting with 4 ex-occupants of Rooms 2.057/2.058 to provide information on all the monitoring results to date, and answer their questions.	
30 Jan 2009	Open Meeting with invitation extended to all current occupants of Rutherford Building. Attended by Andrew Easterbrook, HSL, and by Dr Susan Robson, Dr Melanie Taylor and Alan Ferns.	
5 March 2009	Receipt of HSL report ref OH/2009/09, from Andrew Easterbrook. Recommendations arising from this report are being managed through the Compliance and Risk office.	
	Work in progress	

Psychology Annex

A dynamic risk assessment was carried out whenever mercury vapour measurements were made, in the sense that action would have been taken immediately in the event of finding concentrations in breathing zones in excess of the last published Occupational Exposure Standard, 25 μg/m^3. None were found. The risk assessment for occupiers was documented in November 2008, based on the readings obtained up to that date, after minor works were carried out at one location where elevated mercury vapour concentrations were found. The assessment is reproduced in full in Appendix J, but the main recommendations are given below.

Measurements 25-44 are outside the delineated area, but included for completeness in this part of the building.

Summary of visits, main events and key findings

Date	Building / positions	Main findings
29 Sept 2008	Psychology Annex. See Appendix G, plans for measurement positions 1-41.	Mostly insignificant concentrations, but levels at breathing zone positions in Rooms 1.41/1.41B reached 5.3 μg/m^3. At floor/wall junction under desk in 1.41, concentrations up to 20 μg/m^3.
6 Oct 2008	Psychology Annex. See Appendix G, plans for measurement positions 40-57	Measurements in Rooms 1.41 and 1.41B checked, nothing found. Rooms not accessed on 29 Sept checked. Insignificant concentrations at all breathing zone levels, but measurements with probe pushed into floor conduit in Room 32 up to 25.9 μg/m^3, and also elevated in Room G18 in very localised spot over skirting board (up to 10 μg/m^3).
23 Oct 2008	Psychology Annex, mainly rooms 1.41 and 1.41B Also G32 and H18	Max at ~1m above ground in room 1.41 was nearly 11 μg/m^3. Higher concentrations under desk at ground, near external wall/floor junction. Max 0.6 μg/m^3 at 1m or 1.5m height. Up to 6.5 μg/m^3 with probe pushed into floor conduit.
24 Oct 2008	Psychology Annex, Room 1.41	Floor/wall junction sealed by Contractors. Measurements taken before and after, using MVI and Mercury Analyser RA-915+. Some reduction shown, but strong solvent smell present.
31 Oct 2008	Psychology Annex, Rooms 1.41 and 1.41B	After work on 24 Oct to seal under desk in 1.41, max concentration at ~1m was 2 μg/m^3.
Nov 2008	Risk assessment completed for this building, based on readings to date and work carried out in Room 1.41. Main findings and recommendations were: In most rooms, the mercury vapour levels are low to insignificant, and well below presumed exposure limit averaged over an 8 hour working day.	

	However, it is known that occupational exposure concentrations are under discussion and are likely to be reduced. It is prudent therefore to reduce exposure to mercury vapour to as low a level as reasonably practicable. For these reasons, the following recommendations are made: 1. Regular monitoring of Room 1.41 is carried out (e.g. annually) 2. Before any refurbishment, maintenance or repair work involving penetration to any structural element is carried out, specific and local mercury vapour monitoring should be carried out and a specific risk assessment made. Complete assessment at Appendix J.
3 Nov 2008	Email sent to Head of School of Psychological Sciences, summarising findings to date.

Manchester Museum

A dynamic risk assessment was carried out whenever mercury vapour measurements were made, in the sense that action would have been taken immediately in the event of finding concentrations in breathing zones in excess of the last published Occupational Exposure Standard, 25 μg/m^3. None were found. The risk assessment for occupiers and users was documented in February 2009, based on the readings obtained up to that date and on information given about the time staff spent in certain rooms. The assessment is reproduced in full in Appendix K, but the main recommendations are given below. Since 6 February, the data about duration of work has been revised, and this risk assessment will therefore be suitably amended.

Random samples were taken in areas outside the defined areas referred to in paragraph 3 above.

Summary of visits, main events and key findings

Date	Building / positions	Main findings
13 Aug 2008	Manchester Museum. See Appendix H, plans for measurement positions 1-14, and 15-24 in Old Dental Hospital	Mostly insignificant concentrations, but levels in B62 and B63 up to 13.4 μg/m^3. Nothing detected in Old Dental Hospital areas.
15 Oct 2008	Manchester Museum See Appendix H, plans for measurement positions A – T.	Mostly insignificant concentrations but levels in B58 reached 25.2 μg/m^3.
23 Oct 2008	Manchester Museum, B58, B62-3, Entomology	Revisit with Mercury Analyser RA-915+ and MVI. Concentrations found with mercury-specific analyser lower than previously measured with MVI, possibly because of interference by organic hydrocarbons from resinous wood artefacts. At positions 1.5m and 1.0m above ground, range is 1.1 – 8.4 μg/m^3.
Nov-Dec 2008	Information sought from Museum about pattern of room use, to develop risk assessment.	
Early Feb 2009	Risk assessment finalised on 6 Feb 2009, with main findings and recommendations as follows: In most rooms of the Museum, the mercury vapour levels are low to insignificant, and well below presumed exposure limits averaged over an 8 hour working day. In rooms B58 and B62, concentrations are still well under the WEL, but are elevated compared to other rooms in the Museum. It is known that occupational exposure concentrations are under discussion and are likely to be reduced. It is prudent therefore to reduce exposure to mercury vapour to as low a level as reasonably practicable. For these reasons, the following recommendations are made:	

	1. The Museum should ensure working patterns do not change such that staff spend more time in rooms B58/B62, (or if they do need to change, this risk assessment should be reviewed). 2. Before any refurbishment, maintenance or repair work involving penetration to any structural element is carried out, specific and local mercury vapour monitoring should be carried out and a specific risk assessment made. 3. Further investigations should be made into the possible sources/location of mercury contamination in B58/B62, with a view to removing it in due course. Complete assessment at Appendix K.
18 Feb 2009	Subsequent email correspondence highlighted the need to revise the assessment as information about different patterns of occupation emerged. Work in progress.

Other Buildings

As in all other cases, a dynamic risk assessment was carried out whenever mercury vapour measurements were made, in the sense that action would have been taken immediately in the event of finding concentrations in breathing zones in excess of the last published Occupational Exposure Standard, 25 μg/m^3. With one exception in Chemistry Building (where free mercury was found inside a lab drawer), none were found; most readings were close to zero and insignificant.

Measurements were taken in:

- external locations in the vicinity of Rutherford Building,
- Arthur Lewis Building (new building, no history of mercury use or contamination),
- Humanities Bridgeford Street (Architecture Building), built early 1970s, unlikely to have been used for scientific processes involving mercury
- Martin Harris Building, built 2003, used for arts & theatre, unlikely to have had any mercury contamination
- Schuster Building, built for Physics Dept, mid-late 1960s.
- Morton Laboratory, known site of mercury use and spillage
- The Mill, known site of mercury use and spillage
- Stopford Building, known sites of mercury use and spillage
- Chemistry Building, known sites of mercury use and spillage
- Tunnel between Rutherford Building and Beyer Building – possible site of storage by Rutherford or his associates.

The measurements are documented in Appendix E.

Recommendations

The recommendations specific to each building's risk assessment are already at various stages of implementation, and work will continue. In the case of the Rutherford Building, the HSL's recommendations relating to rooms 2.057/8 are being discussed by the Compliance and Risk Office and Estates. Risk assessments will be kept under review in light of future monitoring and building works.

The following recommendations deal with monitoring issues:

- A regular programme of monitoring in key areas should be developed. Proposals will be submitted to the University's health and safety committees in due course.

- Routine maintenance work involving disturbance of building elements (walls, floors, ceilings and their coverings; pipe and cable runs, and similar) in these buildings already requires a permit-to-work via Estates. This arrangement should be reviewed in light of these findings, and revised if appropriate.

- Any emergency repairs involving penetration to any structural element may disturb mercury deposits that have not been detected by the survey. If practicable in the circumstances, local mercury vapour monitoring should be carried out and a specific risk assessment made, as part of the permit-to-work arrangements.

Appendix A – Complete chronology of measurement visits.

Date	Building / positions	Main findings
13 Aug 2008	Manchester Museum. See Appendix H, plans for measurement positions 1-14, and 15-24 in Old Dental Hospital	Mostly insignificant concentrations, but levels in B62 and B63 up to 13.4 µg/m^3. Nothing detected in Old Dental Hospital areas.
2 Sept 2008	Rutherford Building, see Appendix F, plans for measurement positions 1-39	Insignificant concentrations except in Rooms 2.057 & 2.058. In 2.057, at 1.0m (sitting person) height, concentrations 2.7 – 4.5 µg/m^3; lower in Room 2.058. But, higher concentrations measured at ground levels, especially near wall/floor junction between rooms, and external wall. Probe pushed behind cupboard unit.
3 Sept 2008	Rutherford Building,	Visit confirmed localised high concentrations behind cupboard unit in Room 2.057.
29 Sept 2008	Psychology Annex. See Appendix G, plans for measurement positions 1-41.	Mostly insignificant concentrations, but levels at breathing zone positions in Rooms 1.41/1.41B reached 5.3 µg/m^3. At floor/wall junction under desk in 1.41, concentrations up to 20 µg/m^3.
6 Oct 2008	Psychology Annex. See Appendix G, plans for measurement positions 40-57	Measurements in Rooms 1.41 and 1.41B checked, nothing found. Rooms not accessed on 29 Sept checked. Insignificant concentrations at all breathing zone levels, but measurements with probe pushed into floor conduit in Room 32 up to 25.9 µg/m^3, and also elevated in Room G18 in very localised spot over skirting board (up to 10 µg/m^3).
15 Oct 2008	Manchester Museum See Appendix H, plans for measurement positions A – T.	Mostly insignificant concentrations but levels in B58 reached 25.2 µg/m^3.
23 Oct 2008	Manchester Museum, B58, B62-3, Entomology	Revisit with hired Mercury Analyser RA-915+ and MVI. Concentrations found with mercury-specific analyser lower than previously measured with MVI, possibly because of interference by organic hydrocarbons from resinous wood artefacts. At positions 1.5m and 1.0m above ground, range is 1.1 – 8.4 µg/m^3.
23 Oct 2008	Psychology Annex, mainly rooms 1.41 and 1.41B Also G32 and H18	Max at ~1m above ground in room 1.41 was nearly 11 µg/m^3. Higher concentrations under desk at ground, near external wall/floor junction. Max 0.6 µg/m^3 at 1m or 1.5m height. Up to 6.5 µg/m^3 with probe pushed into floor conduit.

24 Oct 2008	Psychology Annex	Floor/wall junction sealed by Contractors. Measurements taken before and after, using MVI and Mercury Analyser RA-915+. Some reduction shown, but strong solvent smell present.
24 Oct 2008	Rutherford, Room 2.057	Continuous monitoring during work to lift floorboards along party wall to 2.058. Max at ~1m height in room was 5 μg/m^3. At ground level, up to 11 μg/m^3. Between joints (under floor), concentrations ranged from 200-300 μg/m^3. After work, levels at ground level generally < 5 μg/m^3 but higher around external corner.
24 Oct 2008	Outside (Bridgeford St / Brunswick St), and in building receptions	0.004 – 0.068 μg/m^3
27 Oct 2008	Morton Laboratory, ex-lab now used as offices. Mercury spill known to have occurred.	Using the Mercury Analyser RA-915+, concentrations up to 2.4 μg/m^3 at 1m height, and 5.5 μg/m^3 at floor level.
27 Oct 2008	The Mill, D46 – general purpose lab, and B10 UG teaching lab	No significant measurements, even with meters close to open-ended manometers containing mercury.
28 Oct 2008	Rutherford Building, Room 2.057	Working position 5.6 μg/m^3, higher at ground level and wall/floor junction.
28 Oct 2008	Stopford Building – labs known to have used mercury or had localised spillages	< 1.2 μg/m^3
30 Oct 2008	Chemistry Building, Brunswick St	Measurements carried out in labs known to have used mercury, and to have had spillages in the past. Apart from one measurement near mercury discovered in a drawer, max concentrations found were 2.5 -3.0 μg/m^3 near a drain. Otherwise, concentrations effectively zero.
31 Oct 2008	Psychology Annex, Rooms 1.41 and 1.41B	After work on 24 Oct to seal under desk in 1.41, max concentration at ~1m was 2 μg/m$^{3.}$
4 Nov 2008	Tunnel between Rutherford Building & Beyer Building	Concentrations between 1.2 – 1.9 μg/m^3.
6 Jan 2009	Rutherford Building, Room 2.057. Measurement positions 1-6, 13 & 14.	See entry under Rutherford Building for details.
7 Jan 2009	Rutherford Building, Rooms 2.057 & 2.058 (positions shown on plan)	See entry under Rutherford Building for details.

	and Room 1.057.	
8 Jan 2009	Rutherford Building, Room 2.058.	See entry under Rutherford Building for details.
9 Jan 2009	Rutherford Building, Room 2.058.	See entry under Rutherford Building for details.
12 Jan 2009	Rutherford Building, Rooms 2.057 and 2.058	See entry under Rutherford Building for details.

Appendix B – Mercury vapour monitoring, Rutherford Building

2 Sept 2008 (+ one extra measurement, 3 Sept 2008)

CD/MJT, using MVI* on loan from ShawCity
Temperature approx 18ºC, some space heating

* This meter detects mercury vapour but also responds to organic hydrocarbons such as naphthalene used as an insecticide.

Plan ref	Room No	Reading (µg/m3) at			Additional comments
		1.5m	1.0m	Ground	
1a	G.58	0.7	0.4	0.4	Reception
1b	G.58a	0.5	0.4	0.0	
1c	G.58			2.5	Electrical riser, some reaction on the meter - organic vapour?
2a	G.55	0.8	0.6	0.4	Rutherford Room
2b	G.55		3.2		Long desk, in cupboard
2c	G.55		4.6		Long desk, in drawer
2d	G.55		0.4		On cupboard near door
3	Corridor		-2.7		Near lift
4	G.57	-3.0	-3.2	-3.3	
5	G.C03		-3.6		Near original entrance
6	G.C02		-3.5		
7	Corridor		-4.0		Near stairs to basement
8	G.C04		-3.5		
9	G.56	-3.6	-3.7	-3.7	
Basement					
10	Bottom of stairs		-4.0		
First floor					
11	S1.1		-4.0		Stair landing
12			-4.2		
13	1.051	-2.3	-2.3	-2.6	
14	1.052	-2.0	-2.5	-2.5	
15	Corridor		-5.0		
16	Reference No not used				
17	1.053	-4.0	-4.1	-4.3	
18	1.054		-3.7		Gents WC
19	WC for disabled persons		-4.2		
20	Store		-4.1		
21	1.057	-2.6	-2.7	-2.9	
27	1.055	-3.0	-3.4	-3.4	
28	1.055 annex	-3.3	-3.4		

Plan ref	Room No	Reading (µg/m3) at			Additional comments
		1.5m	1.0m	Ground	
Second floor					
22	S1.2		-4.1		
23	2.059	-2.2	-2.4	-2.7	
24	Corridor		-1.0		Near lift
25	2.058(=2.63)	0.0	0.8	-1.0	
25a	2.058(=2.63)		-0.7	17.0	Other side of wall from 26b, probe pushed towards wall/floor junction
26	2.057(=2.62)	3.4	2.7	up to 25	Rutherford's office? / prep room
26a	2.057(=2.62)		4.5		Occupant's chair position
26b	2.057(=2.62)			Max 191 but variable	Probe pushed behind wall storage unit, N corner of room (gap visible between wall and floor)
Extra measurement, 3-9-08	2.057(=2.62)			Up to 200	Very localised, approx 100cm from front of unit towards wall. Levels drop off as probe pushed further in.
29	WC for disabled persons		-4.9		
30	Female WCs		-4.7		
31	2.054	-2.8	-2.5	-2.6	
32	2.053	-2.4	-2.4	-2.2	
33	2.052	-1.8	-2.0	-2.1	
34	2.052b	-4.0	-4.4	-4.4	
35	2.052A	-0.3	-0.5	0.2	Office
37	2.051	-2.4	-2.8		Middle of room
37a	2.051			-1.9	Wall with 2.052A, external corner
37b	2.051			-2.0	Midpoint of party wall with 2.052/A
37c	2.051			0.9	Party wall with 2.052, near door
37d				-2.0	Corner under stairs
37e	2.051B	-2.3	-2.4	-2.4	Office
Mezz floor					
36	3.5	-0.4	-0.7	-0.7	Meeting room over 2.052
38	3.2	-2.2	-2.5	-2.5	
39	3.1	-1.8	-2.6	-2.7	
Roof plant room			-5.2		
1	G58		-3.3		End of measurement period

24 October 2008

CD/MJT, using own MVI* and Mercury Analyser RA-915+ **on hire from Spectronic (in red).
Temperatures cool, window open
Also present : 2 men from Seddons, Rob (monitoring radiation)

* This meter detects mercury vapour but also responds to organic hydrocarbons such as naphthalene used as a preservative.
** This meter responds very specifically to mercury vapour.

All measurements taken in Room 2.057(=2.62)

Reading (µg/m3) at						Additional comments
1.5m		1.0m		Ground		
MVI	Mercury Analyser	MVI	Mercury Analyser	MVI	Mercury Analyser	
				0.0	1.5, 1.5, 1.5	Corridor outside, before work
		3.8, 3.8, 3.8				On desk in room, before work
		4.6		up to 11.0		Behind radiator near occupant's chair
		1.9				Meeting table
						1st floorboards lifted
					5.2, 6.5, 7.5	Right in corner, under boards
					19.0, 14.0, 25.0	Near radiator pipe
						Rubble removed from between wall and first joist. 1-6 floorboards lifted from corner to mid-way.
				11.0		Over container of rubble (away from opened up floor)
				Ranging from 200-300		Under floor on top of ceiling plaster, section of insulation/chicken wire removed
						Boards replaced
		5.1				Corner near radiator
						Series of readings carried out along both walls (some averages of 3 readings) - see plan
				-1.4	Av 1.9	10th floor board from

Reading (µg/m3) at						Additional comments
1.5m		1.0m		Ground		
MVI	Mercury Analyser	MVI	Mercury Analyser	MVI	Mercury Analyser	
						corner
1.6				-1.5	Av 1.6	9th floor board from corner
				-1.5	Av 1.7	8th floor board from corner
				-0.14	Av 1.6	7th floor board from corner
				-0.13	Av 1.6	6th floor board from corner
				-1.4	Av 1.5	5th floor board from corner
				-1.4	Av 1.4	4th floor board from corner
				-1.3	Av 2.4	3rd floor board from corner
				-1.4	Av 1.7	2nd floor board from corner
				-1.2	5.6, 7.6, 19.6	1st floor board from corner
					4.5, 2.4, 2.4, 2.6, 2.8	
					2.0, 2.8, 2.0	Corner
						Series of measurements along party wall at approx 50cm intervals - see plan
					3.7, 3.5, 2.8	A
					3.2, 5.0, 14.3	B (distant door slammed)
					5.4, 3.1, 2.8	
					2.5, 3.3, 2.4	C
					2.3, 2.3, 9.7	D
					4.8, 4.9, 3.9	

28 October 2008

CD/MJT, using own MVI* and Mercury Analyser RA-915+ **on hire from Spectronic (in red).
Temperatures cool, window open

* This meter detects mercury vapour but also responds to organic hydrocarbons such as naphthalene used as a preservative.
** This meter responds very specifically to mercury vapour.

All measurements in Room 2.057

Reading (µg/m3) at						Additional comments
1.5m		1.0m		floor level		
MVI	Mercury Analyser	MVI	Mercury Analyser	MVI	Mercury Analyser	
					26.5,29.3,25.4	Near gap in floor/wall corner
					6.2, 5.8, 6.0	In front of cupboard
					5.6, 5.7, 5.5	Occupant's breathing zone, at desk
					8.0, 6.5, 6.1	Behind cupboard near door to next office
			5.6, 5.5, 5.6			At table

6 January 2009

CD and MJT, 1130 onwards. ShawCity MVI fitted with new micron filter.

Room 2.057(=2.62) visited at request of David Barker.
See plan for measurement references. Heating on, room emptied of furniture and unoccupied, pending work by Estates to extend floor covering across the whole of the floor.

Plan ref	Measurement position	Mercury vapour concentration, µm/m3
14	Outside room, on corridor	-1.3
1	To right of radiator, ground level	Up to 31 but variable
2	At wall/floor junction, party wall to 2.058 (=2.63)	6.0 - 11.7
3	As above, nearer door to 2.58 (=2.63)	Up to 15.0
4	As above, at door frame	4.6
5	Occupier's desk position, 1m up (approx breathing zone)	1.2 to 1.6
	As above, ground level	Up to 10.0
6	Corner of room behind desk position, wall/floor junction	4.0 - 24.0 Up to 50 transiently near widest gap
13	Gap between stone door threshold from corridor and timber flooring, ground level	Up to 40.0
	Sweep all around room perimeter, wall/floor junction, ground level	6.0 - 8.0
14	Outside 2.057(=2.62), in corridor	6.6

7 January 2009

CD. 1130 hours onwards,. Work in progress in Room 2.057(=2.62).

Rooms 1.057 and 2.057(=2.62) visited, following conversation between Les Bramwell (Project Manager, Estates) and Catherine Davidge about dust falling onto occupants of Room 1.057 during building work in Room 2.057(=2.62) directly above.

See plan for measurement positions.

Plan ref	Measurement position	Mercury vapour concentration, µm/m3
	Outside Room 1.057, on corridor	0.5
	Room 1.057, corner, external wall, over dust visible on windowsill (~1.5m high)	2.4
	Mid-point, windowsill	2
	Room 1.057, corner near party wall, windowsill	1
	Middle of Room 1.057, approx breathing zone	2.4
	Room 1.057, near partition to Disabled WC, approx breathing zone	1.9
	Room 1.056, on bench	1.8
14	Corridor outside Room 2.057(=2.62), near bench seat level (approx 0.5m)	8.8 to 10.0
5	In room 2.057(=2.62), approx 1m (breathing zone)	25.7
10	Room 2.058 (=2.63), at hole where pipework comes through skirting board	25.0 falling to 15.5
16	Centre of room 2.058 (=2.63)	10
	Top of stairwell, 2nd floor	0.5
15	Corridor outside 2.057(=2.62)	9.2

MJT and CD. 1400 onwards.

No activity in Room 2.057(=2.62). New plywood sheet had been nailed to floorboards on section of floor never covered by carpet (approx 1/3 floor area), and flexible sealant applied to joints, wall/floor junction. Window partially open, cool (heating on).

3 staff in Room 2.058 (=2.63). Very warm indeed, room radiator + freestanding heaters on. Windows closed.

See plan for measurement positions.

14	Outside Room 2.057(=2.62), on corridor, approx 0.5m height	3.3
2	Wall/floor junction, corner with 2.058 (=2.63), ground level	-0.6
3	As above, moving towards door to 2.058 (=2.63)	-0.4 to -0.7
5	Approx position of occupier's desk, breathing	-0.5

Plan ref	Measurement position	Mercury vapour concentration, µm/m3
	zone	
6	Corner of room behind desk position, wall/floor junction (no sealant)	Pattern of transient peaks, background 0.7, peaks up to 25-30, quite regular pulses. Peaks occurring 2-3 seconds after hearing distant door slams.
6	As above, carpet pulled back to expose more of the gap between wall/floor	0 - 70
14	Corridor outside 2.058 (=2.63)	1.4 to 1.6 (fairly steady)
6	2nd floor Gents WC door slammed	No reaction
6	2nd floor Ladies WC door slammed	No reaction
16	Middle of room 2.057(=2.62), breathing zone	-0.6
16	2nd floor landing doors slammed	No reaction
9	Room 2.058 (=2.63), wall/floor junction, corner with 2.057(=2.62), near hole around pipes through skirting	415, peaking at 1000
10	Room 2.058 (=2.63), wall/floor junction, other external wall corner	13.5 to 15.0, up to 26 when door opened
12	Room 2.058 (=2.63), wall/floor junction, near corridor door	20
7	At occupier's breathing zone	20.0
8	At occupier's breathing zone	23.3
11	At occupier's breathing zone	23.0

8 January 2009

MJT, 0830 onwards. Room 2.058 (=2.63), as arranged with occupants with no additional heating. Room noticeably less warm than on 7th. One occupier present.

Plan ref	Measurement position	Mercury vapour concentration, µm/m3
15	Outside room, on corridor	0
9	Room 2.058 (=2.63), wall/floor junction, corner with 2.057(=2.62), near hole around pipes through skirting	40-71
10	Room 2.058 (=2.63), wall/floor junction, other external wall corner	18-19.0
8	Mandy's breathing zone	13.9
11	Pat's breathing zone	16.8, 17.9
CD and MJT visited at 1115 onwards, as arranged. Temperature cooler than on 7th Jan. MVI zeroed on landing between 1st and 2nd floors. Strong smell of sealant. In room 2.057(=2.62), carpet had been removed. Flexible sealant applied all round the wall/floor junction (one or two defects noted). 2 occupiers present in Room 2.058 (=2.63).		
	On landing between 1st and 2nd floors	-1.6
15	Outside Room 2.058 (=2.63), on corridor	-2.3
17	Middle of room 2.057(=2.62), approx 1m (breathing zone)	-1.8 to 0.0
5	In corner near desk position, ground	-2.2
6	In corner, near party wall, ground	-2.3
17	Room 2.058 (=2.63), middle of room, approx 1m up	5.4
7	Occupier's breathing zone	5.3
11	Occupier's breathing zone	5.3
11	Office door opened	1.6 to 2.1
8	Occupier's breathing zone	5.5
8	Office door opened/closed	2.6 – 3.3
8	Door opened again	1.7 - 1.9
		Stable at 1.4
9	Wall/floor junction behind occupier's desk, near holes in skirting	120-200
10	Wall/floor junction, behind occupier's desk	-2.2
17	Middle of room	Stable at 0.8

9 January 2009

MJT visited Room 2.058 (=2.63) at 1330,as arranged with occupants to have their normal heating, ie very warm as on 7th Jan. One occupier only present.

Plan ref	Measurement position	Mercury vapour concentration, µm/m3
15	Outside door to 2.058 (=2.63)	-2.2
11	Occupier's breathing zone	15.1
7	Occupier's breathing zone	13.0 - 15.8
8	Occupier's breathing zone	13.2 - 15.3
9	Skirting board behind Occupier's desk, into hole around pipes	175 to 213
10	Gap at wall/floor junction, other external corner	15.0
15	In corridor near lift	-4.0

12 January 2009

MJT visited Rooms 2.057-9 (2.63 - 2.61) at 1600, with David Barker and Andrew Easterbrook, HSL.

AE recorded measurements, very similar to those obtained previously with University's MVI and within experimental error, meters run in parallel.
Some measurements recorded by MJT.

Plan ref	Measurement position	Mercury vapour concentration, µm/m3
8	Occupier's breathing zone	14.0
9	Hole in skirting behind occupier's desk	200-400
	Room 2.059, mid-office	-1.7
	Skirting board, adj 2.58 (=2.63), near gaps around pipes	Up to 15 *
		* AE could reach further into the void, and obtained a higher reading.

Appendix C – Mercury vapour monitoring, Psychology Annex

29 September 2008

MJT/GC, using own MVI*
Weather mild (approx 18C), no room heating
This meter detects mercury vapour but also responds to organic hydrocarbons.

No rooms in this building have undergone recent refurbishment.
Most are suspended floors carpeted to wall/floor junctions, with original plaster walls/ceilings.

Plan ref	Room No	Reading (µg/m3) at			Additional comments
		1.5m	1.0m	floor level	
1		0.4	0.4	0.2	Computer cluster
2					N/a
3	G31	1.8	1.3	1.9	
4		0.4	0.7	-1.1	Computer cluster
5		-1.7	-1.7	-1.0	Computer cluster
6	G33	-1.2	-1.3	-1.2	
7		-1.9	-2.0	-1.9	Base of stairs
8		-1.2	-1.1	-1.7	Gents WC
9	G36	-0.9	-2.1	-1.6	
10		-1.0	-0.8	-2.0	Cleaners c/b
11		1.4	1.4	1.6	On stairs in corridor
12		1.3	1.3	1.2	PG room
13		0.6	0.6	0.6	Kitchen
14		0.4	0.4	0.2	PG room
15		0.4	0.4	0.4	
16		0.6	0.7	0.7	Interview room
17	H24a	0.3	0.2	0.0	
18		0.5	0.5	0.5	
19		0.7	0.7	0.7	Disabled persons WC
20		1.6	1.6	0.5	Common room
21		1.6	1.3	1.4	Common room
22		1.5	1.5	1.5	Common room
23		1.2	1.2	1.2	Room off kitchenette
24		-2.7	-2.9	-2.9	Mezz corridor
25	1.29	-0.4	-0.4	-0.6	
26	1.30	-2.5	-2.5	-2.5	MSc study - unused
27	1.30A	-2.1	-2.1	-2.3	Staff WC
28	1.31	-1.5	-1.5	-1.5	Office
29	1.32	-2.5	-2.5	-2.5	Office
30	1.33	-2.4	-2.5	-2.5	Lab
31	1.34	-2.7	-2.7	-2.7	Research room
32	1.35	-1.9	-1.9	-2.0	Child behaviour obs room
33	1.36	-2.5	-2.5	-2.5	Child play room

Plan ref	Room No	Reading (µg/m3) at			Additional comments
		1.5m	1.0m	floor level	
		-2.0 to -2.5			Swept whole floor area
34	1.37	-2.6	-1.9	-1.8	
35	1.37A	-1.8	-1.7	-2.7	
36	1.38	-0.3	-0.7	-1.1	
37		-0.4	-0.8	-0.4	
38	1.39	-0.2	-0.1	-0.7	
39	1.40	-1.0	-1.0	-1.1	
40	1.41	5.3	3.8	3.9	PG office
		Variable but at points > 20			Floor under desk, corner of room
			3.2	3.2	Working position of PG at desk
		2.5 to 2.6			Floor elsewhere in room
41	1.41B	3.4	2.9	2.9	Working position of PG at desk
		2.7			Floor elsewhere in room
		11.0			Floor near corner with Room 1.41

6 October 2008

MJT/CD, using own MVI*
Weather approx 15ºC, individual rooms using space heaters

* This meter detects mercury vapour but also responds to organic hydrocarbons.

No rooms in this building have undergone recent refurbishment. Most are suspended floors carpeted to wall/floor junctions, with original plaster walls/ceilings.

Plan ref	Room No	Reading (µg/m3) at			Additional comments
		1.5m	1.0m	floor level	
42	1.41A	-3.7	-3.8	-3.6	PG room
			-3.7		Breathing zone of seated person
40	1.4			Range -2.8 to -4.0	No reaction on MVI at all
41	1.41B			Range -1.9 to -2.2	No reaction on MVI at all
43				-5.0	In corridor outside WCs
44		-4.2	-4.2	-4.3	Pear Lecture Theatre
45	G32	-5.0	-5.0	-5.1	
		-4.5		25.9	Probe pushed into small gap in plates covering floor conduit, near filing cabinet. Bare floor.
			-4.8		Occupant's breathing zone, seated
				-3.0	Approx 10cm from floor, adj filing cabinet.
46	H16	-6.7	-6.7	-6.8	Conduit not visible under carpet. No reaction behind bookcase on party wall with G32.
47	H17	-6.1	-6.1	-6.1	
48	H18	-7.0	-7.0	-7.0	Room not in use.
				Up to 10 but variable	Gap over skirting board near cabinet. Very localised, marked red on wall.
49		-2.6	-4.2	-6.2	Office. Draughty - gaps around window.
50	H24	-6.6	-6.6	-6.7	Outer office
51		-6.7	-6.7	-6.8	Inner office
52	H25	-7.3	-7.2	-7.3	Photographic equipment store
53	G37	-5.7	-5.7	-5.7	Storeroom
54	G35	-7.8	-7.1	-6.1	
55	G34	-6.1	-6.1	-6.1	
56		-6.0	-6.2	-6.3	Alcove outside common room
57		-6.8	-7.5	-8.0	General store.

23 October 2008

CD/MJT, using own MVI* and Mercury Analyser RA-915+ ** on hire from Spectronic (in red).
Temperatures cool, some local space heating
* This meter detects mercury vapour but also responds to organic hydrocarbons.
** This meter responds very specifically to mercury vapour.

Room No	Reading (µg/m3) at						Additional comments
	1.5m		1.0m		floor level		
	MVI	Mercury Analyser	MVI	Mercury Analyser	MVI	Mercury Analyser	
1.41					12.8, but ranging up to 20.0	13.2, 11.1, 10.2	Very warm, local heaters + radiator. Under desk, near corner of room to 1.41B
						16.7, 17.0, 18.0	Gap near radiator
					14.5		Middle of room
	10.0		10.3		10.8		Middle of room
1.41B					23 but variable	9.7, 9.5, 8.9	Corner adj 1.41
						8.4, 8.6, 8.8	
Corridor outside 1.41					2.9	0.7, 0.6, 0.5	Much cooler
G32	4.5		4.2		4.8		Gap in floor plates behind door
					6.8		Probe pushed into channel
				0.39, 0.3, 0.4, 0.26, 0.25, 0.279		2.9, 2.3, 4.1	Room general
						6.3, 6.4, 6.5	Probe pushed into channel
		0.4, 0.4, 0.3		0.6, 0.56, 0.6			Above channel
H18					3.5	0.1, 0.1, 0.1	Gap over skirting near cabinet
	3.5		3.8		3.7		Mid-room

24 October 2008

CD/MJT, using own MVI* and Mercury Analyser RA-915+** on hire from Spectronic (in red).
Temperatures cool, some local space heating
All measurements in Room 1.41

* This meter detects mercury vapour but also responds to organic hydrocarbons.
** This meter responds very specifically to mercury vapour.

Room No	Reading (µg/m3) at						Additional comments
	1.5m		1.0m		floor level		
	MVI	Mercury Analyser	MVI	Mercury Analyser	MVI	Mercury Analyser	
Corridor					0.0	0.6, 0.5, 0.6	Outside Room 1.41
Before work							
				5.7, 5.8, 5.8			Mid-room, very warm
					21.0		Under corner desk, near gap in floor/wall
						12.0, 12.0, 11.6	In corner of room
						19.6, 18.3, 18.0	Approx 30cm along party wall (change in alignment)
			9.2			8.4, 7.2, 7.2	On desk adj to corner desk
Window opened by occupant (to reduce smell from sealant and because it was so warm!), bead of sealant along external wall/floor under desk							
			7.2			8.1, 8.0, 8.0	Corner
						9.6, 11.4, 8.4	Under desk near radiator
						5.7, 5.7, 5.7	Corner
					14.1, 14.0, 11.8		Approx 30cm from corner along party wall
			6.3	5.8, 5.6, 5.6			Middle of the room

31 October 2008

CD/MJT, using own MVI* and Mercury Analyser RA-915+** on hire from Spectronic (in red).
Temperatures cool, some local space heating

* This meter detects mercury vapour but also responds to organic hydrocarbons.
** This meter responds very specifically to mercury vapour.

Room No	Reading (µg/m3) at						Additional comments
	1.5m		1.0m		floor level		
	MVI	Mercury Analyser	MVI	Mercury Analyser	MVI	Mercury Analyser	
1.41				0.6, 0.6, 0.6			Desk in corner with party wall to 1.41B, breathing zone
						0.5, 0.6, 0.6	Under desk, probe close to sealed wall/floor joint
						0.6, 0.6, 0.6	Approx 30cm along party wall
						0.7, 0.6, 0.6	Corner
						0.0, 0.0, 0.0	Edge of carpet
			0.4				Table adj corner desk
			0.1				Corner desk
			-0.05				Desk in other corner
1.41B					3.7	2.4, 2.5, 2.5	Floor near filing cabinet, party wall
					2.6		External wall near filing cabinet
			2.0				On desk

Appendix D – Mercury vapour monitoring, Manchester Museum

13 August 2008

CD/MJT, using MVI* on loan from ShawCity
Weather mild (approx 18C), no room heating

* This meter detects mercury vapour but also responds to organic hydrocarbons such as naphthalene used as an insecticide.

Museum plan ref	Room No	Reading (µg/m3) at			Room condition	Additional comments
		1.5m	1.0m	floor level		
Following locations under or close to Rutherford Building/Coupland 1						
1	R68 (old courtyard)	-1.4	-0.7	-0.19	solid concrete floated floor/coved at edges	
2	R68 (old courtyard)			-1.5		
3	R68 (old courtyard)		-2.0			
4	B61	-1.8 / -2.0	-2.2	-2.6 / -2.9	solid floor altro floor covering, ceiling - original plaster, sealed	
5	Corridor outside B63		1.8			
6	B62	12.9	13.0	12.8	hot drain radiation - removed, ceiling - original, floor - solid, altro	Smell of naphthalene. See CD's report of measurements using a different meter, Jan 08. Measurement revised downwards to 1.8-2.2 then.
7	B62, under cabinet	13.4	13.0	13.0		
8	hot drain vicinity	12.6				
9	B63	12.0	11.7	12.3	floor/ceiling same	
10	Outside lift, corridor outside B63		<4.0			
11	B64	-1.5	-1.3	-1.3	original parquet floor (not sealed), ceiling original	

Museum plan ref	Room No	Reading (µg/m3) at			Room condition	Additional comments
		1.5m	1.0m	floor level		
12	G54	-4.0		-4.3	lino on solid floor, ceiling original	
12a	G54, mezzanine floor	-4.1				
13	1.5 Entomology	-0.7	0	-1.0	floor ceiling good	+ naphthalene
14	1st floor mezzanine	0.4	0	-0.15	meter swept over floor between racking, didn't exceed 4.0	naphthalene, under Cohen LT & International Office offices
Following locations all in ex-dental hospital building, ceased to be used for this purpose in the 1940s.						
15	2.19	-5.0	-5.5	-5.5		
16	2.39	-4.6	-4.8	-4.9		
17	1.11	-3.8	-4.2	-4.3		
18	Shop		-5.5			
19	Loading bay	-5.5	-5.5	-5.5	solid floor refurbished 2002	
20	B26	-7.0	-7.7	-7.9		mollusc collection, organic solvent?
21	B39 (under café)	-4.3	-4.5	-4.6	finishes good/coved	
21a	B39, bund/drain		-2.0			
22	Kitchen	-4.0	-4.3	-5.5		
23	Café	-4.1	-4.2	-4.5		
24	1.28		-4.7			at end of measuring period

15 October 2008

CD/MJT, using own MVI*
Weather cool, but no noticeable space heating
All these rooms refurbished in 1999, except B85

* This meter detects mercury vapour but also responds to organic hydrocarbons such as naphthalene which is used as an insecticide.

Museum plan ref	Room No	Reading (µg/m3) at			Additional comments
		1.5m	1.0m	floor level	
Basement					
A		1.6	1.7	1.7	Cloakroom
B		1.7	1.6	1.5	School lunch room
C		3.6	3.6	3.6	Staff kitchen
D	Outside B83	1.8	1.7	1.6	Outside strong room
E	B85	2.0			Unimproved store
F		2.1	2.1	2.1	Cloakrooms, under pavement
G		0.1	0.1	0	Public WCs (noticeable air flow)
H	B16	-1.4	-1.2	-0.3	Mineral Store
I	B12	0.4	0.4	0.4	Spirits Store
J		3.2	7.5	7.9	Faint, sweetish, resinous wood smell?
K	B58		25.2		Anthropology Store - smells of resinous wood
L			2.0		Door outside B58
M		-1.1	-1.1	-1.1	Estates area - see plan
N		-1.6			Estates area - see plan
O	B65	-1.8	-1.8	-1.7	Textile Store
2nd Floor					
P		-1.1	-1.1	-1.2	Vivarium
Q		-1.3	-1.3	-1.4	Gallery
R		-1.6	-1.6	-1.6	Mediterranean Gallery - archaeology
S		-2.0	-2.1	-2.1	Money Gallery
T		-2.3	-2.2	-2.3	Fire exit from Cohen Lecture Theatre

23 October 2008

CD/MJT, using own MVI* and Mercury Analyser RA-915+ ** on hire from Spectronic (in red).
Temperatures cool, some space heating

* This meter detects mercury vapour but also responds to organic hydrocarbons such as naphthalene used as an insecticide.
** This meter responds very specifically to mercury vapour.

Room No	Reading (µg/m3) at						Additional comments
	1.5m		1.0m		floor level		
	MVI	Mercury Analyser	MVI	Mercury Analyser	MVI	Mercury Analyser	
B62			12.8	5.2, 5.3, 5.4	12.7	5.0, 5.0, 5.0	Solid floor
B58	13	8.0, 8.0, 8.0	12.7	7.8, 7.9, 8.0	13.5	7.8, 7.8, 7.9	Between racks
				8.4, 8.4, 8.4			In rack
			18.1				Near humidistat on wall
B63	7.7		7.1		7	0.7, 0.7, 0.7	
Corridor			7.9	1.1, 1.2, 1.1			
Entomology			10.6, 11.0	2.3, 2.2, 2.2			Near door
			10.2			2.1, 2.1, 2.2	Top of cupboard near Hymenoptera
				2.2, 2.3, 2.2			Desk nearby
				4.2, 3.9, 3.7		3.9, 4.9, 4.9	Desk of someone using mothballs
			1.9	3.7, 3.6, 3.6			User's breathing zone

Appendix E – Measurements of Mercury Vapour in Other Buildings

Measurement survey outside and in buildings near Rutherford, 24 October 2008

Measurements carried out by MJT/CD using our own MVI and the Mercury Analyser RA-915+ on hire from Spectronic (in red). Temperatures cool, some local heating

Building / Room No	Reading (µg/m3) at						Additional comments
	1.5m		1.0m		floor level		
	MVI	Mercury Analyser	MVI	Mercury Analyser	MVI	Mercury Analyser	
Cafe tables, Bridgeford St			Ranging from -3.6 to 2.0	0.031, 0.015, 0.026			
				0.014, 0.011, 0.018			
Corner of Arthur Lewis Building, Bridgeford St	3.4		3.3		2.9	0.021, 0.02, 0.02	Bit windy
						0.018, 0.016, 0.018	
Arthur Lewis Reception			5.4	0.012, 0.011, 0.008	4.1		Inside new building, no history of Hg use at all
				0.006, 0.008, 0.010			
Bridgeford St building (Architecture)			5.2		5.1	0.010, 0.001, 0.000	
Martin Harris - box office			5.4	0.007, 0.008, 0.009			
Coupland St			4.6	0.019, 0.024, 0.029			Outside
Outside Schuster, Brunswick St			6.2	0.011, 0.004, 0.016			
Schuster Building			1.6 or less	0.061, 0.043, 0.042			In office, 2nd floor. No known history of Hg use

Building / Room No	Reading (µg/m3) at						Additional comments
	1.5m		1.0m		floor level		
	MVI	Mercury Analyser	MVI	Mercury Analyser	MVI	Mercury Analyser	
				0.068, 0.054, 0.053			As above
				0.039, 0.038, 0.040			

Morton Lab

Measurements carried out by MJT/CD using our own MVI and the Mercury Analyser RA-915+ on hire from Spectronic (in red)
Temperatures mild, no local heating

Building / Room No	Reading (µg/m3) at						Additional Comments
	1.5m		1.0m		floor level		
	MVI	Mercury Analyser	MVI	Mercury Analyser	MVI	Mercury Analyser	
B2			2.7				On desk
				2.4, 2.3, 1.9			Middle of room
					4.7 - 8.0	5.4, 5.5, 5.4	Near channel covered with carpet
			4.4				Another Occupier's desk
			3.2				On desk near entrance
			2.3 - 2.7				Generally around the room

The Mill, 27 October 2008

Measurements carried out by MJT/CD using our own MVI and the Mercury Analyser RA-915+ on hire from Spectronic (in red)
Temperatures mild, no local heating

Building / Room No	Reading (µg/m3) at						Additional Comments
	1.5m		1.0m		floor level		
	MVI	Mercury Analyser	MVI	Mercury Analyser	MVI	Mercury Analyser	
D46			0.5				On lab worktop (solvent smell?)
			6				Probe pointing into solvent cupboard containing pentane, hexane, pet ether
			1.3	0.17			On lab worktop nearby
			1.2				Over lab sink
			0.5 - 0.8				Over lab sink
B10			2.2				Over open end of Hg manometer, approx 40cm from Hg.
			1.4				On table near manometer

Stopford Building, 28 October 2008

Measurements carried out by MJT/CD using our own MVI and the Mercury Analyser RA-915+ on hire from Spectronic (in red)
Temperatures cool, some space heating

Building / Room No	Reading (µg/m3) at						Additional Comments
	1.5m		1.0m		floor level		
	MVI	Mercury Analyser	MVI	Mercury Analyser	MVI	Mercury Analyser	
1.223							Lab as originally built in 1970s, with addition of 1 fume cupboard, some new benching
			-1.1	0.288, 0.281, 0.288			On bench near door, near site of known Hg use
			-2.6				Over sink
					-2.4		Floor near drainage channel
			0.1 to -0.3				General lab
3.404				0.086, 0.083, 0.146			Lab empty, used by plant sciences
3.442				0.073, 0.045, 0.044			Table top, in lab with furnaces, also known site of Hg thermometer spillage in past (approx 18 months ago)
			1.2				Near furnace
			0.6				Table top.

Chemistry Building, 30 October 2008

Measurements carried out by MJT/CD using our own MVI and the Mercury Analyser RA-915+ on hire from Spectronic (in red)
Temperatures cool, some local heating

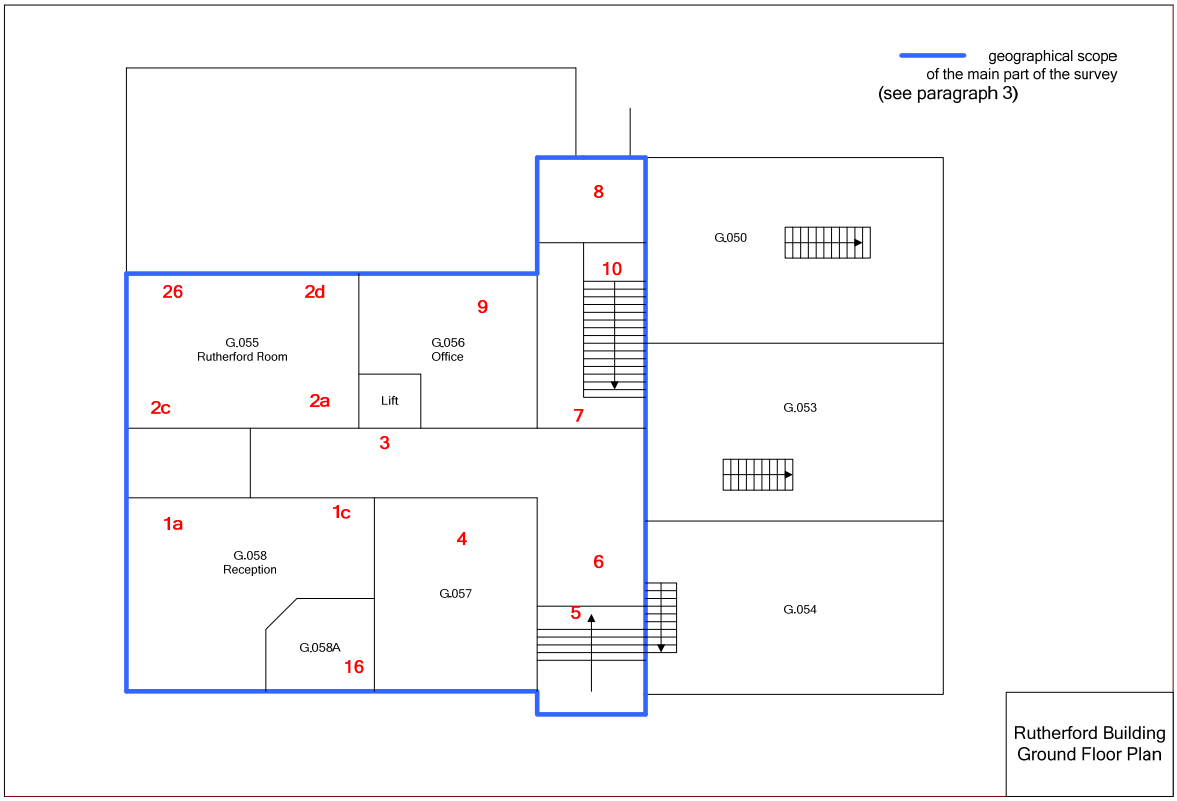
Building / Room No	Reading (µg/m3) at					Additional Comments
	1.5m	1.0m		floor level		
	MVI or Mercury Analyser	MVI	Mercury Analyser	MVI	Mercury Analyser	
G.025		-2.2	0.3, 0.3, 0.4			Office, in old block, refurbished 2006
			0.24, 0.25, 0.24			
6.12			0.4, 0.4, 0.3			Workshop, not recently refurbished. No obvious Hg use
			0.5, 0.5, 0.4			
		No reaction				Over sinks/drains
6.22			0.7, 0.6, 0.5	-0.01	2.6, 2.5, 3.0	Laboratory, site of known spillage
		-0.1				Sink in corridor opposite
6.06		No reaction anywhere				Unimproved labs
6.26						
6.27						
4.06		Ranges from -0.01 to -0.5	0.04, 0.04, 0.03			Teaching Lab - plenty of air movement
4.15						UG teaching lab prep room
		Up to 500 in container				In drawer - plastic tray with 2 droplets of Hg (dusty), and 2 containers - removed to fume c/b
			3.1, 2.4, 2.1			In drawer
		0.04				1m away in the room
2nd floor teaching lab		0.3	0.0, 0.03, 0.12			Near manometer
		1.2				Above bottle of hexane
		2.0				Over sink
		0.0				Other side of bench

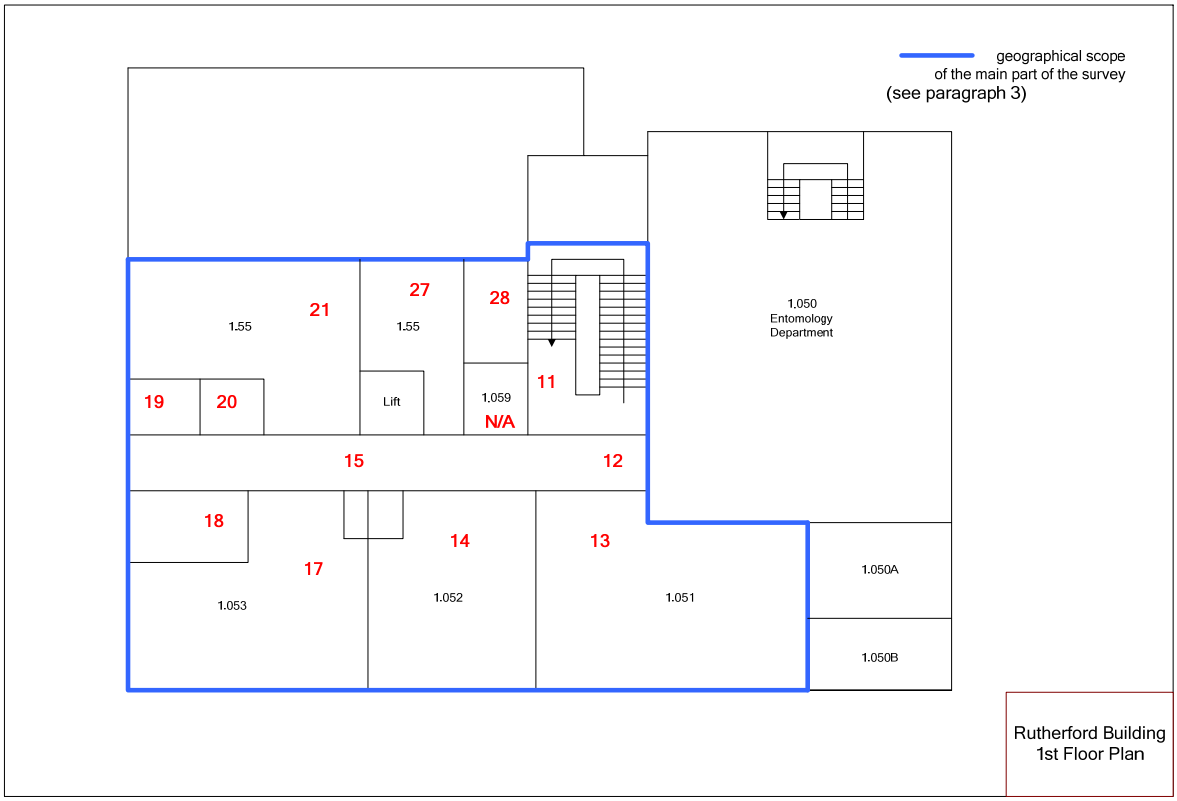
Tunnel between Rutherford Building and Beyer Building, 4 November 2008

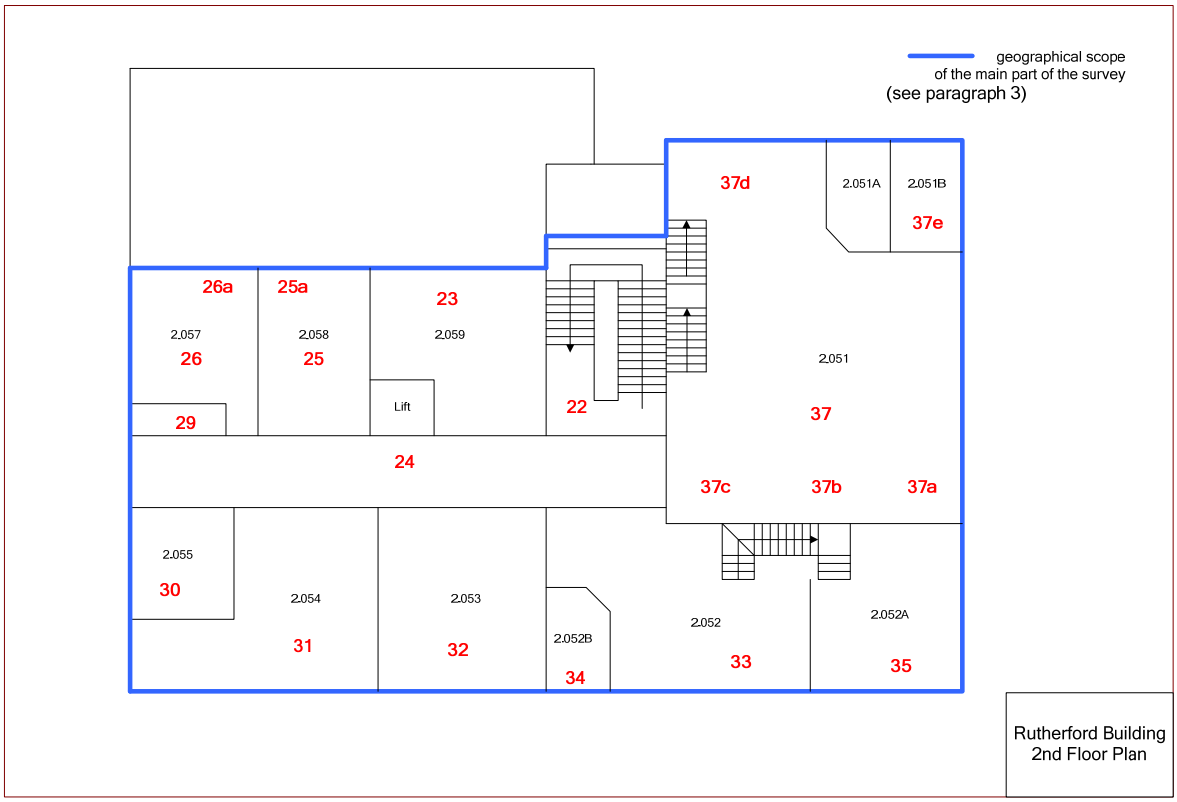
Measurements carried out by CD, using our own MVI

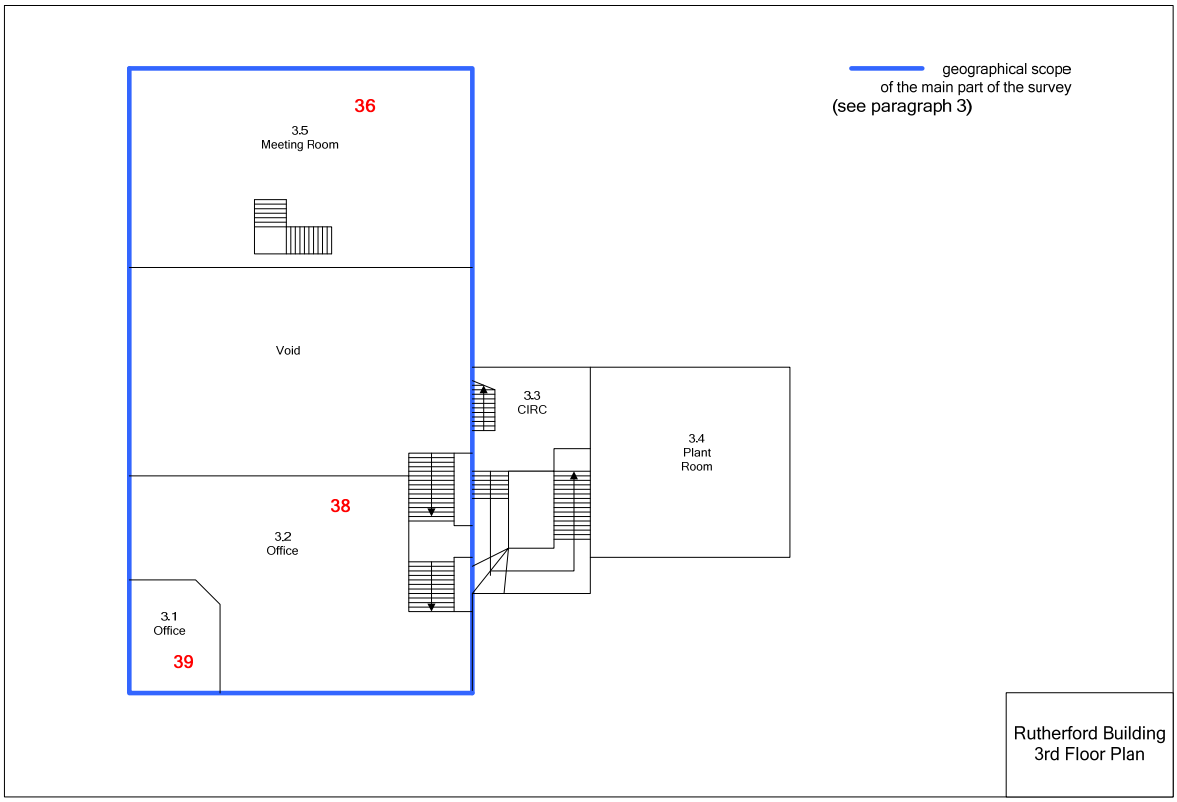
Room No	Reading (µg/m3) at						Additional comments
	1.5m		1.0m		floor level		
	MVI	Mercury Analyser	MVI	Mercury Analyser	MVI	Mercury Analyser	
Museum foyer			0.1				Reference reading
Tunnel			1.2				Entrance at Museum side
					1.2		over drains in tunnel
			1.9				near Beyer/Owens exit

Appendix F Rutherford Building measurement positions

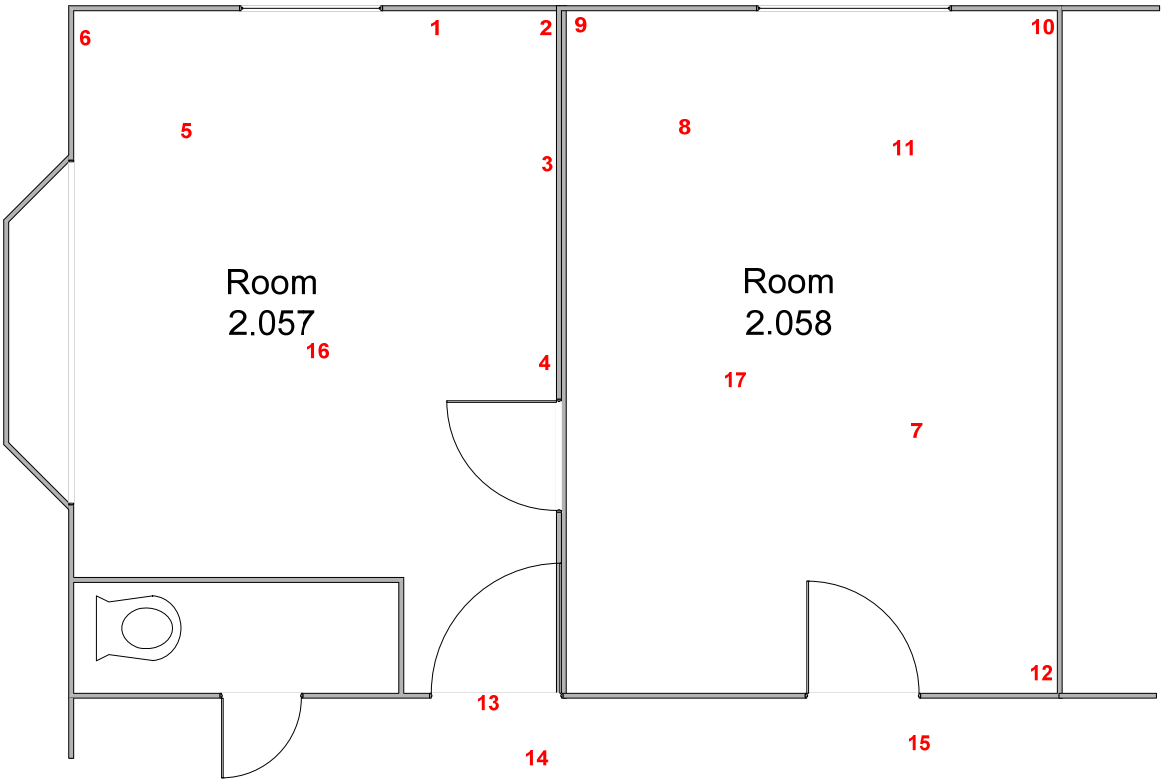




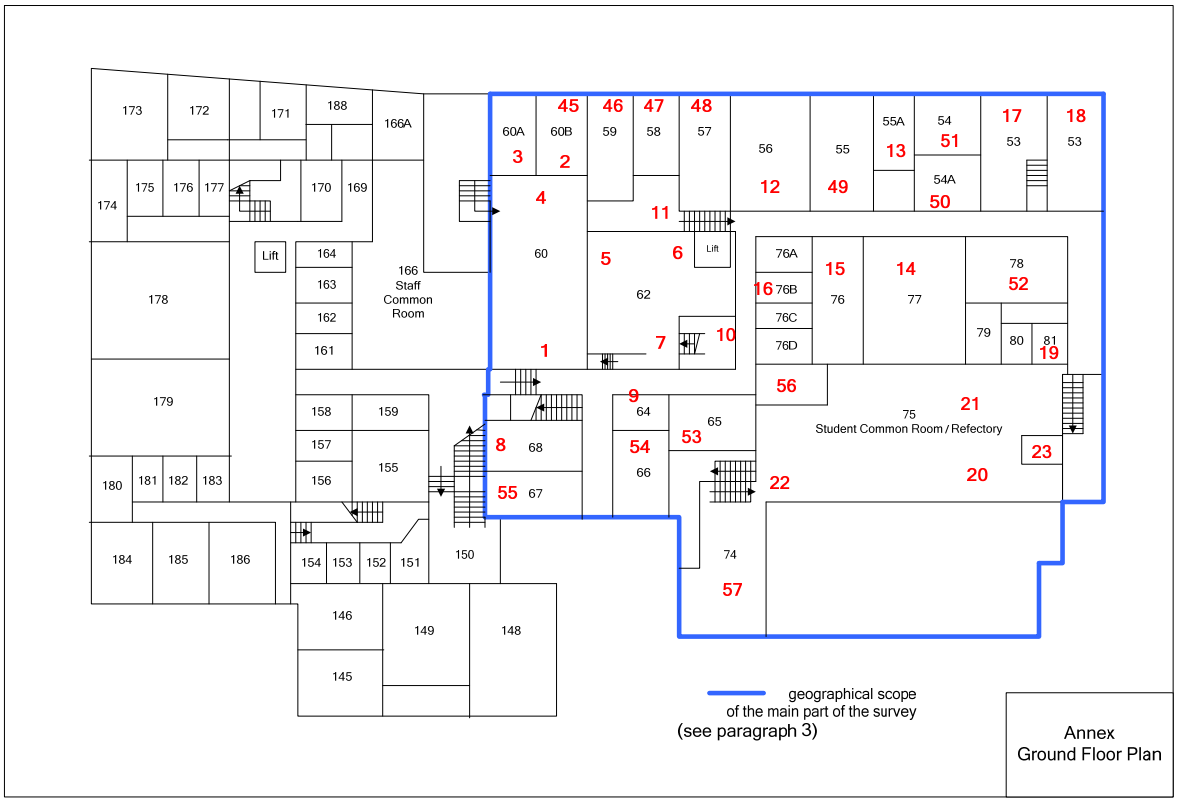

geographical scope
of the main part of the survey
(see paragraph 3)
37d
2.051A
2.051B
37e
26a
25a
23
2.057
2.058
2.059
26
25
2.051
Lift
22
37
29
24
37c
37b
37a
2.055
30
2.054
2.053
2.052
2.052A
31
32
2.052B
33
35
34
Rutherford Building
2nd Floor Plan

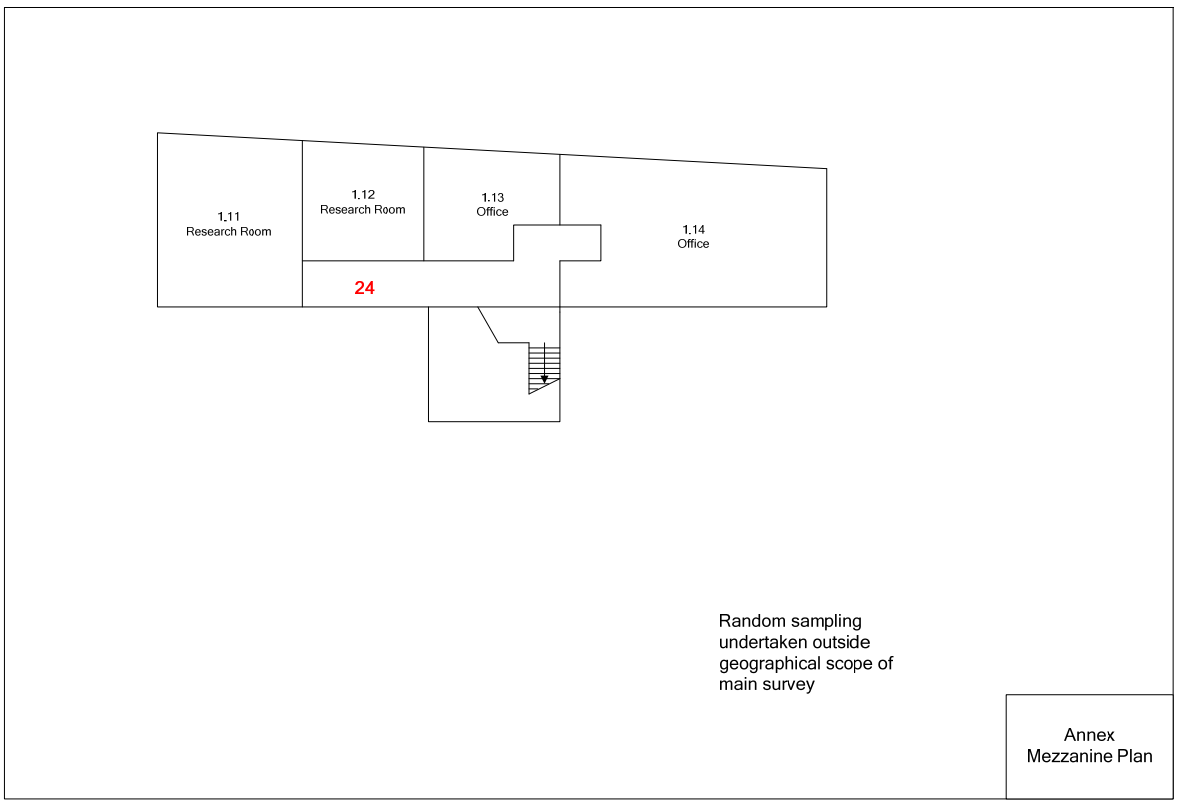

geographical scope
of the main part of the survey
(see paragraph 3)
36
3.5
Meeting Room
Void
3.3
CIRC
3.4
Plant
Room
38
3.2
Office
3.1
Office
39
Rutherford Building
3rd Floor Plan

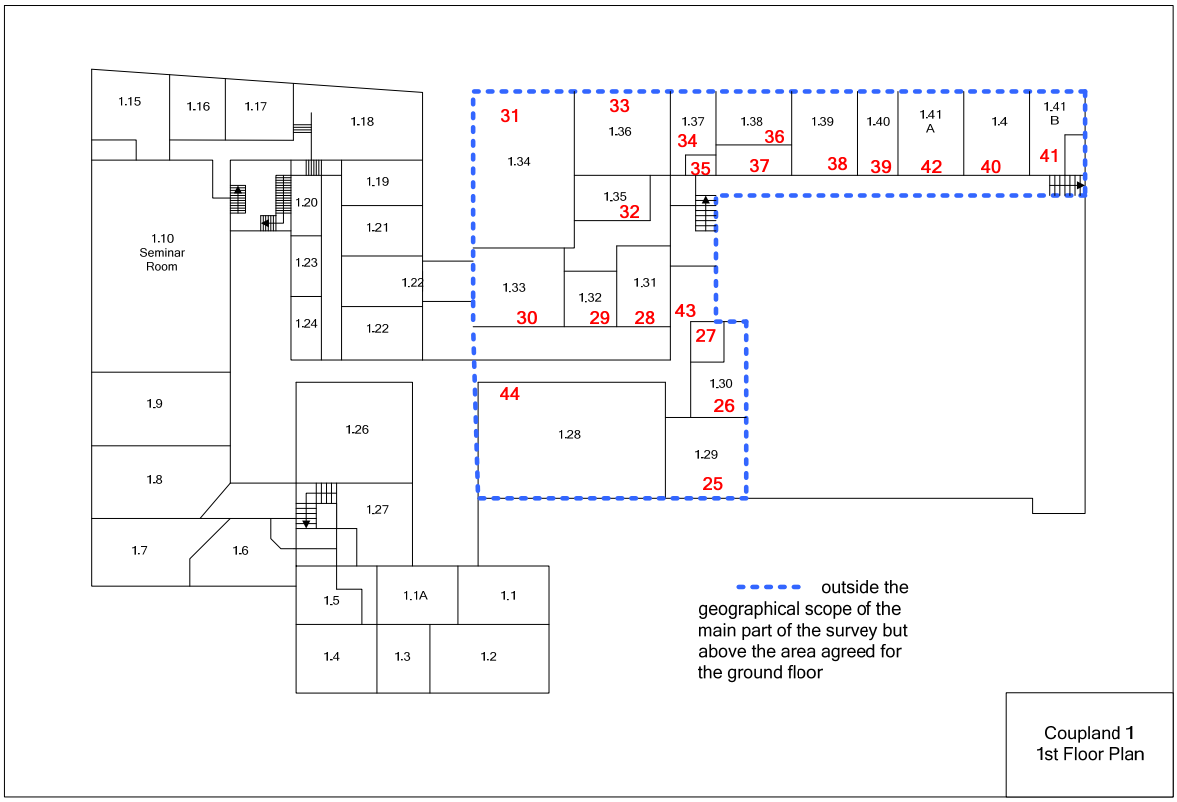
Rutherford Building, 2nd floor rooms
2.057 & 2.058 (= 2.62/3 respectively)



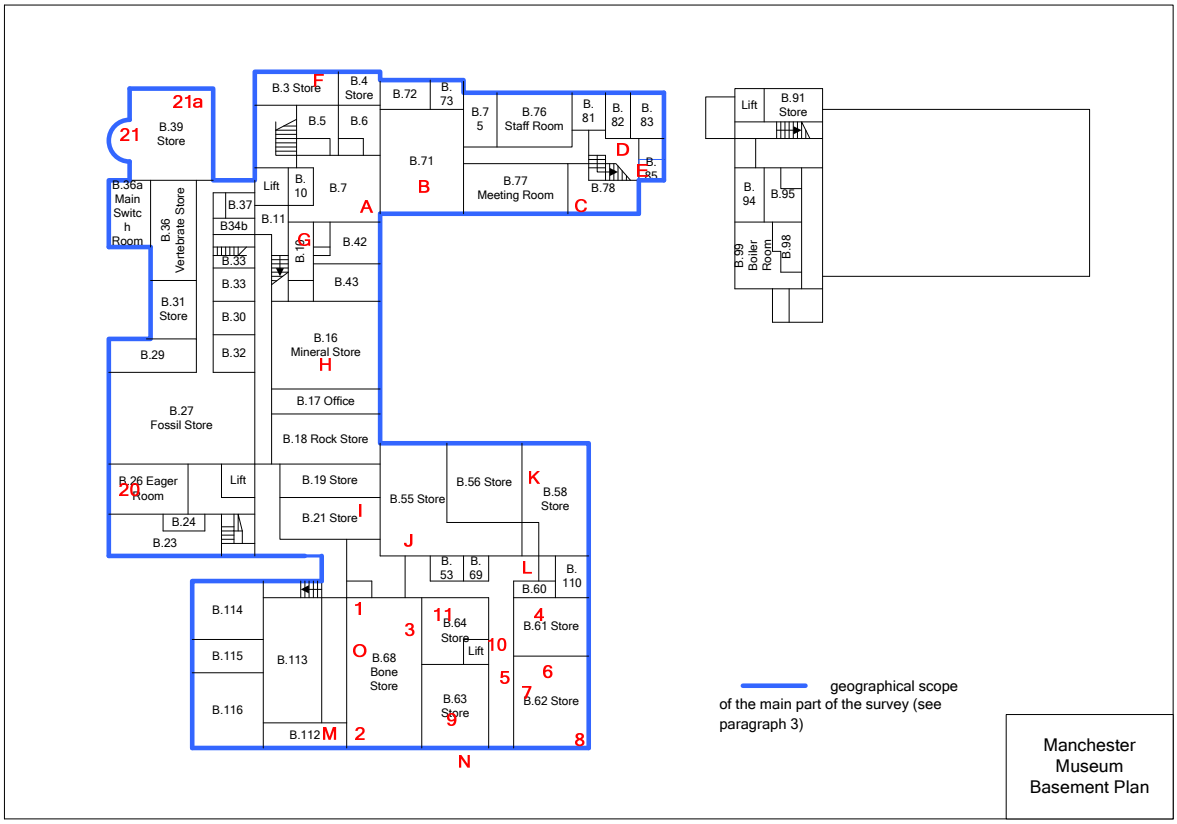
Appendix G Psychology Annex measurement positions

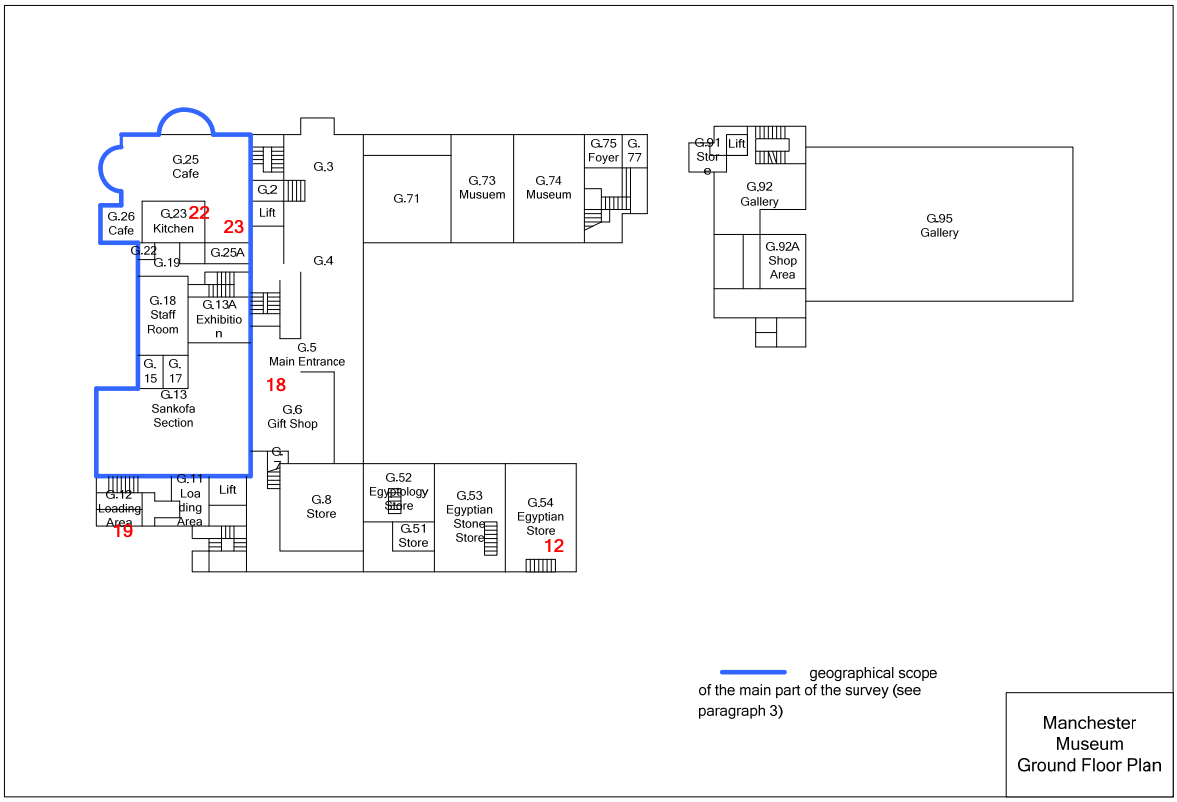


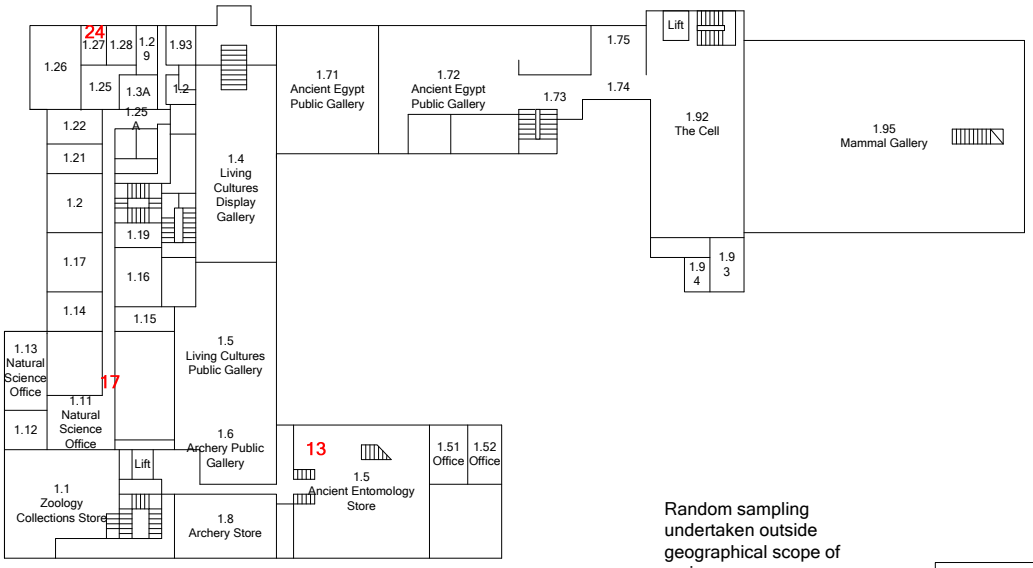



1.15
1.16
1.17
1.18
1.19
1.20
1.21
1.23
1.22
1.24
1.22
1.10
Seminar
Room
1.9
1.8
1.7
1.6
1.26
1.27
1.5
1.1A
1.1
1.4
1.3
1.2
31
33
1.34
1.36
1.37
1.38
1.39
1.40
1.41
A
1.4
1.41
B
34
36
35
37
38
39
42
40
41
1.35
32
1.33
1.32
1.31
30
29
28
43
27
1.30
26
44
1.28
1.29
25
outside the geographical scope of the main part of the survey but above the area agreed for the ground floor
Coupland 1
1st Floor Plan

Appendix H Manchester Museum measurement positions

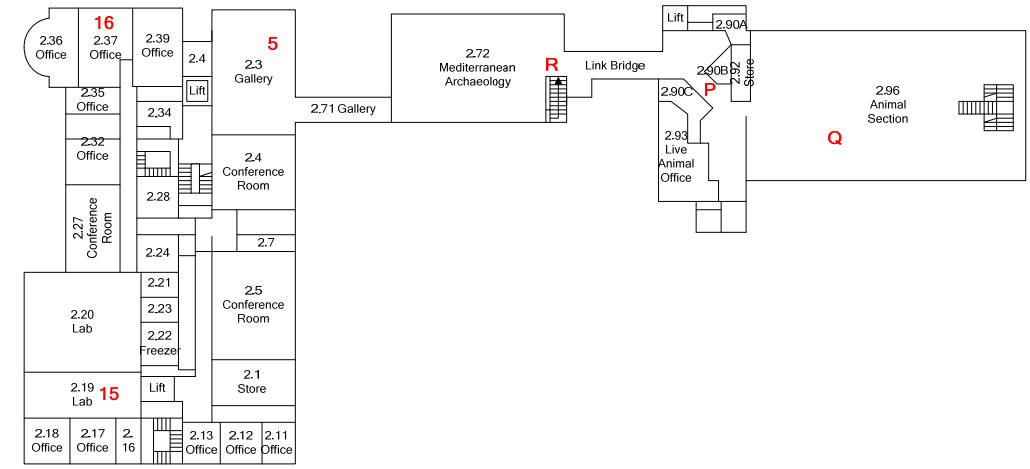






Random sampling undertaken outside geographical scope of main survey

Manchester Museum
1st Floor Plan



Random sampling undertaken outside geographical scope of main survey

Manchester Museum
2nd Floor Plan

Appendix I - Rutherford Building Risk assessments

1. November 2008.

Health & Safety Services

Risk Assessment for historic contamination by mercury in Coupland 1 Building (now the Rutherford Building)

School / Unit	Student Recruitment, Admissions & International Development Division (SRAIDD)
Building	The parts of Coupland 1 Building now known as the Rutherford Building (see plan)
Room Numbers	All basement, ground, first and second floor rooms currently occupied by SRAIDD (see plan)
Brief Description	The rooms are used variously as private and shared offices, stores, and service areas. Room G55 (now the Rutherford Room) is known to have been a laboratory used by Rutherford's research team. Room 2.057 is known to have been Rutherford's office. A major refurbishment of this building took place in 2003/4. Monitoring of mercury was carried out by Casella Winton before the work, and mercury was found in several places under the floorboards. (Ref survey by Casella Winton, project no FLIX0010, received by Estates, 2 Feb 2004. The following rooms were identified, before refurbishment, as significantly or severely contaminated by mercury – G53, G55, 1.52, 1.53, 2.52 & 2.52(a), 2.53, 2.58, 2.60, 2.61, 2.62, 2.63. At ground level then, mercury vapour concentrations of up to 10 $\mu g.m^{-3}$ were found. Material under the floorboards was removed at that time, and was known to have been contaminated with both mercury and radioactive substance(s).

Hazard

Inhalation of mercury vapour is known to harm human health. See WHO publication for a discussion of the studies of occupational and environmental exposures, at http://www.who.int/ipcs/publications/cicad/en/cicad50.pdf

Rutherford and other physicists researching the nature of radioactivity were known to have used elemental mercury in a variety of scientific instruments, in and around this building. Mercury was found under the floor in the Rutherford Building during refurbishments in 2002.

Risk assessment

Measurements of elemental mercury vapour were carried out during autumn 2008 by Health & Safety Services (Melanie Taylor/Catherine Davidge), using HSS's ShawCity mercury vapour indicator (MVI) and a Lumex Mercury Analyser RA-915+ (hired from Spectronic Analytical Instruments). Results are appended.

Summary of findings:

- Mercury vapour concentrations in most of the rooms were very low.
- Compared to the rest of the building, elevated levels were found in 2.057 and the adjoining office. In the breathing zones of people sitting at the desk or meeting table, these ranged from less than zero to 5.6 $\mu g.m^{-3}$. However, with the detector close to ground level and the wall/floor junction behind wall cupboard units, levels well in excess of 25 $\mu g.m^{-3}$ were found with the MVI, and confirmed with the Lumex analyser. In one inaccessible position behind the cupboard and near gaps in the wall/floor junction & radiator pipe, a localised reading of 200 $\mu g.m^{-3}$ was recorded.
- After work to lift the floorboards in the vicinity of the highest readings and remove rubble, the highest concentration (in the inaccessible position at ground level) was reduced to 27 $\mu g.m^{-3}$, although the concentration at breathing zones remained around 5 $\mu g.m^{-3}$

Measurements can be compared with the last published HSE EH40 listing of Occupational Exposure Standards (2002), which gives a value for mercury of 25 $\mu g.m^{-3}$ averaged over an 8 hour working day. This has been withdrawn, pending publication of, and consultation about, the EU 3rd list of Indicative Occupational Exposure Limit Values which is believed to include mercury.

Many users spend irregular hours in the building. Concentrations at typical working positions in room 2.057 are 20% of the WEL, and it would therefore be impossible to exceed the current WEL (since the working day cannot be 5 x 8 hours). However, it is not apparent from this survey whether the measurements are typical of a working day, or if there is significant variation during the day or over longer periods.

Groups of people (e.g. operators, cleaners, public) who could be at risk.

a) Staff occupying and using room 2.057
b) Ancillary staff carrying out maintenance and cleaning operations in that room
c) Visitors to room 2.057 (short duration)

Existing control measures *(e.g. access control, protective clothing):*

Not applicable.
(General ventilation may provide some removal or dilution of vapour concentrations.)

Summary record of the significant findings of the assessment *(e.g. extent and possible consequences of risk):*

In most rooms, the mercury vapour levels are insignificant, and well below presumed exposure limits averaged over an 8 hour working day.

In room 2.057, levels at typical breathing zone positions are 20% of the presumed WEL, but

nevertheless higher than the rest of the building. However, it is known that occupational exposure concentrations are under discussion and are likely to be reduced. It is prudent therefore (and a legal requirement) to reduce exposure to mercury vapour to as low a level as reasonably practicable. For these reasons, the following recommendations are made:

1. Room 2.057 should be fully covered and carpeted with special attention being paid to sealing wall/floor junctions and floorboard junctions (not tongue & grooved).
2. The occupant(s) should be offered biological monitoring through Occ Health
3. Regular monitoring should be carried out (e.g. at least annually)
4. Before any refurbishment, maintenance or repair work involving penetration or disturbance to any structural element is carried out, specific and local mercury vapour monitoring should be carried out and a specific risk assessment made.
5. Further consideration should be given to whether it is reasonably practicable to locate the sources of mercury contamination and eliminate or reduce them, bearing in mind the building refurbishment work that has already been carried out to remove contaminated floor plugging material.

Contingency plans for "reasonably foreseeable" accident:

Any emergency repairs involving penetration to any structural element may disturb mercury deposits that have not been detected by the survey. If practicable in the circumstances, local mercury vapour monitoring should be carried out and a specific risk assessment made.

Arrangements for Monitoring and Review:

In view of the likelihood of a reduced WEL in the future, annual reviews of the data should be carried out and compared with any changes to WEL or scientific evidence about the effects of mercury vapour on health.

Date for next review of this Assessment:

November 2009

Assessor(s) **Melanie Taylor, University Safety Advisor**
Catherine Davidge, University Safety Co-ordinator

Signature(s)

Date: November 2008

2. January 2009.

Rev 1, Jan 09

Health & Safety Services

Risk Assessment for historic contamination by mercury in Coupland 1 Building (now the Rutherford Building)

School / Unit	Student Recruitment, Admissions & International Development Division (SRAIDD)
Building	The parts of Coupland 1 Building now known as the Rutherford Building (see plan)
Room Numbers	All basement, ground, first and second floor rooms currently occupied by SRAID (see plan)
Brief Description	The rooms are used variously as private and shared offices, stores, and service areas. For data and assessment prior to 1/1/09, refer to risk assessment, Nov 08.

Hazard

Inhalation of mercury vapour is known to harm human health. See WHO publication for a discussion of the studies of occupational and environmental exposures, at http://www.who.int/ipcs/publications/cicad/en/cicad50.pdf

Rutherford and other physicists researching the nature of radioactivity were known to have used elemental mercury in a variety of scientific instruments, in and around this building. Mercury was found under the floor in the Rutherford Building during refurbishments in 2002.

Risk assessment

Following work to lift some floorboards and remove debris on 24 October 2008, mercury vapour concentrations in room 2.057 (only) were found to be up to 5.6 $\mu g.m^{-3}$ in the breathing zone of the current occupier (desk towards corner with 2 external walls).

Whilst well under the last published Occupational Exposure Standard of 25 $\mu g.m^{-3}$, it was considered reasonably practicable to reduce the level further by sealing the wall/floor junction.

This work commenced on the 7 January 2009. The room contents and carpet were removed, new plywood sheeting applied to the previously uncovered floorboards, and sealant generously applied to all joints, and particularly to the wall/floor junctions.

Measurements of mercury vapour were carried out by MJT/CD on 6th (prior to work commencing but in an empty room), 7th, 8th, 9th and 12th January, 2009.

Main findings :

(1) concentrations in Room 2.057 dropped significantly during and by the end of the work,

effectively to zero
(2) concentrations in Room 2.058 rose, and were particularly high around the gaps between wall/floor on the party wall to room 2.057.
(3) at breathing zones of the 3 occupants of room 2.058, concentrations reached 23 $\mu g.m^{-3}$.

These concentrations were confirmed when HSL (Andrew Easterbrook) visited on 12 January 2009.

The measurements can be compared with the HSE's last published EH40 listing of Occupational Exposure Standards (2002), which gives a value for mercury of 25 $\mu g.m^{-3}$ averaged over an 8 hour working day. This has been withdrawn, pending publication of, and consultation about, the EU 3rd list of Indicative Occupational Exposure Limit Values which is believed to include mercury.

Groups of people (e.g. operators, cleaners, public) who could be at risk.

- Staff occupying and using room 2.058 for most of their working day.
- To a much lesser extent, ancillary and other staff carrying out maintenance and cleaning operations in that room, or visiting the occupants (although typically these will be of short duration).

Existing control measures *(e.g. access control, protective clothing):*

Not applicable.

Summary record of the significant findings of the assessment *(e.g. extent and possible consequences of risk):*

The concentrations in the breathing zones of the 3 occupants are close enough to the old OES to warrant their removal from the room, pending further investigations and remedial work to reduce/eliminate mercury vapour.

Contingency plans for "reasonably foreseeable" accident:

Arrangements for Monitoring and Review:

Date for next review of this Assessment:

Upon completion of remedial works.

Assessor(s) **Melanie Taylor, University Safety Advisor**
Catherine Davidge, University Safety Co-ordinator

Signature(s)

Date: 12 Jan 2009

Appendix J Risk Assessment for Psychology Annex

Health & Safety Services

Risk Assessment for historic contamination by mercury in Coupland 1 Building (the Psychology Annex)

School / Unit	Parts of the School of Psychological Sciences
Building	The parts of Coupland 1 Building now known as the Psychology Annex (see plans)
Room Numbers	Room numbers in this building are not consecutive. All ground and first floor rooms to the right of the main entrance from Bridgeford St were surveyed.
Brief Description	The rooms are used variously as private offices, student PC clusters, stores, common and teaching areas. Part of the first floor is occupied by the Max Planck Child Study Centre, which has laboratories for observing child behaviour.

Hazard

Inhalation of mercury vapour is known to harm human health. See WHO publication for a discussion of the studies of occupational and environmental exposures, at http://www.who.int/ipcs/publications/cicad/en/cicad50.pdf

Rutherford and other physicists researching the nature of radioactivity were known to have used elemental mercury in a variety of scientific instruments, in and around the adjoining building (originally known as Coupland 1 Building, now the Rutherford Building). Mercury was found under the floor in several rooms in the Rutherford Building during refurbishments in 2004.

It is suspected that his activities took place in surrounding areas and/or his work spread and contaminated surrounding areas.

Risk assessment

Measurements of elemental mercury vapour were carried out during autumn 2008 by Health & Safety Services (Melanie Taylor/Catherine Davidge), using HSS's ShawCity mercury vapour indicator (MVI) and hired Lumex Mercury Analyser RA-915+ instrument (Spectronic Analytical Instruments). Results appended.

Summary of findings:

- mercury vapour concentrations in most of the Annex were below 2.0 $\mu g.m^{-3}$, in most cases significantly below.
- Initially, in the cluster of rooms numbered 1.41/1.41A/1.41B (with the sampler very close to the carpet), elevated mercury vapour concentrations were found with the

ShawCity MVI, and confirmed at up to 20 $\mu g.m^{-3}$ (at ground level) with the Lumex analyser. These concentrations were reduced to 2.5 $\mu g.m^{-3}$ or less after work was carried out to seal the floor/wall junction underneath one of the desks in room 1.41.
- Concentrations at the breathing zone for seated or standing individuals in these rooms did not exceed 4 $\mu g.m^{-3}$ before the floor/wall seal was improved.
- In G32 and H18, initial findings of elevated mercury vapour concentrations inside or very close to a floor duct were not confirmed by the use of the Lumex analyser, which gave concentrations of < 3 $\mu g.m^{-3}$

Measurements can be compared with the last published HSE EH40 listing of Occupational Exposure Standards (2002), which gives a value for mercury of 25 $\mu g.m^{-3}$ averaged over an 8 hour working day. This has been withdrawn, pending publication of, and consultation about, the EU 3rd list of Indicative Occupational Exposure Limit Values which is believed to include mercury.

Groups of people (e.g. operators, cleaners, public) who could be at risk.

a) staff occupying and using the rooms
b) Ancillary staff carrying out maintenance and cleaning operations
c) Students and other visitors using the facilities
d) Young children participating in research projects and under observation in Labs on the first floor, particularly rooms 1.34-1.36.

Existing control measures *(e.g. access control, protective clothing):*

Not applicable.
(General ventilation may provide some removal or dilution of vapour concentrations.)

Summary record of the significant findings of the assessment *(e.g. extent and possible consequences of risk):*

In most rooms, the mercury vapour levels are low to insignificant, and well below presumed exposure limit averaged over an 8 hour working day.

However, it is known that occupational exposure concentrations are under discussion and are likely to be reduced. It is prudent therefore to reduce exposure to mercury vapour to as low a level as reasonably practicable. For these reasons, the following recommendations are made:

1. Regular monitoring of Room 1.41 is carried out (e.g. annually)
2. Before any refurbishment, maintenance or repair work involving penetration to any structural element is carried out, specific and local mercury vapour monitoring should be carried out and a specific risk assessment made.

Contingency plans for "reasonably foreseeable" accident:

Any emergency repairs involving penetration to any structural element may disturb mercury deposits that have not been detected by the survey. If practicable in the circumstances, local mercury vapour monitoring should be carried out and a specific risk assessment made.

Arrangements for Monitoring and Review:

In view of the likelihood of a reduced WEL in the future, annual reviews of the data should be carried out and compared with any changes to WEL or scientific evidence about the effects of mercury vapour on health.
Date for next review of this Assessment: November 2009
Assessor(s) **Melanie Taylor, University Safety Advisor** **Catherine Davidge, University Safety Co-ordinator** **Signature(s)** **Date:** November 2008

Appendix K - Risk assessment for Manchester Museum

Health & Safety Services

Risk Assessment for historic contamination by mercury in certain parts of Manchester Museum

School / Unit	Manchester Museum
Building	Parts of Manchester Museum used in the past as : 1. a dental hospital, and 2. adjacent to areas occupied by Ernest Rutherford, 1907 to 1919
Room Numbers	(i) Basement, ground, 1st & 2nd floors, rooms in the area known as the Old Dental Hospital (not the 1912 and 1927 Waterhouse Buildings), (ii) Basement (rooms & corridors B50-68); ground floor (G50-54, G9) and first floor (1.5, the archives entomology store) These rooms are not in the areas open to the public, but include staff facilities and offices, storage archives, workshops, and similar.
Brief Description	(i) These areas were originally occupied by the Dental Hospital. This is to assess if any residual mercury concentrations from the historic use of dental amalgam present a risk to current occupiers. (ii) These areas are physically close to rooms occupied by Ernest Rutherford in Coupland 1 building (now known as the Rutherford Building). NB: Churcher et al report lists rooms CB05, CB09, CB10, C1.09, C1.10 in the Museum has having elevated radiation levels in 2000, and have associated their use with Rutherford's research. These equate now to rooms B58, B62, B63 and 1.5 & 1.050A/B respectively.

Hazard

Inhalation of mercury vapour is known to harm human health. See WHO publication for a discussion of the studies of occupational and environmental exposures, at http://www.who.int/ipcs/publications/cicad/en/cicad50.pdf

Mercury amalgam was extensively used by dentists (and still is).

Rutherford and other physicists researching the nature of radioactivity were known to have used elemental mercury in a variety of scientific instruments. Mercury was found under the floor in the adjoining Rutherford Building during refurbishments in 2002.

Risks assessment

Measurements of elemental mercury vapour were carried out as follows:

1. June 2006, survey of the Museum's entomology archive (Room 1.5) by Health & Safety

Services (Catherine Davidge), using HSS's ShawCity mercury vapour indicator (MVI). Follow-up survey in early 2008 with hired Lumex Mercury Analyser RA-915+ instrument (Spectronic Analytical Instruments) with a very specific response to mercury. Results appended.

2. Autumn 2008, survey by Health & Safety Services (Melanie Taylor/Catherine Davidge), using HSS's ShawCity mercury vapour meter and hired Lumex Mercury Analyser RA-915+ instrument (Spectronic Analytical Instruments). Results appended.

Summary of findings of both surveys:

- In early 2008, using the mercury-specific Lumex analyser, mercury vapour concentrations in Room 1.5 were 1.6 to 2.2 $\mu g.m^{-3}$.
- In late 2008, using the mercury-specific Lumex analyser, mercury vapour concentrations in Rooms B58, B62 and B63 typically ranged from 5.0–8.0 $\mu g.m^{-3}$. (Higher readings have been obtained using the ShawCity MVI, but these are likely to have been detecting organic materials such as naphthalene in addition to mercury.) These rooms are currently all used as storerooms and archives, and there is no permanent staff presence.
- In all other rooms, including room 1.5, concentrations measured with the mercury analyser were under 4 $\mu g.m^{-3}$; in many cases, well under this level.

Measurements can be compared with the last published HSE EH40 listing of Occupational Exposure Standards (2002), which gives a value for mercury of 25 $\mu g.m^{-3}$ averaged over an 8 hour working day. This has been withdrawn, pending publication of, and consultation about, the EU 3rd list of Indicative Occupational Exposure Limit Values which is believed to include mercury.

If anyone did work in the rooms for 8 hours, 5 days a week, their exposures would be well under the presumed Workplace Exposure Limit concentration. However, occupation of rooms B58, B62 and B63 is limited. Staff retrieve archived objects but there is no work station to encourage them to stay in the rooms. Typically, the maximum time spent in this room by a museum member of staff is 10 hours per week; cleaning staff could be present for approx 45 mins every 3 months (emails dated 2 & 6 Feb 2009, from Nigel Thompson, Assistant Director of the Museum.

Groups of people (e.g. operators, cleaners, public) who could be at risk.

a) Museum staff occupying and using the rooms
b) Ancillary staff carrying out maintenance and cleaning operations
c) Visitors to Museum staff, including volunteers

Existing control measures *(e.g. access control, protective clothing):*

Not applicable.
(General ventilation may provide some removal or dilution of vapour concentrations.)

Summary record of the significant findings of the assessment *(e.g. extent and possible consequences of risk):*

In most rooms of the Museum, the mercury vapour levels are low to insignificant, and well below presumed exposure limits averaged over an 8 hour working day. In rooms B58 and B62, concentrations are still well under the WEL, but are elevated compared to other rooms in the Museum.

It is known that occupational exposure concentrations are under discussion and are likely to be reduced. It is prudent therefore to reduce exposure to mercury vapour to as low a level as reasonably practicable. For these reasons, the following recommendations are made:

1. The Museum should ensure working patterns do not change such that staff spend more time in rooms B58/B62, (or if they do need to change, this risk assessment should be reviewed).
2. Before any refurbishment, maintenance or repair work involving penetration to any structural element is carried out, specific and local mercury vapour monitoring should be carried out and a specific risk assessment made.
3. Further investigations should be made into the possible sources/location of mercury contamination in B58/B62, with a view to removing it in due course.

Contingency plans for "reasonably foreseeable" accident:

Any emergency repairs involving penetration to any structural element may disturb mercury deposits that have not been detected by the survey. If practicable in the circumstances, local mercury vapour monitoring should be carried out and a specific risk assessment made.

Arrangements for Monitoring and Review:

In view of the likelihood of a reduced WEL in the future, annual reviews of the data should be carried out and compared with any changes to WEL or scientific evidence about the effects of mercury vapour on health.

Date for next review of this Assessment:

November 2009

Assessor(s) **Melanie Taylor, University Safety Advisor**
Catherine Davidge, University Safety Co-ordinator

Signature(s)

Date: 6 February 2009

Appendix L – Mercury monitoring in Manchester Museum

Mercury Monitoring, Manchester Museum
June 2006 – January 2008

Summary

Concern had been expressed in the Museum as to whether the previous use as scientific research laboratories could result in significant levels of residual mercury vapour in the entomology area. The area is also contaminated with naphthalene and volatile organic compounds (VOCs) are known to interfere with the equipment owned by H&S Services therefore an alternative method of measurement was deemed necessary.

Values obtained in June 2006 using the Shaw City Mercury Vapour Indicator (H&S Services) were between 9.4 and 36 $\mu g.m^{-3}$ and were quite unstable. In January 2008 the Mercury Analyser RA-915+ instrument (Spectronic Analytical Instruments) gave values of 1.6 to 2.2 $\mu g.m^{-3}$. The latter measurements are approximately one tenth of the HSE's exposure limit values.

Introduction

Mercury vapour is known to be harmful to health; therefore control of exposure is required under the COSHH Regulations. The Entomology area of the Museum occupies a former scientific research area and, though refurbished, concerns were expressed as to whether there was any harmful residual mercury contamination. Mercury vapour measurements were made to determine if this was true and if any exposure limits were being reached.

There are no current Workplace Exposure Limit for mercury published by the HSE. Therefore the latest published Occupational Exposure Standard (OES) level of 25$\mu g.m^{-3}$ (8hr TWA) in EH40/2002 have been used as reference values for this exercise.

Methods

<u>June 2006</u>
Measurements were taken using the Health & Safety Services Shaw City Mercury Vapour Indicator as follows.

The equipment was allowed to warm up and stabilise then zeroed with the charcoal filter in place. The filter was replaced by the sample tube before entering the entomology area and taking a number of measurements.

To obtain each reading the equipment was placed in a horizontal position (samples 1-6) or held upright (7&8) and left until the reading was stable. Readings 1-6 were quite stable, but when used in the upright position there was less stability and the range of readings was recorded. See diagram and table below.

The results obtained were, generally less than half the OES, however, the presence of volatile organic compounds e.g. naphthalene, can interfere with the values obtained from this equipment and their reliability was doubted.

An alternative method of measurement was sought and Nigel Thompson (Museum Assistant Director) contacted the Health and Safety Laboratory, Buxton who recommended hiring the Lumex Mercury Analyser RA-915+ from Spectronic Analytical Instruments.

This equipment is highly sensitive with a detection limit for mercury vapour concentration in air of 2 $ng.m^{-3}$. Its operation is based on differential Zeeman atomic absorption spectrometry which is not affected by the presence of VOCs and should therefore provide accurate data in the presence of naphthalene.

January 2008
There was a very long delay due to the unavailability of equipment which was eventually acquired in January 2008.

The Analyser was zeroed and set to provide the mean mercury vapour concentration of three consecutive 10 second readings.

A reading was taken in Nigel's office some distance away from entomology to serve as a background level.

Where possible, readings were taken in the entomology area in approximately the same locations as in June 2006. Repairs had been carried out to the mezzanine ceiling so some alternative locations were also measured. Readings were taken on two occasions 16th & 18th January and the data presented as the mean of the two.

Results

A diagram of sampling location and the results are given in the appendix below.

The H&S Services equipment gave a mercury vapour concentration ranging from 9.4 to 15.0 $\mu g.m^{-3}$ (excluding Sample 7 which was very unstable). This is approximately half the 25 $\mu g.m^{-3}$ OES value.

The values obtained in January 2008 range from 1.6 to 2.2 $\mu g.m^{-3}$ and measurement by the more specific and sensitive method show that the level of mercury vapour was very low and less than one tenth of the exposure limits given in EH40/2002.

Discussion

The values obtained from the Lumex Mercury Analyser RA-915+ suggest that the level of mercury vapour present in the entomology area does not pose a high risk to the health of those using the facility.

The presence of naphthalene is still a cause for concern though as it also had an Occupational Exposure Standard given in EH40/2002, which, like mercury, was withdrawn and do not appear in the Workplace Exposure Limits introduced in 2005.

The former OES for naphthalene is 53 $mg.m^{-3}$ (8hr TWA) and 80$mg.^{m-3}$ (15min). However the odour threshold value is 0.44$mg.m^{-3}$ which means it will be detected by the sense of smell long before any OSE values are reached.

Naphthalene was historically used as a preservative and its odour strongly pervades the entomology area atmosphere and the surrounding corridors. Therefore the levels of naphthalene should also be measured to determine if there is any risk to health from this source and to determine if exposure is being sufficiently controlled. The ventilation in the entomology area is poor and ways of improving this should be investigated as this would reduce naphthalene exposure. Improved ventilation would have the added desirable effect of reducing the mercury vapour concentration further.

Nigel Thompson has been asked to enquire whether Spectronic Analytical Instruments have a means of measuring naphthalene.

Report prepared by Catherine Davidge
22/1/08

Bibliography

EH40/2002. HSE Books ISBN 0 7176 2083 2
Naphthalene MSDS issued 3/12/04, VWR
Lumex Mercury Analyser RA-95+ User Manual

Appendix

		Mercury Vapour Indicator	Mercury Analyser RA-915+
		6 Jun 06	16 &18 Jan 08
Sample	Location	Reading (µg.m^{-3})	
1	Ground floor, bottom of stairs, floor level	9.4	2.1
2	Ground floor, opposite stairs, floor level	10.5	-
3	Ground floor, opposite stairs, face level	10.9	-
4	Ground floor, narrow access route, floor level	11.6	2.1
5	Ground floor, narrow access route, face level	11.5	2.1
6	Mezzanine, on bench at top of stairs	11.3	1.9
7	Mezzanine, through hole in ceiling plaster when plywood cover removed	12-15 (unstable)	-
8	Mezzanine, probe held to crack in ceiling near bench	11.8-36 (v unstable	-
9	Mezzanine, access route, high level near to 7 above	-	1.9
10	Mezzanine floor, access route, floor level	-	1.9
11	Mezzanine floor, far end, floor level	-	1.6
12	Ground floor, centre of room, floor level	-	2.2
	Nigel Thompson's office away from entomology area		0.063