



State of Utah

Department of
Environmental Quality

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Executive Director

DIVISION OF AIR QUALITY
Richard W. Sprott
Director

JON M. HUNTSMAN, JR.
Governor

GARY HERBERT
Lieutenant Governor

MEMORANDUM

DAQH-0249-07

TO: Utah Air Quality Board

FROM: Richard W. Sprott, Executive Secretary

DATE: April 13, 2007

SUBJECT: Variance Request – Okland Construction Company, Key Bank Tower Implosion

This variance request is to give Okland Construction and associated subcontractors relief from the fugitive dust rules during the implosion of Key Bank Tower located at 50 South Main Street, Salt Lake City, Utah using explosive methods for the implosion.

The Division of Air Quality (Division) received the variance request on April 6, 2007. Division staff has reviewed the variance request and associated dust control plan and recommend that the variance be approved.

Attachments: Variance Request, Block 76 Dust Control and Implosion Management Plan

Transmittal

Block 76
162 West South Temple
Salt Lake City, UT 84101

Project # J770
Tel: 236-4800
Fax: 359-2162

Date: 4/5/2007

Reference Number: 0017

Transmitted To

Bo Collins *Call*
Utah Division of Air Quality
150 N. 1950 W.
Salt Lake City, UT 84114-4820
Tel: 536-4000
Fax:

Transmitted By

Aaron Hall
Okland Construction Company, Inc.
162 W. South Temple
Salt Lake City, UT 84101
Tel: (801) 486-0144
Fax: (801) 486-7570

Acknowledgement Required

Package Transmitted For

Review, Approval

Delivered Via

Hand

Tracking Number

Item #	Qty	Item	Description	Notes
001	2.00		Variance Request	
002	2.00		Dust Control and Implosion Management Plan	

Cc: Company Name

Property Reserve Inc.

Contact Name

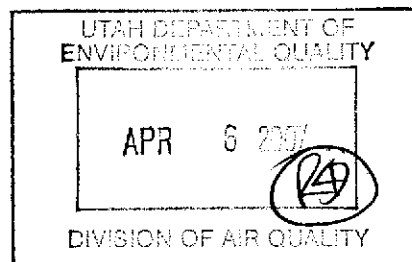
Andy Hartline

Copies

2

Notes

Remarks



Aaron Hall

Signature

4-5-07

Signed Date

3. Describe the business or activity for which the variance is requested. List all past, present, and future businesses and activities.

A variance from the fugitive dust requirements is requested for the implosion of the former Key Bank Tower (50 S. Main Street Tower). The Tower is a 20-story office and mall plaza building constructed of structural steel with concrete floors and a fiberglass façade. It is located on the eastern side of Block 76. The removal of the tower will provide space for new residences and retail shops on Block 76.

4. Describe the emission unit or process equipment or other units/equipment involved in the request.

Fugitive dust from the implosion of a building on a construction site.

5. State the rules or permit conditions (identify whether Approval Order or Title V) from which the applicant seeks relief.

Utah Administrative Code Rule R307-309-5, which sets limits for opacity on the property and at the property boundary, and from 307-309-8, which prohibits depositing materials on roads.

6. State the specific time period(s) for which the variance is requested.

August 18, 2007, from 5 AM to 11 AM

7. State why compliance with the rule or approval order from which variance is sought would produce serious hardship without equal or greater benefits to the public. If financial hardship, include itemized and total costs of compliance.

The variance is necessary because controlling fugitive dust from an implosion event is not possible. The most important reason for selecting the implosion process is safety (both public and worker). This 20-story steel structure can safely be imploded using a minimal amount of selective interior demolition and strategically placing explosive charges to trip the building and have it fall to the southwest just outside its existing footprint.

Because this building is a steel structure, conventional techniques would require that the building be dismantled similarly to the way it was constructed. Each structural member of steel will have to be cut using an acetylene torch and have a crane lower each piece to the ground. The concrete slabs will have to be broken by mechanical means and the rubble would be removed from the floor (either by the elevator shaft or off the exterior of the building).

This method would require workers to be exposed to great heights, the increase the risks of crane failure in dismantling the building, and places equipment on the building slabs under conditions for which they were not designed. One of the most dangerous tasks using conventional demolition would be the removal of the exterior skin, as it would be very difficult to control the large fiberglass sheets that could potentially become airborne, clearly presenting a danger to workers and the public. It is clear that Main Street (including TRAX) should be closed for portions of this demolition, leading to greater traffic congestion and pollution from vehicle emissions.

Lastly, the variance would shorten the project time four to five months and reduce costs \$800,000 to \$1,000,000.

8. List all possible alternatives in lieu of obtaining a variance. Discuss the advantages and disadvantages of each alternative. A cost estimate for each alternative must be included.

A variance would not be necessary using conventional demolition techniques; however, conventional techniques would:

- expose workers (and potentially the public) to safety hazards for up to five months;
- the noise generated by conventional techniques can be enough to disturb guests at the Marriot Hotel; using conventional techniques would disrupt the guests for an additional four to five months;
- interrupt and disrupt vehicle and pedestrian traffic along Main Street and haul routes, and
- cost \$800,000 to \$1,000,000 more.

While the variance would not be necessary if the demolition is conducted using conventional techniques, the total amount of fugitive dust leaving the property may be equal to or even greater than a single one time controlled event requiring a variance. Additionally, if cutting torches are required, the amount of PM₁₀ generated could exceed the estimated amount.

9. State the advantages and disadvantages to nearby residents if the variance is granted.

There are several benefits to the public: increased safety for workers and the general public; less inconvenience for the public, as it will reduce the amount of time that Main Street would have to be closed due to overhead work; and it will allow the local businesses to deal with dust for a very short period of time, rather than dust over a four to five month period.

The main advantage of the implosion process is that it will occur early on a weekend morning where there will be very little traffic or business/tourist activities. Also, most of the immediate surrounding area is business related (Marriott Hotel is a little different in the fact that they have overnight guests). The actual implosion would last less than a minute. There will be a dust plume resulting from the blast, but it will be a one-time event versus lower levels but with more continuous dust for 4 to 5 months.

A disadvantage would include limited site access for a few hours on a weekend day. However, compared to the alternative of disruptions that would be required to dismantle the building without implosion this may be seen as a good advantage.

Additionally, there may be a short-term increase in respirable dust, which should not pose a problem for healthy individuals. Some individuals with respiratory problems may need special care for a short period; however, precautions will be taken to ensure that no adverse health effects occur. Please see implosion management plan.

10. State how the applicant will reduce excess emissions to the maximum extent feasible during the period the variance is in effect.

Dust control measure will include the removal of all hazardous materials from the building and the removal of soft materials from the floors where charges will be placed. In addition, fire hoses will be used to wet the building site as soon as the "all clear" is issued after the implosion. Additionally, the building will be dropped into a bowl-shaped area, where the sides will tend to push the Initial Dust Cloud vertically where it will lose momentum and fall back into the construction area. Fugitive emissions from the construction site will be controlled through a Fugitive Dust Control Plan.

By closing roads and limiting traffic, dust that does move out of the Evacuation Zone will be quickly cleaned up, by pre-positioned cleanup crews as detailed in the attached Dust Control and Implosion Management Plan. The entire public area is scheduled to be cleaned up within 4 hours of the implosion, and likely much sooner.

11. State the facts showing why operations under such variance are not likely to cause a nuisance, as defined in 76-10-803, Utah Code Annotated.

76-10-803. "Public nuisance" defined -- Agricultural operations.

(1) A public nuisance is a crime against the order and economy of the state and consists in unlawfully doing any act or omitting to perform any duty, which act or omission:

(a) annoys, injures, or endangers the comfort, repose, health, or safety of three or more persons;

(b) offends public decency;

(c) unlawfully interferes with, obstructs, or tends to obstruct, or renders dangerous for passage, any lake, stream, canal, or basin, or any public park, square, street, or highway;

(d) is a nuisance as defined in Section 78-38-9; or

(e) in any way renders three or more persons insecure in life or the use of property.

(2) An act which affects three or more persons in any of the ways specified in this section is still a nuisance regardless of the extent to which the annoyance or damage inflicted on individuals is unequal.

(3) (a) Agricultural operations that are consistent with sound agricultural practices are presumed to be reasonable and do not constitute a public nuisance under Subsection (1) unless the agricultural operation has a substantial adverse effect on the public health and safety.

(b) Agricultural operations undertaken in conformity with federal, state, and local laws and regulations, including zoning ordinances, are presumed to be operating within sound agricultural practices.

* Amended by Chapter 183, 2002 General Session

The Implosion Event is being planned using the best available guideline (Philadelphia, 2002), specifically to prevent it from creating a nuisance, or endangering the public. The attached Dust Control and Implosion Management Plan carefully plans the event. All work will be carefully coordinated with all city police and fire departments, as well as with other interested parties. As such, it does not appear that the implosion will cause a nuisance as defined in 76-10-803.

12. The source is located in: a non-attainment area

a. If located in a non-attainment area, will emissions resulting from approval of the variance cause a new violation of the National Ambient Air Quality Standards? Include all supporting data and calculations, such as emission estimates and modeling data. Give the exact location of the activity or business for which variance is sought.

No, PM₁₀ emissions will be very low; see Appendix 1 of the attached Dust Control and Implosion Management Plan.

13. Is the variance request considered an emergency situation? () Yes (X) No

14. Are other regulatory agencies or permit authorities involved in the variance request?

() Yes (X) No

We do not believe there are other agencies involved in the variance request. We know that Salt Lake City will handle the issuance of our demolition permit. Our contact is Lisa Schaffer of Building Services and Business Licensing, Phone Number – 801-535-7752.

Aaron A. Hall 4-5-07
Signature Date

Aaron Hall
Name

Project Manager
Title

EXCESS EMISSIONS CALCULATIONS

Business Name: Okland 50 S. Main Street Tower Implosion

The following emission information must be provided by the applicant and filed with the variance application. Include a description of the methodology used to calculate emissions.

EQUIPMENT DESCRIPTION	AIR CONTAMINANT	EMISSION LIMIT	ACTUAL EMISSIONS ¹	EXCESS EMISSIONS ¹	EXCESS EMISSIONS FOR PERIOD OF VARIANCE ²
Demolition activities (See Appendix 1 of attached Dust Control and Implosion Management Plan	PM ₁₀	150ug/m ³ averaged over 24 hours	~6.2 kilograms		

¹ Express actual emissions and excess emissions in units of pounds per hour

² Express total excess emissions for period of variance in pounds per hour or tons per year



**DUST CONTROL
AND IMPLOSION MANAGEMENT PLAN
50 S. Main Street Implosion – Block 76
Salt Lake City, Utah**

April 6, 2007

Prepared for:

**City Creek Reserve, Inc.
Joseph Smith Memorial Building
15 E. South Temple
Salt Lake City, Utah 84150-4650**

**DUST CONTROL
AND IMPLOSION MANAGEMENT PLAN
50 S. Main Street Implosion – Block 76
Salt Lake City, Utah**

Written By:



**Kent Wheeler
IHI Environmental**

Reviewed By:



**Aaron Hall
Okland Construction**

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MAPS

- Map 1 Site Map
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FIGURE

- Figure 1 Project Organization

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- Appendix 1 Air Modeling Data
- Appendix 2 SLVHD Predemolition Form

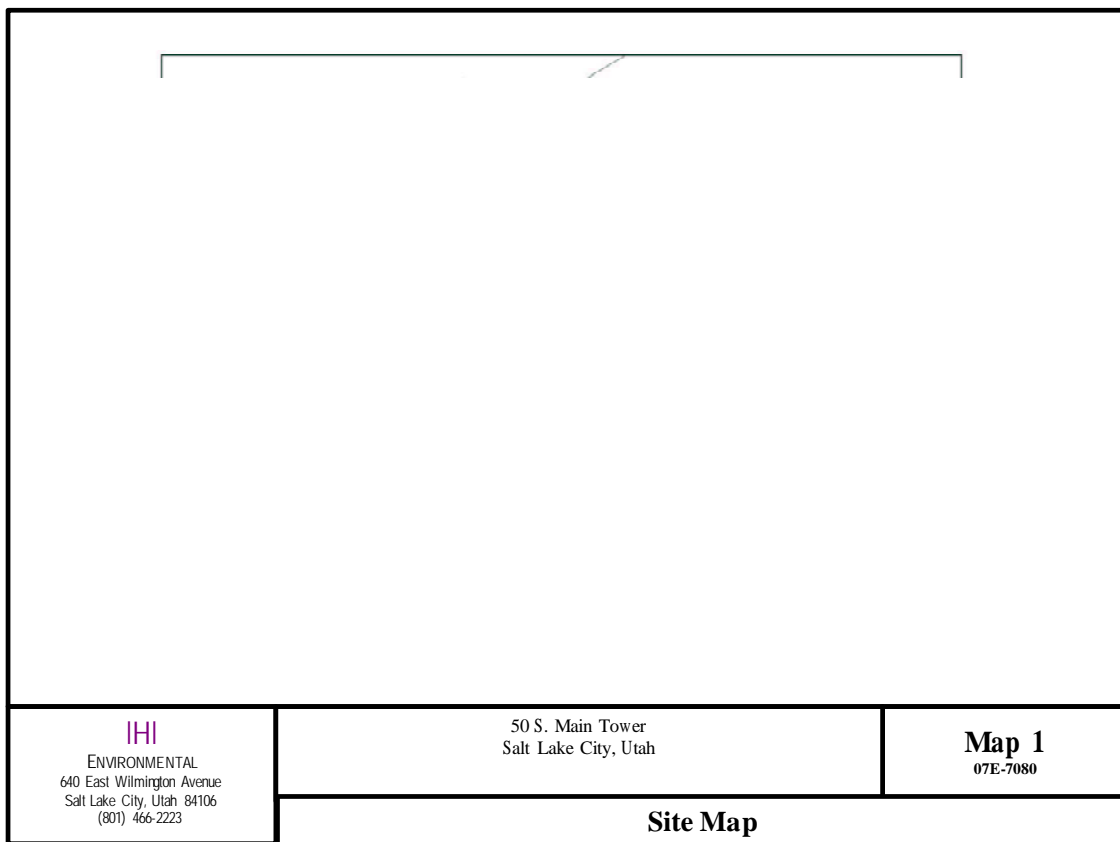
1.0 INTRODUCTION

The 50 S. Main Street Tower is a 20-story building located on the eastern side of Block 76; the bottom two floors of the Tower are part of the Crossroads Plaza building. City Creek Reserve, Inc. (CCRI) is redeveloping the Crossroads Plaza and surrounding areas as part of the City Creek Center development. The removal of the 50 S. Main Street Tower is an integral component of the redevelopment plan and will provide space for residential condominium towers and new retail shops on Block 76. The building is tentatively scheduled for implosion at approximately 6 AM on August 18, 2007.

The following Dust Control and Implosion Management Plan has been developed to provide guidance to Okland Construction for managing and controlling dust and dust impacts from the implosion of the 50 S. Main Street Tower. The Plan has been developed following the criteria outlined in the Guideline for Controlling Dust and Protecting Health at Implosions (Philadelphia, March 22, 2001).

Okland Construction Company, Inc. (Okland), a Salt Lake City firm, is the Construction Manager/General Contractor for Block 76. Grant Mackay Company (GMC) is a subcontractor to Okland for the demolition and removal of the selected buildings on Block 76. Controlled Demolition, Inc. is a specialty explosives subcontractor retained by GMC to implode the 50 S. Main Street Tower. IHI Environmental (IHI), a Salt Lake City environmental, health, and safety-consulting firm, has been retained to provide environmental consulting services.

Block 76 is located between Main Street and West Temple and South Temple and 100 South in Salt Lake City, Utah. The 50 S. Main Street Tower is along the east edge of this block in the center of the block, as shown in Map 1. While the majority of the structures on Block 76 will be demolished to allow for the construction of the City Creek Center, five buildings will remain on the block, and could potentially be occupied during the implosion. These buildings include the following: Gateway Tower West, Marriott Downtown hotel, Temple View Centre, McIntyre and Crandall buildings (Map 1). However, at the present time, the only buildings likely to be occupied are the Marriott hotel, and the Crandall and the McIntyre buildings.



IHI
ENVIRONMENTAL
640 East Wilmington Avenue
Salt Lake City, Utah 84106
(801) 466-2223

50 S. Main Tower
Salt Lake City, Utah

Map 1
07E-7080

Site Map

2.0 PROJECT MANAGEMENT

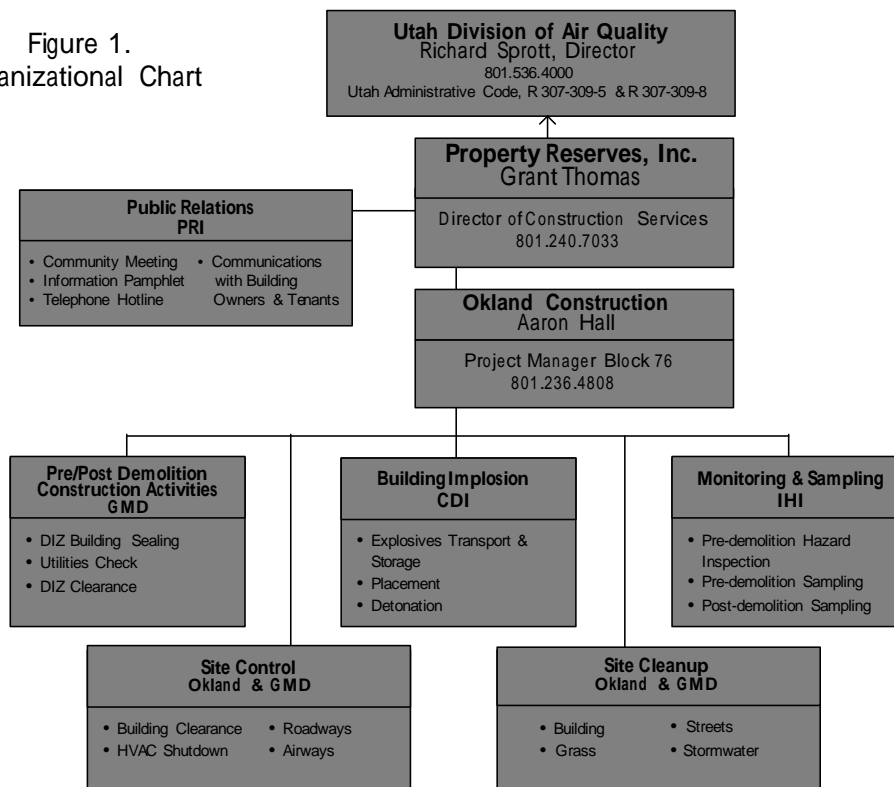
As previously mentioned, the City Creek Center is a redevelopment project by CCRI. Okland is acting as the construction manager/general contractor, and will implement the Dust Control and Implosion Management Plan. Okland has built a Project Team using GMC, CDI, and IHI to complete specific tasks as part of the Dust Control and Implosion Management Plan. Figure 1 outlines the project organization and specific tasks assigned to each company.

Contact names and numbers are provided in Table 2.1.

Table 2.1
Contact Information

Company	Contact	Address	Contact Information
City Creek Reserve, Inc. (CCRI)	Grant Thomas, Director of Construction Services	JSM Building 15 E. South Temple, Rm 800 SLC, UT 84150-4650	O: 801.240.7033 M: 435.901.4710 F: 801.240.7446 ThomasGC@pripd.com
Okland Construction	Dave Kasteler, General Superintendent, Block 76	162 West South Temple SLC, UT 84101	O: 801.236.4808 M: 801.381.7712 F: 801.359.2162 Dave.kasteler@okland.com
Okland Construction	Aaron Hall, Project Manager, Block 76	162 West South Temple SLC, UT 84101	O: 801.236.4808 M: 801.870.7848 F: 801.359.2162 aaron.hall@okland.com
Grant Mackay Company (GMC)	PJ Peterson, Project Manager, Block 76	2455 West 1500 South SLC, UT 84104	O: 801.364.0888 M: 801.509.2190 F: 801.364.1832 PJ@grantmackayco.com
Controlled Demolition Inc. (CDI)	Ray Zurowski, Field Operations Manager	2737 Merrymans Mill Phoenix, Maryland 21131	O: 410.667.6610 F: 410.667.6624 rdz@controlled-demolition.com
IHI Environmental	Ken White VP, IH and Safety	640 East Wilmington SLC, UT 84106	O: 801.466.2223 M: 801.558.1961 F: 801.466.9616 white@ihi-env.com
IHI Environmental	Kent Wheeler Environmental	640 East Wilmington SLC, UT 84106	O: 801.466.2223 M: 801.520.9389 F: 801.466.9616 wheeler@ihi-env.com

Figure 1.
Organizational Chart



3.0 BACKGROUND INFORMATION

The 50 S. Main Street Tower building is a 20-story building constructed with a steel framework and reinforced concrete shear walls. GMC evaluated conventional demolition methods for the 50 S. Main Street Tower, as well as the use of explosives. In general, conventional demolition methods for a building of this height were impractical, dangerous, time consuming, and not cost-effective. As such, imploding the 50 S. Main Street Tower is the best method of completing the demolition. Imploding buildings uses small explosives charges strategically placed on key supporting structural steel columns in the building. By eliminating these columns sequentially, the collapse of the building can be controlled; the building is brought down in a very short timeframe, then loaded and removed from the site, using conventional excavators and trucks. As part of the preparation process for implosion, many of the interior partitions will be removed, leaving only steel framework on specific floors to be treated with explosives. With the use of controlled explosives, the building will fall just outside its footprint toward the southwest. The debris pile will generally be within 30 feet of the existing building's footprint.

With conventional demolition, dust is slowly released over a much longer period, creating a situation whereby the surrounding community cannot take adequate protective measures to prevent the infiltration of dust to their properties. Imploding the 50 S. Main Street Tower should minimize the duration of impacts from dust. Furthermore, since dust released during implosion occurs only for a matter of minutes at a scheduled time, measures can be taken to adequately prepare and prevent the invasion of dust on surrounding properties.

Because this building is a steel structure, it would have to be "deconstructed or dismantled" similar to the way it was constructed. Each structural member of steel would have to be cut and lowered by crane to the ground. The concrete slabs would be broken by mechanical means and the rubble would be removed from the floor, either by the elevator shaft or a chute off the exterior of the building.

This method exposes workers to significant risks, including working at heights, the risk of building failure or crane failure during the dismantling of the building, and exposure to metal fumes.

Conventional techniques would take four to five months to remove the building, causing significant inconveniences to traffic, pedestrians and business in the downtown area, as well as the closure of Main Street on occasion. It is clear that a one-day implosion, with additional cleanup activities, offers the least amount of public disturbance when compared to other demolition options.

GMC estimated that the demolition of the 50 S. Main Street Tower using conventional means would take approximately four to five months and cost an additional \$800,000 to \$1 million.

3.1 Timing of Implosion

To minimize disruption of local life, Saturday morning was selected as the best day of the week. At this time, there is little commercial business being conducted in downtown Salt Lake City. While a slight disruption to downtown activities is possible, current scheduling suggests that all areas will be open before the initiation of most activities.

To best control the dust cloud that will result from the implosion, the ideal implosion time will have low and predictable wind speeds, a constant and predictable wind direction, and the weakest atmospheric mixing (most stable atmosphere).

From the weather data shown in Appendix 1, 6 AM appears to provide the ideal time for the implosion. Historical data from the top of the nearby LDS Church office building show a wind speed of 5.7 miles per hour, with the wind blowing from the southeast.

Because of the early timing, there should be a local ground-based inversion, leading to strong stability, probably Stability Category F.

3.2 Plume Modeling

Dr. Noel DeNevers, Consulting Engineer, was retained to develop a model of the plume generated by the implosion. His report is presented in Appendix 1. The report was used as the basis for determining the timing of the implosion, the expected direction of the plume, the distance that significant levels of dust are likely to be encountered (Dust Impact Zone (DIZ)), and the potential impacts to the ambient air quality in the Salt Lake Valley.

The model assumes a Gaussian plume model that does not well represent the complex nature of the explosion and resulting jets or air pushed from the building as it collapses; however, the model does allow us to understand the interaction of the plume with the atmosphere in a manner that will provide sufficient information for this project.

3.2.1 Initial Dust Cloud

The Initial Dust Cloud is dictated in large part by the jets of air forced from the building as it collapses. The size of this Initial Dust Cloud is important, as this is the area where the larger size particles will settle out, and is generally the area that will be evacuated.

A rule of thumb in the industry is the Initial Dust Cloud can be roughly estimated as having a height equivalent to that of the building, and could extend one building-width from the edges laterally in each direction. Mr. Ray Zuwkowski, CDI, confirmed this observation, stating that the Initial Dust Cloud rarely extends more than one times the lateral dimension of the building in each direction, and he has never observed one extend more than two times the lateral dimension of the building.

The building to be imploded measures 96 feet in width, 215 feet in length, and is 270 feet in height, and so could be assumed to produce, roughly, a 200 feet tall, 600 feet long and 300 feet wide puff. This estimate is in close agreement with calculations from the Air Plume Model, which suggests a spherical Initial Dust Cloud of 588 feet in diameter.

The actual shape of the Initial Dust Cloud will also depend on the nature of the building's collapse and the manner in which air is expelled from the interior. According to CDI, the geometry of the excavation to the west of the 50 S. Main Street Tower, into which the tower will be dropped, will easily contain the Initial Dust Plume, forcing the dust vertically where the energy will dissipate, and drop the dust back into the pit.

3.2.2 Dust Impact Zone

For the purposes of this plan, the Dust Impact Zone (DIZ) is considered the area where streets, sidewalks, and other horizontal surfaces underlying the plume, may need to be cleaned. According to Mr. Ray Zuwkowski, CDI, he anticipated that the Initial Cloud would

be easily contained within Block 76. However, for the purposes of this plan, the DIZ will be assumed to extend approximately 1,000 feet in all directions (Map 2). The actual cleanup is only expected to be required in a very small portion of this area that directly underlies the plume, and may not greatly exceed the Evacuation Zone (EZ).

3.3 Impact to Ambient Air Quality

The Utah Administrative Code (UAC) R 307-309 establishes standards for controlling Fugitive Dust in Non-attainment and Maintenance Areas for PM₁₀. Section 307-309-5 specifically limits opacity at property boundaries to 10 percent.

The opacity rule is designed in part to reduce PM₁₀ emissions, helping keep the Salt Lake Valley within the EPA-designated Ambient Air Quality Standards for PM₁₀ of 150 µg/m³. A variance from UAC 307-309-5 limiting opacity at the property boundary to 10 percent is being requested to allow for the implosion event. Based on CDI's experience with the typical meteorological conditions defined in the Air Plume Model, this plume is likely to dissipate within 10 to 20 minutes.

The Air Quality Model suggests that the 50 S. Main Street implosion will produce a dust cloud of 1.13 million cubic meters, with an average PM₁₀ concentration of 5,500 µg/m³, for a total release of 6.8 kilograms of PM₁₀. However, as the air mass rapidly mixes, this mixing would distribute this mass throughout the Salt Lake Valley air shed. The Model estimates the 24-hour average for PM₁₀ 200 meters downwind (~ boundary of EZ) would be 12.7 µg/m³ due to the implosion. However, the concentrations will return to nearly normal within 5 minutes of the implosion.

As seen in the Air Quality Model, the total increase in ambient PM₁₀ concentrations for the air shed would be less than 0.1 µg/m³, far less than the standard of 150 µg/m³. Even when added to the expected typical background of 38 µg/m³, no Ambient Air Quality Standards will be exceeded.

4.0 PRE-DEMOLITION HEALTH AND SAFETY PLANNING

Buildings often contain numerous potentially hazardous building components and materials, including asbestos-containing building materials (ACM), fluorescent light tubes and ballasts, chlorofluorocarbons (CFCs) associated with HVAC systems, and miscellaneous hazardous materials left by former tenants. The Salt Lake Valley Health Department (SLVHD) requires the identification and removal of these materials before demolition activities. CCRI is in the process of complying with the SLVHD requirements, and all hazardous building components and materials as identified by SLVHD will be removed before the implosion.

4.1 SLVHD Pre-demolition Building Inspection

The SLVHD uses a two-part Pre-Demolition Building Inspection Form to identify and verify the removal of potentially hazardous building components and materials. The inspection must be conducted by a SLVHD-certified inspector.

IHI has surveyed the entire building and completed the first portion of the two-step Pre-Demolition Building Inspection Form (Appendix 2). CCRI will oversee the removal of all identified hazardous building components and materials from the building, including friable and non-friable ACM, fluorescent light tubes and ballasts, transformers, CFCs, and miscellaneous wastes. Upon completion of the removal actions and prior to demolition, IHI will complete the SLVHD form and submit it to the SLVHD.

4.2 Occupied Buildings

As shown in **Figure 1**, there are five occupied buildings within the Evacuation Zone. Three of these buildings may be occupied during the implosion; therefore, special care will be taken to ensure the health and safety of the occupants. The buildings and their approximate distance from the 50 S. Main Street Tower are as follows:

Occupied Facility	Approximate Distance	Owner Contact
Gateway Tower West	130 feet due north	Kevin Scott Zions Securities Corporation 5 Triad Center, Suite 450 Salt Lake City, UT 84180 Office: 801-321-87 67
Temple View Centre	230 feet northwest	Kevin Scott Zions Securities Corporation 5 Triad Center, Suite 450 Salt Lake City, UT 84180 Office: 801-321-87 67
Marriot Downtown Hotel	145 feet south west	Steve Lundgren 75 South West Temple Salt Lake City, UT 84101 (801) 531-0800
Crandall Building	230 feet due south	Robert Crandall 10 West 100 South, Suite #619 Salt Lake City, UT 841 01 Office 355-8195
McIntyre Building	210 feet due south	Mel Pearson Zions Securities Corporation 5 Triad Center, Suite 450 Salt Lake City, UT 84180 Phone: 801-321-87 41

As discussed in **Sections 5 and 7**, precautions taken to protect the occupied buildings and their occupants will include sealing HVAC systems where appropriate, outreach programs to inform owners and workers of potential risks, and their avoidance, and informing the public and employees in the potentially occupied buildings of safe viewing options.

4.3 Special Medical Considerations

A program will be designed to identify individuals, and or buildings, that may have special needs, such as residents with respiratory diseases or other issues requiring special consideration. Okland will work with these issues on a case-by-case basis, ensuring that the medical needs are met. This may require assisting people in finding temporary shelter or helping with special transportation needs.

5.0 PUBLIC NOTICE AND OUTREACH

Individuals who live, work, and travel through the DIZ will be notified in advance of the implosion and will be given public safety information for the Pre-Event, During-Event, and Post-Event phases of the implosion. As part of the community outreach program, a list of buildings and owners will be compiled. A Community Outreach Pamphlet will be prepared and delivered to potentially impacted parties as determined by GMC (Sections 5.1-5.3). The Project Team will also plan and execute a media outreach plan, including a pre-implosion media briefing, prepare materials needed by the media for accurate news stories, and prepare an implosion day strategy for safe viewing and communication.

5.1 Community Meeting

The Project Team will publicize and host an open house meeting no less than five days in advance of the implosion to answer questions and distribute information (such as the Community Outreach Pamphlet) to potentially impacted individuals. The Community Outreach Pamphlet will be available at the community meeting.

5.2 Web Site and Hotline

The Project Team will place implosion information on the City Creek Center website (www.downtownrising.com/city_creek) and on the project's existing hotline (1-866-554-5588) and publicize these sources.

5.3 Distribution of Outreach Packets

As part of the site surveys described in Section 7, building owners in the likely plume area will be contacted and given the Community Outreach Pamphlet, as well as meeting directly with the Project Team to discuss the implosion, potential impacts, and safety measures.

5.4 Special Medical Considerations

Through door-to-door canvassing, the open house meeting, and other communication tools, the Project Team will identify individuals in the DIZ with special medical considerations. The Project Team will advise and/or make special arrangements for these individuals.

6.0 CONTROL ZONES

To control hazards associated with the implosion, two control zones will be delineated as follows:

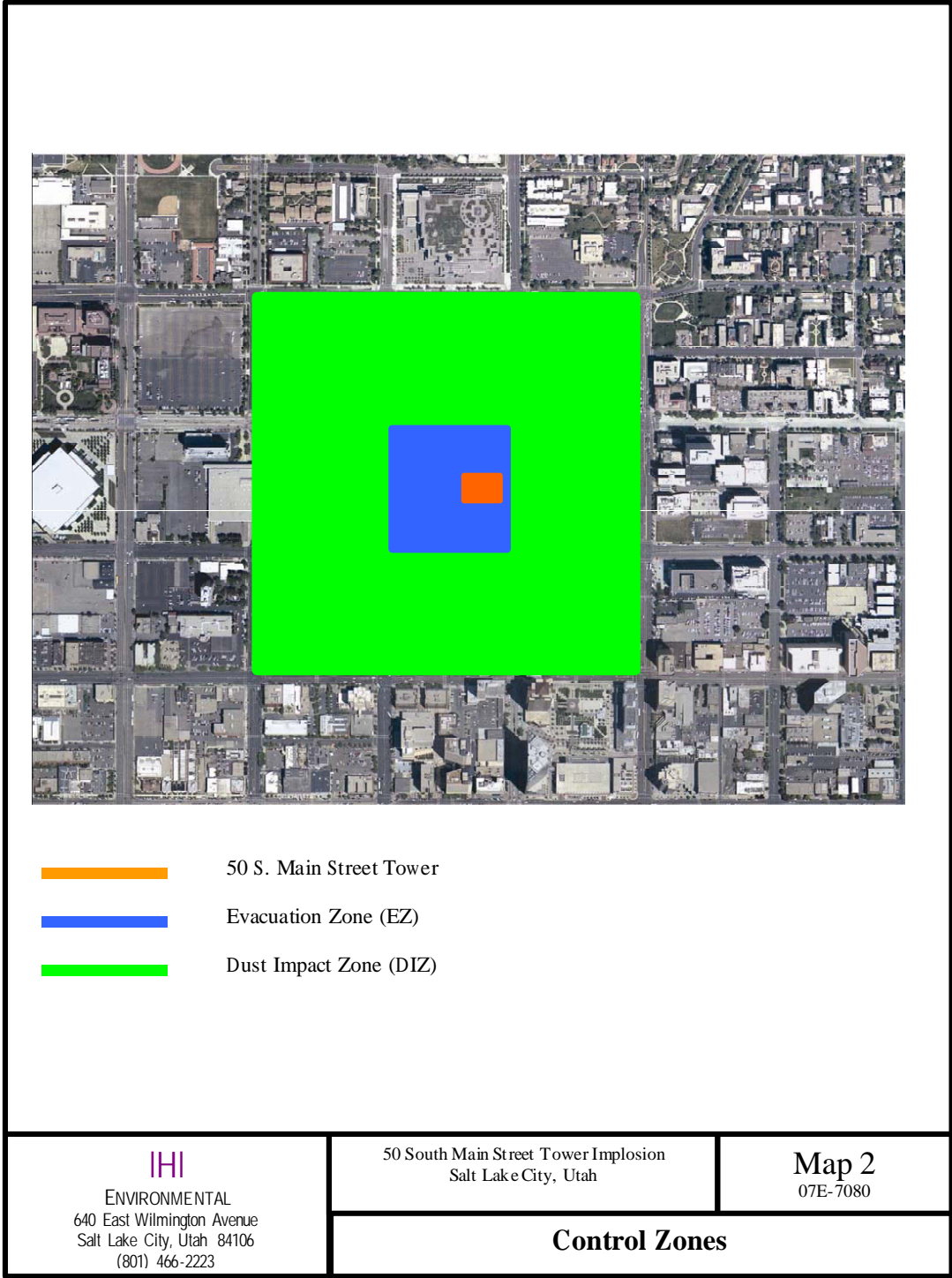
1. Evacuation Zone (EZ)
2. Dust Impact Zone (DIZ)

It should be noted that these zones are based on expert knowledge of CDI, models generated for evaluating the plume produced by this implosion event, and actual site conditions. The delineation for the zones are conservative and take into account a wide variety of variables, such as wind direction and speed, building construction, and the configuration of the site. The defined zones should be considered conservative estimates; however, no activities will be specifically defined by the planning estimates, but rather by actual field conditions. The zones will be re-evaluated on the morning of the implosion to determine if conditions are still acceptable.

6.1 Evacuation Zone

The Evacuation Zone shown on Map 2 generally will be defined as the area that is likely to contain the Initial Dust Cloud from the implosion. In this area, turbulent flow of air is expected to transport large amounts of dust that will be deposited as the blast of air loses its momentum by mixing with the surrounding air. In this area, a heavy deposition of materials is expected. The Implosion Plan has been designed to drop the building in a hole that has been created in the center of Block 76 just southwest of the 50 S. Main Street Tower.

As discussed in Section 3.2.1, the cloud can be roughly estimated based on the building's geometry. The building to be imploded measures 96 feet in width, 215 feet in length, and is 270 feet in height, and so could be assumed to produce, roughly, a 200 feet tall, 600 feet long and 300 feet wide Initial Dust Cloud. The actual shape of the Initial Dust Cloud will also depend on the nature of the building's collapse and the manner in which air is expelled from the building's interior. As the building is being dropped into a bowl-shaped excavation, little dust deposition outside of Block 76 is expected.



To account for variable shapes, the EZ will encompass all of Block 76. This zone will be extended to the east to include Main Street on the morning of the implosion following the last TRAX train. Because CCRI, or affiliated entities, control much of the surrounding area within the likely footprint of the Initial Dust Cloud, control of this area should be easily managed.

The EZ area is well controlled as it is an active construction site and is inaccessible to the general public. Only authorized personnel will be allowed in this area during the implosion event. Within this area, businesses will be encouraged to vacate until post-implosion cleanup has been completed. However, it is recognized that certain businesses in this area may choose not to vacate, in which case occupants will be allowed to “shelter in place.” Buildings in this area will be protected using a variety of methods, including leaving existing walls, erecting curtains and barriers, as well as other appropriate methods.

6.2 Dust Impact Zone

Based on the experience of CDI, significant dust accumulations requiring cleaning are not anticipated outside of the EZ. Due to site features, the DIZ has been conservatively extended to over 1,000 feet around the 50 S. Main Street Tower.

Presently, the DIZ is designated as extending from North Temple to 200 South and from 200 West to State Street. However, the final boundaries of the DIZ will be determined through discussions with the Salt Lake City Police Department, and will depend largely on crowd control issues.

The DIZ, shown on Map 2, is the area outside of the Evacuation Zone that will most likely be impacted by the dust cloud. Building occupants will not be evacuated in the DIZ, but building owners will be contacted regarding the use of HVAC systems during the implosion event. The site survey work (Section 7) may identify some buildings in this area that also require additional protections.

Police will secure the DIZ perimeter. No non-authorized entry or traffic will be permitted beyond this line, except where occupied buildings are present. No street parking will be allowed in this area.

7.0 IMPLOSION ACTIVITIES

7.1 Site Survey

As part of the implosion activities, the Project Team will complete an evaluation of all buildings within the DIZ. The evaluation will include identifying owners, uses of the building, and the likelihood of impacts to the buildings and occupants. Based on the results of the evaluation, building owners in the likely plume area or buildings with sensitive populations will be directly contacted to identify at-risk HVAC systems and sensitive receptors. GMC will lead a team of representatives to evaluate each of the identified buildings and discuss implosion day events and concerns with the building owners of susceptible buildings within the DIZ. GMC will use this information to determine the level of effort needed to protect each of these buildings during the event. Photographs will be taken during the site survey, as well as at other times to help document pre-event conditions.

7.2 Perimeter Control

GMC will coordinate perimeter control with the Salt Lake City Police Department (SLCPD). Control points will be in place around the DIZ two hours prior to the planned event. Details of the perimeter control enforcement will be worked out with the SLCPD. Contact information for the SLPD is provided in Section 9.

The locations of control points in the DIZ will be determined in conjunction with the City, police department, and surrounding property owners. Traffic and street parking will be limited in the DIZ after the control points have been set up. If car towing is necessary, the cars will be placed in a lot on Block 85, and the owners can freely access the vehicles after the implosion event. No cars will be towed unless they appear to be in the likely deposition area.

7.3 Evacuation Plan

As CCRI controls most of the area, no enforced evacuation is planned. Okland will work with property owners to limit access to the buildings in the EZ and DIZ during the event. For people sheltering in-place, efforts will be made to keep the inhabitants in the building with

closed doors and windows during the implosion event. If there are any “issues,” GMC will work with the SLCPD to encourage the evacuation of the EZ and surrounding DIZ. Specific details of the EZ enforcement will be worked out with the SLCPD.

It is recognized that several businesses will continue to operate within the EZ. Oakland will work with these businesses to inform people sheltering in-place about the potential risks to which they may be exposed, including demolition issues, shock waves, dusty conditions, power outages, other disruption of utilities, and difficulties in access (movement). The evacuation plan and reoccupation plan will be discussed with adjacent property owners and the SLCPD. The access and confinement issues will be further refined through these discussions.

7.4 HVAC Protection

As the duration of dust in the area is a direct function of the prevailing wind, adjacent structures, which are situated upwind from the implosion, will not be affected to the extent of those structures downwind. HVAC protection will be based on the modeled plume direction (north to west), as well as certain special considerations that may be identified during the community outreach.

As the dust cloud generated by the implosion will “plume” vertically and then will settle, HVAC systems located on high-rise buildings will be able to go back into operation within 10 to 15 minutes following the implosion. Other dust cleanup on streets and other horizontal surfaces may take up to two to four hours, following the implosion.

HVAC systems within the EZ will need to be shut down for a short duration during the actual implosion while buildings within the DIZ will be evaluated to determine whether closing existing windows, doors, and vents prior to the implosion will be sufficient. While creating an inconvenience, the early morning implosion time should reduce problems associated with non-operating HVAC systems.

During the site survey, HVAC systems within the EZ and DIZ will be identified and the risk of dust infiltration evaluated. If additional protection is needed beyond closing vents and louvers, the systems shall be covered and protected. GMC will notify and coordinate with

the adjacent property/building owners prior to the day of the implosion to make sure their building's HVAC systems are protected. Photos will be taken for legal purposes.

Following the implosion, HVAC covers will be removed immediately after the dust cloud has cleared the area. In no cases, should a system be shut down for more than an hour following the implosion.

7.5 Dust Control

Steps will have been taken prior to the implosion to reduce the total volume of material that could create dust by performing some soft demolition on the blast floors. This includes the lower level of the 50 S. Main Street building, Level 2 and Level 7. Immediately after the building falls and the "All Clear" signal has been given, fire hoses will be directed onto the implosion site to reduce fugitive dust. Personnel will begin to wet down the debris pile at the building's location in order to mitigate post-implosion dust. Settled dust in the construction area west of the 50 S. Main Street Tower will also be wetted as per the Fugitive Dust Control Plan for the Block 76.

Additionally, steps will be taken immediately after the implosion to remove settled dust from the streets. The City's Streets Department will be contracted to assist in the cleanup after the implosion. Presently, it is estimated that all streets will be cleaned within four hours of the implosion.

7.6 Post-Implosion Cleanup

The cleaning and sweeping will commence after the dust cloud has cleared the DIZ (~5 to 15 minutes). A number of cleanup crews will be stationed generally in a downwind direction the morning of the implosion. Immediately following the implosion, the crews will start cleaning impacted streets and sidewalks to allow for the re-population of the area. Based on the geometry of the excavation that the 50 S. Main Street Tower is being dropped into, little dust is expected outside of the EZ. Although the plume is variable and dependent on many meteorological conditions, it is highly unlikely that the clean up area will need to be extended outside of the DIZ.

Okland will coordinate the cleanup with cleanup activities being supervised by GMC. Okland will take the lead on communications with all City departments, cleanup contractors, and public officials. However, GMC will have a large number of people in the streets and will work closely with the SLCPD regarding site security. Because the dust cloud will be highly variable, the areas to be cleaned will be subjective. All streets and sidewalks with significant visible dust deposition will be cleaned. Okland will make this subjective determination of all areas needing cleaning.

To minimize the disruption to business and the public, the focus of the immediate cleanup efforts will be the DIZ and publicly accessed areas in the EZ (i.e., businesses). Dust deposited in the work areas of the EZ will remain in place until removed as part of the redevelopment activities. Dust in this area is controlled under the Fugitive Dust Control Plan for Block 76.

7.6.1 Priorities

The first priority will be to clean streets and sidewalks to allow pedestrian traffic to return to normal as quickly as possible.

7.6.2 Street /Sidewalk Cleaning Procedures

The water trucks and street and sidewalk sweepers will be deployed to clean all streets significantly impacted by dust within the DIZ. The cleanup procedures will depend on the degree of dust impact; however, in general, the sequence for street cleaning will be as follows: street sweepers will be deployed, using a light mist to moisten the dust in the street which will then be swept and picked up by the vacuum truck. Sidewalks will be cleaned in a similar manner with the exception that the personnel with hand brooms and push brooms will be present to clean out corners and other inaccessible areas.

A project-specific Storm Water Pollution Prevention Plan (SWPPP) will be prepared for the cleanup activities. Following the initial sweeping, the streets and sidewalks will be washed using water trucks. To contain stormwater runoff, filter socks or other best management practices (BMPs) will be used at all stormwater drains. Following the washing, BMPs will

be removed, a clearance inspection will be made, and Okland will instruct the police to remove pedestrian and traffic restrictions.

7.6.3 Lawn and Garden

Vegetated areas that accumulate significant amounts of settled dust will be rinsed to prevent the dust from becoming airborne. The dust itself should not have any adverse effects to plants.

7.6.4 Clearance Inspection

The public will not be allowed to return to the DIZ until the streets have been cleaned and inspected and the area is pronounced safe from utility hazards. When these conditions have been met, Okland will ask the SLCPD to remove the control points and allow the area to be repopulated.

The clearance inspection will be a visual inspection of the area by Okland personnel. It should be noted that the atmospheric deposition of dust occurs daily in the Salt Lake Valley. Care will be taken to identify the streets and sidewalks impacted by the implosion and to verify that appropriate cleanup actions have been taken.

If deemed necessary by Questar Gas Company, Salt Lake City Public Utilities, or Rocky Mountain Power, the areas will also have a utility clearance as part of the clearance inspection.

7.7 Personnel Protection

Cleanup crews will follow their company health and safety plan.

7.8 Contingency Plan

Because of the expected stable wind conditions, planning for the implosion will focus on the plume moving in a northwesterly direction. The plan also assumes low but measurable wind speeds, stable atmospheric conditions, and well-controlled crowds. All of these assumptions will be fully reviewed before the implosion.

8.0 AIR AND SURFACE MONITORING PLAN

A detailed Air and Surface Monitoring Plan has not been fully developed; however, an outline is provided below. The final Plan will be completed and submitted to DAQ at least one month prior to the implosion for review and comment. Following the implosion, the data will be tabulated and summarized in an Air Monitoring Sampling Report. The results will be available as they are received, and the report will be provided to DAQ within 90 days.

8.1 Introduction and Objectives

The objectives of the Air and Surface Monitoring will be two-fold: to measure the effect of the Event and the cleanup activities on air quality and to document concentrations of potential "hazardous components" released during the Event. The data collected will be used to document the impacts of the implosion on the air quality and document potential health threats.

As is seen in **Appendix 1**, a large volume of dust will be generated; however, the total mass of respirable particles less than 10 microns in diameter is anticipated to be less than 7 kilograms due to the inefficiencies of generating this small particle size by mechanical means. A small but potentially measurable increase in respirable dust is anticipated but only for a short period immediately following the implosion. The air quality parameters of total suspended particulate (TSP), particulate matter less than 10 microns in diameter (PM₁₀), and particulate matter less than 2.5 microns in diameter (PM_{2.5}) will be monitored for a five-day pre-Event and five-day post-Event monitoring period.

Due to stringent criteria for the assessment and removal of hazardous building materials discussed in **Section 4** of this Plan, it is anticipated that no appreciable release of asbestos, lead, PCBs, volatile organic compounds, mercury, or other potentially hazardous building materials will occur as a result of the demolition. However, there may be a large, local, but short-term increase in total dust, respirable dust, and, possibly crystalline silica levels. Nonetheless, given the sensitivity of the public to the potential release of contaminants, lead, asbestos, total dust, respirable dust, and free crystalline silica (FCS) will be measured before, during, and after the implosion.

Settling plates will be located at air sampling stations to assess the impact of the implosion on surface soiling. The dust-fall method is superior to the wipe-sampling approach since it controls for pre-existing contaminants on surfaces and for spatial variability in surface contaminants. In this approach, a clean metal canister is opened and placed on surfaces just prior to the implosion; the canister remains open for approximately one-half hour, or until all visible traces of dust from the implosion have dissipated. In the downwind direction, materials that settle onto the canister would be predominately materials suspended by the implosion. Upwind canisters would serve as a measure of background deposition, which would likely be non-detectable, given the short sampling period.

Two meteorological towers will record wind speed and direction: the first at a 5-meter height, the second on one of the taller buildings nearby. The towers would be placed in open areas, such that wind speed and direction would not be significantly affected by nearby buildings or structures. Wind speed and direction will be monitored up to the moment of the implosion, allowing the best prediction of where the plume is likely to travel. This information will be used to determine the best location for the mobile "downwind" air sampling station, as well as to advise personnel and spectators outside of the Evacuation Zone that they may wish to relocate to avoid the dust plume.

8.2 Monitoring Approach

In general, sufficient sampling will be conducted to establish baseline conditions; intensive sampling will be conducted during the Event, and post-Event sampling will be performed to determine if any significant impacts remain.

8.2.1 Air Quality

Pre-Event, Event, and post-Event air quality samples will be collected at two fixed locations, using MiniVols™ Portable Air Samplers for TSP, PM₁₀ and PM_{2.5}. MiniVols™ sample ambient air at 5 liters/minute for particulate matter (TSP, PM₁₀, PM_{2.5}). While not a reference method sampler, the MiniVols™ gives results that closely approximate data from Federal Reference Method samplers. Lightweight and portable, the MiniVols™ is ideal for sampling locations where no permanent site has been established. The two fixed-air quality

monitoring locations will be selected based on expected wind direction and ability to locate secure locations. These air quality samples will be collected for five days before the implosion, the day of the implosion, and for five days following the implosion. Samples will be collected for 24 hours. Short-term Event sampling may vary to allow for greater information-gathering during an unusual Event.

8.2.2 Hazardous Constituents

Pre-Event, Event, and post-Event hazardous constituent air samples will be at up to eight fixed locations for asbestos, lead, respirable dust, and free crystalline silica. Baseline samples will be collected within one or two days of the implosion date, over an 8-hour duration that will include the planned time of the implosion (e.g., 6:00 AM to 2:00 PM). The Event samples will be initiated before the planned implosion time and will continue to run up to about 2 hours after the implosion. Short-term Event sampling may vary to allow for greater information gathering during the implosion event. Post-Event sampling will be performed at the completion of clean up operations. These samples will have an 8-hour duration.

Mobile Event hazardous constituent air sampling will be conducted at susceptible receptor locations that are identified through the site survey or outreach program to assess actual concentrations in buildings or at other locations. The locations will be based upon information identified during the community outreach (Section 5) and the building surveys (Section 7). These mobile sampling sites will be selected shortly before the Event based on wind direction. Analysis may vary based on the receptors. Presently, it is assumed that there will be four mobile sampling stations.

8.2.3 Dust Distribution

Up to 10 settling plates will be located to help determine dust loading from the Event. The plates will be located within the EZ and DIZ to help identify the dust deposition pattern. The plates will be analyzed for total mass, lead, and % FCS. Sample duration will be approximately one-half hour.

While samples will be collected at all sampling stations during the Event, all of the samples collected during the Event may not be submitted for analysis. It is anticipated that only those samples in downwind directions are likely to be impacted by the plume, with other “upwind” stations essentially measuring background conditions. Only one or two of these upwind samples will be analyzed, since they are unlikely to show detectable levels.

8.3 Sampling Stations

Sample stations have not been determined, but will be selected based on locations relative to suspected dust cloud, security, and potential receptors.

8.4 Methods

Air sampling will be performed using lightweight battery-powered equipment, such that sampling stations can be quickly and easily deployed, without the need for arranging hard-wired electrical power at each station. While battery-operated equipment provides lower air sampling rates than line-voltage equipment, it is felt that sensitivity and limits of detection will be sufficient due to the high concentrations of dust that will be present in the plume.

Table 8.1 provides details on sample collection methods, equipment used, air-flow rates, and laboratory analyses.

All flow rates will be calibrated using precision rotameters and dry cell flow calibrators. All analyses will be performed by AIHA- and/or EPA-accredited laboratories. Air quality samples will be analyzed using Chester LabNet, Tigard Oregon. Local laboratories will be used for asbestos and other hazardous constituents.

Table 8.1 Sampling and Analytical Methods

Analyte	Collection Media	Equipment	Flow Rate (LPM)	Analytical Method	Analytical Technique
TSP, PM ₁₀ , PM _{2.5}	47 mm filter Teflon □	MiniVols™ Portable Air Samplers	5.0	IO 3.1	Gravimetric
Total Particulate/ Lead	Match-weight 0.8 um, 37 mm MCE filter	Batt.-Operated Pump	4.0	NIOSH 0600 NIOSH 7082	Gravimetric/ AA Spectroscopy
Respirable Dust/ FCS	Pre-weighed 5.0 um PVC, 3- piece cassette	Batt.-Operated Pump, SKC aluminum cyclone	2.5	NIOSH 0600 NIOSH 7500	Gravimetric; X- Ray Diffraction
Asbestos	0.8 um MCE, 25 mm	Batt.-Operated Pump	4.0	NIOSH 7400 NIOSH 7402	PCM & TEM re- analysis
Total Mass, sieve and total lead	Settling Plates	Settling Plates		EPA 6000 Series	AA Spectroscopy

9.0 COORDINATION WITH CITY, SAFETY AND UTILITY PERSONNEL

9.1 Coordination with City

The Salt Lake City Transportation Department was contacted to determine if they had requirements for the transportation of explosives through the City. They stated that the City must approve and execute the final plan for road security and closures at the time of demolition and they requested that a plan regarding proposed road closure locations and times be submitted. The City noted that they do not have a formal submittal process, but a simple plan, which the department can review and return with comments, will suffice.

The City Events Coordinator was also contacted. She mostly coordinates parades, filming, etc., but also works with the police department to set up perimeter controls and other restrictions.

9.1.1 City Contact

The City Transportation Department contact is Scott Vaterlaus (801-535-7129). He coordinates safety and approves the explosives transport and security and zone closures around the areas of implosion. Shawn McDonough (801-972-7845) is the City Events Coordinator.

9.2 Coordination with Police Department

The Salt Lake City Police Department was contacted regarding the planning for the implosion event. They directed Okland to contact the City Events Coordinator and she would work with the police department regarding street closures and security. The Project Team will work closely with the police department to ensure security around the DIZ.

9.3 Coordination with Fire Department

The fire department was contacted to initiate the coordination of safety oversight and emergency response and equipment, if necessary. The department indicated that they plan to be on site during the implosion in case deployment of emergency fire and paramedic equipment becomes necessary. They will coordinate with their on-duty platoon to be present

as soon as they are made aware of the implosion date. They also indicated that they would coordinate with the police department.

9.3.1 Fire Department Contact

The fire department contacts are Kim Matthews of the Fire Prevention Division, who can be reached at 801-799-4150 (cell 801-330-2405) and Deputy Chief Littleford, who can be reached at 801-799-4202.

9.4 Federal Aviation Administration

The Federal Aviation Administration (FAA) was contacted in an attempt to ensure the building implosion would not interrupt aviation airspace. The FAA noted that there was no federal airspace directly above downtown Salt Lake City, but that a completed Airspace Evaluation Form would be helpful, especially if the event might interrupt airspace more than 200 feet above ground level. The Airspace Evaluation Form is located at www.oa.faa.gov (Form 7460-1, Notice of Proposed Construction or Alteration). The form will need to be completed and filed 30 days in advance to allow for processing time.

9.4.1 FAA Contact

The Federal Aviation Administration contact is Marsha Hofer, Airspace Specialist, of the FAA Denver office, who can be reached at 303-342-1251.

9.5 Utility Contacts

In order to ensure that natural gas, water/sanitary waste, and electrical supplies are protected and not interrupted due to the implosion, the following utility companies have been contacted.

9.5.1 Questar Gas Contact

Craig Johnson (801-324-3841) handles construction operations for Questar Gas. He indicated that he thinks all the gas lines in the area have been disconnected except for lines into the building to the north of the 50 S. Main Street Tower, although there might still be a

meter in the 50 S. Main Street Tower. Due to the ground shaking associated with the implosion and the potential to disrupt natural gas piping, Okland will ask Questar Gas to have personnel available for the implosion event.

9.5.2 Electrical

Rocky Mountain Power was contacted regarding the electrical conduits. Due to the ground shaking associated with the implosion and the potential to disrupt electrical supplies in the downtown area, Okland will ask Rocky Mountain Power to have personnel available for the implosion event. Jake Barker (801-220-2080) is the project coordinator for Block 76 for Rocky Mountain Power.

9.5.3 Public Utilities

Brad Stewart (801-483-6733), of the Public Utilities Division of Salt Lake City Corporation, is overseeing the public water utility disconnection of Block 76, where 50 S. Main Street Tower is located. Due to the ground shaking associated with the implosion and the potential to disrupt subgrade piping, Okland will ask the Salt Lake City Public Utilities Division to have personnel available for the implosion event.

9.6 UTA TRAX

UTA TRAX was contacted regarding the use of the TRAX Light Rail. UTA noted the TRAX lines have high voltage electrical lines immediately overhead. These lines will require special precautions. Okland will work directly with UTA to ensure electrical hazards are accounted for properly.

9.6.1 TRAX Contact

The UTA TRAX coordinator is Mr. Jeff LaMora (801-287-6638)

A P P E N D I X 1

Air Modeling Data

Air Quality Modeling for the 50 S. Main Street Implosion
Noel de Nevers, Consulting Engineer

Air Quality Modeling for the 50 S. Main Street Tower Implosion

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Introduction

In August of 2007 the contractors for the demolition of the 50 S. Main Street Tower plan to use a controlled implosion to reduce the approximately 20-story building to a ground-level rubble pile. This report presents the results of an air quality modeling effort, which predicts the behavior of the dust plume to be produced by that implosion.

The Nature of Building Implosion Clouds

As a building is imploded, almost all of the air in it is ejected in a few seconds, mostly close to ground level. This forms a pancake-shaped dust cloud, along the ground, centered on the rubble pile of the building. For the next few seconds this cloud expands radially, driven by the momentum of the outflowing air. The front of the expanding cloud mixes with the air it encounters, so that the front slows down as the volume of the cloud expands. Eventually the cloud stops expanding, because of this mixing with non-moving air and, because in a radial geometry, an expanding cloud loses velocity. The first part of the process ends when the cloud stops expanding because of its initial momentum.

Figures 1 and 2 (Courtesy of Mr. Ray Zulkowski of Controlled Demolition Incorporated (CDI) show the Broadway Building in Baltimore, MD, being imploded on August 19, 2000 (all Tables and Figures are at the end of the report). This building is chosen as an illustration because investigators from the Johns Hopkins School of Public Health monitored its dust cloud and published the results (Reference 1; all references are listed at the end of the report). In Figure 1 the internal explosions, which selectively weaken the structure so that it will collapse inward, are venting at several places, the building has begun to rotate clockwise (as seen by the photographer) and a large cloud has begun to exit the building at ground level at the right (behind the 1-story parking structure between the photographer and the building).

Air Quality Modeling for the 50 S. Main Street Implosion
Noel de Nevers, Consulting Engineer

In Figure 2, only a few seconds after Figure 1, the building has completely collapsed to a neat rubble pile and the dust cloud has ended its momentum expansion. By scaling on these photos from the known height of the building (281 ft), one finds that the dust cloud (looking north) is about 100 ft high and about 350 ft wide. Other evidence (discussed below) suggests that the cloud extended at least 160 m (515 ft) to the north, behind the view shown here. Thus, from all the available evidence, it appears that the cloud was about 100 ft high, 350 ft wide and about 615 ft long.

The cloud is not a tidy rectangle, nor is its top uniformly flat, reflecting the non-uniform escape of the air from the lower floor(s) of the collapsing building. The much less-dense vertical cloud above the center of the main cloud is presumably the remnant of the dust cloud ejected from the building while it was still standing and as it fell, as shown by the faint wisps in Figure 2.

The estimated cloud volume was about 8 times the volume of the building before collapse. This suggests that the out-flowing cloud from the base of the building, whose initial volume must have been equal to the building's volume, mixed with 7 times its own volume as it expanded and slowed down.

Estimating the particle content of the cloud

The EPA Emission Factors site (2) explicitly states that it has no emission factor data or estimates for building demolition, including implosions; that standard and widely accepted source of emissions estimates is of no use to us here. This report uses the Johns Hopkins School of Public Health paper, (1) which reports ambient measurements in the vicinity of the demolition shown in Figures 1 and 2 to estimate PM_{10} emissions. The only pollutant they measured was PM_{10} ; the larger particles that make up most of the solid mass and appearance of the cloud are a local nuisance but not a recognized or regulated air pollutant.

Figure 3 shows the PM_{10} concentrations (based on nephelometer measurements) for three sites north of the demolition (H 1, 2 and 3) and three sites south of it (C 4, 5 and 6) as a function of time. During the whole time shown on this plot, the wind blew from the north, at speeds from 4 to 11 mph. Based on the time for plume peak values to arrive at various sampling points, the authors estimated that the plume moved an average of 5.8 mph. From this plot we see:

1-The H3 site, 300 meters north northeast of the demolition (upwind) did not detect the plume.

2-The H1 site, 100 meters north of the demolition on a 3rd floor patio, detected three successive peaks, the first 54,000 micrograms/cubic meter ($\mu\text{g}/\text{m}^3$), the second about 20,000, the third about 5000 over an interval of about 2 minutes.

3-The H2 site, 160 meters north northeast of the demolition, recorded a somewhat flat peak of about 5000 $\mu\text{g}/\text{m}^3$, which began about the same time as H1, and lasted about 5 minutes.

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Noel de Nevers, Consulting Engineer

4-The C4 site, 475 meters south of the demolition, measured a concentration of about 1000 $\mu\text{g}/\text{m}^3$ over about 4 minutes, starting about 5 minutes after the demolition.

5-Sites C5 and C6, 825 and 1130 m south of the demolition recorded lower concentration peaks, which arrived 5 and 7 minutes after the demolition.

The plot makes clear that these were not tidy peaks, but had many subspikes, indicating that the plume was anything but well mixed. However, to make quantitative estimates, the complicated picture (reality) on Figure 3 is replaced with an idealized plume, as described above, 100 ft high, 350 ft wide and 615 ft long, with a PM_{10} concentration of 10,000 $\mu\text{g}/\text{m}^3$ at its north end and 1000 $\mu\text{g}/\text{m}^3$ at its south end, for an average concentration of 5500 $\mu\text{g}/\text{m}^3$. Such a cloud would have a total of 3350 g of PM_{10} . Based on that 3350 g of PM_{10} , the implosion had an emission factor of 0.0013 g/cubic foot of building imploded.

While this emission factor is clearly speculative, it is unlikely to be wrong by a factor of 100, and probably is within a factor of 10 of the correct value. We may also observe that such buildings normally weigh about 75 lb/square foot of floor, so that the building weighed about 16 million pounds; based on this emission factor about 0.5 part per million of the building was converted to PM_{10} . This should not surprise us; mechanical processes like demolition are very inefficient at producing particles 10 microns and smaller. Most such particles are the result of combustion processes.

Figure 2 also illustrates the different characters of the ground-level plume and the vertical plume above it. The ground-level plume presumably contains many large particles produced by the demolition, and is white and thick. The vertical plume is the remnant of a very similar plume that existed earlier, from which most of the large particles have been removed by gravity. It is of a different color, and has lost the thick, mashed-potatoes appearance it had during the collapse.

The behavior of the plume after its initial expansion

When the cloud stops expanding by momentum, it then behaves as a pollutant "puff" drifting with the local wind, and expanding and diluting by turbulent exchange with the local surrounding air.

During this drift, the larger dust particles settle to the ground, while the finer particles do not. A 100-micron, 2-specific-gravity spherical particle settles in air about 1 ft/s, so that if the cloud were 100 ft high, we would expect particles this large or larger to mostly deposit in two minutes or less. At a horizontal drift velocity of 4 miles/hr = 350 ft/min, we would expect this mostly to occur within 700 ft = 215 m of the leading edge of the cloud at the end of the expansion phase. Smaller particles deposit more slowly; a 10-micron particle settles about 1/100 times as fast. We would expect most particles this small or smaller to remain in the cloud after 700 ft of drift.

Meteorology

Air Quality Modeling for the 50 S. Main Street Implosion
Noel de Nevers, Consulting Engineer

To model the behavior of that dust cloud, we must estimate the meteorology at its time and place. The 50 S. Main Street Tower is located in downtown Salt Lake City, near the corner of Main and South Temple Streets, as part of the Crossroads Mall, which is all being removed to make way for future construction.

The National Climate Data Center provides complete historic weather data for the Salt Lake International Airport, about 4 miles west of the demolition site, 290 ft lower, and further than the demolition site from the mountains which circle the north end of the Salt Lake Valley and influence its microclimate. The Meteorology Department at the University of Utah conducted a two-year study (2001-2002) in which they recorded weather parameters on the roof of the LDS Church Office Building, 420 ft tall, about 1200 ft northeast and 30 ft uphill from the Key Tower. I thank John Horel and Kyle Van Peurse of the University of Utah Meteorology Department for providing me these data.

The morning wind speed and direction data for August 1-20, 2002, are displayed on Figures 3 and 4 and Table 1, and discussed below. The LDS Office data are reported every five minutes, while the Airport data are reported at three-hour intervals, 2, 5, 8, 11, ... AM Mountain Standard Time (3, 6, 9, 12 ... AM Mountain Daylight Time). Of these times 5 and 8 AM probably bracket the planned demolition time; only those are examined here, although all the other times are recorded in this project's database.

Figure 4 shows the 5 AM wind speeds at the Airport and the LDS Office. We see that those at the office average 5.7 mph and that the two tend to move up and down together, but not always proportionally.

Figure 5 shows the 5 AM wind direction at the Airport and the LDS Office. On this plot and Table 1 a value of 16 (the most common reading) corresponds to the wind **coming from** 160 degrees clockwise from north, i.e. south-southeast. Values of 36 or 0 both correspond to a wind coming from due north. We see that the LDS Office winds have more variation in direction than those at the Airport. Their average (143 degrees) is similar, but rotated 23 degrees toward the west (coming from the east).

Table 1 shows the relation between wind speed and direction, at 5 and 8 AM (MST) for August 1-20, 2002 at the LDS Office only. From it we see:

- 1-The wind speeds are more concentrated in the (coming from) southeast direction at 5 than at 8 AM.
- 2-The days when the 5 AM wind was not from that general direction, the wind speeds were low (1 to 5 mph)
- 3-The 8 AM winds that came from directions other than southeast were mostly 0 to 3 mph.
- 4-Almost all the winds greater than 5 miles per hour came from the general southeast direction.

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The explanation of these findings is as follows:

1-During the night and early morning in August down-valley drainage flow passes south-southeast to north-northwest in the bottom of the Salt Lake Valley. This produces a consistent wind speed and direction at the Airport at 5 AM.

2-The East-West mountain ridge north of the LDS Office slows this wind and turns it slightly toward the northwest.

3-Local sunrise in mid-August is about 5:30 AM (MST) so the 5 AM (MST) wind velocity and direction are not influenced by the sun. The sun actually reaches the ground somewhat later than 5:30 AM because of the mountains in the east of the valley, but by 8 AM (MST) much of the ground in the valley has been heated by the sun, weakening the drainage flow and introducing morning thermal circulations, which make the wind speed and direction more variable than at 5 AM.

4-On most cloudless days in summer, the wind at the Airport blows from southeast to northwest at night, in the evening and early morning, while at noon and most of the afternoon it blows in the opposite direction, northwest to southeast. During the transition from one to the other, there is a period of low wind velocity. The zero wind speeds and winds from the northwest shown in the 8 AM (MST) column of Table 1 suggest that this transition occurs at the LDS Office building early in the morning on some days.

The SLC NOAA Weather Station meteorologists report that in August the morning inversion height is typically 1500 to 1800 ft above ground, and that it is largely removed by 90 minutes after sunrise.

Based on all this information, the best estimate of the ground-level weather at the 50 S. Main Street site at 5 AM (MDT) in mid August is:

1-Wind from the south-southeast (about 160 degrees)

2-Wind speed about 4 mph. This value is chosen less than the average measured value at the top of the LDS Office building, to account for the elevation difference of about 420 ft.

3-Stability category F (wind less than 2 m/s, clear night).

These values are be used in subsequent modeling.

Estimates for the Dust Cloud formed by the 50 S. Main Tower Implosion

The Key Tower's volume is 2.04 times the volume of the building in Figure 1, so we would normally expect it to emit 2.04 times as much PM₁₀. However, it is a steel-frame building, while the building in Figure 1 was a reinforced concrete building. Mr. Ray Zuwkowski of CDI reports that steel-frame buildings produce much less dust on demolition than reinforced concrete buildings; but neither he nor I have a quantitative estimate of the

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appropriate ratio. The same emission factor shown above was used, and it was estimating that the 50 S. Main Street will produce a dust cloud 2.04 times that in Figure 2, or 1.24 million cubic meters, with an average PM₁₀ concentration of 5500 µg/m³.

Behavior of the cloud after its formation

After the cloud is formed, it will drift downwind (to the northwest) and mix with the surrounding air. The large particles will drop out quickly, but the PM₁₀ particles will mostly be diluted into the general atmosphere without coming to ground soon.

To estimate this behavior we replace the real (untidy, non-uniform) cloud with an idealized one, to which we can apply the standard Gaussian Plume calculation procedures. The moving cloud will behave as a "puff", described by the Gaussian Puff equation

$$c = \frac{Q \Delta t}{(2\pi)^{1.5} \sigma_x \sigma_y \sigma_z} \exp\left[-\frac{x^2}{2\sigma_x^2}\right] \exp\left[-\frac{y^2}{2\sigma_y^2}\right] \left[\exp\left[-\frac{(z-H)^2}{2\sigma_z^2}\right] + \exp\left[-\frac{(z+H)^2}{2\sigma_z^2}\right] \right] \quad (1)$$

* uneditable error in equation, the letter **g** should be a π

where c is the instantaneous concentration at some point in the cloud, $Q \Delta t$ is the product of the emission rate and time of emission, giving the total mass of pollutant in the whole cloud, x , y and z are distances in three perpendicular directions, measured from the moving center of the cloud, except for z which is measured up from the ground, H is the emission height above ground, and $\sigma_x \sigma_y \sigma_z$ are the dispersion parameters in the x , y and z directions.

If the emission source is at ground level, then H is zero and the two terms at the right become identical, leading to

$$c = \frac{2Q \Delta t}{(2\pi)^{1.5} \sigma_x \sigma_y \sigma_z} \exp\left[-\frac{x^2}{2\sigma_x^2}\right] \exp\left[-\frac{y^2}{2\sigma_y^2}\right] \exp\left[-\frac{z^2}{2\sigma_z^2}\right] \quad (2)$$

* uneditable error in equation, the letter **g** should be a π

If one wants x to represent a fixed ground coordinate, instead of one that moves with the cloud, then the only x in this equation is replaced by $(x - ut)$ where u is the wind speed (which equals the downwind speed of the center of the cloud) and t is the time since the puff was emitted. This equation is correct in any dimension system, but is normally applied with all lengths in meters, and masses in grams. The dispersion parameters with dimensions of meters are a function of stability category and downwind distance from the source. These are built into most air pollutant modeling programs; those used here are taken from (3).

The initial state is first represented as a circular disc, with the same volume shown above, and a diameter/height ratio of 4. For a 1.24 million cubic meter cloud, the dimensions

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are height 46 m = 152 ft and diameter 184 m = 607 ft. The total mass of PM₁₀ particles is estimated as 6830 grams. As discussed above the wind is estimated to blow at 4 mph = 1.79 m/s, with dispersion parameters estimated for F stability. To convert from the disc-shaped cloud, which standard Gaussian Plume methods do not represent, the cloud is reformulated as one of equivalent volume and mass of contained PM₁₀ particles, which was emitted as a point discharge, and which had flowed 1500 meters downwind by time zero. This "virtual source" estimation method is outlined in (4). From time zero the cloud follows the wind, and expands and dilutes according to equation 1. Figure 6 shows the calculated values at ground level in the center of the cloud, for various times after the implosion. The estimated concentration at the center at time zero is more than the assumed 5500 µg/m³ discussed above. But at the edge of the cloud the concentration has fallen to practically zero. The Gaussian formulation keeps the same mass of particles in the cloud, but distributes them differently than the first assumption.

Figure 7 shows the calculated ground level peak concentration under the center of the cloud, as a function of downwind distance. It also shows the corresponding calculated peak concentration 100 m to either side of the center of the cloud. We see that for this assumed atmospheric stability the cloud quickly loses its center peak, and becomes flatter.

Figure 8 shows the calculated ground level concentration at 200 and 500 meters downwind, as a function of time as the center of the cloud passes over these locations. As expected the concentration rises as the front of the cloud reaches that site, increases until the center arrives, then decreases as the center passes further downwind. The cloud arrives later at the 500 m location, has a lower peak value and a greater length than at 200 m.

Summary and conclusions

- 1-The numerical concentration estimates in this report are based on a generalization and extension of the ambient measurements made at an actual building implosion, published in a peer-reviewed journal (1). They are unlikely to be in error by more than a factor of 10.
- 2-The data in Figure 3 make clear that the cloud is far from the tidy shape in Gaussian Plume Calculations. The peak value at H1 in that figure occurred upwind of the site, at a distance substantially larger than the width of the plume shown in Figure 2. So some lobe of the plume had to protrude out and produce that short-term high concentration. No models were identified that predict such lobe generation nor its dimensions or concentrations.
- 3-The ambient estimates in this report are based on best-estimate meteorology at the site for a typical August morning. Based on the previously discussed meteorology, the planning group for the implosion has, at least tentatively, selected first light, near 6 AM MDT for the implosion.
- 4-The ambient estimates are based on flat-earth geography. The actual implosion will take place in a downtown, with many large buildings surrounding the site and modest surface elevation gradients. Advanced modeling procedures are known for such conditions;

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however, given the large number of unknowns and variables they would not be appropriate to use with the speculative emissions estimates used here.

5-All of the emission and modeling results concern only PM_{10} ; we would like information on $PM_{2.5}$. A report on the implosion of a group of hospital buildings in Calgary, Alberta, in October 1998 (5) allow us to estimate the ratio of $PM_{2.5}$ to PM_{10} . The authors' mobile laboratory attempted to follow the center of the cloud downwind, simultaneously measuring 1-minute average concentrations of TSP (Total Suspended Particulate), PM_{10} and $PM_{2.5}$ with a laser dispersion instrument. They found that inside the dust cloud, up to 19 minutes after the explosion, the concentrations of TSP and PM_{10} exceeded the instrument's capability, reported at more than $99,999 \mu\text{g}/\text{m}^3$. For the next hour, as they tracked the plume for 20 km, they found that the three sizes of particles had the average ratios (TSP/ PM_{10} / $PM_{2.5}$) of 1.4/1/0.18. This suggests that if we have a useful estimate of the PM_{10} concentration, we can multiply that by 0.18 to estimate the $PM_{2.5}$ concentration. Their data also show that the cutoff between dust that will settle quickly and PM_{10} is not sharp at 10 microns. On average about 0.4 g of particles larger than 10 microns accompanied one g of particles 10 microns or smaller. Logic suggests that these were in the size range 10-20 microns, most likely not larger.

6-Using the values in Figures 7 and 8 we can estimate the expected peak concentration and cumulative exposure downwind directly under the center of the cloud. For the clouds shown at 200 and 500 meters on Figure 8, the peak values are 15,090 and 10,840 $\mu\text{g}/\text{m}^3$. However the duration of the peaks are only about 5 and 8 minutes so that the average values over 24 hours due to that plume at those two locations are only 12.7 and 10.2 $\mu\text{g}/\text{m}^3$.

The air quality significance of the estimated plume exposures

Table 2 compares the above maximum-modeled PM_{10} 24-hour average, and the corresponding estimated $PM_{2.5}$ 24-hour average with the applicable NAAQS and with the 2005 (most recent published, ref 6) values for the North Salt Lake monitoring station. The maximum estimated increases in 24-hour average concentration are modest compared to the standards or the measured values. Thus, we appear justified in concluding that the implosion will produce a short-lived, intense, narrow cloud of fine particles, whose time of exposure at any site will be short enough that its contribution to the 24-hour average at that site will not imperil meeting the NAAQS nor probably impact human health.

This implosion will not have a significant effect on regional air quality. The State of Utah 2005 emission inventory (7) shows PM_{10} annual emissions of 15,885 tons per year in Salt Lake County, corresponding to an average of 87,000 lb/day. The 15.04 lb (6830 g) of PM_{10} expected here corresponds to 0.00017 of the average daily emission rate. If the air in Salt Lake City has one-day turnover and perfect mixing, then the emission from this implosion would raise the average PM_{10} concentration to 1.00017 times its value without the implosion. Taking the 38 $\mu\text{g}/\text{m}^3$ Annual average in Table 2 as representative, then this implosion would raise that to 38.007 $\mu\text{g}/\text{m}^3$.

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- 4-Turner, D.B. *Workbook of Atmospheric Dispersion Estimates AP-26* Revised 1970, EPA, RTP, NC page 40.
- 5-Stefani, D. D. Wardman and T. Lambert "The Implosion of the Calgary General Hospital: Ambient Air Quality Issues", *J. Air and Waste Management Assoc.* 55, 52-59, January 2005.
- 6-Utah Division of Air Quality, Annual Report, February 2006
<www.airquality.utah.gov/Public-Interest/annual-report/ambient_air_quality>
- 7-<www.airquality.utah.gov/Planning/Emission-inventory/2005_State/0.5_State_list.htm>

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Table 1 Linear Wind Rose August 2002, Roof of LDS Office Building. The 5 in column 2, row 5 indicates that one of those days the 5 AM wind blew from 30 degrees (north east) with a wind speed of 5 mph. Wind speeds of zero indicate that the wind direction was indicated by the instruments, but the wind speed was too low to record.

Wind Direction, (degrees/10) measured clockwise from due north. 18 indicates a wind from due south.	5 AM MST = 6 AM MDT Each number indicates one occurrence with the wind speed indicated in mph.	8 AM MST = 9 AM MDT Each number indicates one occurrence with the wind speed indicated in mph.
0 (or 36) North		
1		
2		
3	5	
4	1	
5		
6		0
7		
8		
9 East	16	
10	4	
11	4, 3	7, 10, 1, 0
12		2
13	14, 15, 10, 2	
14	1	4
15	5	13, 10
16	6	8, 18
17	0, 8	
18 South	11, 2	
19		
20		0
21	4	
22		
23		
24		0
25		
26		0
27 West		0
28		3
29		
30		11
31		
32		1, 1
33		
34		
35	2	

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Table 2 Comparison of modeled impacts to standards and current observations

	Modeled 200 m downwind increase due to plume, $\mu\text{g}/\text{m}^3$ (See Figure 8)	NAAQS $\mu\text{g}/\text{m}^3$		North Salt Lake 2005 values, $\mu\text{g}/\text{m}^3$	
		Annual	24 hour	Annual	24 hour
	24 hour average				
PM ₁₀	12.7	-	150	38	152
PM _{2.5}	2.3	15	35	14	140

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Figure 1 The Broadway Building in Baltimore, MD, in the early stage of controlled demolition, looking north over a 1-story parking structure, courtesy of CDI.

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Figure 2 The same view as Figure 1, after the demolished building has been reduced to a rubble pile, and the cloud of dust has largely stopped moving due to its own momentum. Courtesy of CDI.

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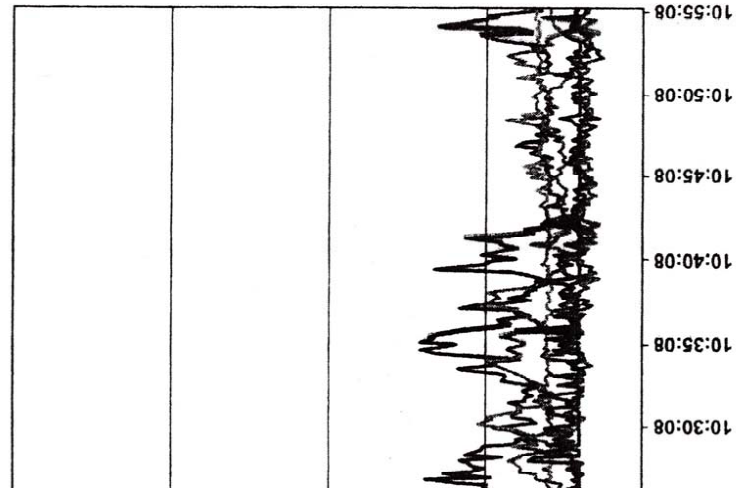


Figure 3, Reported particle concentrations from (1) at various locations and times for the building implosion shown in Figures 1 and 2. The explosive events that produced the implosion began at or near 10:00 AM.

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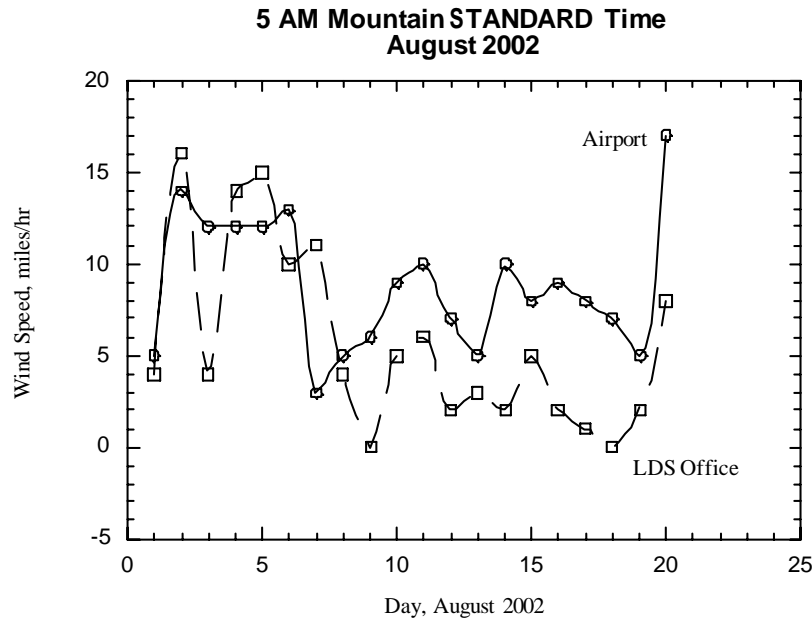


Figure 4 Wind speeds at the SLC Airport and at the roof of the LDS Office building at 5 AM Standard Time = 6 AM Daylight time from the 1st to 20th of August 2002.

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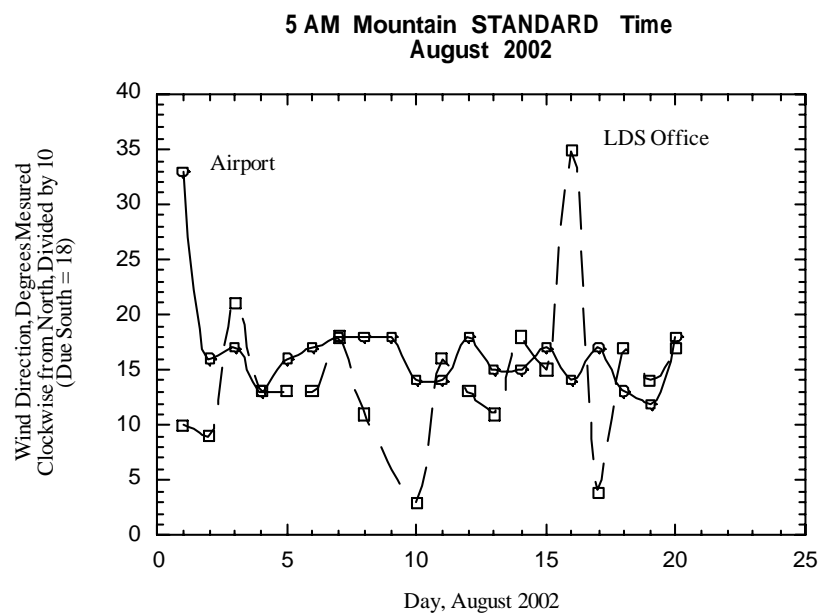


Figure 5 Wind directions at the SLC Airport and at the roof of the LDS Office building at 5 AM Standard Time = 6 AM Daylight Time from the 1st to 20th of August 2002. This is the direction from which the winds come; 18 indicates a wind that blows from south to north.

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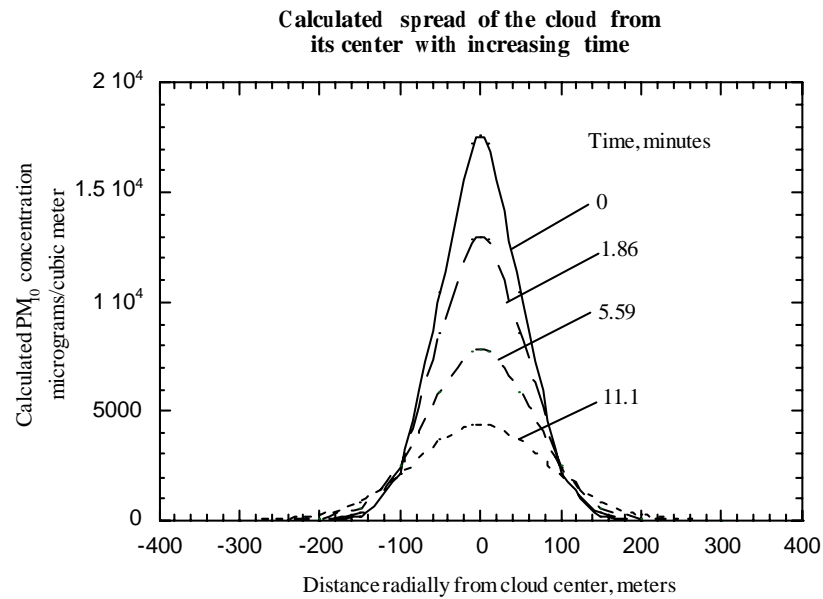


Figure 6 The modeled cloud has a Gaussian bell-shaped concentration-radius distribution. Over time it flattens and spreads laterally, keeping the total mass of particles in the cloud constant.

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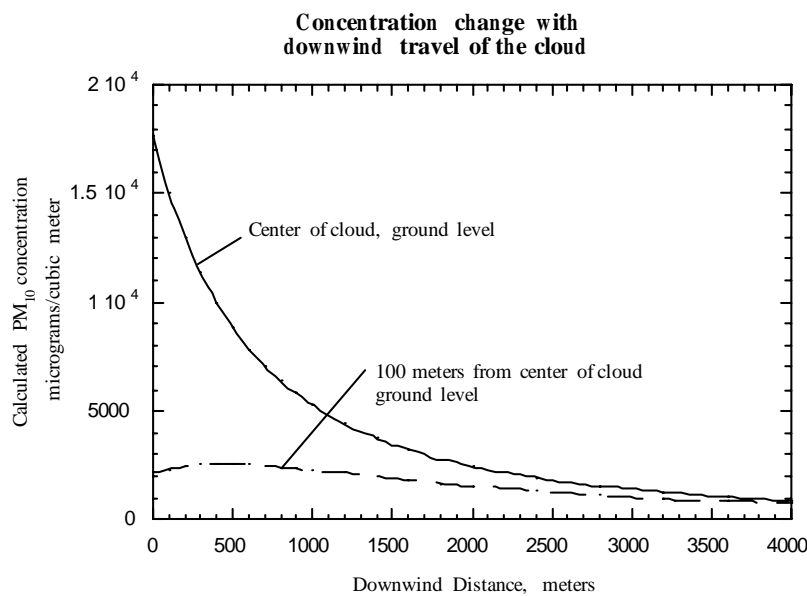


Figure 7 The cloud's particle concentration declines with time as it flows downwind and spreads as shown in Figure 6.

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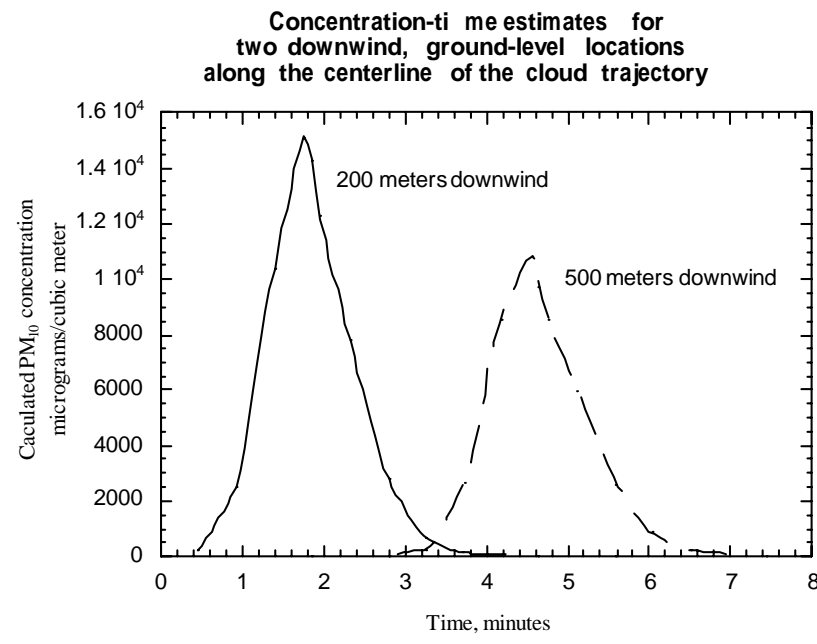


Figure 8 Calculated concentration-time plots for two downwind locations, at ground level, along the centerline of the cloud's trajectory.

A P P E N D I X 2

SLVHD Predemolition Form

SALT LAKE VALLEY HEALTH DEPARTMENT

788 East Woodoak Lane, #120
Murray, Utah 84107 (801) 313-6700, (801) 313-6734 (fax)

Predemolition Building Inspection Form

Residential / Business (circle one)

GENERAL INFORMATION

Inspection Dates: Jul;Dec 05;Jan;Mar 06 Bldg. Address: 50 S. Main Street (Key Bank Tower)
City: Salt Lake City
Property Owner: Property Reserve, Inc. Phone: 240-6448
Address: 15 East South Temple St., 8th Floor
Salt Lake City, Utah 84150
Demolition Permit Applicant (if not owner): Grant Mackay Company
Address: 1500 South 2455 West, Salt Lake City, Utah Phone: 509-2190

INSPECTION RESULTS

List amounts present for each item

Mercury Thermostats: 0 Condition: N/A
Mercury Fluorescent Lights: ~13,650 tubes Condition: Good
PCB Ballasts or Transformers: ~68 Condition: Good
Refrigeration Units Containing CFCs: ~17 Condition: Good
Containers of Liquid or Hazardous Waste (include vehicular batteries): None Condition: N/A

Suspect Asbestos-Containing Material (ACM): See the attached executive summary

Signature of Predemolition Building Inspector: _____
Predemolition Building Inspector(Print name): Lono Folau/Jim Nicol Regis.# PBI-023/015

FOLLOW-UP INSPECTION RESULTS

Date: _____ Inspector: _____

Have all identified items been removed? No
If yes, attach disposal receipts or manifests to this form.

Disposition of Identified Items (Disposal or Recycling Facility)

Mercury Thermostats: _____ Date: _____
Mercury Fluorescent Lights: _____ Date: _____
PCB Ballasts/Transformers: _____ Date: _____
Refrigeration Units w/CFCs: _____ Date: _____
Containers of Liquid/Haz. Waste: _____ Date: _____
ACM: _____ Date: _____

Signature of Inspector: _____ Date: _____

DO NOT WRITE IN THIS SECTION - FOR DEPARTMENT USE ONLY
Date Received: _____ Approved? Yes No Approved by: _____
Reason for Denial: _____

Executive Summary
Asbestos-containing Materials by Homogeneous Area
Key Bank Tower

Homogeneous Area	Material Description	Asbestos Content	Amount
M032	Sink Undercoat - White binder with mica and limestone, Sixth Floor, 650	5% Chrysotile	1 unit
M042	Vinyl Floor Sheeting - Gray sheet vinyl flooring, Ninth Floor, 900	ND: sheet >1% vinyl Chrysotile: mastic	144 sq. ft.
M058	Floor Tile-Exposed - 12" x 12" Light gray vinyl floor tile, Eleventh Floor, 1100	<1% Tremolite: tile >1% Chrysotile: mastic	3,240 sq. ft.
M060	Floor Tile Mastic - Black tar mastic, Eleventh Floor, 1100	>1-8% Chrysotile	3,370 sq. ft.
M068	Transite Panel - Gray corrugated Cement, Roof	12% Chrysotile	46 units
M069	Roof Sealant - Black tar sealant on wooden walkways,	15% Chrysotile	1,080 ln. ft.
M089	Floor tile and mastic - 12" x 12" beige vinyl floor tile with black mastic, Fourth floor corridor closet	>1% Chrysotile	25 sq. ft.
M090	Floor tile and mastic - 12" x 12" tan mosaic vinyl floor tile with black, Fourth floor west corridor	>1% Chrysotile	225 sq. ft.
M101	Floor Tile Mastic-under glued-down carpet - Black mastic, Sixth floor, Suite 640 entrance corridor	5% Chrysotile	90 sq. ft.
M104	Floor tile and mastic - 12" beige mosaic vinyl tile, East stairwells of building	>1% Chrysotile	400 sq. ft.
M111	Vinyl Floor Sheeting - Tan vinyl, Seventh floor server room entrance	60% Chrysotile	3 ln. ft.
M119	Floor tile and mastic - 12" beige mosaic vinyl tile, West stairwells of building	>1-5% Chrysotile	400 sq. ft.
M130	Floor tile and mastic - 12" beige mosaic vinyl tile, 17th floor, copy and file rooms	>1-5% Chrysotile	630 sq. ft.
M133	Sink Undercoat - Black tar-like 17th floor, room southeast of east stairwell	5% Chrysotile	1 units
M135	Floor tile and mastic - 12" beige mosaic vinyl tile, 16th floor, copy room	>1% Chrysotile	405 sq. ft.
M142	Sink Undercoat - Lavender tar-like coating Key Bank Branch, basement kitchen (lunch room)	6% Chrysotile	1 units
M144	Floor tile and mastic - 12" beige mosaic vinyl tile, Key Bank Branch, custodial closet in basement	>1-5% Chrysotile	50 sq. ft.
M146	Floor tile and mastic - 12" light gray vinyl tile, Key Bank Branch, northeast corridor in basement	>1% Chrysotile	340 sq. ft.
M148	Floor Tile - Under Glue Carpet - 12" light gray vinyl tile Key Bank Branch, northeast corridor in basement	5% Chrysotile	260sq. ft.
M152	Floor Tile Mastic-under glued-down carpet - Black mastic, 18th floor, east copy rooms	5% Chrysotile	520 sq. ft.

Homogeneous Area	Material Description	Asbestos Content	Amount
M154	Floor tile and mastic - 12" tan mosaic vinyl tile, 18th floor, east computer server rooms	>1% Chrysotile	190 sq. ft.
M155	Floor tile and mastic - 12" tan mosaic vinyl tile with black mastic, 18th floor, northwest file rooms	>1% Chrysotile	525sq. ft.
M160	Floor Tile - Under Glue Carpet - 12" black vinyl tile and black mastic under glued-down carpet, 18th floor, southwest corridor and office	>1% Chrysotile (tile and mastic)	150 sq. ft.
M161	Floor Tile - Under Glue Carpet - 12" beige, 18th floor, west side cubicle area	>1% Chrysotile	225 sq. ft.
M166	Floor tile and mastic - 12" off-white beige vinyl tile, Key Bank Branch, telecommunication rooms in basement	>1% Chrysotile	530 sq. ft.
M171A	Sealant - Black tar sealant Seams of fibrous glass wall and ceiling panels in air handling mechanical rooms	10% Chrysotile	440 ln. ft.
M202	Roof Sealant - Black tar sealant around roof penetrations - mechanical equipment, Roof penetrations - mechanical units	15% Chrysotile	120 ln. ft.
T001A	Pipe Insulation Binder/Sealant - Off-white binder, Air handler rooms (5th, 8th, 11th, 15th floors) and penthouse	15-40% Chrysotile	170 ln. ft.
T002	Pipe Coating - Off-white cross-woven cloth with binder - ACM in binder, Air handler mechanical rooms (5, 8, 11, 15th floors)	1.2-3% Chrysotile	85 sq. ft.
T003	Tank Insulation - White binder and plaster Penthouse	15% Chrysotile	10 sq. ft.