iras LIMITED
Independent Radiation Assessment Services

RADIATION PROTECTION AND WASTE CHARACTERISATION DURING THE SOFT STRIPPING OF COUPLAND 1 BUILDING

November 2004

SM Slater
AJ Frith

Invoice Date 05-NOV-04
Supplier Name
Danwood Group Limited
Supplier Invoice Number 2308768
XX 894651
515.75

Technical Report

E04003/TR/001
Issue 01

IRAS DOCUMENT ISSUE RECORD

Document Title: Radiation Protection And Waste Characterisation During The Soft Stripping Of Coupland 1 Building

Document Reference: E04003/TR/001

Purpose of Issue: For use

Security Classification: Commercial-in-confidence

Issue	Description of Amendment	Author / Originator	Approved by	Date
01	For use.	S. M. Slater SM Slater AJ Frith	B. Frith B Frith	29/11/2004

© IRAS Limited

All rights reserved. No part of this document, or any information within it may be disclosed, loaned, reproduced, copied, translated or transferred to an electronic medium or machine readable format without the written permission of the company.

Distribution: Client, File

1 Executive Summary

The use of Coupland I building at the University of Manchester for work with radioactive materials dates back to the dawn of nuclear physics. Work undertaken by Rutherford and his colleagues and students in the building in the early 1900's resulted in a number of fundamental discoveries being made in this field. It is understood that biomedical research undertaken more recently, and prior to the building being assigned to the Department of Psychology, also involved work with radioactive material.

Whilst it is thought that previous remediation work undertaken in 2000-2002 removed the main areas of radioactive contamination, radiation monitoring surveys undertaken at that time, and which were limited by the presence of floor coverings, fixtures, fittings and significant amounts of stored departmental material, indicated that further radioactive contamination was likely to be present to an undetermined degree throughout Coupland I. At that time the University was advised that any work to be undertaken in Coupland 1 which involved the disturbance of the building fabric should be subject to prior radiological risk assessment.

The objective of the current project is to remove radiological restrictions on future development and occupation of Coupland 1. This is to be achieved by the systematic and thorough surveying of the building, with the decontamination of areas of contamination.

The first part of this process (Stage 1 – Soft Stripping) is to remove the contents of the building to facilitate an extensive radiological survey. IRAS Limited, as the appointed Radiation Protection Adviser to the UoM for the decommissioning of C1, put radiation protection measures in place in order to ensure the health and safety of those undertaking the stripping work, and also to assess for disposal purposes those items of waste identified during the work as contaminated. It is the radiation and mercury protection aspects of this initial work that are the subject of this report.

The findings of the report are summarized as follows:

- Health and Safety of those undertaking the work

  The monitoring of radiological conditions in the Supervised Areas throughout the soft stripping confirmed the absence of radiation risks that would require the designation of Controlled Areas.

  Calculations of radiation exposure based on the likely most significant exposure route, that of internal radiation via inhalation, confirmed that the radiation exposure to those undertaking the work was occupationally insignificant. These calculations are based on a number of worst case assumptions. In addition, no instances of personal contamination were identified.

  It can be concluded, therefore, that radiation protection arrangements were adequate in all respects and that exposure was restricted to as low as reasonably practicable.

  In addition to the radiological monitoring, monitoring of mercury confirmed that, on all occasions, the level of mercury was below the long term Occupational Exposure Standard (OES).

- Identification of contaminated items

The monitoring of all items removed as part of the soft stripping identified four which were contaminated. Of these, three are likely to become waste and will be assessed for disposal purposes. It is understood that the University may wish to retain the fourth item, a period display cabinet. A suitable assessment needs to be made of the measures which can be taken to reduce the radiation risks associated with this item, and to determine the radiological restrictions that would be necessary in order that the item be retained. It is suggested that this may be done in conjunction with the similar work being undertaken in respect of the retention of Rutherford's Bench.

It is recommended that the radionuclide and activity assessment required for this small number of items be left until the waste arising from decontamination operations requires assessment.

- Suitability of the building for surveying

In general, the soft striping of the building has left Coupland 1 in a suitable condition for a systematic and thorough monitoring operation. Exceptions to this are the main corridor on each floor and the Lecture Theatre both of which require further work in order that monitoring access is unrestricted. It is anticipated that this will take place as part of the Stage 2 Hard Stripping work.

2 Introduction

Work with radioactive material in the Coupland 1 building, Manchester University dates back to the early twentieth century when Ernest Rutherford carried out research into the structure of the atom. It was in 1909 that Rutherford first collected helium formed by alpha particles and photographed the spectrum. This work did, however, leave areas of the building and some laboratory furniture contaminated with the radioactive material used in his experiments.

Recent radiological hazard investigations undertaken in the building have identified discrete, localised areas of contamination due to the naturally occurring radionuclides that Rutherford would have used. Radium-226 and lead-210 in equilibrium with polonium-210 predominate, and are to be regarded as being of high radiotoxicity. Some remediation was undertaken, but this was hindered by the insensitivity of portable monitoring equipment to lead-210/polonium-210 beneath floorboards and under floor coverings such as vinyl, plywood, and carpets, which the radiations from these radionuclides cannot readily penetrate. Further work involving the removal of floor coverings and floor boards in sample areas indicated the likelihood that a considerable amount of significant contamination had gone undetected, and led to recommendations that any future work which involved disruption of the building fabric should be preceded by a radiological risk assessment.

Whilst these naturally occurring radionuclides are still thought to be present in the building fabric, it is possible that artificially produced radionuclides may have been used in the building after Rutherford's time.

Identified areas of contamination found in previous work were remediated at that time. However the survey was limited since floor coverings remained, not allowing access to the original floorboards. Therefore the final report concluded that any future work which is likely to disturb the building fabric would require radiological assessment.

The presence in the building of undetectable radioactive contamination involving man-made radionuclide used for research is regarded as very unlikely. There is however one exception i.e. tritium. Tritium is low radiotoxicity isotope of hydrogen with a relatively short half-life of 12.26 years. It is judged highly unlikely that sufficient tritium will have been used in the building to have resulted in residual contamination that would be occupationally significant today.

The University of Manchester have decided to remediate the building so that there is no radiological restriction for future refurbishment and occupation of the building.

With this the aim, the University have appointed IRAS Limited as RPA for the remediation of Coupland 1 building.

Three stages have been defined and are briefly described as follows:

Stage 1: Soft stripping of the building followed by an initial survey to determine the extent and nature of detectable contamination.

Stage 2: Hard stripping of areas where Stage 1 is unlikely to have achieved sufficient monitoring confidence, followed by a further survey in these areas.

Stage 3: The decontamination of Coupland I and the disposal of waste.

Stage 1 of this project involves the preparation of each identified room by the removal of furniture, shelving, partitions (not original to be building) floor coverings, pipe work, conduit etc so as to expose the original floor boards and walls etc. (soft stripping) to enable the exposed surfaces in each room to be marked out on a 1m grid and a full monitoring survey undertaken.

This report describes the operational radiation protection measures taken during the Stage 1 soft strip for the protection of operatives and others, and the results of the work.

Bagnall Group was appointed as the contractor to carry out the soft stripping work in Stage 1.

3 Method

3.1 Preoperational work.

3.1.1 Radiological Protection

Previous radiological hazard investigation work in Coupland 1 building identified areas of radioactive contamination at levels that could not be disregarded for the purposes of radiation protection. The work comprising Stage 1 (soft strip) was, therefore, carried out in accordance with the Ionising Radiation Regulations 1999. Upon IRAS's appointment as RPA to the University of Manchester, a prior risk assessment was undertaken, document reference E04003/PRA040406. This concluded that an area on each floor of the building, which comprised the main corridor and adjoining rooms, should be designated Supervised.

Local Rules were written and displayed at the entrance to each area, document reference E04003/Stage1/Local Rules/Issue 2.

Training of all those involved in the soft strip was given by the RPS with records contained in Appendix A. Visitors to the site were accompanied.

3.1.2 Mercury

Previous remediation work in the building had identified elemental mercury residues located, in particular, in the spaces between floor boards and the ceiling of the room below. An assessment of each room was carried out by Casella Winton and reported in report reference FLIX0010. Before the soft strip began, a COSHH assessment was undertaken by IRAS Limited, reference E04003/Project/Stage 1/HPS/COSHH 01, and concluded that mercury levels should be measured in each of the four identified rooms on each day that work was undertaken in these areas. These rooms are 2.52, 2.53, 2.62 and 2.63.

The assessment also recommended the that further "one-off" measurements be made after floor coverings were removed in the remaining areas, as this may result in elevated levels of mercury vapour in the working environment.

3.2 Method for Soft Stripping

Bagnall Group were appointed as the demolition contractor for the soft stripping of Coupland 1 building, and given the task of removing all items, partitions not original to the building and floor coverings. This would permit an extensive radiological survey on a 1m grid to be undertaken on the floors, walls and ceilings.

The work was undertaken as detailed in the method statement, reference E04003/STAGE 1/Method Statement Issue 01, and summarised as follows:

- Bagging of all paperwork including books, journals and other.
- Removal of all electrical equipment

- Removal of furniture, chairs, blackboards, benches, desks etc.
- Removal of partitions
- Removal of wall tiles
- Removal of floor coverings.
- Removal of pipework, conduit, data cables etc.

All work was undertaken by Bagnall's with radiological monitoring of all items removed carried out by IRAS Limited, acting as Radiation Protection Supervisors for the project.

3.2.1 Operational Controls - Radiation Protection

3.2.1.1 Airborne contamination monitoring

Internal radiation hazards were assessed by airborne contamination monitoring in each room and on each day of work. Airborne particulates were collected over typically an 8 hour period, using portable air samplers of the type L60. In order to give an early indication of higher than anticipated levels of airborne activity each portable air sampler was stopped, momentarily, at hourly intervals and the filter monitored directly using the Mini 900 EP15. Hourly count rates were recorded on the air filter-monitoring sheet.

Higher sensitivity measurements were made in the laboratory after the filters had been stored for a period of at least 3 days, to permit the decay of collected radon daughters, before counting.

3.2.1.2 Contamination monitoring – surface contamination.

Items to be removed from the building were directly monitored using a Mini 900 Type EP15 probe. These instruments use a halogen quenched Geiger-Muller tube with an end window of active area of 15 cm2. They are particularly recommended for beta monitoring and the thin window makes it suitable for monitoring alpha particles above 3 MeV energy. The alpha particles emitted by the natural radionuclides in this instance are in the energy range 4.2 MeV to about 7 MeV. Items were monitored with the end cap removed. Any item monitored giving a reading above the instruments background was retained, marked with radioactive tape and segregated for assessment.

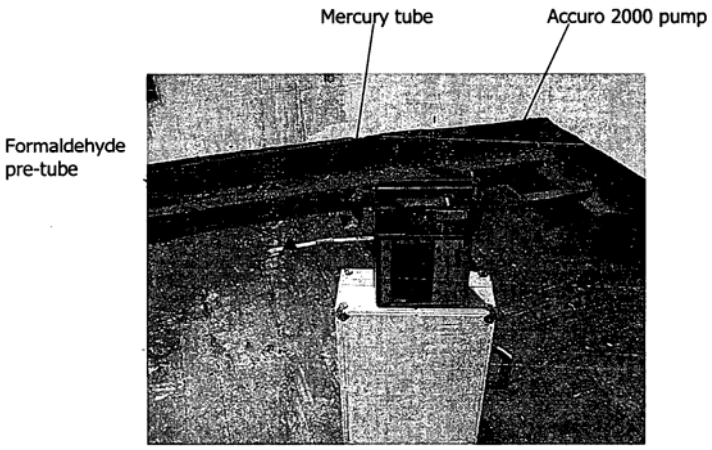
To prevent the spread of contamination from each of the designated areas, personnel monitoring was carried out by the RPS on each working day with a record kept.

3.2.2 Mercury

Mercury measurements were made on each day of work in the four identified rooms using Draegar equipment. The mercury measurement system consisted of a Draegar Activating tube for formaldehyde, attached to a Draegar Tube CH231010 Mercury vapour 0.1/b, which was inserted into the Accuro 2000 pump. The battery-operated unit was set to 100 pumps and the measurement commenced. As mercury vapour is detected the crystals in the mercury tube change colour to a pale orange. When the change of colour reaches the marking line of the indicator layer, the mercury vapour concentration can be calculated.

The Draegar tube instructions gave 40 strokes indication 0.05mg/m3. The OES level is 0.025 mg/m3. Therefore if the colour changed to the indicating line in 80 pumps, the OES level is reached. Measurements were made using 100 pumps. The configuration of the equipment for measurement is shown in Figure 1.

Figure 1 The mercury vapour measurement configuration



4 Results

4.1 Airborne contamination monitoring

At the laboratory air filters were logged into the laboratory system for analysis. A total of 84 samples were taken during the soft strip and of these, 75 of the samples were suitable for counting. Table 1 gives the gross alpha airborne contamination concentrations expressed in terms of a counting efficiency appropriate for Po-210 distributed within an air filter. Those which were not analysed are identified by "ND", "Not Determined".

Table 1 The analytical measurements of airborne contamination concentrations during the soft stripping operation.

Lab Ref	Area Ref	Sample Date	Sample Period (Hours)	Gross alpha activity concentration ($Bq.m^{-3}$ as Po-210)		
L2004022-01	Floor 2 entrance	13/07/2004	8.00		<	0.0020
L2004022-02	Mezzanine and room 2.60	13/07/2004	8.00	0.0010	+/-	0.0005
L2004022-03	First floor + ground floor exit	14/07/2004	8.00		<	0.0019
L2004022-04	1.54 + G.56	14/07/2004	7.67		<	0.0027
L2004022-05	First floor exit + 1.51	15/07/2004	8.17	0.0005	+/-	0.0005
L2004022-06	1.55, 1.52 + mezzanine	15/07/2004	8.25	0.0004	+/-	0.0004
L2004022-07	2nd floor exit	16/07/2004	8.08		<	0.0020
L2004022-08	Mezzanine and 1.51 corridor	16/07/2004	5.75		<	0.0031
L2004022-09	1st Floor exit	19/07/2004	6.83	0.0022	+/-	0.0006
L2004022-10	2nd Floor exit	19/07/2004	3.50		<	0.0081
L2004022-11	2nd floor exit	20/07/2004	8.00	0.0028	+/-	0.0016
L2004022-12	Mezzanine & 1st floor exit	20/07/2004	8.17	0.0012	+/-	0.0014
L2004022-13	1st Floor exit	21/07/2004	8.00	0.0035	+/-	0.0018
L2004022-14	2nd floor exit & mezzanine	21/07/2004	8.08	0.0020	+/-	0.0015
L2004022-15	1st Floor exit	22/07/2004	7.83		<	0.0027
L2004022-16	2nd floor + others	22/07/2004	7.92	0.0015	+/-	0.0015
L2004022-17	2nd floor exit	23/07/2004	7.08		<	0.0022
L2004022-18	1st Floor exit	23/07/2004	7.00		<	0.0021
L2004022-19	2.61 exit	26/07/2004	8.00	0.0029	+/-	0.0033
L2004022-20	2.59 exit am	27/07/2004	4.33	0.0038	+/-	0.0057
L2004022-21	2.59 exit pm	27/07/2004	3.00	0.0056	+/-	0.0084
L2004022-22	2.59 exit	28/07/2004	8.58		<	0.0043
L2004022-23	2.59 & 2.52-2.56 lobby am	29/07/2004	4.42		ND	
L2004022-24	2.52- 2.56 lobby pm	29/07/2004	2.92		ND	
L2004022-25	beekeepers am	30/07/2004	0.58		<	0.0780
L2004022-26	2.52 - 2.56 lobby am	30/07/2004	4.00		ND	
L2004022-27	2.52 - 2.56 lobby pm	30/07/2004	2.75		ND	
L2004022-28	2.52-2.56 lobby am	02/08/2004	4.17		ND	
L2004022-29	2.52-2.56 lobby pm	02/08/2004	3.00		ND	
L2004022-30	beekeepers	02/08/2004	5.67		<	0.0085
L2004022-31	2.56	03/08/2004	6.00		ND	
L2004022-32	2nd floor exit	03/08/2004	7.00	0.0023	+/-	0.0035
L2004022-33	2.52-2.56 lobby	04/08/2004	7.92		ND	

Lab Ref	Area Ref	Sample Date	Sample Period (Hours)	Gross alpha activity concentration ($Bq.m^{-3}$ as Po-210)		
L2004022-34	2.52-2.56 lobby + 2.62	05/08/2004	8.25		<	0.0044
L2004022-35	2.62	06/08/2004	8.50	0.0053	+/-	0.0036
L2004022-36	2.62	09/08/2004	7.75	0.0079	+/-	0.0044
L2004022-37	1st Floor exit	10/08/2004	8.17		<	0.0042
L2004022-38	1st Floor exit	11/08/2004	4.92	0.0048	+/-	0.0055
L2004022-39	1st and 2nd floor exit	11/08/2004	8.00		<	0.0041
L2004022-40	1.52 -1.55	12/08/2004	7.42	0.0030	+/-	0.0034
L2004022-41	2ND FLOOR EXIT	13/08/2004	4.00		<	0.0122
L2004022-42	1st Floor exit	13/08/2004	7.50		<	0.0064
L2004022-43	2nd floor exit	16/08/2004	3.25		<	0.0086
L2004022-44	1.51	16/08/2004	8.17	0.0031	+/-	0.0032
L2004022-45	ground floor exit	16/08/2004	3.17	0.0106	+/-	0.0086
L2004022-46	G53 exit	17/08/2004	8.25	0.0052	+/-	0.0035
L2004022-47	1st Floor exit	17/08/2004	8.17	0.0018	+/-	0.0028
L2004022-48	ground floor exit	18/08/2004	8.25	0.0037	+/-	0.0035
L2004022-49	ground floor exit	19/08/2004	8.25	0.0026	+/-	0.0029
L2004022-50	1.57	19/08/2004	2.00	0.0137	+/-	0.0129
L2004022-51	ground floor exit	20/08/2004	7.75	0.0035	+/-	0.0033
L2004022-52	G.52 & G.53 am	23/08/2004	4.83	0.0141	+/-	0.0073
L2004022-53	G.53 pm	23/08/2004	3.00	0.0113	+/-	0.0098
L2004022-54	G.56 am	24/08/2004	3.25	0.0099	+/-	0.0086
L2004022-55	1.54 pm	24/08/2004	4.50	0.0049	+/-	0.0057
L2004022-56	ground floor pm	24/08/2004	4.92	0.0041	+/-	0.0053
L2004022-57	1.53 am	25/08/2004	4.00	0.0072	+/-	0.0068
L2004022-58	1.52 pm	25/08/2004	4.08		<	0.0114
L2004022-59	ground floor	25/08/2004	7.92		<	0.0051
L2004022-60	1.51 am	26/08/2004	3.67	0.0071	+/-	0.0074
L2004022-61	Ground floor corridor am	26/08/2004	4.08	0.0049	+/-	0.0064
L2004022-62	2.64 pm	26/08/2004	2.00		<	0.0190
L2004022-63	1.51 + corridor pm	26/08/2004	2.33		<	0.0143
L2004022-64	2.61/4 am	27/08/2004	2.33	0.0066	+/-	0.0100
L2004022-65	2.60 2.61 pm	27/08/2004	4.58		<	0.0101
L2004022-66	Ground floor pm	27/08/2004	1.25		<	0.0158
L2004022-67	2.56 am	31/08/2004	3.83		ND	
L2004022-68	2.61 am	31/08/2004	4.00		<	0.0095
L2004022-69	2.56 pm	31/08/2004	2.83		<	0.0146
L2004022-70	beekeepers	01/09/2004	5.17	0.0041	+/-	0.0047
L2004022-71	2.60 am	01/09/2004	5.25		<	0.0072
L2004022-72	beekeepers pm	01/09/2004	2.92		<	0.0091
L2004022-73	2.55	02/09/2004	7.92		<	0.0043
L2004022-74	mobile	02/09/2004	7.75		<	0.0054
L2004022-75	G53	03/09/2004	5.67	0.0032	+/-	0.0041
L2004022-76	all floor exits	06/09/2004	8.00		<	0.0038
L2004022-77	G52, 55,56	07/09/2004	7.58	0.0057	+/-	0.0041
L2004022-78	1.51/1.52 Am	08/09/2004	8.08	0.0038	+/-	0.0033
L2004022-79	1.53 1.55 pm B	08/09/2004	5.17		<	0.0088
L2004022-80	1.55/1.57/2.54-2.56	09/09/2004	7.83	0.0060	+/-	0.0041
L2004022-81	VARIOUS 2ND FLOOR	10/09/2004	7.67	0.0071	+/-	0.0042
L2004022-82	Lecture theatre	13/09/2004	5.00	0.0031	+/-	0.0047
L2004022-83	Lecture theatre am	14/09/2004	4.00		<	0.0107

Lab Ref	Area Ref	Sample Date	Sample Period (Hours)	Gross alpha activity concentration ($Bq.m^{-3}$ as Po-210)		
L2004022-84	Lecture theatre pm	14/09/2004	0.83	0.0271	+/-	0.0311

From these airborne contamination concentrations, it is possible to calculate the internal radiation exposure to those undertaking this work. A time-integrated exposure may be calculated, but initially it is useful to consider the exposure based on the highest airborne contamination concentration measured and assume this applies throughout. This maximum concentration is 0.0271 Bq/m3. It should be noted that some of the detection limits are considerably higher than this. It is not reasonable to adopt these "less than" figures as real concentrations, as the poor limits of detection result only from short sampling periods, i.e. to cover the completion of work in a particular area.

Based on exposure to this worst case airborne contamination measurement, a breathing rate of 1.2m3/h, an exposure time of a working year (2000 hours), and a dose coefficient for Pb/Po-210 is 2.2×10^{-6}Sv/Bq (that for Po-210, 5um particles), a committed effective dose is calculated to be 143uSv/a. As this is occupationally insignificant, further refinement of the calculation has not been made.

In considering the internal radiation exposure from airborne contamination, it is necessary to consider those nine samples with too great a dust loading to permit the direct analysis of alpha activity. The majority of these high mass samples originated from the period when the partitions were removed. Given that the partitions had been subjected to extensive monitoring prior to removal, and that the hourly monitoring of the air filters confirmed the absence of gross airborne contamination, it is reasonable to accept this as confirmation of the absence of conditions that would warrant designation of the area as Controlled.

In addition, consideration needs to be given to the hourly monitoring results relating to Room 2.59 on 29 July 2004. Here, count rates increased from a background rate of typically 2-3 counts per second to 20 counts per second in the first hour of work. More frequent monitoring was adopted, and when a count rate of 25 counts per second was reached half an hour later, work in that room was abandoned. The air pump was stopped and was re-measured at intervals throughout the day. In 30 minutes the count rate had reduced by half, indicating that the airborne activity was due to one or more short-lived radionuclides. It is concluded that this occurrence relates to a peak in radon gas concentration, with the short-lived solid decay products being collected on the filter. The origins of this radon are not clear, but could be either from radon from the ground or construction materials, or from radon produced by radium-226 contamination in this area. Irrespective of the cause, the action taken in accordance with the contingency plans prevented any significant exposure.

4.2 Item monitoring

All items to be removed from the building as part of the soft stripping work were monitored prior to removal.

Monitoring was undertaken using a Mini 900 Type EP 15, with the end cap removed. The majority of the items removed gave no reading above the instrument background and were removed to the skip for disposal. Four items gave a reading in excess of the instrument background and were labelled and retained. These are listed in Table 2.

Table 2. Contaminated items identified in the soft stripping waste monitoring operation.

Item description	Alpha cps	Mini 900 EP15 cps	Mini 900 42A cps
Large bench top from 1.51	0	1000	background
Small bench top from 1.51	0	8	background
Large display case from 1.51	80 0 with paper	800	150
Lens	0	150	300

4.3 Personnel monitoring

Monitoring of hands and the soles of shoes was undertaken directly using the Mini 900 on each exit of the Supervised Area. In general this was undertaken on a minimum of four occasions during the day including break am, lunch, break pm and the end of the day. No readings above the instrument background were recorded. Personnel monitoring records are appended in Appendix B.

4.4 Mercury results.

Mercury measurements were taken at the beginning of each day of work in the four rooms identified in the risk assessment, these being 2.52, 2.53, 2.62, 2.63, and as time permitted, in other rooms when the floor covering had been removed. Over a period of 100 pumps, many of the tubes showed no colour change. A few tests in those four areas identified as having mercury contamination, a few a slight colour change occurred but none were up to the mark. Therefore all mercury measurements confirmed levels were less than the OES of 0.025mg/m^3. Tables 3 and 4 give the details of the mercury measurements made in the identified higher risk rooms and those measurements that were undertaken after removal of floor coverings.

Table 3 Measurements of mercury vapour in the higher risk rooms.

Date	Room	Results	Initials
03/08/04	2.52	100 pumps no colour change ie <OES level	BF
03/08/04	2.53	100 pumps no colour change ie <OES level	BF
03/08/04	2.62	100 pumps no colour change ie <OES level	BF
03/08/04	2.63	100 pumps no colour change ie <OES level	BF
31/08/04	2.52/2.53	100 pumps no colour change ie <OES level	SMS
01/09/04	2.52	100 pumps no colour change ie	RWP

Date	Room	Results	Initials
		<OES level	
02/09/04	2.52	100 pumps no colour change ie <OES level	RWP
14/09/04	2.62/2.63	100 pumps, slight colour change but not to mark. <OES	AJF

Table 4 Measurements of mercury vapour after removal of floor coverings.

Date	Room	Results	Initials
25/08/04	G.52	100 pumps no colour change ie <OES (0.025mg/m3)	SMS
26/08/04	1.51	100 pumps only slight colour change, not to mark <OES	AJF
27/08/04	2.64	100 pumps no colour change ie <OES (0.025mg/m3)	SMS
27/09/04	2.52/2.53	100 pumps only slight colour change, not to mark <OES	SMS
27/09/04	2.54/2.55/2.56	100 pumps only slight colour change, not to mark <OES	SMS
27/09/04	2.57/2.58/2.59	100 pumps only slight colour change, not to mark <OES	SMS
27/09/04	2.60/2.61	100 pumps only slight colour change, not to mark <OES	SMS
27/09/04	2.64	100 pumps no colour change ie <OES	SMS
15/10/04	2.57	100 pumps no colour change ie <OES	AJF

5 Conclusions and Recommendations

5.1 Health and Safety

The monitoring of radiological conditions in the Supervised Areas throughout the soft stripping confirmed the absence of radiation risks that would require the designation of Controlled Areas.

Calculations of radiation exposure based on the likely most significant exposure route, that of internal radiation via inhalation, confirmed that the radiation exposure to those undertaking the work was occupationally insignificant. These calculations are based on a number of worst case assumptions. In addition, no instances of personal contamination were identified.

It can be concluded, therefore, that radiation protection arrangements were adequate in all respects and that exposure was restricted to as low as reasonably practicable.

In addition to the radiological monitoring, monitoring of mercury confirmed that, on all occasions, the level of mercury was below the long term Occupational Exposure Standard (OES).

5.2 Identification of contaminated items

The monitoring of all items removed as part of the soft stripping identified four which were contaminated. Of these, three are likely to become waste and will be assessed for disposal purposes. It is understood that the University may wish to retain the fourth item, a period display cabinet. A suitable assessment needs to be made of the measures which can be taken to reduce the radiation risks associated with this item, and to determine the radiological restrictions that would be necessary in order that the item be retained. It is suggested that this may be done in conjunction with the similar work being undertaken in respect of the retention of Rutherford's Bench.

It is recommended that the radionuclide and activity assessments required for these items are left until waste arising from decontamination operations requires assessment.

5.3 Suitability of the building for survey

In general, the soft striping of the building has left Coupland 1 in a suitable condition for a systematic and thorough monitoring operation. Exceptions to this are the main corridor on each floor and the Lecture Theatre both of which require further work in order that monitoring access is unrestricted. It is anticipated that this will take place as part of the Stage 2 Hard Stripping work.

6 Appendix A – Training Log

The following two pages confirm that training in the Local Rules was provided.

6 Training Log

Name	Company	Signature	
M. WEST	BAGNALLS	M. West	12.7.04
P. BELISLE	BAGNALLS	P. Belisle.	12.7.04
T. CLARKE	BAGNALL		12.7.04
P BELISLE	BAGNALL GROUP	P. Bell	16.7.04.
FC JAMES	BAGNALL GROUP		16-7-04
P. Pokato	Bagnall Group		19-7-04
PJ MOOR.	BAGNALL GROUP	P J Moore	17-8-04
R. YATES	SERCO	R. Yates	26-8-04
G. CLARKE	IRAS		04/10/04

Tfung Leg.

Local Rules for Supervised Areas, Courtyard 1.

I have read the Local Rules and received the site safety induction from the RPS.

NAME (PRINT)	COMPANY	SIGNATURE	DATE
T FUNG WONG	BAC-TECH	T Fung	11.8.04

7 Appendix B – Personal Contamination Monitoring

The following 4 pages provide details of the personal contamination monitoring that took place during the soft stripping work.

iras LIMITED
Independent Radiation Assessment Services

Personnel Monitoring records

(on leaving the Supervised Area)

Date	Name	Instrument background	Monitoring result	Comments	Initial RPS	
12/7/04	B. FRITH A. PRICE S. ADAMS	EP15 1-2cps	=background		SMA	16.30
12/7/04	BAGNALLS MW, PB, TC	EP6 1-2cps	—" —		SMA	16.30
13/7/04	RP, SA, MW, PB, TC	EP15 1-2cps	—" —	12.15	SMA	
13/7/04	RP, SA, MW, PB, TC	—" —	—" —	16:25	SMA	
14/7/04	RP, SA, MW, PB, TC	—" —	—" —	12.15	SMA	
14/7/04	ELECTRICIANS	—" —	—" —	13:00	SMA	
14/7/04	RP, SA, MW, PB, TC	—" —	—" —	END OF DAY.	SMA	
15/7/04	RP, SA, MW, PB, TC	EP15 —" —	—" —	LUNCH + END OF DAY	SMA	
16/7/04	RP, SA, MW, TC, PB, PB, FT	—" —	—" —	LUNCH + END OF DAY	SMA	
19/7/04	RP, SA, MW, PB, TC, PB, FT, PP	—" —	—" —	LUNCH + END DAY	RWP	
20/7/04	RP, SA, MW, PB, PP	—" —	—" —	—" —" —	SMA	
21/7/04	RP, SA, MW, PB, PP	—" —	—" —	—" —" —	SMA	
22/7/04	Electrician	—" —	—" —	ON LEAVING	SMA	
26/7/04	RP, SA, MW, PB, PP, TC.	—" —	—" —	—" —" —	SMA	
27/7/04	2 × Plumbers	—" —	—" —	END OF DAY	SMA	
28/7/04	RP, SA, MW, PB, PP	—" —	—" —	—" —" —	SMA	
23/7/04	2x PLUMBERS ELECTRICIAN	—" —	—" —	ON LEAVING END OF DAY	SMA	
26/7/04	RP, SA, BF, MW, PB, PP	—" —	—" —	LUNCH + END OF DAY	SMA	
28/7/04	RP, MW, PB, PP	—" —	—" —	—" —	RWP	
28/7/04	RP, SA, MW, PB, PP	—" —	—" —	—" —	SMA	
29/7/04	RP, SA, MW, PB, PP	—" —	—" —	—" —	SMA	
30/7/04	RP, SA, MW, PP, PB	—" —	—" —	—" —	SMA	

iras LIMITED
Independent Radiation Assessment Services

Personnel Monitoring records

(on leaving the Supervised Area)

Date	Name	Instrument background	Monitoring result	Comments	Initial RPS
2/8/04	Bagnall's x3	1 cps	1 cps	break am, lunch, break pm end of day	[redacted] SHA
3/8/04	"	"	"	"	BF
4/8/04	"	"		"	SMS
5/8/04	"	"	1 cps	"	SMS
6/8/04	Electrician	1 cps	1 cps	Left ~12 noon	SMS.
6/8/04	Bagnall's x3	1 cps	= background.	break am, lunch break pm, end of day.	SMS
9/8/04	Bagnall's x3	1 cps	= background	BREAK AM, LUNCH BREAK PM, END OF DAY	SMS
10/8/04	BAGNALLS x3	1 CPS	1 CPS	BREAK AM, LUNCH BREAK PM, END OF DAY	R.V.P.
11/8/04	BAGNALLS x3	1 CPS	1 CPS	BREAK AM, LUNCH, BREAK PM, END OF DAY	SMS
12/8/04	BAGNALLS x 2	1 CPS	1 CPS	—" —	R.V.P.
13/8/04	BAGNALLS x4	1 CPS	1 CPS	BREAK AM, LUNCH, BREAK PM, END OF DAY.	S.M.S.
16/8/04	BAGNALLS x4	1 CPS		BREAK AM, LUNCH, BREAK AM, END OF DAY.	S.M.S.
17/8/04	BAGNALLS x4	1 CPS	1 CPS	—" —	R.V.P.
18/8/04	BAGNALLS x5	1 CPS	1 CPS	—" —	SMS
19/8/04	BAGNALLS x 5	1 CPS	1 CPS	—" —	R.V.P
20/8/04	BAGNALLS x5	1 CPS	1 CPS	—" —	R.V.P.
23/8/04	BAGNALLS x4	1 CPS	1 CPS	BREAK AM, LUNCH BREAK PM	S.M.S.

iras LIMITED
Independent Radiation Assessment Services

Personnel Monitoring records

(on leaving the Supervised Area)

Date	Name	Instrument background	Monitoring result	Comments	Initial RPS
23/8/04	Bagnalls x5	1cps	1cps	END OF DAY.	S.M.S.
24/8/04	Bagnalls x5	1cps	1cps	BREAK AM, LUNCH, BREAK PM, [redacted]	S.M.S.
24/8/04	M. WEST, P. POTATO [redacted]	1cps	1cps.	END OF DAY.	SMS.
25/8/04	M. WEST P. POTATO [redacted]	1cps	1cps	BREAK AM	SMS
25/8/04	m.w. P.P, T.C. F. JAMES	1cps	1cps	LUNCH	SMS.
25/8/04	m.w, P.P, T.C, F.J	1cps	1cps	Break pm	SMS
25/8/04	P.P.T.C.	1cps	1cps	End of day	SMS.
26/8/04	AJF Bagnall x2 1st floor	1cps	1cps	BREAK AM	AJF
"	Bagnall x2 ground floor	1cps	1cps	" "	AJF
"	AJF + 5 Bags	1cps	1cps	LUNCH	AJF
"	AJF Bag	1cps	1cps	End of day	AJF
27/8/04	Bagnall's x2	1cps	1cps	Break am + lunch.	SMS.
11	Bagnall's x3	1cps	1cps	end of day	SMS.
31/8/04	m.w. P.P, P.B. T.F. F.J (not lunch)	1cps	1cps	Break am + lunch.	SMS
"	m.w. P.P. P.B. T.F	1cps	1cps.	Break pm + end of day.	
1/9/04	BAGNALLS x6	1cps	1cps	BREAK AM, LUNCH, BREAK PM, FINISH	R. Price
2/9/04	BAGNALLS x3	1cps	1cps	BREAK AM, LUNCH BREAK PM, FINISH	R. Price

iras LIMITED
Independent Radiation Assessment Services

Personnel Monitoring records

(on leaving the Supervised Area)

Date	Name	Instrument background	Monitoring result	Comments	Initial RPS
3/9/04	BAGNALLSx4	1cps	1cps	AM BREAK, LUNCH FINISH	R.J.P.
6/9/04	BAGNALLSx4	1cps	1cps	AM BREAK, LUNCH PM BREAK, FINISH	R.J.P.
7/9/04	BAGNALLSx4	1cps	1cps	AM BREAK, LUNCH PM BREAK, FINISH	R.J.P.
8/9/04	BAGNALLSx4	1cps	1cps	AM BREAK, LUNCH PM BREAK, FINISH	R.J.P.
9/9/04	BAGNALLSx4	1cps	1cps	AM BREAK, LUNCH PM BREAK, FINISH	R.J.P.
10/9/04	BAGNALLSx4	1cps	1cps	AM BREAK, LUNCH PM BREAK, FINISH	R.J.P.
13/9/04	BAGNALLx3	1cps	1cps	AM BREAK, BREAK PM, FINISH	S.H.S.
13/9/04	BAGNALLX2	1CPS	1CPS	LUNCH, FINISH	S.H.S.
14/9/04	" x 4	1cps	1cps	AM BREAK	AJF
14/9/04	BAGNALLx4	1cps	1cps	LUNCH	AJF
14/9/04	Bagnallx4	1cps	1cps	PM/FINISH	AJF.
15.9.04	M. Renshaw +1	1c/s	1c/s	shed unit with archivist	BY
16.9.04	Bagnallsx4	1 cps	1 cps	end of secon to S.H.	BY
20.9.04	SMS, AJF, RP, RY	1cps	1cps	BREAK AM, LUNCH	SMS
20.9.04	SMS, RP, RY	1cps	1cps	Break pm, End of day	SMS
21.9.04	AJF, RP, RY	1cps	1cps	Break am, lunch, break pm end of day	RP
22.9.04	SMS, RY	1CPS	1CPS	"	SMS

END OF SOFT STRIP