

**LEDERLE GRADUATE RESEARCH CENTER
TOWER A AND LOW-RISE
UNIVERSITY OF MASSACHUSETTS
AMHERST, MASSACHUSETTS**

**PLAN FOR THE REMOVAL AND
ABATEMENT OF BUILDING-RELATED
POLYCHLORINATED BIPHENYLS (PCBs)**

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LIST OF ABBREVIATIONS AND ACRONYMS

CFR	Code of Federal Regulations
DQI	data quality indicator
EH&E	Environmental Health & Engineering, Inc.
EPA	U.S. Environmental Protection Agency
HEPA	high efficiency particulate air
LGRC	Lederle Graduate Research Center
OSHA	U.S. Occupational Safety and Health Administration
PCB	polychlorinated biphenyl
ppm	parts per million by weight
QC	quality control
RCRA	Resource Conservation and Recovery Act
TSCA	Toxic Substances Control Act
UMass	University of Massachusetts Amherst
$\mu\text{g}/100 \text{ cm}^2$	micrograms per 100 square centimeters
$\mu\text{g}/\text{m}^3$	micrograms per cubic meter

1.0 SUMMARY

Contractors working for the University of Massachusetts Amherst (UMass) collected samples from exterior concrete panel joint components in preparation for a planned structural rehabilitation and renovation project of the three towers and low-rise building of the Lederle Graduate Research Center (the LGRC). Sample results indicate the presence of polychlorinated biphenyls (PCBs) of exterior caulking materials associated with Tower A and the low-rise building above the allowable concentrations specified by the U.S. Environmental Protection Agency (EPA) in the Toxic Substances Control Act (TSCA) regulations.

UMass contracted Environmental Health & Engineering, Inc. (EH&E) to prepare and submit an abatement protocol to address the presence of unauthorized PCB caulking. This work plan was prepared to support applications under the Code of Federal Regulations Title 40 Section 761.79(h) (40 CFR §761.79(h)) and 40 CFR §761.61(a) for EPA approval of alternative decontamination and sampling approaches for specified porous and non-porous materials impacted by specified non-liquid PCB-containing caulking associated with Tower A and the low-rise building. Decontamination sampling procedures and acceptance criteria will be based on post-abatement visual inspections and applicable confirmatory bulk, wipe, and air sampling.

Under a separate cover, EH&E in conjunction with the Science Collaborative has proposed risk-based acceptance criteria for indoor air and exterior concrete panels on the buildings (Appendix B). These criteria were developed based on sample data specific to the two buildings affected by this work. The proposed health-based acceptance criteria for remaining PCBs concentrations in the two buildings meets the regulatory values for minimal risk based on site specific exposure scenarios.

The proposed health-based acceptance criteria for total PCB concentration in porous surfaces on Tower A and the low-rise building is 28 parts per million by weight (ppm) with and indoor air concentration of 0.29 micrograms per cubic meter ($\mu\text{g}/\text{m}^3$) for the two buildings. The health-based acceptance criterion of 28 ppm is higher than the acceptance criterion that will be used for this abatement project.

For this project, EH&E will use the following acceptance criteria.

- Remaining concrete surfaces on the first floor will be at or below one ppm.
- Remaining concrete surfaces above the first floor will be at or below 25 ppm.
- Non-porous window frames on the first floor will be at or below 10 $\mu\text{g}/100\text{ cm}^2$.
- Non-porous window frames above the first floor will be at or below 100 $\mu\text{g}/100\text{ cm}^2$.

The scope of the abatement work will be sequenced into two phases.

- **Phase One:** This phase of the work encompasses exterior PCB caulking associated with Tower A of the LGRC, specifically the removal of exterior PCB caulking found in between concrete joints throughout all elevations of Tower A. In addition, work will also include the removal of frame caulking and concrete around intact window frames of the tower. Most of the abatement work will entail channel cuts in the concrete along the caulking joint. This will increase the gap between the concrete panels in order to provide adequate expansion for the new waterproofing system. At no point will the abatement contractor mechanically cut into the caulking without the use of vacuum attached capture devices. Caulking will be disposed as PCB bulk product waste and any debris generated during the work will be disposed as PCB remediation waste at a TSCA approved disposal facility.

Phase One work will also include the removal of stained asphalt from the dumpster location that had been previously identified to contain PCBs in excess of 50 ppm in preliminary EH&E sampling. Removed asphalt will be disposed as PCB remediation waste. Remaining asphalt material shall be at concentrations below one ppm based on sampling criteria described under 40 CFR §761.181.

- **Phase Two:** This phase of the work encompasses the removal of exterior PCB caulking between concrete panels associated with the low-rise building of the LGRC. In addition, Phase Two work will also encompass the removal and cleaning of frame caulking from non-porous window frames associated with the low-rise building. The abatement contractor will make channel cuts to remove caulking and concrete from joints. The cuts will increase the gap between the concrete panels to provide adequate expansion for the new waterproofing system. At no point will the

abatement contractor mechanically cut into the caulking without the use of vacuum attached capture devices. In addition, the temporary foam backer rods installed to maintain temporary weather tightness in the building will be removed during this phase of the project. Caulking will be disposed as PCB bulk product waste and any debris generated during the work will be disposed as PCB remediation waste at a TSCA approved disposal facility. Interim foam backer rods will also be disposed as PCB remediation waste at a TSCA approved disposal facility.

Phase Two work will also include the removal and disposal of carpeting in a conference room in the Engineering library that contained carpet dust concentrations that were in excess of one ppm, but less than 50 ppm. This carpet will be disposed as PCB remediation waste and replaced.

This application solely addresses the specified caulking associated with the two phases.

2.0 CASE NARRATIVE

2.1 BUILDING AND CASE HISTORY

The LGRC consists of three 17 storey towers (Towers A, B, and C), a three storey low-rise building, and seven storey research building (the Conte Polymer Research Building). The three towers house Astronomy, Biochemistry, Chemistry, and Mathematics departments. The low-rise houses the Physical Sciences library and the Office of Information Technology for UMass. Undergraduate classrooms are interspersed throughout the LGRC.

Tower A and the low-rise were completed in 1972. Towers B and C were completed in 1974. The Conte building was constructed in the 1990s.

EH&E understands that UMass had to address structural safety concerns associated with rusting bolts used to attach concrete panels to the LGRC (excluding the Conte building). As a result, UMass is undertaking an exterior renovation and rehabilitation project for the three towers and the low-rise building. This project involves securing the existing concrete panels with new additional steel bolts. The structural renovation work also includes upgrading the existing sealants associated with the exterior façade. All work will be conducted from the outside and does not include the replacement of existing window frames, although glass window panes may be replaced in some locations on the three towers.

As part of the project, a number of samples were taken in June 2006 to characterize the waste stream of materials that may be disturbed during the scheduled work. Specifically, panel sealant materials from the LGRC were tested for PCBs. Results from the previous sampling collected by other consultants are summarized in the following Table 2.1.

Table 2.1 Summary Results of Bulk Samples Collected Prior to EH&E Involvement, Lederle Graduate Research Center, University of Massachusetts, Amherst, Massachusetts

Sample Date	Laboratory	Sample Description	Results (ppm)	Notes
6/2/2006	Norlite Analytical	Old caulking material	16	PCBs
6/21/2006	Norlite Analytical	Building 6A	19	Arochlor 1254
6/21/2006	Norlite Analytical	Window caulking 6B	0.2	PCB
6/21/2006	Norlite Analytical	Low-rise building	20	Arochlor 1254
7/10/2006	AmeriSci	Wall sealant, low-rise building	9,040	Arochlor 1254
7/10/2006	AmeriSci	Wall sealant, building A	6,300	Arochlor 1254
7/10/2006	AmeriSci	Wall sealant, building B	2	Arochlor 1254
7/10/2006	AmeriSci	Wall sealant, building C	ND	None
7/11/2006	AmeriSci	GRC-PCB-W1 (south side)	132,999	Arochlor 1254
7/12/2006	AmeriSci	GRC-PCB-W1 (south side) duplicate	123,000	Arochlor 1254
7/12/2006	Spectrum Analytical	GRC-PCB-W2 (east side)	334,000	Arochlor 1254
7/12/2006	Spectrum Analytical	GRC-PCB-W4 (west side)	303,000	Arochlor 1254
7/12/2006	Spectrum Analytical	GRC-PCB-S1 (south side)	723,000	Arochlor 1254
7/12/2006	Spectrum Analytical	GRC-PCB-S2 (east side)	532,000	Arochlor 1254
7/12/2006	Spectrum Analytical	GRC-PCB-S4 (west side)	195,000	Arochlor 1254
7/12/2006	Spectrum Analytical	GRC-Core 1	13	Arochlor 1254
7/12/2006	Spectrum Analytical	GRC-Core 2	5	Arochlor 1254

EH&E Environmental Health & Engineering, Inc.
 ppm parts per million by weight
 ND non detected

PCBs were detected in concentrations above 50 ppm from caulking from Tower A and the low-rise. A number of samples results reported by Spectrum Analytical were higher than samples collected by EH&E. While the actual concentrations are irrelevant, these samples are much higher than 50 ppm, the allowable threshold for authorized use, as specified in the EPA TSCA regulation (40 CFR 761). These samples appeared to confirm that samples from Tower A and the low-rise contained PCBs in excess of 50 ppm. However, the sample results from Towers B and C were less than 50 ppm. Considering the variable sample results, EH&E conducted further exploratory work in order to better characterize the extent of PCB-containing caulking.

2.2 EH&E TESTING SUMMARY

On August 21 and 22, 2006, EH&E conducted bulk sampling of the exterior façade and window openings of the building to characterize the extent of PCB caulking. The initial EH&E bulk sample results are presented in the following summary Table 2.2.

Table 2.2 Bulk Sampling Plan and Results Summary, Lederle Graduate Research Center, University of Massachusetts, Amherst, Massachusetts, August 21 and 22, 2006			
Homogenous Unit	Bulk Sampling Category	Number of Samples¹	PCBs > 50 ppm
Tower B	Exterior panel caulking	11	No
Tower C	Exterior panel caulking	11	No
Low-rise	Exterior panel caulking and core samples	4	Yes
Tower A	Exterior panel caulking and core samples	9	Yes
Asphalt sample	Bulk asphalt	3	Yes
PCB polychlorinated biphenyl > greater than ppm parts per million by weight ¹ Includes control samples.			

EH&E collected a total of 38 bulk samples of materials from the LGRC. Sixteen samples were from the exterior of Towers A, the low-rise, and a dumpster location affected by previous work. EH&E collected 22 bulk samples from Towers B and C to determine if exterior caulking associated with these two towers contained caulking that was less than 50 ppm.

Samples from the exterior of Tower A and the low-rise buildings were positive for PCBs (e.g., >50 ppm) and are presented in Section 4.1 of this report. Results from the three dumpster asphalt samples from August 21, 2006, are presented in the following Table 2.3.

Table 2.3 Bulk Sample Results from Dumpster Site at Lederle Graduate Research Center, University of Massachusetts, Amherst, Massachusetts, August 21, 2006

Sample ID	Location	Description	Aroclor 1254 ^{1,2} (ppm)	Notes
79258	Dumpster	"Stained" asphalt sample 1	1.4	2C(1.2)
79259	Dumpster	"Stained" asphalt sample 2	140	2C(110)
79260	Dumpster	Downgrade of stain on asphalt	0.3	2C(0.3)

ppm parts per million by weight

2C Confirmation concentration reported from second column quantification

¹ Polychlorinated biphenyl (PCB) concentration analysis performed by Groundwater Analytical, Inc., using U.S. Environmental Protection Agency (EPA) method 8082 (GC/ECD).

² Aroclor 1016, 1221, 1232, 1242, 1248, and 1260 also tested. All results below reporting levels, unless noted.

One sample from the "stained" surface was at 140 ppm, indicating that removal and replacement of asphalt will be required as part of this application.

Sample results from Towers B and C were all well below 50 ppm and presented in Appendix B. On behalf of UMass, EH&E submitted a letter to the EPA summarizing the result of Towers B and C on September 19, 2006.

On September 22, 2006, EH&E collected two bulk and four wipe samples from Tower A and the low-rise. These samples were collected to confirm the presence of PCBs in excess of 50 ppm and to identify and quantify homolog and dioxin-like congener concentrations for the development of health-based acceptance criteria.

Summary results from the bulk samples collected on September 22, 2006, are presented in the following two tables.

Table 2.4 Bulk Sample Results from Lederle Graduate Research Center, University of Massachusetts, Amherst, Massachusetts, September 22, 2006		
Sample ID	Description	Total Homologs (ppm)
80244	Surface scraping of caulking sampled from low-rise building from east side	14,000
80247	Surface scraping of caulking sampled from west side of Tower A	670
ppm part per million by weight Samples analyzed by Alpha Analytical (Westborough, Massachusetts) using EPA Method 1668.		

Bulk samples analyzed on a total homolog basis were above 50 ppm from both Tower A and the low-rise building. More detailed dioxin-like congener and PCB homolog information was analyzed by the laboratory and used by the Science Collaborative to develop appropriate health-based acceptance criteria for Tower A and the low-rise buildings.

EH&E also collected wipe samples from surfaces at specified distances from the bulk samples referenced in the preceding table.

Table 2.5 Wipe Sample Results, Lederle Graduate Research Center, University of Massachusetts, Amherst, Massachusetts, September 22, 2006				
Sample ID	Description	Surface Area (square cm)	Total Homologs (ng/wipe)	Calculated Total Homolog $\mu\text{g}/100 \text{ cm}^2$
80245	Wipe of low-rise panel joint adjacent to sample 80244	310	9055	2.97
80246	12" away from joint wipe from sample 80244	310	2161	0.68
80248	Wipe of Tower A panel joint adjacent to sample 80247	310	3148	1.00
80249	12" away from joint wipe from sample 80247	310	377	0.12
cm centimeters ng nanogram $\mu\text{g}/100 \text{ cm}^2$ micrograms per 100 square centimeters Samples analyzed by Alpha Analytical (Westborough, Massachusetts) using EPA Method 1668				

The four wipe samples were collected from concrete panels at distances away from caulking joints known to contain PCBs in excess of 50 ppm. EH&E obtained results for both homolog and dioxin-like congeners for these samples. Both homolog data and dioxin-like congener data from these four wipe samples, the two bulk samples, and from air samples collected on this date were incorporated in the development of health-based acceptance criteria for Tower A and the low-rise building.

2.3 OVERVIEW OF ABATEMENT GOALS

At a minimum, the abatement activities will involve the removal of identified PCB-containing materials that have levels of PCBs greater than 50 ppm from Tower A and the low-rise. In addition, surface contamination will also be remediated to the acceptance criteria specified in Section 13, determined by the location and matrix of the contaminated surfaces.

The abatement project will ensure compliance with the EPA TSCA requirements and protect both public health and the environment. Materials that are classified as PCB remediation or bulk product waste will be disposed in compliance with federal and state regulatory requirements.

As stated in the Summary Section, this application solely addresses PCB-containing caulking and remediation waste associated with the two phases of the work.

3.0 REGULATIONS, PERMITS AND QUALIFICATIONS

The contractor hired to remove and abate the specified PCB-containing materials from Tower A and the low-rise shall be responsible for obtaining all permits necessary to execute the abatement work. The cost for securing all necessary permits shall be included in the contractor's bid to UMass. The contractor shall be responsible for adhering to all applicable federal, state, and local rules and regulations including, but not limited to, those from the EPA, the Massachusetts Department of Environmental Protection, the U.S. Occupational Safety and Health Administration (OSHA), and the local fire department.

The contractor shall conform with all stipulations and permits identified in the façade restoration contract bid documents. Where a conflict arises between regulations, the contractor shall adhere to the most stringent regulation. The contractor shall also confer with the project team to determine if the abatement procedures and/or materials conflict with planned renovations to the building.

3.1 FIRE SAFETY AND EMERGENCY ACTION PLANS

The contractor will comply with the on-site fire safety and emergency action plans employed by the owner and the general contractor.

3.2 STANDARD OPERATING PROCEDURES

UMass requires that the contractor prepare a written contractor work plan and health and safety plan for abatement work performed at the LGRC. The two plans must ensure maximum protection of workers, visitors, and employees from PCB exposure and must prevent the release of PCBs or PCB-laden dust into the environment. These procedures should include, but are not limited to the following:

- Engineering controls and work practices to minimize airborne contamination into the work area and to prevent the spread of such contamination outside the work area. These controls and practices instituted during abatement activities must keep workers' exposures to PCBs below the permissible exposure limit and ensure no release of PCBs from the work area to the general environment.

- Specifications regarding containment processes to prevent the release of abatement debris from the work area and to provide weather protection for the two buildings.
- Directions regarding pre-cleaning of the work area with a high efficiency particulate air (HEPA) vacuum.
- Specifications for sufficient and proper protective clothing and respiratory protection equipment, as may be required by OSHA regulations.
- Specifications for safe work practices in the workplace and exclusion of eating, drinking, smoking, or in any way breaking the respiratory protection, if respirators are required.
- Removal and/ or engineering methods that minimize the amount of airborne dust generated from abatement activities.
- Specifications regarding end of work shift cleaning procedures.
- Specifications regarding the handling, storage, transport, and disposal of all appropriately classified PCB waste in a manner that minimizes exposure and that complies with federal, state, and local regulations regarding PCBs.
- Specifications identifying disposal sites for PCB waste.
- Specifications regarding possible contingency plans pertaining to accidental spills and/or contamination in the work area or outside the work area.
- Mandatory and proper use of decontamination facilities when exiting the work area.
- Directions regarding the cleaning of work areas following abatement procedures.
- Supervision of work by a competent person.

In addition, the submitted contractor work plan should provide sufficient detail to describe specific plans and actions. Moreover, where applicable, the contractor work plan may reference this document, but will still need to be of sufficient detail in its descriptions.

3.3 TRAINING AND CERTIFICATION

All personnel performing abatement activities at the building must have all the required training, medical examinations, and respirator fit testing (if required) as specified by OSHA. The contractor must at all times have a competent manager at the job site. Site-specific hazards and hazards associated with the handling and disposal of PCB products must be effectively communicated to the contractor's staff to minimize potential exposures. Completion of a Hazard Communication program in conformance with the elements of 29 CFR 1926.59 is required. In addition, the contractor must provide proper training and equipment for all safety-related issues. Please refer to Section 15 for more details on the health and safety requirements.

3.4 CONTRACTOR QUALIFICATIONS

The contractor shall demonstrate the following minimum requirements and competencies in accordance with procedures and process established by UMass.

- Experience in surface cleaning and decontamination of large, PCB-contaminated non-industrial facilities will be preferential, but not a necessary requirement.
- Experience in the abatement and disposal of asbestos-containing materials for exterior façades would be preferable, given the similarity of procedures and work practices.
- Maintain and operate a fully functioning health and safety program dealing with the cleanup of hazardous materials and substances in or on commercial real estate.
- Maintain sufficient equipment, materials, and staff to complete the scope of work as outlined in this specification. A complete list of permanent staff, equipment, and materials shall be provided in the bid submission.
- Knowledge of the federal TSCA regulations.

4.0 PILOT PROJECT

The project team designed and implemented a number of pilot programs to determine the extent and manner of exterior caulking that will have to be removed during each phase of the abatement process in order to meet the acceptance criteria described in Section 13. Information from the pilot projects is presented below and will be incorporated into bid contract documents for the abatement project. Sample results conducted by EH&E and the established risk based acceptance criteria (Appendix B) for the building have been used to establish the amount of material that will have to be removed from the concrete joints.

4.1 AUGUST 21, 2006, TESTING

As part of the August 21, 2006, sampling program, the project team conducted bulk sampling to determine the extent of caulking and concrete that will have to be removed during each phase of the abatement process in order to meet the acceptance criteria described in Section 13. Information from this sampling is presented below and will be incorporated into bid contract documents for all phases of the abatement project.

EH&E collected caulking from the concrete panel joint to determine source residue concentration. EH&E then collected bulk samples by coring a number of shallow holes at set distances away from the caulking joint to determine if PCBs found in the joint caulking compound had migrated into the concrete panel, and to characterize the extent of that migration.¹ Sample results are presented in the following Table 4.1.

¹ Bulk core samples collected following the 1997 *Region One EPA-New England Draft Standard Operating Procedures for Sampling Concrete in the Field*.

Table 4.1 Panel Caulking and Concrete Core Sample Results from Lederle Graduate Research Center, University of Massachusetts, Amherst, Massachusetts, August 21, 2006

Sample ID	Building	Side	Type	Description	Distance from Corner Caulking	Aroclor 1254 ^{1,2} (ppm)	Notes
79246	Low-rise	East	Bulk	Panel caulking	NA	74,000	2C(73,000)
79247	Low-rise	East	Core	South side bumpout	3.0" away caulking	1.9	2C(1.6)
79248	Low-rise	East	Core	South side bumpout	1.5" away caulking	2	2C(1.7)
79249	Low-rise	East	Core	South side bumpout	0.25" away caulking	92	2C(85)
79250	Tower A	West	Bulk	Panel caulking	NA	57,000	2C(56,000)
79251	Tower A	West	Core	West end	3.0" away caulking	0.4	2C(0.3)
79252	Tower A	West	Core	West end	2.0" away caulking	0.4	2C(0.3)
79253	Tower A	West	Core	West end	1.0" away caulking	0.8	2C(0.6)
79254	Tower A	West	Core	West end	0.25" away caulking	40	2C(34)
79255	Tower A	West	Bulk	Panel caulking	NA	57,000	2C(53,000)
79256	Tower A	West	Core	South end	3.0" away caulking	0.9	2C(0.7)
79257	Tower A	West	Core	South end	1.5" away caulking	1.8	2C(1.3)
79405	Tower A	West	Core	South end	0.25" away caulking	12	2C(9.5)

ppm parts per million by weight
 NA not applicable
 2C Confirmation concentration reported from second column quantification

¹ Polychlorinated biphenyl (PCB) concentration analysis performed by Groundwater Analytical, Inc., using U.S. Environmental Protection Agency (EPA) method 8082 (GC/ECD).

² Aroclor 1016, 1221, 1232, 1242, 1248, and 1260 also tested. All results below reporting levels, unless noted.

Sample results indicated that porous materials in contact with the panel caulking from Tower A and the low-rise may contain PCBs in excess of 50 ppm at least 0.25 inches away from the caulking. Samples at 0.25 inches away ranged from 12 to 92 ppm from the three locations. At a distance of one and one-half inches away from the panel joint, sample results ranged from 0.8 to 2 ppm. At a distance of three inches away from the panel joint, sample results ranged from 0.4 to 1.9 ppm. These results have been used to determine an appropriate amount of concrete that will need to be removed to insure that remaining concrete concentrations remain less than the risk-based concrete concentration.

Based on these observations and data, EH&E has recommended treating exterior caulking found between concrete panel joints from Tower A and the low-rise building as PCB bulk product waste for this work plan.

4.2 CHANNEL CUTS

On November 20, 2006, EH&E collected four bulk samples from four concrete panel joints on the first floor of the low-rise and Tower A. The contractor removed ¼" of concrete from both sides of the panel joint that avoided contact with caulking identified to contain PCBs. The channel cut allowed removal of concrete and caulking *in situ* without coming into direct contact to the PCB caulking. EH&E then collected bulk samples from the remaining concrete surface by coring a number of shallow holes to determine if the removal of a ¼" of concrete would be sufficient to leave the residual concrete at concentrations of ≤ 25 ppm.² Sample results are presented in the following Table 4.2.

In order to prevent the generation of dust, the contractor employed a number of control measures during the channel cutting process. These controls included: 1) the protective tarping of work areas; 2) the use of HEPA equipped cutting tools; 3) the storage of cutting debris as PCB remediation waste; and 4) the appropriate use of PPE.

² Bulk core samples collected following the 1997 *Region One EPA-New England Draft Standard Operating Procedures for Sampling Concrete in the Field*.

Table 4.2 Exterior Panel Joint Bulk Sample Results from Tower A and Low-rise of Lederle Graduate Research Center, University of Massachusetts, Amherst, Massachusetts, November 20, 2006					
Sample ID	Building	Side	Description	Aroclor 1254^{1,2} (ppm)	Notes
81253	Low-rise	East	Sample following removal of ¼" of concrete from joint	3.1	2C(3.1)
81254	Low-rise	East	Duplicate of 81253	BRL<0.9	NA
81255	Low-rise	East	Sample following removal of ¼" of concrete from joint	64	2C(61)
81256	Tower A	West	Sample following removal of ¼" of concrete from joint	0.98	1C(0.97)
81257	Tower A	West	Sample following removal of ¼" of concrete from joint	2.7	1C(2.4)
ppm parts per million by weight BRL below reporting limits NA not applicable 1C Confirmation concentration reported from first column quantification 2C Confirmation concentration reported from second column quantification ¹ Polychlorinated biphenyl (PCB) concentration analysis performed by Groundwater Analytical, Inc., using U.S. Environmental Protection Agency (EPA) method 8082 (GC/ECD). ² Aroclor 1016, 1221, 1232, 1242, 1248, and 1260 also tested. All results below reporting levels, unless noted.					

EH&E found that the removal of ¼" of concrete on both sides of the caulking joint was generally sufficient to result in the lowering of concentrations to less than 25 ppm, the acceptance criterion for concrete found above the first floor of Tower A and the low-rise. A previous caulking sample collected by EH&E from the same joint from the west side of Tower A contained PCBs in concentration of 57,000 ppm. The removal of a ¼" of concrete was sufficient to bring the residual concrete to a concentration of 2.7 ppm at the same joint. One sample collected from a ¼" cut was above 25 ppm, this result demonstrates the importance of confirmatory testing that will be part of the abatement plan.

4.3 BULK SAMPLES OF NEWLY INSTALLED CAULKING

In some locations of both Tower A and the low-rise, old PCB caulking was removed and new non-PCB caulking was installed over residues from the PCB-caulking. EH&E collected bulk samples of newly installed caulking and underlying concrete to assess if these areas would also have to be included as part of the abatement of specified PCBs

from Tower A and the low-rise building. Results from EH&E's samples are presented in Table 4.3.

Table 4.3 Exterior Panel Joint Bulk Sample Results from Tower A and Low-rise of Lederle Graduate Research Center, University of Massachusetts, Amherst, Massachusetts, November 20, 2006					
Sample ID	Building	Side	Description	Aroclor 1254^{1,2} (ppm)	Notes
81258	Tower A	East	Underlying concrete below new caulking	98	2C(94)
81259	Tower A	East	Underlying concrete below new caulking	210	2C(200)
81260	Tower A	East	Newly installed caulking taken from 81258	860	1C(800)
81261	Tower A	East	Newly installed caulking taken from 81259	410	2C(370)
81262	Tower A	East	Duplicate of 81261	590	1C(470)
81263	Tower A	East	Newly installed caulking	190	1C(180)
81264	Tower A	East	Underlying concrete below new caulking from sample 81263	52	2C(50)
81265	Low-rise	West	New caulking above sample 81266	280	2C(270)
81266	Low-rise	West	Underlying concrete below new caulking	69	2C(65)
81267	Low-rise	West	Newly installed caulking	4,200	1C(4,100)
81268	Low-rise	West	Underlying concrete below new caulking from sample 81267	550	2C(520)
81269	Tower A	East	Second floor new installed caulking	410	2C(400)
81270	Tower A	East	Second floor concrete below new installed caulking	340	2C(330)
81271	Low-rise	North	Newly installed caulking above sample 81272	2,600	2C(2,500)
81272	Low-rise	North	Underlying concrete below new caulking	1,900	2C(1,800)
81273	Low-rise	North	Newly installed caulking	480	2C(470)
81274	Low-rise	North	Underlying concrete below new caulking from sample 81273	510	2C(490)
<p>BRL below reporting limits ppm parts per million by weight 1C Confirmation concentration reported from first column quantification 2C Confirmation concentration reported from second column quantification</p> <p>¹ Polychlorinated biphenyl (PCB) concentration analysis performed by Groundwater Analytical, Inc., using U.S. Environmental Protection Agency (EPA) method 8082 (GC/ECD). ² Aroclor 1016, 1221, 1232, 1242, 1248, and 1260 also tested. All results below reporting levels, unless noted.</p>					

These results indicate that newly installed caulking contains residues from old caulking that result in concentrations greater than one ppm. Furthermore, concrete concentrations below the newly installed concrete are in excess of 25 ppm. As a result, these areas require abatement as part of this plan.

4.4 WIPE SAMPLES

On December 12, 2006, EH&E collected samples from window frame in contact with caulking to assess preliminary residue concentrations from frames that had been stripped of old caulking, but had not been cleaned. Results from the samples collected are presented in the following Table 4.4.

Table 4.4 Calculated Wipe Sample Results Collected from Engineering Library, Lederle Graduate Research Center, University of Massachusetts, Amherst, Massachusetts, December 12, 2006

Sample ID	Floor	Location	Sample Description	Aroclor 1254* (µg)	Calculated Aroclor 1254* (µg/100 cm ²)	Notes	Wipe Area (sq.ft.)
81533	First	South side	Frame from third bay	150	21.5	2C(18.6)	0.75
81534	First	South side	Frame from fourth bay	160	22.9	2C(20.1)	0.75
81535	First	South side	Frame from second large bay	260	55.9	2C(45.2)	0.5
81536	First	South side	Duplicate of 81535	430	92.5	2C(81.8)	0.5
81537	First	South side	Frame from fourth large window	460	132.0	2C(114.8)	0.38
81538	First	West side	Fourth bay past north entrance	750	107.6	2C(96.1)	0.75
81539	First	West side	Second to last bay from north side	540	116.2	2C(99.0)	0.5
81540	First	West side	Last bay from north side	630	90.4	2C(81.8)	0.75
81541	NA	Field blank	Field blank	1.2	NA	2C(0.75)	NA
NA	NA	NA	Method blank	BRL<1.0	NA		NA

µg microgram
 µg/100 cm² micrograms per 100 square centimeters
 sq.ft. square feet
 2C Confirmation concentration reported from second column quantification
 NA not applicable
 BRL below reporting limit

* Aroclor 1016, 1221, 1232, 1242, 1248, and 1260 were also tested, but concentrations were below reporting limits.

Concentrations calculated based on wipe surface area.

Analysis performed by Alpha Analytical, Inc. (Westborough, Massachusetts) following U.S. Environmental Protection Agency (EPA) Method 8082 (GC/ECD).

Results from the wipe samples indicate that concentration window frames would be above the 10 micrograms per 100 cubic centimeters ($\mu\text{g}/100 \text{ cm}^2$) criterion for unrestricted use as defined by the EPA. However, concentrations in a number of samples were below the 100 $\mu\text{g}/100 \text{ cm}^2$ criterion for low occupancy areas that could be applied for window frames above the first floor.

5.0 SCOPE AND SCHEDULE

5.1 SCOPE

The scope of work for the abatement project solely addresses identified PCB-containing caulking and remediation waste associated with the Tower A and the low-rise. Phase One solely addresses the exterior panel and window frame caulking associated with Tower A. Phase Two solely addresses the concrete and window frame caulking associated with the low-rise building.

Both phases will require the removal of identified PCB-containing caulking and associated PCB remediation waste generated by the abatement process. Abatement work will include the cutting of a channel in the concrete panels as specified under the acceptance criteria in Section 13. UMass, at the direction of the project team, may elect to cut away more concrete as part of the restoration process. Windows in contact with caulking will be stripped of caulking and cleaned to meet the acceptance criterion for non-porous surfaces. The work consists of the following general elements:

- Site isolation and protection.
- Source containment and removal.
- Material disposal.
- Decontamination and/or removal of PCB residues.
- Acceptance testing and verification.
- Site restoration.

The abatement contractor shall supply all labor, materials, and equipment necessary to carry out the scope of work detailed in this document in a professional, workman-like manner. Final acceptance of the work is predicated on obtaining successful testing and inspection results (see Section 13) and completing site restoration activities (see Section 14). In addition, the abatement contractor shall be required to submit for review and approval a work plan to UMass and EH&E detailing its planned abatement activities at the building. The plan must include, at a minimum, a description of the removal activities, engineering controls, decontamination activities, and reporting.

5.2 SCHEDULE

All work shall be performed within UMass's allocated time period for abatement activities related to the building. Under a separate cover, the project team will conduct abatement activities regarding soil conditions around the buildings upon completion of the caulking abatement. Due to the nature of this project, the abatement contractor may be required to provide a large workforce to complete the abatement work within a short timeframe. The abatement contractor shall closely coordinate his/her schedule with other contractors' schedules to expedite the work, as necessary.

The abatement contractor will have to confirm the project schedule as part of the project award. Final approval of the schedule will be at the discretion of UMass.

6.0 BUILDING INSPECTION AND CONTRACTOR PROPOSAL

6.1 BUILDING INSPECTION

The abatement contractor is advised to inspect the site to verify amounts of materials to be removed and the amount of waste generated. UMass's environmental consultant (EH&E) and project team will be on-site to show contractors the locations of the materials to be abated. If discrepancies exist between these specifications and/or site conditions, the contractor must notify the designated UMass representative prior to signing the contract. Additional compensation to correct a difficulty or difference from conditions implied or indicated in this specification that would have been apparent during the site visit will not be approved by UMass or its designee.

6.2 CONTRACTOR PROPOSAL

The contractor shall submit a proposal based on UMass and the Commonwealth of Massachusetts' proposal requirements for the work specified herein.

7.0 UTILITIES

UMass will provide electrical power to the site consistent with UMass general conditions. Any additional work to distribute power will be the responsibility of the contractor. Water will be provided on-site consistent UMass contract documents. The abatement contractor will have to make arrangements to distribute all needed water for abatement and cleaning activities.

7.1 WATER SYSTEMS

All water systems running through the work area and not being used must be shut off at the source. For any system that must be left on, the location of a shut-off valve must be clearly marked on the emergency plan. Water systems used by the contractor should be consistent with UMass policy.

7.2 ELECTRICAL SYSTEMS

Appropriate electrical systems that may pose a hazard during the abatement process must be shut down when being abated or cleaned. The power must be locked out at the control panel, and those individuals that have the ability to reenergize the area must be in close communication with the general contractor the abatement contractor. The lockout of electrical systems must be conducted in accordance with the contractor's lock-out/tag-out safety program. Ground-fault circuit interrupters must be used for all temporary power supplies and extension cords, and any power lines potentially exposed to water or moisture.

7.3 EXISTING FACILITIES

Consistent with UMass policies, the contractor shall not conduct any work that will result in the damage of existing facilities not part of the scope of work defined under the work plan. The contractor shall be responsible for replacing or repairing any damage to existing facilities at the building.

8.0 MATERIALS AND PRODUCTS

Table 8.1 summarizes the estimated quantities of PCB-containing materials identified at the building that the contractor will have to remove from the site during the three phases of the abatement plan.

Table 8.1 Estimated Amount ¹ of Abated Caulking, Tower A and Low-rise Building, Lederle Graduate Research Center, University of Massachusetts, Amherst, Massachusetts			
Phase	Specified Material	Description	Openings or Linear Feet
One	Concrete joint caulking	Caulking found between concrete joints associated with Tower A.	~30,340 linear feet
One	Concrete joint caulking	Caulking found between concrete joints and window frames associated with Tower A.	~1,276 linear feet
Two	Concrete joint caulking	Caulking found between concrete joints associated with the low-rise building.	~14,148 linear feet
Two	Concrete joint caulking	Caulking found between concrete joints and window frames associated with the low-rise building.	~2,790 linear feet
¹ Estimates do not include associated polychlorinated biphenyl remediation waste that will be generated as part of the abatement project, which could be substantial.			

9.0 EXECUTION OF ABATEMENT PROGRAM

9.1 SITE PREPARATIONS

9.1.1 Ground Cover

In order to prevent debris from escaping the work zone, and to protect existing facilities and the environment, the abatement contractor shall use sufficient ground cover along areas where work will take place. A standard water-impervious membrane covering or equivalent will be secured into the ground surrounding each respective building to prevent tripping. The covering shall extend sufficiently from the outside edge of the building envelope to capture any loose debris. On top of the secured tarp, place a single layer of 6-mil polyethylene sheeting temporarily secured with high quality fabric duct tape to prevent the sheeting from blowing or billowing due to weather/wind conditions. This sheeting shall serve to collect dust and debris from the caulking removal, concrete scarification and surface cleaning operations. The abatement contractor shall remove all visible caulking or abatement debris by HEPA vacuuming continuously throughout the work shift and at the end of the work shift. If tears or rips occur in the sheeting, the sheeting may be repaired with duct tape or removed and replaced with a new sheet, as warranted by the extent of the damage.

9.1.2 Site Isolation

During all phases of abatement work, the contractor will need to address security and access concerns of the occupied building as part of the project. The goal of each phase will be to abate identified PCB-containing exterior caulking. Wind barriers in conjunction with local exhaust controls (e.g., power tools equipped with HEPA vacuums) will be required during cutting work to minimize airborne dust generated during the project. The contractor will need to coordinate with UMass and the project team to address site isolation issues. In addition, the contractor will need to document site isolation procedures in the work plan submittals.

During both phases of the abatement work, the project team will keep the work areas negatively pressurized relative to non-work areas. This will help prevent potential migration of abatement debris out of the work area.

9.1.3 Concrete Joints (Phase One and Two)

The concrete joints found at the building shall be sufficiently protected to prevent any loose debris from getting outside the containment screens as a result of the abatement work. All of the work will occur on the exterior of the building. The abatement contractor will utilize wind screens on any staging to control dust and debris along with appropriate ground cover to perform the abatement work. Each staging area or work area will be cleaned of loose caulking material at the end of each work shift. Sufficient cover material will be utilized on the swing stage or work area to collect and capture loose caulking and debris from the abatement work. Cover for work areas should be sufficient to prevent inclement weather from washing away caulking or debris from the work zone. Only hand tools or power tools fitted with appropriate dust/debris collection systems will be used during the abatement work.

9.1.4 Window Frames in Contact (Phase One and Two)

Window frames shall be protected during the exterior work by swing stage and/or scaffolding used to access the frames. Any exterior scaffolding that will be used will need to be sufficient enough to provide weather protection for the window frames. The contractor shall specify protective measures in their Standard Operating Procedures submittal. Sufficient cover material will be utilized on the swing stage or work area to collect and capture loose caulking and debris from the abatement work and to prevent inclement weather from affecting work or releasing loose debris or caulking. Only hand tools or power tools fitted with appropriate dust/debris collection systems will be used during the abatement work.

9.1.5 Waste Containers

The contractor shall obtain and locate the approved PCB waste containers on-site. Dumpsters will be lined, covered, and secured. Access to dumpsters will be with fencing to prevent unauthorized access. The contractor will coordinate the location of the PCB waste containers with other trades, the project team, and EH&E. The PCB waste containers shall be clearly marked as described under §761.45 to avoid confusion with ordinary waste containers. At the end of each day, the containers will be secured onsite. When sufficiently full, the contractor will coordinate with an approved waste hauler to

remove PCB waste containers from the site to be transported to an approved landfill for disposal. The contractor shall submit a waste handling and storage plan for approval.

If the project team elects to use wet cutting methods, the wastewater collected will be stored in approved containers (§761.65). Wastewater will be tested to meet disposal requirements or be disposed as PCB remediation waste under (§761.79)

9.2 WORK SEQUENCE

The general work sequence for the various tasks is presented in Section 5. The general flow of the work will be as follows:

- site protection
- source removal
- surface cleaning or scarification
- material decontamination
- testing and verification
- site restoration
- project acceptance and completion.

10.0 MATERIAL STORAGE AND HANDLING PROCEDURES

10.1 PCB BULK PRODUCT WASTE MATERIALS

PCB bulk product waste (e.g., caulking) shall be handled and removed from specified surfaces in a manner to avoid the breakdown of these materials into fine dust or powders. Once removed, these materials shall be placed in the lined container or into an appropriate temporary container (e.g., 6-mil plastic disposal bag) for transport into the PCB container at the end of the work shift. PCB bulk product waste and PCB-containing (PCB remediation waste) items shall be stored for disposal in accordance with 40 CFR §761.40 and §761.65. If temporary waste containers are used, then UMass's environmental consultant must approve all temporary containers that will store PCB bulk product waste. Commercial grade plastic or hard rubber trash barrels lined with a single 6-mil plastic disposal bag and a securable lid will be considered acceptable temporary containers. Once in the container, these materials will be covered and protected from the weather. All containers and temporary containers shall be clearly marked as PCB-containing waste materials as required under §761.45.

Lined and covered barrels containing PCB materials will be marked with designations indicating that the PCB materials are contained in the barrel, as stated in 40 CFR §761.65(c)(1). All barrels and PCB-contaminated materials will be non-liquid materials. In addition, a tarp shall be used to prevent spillage onto the floor of the storage area. When not in use, barrels will remain covered by both lids and tarps. All areas containing PCB waste must be secured at the end of the day.

To insure that the material storage areas will not be a possible source of contaminants, EH&E may conduct limited air monitoring in the complex. Any dried or brittle PCB bulk product waste will require additional care, such as the use of a HEPA vacuum during the removal of material, to prevent the inadvertent release of PCB dust or powder into the work area or the environment.

10.2 PCB REMEDIATION WASTE

The primary PCB remediation wastes generated by this abatement project will be potentially contaminated dust and/or debris generated by the scarification or cutting of

concrete in contact with the PCB caulking. Due to the nature of this waste stream, this waste must be collected in sealable airtight containers or 6-mil plastic bags for disposal. These containers (plastic bags sealed with duct tape) shall be brought to the PCB container when full. The abatement contractor shall never empty a container of this waste, as this may result in unacceptable production of fugitive dust emissions.

No dry dusting or sweeping will be allowed for this waste stream. The use of minimal quantities of water to moisten the generated dust prior to collection will be allowed. Under no circumstances shall the PCB remediation waste show evidence of free liquid water, pooling, or ponding within the waste stream. Any liquid used to wet the dust will be collected along with dust and disposed as PCB bulk product waste according to procedures outline in Section 11. All rags and/or cleaning materials used to clean PCB-contaminated materials shall also be disposed as PCB remediation waste.

11.0 DISPOSAL

Disposal of all waste shall be in accordance with applicable state and federal regulations and sent to a licensed facility or facilities that will receive and retain PCB bulk product waste and PCB remediation waste, in accordance with EPA regulations under §761.61 and §761.62. All PCB bulk product waste and PCB remediation waste removed from the building will be kept separate from other ordinary construction waste streams that the contractor may generate. UMass' Department of Environmental Health and Safety will be responsible of reviewing and signing all shipping papers that designate UMass as the waste generator. Copies of all bills of lading, waste shipment records, certificates of disposal, and any other documentation must be provided to the project team as proof of proper disposal of waste. Furthermore, copies of all manifests shall be provided to the EPA as part of the final summary report.

PCB bulk product and PCB remediation wastes will be stored according to applicable EPA TSCA regulations. The contractor shall ensure compliance with storage and marking requirements described in §761.40 and §761.65. The contractor shall also ensure that no visible emissions of dust will occur during the disposal of PCB bulk product and PCB remediation wastes into appropriate disposal containers.

The PCB bulk product waste and PCB remediation waste shall be disposed of in accordance with 40 CFR 761.62 and §761.61(b), respectively, at an approved landfill(s) for such disposal. The project team shall submit the name of the landfill(s) with appropriate documentation to verify that it is capable of accepting PCB waste in accordance with these requirements.

12.0 ABATEMENT PROCEDURES

Contractors must obtain proper permits and conduct work in compliance with all applicable regulations, including the TSCA, the Resource Conservation and Recovery Act (RCRA), and any other applicable federal, state, and local laws.

Abatement procedures for the work shall consist of the removal of identified PCB-containing materials.

- Phase One work consists of the exterior caulking associated with the concrete joints of Tower A.
- Phase Two work consists of the exterior caulking associated with the concrete joints of the low-rise.

12.1 CONCRETE SURFACES (BOTH PHASES)

- Locate area to cut (Phases One and Two) and verify that proper site protection is in place (see Sections 5 and 9).
- When applicable, use a cutting tool equipped with a local exhaust manifold attached to a HEPA vacuum cleaner to collect bulk dust generated during cutting operation. Alternatively, use a chipping tool in conjunction with appropriate debris catching material to collect abatement debris.
- For both phases, utilize HEPA filtered portable air filtration device to prevent the escape of debris from within the work area. Pre-filters should be used and will need to be changed regularly to prevent degrading the performance of the air filtration device.
- Minimally, moisten concrete with water using a low-pressure hand-held sprayer (e.g., garden sprayer) and maintain moisture content to reduce dust levels.
- Clean up dust and residues with HEPA vacuuming and/or wet wiping techniques.

- Items designated as PCB remediation or PCB bulk product waste shall be transported to the appropriate disposal dumpster via sealed bags or containers.
- No chutes or other transport methods that may generate fugitive emissions may be used to dispose PCB remediation or PCB bulk product waste from the work area.

12.2 METAL FRAMES (PHASES ONE AND TWO)

The metal window frames found in Tower A and the low-rise building are non-porous surfaces. Phase One window frames are limited to approximately 220 window openings and Phase Two window glass panes and frames are limited to approximately 150 window openings.

12.2.1 Cleaning Guidelines (Both Phases)

UMass will abate the Phase One and Two non-porous materials for unrestricted use on the first floor (less than 10 $\mu\text{g}/100\text{ cm}^2$) of both buildings and will abate for low occupancy status on floors above the first floor (less than 100 $\mu\text{g}/100\text{ cm}^2$). The abatement contractor will need to adhere to specific cleaning procedures. In general, the contractor will need to remove and clean any caulking residues in contact with the identified caulking. Following the removal of all caulking residues, the contractor will clean the surfaces of the window frames. The cleaning process of the identified window openings shall adhere to the following procedures or equivalent:

- Hand scraping to remove all caulking residue from identified non-porous surfaces.
- A wiper (or equivalent) moistened with an organic solvent (e.g., mineral spirits) shall be used to clean the non-porous surfaces of the identified surfaces, focusing the cleaning on areas where PCB bulk products contacted the surface. The surface shall be cleaned to the point of no visible contamination and until the surface appears to have a “bright” finish.
- The wipers and any solvent wash shall be collected for disposal as TSCA/RCRA waste.

- All solvents must be stored and used in conformance with OSHA, EPA, and local fire department requirements and guidelines to minimize the hazard associated with the solvent.
- The contractor must specify work practices, procedures, and engineering controls that will be used to minimize entrainment of solvent vapors into the building and to protect workers from elevated exposures to vapors.

Upon completion of the additional cleaning, EH&E would conduct visual inspections and confirmatory wipe sampling to verify the completeness of the cleaning effort.

13.0 ABATEMENT COMPLETION ACCEPTANCE CRITERIA

As part of the abatement process, verification that abatement and decontamination have been properly completed and have met the acceptance criteria described in this section will be required for both Tower A and the low-rise. EH&E will conduct random and representative sampling during the two phases to verify the effectiveness of removal and abatement activities. Prior to collecting samples, EH&E will conduct visual inspections of representative areas to note any visible buildup of dust or debris.

13.1 VISUAL INSPECTION CRITERIA (ALL PHASES)

Upon completion of abatement work, EH&E will visually inspect abated areas and surfaces for evidence of dust, debris, or the presence of any PCB source material. All areas where abatement activities have occurred shall be inspected. Inspections of various systems or surfaces will be conducted as the cleaning and decontamination is completed if, at the discretion of EH&E, recontamination of the surface by ongoing work is highly unlikely. Visual inspection will be used as a preliminary verification that abatement has been completed, but will not replace random sampling of materials and surfaces.

The acceptance criterion is that all surfaces shall be free of dust or debris including work areas, work surfaces, protective sheeting and tarps. In addition, no visible PCB material identified for removal shall remain in place.

13.2 PCB SAMPLING CRITERIA

As detailed more fully in the sample results described in Sections 2.2 and 4.0, EH&E had found the following conditions at Tower A and the low-rise building of the LGRC:

- Caulking found at the building contains concentrations of PCBs in excess of 50 ppm. The maximum concentration seen in EH&E's sample results was 74,000 ppm.³

³ EH&E understands that data collected by ATC indicate laboratory results of 700,000 ppm. EH&E's samples have yet to approach those concentrations.

- Residual concentrations seen in concrete surfaces with only moderate cleaning were all below 25 ppm, the EPA's threshold for authorized use in low-occupancy areas.
- Concrete surfaces associated with the building will be abated, and repaired.
- Operable windows in the building have been bolted shut by UMass, and will be sealed during work operations.

Based on these findings and sample results from within the LGRC, EH&E and the Science Collaborative developed the proposed health-based risk acceptance criteria for Tower A and the low-rise building. The health-based acceptance criteria are described in detail in Appendix B of this report. In summary, the health-based criteria were developed to conform with Massachusetts cancer risk and non-cancer hazard index benchmarks for an adult full-time worker of the LGRC.

13.2.1 Phase One Samples

Phase One samples that will be taken from abated concrete panel joint surfaces shall meet the following acceptance criterion:

- For all concrete joints above the first floor, the bulk sample acceptance criterion will be less than or equal to 25 ppm for total PCBs.
- For all concrete joints on the first floor, the bulk sample acceptance criterion will be less than or equal to one ppm for total PCBs.
- For metal window frames on the first floor, the wipe sample acceptance criterion will be less than or equal to 10 $\mu\text{g}/100\text{ cm}^2$ for total PCBs.
- For metal window frames above the first floor, the wipe sample acceptance criterion will be less than or equal to 100 $\mu\text{g}/100\text{ cm}^2$ for total PCBs.
- Upon completion of the abatement work, air concentrations in the Tower shall be less than 0.29 $\mu\text{g}/\text{m}^3$.

13.2.2 Phase Two Samples

Phase Two samples that will be taken from abated concrete joints shall meet the following acceptance criterion.

- For all concrete joints above the first floor, the bulk sample acceptance criterion will be less than or equal to 25 ppm for total PCBs.
- For all concrete joints on the first floor, the bulk sample acceptance criterion will be less than or equal to one ppm for total PCBs.
- For metal window frames on the first floor, the wipe sample acceptance criterion will be less than or equal to 10 $\mu\text{g}/100 \text{ cm}^2$ for total PCBs.
- For metal window frames above the first floor, the wipe sample acceptance criterion will be less than or equal to 100 $\mu\text{g}/100 \text{ cm}^2$ for total PCBs.
- Upon completion of the abatement work, air concentrations in the low-rise shall be less than 0.29 $\mu\text{g}/ \text{m}^3$.

13.3 SAMPLING

13.3.1 Sampling Plan

In order to measure the success of the abatement process, EH&E will conduct representative sampling of abated surfaces during each phases of the abatement work. The frequency and number of the representative samples shall be determined by the amount of PCB-containing building materials abated, based on linear feet of material for each of the two phases. Specifics of the sampling plan are described in more detail in the EH&E Sampling Plan filed under Appendix E.

The proposed sampling frequencies are stated in two tables in Appendix E. These sample frequencies will provide adequate representation of the environmental conditions that can be expected in the building following each abatement phase. Should initial samples fail to meet the acceptance criteria, EH&E will collect additional confirmatory

samples to verify the efficacy of the abatement effort. EH&E anticipates the overall sample frequencies will not dramatically differ from the proposed numbers in the following tables.

13.3.2 Contingency Sampling

In the event that the sampling results are greater than the specified acceptance criteria, additional abatement procedures shall be conducted. Following additional decontamination, confirmatory sampling of the re-abated areas and/or surfaces shall be conducted. Additional abatement procedures include, but are not limited to, additional cleaning of surfaces with solvents, additional scarification or wire brushing of surfaces at deeper levels, and more thorough vacuuming of surfaces.

13.4 QUALITY ASSURANCE/QUALITY CONTROL

This section describes the quality assurance objectives, measurement criteria, and performance criteria that will be employed for this program. The selected analytical test methods for this project will have laboratory quantitation limits that are lower than the established project action limits specified in Section 13.2.

The ultimate objective of this project is to remove PCB source materials and clean contaminated surfaces of PCB residues, as specified in this plan. The data collected must be of sound quality to support a determination that sources have been removed and surfaces cleaned to meet the acceptance criteria.

The ability of the data to meet the project quality objectives shall be measured using data quality criteria, which include precision, accuracy, representativeness, comparability, completeness, and sensitivity parameters. Laboratory and field sampling activity documentation will be used to assess these parameters. In addition, only certified laboratories shall be used to insure proper data handling techniques. The acceptance criteria and frequency of measurement of these parameters are summarized in Table 13.2.

Table 13.2 Quality Assurance and Control by Media, Lederle Graduate Research Center, University of Massachusetts, Amherst, Massachusetts

Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	Frequency
Matrix Bulk Samples			
Precision—overall	±45%	Field duplicates	Minimum: One per group or 10% of samples
Precision—laboratory	±45%	1. Matrix spike 2. Matrix spike duplicates	Minimum: One per analysis.
Accuracy/bias	±45%	1. Matrix spike 2. Matrix spike duplicates	Minimum: One per group or 10% of samples
Accuracy/bias	Acceptable quality control range based on analytical technique	Laboratory control samples	Double column GC surrogate compound
Accuracy/bias-contamination	No target analytes above laboratory quantification limit with the exception of common field/laboratory contaminants	1. Equipment blanks 2. Method blanks 3. Instrument blanks	Minimum: One per group or 10% of samples
Comparability	Not applicable	Comparability check	Double column GC
Data Completeness	90% Overall	Data completeness check	
Sensitivity	±100%	1. Laboratory fortified blank 2. Low calibration standard	Minimum: One per group or 10% of samples
Wipe Samples			
Precision—overall	±45%	Field duplicates	Minimum: One per group or 10% of samples
Precision—laboratory	±45%	1. Matrix spike 2. Matrix spike duplicates	Minimum: One per analysis.
Accuracy/bias	±45%	1. Matrix spike 2. Matrix spike duplicates	One per analysis
Accuracy/bias	Acceptable quality control range based on analytical technique	Laboratory control samples Surrogate compound	Minimum: One per group or 10% of samples
Accuracy/bias-contamination	No target analytes above laboratory quantification limit with the exception of common field/laboratory contaminants	Equipment blanks Method blanks Instrument blanks	Minimum: One per group or 10% of samples
Comparability	Not applicable	Comparability check	
Data completeness	90% overall	Data completeness check	
Sensitivity	±100%	Laboratory fortified blank Low calibration standard	Minimum: One per group or 10% of samples
QC	quality control		
GC	gas chromatography		

13.4.1 Precision

Precision is the degree of agreement among repeated measurements of the same characteristic under the same or similar conditions. In general, EH&E collects one duplicate sample for every ten samples collected or 10% of the sample size. No less than one duplicate set will be collected, regardless of the sample size. The identity of the duplicate sample(s) is not revealed to the analytical laboratory. The target precision among field duplicates is $\pm 30\%$, indicating good reproducibility. Because of the low possibility of residual PCBs in the collected samples, EH&E believes that a precision of 30% will be an acceptable indicator for reproducibility. Precision levels greater than 30% will not invalidate the sample data set, but will be flagged to caution users about the variability within the data.

13.4.2 Accuracy

Accuracy is the extent of agreement between an observed value (sample result) and the accepted or true value of the parameter being measured. EH&E employs proper quality control (QC) techniques, including the submittal of two field blanks or 10% of the sample number, whichever one is greater. In addition, all field equipment are calibrated and maintained to minimize variability. EH&E also observes proper handling and packaging techniques to preserve the integrity of the samples. Where appropriate, EH&E will use pre-spiked samples prepared by the laboratory to document the integrity of the sampling and analytical process. The appropriate laboratory QC program and analytical method determine acceptable recoveries. The laboratory will utilize spiked samples, reference standards, and blanks to assure accuracy. Recoveries outside the acceptable limits will not invalidate the sample data set; however, the data will be flagged to warn of its reliability.

13.4.3 Representativeness

Representativeness is a qualitative term that describes the extent to which a sampling design adequately reflects the environmental conditions of a site. The samples will be selected to represent the various field conditions and the types of areas that will be remediated.

13.4.4 Reasonableness

All data will be evaluated for reasonableness based on existing knowledge of the Aroclor mixtures in the building environment and on pre-abatement levels. In addition, levels published in the scientific literature will be consulted to evaluate the data both before and after the abatement. It is expected that the abatement will substantially reduce residues below target cleanup levels. Any data that substantially falls outside these expected levels will be further evaluated for accuracy and additional data collection may be required.

13.4.5 Completeness

Completeness is a measure (percentage) of the amount of valid data obtained meeting the data quality objectives. Valid data are data that are soundly founded as evidenced by the data quality indicators (DQIs). The acceptable completeness percentage for this project is 90%.

14.0 SITE RESTORATION

Upon successful completion of the work, including meeting the acceptance criteria specified in Section 13.0, the site shall be restored to its original condition and will include the following specific tasks:

- Removal of all abatement materials.
- Removal of containers and off-site disposal of all waste.
- Repair of any damage to building materials, components or surrounding grounds caused by the abatement contractor's work.

15.0 HEALTH AND SAFETY

15.1 CONTRACTOR HEALTH AND SAFETY PLAN

The abatement contractor must submit a written health and safety plan that details engineering controls, practices and procedures, protective equipment, and training that will be used to control and minimize exposures. In addition, the plan will include provisions for all relevant health and safety issues. This plan must be submitted with the bid proposal and will be considered in the bid selection process.

The safety plan shall include copies of training materials and training records for those who will be working on-site at any time during the abatement project. If new employees are hired during the course of the work, they must receive training prior to beginning work and evidence of this training must be provided to the project team.

15.2 OSHA REGULATIONS

All applicable federal and state OSHA standards and regulations to insure worker safety will be in effect during the abatement process. The following programs must be addressed in the contractor's health and safety plan. This is not a comprehensive list of the required programs, and the contractor is responsible for determining which programs apply and how best to implement the required programs.

- Respiratory Protection
- Fall Protection
- Personal Protective Equipment
- Lockout/Tagout
- Confined Spaces
- Machine Safety
- Ladder/Scaffolding Safety
- Electrical Safety
- Housekeeping (slips, trips, falls)
- Injury Reporting

- First Aid
- Fire Safety

15.3 PUBLIC SAFETY

All of the abatement work will take place from the exterior of each respective building. The contractor, in conjunction with UMass and EH&E, will need to ensure public safety during all phases of the abatement work. Work will occur on the outside of two occupied buildings. As a result, contractor will need to implement containment measures designed to protect workers, occupants, and the environment from the release of PCB-containing materials. Containment will include, but not be limited to, draping work areas, the use of HEPA filters to collect fugitive emissions during the cutting operations, isolation of work areas from occupied areas, blocking off fan induction coils, and protective wind screens.

Access to work areas will need to be limited to insure that only workers aware of the abatement project will be within the work zone. Proper hygiene and decontamination procedures must be followed to limit the potential for transferring PCB remediation waste outside the work area.

During the abatement work, EH&E will conduct visual assessments to verify the effectiveness of the containment controls of the abatement contractor. If observations indicate that additional containment or engineering controls are required, the abatement contractor will be responsible for making the necessary adjustments to engineering controls and work practices to minimize fugitive emissions, as determined by UMass's environmental consultant. In addition, if there is evidence of PCB bulk product waste or remediation waste outside of the immediate work area (as determined by visual inspection by UMass's environmental consultant), the abatement contractor shall be responsible for cleaning up the dust/debris in accordance with the procedures and to the standards specified in Section 13, and shall modify controls and procedures to prevent a reoccurrence, at no cost to UMass.

16.0 FINAL APPROVAL AND ACCEPTANCE

Final approval of the remedial work will be given when the following conditions are met:

- The work has been completed in a professionally competent manner, as demonstrated by successful visual inspections described in Section 13.
- The results of all testing (surface and bulk) meet the standards specified in Section 13.
- The site has been successfully restored to its original condition, as described in Section 14.
- UMass receives a completed and accurate waste manifest for every PCB waste container removed from the site.

Both UMass and EH&E must give final approval of the completion of the abatement work to the abatement contractor.

APPENDIX A
LIMITATIONS

LIMITATIONS

1. Environmental Health & Engineering, Inc.'s (EH&E) indoor air assessment described in the attached report number 14680, *Lederle Graduate Research Center, Tower A and Low-Rise, University of Massachusetts, Amherst, Massachusetts, Plan For the Removal and Abatement of Building-related Polychlorinated Biphenyls (PCBs)* (hereafter "the Report"), was performed in accordance with generally accepted practices employed by other consultants undertaking similar studies at the same time and in the same geographical area; and EH&E observed that degree of care and skill generally exercised by such other consultants under similar circumstances and conditions. The observations described in the Report were made under the conditions stated therein. The conclusions presented in the Report were based solely upon the services described therein, and not on scientific tasks or procedures beyond the scope of described services.
2. Observations were made of the site as indicated within the Report. Where access to portions of the site was unavailable or limited, EH&E renders no opinion as to the presence of chemical residues, or to the presence of indirect evidence relating to chemical residues in that portion of the site.
3. The observations and recommendations contained in the Report are based on limited environmental sampling and visual observation, and were arrived at in accordance with generally-accepted standards of industrial hygiene practice. The sampling and observations conducted at the site were limited in scope and, therefore, cannot be considered representative of areas not sampled or observed.
4. When an outside laboratory conducted sample analyses, EH&E relied upon the data provided and did not conduct an independent evaluation of the reliability of these data.
5. The purpose of the Report was to assess the characteristics of the subject site as stated within the Report. No specific attempt was made to verify compliance by any party with all federal, state, or local laws and regulations.

APPENDIX B
HEALTH-BASED ACCEPTANCE CRITERIA

**Lederle Graduate Research Center
University of Massachusetts
Amherst, MA**

**TOWER A AND LOW RISE
RISK-BASED REOCCUPANCY CRITERIA**

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Figure 1	Comparison of PCB Homolog Weight Fractions in Indoor Air and Wipe Samples from the LGRC to PCB Homolog Weight Fractions in Commercial PCB Aroclor Mixtures
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1. INTRODUCTION

The Science Collaborative has calculated risk-based Reoccupancy Criteria for the presence of specified polychlorinated biphenyls (PCBs) associated with Tower A and the low rise buildings at the Lederle Graduate Research Center (LGRC) of the University of Massachusetts (UMass) in Amherst, Massachusetts. These Reoccupancy Criteria for indoor air and concrete on the building exterior correspond to cancer risk and noncancer hazard index benchmarks established by the Massachusetts Department of Environmental Protection (MADEP). This report provides recommended Reoccupancy Criteria and their underlying assumptions and methodology.

2. DATA SUMMARY

EH&E collected indoor air, bulk, and wipe samples from the LGRC to define the nature and extent of building-related sources of PCBs and to measure possible human exposures in the indoor environment. These data are described briefly here and are discussed in greater detail by EH&E (2006). All data are provided in Appendix C of EH&E's report dated February 21, 2007.

The LGRC consists of Tower A, Tower B, Tower C, the low rise, and the Conte National Center for Polymer Research building. EH&E conducted sampling on three occasions: August 21-22, 2006, September 6-7, 2006, and September 22, 2006. The August sampling round was designed to answer questions of concern about nature and extent of building-related PCBs and indoor human exposures. The September 6th sampling followed implementation of EH&E ventilation and space pressurization recommendations intended to reduce indoor air concentrations in the engineering library, which is in the low rise. Right after the September 6th sampling event, UMass hired Clean Harbors, Inc. to clean the library as a precautionary measure. [Note that EH&E 2006 does not report the dates on which cleaning occurred.] The September 22nd sampling round was intended to document the effect of library cleaning.

2.1 Bulk Samples

EH&E collected the following samples from the LGRC buildings on August 21 and 22, 2006:

- Exterior panel caulking samples from the low rise and Towers A, B & C
- Exterior panel concrete core samples (taken at specific distances from the caulking joint) from Tower A and the low rise building
- Asphalt samples underneath the dumpster inadvertently used to dispose of construction debris prior to the discovery of PCB-containing caulking

Groundwater Analytical, Inc. analyzed all samples for PCBs using EPA Method 8082. The laboratory quantified the PCBs as Aroclor 1254. Caulking samples collected from Towers B and C had PCB concentrations ranging from 0.2 to 3.3 ppm (EH&E 2006), well below the EPA threshold of 50 ppm for an unauthorized use of PCBs.

On September 22, 2006, EH&E collected bulk samples from the uncleaned panel joints associated with the low rise and Tower A. Alpha Woods Hole Laboratories analyzed these

samples for dioxin-like PCB congeners and PCB homologs. The laboratory reported total PCB concentrations as the sum of homologs.

2.2 Air Samples

On August 21, 2006, EH&E collected air samples from locations throughout all five buildings of the LGRC (the low rise, Tower A, Tower B, Tower C and Conte National Center for Polymer Research buildings). Galson Laboratories analyzed these samples for total PCBs using NIOSH method 5503. The laboratory reported a predominant pattern of Aroclor 1248. This pattern represents a more volatile mixture of PCB congeners than the mixture detected in bulk samples, which is to be expected given that the more volatile congeners partition more readily to air than the less volatile congeners.

PCBs were below the detection limit in samples from the Conte building, Tower B, and Tower C. Concentrations in the three samples from Tower A ranged from 0.18 to 0.24 ug/m³. Air concentrations from the low rise (excluding the library) ranged from 0.44 to 0.69 ug/m³. EH&E recommended that ventilation rates and outdoor air to the library be increased to reduce indoor air concentrations of PCBs in that area.

On September 6, 2006, additional air samples were collected on all three floors of the Engineering Library to confirm that the increased ventilation rate and space pressurization were effectively reducing air concentrations of PCBs. As in the previous sampling round, these samples were analyzed for total PCBs, and the laboratory reported a predominant pattern of Aroclor 1248. Concentrations were lower than in the samples taken in August, ranging from 0.22 to 0.64 ug/m³.

EH&E collected air samples from the library on September 22, 2006, after the area was cleaned by Clean Harbors. Alpha Woods Hole Laboratories analyzed these samples for PCB homologs and reported total PCB concentrations as the sum of homologs. Total PCB concentrations ranged from 0.14 to 0.36 ug/m³ and were lower than concentrations measured in previous sampling rounds.

2.3 Wipe Samples

On August 21, 2006, EH&E collected wipe samples from work surfaces, window ledges, and ventilation surfaces in the low rise and Tower A buildings. One sample from a low window ledge of the reading room of the library had a concentration higher than the EPA PCB clean-up standard acceptance criterion of 10 ug/100 cm². On September 6, 2006, EH&E collected additional wipe samples from window ledges, shelves, stairs, work surfaces, and ventilation system surfaces in the library. It was after this sampling effort that the university contracted the services of Clean Harbors, Inc. to clean the library.

On September 22, 2006, EH&E collected wipe samples in association with bulk sampling of the uncleaned exterior panel joints from the low rise and Tower A. Two wipe samples are associated with each bulk sample: one collected from the joint following some limited cleaning of the surface, and one collected approximately 1 foot away from the panel joint. Alpha Woods Hole Laboratories analyzed these samples for dioxin-like PCB congeners and PCB homologs

and reported total PCB concentrations as the sum of homologs. Total PCB concentrations ranged from 0.12 to 2.97 ug/100 cm² and are below EPA's PCB clean-up standard acceptance criterion.

2.4 Soil and Dust Thimble Samples

As required by MADEP, EH&E was scheduled to collect soil samples around the exterior of the GRC buildings, primarily near Tower A and the low rise, starting in October 2006. Also, EH&E collected dust thimble samples from the library on September 6, 2006, but these data are not discussed by EH&E in its preliminary report (2006). The soil data and dust thimble data have not been analyzed as part of this report.

2.5 Data Quality Issues

Both of the bulk samples and one of the wipe samples collected during the September 22, 2006 sampling round had concentrations that exceeded the calibration range of the instrument. Therefore, the lab further diluted and reanalyzed these samples, and both analyses are reported in the lab report. No quality control data were reported by EH&E 2006 for the August and early September sampling rounds. For the purposes of calculating the Reoccupancy Criteria, we assume that no significant data quality issues were identified by the laboratories.

3. TOXICITY OF PCB MIXTURES IN INDOOR AIR AND CONCRETE

EPA has developed toxicity values for cancer and noncancer effects of PCBs (EPA 2006). The toxicity values for cancer are known as cancer slope factors (CSFs), and toxicity values for noncancer effects associated with oral exposures are known as reference doses (RfDs). To quantify risk from PCBs, one must select those toxicity values most applicable to the PCB mixture under evaluation. The PCB mixtures to which people are exposed usually differ to some extent from the commercial Aroclor mixtures used in studies from which the toxicity values are derived. Therefore, we used both the Aroclor and PCB homolog concentration data for indoor air and exterior concrete bulk and wipe samples to determine the appropriate PCB toxicity values for calculating Reoccupancy Criteria. We also conducted a sensitivity analysis of the possible influence of dioxin-like PCB congeners on the Total PCB Reoccupancy Criteria (See Section 5.1).

3.1 Noncancer Reference Dose for PCBs

EPA has established a noncancer RfD for Aroclor 1016 of 7E-5 mg/kg-d and a noncancer RfD for Aroclor 1254 of 2E-5 mg/kg-d.

3.1.1 *Indoor Air*

As shown in Figure 1, indoor air samples collected on September 22, 2006 contain homolog mixtures that do not look like either Aroclor 1016 or Aroclor 1254, falling somewhere in between with respect to chlorination level. Galson Laboratories analyzed total PCBs in indoor air from the August and September 6th sampling and reported that the PCB patterns in these samples most closely matched Aroclor 1248. As a result, it is not clear which RfD better represents the toxicity of the PCB mixture detected in indoor air.

To ensure that the Reoccupancy Criteria are protective, we selected the lower RfD for Aroclor 1254. This RfD is applicable to the oral route of exposure, but we also used it to evaluate the dermal and inhalation routes. To evaluate the inhalation route of exposure, we converted the RfD to a Reference Concentration (RfC) of 7E-5 mg/m³ by assuming a body weight of 70 kg and an inhalation rate of 20 m³/d.

3.1.2 *Concrete*

In Figure 1, bulk and wipe samples look most like Aroclor 1254. Both laboratories that analyzed total PCBs in bulk and wipe samples reported that the PCB patterns in these samples most closely matched Aroclor 1254. Therefore, we selected the RfD for Aroclor 1254.

3.2 **Cancer Slope Factor for PCBs**

To evaluate cancer risk from exposure to environmental mixtures of PCBs, EPA recommends an approach that accounts for different PCB mixtures typically found in environmental media (EPA 2006). Studies to date suggest that more highly chlorinated and less volatile congeners are associated with greater cancer risk. These congeners tend to persist in the environment (e.g., in soil and sediment) and accumulate and biomagnify in biota. More volatile, less chlorinated congeners are more likely to be metabolized and eliminated than highly chlorinated congeners. An exposure pathway can be used to indicate how the potency of a mixture might have changed following release to the environment. EPA's recommendations are summarized in Table 1.

Figure 1. Comparison of PCB Homolog Weight Fractions in Indoor Air and Wipe Samples from the LGRC to PCB Homolog Weight Fractions in Commercial PCB Aroclor Mixtures.



Table 1. Tiers of CSF Estimates for Environmental Mixtures of PCBs

Central Slope (mg/kg-d) ⁻¹	Upper-Bound Slope (mg/kg-d) ⁻¹	Criteria for Use
High Risk and Persistence		
1.0	2.0	Food chain exposure
		Sediment or soil ingestion
		Dust or aerosol inhalation
		Dermal exposure, if an absorption factor has been applied to reduce the external dose
		Presence of dioxin-like, tumor-promoting, or persistent congeners in other media
		Early-life exposure (all pathways and mixtures)
Low Risk and Persistence		
0.3	0.4	Ingestion of water-soluble congeners
		Inhalation of evaporated congeners
		Dermal exposure, if no absorption factor has been applied to reduce the external dose
Lowest Risk and Persistence		
0.04	0.07	Congener or isomer analyses verify that congeners with more than four chlorines comprise less than 0.5% of Total PCBs

Source: EPA 2006.

3.2.1 Indoor Air

The upper bound CSF for low risk and persistence (0.4 [mg/kg-d]⁻¹) was selected because EPA recommends its use to evaluate reasonable maximum exposure to evaporated congeners. PCB mixtures in indoor air samples were quantified as Aroclor 1248, a relatively volatile PCB mixture. Also, the September 22, 2006 homolog data reveal a congener pattern that is more volatile than Aroclors 1254 and 1260, which are associated with higher cancer risk in animal studies (Cogliano 1998; EPA 2006). Following cleaning of the indoor environment, PCB-contaminated dusts that would contribute to dust in the indoor air would be minimized; therefore, use of the low persistence and toxicity CSF for the indoor air exposure pathway will probably remain appropriate for use, although this could be verified with future monitoring results.

Like the RfD for Aroclor 1254, this CSF applies to the oral route of exposure. To evaluate the inhalation route of exposure, we converted the CSF to an inhalation Unit Risk (UR) of 1E-4 (ug/m³)⁻¹ by assuming a body weight of 70 kg and an inhalation rate of 20 m³/d.

3.2.2 Concrete

The upper bound CSF for high risk and persistence (2 [mg/kg-d]^{-1}) was selected because EPA recommends its use to evaluate exposure to soil and sediment, and concrete is a similar medium with respect to expected PCB accumulation. Also, PCBs in concrete were quantified as Aroclor 1254, which is associated with relatively high cancer risk in animal studies as compared with less chlorinated PCB mixtures (Cogliano 1998; EPA 2006).

3.3 Cancer Slope Factor for Dioxin-like PCB Congeners

Twelve PCB congeners are believed to exhibit some amount of dioxin-like toxicity (Van den Berg et al. 1998, 2006). As a result, toxic equivalency factors (TEFs) have been defined for these congeners that can be multiplied by dioxin-like congener concentrations to obtain the dioxin toxic equivalent (TEQ) concentration for the congeners. To date, EPA has not published toxicity values in its Integrated Risk Information System (IRIS) database for dioxin-like PCB congeners or for 2,3,7,8-tetrachlorodibenzo-p-dioxin, which is often referred to as simply dioxin. Therefore, we used the provisional CSF for dioxin to evaluate dioxin-like PCB congeners (EPA 1997).

3.3.1 Indoor Air

Indoor air samples were not analyzed for dioxin-like congeners because they are unlikely to be prevalent in this medium.

3.3.2 Concrete

Dioxin-like PCB congeners could be important in weathered PCB mixtures associated with concrete. Therefore, the bulk and wipe samples that were collected on September 22, 2006 also were analyzed for dioxin-like congeners along with homologs. These data were used to determine if a concrete Reoccupancy Criterion for PCBs based on the cancer potency of the dioxin-like congener content in concrete panels might correspond to a lower Reoccupancy Criterion than one based on the cancer potency of total PCB content in the panels.

To make this comparison, we calculated the TEQ concentration from dioxin-like congeners in each wipe and bulk sample. To provide an upper bound estimate of TEQ concentration, we assumed that nondetected congeners were present at the detection limit. Also, we used the most recently published mammalian TEFs (Van den Berg, 2006). With TEQ concentration data and total PCB concentration data for each sample, we have some indication of how much TEQ might be present in a sample per unit PCB concentration. Therefore, we used the TEQ to total PCB concentration ratios to check whether Reoccupancy Criteria based on TEQ might be lower than criteria based on total PCBs (See Section 5.1).

From Table 2, it is apparent that the 2006 TEFs differ somewhat from the 1998 TEFs; however, the differences have little effect on TEQ estimates. For example, ratios of TEQ to total PCB concentrations in the four wipe samples that are based on the 1998 TEFs range from 0.00005 to 0.0003, and ratios that are based on the updated TEFs range from 0.00004 to 0.00029.

Table 2. Toxicity Equivalency Factors (TEFs) for Dioxin-like PCBs

Compound	1998 TEF	2006 TEF
<i>Dioxin-like PCBs</i>		
PCB-77: 3,4,3',4'-TeCB	0.0001	0.0001
PCB-81: 3,4,4'5-TeCB	0.0001	0.0003
PCB-126: 3,4,5,3',4'-PeCB	0.1	0.1
PCB-169: 3,4,5,3',4',5'-HxCB	0.01	0.03
PCB-105: 2,3,4,3',4'-PeCB	0.0001	0.00003
PCB-114: 2,3,4,5,4'-PeCB	0.0005	0.00003
PCB-118: 2,4,5,3',4'-PeCB	0.0001	0.00003
PCB-123: 3,4,5,2',4'-PeCB	0.0001	0.00003
PCB-156: 2,3,4,5,3',4'-HxCB	0.0005	0.00003
PCB-157: 2,3,4,3',4',5'-HxCB	0.0005	0.00003
PCB-167: 2,4,5,3',4',5'-HxCB	0.00001	0.00003
PCB-189: 2,3,4,5,3',4',5'-HpCB	0.0001	0.00003

Source: Van den Berg et al. 1998 and Van den Berg et al. 2006.

4. DEVELOPMENT OF REOCCUPANCY CRITERIA

The Reoccupancy Criteria are based on an exposure scenario that reflects a building occupant who is likely to have the highest exposure. These criteria represent long-term average concentrations intended to protect occupants from adverse health effects resulting from chronic exposures. Therefore, they should be compared to the average concentration (often represented as a 95% upper confidence limit of the mean) and not the maximum concentration detected in future monitoring efforts.

We reviewed dioxin-like PCB congener data and evaluated whether total PCB Reoccupancy Criteria based on TEQ from dioxin-like PCB congeners might be lower than total PCB Reoccupancy Criteria based on total PCB toxicity (See discussion in Section 5.1).

4.1 Hypothetical Exposure Scenario Used to Calculate Reoccupancy Criteria

Based on our understanding of LGRC building use, we assumed that the people potentially exposed to PCBs in indoor air or exterior concrete include adult indoor workers (e.g., maintenance staff, librarian), building construction/renovation workers, college-age students, and graduate students. We assumed that no children are present in the building now or in the future. Also, we assumed that construction/renovation workers would not be in direct contact with the concrete joints without appropriate personal protective equipment (PPE) and dust controls. With these restrictions, an occupant likely to experience the highest exposure would be someone working full-time inside an LGRC building who also leaves the building for periodic breaks immediately outside of the building. Students are likely to spend less time in the building than a full-time employee. In addition, given that students are at least 18 years old, their intake to body weight ratios would be similar to those of the hypothetical adult worker. Therefore, the

Reoccupancy Criteria are based on a hypothetical adult worker who works full-time in an LGRC building.

The worker is assumed to be exposed to PCBs via the following exposure pathways:

Indoor Air: inhalation of air inside the building

Concrete on Exterior of Building: Dermal contact and incidental ingestion following dermal contact

We calculated Reoccupancy Criteria based on the cumulative exposure from inhalation of indoor air and incidental ingestion and dermal contact with concrete dust on the building exterior.

4.4.1 *Additional Exposure Considerations*

Workers might be exposed to any PCBs detected in indoor dust. However, in September 2006, Clean Harbors, Inc. cleaned PCB-contaminated indoor surfaces within the library. Assuming that indoor surfaces will be kept clean over time here and in Tower A, we did not include an indoor dust exposure pathway in the Reoccupancy Criteria calculations.

Workers could be exposed to any PCBs originating from the building that reach nearby surface soil. However, the building is generally surrounded by concrete pavement (Personal communication with EH&E, 2006); therefore, we assume that the hypothetical adult worker is not exposed to soil contaminated with PCBs from the building. In addition, the soil will be remediated to meet MADEP requirements.

PCBs can be passed on from the mother to a fetus or from mother to infant through breastfeeding. Insufficient data are available to quantify risk to fetuses from PCB exposure. Some models exist for predicting breast milk concentrations of PCBs, but these models are subject to uncertainty. Use of the toxicity values currently available for PCBs may or may not be adequate to protect infants and fetuses; however, at this time, insufficient data are available to quantify Reoccupancy Criteria specific to infants and fetuses.

4.2 **Reoccupancy Criteria Equations**

The indoor air Reoccupancy Criteria are based on an average daily exposure (ADE) model of the inhalation pathway. The exterior concrete Reoccupancy Criteria are based on an average daily dose (ADD) model of dermal and incidental ingestion pathways. The ADE and ADD model equations are shown in Tables 3, including the inputs to each model. Both criteria reflect the cumulative risk associated with all three exposure pathways.

4.3 Exposure Assumptions

The exposure assumptions used to calculate air and concrete Reoccupancy Criteria are summarized in Table 3 and described in this section. The target cancer risk and noncancer hazard quotients are from the Massachusetts Contingency Plan regulations (310 CMR 40.0902(2)).

4.3.1 Indoor Air – Inhalation Exposure

The hypothetical worker is assumed to work full-time in Tower A or the low rise building for 8 hours per day, 5 days per week, and 50 weeks per year for 25 years. This 40-hour work week is typical, and the assumption of 50 weeks per year allows time for a two-week vacation each year. The work tenure of 25 years is an upper bound estimate for work tenure, especially at a single location (See EPA 1997b, Section 15.2). However, this assumption is commonly used in MADEP and EPA site-specific risk assessments. We assumed 100% bioavailability of PCBs via the inhalation route of exposure.

4.3.2 Exterior Concrete Dust – Dermal Exposure

The hypothetical worker is assumed to contact the concrete on the building exterior (e.g., while on break and/or while posting signs) 1 time per day, 5 days per week, 50 weeks per year for 25 years. [Note that the panels of concern are on the low rise building and Tower A.] These assumptions are intended to represent an upper bound exposure that might be experienced in the absence of any site-specific information about actual contact frequency. In addition to these assumptions about exposure frequency, we assumed the following:

- *The surface area for exposure is half the average hand surface area of adult males and females (452 cm²), representing the palm side of the hands.* The hypothetical worker was assumed to contact exterior concrete with his or her hands.
- *The dermal adherence rate of concrete dust is 0.019 mg/cm² (EPA 1997b).* This value is the 95th percentile rate for people practicing Tae Kwon Do indoors. The martial arts activity lasted 90 minutes with 30 minutes of warm up spent largely on a carpeted floor and subsequent activities spent standing. Subjects were barefoot and wore loose fitting pants with rolled back sleeves. This scenario was selected because it represents an adult exposure to dust that likely represents a high end exposure estimate for contact with exterior concrete. All other available rates apply to children or to outdoor soil exposures (EPA 1997b).
- *The fraction of PCBs in concrete dust that is absorbed is 0.14 (EPA 2004).* This fraction is based on a study by Wester (1993) that investigated percutaneous absorption of PCBs from soil. The actual dermal absorption fraction from concrete dust could be smaller or larger than what was experimentally determined for soil. In addition, the dermal absorption fraction would be influenced by the organic content of the exposure medium. The higher the organic content, the lower the likely dermal absorption fraction. The soil used in the study (Wester 1993) from which the fraction of 0.14 was derived contained a relatively small amount of organic carbon (i.e. 0.9%).

Table 3. Reoccupancy Criteria Equations for a Hypothetical Adult Worker

INHALATION OF INDOOR AIR			
$RC_{ADE, cancer} = \frac{TCR \times AT_c \times CF_1}{EF \times ED \times ET \times IUR}$		$RC_{ADE, noncancer} = \frac{THQ \times AT_{nc} \times CF_1 \times CF_2 \times RfC}{EF \times ED \times ET}$	
Where:	Value	Units	Notes & References
RC _{ADE, cancer} = Reoccupancy criterion corresponding to the target cancer risk		ug/m ³	
RC _{ADE, noncancer} = Reoccupancy criterion corresponding to the target noncancer hazard quotient		ug/m ³	
TCR = Target Cancer Risk	1.00E-05	-	310 CMR 40.0902(2)
THQ = Target Hazard Quotient	1	-	310 CMR 40.0902(2)
CF ₁ = Conversion factor	24	hr/d	
CF ₂ = Conversion factor	1000	ug/mg	
EF = Exposure frequency	250	d/yr	50 weeks per year; two weeks vacation
ED = Exposure duration	25	yr	upper bound work tenure (EPA 1997b)
ET = Exposure time	8	hr/d	Assumed typical work day length
AT _c = Averaging time	25,550	d	70-year lifetime
AT _{nc} = Averaging time; ED * 365 (d/yr)	9,125	d	
IUR = Inhalation unit risk	1E-04	(ug/m ³) ⁻¹	Oral CSF for PCBs converted to IUR (EPA 2006)
RfC = Reference concentration	7.00E-05	mg/m ³	Oral RfD for PCBs converted to RfC (EPA 2006)
DERMAL CONTACT WITH EXTERIOR CONCRETE SURFACE			
$RC_{ADD dermal, cancer} = \frac{TCR \times AT_c \times BW \times CF_1}{EvF \times EF \times ED \times SA \times DA \times AF \times CSF}$		$RC_{ADD dermal, noncancer} = \frac{THQ \times AT_{nc} \times BW \times RfD \times CF_1}{EvF \times EF \times ED \times SA \times DA \times AF}$	
Where:	Value	Units	Notes & References
RC _{ADD dermal, cancer} = Reoccupancy criterion corresponding to the target cancer risk		mg/kg	
RC _{ADD dermal, noncancer} = Reoccupancy criterion corresponding to the target hazard quotient		mg/kg	
TCR = Target Cancer Risk	1.00E-05	-	310 CMR 40.0902(2)
THQ = Target Hazard Quotient	1	-	310 CMR 40.0902(2)
BW = Body weight for adult	70	kg	
CF ₁ = Conversion factor	1.E+06	mg/kg	
EvF = Event frequency	1	event/d	Frequency of contacting concrete
EF = Exposure frequency	250	d/yr	50 weeks per year; two weeks vacation
ED = Exposure duration	25	yr	upper bound work tenure (EPA 1997)
SA = Surface Area	452	cm ² /event	Half the average hand surface area of adult males and females, representing the palm side of the hands; EPA (2004, Exhibit C-1)
DA = Dermal Adherence Rate	0.019	mg/cm ²	EPA (1997b); 95th percentile for "tae kwon do" activity
AF = Dermal Absorption Fraction	0.14	-	EPA (2004) for PCBs in soil
AT _c = Averaging time	25,550	d	70-year lifetime
AT _{nc} = Averaging time; ED * 365 (d/yr)	9,125	d	
CSF = Oral cancer slope factor	PCBs: 2	(mg/kg-d) ⁻¹	Upperbound (EPA 2006)
	TEQ: 1.5E+5	(mg/kg-d) ⁻¹	EPA (1997a)
RfD = Oral reference dose	2.E-05	mg/kg-d	EPA (2006)
INCIDENTAL INGESTION OF EXTERIOR CONCRETE DUST FOLLOWING DERMAL CONTACT			
$RC_{ADD ingestion, cancer} = \frac{TCR \times AT_c \times BW \times CF_1}{EvF \times EF \times ED \times SA \times DA \times CSF}$		$RC_{ADD ingestion, noncancer} = \frac{THQ \times AT_{nc} \times BW \times RfD \times CF_1}{EvF \times EF \times ED \times SA \times DA}$	
Where:	Value	Units	Notes & References
RC _{ADD dermal, cancer} = Reoccupancy criterion corresponding to the target cancer risk		mg/kg	
RC _{ADD dermal, noncancer} = Reoccupancy criterion corresponding to the target hazard quotient		mg/kg	
TCR = Target Cancer Risk	1.00E-05	-	310 CMR 40.0902(2)
THQ = Target Hazard Quotient	1	-	310 CMR 40.0902(2)
BW = Body weight for adult	70	kg	
CF ₁ = Conversion factor	1.E+06	mg/kg	
EvF = Event frequency	1	event/d	Frequency of contacting concrete
EF = Exposure frequency	250	d/yr	50 weeks per year; two weeks vacation
ED = Exposure duration	25	yr	upper bound work tenure (EPA 1997b)
SA = Surface Area	145	cm ² /event	Maximum surface area for palmer side of fingers (EPA 1997b and Canales and Leckie 2004)
DA = Dermal Adherence Rate	0.019	mg/cm ²	EPA (1997b); 95th percentile for "tae kwon do" activity
AT _c = Averaging time	25,550	d	70-year lifetime
AT _{nc} = Averaging time; ED * 365 (d/yr)	9,125	d	
CSF = Oral cancer slope factor	PCBs: 2	(mg/kg-d) ⁻¹	Upperbound; EPA (2006)
	TEQ: 1.5E+5	(mg/kg-d) ⁻¹	EPA (1997a)
RfD = Oral reference dose	2.E-05	mg/kg-d	EPA (2006)

4.3.3 Exterior Concrete Dust – Incidental Ingestion Exposure

The hypothetical worker is assumed to contact the concrete panels and subsequently ingest dust that adheres to the palm side of fingers 1 time per day, 5 days per week, and 50 weeks per year for 25 years. If workers indeed contact exterior concrete panels one time per day, this approach may result in double-counting exposure to dust adhering to fingers by assuming dermal exposure as well as incidental ingestion exposure.

To estimate the amount of PCBs that might be ingested following dermal contact with concrete panels, we used the same inputs as those used to quantify dermal exposure with the following exceptions:

- *The dermal absorption factor is not relevant to this exposure pathway.* Therefore, it was not used. Instead, we assumed 100% bioavailability of PCBs via the ingestion route of exposure.
- *The surface area for exposure is palm side of fingers on both hands (145 cm²).* This area represents 16% of the total hand surface area, which is the maximum reported by Canales and Leckie (2004). We assumed that 100% of the dust on fingers would be transferred to the mouth. Michaud (1994) assumed incidental ingestion of the mass of contaminants adhered to 30 cm² of skin, explaining that this is the approximate surface area of the fingertips. However, the authors do not provide a citation for this surface area. May et al. (2002) assume a dermal surface area “available for ingestion” for industrial workers exposed to indoor dust of 198 cm². For this estimate, the authors rely on EPA Region III guidance called “Guidance for Assessing Wipe Samples” dated July 9, 1997. However, we could not locate this guidance.

The following table summarizes the assumptions and inputs to the ADE and ADD model equations for each exposure pathway.

5. RECOMMENDED REOCCUPANCY CRITERIA

Our recommended Reoccupancy Criteria to PCBs in indoor air and exterior concrete are listed in Table 4. These concentrations correspond to the lower of MADEP’s two risk benchmarks (Hazard Index of 1 or Cancer Risk of 1E-5) for cumulative risk across all three exposure pathways. Many exposure assumptions used to develop the recommended criteria are more likely to overestimate than underestimate exposure. For example, we assumed a single contact each day for 250 working days per year (palm side of hands for dermal and fingers for ingestion). The concrete criterion would rise linearly with a revised assumption of a single contact each day for only the warmer days of the year (i.e. approximately 160 days).

Table 4. Recommended Reoccupancy Criteria for Total PCBs

Medium of Exposure	Reoccupancy Criteria
Indoor Air	0.29 ug/m ³
Exterior Concrete	28 mg/kg

Table 5 provides the noncancer hazard and cancer risks associated with a hypothetical worker's exposure to PCB concentrations in air and exterior concrete panels equal to the recommended Reoccupancy Criteria. These calculations incorporate the exposure assumptions and toxicity values summarized in Table 3.

Table 5. Cumulative Noncancer Hazard and Cancer Risk Calculations for a Hypothetical Indoor Worker's Exposure to PCB Concentrations in Air and Exterior Concrete Panels That Are Equal to the Recommended Reoccupancy Criteria

Noncancer Hazard		
Pathway	Hazard Quotient Equation	HQ
Inhalation of Air Indoor Air	$\frac{0.29 \text{ ug/m}^3 \times 250 \text{ d/yr} \times 25 \text{ yr} \times 8 \text{ hr/d}}{9,125 \text{ d} \times 24 \text{ hr/d} \times 1,000 \text{ ug/mg} \times 7\text{E-}5 \text{ mg/m}^3}$	= 0.946
Dermal Contact with Concrete	$\frac{28 \text{ mg/kg} \times 250 \text{ d/yr} \times 25 \text{ yr} \times 1 \text{ event/d} \times 452 \text{ cm}^2/\text{event} \times 0.019 \text{ mg/cm}^2 \times 0.14}{9,125 \text{ d} \times 70 \text{ kg} \times 1\text{E}+6 \text{ mg/kg} \times 2\text{E-}5 \text{ mg/kg-d}}$	= 0.016
Ingestion of Concrete Dust	$\frac{28 \text{ mg/kg} \times 250 \text{ d/yr} \times 25 \text{ yr} \times 1 \text{ event/d} \times 145 \text{ cm}^2/\text{event} \times 0.019 \text{ mg/cm}^2}{9,125 \text{ d} \times 70 \text{ kg} \times 1\text{E}+6 \text{ mg/kg} \times 2\text{E-}5 \text{ mg/kg-d}}$	= 0.038
Hazard Index		= 1
Cancer Risk		
Pathway	Risk Equation	Risk
Inhalation of Air Indoor Air	$\frac{0.29 \text{ ug/m}^3 \times 250 \text{ d/yr} \times 25 \text{ yr} \times 8 \text{ hr/d} \times 1\text{E-}4 \text{ m}^3/\text{ug}}{25,550 \text{ d} \times 24 \text{ hr/d}}$	= 2.36E-06
Dermal Contact with Concrete	$\frac{28 \text{ mg/kg} \times 250 \text{ d/yr} \times 25 \text{ yr} \times 1 \text{ event/d} \times 452 \text{ cm}^2/\text{event} \times 0.019 \text{ mg/cm}^2 \times 0.14 \times 2 \text{ kg-d/mg}}{25,550 \text{ d} \times 70 \text{ kg} \times 1\text{E}+6 \text{ mg/kg}}$	= 2.35E-07
Ingestion of Concrete Dust	$\frac{28 \text{ mg/kg} \times 250 \text{ d/yr} \times 25 \text{ yr} \times 1 \text{ event/d} \times 145 \text{ cm}^2/\text{event} \times 0.019 \text{ mg/cm}^2 \times 2 \text{ kg-d/mg}}{25,550 \text{ d} \times 70 \text{ kg} \times 1\text{E}+6 \text{ mg/kg}}$	= 5.39E-07
Total Cancer Risk		3E-06

5.1 Possible Influence of Dioxin-like PCB Congeners on Reoccupancy Criteria for Total PCBs

On September 21, 2006, EH&E collected bulk concrete samples from the low rise and Tower A and analyzed them for homologs and dioxin-like PCB congeners. Associated with each of these bulk samples are two wipe samples: one at the panel joint and one 12 inches away from the panel joint. We calculated TEQ/total PCB ratios for each sample as part of a sensitivity analysis. As noted in Section 3.3.2, these ratios represent upper bound estimates because congeners that were not detected were assumed to be present at their full detection limit.

Using these fractions, we calculated an alternate range of total PCB Reoccupancy Criteria that are based on dioxin-like PCB congener cancer potency (See Table 6). All of the calculations are based on the assumption that the hypothetical adult worker is simultaneously exposed to PCBs in indoor air at the recommended total PCB Reoccupancy Criterion of 0.29 ug/m³. These estimates range from values below to values well above the recommended Reoccupancy Criterion for concrete. There is no apparent pattern between the lowest ratios (calculated for the low rise bulk sample and 12" wipe sample) and the highest ratios (calculated for the low rise panel joint sample and the Tower A 12" wipe sample). Based on these data, it appears unlikely that a lower Reoccupancy Criterion for concrete is warranted based on TEQ risk from dioxin-like congeners.

Table 6. Possible Influence of Dioxin-like PCB Congener Toxicity on the Reoccupancy Criterion for Exterior Concrete Panels

Sampling location	Ratio of TEQ from dioxin-like PCB Congeners to Total PCBs	Total PCB Reoccupancy Criterion for Concrete Based on TEQ Toxicity (mg/kg) ¹
Low rise		
bulk	0.00003	120
panel joint wipe	0.00028	13
12' from panel joint wipe	0.00004	92
Tower A		
bulk	0.00011	33
panel joint wipe	0.00018	20
12' from panel joint wipe	0.00029	12
¹ These estimates correspond to a cumulative cancer risk of 1E-5 from exposure to Total PCBs in air and TEQ in concrete.		

6. REFERENCES

- Canales RA and Leckie JO. 2004. Using Contact-Specific Surface Area Estimates in Exposure Models. *Journal of Children's Health*, 2(3-4):345-362.
- Cogliano VJ. 1998. Assessing the Cancer Risk from Environmental PCBs. *Environmental Health Perspectives*, 106(6):317-323.
- EH&E (Environmental Health & Engineering, Inc.). 2006. Preliminary Report of Building-Related Polychlorinated Biphenyls Assessment, Lederle Graduate Research Complex, University of Massachusetts, Amherst, Massachusetts. October 12, 2006.
- EPA (U.S. Environmental Protection Agency). 1997a. *Health Effects Assessment Summary Tables*. Office of Research and Development. July 1997
- EPA (U.S. Environmental Protection Agency). 1997b. *Exposure Factors Handbook, Volume III*. Office of Research and Development.
- EPA (U.S. Environmental Protection Agency). 2004. Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. Office of Superfund Remediation and Technology Innovation, Washington, DC. July 2004. EPA/540/R/99/005
- EPA (U.S. Environmental Protection Agency). 2006. Integrated Risk Information System (IRIS) Summary for Polychlorinated Biphenyls (PCBs). On-Line Database, PCBs Last Updated 6/1/1997, Accessed 11/15/2006.
- May LM, Gaborek B, Pitrat T, Peters L. 2002. Derivation of Risk Based Wipe Surface Screening Levels for Industrial Scenarios. *The Science of the Total Environment*, 288:65-80.

- Michaud, J.M., S.L. Huntley, R.A. Sherer, M.N. Gray, and D.J. Paustenbach. 1994. PCB and dioxin re-entry criteria for building surfaces and air. *Journal of Exposure Analysis and Environmental Epidemiology*. 4(2): 197-227.
- Van den Berg M, Birnbaum LS, Bosveld ATC et al. 1998. Toxic equivalency factors (TEFs) for PCBs, PCDDs, PCDFs, for humans and wildlife. *Environmental Health Perspectives* 106(12):775-792.
- Van den Berg M, Birnbaum LS, Denison M, et al. 2006. The 2005 World Health Organization Reevaluation of Human and Mammalian Toxic Equivalency Factors for Dioxins and Dioxin-Like Compounds. *Toxicological Sciences* 93(2):223-241.

APPENDIX C
COPIES OF LABORATORY RESULTS

APPENDIX D

**LETTER TO U.S. ENVIRONMENTAL PROTECTION
AGENCY FOR TOWERS B AND C**



Environmental Health
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September 19, 2006

Ms. Kimberly N. Tisa
PCB Coordinator
United States Environmental Protection Agency
One Congress Street, Suite 1100 – CPT
Boston, MA 02114-2023

**RE: Findings of Polychlorinated Biphenyls (PCBs) in Caulking from Towers B and C,
Lederle Graduate Research Center, University of Massachusetts, Amherst,
Massachusetts (EH&E 14680)**

Dear Ms. Tisa:

On behalf of the University of Massachusetts, Amherst (the University), Environmental Health & Engineering, Inc. (EH&E) is submitting these sample results from exterior panel caulking found on Towers B and C of the Lederle Graduate Research Center (LRGC), Amherst, Massachusetts.

BACKGROUND

EH&E understands that the University discovered PCBs in exterior caulking at the Toxic Substance Control Act (TSCA) regulated and unregulated concentrations during the course of a planned waterproofing and concrete panel structural reinforcement project for LRGC. Samples for caulking contained TSCA regulated levels from Tower A and the low-rise ranged from 6,300 to 729,000 parts per million (ppm) as reported by analytical laboratories used by other consultants. Samples of caulking from Towers B and C contained unregulated levels of PCBs ranging from non detectable (ND) < 0.73 to 2.23 ppm as reported by other consultants.

LRGC is comprised of four buildings that were constructed in the early and mid seventies. Tower A and the low-rise building were completed in 1972; and Towers B and C were completed in 1974. Although PCBs were detected in caulking and soil samples taken from locations around LRGC, initial sample results were inconclusive regarding the location and

source of the PCB caulking and caulking residues. Based on the different construction time frames and the finding of both regulated and unregulated levels of PCBs in caulking, EH&E recommended that the University conduct additional confirmatory representative sampling of the caulking for the entire building complex.

EH&E SAMPLING

On August 21 and 22, 2006, EH&E collected bulk samples of exterior caulking from Towers A, B, and C, and the attached low-rise building. Approximately 27 samples of caulking were collected from the four buildings and placed into sterile glass jars for shipment. The samples were sent to Groundwater Analytical, Inc., in Buzzards Bay, Massachusetts, a National Environmental Laboratory Accreditation Conference (NELAC) accredited laboratory, by courier service under chain of custody on August 22.

The samples were extracted using a Soxhlet extraction procedure and analyzed by gas chromatography equipped with an electron capture device for quantification (GC-ECD) following the U.S. Environmental Protection Agency (EPA) Method 8082.

SAMPLE RESULTS

The following Table 1 summarizes the results of the PCB analysis for all exterior caulking samples collected by EH&E for Towers B and C. Exterior caulking samples from Towers A and the low rise building confirmed regulated levels of PCBs in the caulking from these two structures, and this data will be presented under a separate cover to the EPA pursuant to a 40 CFR 761.79(h) filing for an alternative decontamination plan approval.

As demonstrated by the data in Table 1, all the sample results from Towers B and C were well below the TSCA level for authorized use of non-liquid PCBs (<50 ppm). In fact, the levels were at or very close to the EPA level for unrestricted use of a contaminated surface or material (<1ppm). Based on these findings, which confirm earlier sample results, the University is requesting approval to proceed with the waterproofing on Towers B and C. Although the original exterior caulking is considered an excluded product under 40 CFR 761, the University will be appropriately removing and disposing of the caulking during this project. The University will employ reasonable protective measures to prevent the build up of caulking or caulking residues

associated with Towers B and C in the surrounding environment as described in the next section of this letter.

Table 1 Exterior Panel Caulking Bulk Sample Results from Tower B of Lederle Graduate Research Center, University of Massachusetts, Amherst, Massachusetts, August 21 and 22, 2006						
Sample ID	Building	Floor	Side	Description	Aroclor 1254^{1,2} (ppm)	Notes
78155	Tower B	16	West	Bottom, southwest corner	1.4	1C(1.3)
78156	Tower B	14	West	Top, line on the first panel	0.2	1C(0.2)
78157	Tower B	12	West	Top, middle right panel	0.3	1C(0.2)
78158	Tower B	10	West	Bottom, middle left panel	0.8	1C(0.7)
78159	Tower B	9	West	Top, corner bead for the western panel	2.8	2C(2.7)
78160	Tower B	7	West	Bottom, corner bead for the western panel	0.9	1C(0.7)
78161	Tower B	5	West	Bottom, middle left panel	0.5	1C(0.5)
78162	Tower B	3	West	Top, middle right panel	0.8	1C(0.7)
78163	Tower B	1	West	Southwest corner	1.6	1C(1.4)
78167	Tower B	1	North	Window/panel interface	2.5	1C(2.3)
78168	Tower B	1	North	Panel caulking	2.5	1C(2.4)
79406	Tower C	17	North	Caulking from horizontal panel joint (whitish)	1.0	1C(1.0)
79407	Tower C	15	North	Caulking from horizontal panel joint (whitish)	1.0	1C(0.9)
79408	Tower C	15	North	Duplicate of 79407	1.1	2C(1.1)
79409	Tower C	13	North	Caulking (whitish)	0.6	1C(0.6)
79410	Tower C	11	North	Horizontal and vertical panel caulking (whitish)	1.7	1C(1.7)
79411	Tower C	9	North	Horizontal panel caulking (whitish)	1.5	1C(1.5)
79412	Tower C	7	North	Caulking from panel joint (whitish)	2.8	1C(2.6)
79413	Tower C	5	North	Caulking from panel joint (whitish)	2.8	2C(2.4)
79414	Tower C	4	Northeast bumpout	Panel joint caulking (whitish)	3.3	2C(3.0)
79415	Tower C	2	Northeast bumpout	Panel joint caulking (whitish)	1.2	2C(1.1)
79416	Tower C	2	Northeast bumpout	Thinner panel joint caulking from 79415	3.0	2C(2.9)

ppm parts per million
 1C Confirmation concentration reported from first column quantification
 2C Confirmation concentration reported from second column quantification

¹ Polychlorinated biphenyl (PCB) concentration analysis performed by Groundwater Analytical, Inc., using U.S. Environmental Protection Agency (EPA) method 8082 (GC/ECD).
² Aroclor 1016, 1221, 1232, 1242, 1248, and 1260 also tested. All results below reporting levels, unless noted.

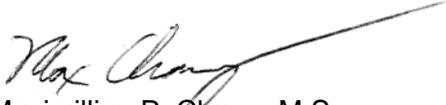
REASONABLE PROTECTIVE MEASURES FOR CAULKING REMOVAL

For Towers B and C only, the University will implement the following measures to contain the original caulking, caulking debris, and residues from accumulating in the environment surrounding the LGRC.

- Contain original caulking and caulking debris by securing drop cloths on the ground below all work that will disturb the existing caulking.
- Collect all original caulking and caulking debris in plastic bags, disposable drums, or equivalent method to prevent fugitive dust emissions during handling and disposal.
- Inspect daily and clean as necessary the ground under or near the work areas for any visible caulking or caulking debris.
- If the building is power washed with the original caulking in-place, the rinseate will be collected and tested for PCBs. Appropriate and reasonable measures will be implemented to contain the rinseate if the PCB levels exceed 0.5 micrograms of PCBs per liter of water ($\mu\text{g/l}$) or parts per billion (ppb).
- Alternatively, the work will be sequenced so that power washing will not be conducted until the original caulking is removed from the building to prevent the rinseate from contacting the original caulking. In this case, the rinseate will not be collected or tested.

The University is ready to re-start the activities on Towers B and C, and your quick response is greatly appreciated. Please do not hesitate to contact either one of us at 1-800-TALK EHE (1-800-825-5343) if you any questions or concerns.

Sincerely,


Maximillian P. Chang, M.S.
Staff Scientist/Project Manager


Kevin M. Coghlan, M.S., C.I.H.
Director
EH&S Compliance and Strategic Support

Attachments: Groundwater Analytical Laboratory Reports

cc: Donald Robinson, Ph.D., EH&S Director, University of Massachusetts
Brian Fitzpatrick, CHMM, EH&S/EMS Program Head, University of Massachusetts

APPENDIX E
EH&E SAMPLE PLAN



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**VERIFICATION SAMPLING PLAN
REMOVAL AND ABATEMENT OF BUILDING-RELATED
POLYCHLORINATED BIPHENYLS (PCBs)
TOWER A AND LOW-RISE BUILDING
LEDERLE GRADUATE RESEARCH CENTER, AMHERST, MASSACHUSETTS**

On behalf of the University of Massachusetts, Amherst Campus (UMass), Environmental Health & Engineering, Inc. (EH&E) will implement the following verification sampling program as specified in the Plan for the Removal and Abatement of Building-Related Polychlorinated Biphenyls (Abatement Plan) under 40 CFR §761.79(h) and §761.61, dated February 21, 2007. This plan has identified the presence of PCBs associated with exterior caulking found on Tower A and the low-rise building of the Lederle Graduate Research Center (LGRC).

Upon completion of each work area, EH&E will conduct visual inspections of all remediated areas and surfaces for visible evidence of dust and debris. In addition, EH&E will visually inspect surfaces for the presence of any PCB source material that may not have been removed. Visual inspection will provide preliminary verification that abatement has been completed. In addition, visual inspection will be supplemented with representative sampling of materials and surfaces to confirm that the acceptance criteria have been achieved.

The visual acceptance criterion will be no visible debris or dust on all inspected work area surfaces that require cleaning or decontamination, including protective sheeting and tarps inside and outside containment areas. In addition, no PCB material specified for removal shall remain in place. Samples will not be collected until the visual acceptance criterion has been satisfied.

CONCRETE MATERIALS

General

EH&E will utilize the U.S. Environmental Protection Agency's (EPA's) *draft Standard Operating Procedure for Sampling Concrete in the Field* (dated December 30, 1997), to collect verification samples after concrete surfaces have been decontaminated. The sampled areas will adequately represent the variety of conditions observed and abated by the contractor. Appropriate control samples will be collected following procedures outlined in Sections 12 and 13 of *the Abatement Plan* filed with the EPA. Concrete panels that remain on both buildings will be in compliance with the EPA approved acceptance criterion for bulk samples for the LGRC.

Phase One Panel Joints (Tower A)

EH&E will collect bulk samples of concrete material from representative caulk joints for the Phase One verification sampling. Each sample shall comprise a composite sample representing a minimum of 250 linear feet of abated surfaces. Each composite sample will be composed of at least three equally spaced samples. The samples will be analyzed by Groundwater Analytical (Buzzards Bay, Massachusetts) following EPA Method 8082. Based on previous discussions with Kimberly Tisa from an unrelated abatement project, EH&E understands that samples may be extracted following EPA method 3545 for accelerated solvent extraction to facilitate laboratory turnaround time.

The Phase One bulk sample acceptance criterion will be less than or equal to 25 parts per million (ppm) of total PCBs for bulk samples collected above the first floor. The acceptance criterion for bulk samples collected on the first floor will be less than or equal to one ppm of total PCBs.

EH&E will collect more frequent samples during the initial stages of the abatement work to verify work completeness and effectiveness. Initial sampling frequencies will be approximately one bulk sample per 50 linear feet of caulking. Results from the initial sampling will be conveyed to the EPA under a separate cover, If sample results are consistently below the acceptance criterion EH&E will collect less frequent sampling (approximately one sample per 250 linear feet) during later stages of the abatement work.

Phase Two Panel Joints (Low-Rise Building)

EH&E will collect bulk samples of concrete material from representative caulk joints for the Phase Two verification sampling of the low-rise building. Each sample shall comprise a composite sample representing a minimum of 250 linear feet of abated surfaces. As with the Phase One samples, each composite sample will be composed of at least three equally spaced samples. Samples will be analyzed by Groundwater Analytical (Buzzards Bay, Massachusetts) following EPA Method 8082.

The Phase Two bulk sample acceptance criterion will be less than or equal to 25 ppm of total PCBs for samples collected above the first floor, and one ppm or less for bulk samples collected on the first floor.

As with Phase One, EH&E will initially collect more frequent samples at the start of the abatement work to verify work completeness. If these initial sample results are consistently below the acceptance criterion, then EH&E will perform less frequent sampling during later stages of the abatement work.

PHASE ONE AND TWO METAL FRAMES

General

EH&E will collect wipe samples of cleaned metal frames from representative window frames for the Phase One and Two verification sampling. EH&E anticipates collecting samples from at least 10% of the window openings from both buildings. In both phases of this project, EH&E has identified that non-porous metal window frames are in contact with the PCB caulking. The metal frames will remain on the building at the end of the abatement work. As a result, the contractor will need to strip caulking in contact with the metal frames and then clean the metal frames in place.

Phase One (Tower A)

EH&E will collect wipe samples from metal frames of representative window openings associated with Tower A. EH&E has identified the presence of approximately 220 window openings on Tower A that will require the removal of caulking and the cleaning of each metal frame. Each sample shall include a measured wipe sample. The samples will be analyzed by

Groundwater Analytical (Buzzards Bay, Massachusetts) following EPA Method 8082. Based on previous discussions with Kimberly Tisa from an unrelated abatement project, EH&E understands that samples may be extracted following EPA method 3545 for accelerated solvent extraction to facilitate laboratory turnaround time.

The sample acceptance criterion will be less than or equal to 10 micrograms per 100 square centimeters ($\mu\text{g}/100 \text{ cm}^2$) of total PCBs from metal frames found on the first floor and 100 $\mu\text{g}/100 \text{ cm}^2$ from frames found above the first floor.

Phase One (Low-rise Building)

EH&E will collect wipe samples from metal frames of representative window openings associated with the low-rise building. EH&E has identified the presence of approximately 150 window openings that will require the removal of caulking and the cleaning of each metal frame. Each sample shall include a measured wipe sample. The samples will be analyzed by Groundwater Analytical (Buzzards Bay, Massachusetts) following EPA Method 8082. Wipe samples will be extracted following EPA Method 3545 or 3540.

As with Phase One, the sample acceptance criterion will be less than or equal to 10 $\mu\text{g}/100 \text{ cm}^2$ of total PCBs from metal frames found on the first floor and 100 $\mu\text{g}/100 \text{ cm}^2$ from frames found above the first floor.

SAMPLE PLAN

The following tables present the sample frequencies proposed for each phase of the abatement work.

The bulk sampling plan for the abatement phases are presented in Table E.1.

Table E.1 Bulk Sampling Plan		
Types of Surfaces	Total Unit Numbers and Amount of Caulking	Number of Samples (as applicable)
<i>Phase One</i>		
Concrete joints	30,340 In. ft.	121
<i>Phase Two</i>		
Concrete joints	14,148 In. ft.	57
In. ft. linear feet		

Table E.2 Wipe Sampling Plan		
Types of Surfaces	Total Unit Numbers and Amount of Caulking	Number of Samples (as applicable)
<i>Phase One</i>		
Window frames	220	25
<i>Phase Two</i>		
Window frames	150	20
In. ft. linear feet		

SAMPLE CONTINGENCY

If initial sample results do not meet the above acceptance criteria, EH&E in consultation with the project team will collect additional verification samples to increase the sample frequency.

AIR SAMPLING

Upon completion of the abatement work, EH&E will collect air samples from both Tower A and the low-rise building to verify that air concentrations in the two buildings are below 0.29 micrograms per cubic meter.

Air samples will be collected following procedures described in the Addendum Report (dated February 21, 2007). Samples will be sent to Galson Laboratories (Syracuse, NY) for analysis under NIOSH method 5503.



APPENDIX F
CONTRACTOR WORK PLAN

CHAPMAN WATERPROOFING COMPANY
395 Columbia Road
Boston, Massachusetts 02125

**Work Plan for the Removal and Abatement of
Building-Related Polychlorinated Biphenyls (PCBs)**

1) Introduction

Chapman Waterproofing Company (Chapman) has prepared this *Work Plan for the Removal and Abatement of Building-Related Polychlorinated Biphenyls (PCBs)* associated with exterior concrete panel caulking found on Tower A and the low-rise building of the Lederle Graduate Research Center (LGRC) at the University of Massachusetts (UMass) campus in Amherst, Massachusetts. Chapman shall perform the removal and abatement of specified PCB-containing materials in accordance with all applicable local, state, and federal regulations governing PCBs. Chapman has submitted this Work Plan and shall perform the following work activities.

2) Phase One (Tower A)

- a) Chapman understands that all of the following specified PCB-containing caulking associated with concrete panel joint caulking will be addressed as part of Phase One.
 - i) Approximately 30,340 linear feet of caulking material associated with concrete panels will need to be removed from the 17-story tower.
 - ii) The Phase One scope of work includes the removal of all specified caulking around metal window frames of Tower A. Chapman understands that there are a total of approximately 220 window openings identified in the Phase One scope of work. In addition, Chapman understands that the identified window caulking contains concentrations of PCBs in excess of 50 parts per million (ppm). Window glazing not part of the scope of the abatement project and not in contact with identified PCB containing window frame caulking has been identified to contain non-friable asbestos.
- b) For the second floor and above, concrete in contact with the specified caulking will need to be cleaned so that all remaining concrete contains concentrations of total PCBs less than or equal to 25 ppm. Pilot project results indicate that channel cutting of concrete surfaces has been sufficient to meet the 25 ppm acceptance criterion for the Phase One concrete surfaces.

- c) For the first floor, concrete in contact with the specified caulking will need to be cleaned so that all remaining concrete contains concentrations of total PCBs less than or equal to one ppm.
- d) Metal window frames in contact with the specified caulking will need to be cleaned so that all remaining non-porous surfaces from the first floor window openings contain concentrations less than or equal to 10 micrograms per 100 square centimeters ($\mu\text{g}/100 \text{ cm}^2$) of total PCBs. For window openings above the first floor, metal frames must meet an acceptance criterion of total PCBs less than or equal to $100 \mu\text{g}/100 \text{ cm}^2$.

3) Phase Two (Low-rise building)

- a) Chapman understands that all specified PCB-containing caulking materials located between exterior concrete joints found on all floors of the building will be addressed during Phase Two. Specified materials include the following:
 - i) Approximately 14,148 linear feet of caulking material associated with concrete panels will need to be removed from the three story tower as part of Phase Two abatement project.
 - ii) The Phase Two scope of work includes the removal of all specified caulking around metal window frames of the low-rise building. Chapman understands that there are a total of approximately 150 window openings identified in the Phase Two scope of work. In addition, Chapman understands that the identified window frame caulking contains concentrations of PCBs in excess of 50 ppm. Window glazing not part of the scope of the abatement project and not in direct contact with PCB containing window frame caulking has been identified to contain non-friable asbestos.
 - iii) Temporary foam backer rods found between concrete panels will be removed and disposed as PCB remediation waste.
- b) For floors two and above, concrete in contact with the specified caulking will need to be cleaned so that all remaining concrete contains concentrations of total PCBs less than or equal to 25 ppm of total PCBs. Pilot project results indicate that channel cutting of concrete surfaces has been sufficient to meet the 25 ppm acceptance criterion for the Phase Two concrete surfaces.
- c) For the first floor, concrete in contact with the specified caulking will need to be cleaned so that all remaining concrete contains concentrations of total PCBs less than or equal to one ppm of total PCBs.

- d) Metal window frames in contact with the specified caulking will need to be cleaned so that all remaining non-porous surfaces from first floor window openings contain concentrations of less than or equal to 10 $\mu\text{g}/100 \text{ cm}^2$ of total PCBs. For window openings above the first floor, metal frames must meet an acceptance criterion of total PCBs less than or equal to 100 $\mu\text{g}/100 \text{ cm}^2$.

4) Work Area Preparation

a) General

- i) Ground cover will be placed under and along the perimeter of all areas where work activities will take place in order to prevent debris and/or contaminated materials from escaping the work zone and to protect existing facilities and the environment. A standard water-impervious membrane covering or equivalent shall be used at ground level. The tarp shall extend sufficiently from the outside edge of the building envelope to capture any loose debris. On top of the secured tarp, Chapman shall install a single layer of 6-mil polyethylene sheeting or equivalent temporarily secured with high quality fabric duct tape to prevent the sheeting from blowing or billowing due to weather/wind conditions. This sheeting shall serve to collect dust and debris from remediation activities and surface decontamination operations associated with abatement activities. During and at the end of every work-shift, Chapman employees shall remove all visible debris. If tears or rips occur in the sheeting, the sheeting will be repaired with duct tape or equivalent. If the tear is sufficiently large, Chapman may repair and/or replace the damaged area with a new sheet, as warranted. Chapman employees will take care to minimize the generation of trash and debris on the work-site that would require controlled collection and disposal under this work plan.
- ii) Pre-filters will be installed to prevent the entrainment of debris when abatement work is within 100 feet of air intakes of either building.
- iii) Access to work areas will be limited to personnel associated with the abatement project through construction fencing and controlled access points. All abatement and removal work will be accessed from the exterior of the two buildings.

b) General Staging Requirements

- i) Any abatement work requiring the set-up of staging or swing stages will have wind screens installed to control the release of dust and debris from work areas.

- ii) Appropriate tool guards and dust collection systems will be required to catch any channel cutting debris generated by work activities. Only manual hand tools or tool-mounted dust/debris vacuum collection systems on powered tools will be used for the channel cutting procedures described below.
 - iii) Disposal of PCB Bulk Product and PCB Remediation waste will be performed in accordance with the provisions of this Work Plan and the Abatement Plan.
 - iv) All employees will have appropriate fall protection consistent with the owner's and Chapman's policies, whichever is more stringent.
- c) Staging Requirements
- i) Work requiring staging will have wind screens installed to control the blowing of dust and debris.
 - ii) Staging areas will use air moving devices to create negative pressure within the work area relative to the building. Local exhausts with flexible ductwork may be used to create the negatively pressurized work area.
 - iii) Appropriate tool guards and dust collection systems will be required to catch channel cutting debris during any channel cutting activities. Only appropriate manual hand tools or powered tools with mounted dust/debris collection systems shall be used for cleaning when using staging.
 - iv) Disposal of PCB Bulk Product and PCB Remediation waste will be performed in accordance with the provisions of this Work Plan and the Abatement Plan.
 - v) All employees will have appropriate fall protection consistent with the owner's and Chapman's policies, whichever is more stringent.

5) General Containment Controls

- a) During all phases of the abatement work, containment controls will be utilized to prevent the release of fugitive emissions from the project to protect workers, and the environment.
 - i) Wet wiping and high efficiency particulate air (HEPA) vacuuming will be performed at the end of each work shift to clean all surfaces within the work area, including work surfaces, tools, and equipment inside the work area.
 - ii) Exterior staging will have wind screens installed to control the blowing of dust and debris.
 - iii) Tarping or equivalent will be utilized throughout the abatement and removal process to catch any debris generated.

6) Engineering Controls

- a) Powered cutting tools will be equipped with HEPA exhaust/collection units to collect dust and debris.
 - i) Flexible ductwork may be used as part of the tool exhaust system.
 - ii) Powered tool operators will change out vacuum collection system filters on a regular schedule or as needed to prevent overloading
- b) General exhaust ventilation systems such as negative air machines equipped with HEPA filtration will be utilized within work area containment enclosures when performing abatement work.
 - i) Flexible ductwork may be used as part of the general exhaust ventilation.
 - ii) Chapman employees will change out vacuum collection system filters on a regular schedule or as needed to prevent overloading.
- c) Wet wiping and HEPA vacuuming will be performed at the end of each work shift to clean all non-porous surfaces, including work surfaces, tools, and equipment inside the work area.

7) Standard Operating Procedures

- a) Cutting operations (Both Phases)
 - i) Work surfaces will be misted with hand sprayers to minimize dust during channel cutting operations.
 - ii) Workers will use HEPA exhaust/collection units on powered channel cutting tools to control emissions.
 - iii) Workers will use hand tools or HEPA-equipped power tools to remove caulking found along the concrete panel joints. Wet cutting methods shall not be used for this project.
 - iv) Cutting blades will be changed out with new blades on a regular basis throughout the work day.
 - v) Once visible caulking has been removed, workers will cut at least ¼" away from concrete joints to remove any PCBs residues. Abated concrete surfaces shall contain residual concentrations of PCBs at or less than 28 ppm. Workers will wear appropriate Tyvek garments, (suits with hoods, booties, etc.), nitril or latex gloves, and negative pressure air-purifying full-face respiratory protection equipped with HEPA filters during all phases of the removal process. All openings in protective garments will be taped closed using duct-tape or equivalent.

- vi) Chapman employees will transport all loose PCB-containing materials for disposal in either leak-proof containers or double bags to prevent the release of any debris from the work area. All bags or containers will be wiped down before being transported for disposal.
 - vii) Upon completion of the channel cutting activities, the abatement contractor shall HEPA vacuum and wet wipe the surfaces within the work area enclosure and clean to the point of no visible dust or debris. Workers will decontaminate their personal protective equipment utilizing alcohol wipes and dispose of contaminated wastes and Tyvek garments as PCB remediation waste upon completion and before exiting work zones.
 - viii) Upon completion of abatement activities, Environmental Health and Engineering (EH&E) will conduct a visual inspection. Any surfaces that do not meet the visual clearance criteria will be re-cleaned.
 - ix) The containment enclosure including all tarps, sheeting, wind screens, etc. will be dismantled only upon receipt of acceptable analytical results that meet the clearance requirement.
- b) Metal frames (Both Phases)
- i) Cleaning of Metal Frames
 - (1) All decontamination or cleaning work will be conducted within the work area defined by containment barriers.
 - (2) Non-porous window frames in contact with specified caulking shall be cleaned to remove visible caulking for unrestricted disposal. All non-porous materials that will be decontaminated shall be scraped with a razor scraper or equivalent to remove caulking residue. No mechanically assisted scraping or abrasives will be allowed. Cleaning methods will be consistent with methods described in the Abatement Plan filed with the EPA. Following the scraping, the non-porous surfaces will be wet wiped with mineral spirits such that no visible debris or residue is present, and the surface is restored to a bright finish.
 - (3) Surfaces cleaned of caulking will await visual inspection by EH&E. Any surfaces that do not meet the visual clearance criteria will be re-cleaned to remove caulking residues.
 - (4) Verification wipe sampling will be conducted on the cleaned metal frames. The wipe sample acceptance criterion for unrestricted disposal of non-porous

surfaces is less than or equal to 10 $\mu\text{g}/100\text{ cm}^2$ for window openings on the first floor and 100 $\mu\text{g}/100\text{ cm}^2$ for window openings above the first floor.

- (a) All PCB Bulk Product or Remediation waste generated by the cleaning will be bagged prior to transport to the PCB waste container. Chutes or other transport methods that may generate fugitive dust may not be used during the abatement work. Bags will be wiped clean before being transported to PCB waste container.
- (b) Wet wiping and HEPA vacuuming will be performed at the end of each work shift to remove dust and debris in the work area.
- (c) All PCB-contaminated water or liquids generated during abatement process will be stored in leak-proof containers and disposed according to 40 Code of Federal Regulations (CFR) §761.70.

9) PCB Waste Containers

- a) An approved PCB waste container will be on-site during the abatement work. The container will be secure, lined, and covered to prevent the release of PCB waste. The PCB waste containers shall be clearly marked as such to avoid confusion with ordinary waste containers. At the completion of work, the container will be removed from the site and transported by a licensed Hazardous Waste Disposal Contractor, to the CWN Chemical Services, LLC landfill in Model City, New York for disposal. This facility has approved this PCB-contaminated waste as being acceptable for disposal at this location.
- b) All PCB waste generated during the PCB remediation activities, including personal protective equipment (PPE), poly sheeting, and PCB-containing materials and contaminated debris will be disposed of as PCB Remediation waste. The building owner or its representative must sign for the disposal of the waste material when picked up by the waste transporter. Appropriate copies of all waste manifests will be kept by building owner for record-keeping purposes and confirmation of proper disposal.
- c) An approved PCB waste container for all PCB-contaminated liquid waste generated under the abatement project will be disposed in a manner consistent with 40 CFR §761.70.

11) Waste Classification

- a) PCB Bulk Product Waste
 - i) PCB containing caulking

- b) PCB remediation waste
 - i) Cutting debris in contact with caulking
 - ii) Used PPE in contact with specified PCBs
 - iii) Used poly-sheeting in contact with specified PCBs
 - iv) Contaminated debris in contact with specified PCBs
 - v) Rags/wipes used to clean non-porous surfaces
- c) PCB-contaminated liquids
 - i) Mineral spirits collected from decontamination operations of non-porous surfaces.

12) Contractor Qualifications

The removal contractor, Chapman Waterproofing Company, possesses over eighty years experience in the waterproofing and specialty masonry and repair industry. They have routinely performed similarly hazardous work operations where occupational exposures to lead, asbestos, and silica were possible, and have developed comprehensive exposure plans for operating under similar conditions.

13) Training and Certification

The Superintendent and Safety Coordinator assigned to this PCB remediation project have completed the OSHA 40 hour, Hazardous Waste Operations/Emergency Response (HAZWOPER) training course and eight-hour annual refresher as required. In addition, formal onsite training has been scheduled for PCB Remediation procedures for all Chapman employees assigned to remediation work crew. These employees have in the past, also received structured company training on occupational exposures to hazardous materials such as; silica, lead, and asbestos under similar circumstances. Formal Company policies exist for the performance of similar work duties when exposures to silica, lead, or asbestos are available.

Occupational exposure to PCB's and the unique hazards associated with this operation will be an ongoing topic of weekly toolbox talks and job-site safety meetings throughout the course of this project.

14) Health and Safety Plan

The Chapman Waterproofing Company -Standard Corporate Safety Plan is attached. Also included are copies of the following program specific safety policies:

- a) Asbestos Abatement Guidelines
- b) Polychlorinated Biphenyls Program

- c) Hazard Communication Program
- d) Respiratory Protection Program