

100 Church St

ENVIRONMENTAL ASSESSMENT REPORT

**100 CHURCH STREET
NEW YORK, NEW YORK**

prepared for

NEW YORK CITY LAW DEPARTMENT

prepared by

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1.0 OVERVIEW OF PROJECT AND REPORT

1.1 Introduction

The New York City Law Department (NYCLD) retained TRC Engineers, Inc. (TRC) to perform an environmental assessment of its office space at 100 Church Street, New York, New York. The purpose of TRC's evaluation was to determine whether the NYCLD space on floors 2 through 6 is fit for re-occupancy subsequent to cleaning activities conducted by the building owner and operator, ZAR Management (ZAR), and by the NYCLD.

As is described in this report and further detailed in the accompanying technical materials set out in the appendices, TRC inspected the NYCLD space and the heating, ventilation, air-conditioning (HVAC) system that serves the NYCLD space. TRC also conducted extensive sampling of the interior space of the floors occupied by the NYCLD, sampled the outside air, reviewed the building systems and the work performed by ZAR.

1.2 Re-Occupancy Sampling

TRC worked with the NYCLD to develop the following sampling strategy to determine conditions prior to re-occupancy. Sampling strategy included the collection of both surface and air samples. The following lists the substances which TRC and NYCLD agreed should be sampled for, along with a brief description of the rationale for the selection of each substance.

- **Asbestos** – It has been documented that some dust released from the World Trade Center (WTC) collapse contained asbestos. This asbestos originated from the asbestos-containing fireproofing that existed on sections of the WTC prior to collapse. TRC collected asbestos air and surface dust samples as part of this investigation.
- **Polychlorinated Biphenyls (PCB's)** – PCBs may be found in liquids used in many electrical components including fluorescent light ballasts, capacitors and transformers. TRC collected PCB air and surface samples as part of this investigation.
- **Lead** – Lead has been used in lead-based paints, storage batteries, and solder. Lead fumes and dust were released during the WTC collapse, fires and subsequent steel torch cutting. TRC collected lead air and surface samples as part of this investigation.

- Dioxin – Dioxins are a group of compounds that can be released by the incomplete combustion of PCB contaminated liquids and plastics. TRC collected Dioxin wipe and air samples as part of this investigation.
- Volatile Organic Compounds (VOC) – VOCs are a group of compounds that are released to the air during the incomplete combustion of hydrocarbon based materials, such as petroleum products and plastics in a fire. TRC collected VOC air samples as part of this investigation.
- Polynuclear Aromatic Hydrocarbons (PAH) – PAHs are a group of semi-volatile organic compounds that are released to the air during incomplete combustion of hydrocarbon based materials, such as during a fire. TRC collected PAH air samples as part of this investigation.
- Metals – Various metals were present in the WTC steel, building components, furnishings and equipment. Metal fumes and dusts were released during the WTC collapse, fires and subsequent steel torch cutting. TRC collected air samples for the following twenty-two (22) metals as part of this investigation: Aluminum, Antimony, Arsenic, Barium, Beryllium, Cadmium, Calcium, Chromium, Cobalt, Copper, Iron, Lead, Magnesium, Manganese, Nickel, Selenium, Silver, Thallium, Tin, Titanium, Vanadium, and Zinc.
- Mercury – Mercury is a heavy metal that has been used in thermostats, manometers, thermometers, fluorescent and high intensity light bulbs. TRC collected air samples as part of this investigation.
- Respirable Particulates – Respirable particulates are dust particulates, not otherwise regulated, that are less than 10 microns in size. TRC collected air samples for respirable particulates.
- Respirable Silica Quartz – Respirable silica quartz dust particles are the respirable fraction of silica quartz particulates. Silica quartz is a component of concrete. TRC collected air samples for respirable silica quartz.
- Biological – Due to flooding of the sub-cellar storage area, fungal and bacteria samples were collected. TRC collected swab and air samples in the cellar and sub-cellar.
- Fibers – Fibers defined by the aspect (length to width) ratio of three to one and can include fiberglass, refractory ceramic fibers, and asbestos. TRC collected air samples for fibers during the carpet removal activities.

- Ethanolamine – Ethanolamine or 2-Aminoethanol, was a component of the carpet mastic release agent sprayed on the carpet during carpet removal. TRC collected air samples for ethanolamine during carpet removal activities.

1.3 Report Layout

TRC's primary findings regarding its evaluation of the NYCLD-occupied floors of 100 Church Street are set out in Section 2.0, and the remaining sections of the report describe the work that was done and the basis for TRC's findings in detail. Specifically, Section 3.0 reviews the specific tasks and approach undertaken by TRC in conducting this work. Section 4.0 discusses the results of these activities and presents a general overview of the results of the environmental sampling conducted by TRC. Section 5.0 describes the samples collected by International Technical Corp. (IT). Section 6.0 sets out TRC's evaluation of the significance of these results with respect to the suitability of the NYCLD space at 100 Church Street for re-occupancy. Finally, Section 7.0 details recommendations to be implemented subsequent to return to 100 Church Street.

Appendix A presents the data tables showing the results of the samples collected (note that although samples were collected on the 20th floor and the results of those samples are included in the data tables presented in Appendix A, this report does not discuss those results). Appendix B sets forth the human health risk assessment data. Appendix C presents the microbiological investigation report dated March 8, 2002. Appendix D presents the laboratory data and field documentation. Appendix E provides the IT results.

2.0 PRIMARY FINDINGS

The Primary Findings are summarized as follows:

- **Re-Occupancy Recommendation.** Based upon the sampling conducted to date and the evaluation of the data compared to the applicable standards, guidelines and human health risk assessment protocols, TRC has determined that re-occupancy of the NYCLD space at 100 Church Street is recommended.
- **ZAR's Initial Response.** ZAR informed TRC that its response to the events of September 11 included shutting down the HVAC system and closing fresh air intakes immediately after the planes struck the World Trade Center and prior to the collapse of the two buildings. ZAR also stated that it secured the perimeter doors after the building was evacuated. In the fall of 2001, ZAR retained a licensed asbestos contractor, Branch Services, to clean the areas inside the building that sustained the greatest amount of dust/debris impact. This gross cleaning was supplemented by detailed cleaning in the interior office spaces, including office contents by Milro, a restoration contractor. The building exterior was power washed by Milro. In addition, G&G, an HVAC contractor was hired by ZAR to clean the entire building HVAC system, and Rosenwach Tank, was retained to perform tank cleaning of the two (2) rooftop domestic water house tanks.
- **Indoor Air Quality.** Between January 11 and March 31, 2002, TRC collected one hundred and sixty one (161) air samples in the NYCLD space. These samples were analyzed for one hundred and one (101) individual compounds. All air samples were well below applicable standards for all the compounds tested.
- **Outdoor Air Quality.** Between January 14 and March 21, 2002, TRC collected eight (8) outdoor air samples, one each for metals, volatile organic compounds (VOC), polynuclear aromatic hydrocarbons (PAH), polychlorinated biphenyls (PCB), mercury, respirable dust, respirable silica and dioxin. All these air samples were either below the analytical detection limit or well below the applicable OSHA standards for all the compounds tested.

- **Surface Dust.** Between January 11 and March 29, 2002, TRC collected two hundred and forty five (245) dust/surface samples, with samples taken from each floor in a number of locations in the NYCLD space and the HVAC system. These dust/surface samples were tested for asbestos, lead, PCBs, and dioxins. Post re-cleaning dust testing for asbestos in the NYCLD office space is continuing, as explained below in 4.4.1.

Subsequent to ZAR's initial cleaning activities in the fall of 2001, TRC's sampling results identified elevated concentrations of asbestos in the carpeting, in one sample taken on the top of a perimeter induction unit, in the computer and printer equipment, and in the HVAC system. Elevated concentrations of lead were also found on some surfaces within the NYCLD space and the HVAC system. As a result of these findings, the NYCLD has replaced the carpeting, computer, fax, printer and copier equipment and painted the perimeter induction units. In addition, extensive re-cleaning of the space occupied by the NYCLD and the HVAC system has been performed. The results of asbestos and lead sampling conducted to date by TRC after the re-cleaning were below target individual sample and geometric mean concentrations. No PCBs were detected in any of the wipe samples. Low levels of dioxin were detected in wipe samples of surfaces within NYCLD space. TRC has conducted a site specific human health risk assessment using the sampling data. The assessment indicated that the concentrations of dioxin do not represent a significant increased risk of cancer (i.e., less than one in one million) to building occupants. The entire NYCLD space is being re-cleaned.

3.0 DESCRIPTION OF TASKS PERFORMED BY TRC

This section of the report reviews the tasks performed by TRC and identifies the methodologies used in connection with the environmental assessment of the conditions at 100 Church Street.

3.1 Review of Building Systems

Beginning in January 2002, TRC met with ZAR and its consultant, the Ambient Group, Inc., to review and inspect the heating, ventilation and air conditioning (HVAC) system that serves the NYCLD spaces. The purpose of the review was to identify how the HVAC system is configured to ultimately determine how the air is filtered, conditioned and transported to the space occupied

by the NYCLD. Additionally, TRC inspected the HVAC system to determine the general condition of the system with respect to levels of gross contamination (presence of dirt and debris), and visual observation of the components of the system (i.e., coils, filters, prefilters, condensate pans, etc.) indicating general condition/maintenance of system. TRC also conducted dust sampling and analysis, as described in Section 3.4 of this report, within the HVAC system.

3.2 Review of Building Management Response.

TRC also met with NYCLD and ZAR to determine what response activities have been conducted to allow for re-occupancy of the building. As is further discussed in Section 4.2 below, ZAR reported taking the following response actions:

- Immediate shutdown of HVAC and post-evacuation securing of the perimeter doors
- Initial sampling for asbestos in the fall of 2001 to evaluate the presence and content of dust
- Interior and exterior cleaning
- Cleaning and flushing of domestic water system
- Cleaning of HVAC system, including fan units, ductwork, risers and return plenum
- Replacement of existing HVAC bag filters with high efficiency filtration, that provides more efficient air filtration

TRC reviewed the procedures used by ZAR in each of these response actions to determine their suitability considering the results of dust/debris sampling conducted by the building. TRC also evaluated these response actions to determine if they met the New York City Department of Environmental Protection (NYCDEP) and New York City Department of Health (NYCDOH) guidance criteria for cleaning up of buildings affected by the World Trade Center (WTC) attack. TRC also evaluated the types of contractors used by ZAR to determine the appropriateness of their certifications and experience for this project.

3.3 Visual Inspection of NYCLD Space

TRC had a Certified Industrial Hygienist (CIH) visually inspect the entire NYCLD space, common spaces that NYCLD employees enter in the course of their work in the building, and “hidden” spaces that serve the area, including the HVAC and other mechanical spaces. This inspection included accessible areas of the HVAC system serving the NYCLD spaces. A boroscope with a self-contained light source was utilized as needed to assist in the visual inspection of the ductwork.

3.4 Dust Sampling and Analysis

TRC conducted wipe and microvacuum sampling of residual dust to confirm the effectiveness of the response actions. The following identifies the sampling and analysis that was conducted along with associated standards and guidelines:

- Asbestos – American Society for Testing and Materials (ASTM) Test Method D5756-95 Microvacuum Sampling and Indirect Analysis (Filter Sample Analysis) of Dust by Transmission Electron Microscopy (TEM) for Asbestos Structure Number Concentration. A post-cleaning individual sample target concentration of less than 10,000 structures per square centimeter (str/cm²) and a geometric mean concentration of 1000 str/cm² was established for this project.
- Lead – United States Department of Housing and Urban Development (HUD) Wipe Sampling Guidelines. A post-cleaning lead wipe target concentration of 40 micrograms per square foot (ug/ft²) for occupied spaces and 400 ug/ft² for non-occupied spaces was established for this project.
- PCBs – United States Environmental Protection Agency (USEPA) Document EPA 560/5-85-026 Verification of PCB Spill Cleanup by Sampling and Analysis. The USEPA clearance criteria of 10 micrograms per 100 square centimeters was used for this project.
- Total Particulates – Modified National Institute for Occupational Safety and Health (NIOSH) Sampling and Analytical Method 0500. Dust loading inside computer equipment was compared to non-impacted control concentrations.
- Dioxin – USEPA Document EPA-Methods 8290 and 1668. No clearance concentrations are established for surface dioxin concentrations. Therefore, TRC incorporated wipe data into a site specific human health risk assessment.
- Biological – American Industrial Hygiene Association Sampling Guidelines. Data was compared to New York City Department of Health (NYCDOH) guidelines.

All analytical work was performed by an independent laboratory certified by the New York State Department of Health (NYSDOH) under the Environmental Laboratory Accreditation Program (ELAP).

3.5 Air Sampling and Analysis

TRC conducted air sampling to evaluate air quality and determine if areas were fit for re-occupancy. The following identifies the air sampling and analysis that was conducted along with associated standards and guidelines:

- Asbestos – Transmission Electron Microscopic (TEM) analysis for asbestos. The USEPA AHERA standard of 70 structures per square millimeter (str/mm²) was used for comparison.
- Metals –NIOSH Sampling and Analytical Method 7300 for twenty-two (22) metals. The applicable Occupational Safety and Health Administration (OSHA) permissible exposure limit (PEL) for each metal is presented on the data results table in Appendix A of this report for comparison.
- Volatile Organic Compounds (VOC) – USEPA Modified Sampling and Analytical Method with GC/MS Scan and Library Search. The applicable OSHA PEL for each VOC is presented on the data results table in Appendix A of this report for comparison.
- Polychlorinated Biphenyls (PCB) – NIOSH Sampling and Analytical Method 5503. Results were compared to the OSHA PEL for PCB of 0.5 milligrams per cubic meter of air.
- Polynuclear Aromatic Hydrocarbons (PAH) – USEPA Modified PUF/XAD Sampling Method. The applicable OSHA PEL for each PAH is presented on the data results table in Appendix A of this report for comparison.
- Mercury – NIOSH Sampling and Analytical Method 6009. Results were compared to the OSHA PEL for Mercury of 50 micrograms per cubic meter (ug/m³) of air.
- Respirable Particulates (Dust) – NIOSH Sampling and Analytical Method 0600. Results were compared to the OSHA PEL for Respirable Dust 5 milligrams per cubic meter of air.
- Respirable Silica Quartz – NIOSH Sampling and Analytical Method 7500. Results were compared to the OSHA PEL for Respirable Silica Quartz, which is dependant upon the concentration of silica identified.
- Dioxin – USEPA Method TO-09A. Results were compared to the NIOSH recommended concentration for Dioxin of less than 10 picograms per cubic meter of air.
- Biological – Anderson single stage impact sampling for fungi and bacteria. Results were compared to NYCDOH guidelines.

- Fibers – NIOSH Sampling and Analytical Method 7400. Results were compared to the OSHA PEL for asbestos fibers of 0.1 fibers per cubic centimeter of air.
- Ethanolamine – NIOSH Sampling and Analytical Method 2007. Results were compared to the OSHA PEL for Ethanolamine of 3 parts per million.

Representative sampling was conducted on each floor within the NYCLD space.

Because there is reason to believe that the fibers generated by the WTC collapse were small fibers, TEM analysis of air samples for asbestos was the analytical method used in this assessment to determine whether asbestos was present in the air. TEM is the state of the art analytical technique with the greatest analytical sensitivity to identify small asbestos fibers that can be missed by other analytical techniques, including Phase Contrast Microscopy (PCM).

Biological sampling was conducted in the cellar and subcellar areas. These areas were the only areas impacted by water intrusion as a result of power failure. Results of this sampling are presented in Appendix C and under separate cover in the March 8, 2002 report entitled "Microbiological Investigation of Subcellar and Cellar at 100 Church Street."

Air sampling for fibers and ethanolamine (the active ingredient in the carpet mastic release agent) was conducted during carpet removal activities. Sampling was conducted to determine if carpet removal control procedures were effective in controlling potential exposures below United States Occupational Safety and Health Administration (OSHA) permissible exposure limits (PEL). Due to the quantity of data, the results of this sampling are presented under separate cover in the April 2, 2002 report entitled "Environmental Monitoring for Carpet Removal at 100 Church Street." Any results for fiber air sampling by PCM that exceeded the OSHA PEL or New York City Department of Environmental (NYCDEP) clearance air standards for personal and area samples, respectively, were further analyzed by TEM to determine if the fibers present were asbestos.

All analytical work was performed by independent laboratories certified by the NYSDOH under ELAP.

3.6 Outside Air Quality Data

TRC collected and analyzed eight (8) air samples outside of 100 Church Street. This air sampling was conducted to determine airborne concentrations of target analytes outside of the building in areas NYCLD employees will pass when entering or exiting 100 Church Street and to compare to inside air concentrations. Air sampling of the outside air was conducted for metals, volatile organic compounds, polynuclear aromatic hydrocarbons, polychlorinated biphenyls, mercury, respirable particulates, respirable silica, and dioxin. All outside air samples were found to be either below the detection limit or much less than associated OSHA PELs.

4.0 RESULTS OF WORK PERFORMED BY TRC

4.1 Evaluation of Building Systems

TRC met with Mr. Joseph Nunez, Chief Engineer of ZAR, to review and sample the HVAC system serving the NYCLD spaces. The main house fan units serving the NYCLD space on floors 2-6 are located on the 7th floor of 100 Church Street. The fan units serving the Lobby are on the 2nd floor. Each floor of the NYCLD space is serviced by a combination of the following three air supply systems:

- Interior air supply system
- Perimeter air supply system
- Supplemental air system

The core or interior spaces are supplied through 4 supply risers or rectangular ducts that run vertically through all the NYCLD floors. These risers are located in an interior enclosed chase in the northwest, northeast, southwest and southeast sections of the building. Each riser has a dedicated supply fan located on the 7th floor. There are 6 return air risers on each floor. All six risers carry the return air to two return air fans located on the 7th floor. The two return air fans are interconnected through a horizontal duct/airway within the 7th floor fan room. Under normal operating conditions, outdoor air is pulled in through adjustable louvers and prefilters into an airway/fresh air plenum. Ten to fifteen percent outside air is mixed with return air in a mixing chamber; the air passes through newly installed high efficiency filters (Airguard Variplus VPL-0495-DOP) and over heating/cooling coils. The conditioned air is then forced by the supply air fans through the supply risers to the tenant spaces located on floors 2 through 15. Air from the supply risers runs along horizontal supply ducts on each floor above the suspended ceiling and through diffusers to individual spaces. Return air is pulled back through return air grilles into the

space above the suspended ceiling which acts as a return air plenum. Air then travels into the return air risers and returns to the 7th floor fan room

The perimeter induction units, visible as units under the windows, are supplied through a supply fan located on the 7th floor. The perimeter air handler forces air through risers running along perimeter columns. The supply risers are connected to circular ducts connected to the perimeter induction units on every floor. The return air from the perimeter units mixes with the supply air on the floors and returns via interior system return air risers. There is no dedicated return air fan for the perimeter air supply system.

In addition to the air supply from the main building HVAC system located on the 7th floor, supplemental air handling units have been installed in various locations to provide additional cooling. These vary from floor to floor generally re-circulating the building air from above the suspended ceiling through a cooling coil.

An inspection of the air handlers and ductwork indicated that visible accumulation of dust/debris was present. Although the air handlers appeared to have been partially cleaned and there was no gross debris observed which could be obviously associated with the WTC collapse, visible dust was noted. The inspection of ductwork revealed the presence of significant accumulations of dust and debris, which would not have been expected subsequent to a duct cleaning effort.

At the time of the inspection, the building had upgraded the filtering system to include high efficiency filters for particulate control. These high efficiency filters replaced the normal bag filtering system and significantly increased the filtering capability of the system that provides conditioned air to the NYCLD space.

4.2 Evaluation of Building Management Response

Based on the information provided by ZAR and its environmental consultant, Ambient Group, Inc. (Ambient), the building response actions appear to have been appropriate and in conformance with NYCDEP and NYCDOH guidelines relative to clean up of WTC generated dust/debris. ZAR hired Branch Services (Branch), a New York State certified asbestos abatement company, to perform initial cleanup of gross debris at 100 Church Street. These

activities were performed under asbestos abatement conditions. In addition to the Branch clean-up, Milro performed fine cleaning of the entire interior space and its contents utilizing wet-wipe and HEPA vacuuming protocols. Milro also power-washed the exterior of the building. Rosenwach Tank was retained to clean and flush the two domestic water rooftop house tanks, and G & G was hired to clean the HVAC system. Although TRC did not oversee the initial clean-up of the building, based upon our initial inspection and a review of the TRC wipe sampling data compared to reports from Ambient on pre-cleaning conditions, the performance of clean-up contractors appears to have significantly reduced the dust/contamination in the building caused by the collapse of the WTC. One exception appears to have been the performance of G&G, the first contractor to clean the HVAC.

4.3 Results of Visual Inspection of NYCLD Space

A TRC Certified Industrial Hygienist (CIH) conducted a visual inspection of the NYCLD space, the HVAC fan room on the 7th floor, the ground floor lobby and associated 2nd floor HVAC system and other common areas. This visual inspection indicated that the NYCLD office space areas had been cleaned and that minimal visible dust accumulation was present. Such dust as was present was sampled and analyzed, and the results of that work are discussed in Section 4.4 below.

The inspection of the HVAC system including fan units, supply and return air ductwork and return air plenum indicated that visible dust accumulation was present, which was greater than would be expected under normal operations. As a result of TRC's inspection and surface dust sampling in the HVAC system, as discussed in Section 4.4 below, a HVAC re-cleaning program was recommended and implemented.

4.4 Results of Surface Dust Sampling and Analysis

Dust/residue on surfaces in the NYCLD space was sampled and analyzed for asbestos, lead, PCBs, dioxins, and total particulates. Dust on surfaces of the HVAC serving NYCLD spaces was also sampled for asbestos and lead.

4.4.1 Asbestos Surface Dust Sampling and Results

NYCLD Space

TRC performed asbestos surface dust sampling on floors 2 through 6 and 20 following cleaning activities conducted by ZAR's cleaning contractors. Surface dust samples were collected on many surfaces within the space. Results, which are presented in Appendix A, are organized as follows:

- Table 1a – Carpet
- Table 1b – Top of Perimeter Induction Units
- Table 1c – Hard Surfaces
- Table 1d – Soft Goods
- Table 1e – Computer/Copier Equipment
- Table 1f – Boxed Items
- Table 1g – Field Blanks

A total of one hundred and nineteen (119) samples were collected and analyzed for asbestos in surface dust via ASTM 5755 microvacuum method. A post cleaning target concentration of less than 10,000 structures per square centimeter (str/cm²) for all samples and a geometric mean concentration of less than 1,000 str/cm² for each data set was established. In calculating the geometric mean, one-half of the sample detection limit was used in the calculation for samples found to be below the analytical detection limit.

Carpet results indicated that three (3) of the ten (10) samples collected were in excess of the post cleaning target concentrations. The carpet has since been removed and replaced with new carpeting.

Results of sampling the tops of the perimeter induction units indicated that one (1) of the seven (7) samples was in excess of the post cleaning target and the geometric mean was slightly higher than the 1,000 target geometric mean. These areas have since been re-cleaned and all induction units have been painted.

TRC sampled hard surfaced items such as desks, bookshelves, file cabinets, floors. None of the twelve (12) surface samples exceeded the post cleaning target concentration. Nine (9) of the twelve (12) samples were less than the analytical detection limit. Although results indicated no action was required, all furniture was re-cleaned twice, once according to a defined wet-wipe

protocol prior to placement on newly installed carpeting, and a second time as part of the capital cleaning program, which also followed a specific wet-wipe protocol.

TRC also sampled soft goods, such as cloth chairs, couches, fabric wall partitions. None of the thirty-one (31) samples exceeded the individual sample post-cleaning target and the geometric mean was less than 1,000 str/cm². Twenty-two (22) samples were found to be below the analytical detection limit. Although results indicated that no action was required, all fabric based chairs, couches and fabric partitions were steam cleaned.

TRC sampled internal components of computers and copiers. This involved the partial disassembly of computers and copiers prior to sampling. Thirty (30) samples were collected and analyzed. Four of the thirty samples exceeded the post cleaning target concentration and the geometric mean target concentration was exceeded. All computers, monitors, printers, copiers and fax machines have been removed from the NYCLD space and replaced.

TRC sampled boxed items, such as files, papers, personal effects, in offices and general areas. Twenty-five (25) samples were collected and analyzed. None of the twenty-five (25) samples exceeded the post cleaning target concentration and the geometric mean target concentration was not exceeded. Twenty-two (22) of the twenty-five (25) samples were found to be below the analytical detection limit.

HVAC System

The primary components of the HVAC system include the supply ductwork, return ductwork, air handling unit, and ceiling return plenum. Each of these components was sampled for asbestos in surface dust following ASTM microvacuum techniques. TRC sampled the HVAC system after the system was cleaned by ZAR's initial HVAC cleaning contractor, G & G. Results of HVAC sampling, presented in Appendix A, are organized as follows:

- Table 2a – Supply Ducts
- Table 2b – Return Ducts
- Table 2c – Air Handling Units
- Table 2d – Induction Units
- Table 2e – Ceiling Return Plenum

Ten (10) of the initial round of fifty-eight (58) samples from the HVAC system contained a level of asbestos that exceeded the individual sample target post-cleaning concentration of 10,000 str/cm². The ten samples were located as follows:

- Southeast supply duct on the 6th floor,
- Southwest return duct on the 2nd floor,
- Southwest ceiling tile on the 20th floor,
- Air handler supply #11 on the 21st floor,
- Return air duct #F12 on the 21st floor,
- Air handler supply #1 on the 21st floor,
- Air handler supply #2 on the 7th floor,
- Air handler supply #3 on the 7th floor,
- Air handler supply #4 on the 7th floor, and
- Supplemental supply air handler in the LAN room on the 20th floor.

In response to this and the lead results described in Section 4.4.3, ZAR hired a National Air Duct Cleaning Association (NADCA) certified duct cleaning contractor to re-clean and encapsulate the interior supply ducts, supply risers, return ducts and risers, and re-clean the HVAC fan units serving the NYCLD spaces. The building has reported that once the cleaning is complete for the NYCLD space, the remaining interior HVAC units and ductwork supplying air for the remainder of the building will be re-cleaned as well.

The HVAC re-cleaning effort was performed by Branch Services (Branch), Cunningham Mechanical (Cunningham), and Indoor Air Professionals (IAP). Branch is a New York State certified asbestos abatement contractor and Cunningham and IAP are NADCA certified duct-cleaning contractors. Branch conducted power-washing of fan units and Cunningham and IAP performed duct cleaning activities. Branch applied an encapsulant to the HVAC system surfaces subsequent to HVAC cleaning. Encapsulating is the process of applying of a thin layer of sprayed liquid material that creates a membrane locking down any residual dust subsequent to cleaning operations. Cleaning activities utilized HEPA filtered equipment and followed NADCA protocols.

Post Re-cleaning Sampling

TRC collected a second set of samples after NYCLD's office space and the HVAC system were re-cleaned. These results are presented in Table 3. Table 3a presents the post-cleaning microvacuum samples collected in the NYCLD office area. Table 3b presents the post-cleaning microvacuum samples collected in the HVAC system.

All post-cleaning HVAC samples were found to be below the target post-cleaning individual sample and target geometric mean concentrations. Thirty-four (34) of forty-five (45) samples were found to be less than the analytical detection limit.

TRC is collecting at least three (3) microvacuum samples for asbestos per floor in the office space as re-cleaning is completed. TRC anticipates that re-cleaning of all five floors will be completed by the week of April 15, 2002 and anticipates that sample collection will be completed shortly thereafter. The results received to date are presented in Table 3a.

Sampling methodology.

Sampling and analysis of dust for asbestos was conducted utilizing microvacuum techniques to collect a sample for transmission electron microscopic (TEM) analysis to determine the number of asbestos structures in the dust collected per a measured surface area. This protocol utilizes a flexible tygon tube attached to the end of a sample filter cassette to microvacuum dust using a sampling pump. Microvacuumed dust is collected on the filter, cassette and tubing, which is then recovered for TEM analysis.

4.4.2 PCB Sampling and Results

Eighteen (18) PCB wipe samples were collected and analyzed within the NYCLD space and HVAC system. The results are presented in Table 4 of Appendix A. All samples were below the analytical detection limit (less than 2.0 micrograms per 100 square centimeters). This means that the laboratory equipment and test method employed were unable to detect any PCBs in any of the wipe samples.

Sampling Methodology

Sampling and analysis for PCBs on surfaces was conducted utilizing sterile wipes impregnated with hexane. A known surface area (10cm x 10cm) is wiped and the wipe sample submitted to the lab and analyzed.

4.4.3 Lead Wipe Sampling and Results

TRC collected lead wipe samples from surfaces in the NYCLD office space, from materials, such as papers, books, and files, which were placed in boxes, and from the HVAC system. Lead wipe results are presented in the following tables in Appendix A:

Table 5a – Office Area

Table 5b – Boxed Items

Table 6a – HVAC Supply Ducts

Table 6b – HVAC Return Ducts

Table 6c – HVAC Air Handling Units

Table 6d – HVAC Induction Units

Table 6e – HVAC Return Plenum

Table 6f – Field Blanks

Table 7a – Post Re-Cleaning Office

Table 7b – Post Re-Cleaning HVAC

Lead Wipe Results for NYCLD Space

Table 5 presents the fifty eight (58) lead wipe samples that were collected and analyzed within the NYCLD spaces. TRC collected the samples listed on Table 5 after ZAR's cleaning contractors (Branch and Milro) cleaned the NYCLD space. Table 5a in Appendix A, presents the results for lead wipe samples collected on surfaces in the office area. Of the twenty-five (25) samples collected on surfaces in the NYCLD offices, seven (7) samples slightly exceeded the office area target post-cleaning concentration of forty (40) micrograms per square foot ($\mu\text{g}/\text{ft}^2$). Utilizing specific wet wiping techniques, the entire NYCLD space has been re-cleaned twice, once during placement of furniture on newly installed carpet and once as part of capital cleaning just prior to re-occupancy. All samples collected following re-cleaning activities were found to be less than $25 \mu\text{g}/\text{ft}^2$. These results are presented in Table 7a.

Table 5b in Appendix A presents the results for lead wipe samples collected within boxes in the NYCLD space. According to ZAR's cleaning contractor, Milro, all items such as files, papers, books, personal effects, etc. were cleaned in the fall of 2001. Therefore, these items were cleaned prior to placement in the boxes. All results were below the analytical detection limit.

Heating, Ventilation, Air Conditioning System

Fifty (50) lead wipe samples were collected and analyzed within the HVAC system serving the NYCLD and the Office of Mayor spaces. TRC collected the samples after ZAR's initial duct cleaning contractor, G&G cleaned the HVAC. Samples were collected in the supply and return ductwork, air handling units serving the spaces, induction units and return air plenum. As can be seen from Tables 6a through 6f, twenty-seven (27) of the fifty (50) lead wipe samples collected in the HVAC system exceeded the HVAC post-cleaning target concentration of four hundred micrograms per square foot (400 ug/ft^2).

In response to these results, ZAR retained the services of Branch, an abatement contractor who subcontracted the services of Cunningham and IAP, two National Air Duct Cleaning Association (NADCA) certified duct cleaning contractors. Together they re-cleaned and encapsulated the entire HVAC system serving the NYCLD space following NADCA cleaning protocols. The re-cleaning of the HVAC system serving the NYCLD was successfully completed on March 20, 2002. TRC collected a second set of wipe samples after the re-cleaning. Results of post re-cleaning lead wipe sampling are presented in Table 7b of Appendix A. Only one (1) sample associated with Fan No. 8 on the 21st floor exceeded the post-cleaning target of less than 400 ug/ft^2 . The area was re-cleaned and re-sampled and found to be less than the analytical detection limit. Of the other forty five (45) samples taken, all were below the post cleaning target of 400 ug/ft^2 , and thirty were below the analytical detection limit.

Sampling Methodology

Sampling and analysis for lead on surfaces was conducted utilizing specially manufactured sampling wipes. A known surface area (typically $1 \text{ ft} \times 1 \text{ ft}$) is wiped, and the wipe sample is submitted to the lab and analyzed.

4.4.4 Total Particulate Matter Samples and Results

Twenty-eight (28) samples were collected from inside computers and related equipment and analyzed for total dust. The results of this sampling are presented in Table 8 in Appendix A. Samples were collected of dust present inside the computers to determine the extent of dust accumulation. A sample was also collected from a TRC West 29th Street New York office computer to represent background control concentration of dust present in a computer. As can be seen from Table 8, only one sample was found to be higher than the control sample taken from TRC's office.

Sampling Methodology

Sampling was conducted utilizing a 37-millimeter filter cassette with a 5 micron PVC filter attached to an air sampling pump. A short piece of tygon tubing was attached to the end of the cassette to microvacuum a measured surface area to collect dust present on the internal computer components. Analysis of the filter was via gravimetric analysis following NIOSH Sampling and Analytical Method 0500.

4.4.5 Dioxin Wipe Sampling and Results

Table 9a in Appendix A presents the sampling and results for dioxin. Dioxins were detected in low concentrations in fourteen (14) of the twenty (20) wipe samples collected. TRC incorporated these results into a site specific human health risk assessment to determine the risk associated with the concentrations found at 100 Church Street. TRC conducted this risk assessment following United States Environmental Protection Agency (USEPA) protocols. A conservative, that is a highly protective, estimate of risk of cancer associated with the dioxin wipe and air concentrations was found to be 8.5E-07 (or 8.5 in ten million) which is less than (i.e., better than) the target cancer risk level of one in one million. The human health risk assessment calculations and assumptions can be found in Appendix B of this report.

These results notwithstanding, the NYCLD space was re-cleaned in an effort to remove any residual dioxin from surfaces. As each floor is re-cleaned, TRC is resampling surfaces for dioxin.

Sampling Methodology

Sampling and analysis for Dioxins on surfaces was conducted utilizing sterile wipes impregnated with hexane. A known surface area (100cm x 100cm) was wiped and the wipe sample submitted to the lab and analyzed.

4.5 Results of Air Sampling and Analysis

Air sampling was conducted for a comprehensive list of substances as indicated above. All air samples collected by TRC were collected with the HVAC operating. The following discussion summarizes the findings of the air sampling program.

4.5.1 Asbestos Air Sampling and Results

Air Sampling Results

Sixty (60) air samples (excluding blanks) were collected in an aggressive manner and analyzed by TEM for asbestos. Results of asbestos air samples are presented in Table 10 of Appendix A. None of the samples were found to be greater than 70 structures per square millimeter (s/mm²), which is the AHERA clearance criterion established for re-occupancy following asbestos abatement in schools. In fact, all samples were less than the detection limit of the analytical method, that is no asbestos fibers were found in any of the air samples.

Aggressive Asbestos Air Sampling Methodology

Asbestos air samples were collected using "aggressive" techniques to simulate a worst-case scenario and re-suspend into the air any settled dust that could be the source of asbestos fibers. Aggressive sampling techniques involve agitating air within the space using an electric leaf blower. The exhaust from the leaf blower is directed against vertical and horizontal surfaces on which dust may have settled. Particular attention is given to hard to clean areas such as corners of the room and behind desks. Additionally, the exhaust was directed into the air to assist air movement and circulation. During the clearance air sampling period, the building's HVAC system in the areas was in operation.

Asbestos Standard

The AHERA regulations were promulgated to protect school children from exposure to asbestos. This regulation defines inspection and management requirements as well as clearance re-occupancy testing requirements. The re-occupancy testing requirements are designed to facilitate re-occupancy of a classroom following an asbestos abatement action. The AHERA regulations apply to all public school buildings from K through 12th grade. In accordance with AHERA, an abatement action can be considered complete and the classroom reoccupied by school children when the results of final clearance air samples collected within the work area are less than 70 str/mm². In fact the AHERA regulations allow for a statistical analysis of the clearance data relative to 70 str/mm², which allows some samples to be greater than 70 str/mm². The clearance criteria for this project required that all results be less than 70 str/mm², which in fact is stricter than the AHERA regulations for school children.

Sampling Methodology

The air samples are collected by drawing air through a mixed cellulose ester filter (MCE), 25 millimeters (mm) in diameter, with a pore size of 0.45 micrometers. The air is pulled by a 120-volt AC powered, constant flow vacuum pump operated at nominal flow rate of 10 liters per minute (lpm). The pumps are calibrated prior to sampling, using a secondary calibration standard (rotometer). The secondary calibration standards are calibrated periodically (at least once every six months) using a primary standard. The flow rate of each pump is rechecked following each sampling period.

To analyze a sample, circular sections of the filter are cut and placed on a clean glass slide. The slide(s) is then placed in a petri dish containing acetone to fuse and clear the filters. The filter is then plasma etched and transferred to a rotating stage inside a bell jar of a vacuum evaporator. A 1- by 5-mm graphite rod is then evaporated on the filter and the filter is transferred to a clean petri dish. A wicking substrate covered with filter or lens paper is then placed in another petri dish. Carbon-coated TEM grids are then placed on the filter or lens paper and acetone is placed in the petri dish until the wicking substrate is saturated. A portion of the carbon-coated filter is removed from the glass slide and placed carbon-coated side down on a labeled grid in the acetone saturated petri dish.

Using TEM, asbestos fibers, bundles, clusters or matrices are counted as structures. A structure is considered part of this group (i.e., a countable fiber) based on geometric and dimensional criteria. That is, a structure must satisfy size requirements (greater than 0.5 micrometers long) and have an aspect (length to width) ratio of greater than 5 to 1. All structures fitting these criteria are counted. The method allows the analyst to distinguish between asbestos and non-asbestos structures.

The airborne structure concentration is calculated by proportioning the structures counted per area of filter to the total filter area. The result is an expression of the concentration of airborne asbestos in structures per square millimeter (s/mm^2).

4.5.2 *Metals Sampling and Results*

Thirty-five (35) air samples, including blanks, were collected and analyzed for twenty-two (22) metals. Results of metals air samples are presented in Table 11 of Appendix A. A review of the results indicate that most of the air samples were found to be below the analytical detection limit for metals. Only two (2) air samples were found to contain measurable concentrations of metals in the air and for those samples, only lead was detected in one and aluminum was detected in the other. For those two samples in which measurable concentrations of specific metals were identified, all air concentrations were much lower than their respective OSHA permissible exposure limits (PELs).

4.5.3 *Volatile Organic Compounds Sampling and Results*

Eight (8) air samples were collected and analyzed for twenty-three (23) volatile organic compounds (VOCs). Results of VOC air samples are presented in Table 12 of Appendix A. While measurable concentrations of specific VOCs were identified in some of the air samples, all air concentrations were much lower than their respective OSHA PELs.

4.5.4 *PAHs*

Eight (8) air samples were collected and analyzed for semi-volatile organic compounds polynuclear aromatic hydrocarbons (PAHs) (16 individual semi-volatile compounds). Results of PAH air samples are presented in Table 13 of Appendix A. A review of the data indicates that all of the results were below the analytical detection limit for PAH compounds.

4.5.5 Polychlorinated Biphenyls

Seven (7) air samples were collected and analyzed for Polychlorinated Biphenyls (PCBs). Results of PCB air sampling are presented in Table 14 of Appendix A. A review of the data indicates that all of the results were below the analytical detection limit for PCBs.

4.5.6 Mercury

Seven (7) air samples were collected and analyzed for mercury. Results of mercury air sampling are presented in Table 15 of Appendix A. A review of the data indicates that all of the results were below the analytical detection limit for mercury.

4.5.7 Respirable Particulates

Eighteen (18) air samples were collected and analyzed for respirable particulates. Results of respirable particulate air sampling are presented in Table 16 of Appendix A. A review of the data indicates that all of the results, except one air sample, were below the analytical detection limit for respirable particulates. The air concentration of respirable dust for the one air sample where dust was detected was much lower than 5.0 mg/m^3 , the OSHA PEL.

4.5.8 Respirable Silica Quartz

Eighteen (18) air samples were collected and analyzed for respirable silica quartz. Results of respirable silica quartz air sampling are presented in Table 17 of Appendix A. A review of the results indicate that all of the results were below the analytical detection limit for respirable silica quartz.

4.5.9 Dioxins [Change to picograms to match Table 18]

Seven (7) air samples were collected and analyzed for dioxins. Results of dioxin air sampling are presented in Table 18 of Appendix A. The results indicate that concentrations ranged from 0.0164 to 0.0856 picograms per cubic meter (pg/m³) expressed as 2,3,7,8 tetrachlordibenzo-p-dioxin (TCDD) toxicity equivalents (TEQ). The TEQ essentially sums the relative toxicities of each of the forms of dioxin found relative to TCDD, the most toxic form of dioxin. All results were well below the NIOSH limit of 10,000 fg/m³. In addition, these results were incorporated

into the site specific human health risk assessment described previously in Section 4.4.5 and presented in Appendix B.

4.5.10 Biological

Air samples were collected and analyzed for fungi and bacteria in the subcellar and cellar of 100 Church Street. Results of this effort are provided in a separate Microbiological Investigation Report dated March 8, 2002 and included in Appendix C of this report.

4.5.11 Fibers

Air samples were collected and analyzed for fibers during the carpet removal to ensure compliance with OSHA standards during these activities. Most personal air samples were less than the OSHA standard of 0.1 fibers per cubic centimeter (f/cc) of air. Most area air samples were less than the NYCDEP clearance criteria of 0.01 f/cc. Any air sample results that exceeded the OSHA or NYCDEP standard were further analyzed by TEM to determine if the fibers were asbestos. None of the samples exceeded the applicable standard when analyzed for asbestos. A separate report has been prepared for analytical samples collected during carpet removal/replacement. This April 2, 2002 report entitled "Environmental Monitoring for Carpet Removal at 100 Church Street" is presented under separate cover.

4.5.12 Ethanolamine

Air samples were collected and analyzed for ethanolamine during the carpet removal to ensure compliance with OSHA standards during these activities. All samples were less than the OSHA permissible exposure limit. separate report has been prepared for analytical samples collected during carpet removal/replacement. This April 2, 2002 report entitled "Environmental Monitoring for Carpet Removal at 100 Church Street" is presented under separate cover.

5.0 SAMPLES COLLECTED BY INTERNATIONAL TECHNOLOGY CORPORATION

International Technology Corporation (IT) collected and analyzed one hundred and eighty-seven (187) air and surface samples within the NYCLD space. This work was completed prior to TRC's work. All samples were collected before the HVAC system began operating. IT collected the following samples (number of samples for each analyte in parenthesis):

- Asbestos air samples (55)
- VOC air samples (5)
- PAH air samples (7)
- PCB air samples (7)
- Total particulate air samples (33)
- Silica air samples (33)
- Asbestos dust samples (28)
- PCB wipe samples (19)

Results of IT samples are presented in Appendix E with associated data forms. A review of the data indicates that overall, the results are similar to TRC results. All air samples were found to be less than the analytical detection limit or well below applicable standards, no PCBs were detected in wipe samples and asbestos was detected in dust in the NYCLD space. Therefore the IT data supports the response actions implemented, including removal, re-cleaning, painting and sampling activities conducted in the space prior to re-occupancy.

6.0 CONCLUSIONS

- Indoor Air Quality TRC has collected and analyzed a total of one hundred and sixty one (161) air samples in the NYCLD space, between January 11 and March 31, 2002. These samples were analyzed for one hundred and one (101) individual compounds. All air samples were well below applicable standards and guidelines for all the compounds tested.
- Outdoor Air Quality – Between January 14 and March 21, 2002, TRC collected and analyzed eight (8) outdoor air samples, one each for metals, volatile organic compounds (VOC), polynuclear aromatic hydrocarbons (PAH), polychlorinated biphenyls (PCB), mercury, respirable dust, respirable silica and dioxin. All these air samples were either below the analytical detection limit or well below the applicable OSHA standards for all the compounds tested.
- Surface Dust – Between January 11 and March 29, 2002, TRC collected and analyzed two hundred and forty five (245) dust/surface samples, with samples taken from each floor of the NYCLD space and HVAC system. These samples were tested for asbestos, lead, PCBs, and

dioxins. No PCBs were detected in any of the samples. Asbestos, lead and dioxins were detected in samples collected. As a result of these findings, carpets, computers, faxes, printers and copiers were replaced, air induction units were repainted and the NYCLD space and HVAC system were extensively re-cleaned. Subsequent to completion of these activities, TRC re-tested surfaces in the HVAC system. All samples were found to be less than applicable target post-cleaning standards. TRC is in the process of re-testing surfaces in the NYCLD space. All results received to date were found to be less than the applicable target post-cleaning standards.

- Based upon the sampling conducted to date and the evaluation of the data compared to applicable standards, guidelines and human health risk assessment protocols, TRC has determined that re-occupancy of the NYCLD space at 100 Church Street is recommended.

7.0 RECOMMENDATIONS

Subsequent to re-occupancy, TRC recommends the following:

- Conduct on-going air monitoring within the NYCLD space on a routine basis. The intent of this on-going air monitoring is to confirm that the air quality within the NYCLD space is maintained and that changing conditions associated with the construction activities at the WTC do not adversely impact the NYCLD air quality. This program will continue until site activities which have the potential to generate emissions or concern cease or until analysis of data shows that continuance of the program is no longer necessary. On the same basis, the program may be modified to decrease the frequency of sampling events or target list, should data from the ongoing monitoring activities support such modification. The on-going air monitoring program will include air sampling for asbestos (TEM), total respirable dust, metals, carbon dioxide, carbon monoxide, temperature and humidity.

During each sampling event, three interior sample locations will be selected for monitoring. Sample locations within the building will vary with each sampling event so that each floor will be sampled. Sample locations on a floor will vary between sampling events to provide a representation of the various functional areas (i.e. offices, cubicle spaces, interior spaces, etc.). The overall program will be reviewed monthly to determine if modification of the program is appropriate.

- Work with ZAR to install disposable tacky step-off runners/pads at the entrance to the building to limit the tracking of exterior dust into the building. Should the building refuse to implement this recommendation or ineffectively maintain the runners/pads, NYCLD should install and maintain runners/pads in the lobby on each of their floors.
- Provide employees access to a maintenance staff member with a HEPA equipped vacuum cleaner. Inspection and testing has determined that minimal dust exists in the NYCLD space and dust sampled subsequent to re-cleaning operations does not contain elevated concentrations of asbestos or metals. However as a precaution, suspect accumulations of dust/debris identified during re-occupancy of individual work areas should be cleaned using a HEPA equipped vacuum and/or wet-wiping techniques.

Appendix A

Data Tables

Appendix B

Human Health Risk Assessment

Appendix C

Microbiological Investigation Report dated March 8, 2002

Appendix D

Laboratory Data

Appendix E

IT Results