

# Health Consultation

---

EQ RESOURCE RECOVERY EXPLOSION AND FIRE

ROMULUS, WAYNE COUNTY, MICHIGAN

EPA FACILITY ID: MID060975844

MARCH 1, 2006

,

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES

Public Health Service

Agency for Toxic Substances and Disease Registry

Division of Health Assessment and Consultation

Atlanta, Georgia 30333

## **Health Consultation: A Note of Explanation**

An ATSDR health consultation is a verbal or written response from ATSDR to a specific request for information about health risks related to a specific site, a chemical release, or the presence of hazardous material. In order to prevent or mitigate exposures, a consultation may lead to specific actions, such as restricting use of or replacing water supplies; intensifying environmental sampling; restricting site access; or removing the contaminated material.

In addition, consultations may recommend additional public health actions, such as conducting health surveillance activities to evaluate exposure or trends in adverse health outcomes; conducting biological indicators of exposure studies to assess exposure; and providing health education for health care providers and community members. This concludes the health consultation process for this site, unless additional information is obtained by ATSDR which, in the Agency's opinion, indicates a need to revise or append the conclusions previously issued.

You May Contact ATSDR TOLL FREE at  
1-888-42ATSDR

or

Visit our Home Page at: <http://www.atsdr.cdc.gov>

HEALTH CONSULTATION

EQ RESOURCE RECOVERY EXPLOSION AND FIRE

ROMULUS, WAYNE COUNTY, MICHIGAN

EPA FACILITY ID: MID060975844

Prepared by:

Michigan Department of Community Health  
Under Cooperative Agreement with the  
U.S. Department of Health and Human Services  
Agency for Toxic Substances and Disease Registry

## Table of Contents

Table of Contents .....	i
List of Figures .....	i
List of Tables .....	ii
List of Appendices .....	iii
Abbreviations and Acronyms .....	iv
Summary .....	6
Purpose and Health Issues .....	6
Incident and Agency Response .....	6
Discussion .....	7
Environmental Contamination .....	7
Plume and Ambient Air Investigation .....	7
Fallout (Soot and Debris) Investigation .....	9
Roosevelt-McGrath Elementary School (Independent Analysis) .....	12
Tentatively Identified Compounds (TICs) in Soot .....	12
Exposure Pathways .....	12
Toxicological Evaluation .....	14
Vanadium .....	14
Tentatively Identified Compounds (TICs) .....	15
Children’s Health Considerations .....	15
Community Health Concerns .....	15
Conclusions .....	16
Recommendations .....	17
Public Health Action Plan .....	17
Preparer of Report .....	18
Scientific and Technical Support .....	18
References .....	19
Certification .....	36

## List of Figures

Figure 1a. EQ Resource Recovery and Greater Detroit Area, Wayne County, Michigan .....	21
Figure 1b. EQ Resource Recovery plant and vicinity, Romulus, Wayne County, Michigan .....	22
Figure 2. August 9, 2005 explosion and fire at EQ Resource Recovery, Romulus, Michigan. (Detroit Free Press photo.) .....	7
Figure 3. Wipe and bulk sampling: EQ chemical site. [Map provided by EPA Environmental Response Team.] .....	23
Figure 4a. Explosion/fire-associated debris sampled from Kendall Street in Romulus, Michigan. (Address has been blacked out. EPA contractor photo.) .....	10

Figure 4b. Explosion/fire-associated debris sampled from Kendall Street in Romulus, Michigan (close-up). (Address has been blacked out. EPA contractor photo.).....	10
Figure 4c. Explosion/fire-associated debris (grit-like material) on pool deck, Romulus, Michigan (8/12/05). (EPA contractor photo.).....	10
Figure 4d. Explosion/fire-associated debris (grit-like material) on hot tub cover, Romulus, Michigan (8/12/05). (EPA contractor photo.).....	10
Figure 5. Solid metal strap included in explosion/fire-associated debris sampling, Romulus, Michigan (8/12/05). (EPA contractor photo.).....	11

### **List of Tables**

Table 1a. Volatile Organic Compounds Tested for in Air Samples Taken 8/10/05 at EQ Resource Recovery Fire in Romulus, Michigan.....	24
Table 1b. Volatile Organic Compounds Detected in Air Samples Taken 8/10/05 at EQ Resource Recovery Fire in Romulus, Michigan.....	25
Table 2a. Base-Neutral-Acid (BNA) Compounds Tested for in Wipe and Bulk Soot Samples Taken 8/11-12/05 at EQ Resource Recovery Fire in Romulus, Michigan...	26
Table 2b. Base-Neutral-Acid (BNA) Compounds Detected in Wipe Samples Taken 8/11-12/05 at EQ Resource Recovery Fire in Romulus, Michigan.....	27
Table 2c. Base-Neutral-Acid (BNA) Compounds Detected in Bulk Soot Samples Taken 8/11-12/05 at EQ Resource Recovery Fire in Romulus, Michigan.....	28
Table 3a. Metals Tested for in Wipe and Debris Samples Taken 8/11-12/05 at the EQ Resource Recovery Fire in Romulus, Michigan.....	29
Table 3b. Metals Detected in Wipe Samples Taken 8/11-12/05 at the EQ Resource Recovery Fire in Romulus, Michigan.....	30
Table 3c. Metals Detected in Debris Samples Taken 8/11-12/05 at EQ Resource Recovery Fire in Romulus, Michigan.....	31
Table 4a. Metals Tested for in Soot/Debris and Indoor Air Samples Taken 8/10/05 by School District-hired Contractor at Roosevelt-McGrath Elementary School in Wayne, Michigan.....	32
Table 4b. Metals Detected in Soot/Debris Samples Taken 8/10/05 by School District-hired Contractor at Roosevelt-McGrath Elementary School in Wayne, Michigan....	33

Table 5a. Volatile and Semivolatile Organic Compounds (VOCs and SVOCs) Tested for in Soot/Debris and Indoor Air Samples Taken 8/10/05 by School District-hired Contractor at Roosevelt-McGrath Elementary School in Wayne, Michigan.....	34
Table 5b. Semivolatile Organic Compounds Detected in Debris Samples Taken 8/10/05 by School District-hired Contractor at Roosevelt-McGrath Elementary School in Wayne, Michigan.....	35
Table 6. Exposure pathways evaluated for the August 9, 2005 EQ Resource Recovery explosion and fire, Romulus, Michigan.....	13

### **List of Appendices**

Appendix A. Screening Levels Used When Evaluating Measured Air Emissions from the August 2005 EQRR Fire in Romulus, Michigan.....	A-1
Appendix B. Deriving Screening Levels for Wipe Samples Taken Following the August 2005 Fire at EQ Resource Recovery in Romulus, Michigan.....	B-1
Appendix C. ATSDR Public Health Hazard Categories.....	C-1
Appendix D. Understanding the Results of Sampling From the EQ Fire in Romulus, Michigan [MDCH factsheet].....	D-1

## Abbreviations and Acronyms

µg	microgram
AEGL	Acute Exposure Guideline Level
ASPECT	Airborne Spectral Photometric Collection Technology
AT	averaging time
ATSDR	Agency for Toxic Substances and Disease Registry
BNA	base-neutral-acid compound
BW	body weight
CalEPA	California Environmental Protection Agency
CaREL	California Acute Reference Exposure Level
CF	conversion factor
CHPPM	U.S. Army Center for Health Promotion and Preventive Medicine
cm	centimeter
CR	contact rate
C <sub>s</sub>	acceptable wipe screening level
CSF	cancer slope factor
CSF <sub>dermal</sub>	cancer slope factor for dermal exposure
CSF <sub>ingest</sub>	oral cancer slope factor
CSF <sub>inhale</sub>	cancer slope factor for inhalation exposure
DAF	dermal absorption efficiency
DCC	MDEQ Direct Contact Criteria
DOE	U.S. Department of Energy
ED	exposure duration
EF	exposure frequency
EMEG	ATSDR Environmental Media Evaluation Guide
EPA	U.S. Environmental Protection Agency
EQRR	EQ Resource Recovery
ERPG	Emergency Response Planning Guideline
EV	contact frequency with contaminated surface (“event”)
F <sub>d</sub>	fraction of available skin that contacts the contaminated surface
F <sub>g</sub>	fraction of available dermal area that contacts the mouth
ft	foot
FT <sub>ftm</sub>	fraction of dust transferred from the skin to the mouth
FT <sub>ss</sub>	fraction of dust transferred from the contaminated surface to the skin
HEAST	Risk Assessment Information System’s Health Effect Assessment Summary Tables
HTME	hand-to-mouth events
HUD	U.S. Department of Housing and Urban Development
IR <sub>i</sub>	inhalation rate
IURF	Inhalation Unit Risk Factor
K	resuspension factor
kg	kilogram
m	meter
MDCH	Michigan Department of Community Health
MDEQ	Michigan Department of Environmental Quality

mg	milligram
NA	not applicable
NRC	National Response Center
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyl
ppm	parts per million
RfC	Reference Concentration
RfD	Reference Dose
SA <sub>d</sub>	dermal surface area available for absorption
SA <sub>g</sub>	dermal surface area available for ingestion
SVOC	semivolatile organic compound
TEEL	Temporary Emergency Exposure Limit
THQ	target hazard quotient
TIC	Tentatively Identified Compound
TR	target cancer risk
VOC	volatile organic compound



## **Summary**

On August 9, 2005, a hazardous waste tank at the EQ Resource Recovery plant in Romulus (Wayne County), Michigan exploded and burned, setting off fires in surrounding tanks. The U.S. Environmental Protection Agency (EPA) assisted local hazmat teams with response activities and contamination assessment. EPA and the Wayne County Health Department requested an assessment of the air, soot, and fire-related debris analyses. The federal Agency for Toxic Substances and Disease Registry (ATSDR) and the Michigan Department of Community Health (MDCH) provided toxicological expertise in assessing public health implications of the contamination. The explosion and fire at the facility posed an urgent public health hazard, warranting the evacuation that was ordered by local officials. Concentrations of volatile organic compounds (VOCs) in the air, polycyclic aromatic hydrocarbons (PAHs) in soot, and metals in soot and debris posed no apparent short-term public health hazard. Additionally, any residual contaminant concentrations pose no apparent current or future public health hazard. The cause of the explosion and fire should be investigated and steps taken to ensure the future safety of the community surrounding the facility.

## **Purpose and Health Issues**

The primary purpose of this public health consultation is to document federal and state health agencies' response to a hazardous waste tank explosion and fire. Local fire, hazmat, health, and federal regulatory officials requested assistance in determining if reoccupancy was appropriate. This document discusses the analytical results of environmental sampling conducted during and after the incident and the public health conclusions reached by the health agencies. Discussion of reported health effects can be found in the "Community Health Concerns" section.

## **Incident and Agency Response**

On Tuesday, August 9, 2005 at about 9:35 PM EST, a hazardous waste tank at the EQ Resource Recovery plant (EQRR), 36345 Van Born Road in Romulus, Wayne County, Michigan (Figures 1a-b on pages 21-22) exploded and burned, setting off a chain reaction of fires in surrounding tanks (Figure 2, below). EQRR stores, treats, and recycles chemical wastes, recovering some solvents for reuse and blending other wastes for fuel. Of the 39 above-ground storage tanks at the facility, about 29 were impacted by the explosion/fire. The fire also destroyed several hundred 55-gallon drums (EPA 2005c).

Local and neighboring fire officials and hazmat teams responded to the incident. About 900 homes in Romulus and Wayne, within a one-half mile radius of the plant, were evacuated as a precaution (EPA 2005a; Figure 1b). Fire officials allowed the majority of the fire to burn itself out, which it did by Thursday, August 11. A covered cement pad housing about 400 drums smoldered longer until extinguished with water and foam on August 13 (EQRR 2005).



Figure 2. August 9, 2005 explosion and fire at EQ Resource Recovery, Romulus, Michigan. (Detroit Free Press photo.)

EPA mobilized to the site to assist with response activities and assess area contamination. Upon arrival, the agency instructed EQRR to notify the National Response Center (NRC). The local NRC representative alerted federal and state agencies, including ATSDR and the Michigan Department of Environmental Quality (MDEQ), of the explosion. ATSDR contacted the Michigan Department of Community Health (MDCH), with whom the federal agency has a cooperative agreement to conduct public health activities at sites of environmental contamination.

Once the fire was extinguished and as environmental data became available, EPA conferred with ATSDR, MDCH, and the Wayne County Health Department to determine the level of public health threat. Toxicologists and health officials concluded that the contamination did not pose an acute health risk. On Thursday, August 11, Romulus and Wayne city officials lifted the evacuation order (EPA 2005c). Health officials continued to review the data and incident follow-up to ensure the well-being of area residents and employees.

## **Discussion**

### **Environmental Contamination**

#### *Plume and Ambient Air Investigation*

Initial air monitoring activities focused on characterizing the degree of the hazard so that first responders and neighboring businesses and residences would be appropriately protected from any toxic chemicals. Upon arrival at the scene, the EPA on-scene coordinator, the agency's contractors, and the Western Wayne County Hazmat Team began monitoring the air for volatile organic compounds (VOCs). These compounds most likely would be present in a fire involving solvents and can be toxic at high

concentrations. Field technicians started monitoring the air three miles from EQRR, moving closer and eventually stationing multi-gas detectors (“AreaRAEs”) about one-half mile from the facility in residential areas. Although AreaRAEs do not identify specific VOCs (other than gases associated with a fire), monitoring for total VOCs allowed safety personnel to determine whether overall concentrations in the smoke plume posed an immediate risk to response workers or the public. Results from the monitoring, conducted late morning through mid-afternoon on August 10, showed occasional, and minimal, detections of carbon monoxide, hydrogen sulfide, and displacement of oxygen (EPA 2005d-i).

The EPA also activated its Airborne Spectral Photometric Collection Technology (ASPECT) aircraft, based in Texas. This aircraft essentially is a flying laboratory that allows for timely surveillance of gaseous chemical releases from a safe distance. The ASPECT can give on-ground personnel critical information regarding the size, shape, composition, and concentration of gas plumes emanating from disaster scenarios, such as a chemical tank explosion. Images taken from the plane and enhanced with infrared, thermal imaging, and global positioning satellite technology can show the main plume as well as places where gas has collected and settled, such as in low-lying areas or location where there is little or no air movement. The ASPECT generally detects most VOCs in the low part-per-million (ppm) range and is used primarily as a screening tool (Rickman 2005, EPA 2005k).

The ASPECT started collecting data at the EQRR site at around 6 AM local time August 10. It flew two sorties that day and an additional sortie on August 11, identifying several VOCs. The chemicals detected were diethyl amine, n-butyl acetate, isobutylene, ethylene, methanol, and p-xylene (EPA 2005j). Concentrations were highest on the first sortie and decreased over subsequent sorties. Diethyl amine peaked at 12 ppm (volumetric) at about 200 meters downwind of the facility (EPA 2005j). This concentration is below the most protective acute (short-term) screening level for this chemical, 15 ppm (DOE 2005). (This is the Temporary Emergency Exposure Limit [TEEL] that the American Industrial Hygiene Association developed for the U.S. Department of Energy [DOE]. TEELs are used in evaluating the effects of accidental chemical releases on the general public. See Appendix A for discussion of the acute air screening levels used.) N-butyl amine peaked at 6 ppm (volumetric; EPA 2005j), which is slightly above the most protective acute screening level for this chemical, 5 ppm (DOE 2005). (This is the Emergency Response Planning Guideline [ERPG] that the American Industrial Hygiene Association developed for the DOE. The ERPG is the finalized version of the TEEL.) The slight exceedance of n-butyl amine over its ERPG is not significant enough to expect adverse health effects. The concentrations of the other detected chemicals were at low levels. Therefore, the screening provided by the ASPECT suggested that there were no harmful concentrations of VOCs present.

During the evening of August 10, the EPA took “grab” (about 30-second duration) air samples in Summa canisters (depressurized devices that draw in air when a valve is opened) to analyze for individual VOCs. One sample was from on-site, two were downwind of the EQRR facility in the evacuated neighborhood, and a fourth sample was

taken from an upwind location (southwest of the EQRR facility) as a control. The results of the analyses of these samples are in Tables 1a and 1b (pages 24-25). When compared to acute exposure screening levels, discussed in Appendix A, all detected chemicals were well below acceptable levels, indicating that no harm would be expected during short-term exposure (EPA 2005c). Once the fire at EQRR was extinguished, the potential for harmful releases of VOCs was eliminated.

MDCH asked the MDEQ Air Monitoring Unit if there were any 24-hour air monitoring stations maintained downwind of EQRR and if data were available for the time of the fire at the plant. The downwind MDEQ air monitoring stations are located at Allen Park, Dearborn, Newberry School (about 1 mile southwest of the I-94/I-96 interchange, about 17 miles east-northeast from EQRR), and the Family Independence Agency on West Lafayette Street in Detroit (near the Ambassador Bridge to Canada, about 20 miles east-northeast from EQRR; Figure 1a). The closest station (Allen Park) is about 10 miles east-southeast from EQRR. The emissions released from the EQRR fire would have been too diluted or else mixed with chemical emissions from other sources by the time they reached these monitors, rendering the data unusable. Additionally, these monitors are on a rotating three- and six-day schedule (sampling for particulate matter and VOCs) and were not operating the day the fire started nor the following day (M. Heindorf, MDEQ Air Monitoring Unit, personal communication, 2005). Therefore, there are no data available for local (near EQRR) air concentrations immediately following the initial explosion. These air concentrations cannot be estimated because wind speed and direction can vary within a short distance from an emission source. Additionally, the pressure in the tanks, the force of the explosions, and the heat of the fire itself might have changed the contents of the tanks into different chemicals.

#### *Fallout (Soot and Debris) Investigation*

As is typical of a fire, the incident at EQRR generated soot and ash, which were deposited downwind of the facility. The health agencies and EPA wanted to know to what degree soot was depositing on neighborhoods and whether there were chemicals present that would not be expected from what one would consider a “normal” (i.e., non-chemical) fire. EPA took wipe samples from windows facing toward the EQRR facility and from windows facing away from the facility and tested them for polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), and metals (see Figure 3 on page 23 for general sampling locations). PAHs are commonly formed during incomplete combustion and can be found in soot, engine exhaust, and grilled food. EQRR is licensed to handle wastes containing PCBs, and at the time of the fire, it was unclear what the involved tanks contained. Metals can be found in paints and paint wastes, such as those accepted by EQRR. Wipe sampling would identify the compounds present and how much of them were on the wipes. (This type of sampling is generally used for industrial hygiene purposes, when employees are working in dusty settings.) EPA also took bulk samples of soot from the ground to test for PAHs. The results of these samplings are in Tables 2a-c (PAHs) and 3a-b (metals) (pages 26-30). (No PCBs were detected.) The health agencies compared the results to wipe screening levels derived for this site (see Appendix B for discussion of the derivation of these screening levels) and to the MDEQ Part 201 Residential and Commercial I Direct Contact Criteria (DCC) for contaminated

soils. (The DCC address long-term dermal [skin] exposure to and unintentional ingestion [swallowing] of contaminated soils.) No detected chemicals exceeded their wipe or soil-contact screening levels.

Local residents reported metallic-looking debris raining down shortly after the initial explosion at EQRR (Figures 4a-d, below). This phenomenon was not widespread, like the ash and soot were, but fairly contained in the area that had been evacuated (Figure 1b). ATSDR and MDCH were concerned that the granules, reported to be about the size of an apple seed, might contain high concentrations of potentially toxic metals. The size of most the granules would make them easily swallowed by children. The health agencies requested that EPA sample this debris and test it for metal content.



Figure 4a. Explosion/fire-associated debris sampled from Kendall Street in Romulus, Michigan. (Address has been blacked out. EPA contractor photo.)



Figure 4b. Explosion/fire-associated debris sampled from Kendall Street in Romulus, Michigan (close-up). (Address has been blacked out. EPA contractor photo.)



Figure 4c. Explosion/fire-associated debris (grit-like material) on pool decking, Romulus, Michigan (8/12/05). (EPA contractor photo.)



Figure 4d. Explosion/fire-associated debris (grit-like material) on hot tub cover, Romulus, Michigan (8/12/05). (EPA contractor photo.)

The results of the debris sampling are in Table 3c (page 31). The health agencies compared the results to the MDEQ Part 201 Residential and Commercial I DCC. One debris sample exceeded the DCC for aluminum. Upon further investigation, the health agencies learned that this sample was a piece of metal (Figure 5, below) and not likely to be ingested by a child. Therefore, potentially harmful exposure to aluminum is *not* expected.



Figure 5. Solid metal strap included in explosion/fire-associated debris sampling, Romulus, Michigan (8/12/05).

Five debris samples exceeded the DCC for vanadium. The DCC for this metal is 750 ppm (MDEQ 2004). The highest concentration found was 991 ppm. Further evaluation of these findings can be found in the Toxicological Evaluation section.

MDCH visited the area in October 2005 and, along with the EPA contractor, investigated the area where the majority of the debris had deposited. It was difficult to find any residual granules, although about one-fourth to one-half teaspoon-full was found after searching an alley and a yard. As one field technician reported when the sampling originally occurred, the granules had the appearance of crushed lava rock, varying in color from brown to purplish to dark gray or black, with holes and air pockets in the material (see Figures 4a-b). When squeezed between the thumb and forefinger, the granules were crushed easily, leaving a chalky residue of the same color. It is likely that the granules that remained following the original sampling have been swept away or hosed off by the residents, crushed underfoot or by vehicles and washed away by rain, or, if left in unpaved areas that received little traffic, were settling into the lawn, the soil, or under landscaping materials (e.g., gravel, mulch).

#### *Roosevelt-McGrath Elementary School (Independent Analysis)*

Officials at the Roosevelt-McGrath Elementary School, less than one-fourth mile north-northeast of EQRR (see Figure 1b), noticed soot deposits on the premises the day following the start of the fire. The Wayne-Westland Community School District hired a private environmental consultant to evaluate the debris on the school grounds and to assess indoor air quality. (Classes were scheduled to begin at the end of August.) Four soot/debris samples were analyzed for VOCs, semivolatile organic compounds (SVOCs, which would include PAHs), and metals. Ten indoor air samples were analyzed for SVOCs and metals. (Incident-related VOCs likely would not be present in indoor air, having most probably been consumed in the fire.) The results for the soot/debris samples are in Tables 4a-b and 5a-b (pages 32-35). The consultant compared the results to the MDEQ Part 201 Residential and Commercial I DCC. There were no harmful concentrations of chemicals detected. No chemicals were detected in the indoor air samples.

#### *Tentatively Identified Compounds (TICs) in Soot*

The data report released by the EPA regarding chemicals detected in the air and soot from the explosion and fire at EQRR indicated that there were compounds present that could not be identified definitively. These compounds are called “Tentatively Identified Compounds,” or “TICs.” Even the most comprehensive database of chemicals that can be identified in laboratory tests cannot include all of the thousands of chemicals that exist. Given the sensitivity of analytical equipment, it is not unusual for TICs to be reported in environmental contamination investigations. More discussion regarding these findings is in the Toxicological Evaluation section of this document.

#### Exposure Pathways

To determine whether persons are, have been, or are likely to be exposed to contaminants, MDCH evaluates the environmental and human components that could lead to human exposure. An exposure pathway contains five elements: (1) a source of contamination, (2) contaminant transport through an environmental medium, (3) a point of exposure, (4) a route of human exposure, and (5) a receptor population. An exposure pathway is considered complete if there is evidence, or a high probability, that all five of these elements are, have been, or will be present at a site. It is considered either a potential or an incomplete pathway if there is no evidence that at least one of the elements above are, have been, or will be present, or that there is a lower probability of exposure. The exposure pathway elements for this site are shown in Table 6 below:



Table 6. Exposure pathways evaluated for the August 9, 2005 EQ Resource Recovery explosion and fire, Romulus, Michigan.

Romulus, Michigan.

Source	Environmental Transport and Media	Chemicals of Interest	Exposure Point	Exposure Route	Exposed Population	Time Frame	Status
Explosion/- fire at EQRR	Air (as vapors)	VOCs	Outdoor and indoor air	Inhalation	Downwind residents and businesses	Past	Complete
						Present	Incomplete
						Future	Potential
	Air (as soot and debris)	VOCs, SVOCs, PAHs, metals	Soil, lawn, decking, other surfaces and structures	Dermal, ingestion, inhalation	Downwind residents and businesses	Past	Complete
						Present	Potential
						Future	Potential
NOTE: THE PRESENCE OF A COMPLETE EXPOSURE PATHWAY IN THIS TABLE DOES NOT IMPLY THAT AN EXPOSURE WOULD BE SUBSTANTIVE OR THAT AN ADVERSE HEALTH EFFECT WOULD OCCUR.							

Acronyms and Abbreviations:

EQRR EQ Resource Recovery  
PAHs polycyclic aromatic hydrocarbons  
SVOCs semivolatile organic compounds  
VOCs volatile organic compounds

The initial explosion at the EQRR facility likely released unknown concentrations of the chemicals in the affected tank. (Those chemicals primarily were acetone, xylene, and t-butyl amine [L. King, MDEQ Waste and Hazardous Materials Division – Warren Office, personal communication, 2005].) Residents or workers who were downwind at the time, outside or inside with doors or windows open, likely would have been exposed to the greatest air concentrations of VOCs shortly after the first explosion. The heat of the subsequent fire likely consumed the chemicals released from other tanks and drums, minimizing later exposure during the fire.

The fire was extinguished completely on August 13, 2005. There are no current exposures to VOCs in the air related to the incident. However, even with updated and stricter safety practices in place, a similar event could happen in the future. Thus, future exposures are possible.

Several residents who called the MDCH Michigan Toxics Hotline for information regarding the soot and debris described the debris coming down on them like hail. Some callers indicated that they were barefoot in their yards or driveways at the time. Others reported the fallout coating their vehicles, lawn furniture, or decks and being difficult to remove. The health agencies suggested that people clean up the soot with water and a mild detergent and that they wear rubber gloves while doing so. The debris could be swept up or hosed off of surfaces, per the health agencies' suggestion. It is not known to what degree people followed these recommendations. However, it is likely that weathering, along with any cleaning, has removed much of the soot and diluted the debris (granules) into the soil. While the chemicals from the soot and debris may still be present



in some areas of people's yards, the concentrations should *not* pose a public health concern.

### Toxicological Evaluation

#### *Vanadium*

As discussed earlier, vanadium was found in five "swallowable" debris samples at concentrations greater than its screening level. The analysis did not identify the specific compound form of the metal.

Vanadium occurs naturally in fuel oils and coal as well as in some foods and drinking water. Vanadium compounds are found in steel and nonferrous (non-iron) alloys. (The hazardous waste tanks at EQRR likely are made of steel [P. Quackenbush, MDEQ Waste and Hazardous Materials Division, personal communication, 2005].) Vanadium is used in making rubber, plastics, ceramics, and other chemicals (ATSDR 1992).

Most of the knowledge of vanadium's toxicity comes from worker studies and experiments in laboratory animals. Occupational exposure to vanadium typically occurs via inhalation of vanadium dusts. Workers who have been exposed to large amounts of the metal may have a green color on the tongue. Studies in rats suggest that vanadium can have developmental effects, specifically reduction in offspring weight and length when exposed pre- and post-natally (ATSDR 1992, OEHHA 2000). The MDEQ DCC for vanadium is derived to be protective of the developing fetus and child (MDEQ 2004).

Some researchers have argued that an upper limit for oral exposure to vanadium in humans can be set at 100-200 micrograms per day ( $\mu\text{g}/\text{day}$ ) (OEHHA 2000). If a child were to ingest 200 milligrams (mg, or  $2\text{E}-4$  kilogram [kg]) of soil per day (a generic default value) that contained the highest concentration of vanadium found in the debris from the EQRR incident (991 ppm, or mg/kg), the dose would be near the upper limit of  $200 \mu\text{g}/\text{day}$ :

$$\frac{2\text{E}-4\text{kg}_{\text{soil}}}{\text{day}} \times \frac{991\text{mg}_{\text{vanadium}}}{\text{kg}_{\text{soil}}} \times \frac{1,000\mu\text{g}}{\text{mg}} = \frac{198\mu\text{g}}{\text{day}}$$

Combined with any dietary contribution of vanadium, a child's total exposure to vanadium could exceed the upper limit if the highest concentration found is used for the calculation. However, it is more likely that a child will be exposed to an average concentration, from multiple locations, and not just the "hotspot." The average concentration of vanadium *detected* in the samples was 589 ppm. (If including the one sample that did not have a detection and using one-half the detection limit as an estimate of the concentration, the average concentration of vanadium for *all* debris samples was 524 ppm.) This value is below the MDEQ DCC. As well, the debris from the EQRR incident likely will degrade and be diluted into the soil (a pervious surface) or washed away on impervious surfaces. Exposure to vanadium in the debris from the EQRR is *not* expected to result in adverse health effects.

### *Tentatively Identified Compounds (TICs)*

A toxicological evaluation of the TICs detected in the air and soot from the explosion and fire at EQRR is not possible. It is necessary to know the identity of a specific chemical to assess its potential impact on public health. However, the incident at EQRR did not result in heavy or high contamination. The concentrations of the chemicals that *have* been identified are all well below the screening levels used to evaluate them. The likelihood exists that the TICs are also at levels that would not cause adverse health effects.

### Children's Health Considerations

Children may be at greater risk than adults from exposure to hazardous substances at sites of environmental contamination. Children engage in activities such as playing outdoors and hand-to-mouth behaviors that could increase their intake of hazardous substances. They are shorter than most adults, and therefore breathe dust, soil, and vapors found closer to the ground. Their lower body weight and higher intake rate results in a greater dose of hazardous substance per unit of body weight. The developing body systems of children can sustain permanent damage if toxic exposures are high enough during critical growth stages. Even before birth, children are forming the body organs they need to last a lifetime. Injury during key periods of growth and development could lead to malformation of organs (teratogenesis), disruption of function, and premature death. Exposure of the mother could lead to exposure of the fetus, via the placenta, or affect the fetus because of injury or illness sustained by the mother (ATSDR 1998). The obvious implication for environmental health is that children can experience substantially greater exposures to toxicants in soil, water, or air than adults can.

The debris (granules) from the EQRR fire raised the most concern with the health agencies, which prompted the request for metals analysis of the debris. Hand-to-mouth behavior normally expressed by young children could result in exposure to harmful levels of environmental contaminants. However, analytical results indicated that the concentrations of metals, including vanadium, a developmental toxicant, found in the debris were *not* expected to cause harm.

Elementary school officials proactively sought to ensure the safety of their students by having an environmental consultant test the soot/debris on the school grounds and the indoor air. Results from that testing indicated that the students and staff would not be exposed to harmful levels of chemicals from the EQRR fire.

### Community Health Concerns

Area residents and businesses called the Michigan Toxics Hotline at MDCH with their concerns.

1. **Can the fallout (the soot and granular debris) in my yard harm my family or pets?** According to the data, MDCH and ATSDR concluded that the debris posed no immediate threat. As well, further evaluation of the data indicated that no long-term threat exists.
2. **Is the dust that entered my home during the incident and coated my china toxic?** According to the data, MDCH concluded that the dust should not be

harmful. MDCH suggested that, for peace of mind, the caller wear rubber gloves while washing off the dust.

3. **How should I remove the debris and fallout from my swimming pool?**

MDCH suggested that pool-owners contact their swimming pool supply representatives for direction on cleaning their pools.

Several callers, including an occupational and environmental clinician who was treating patients reporting health symptoms from the explosion/fire, requested a list of the chemicals detected in the environmental sampling. At the time, only the preliminary (unvalidated) data were available. MDCH provided the data to the callers, listing only the chemicals detected and not the concentrations. (The data were validated and made publicly available by EPA in late September 2005.)

Health effects reported in the press, via emergency rooms and medical clinics, or by residents calling the Michigan Toxics Hotline included:

- stuffy nose
- shortness of breath
- exacerbation of exercise-induced asthma
- development of Reactive Airways Dysfunction Syndrome (RADS)
- scratchy throat
- burning sensation to face, eyes, tongue, and lungs
- persistent skin irritation/dermatitis
- elevated arsenic (no information regarding whether biomarker tested was urine, blood, or hair)

According to one medical clinic, three patients were receiving follow-up care as of the end of October 2005. Although initial exposures likely were high, the exposure duration was brief and should not result in lasting health effects.

## **Conclusions**

ATSDR public health hazard categories are described in Appendix C.

**The August 9, 2005 explosion at the EQRR facility posed an urgent public health hazard.** The fire at and release of chemicals from the facility threatened the immediate safety and welfare of residents and businesses downwind from the site. The evacuation that occurred was prudent and necessary. Once it was apparent that the fire was contained to the facility, the physical hazard was reduced.

**The VOCs detected in the air the day after the initial explosion at the EQRR facility posed no apparent public health hazard.** While VOCs were present, their concentrations were below screening levels used for short-term exposure. There are no data for air concentrations in the residential area before this time. People likely were exposed for a short duration to high concentrations of VOCs immediately after the initial explosion. This exposure could have resulted in irritation and breathing difficulties. These health effects are not expected to be lasting.

**The PAHs detected in wipe and soot samples posed no apparent public health hazard.** Concentrations of PAHs did not exceed screening levels. No adverse health effects are expected to occur as a result of exposure. Weathering or cleaning by the residents has likely removed most, if not all, of the PAH contamination.

**The metals detected in wipe and debris samples pose no apparent public health hazard in the past (when the fallout first deposited in the area), present, or future.** The concentrations did not exceed MDEQ or nutrition researchers' screening levels. No adverse health effects are expected to occur as a result of exposure.

### **Recommendations**

1. Investigate the cause of the explosion and fire and refine/instigate protocols to prevent another incident.
2. Review emergency management plans to ensure they are adequately protective of the community.
3. Provide information to healthcare providers regarding contaminants released and likely exposures so that patients complaining of health effects associated with the EQRR explosion/fire can be treated effectively.
4. Provide environmental contamination information, including interpretation, to all stakeholders.

### **Public Health Action Plan**

1. The MDEQ Waste and Hazardous Materials Division and insurance companies for EQRR are investigating the cause of the explosion. (According to a 12/29/05 Detroit Free Press article, the cause of the fire "may never be known.") EQRR will refine/instigate safety protocols under MDEQ oversight.
2. Local fire departments and EQRR will review emergency management plans, inviting public input.
3. MDCH provided both the preliminary and validated data, compiled by EPA and its contractors, to healthcare providers. MDCH will also provide a copy of this public health consultation to those providers.
4. EPA released the validated data in late September 2005. MDCH prepared a factsheet on the data (Appendix D and available on-line at [http://www.michigan.gov/documents/EQ\\_Data\\_Results\\_Factsheet\\_137513\\_7.pdf](http://www.michigan.gov/documents/EQ_Data_Results_Factsheet_137513_7.pdf)).

If any citizen has additional information or health concerns regarding this public health consultation, please contact the MDCH Division of Environmental and Occupational Epidemiology at 1-800-648-6942. ATSDR and MDCH remain available for further consultation on this site.

## **Preparer of Report**

### **Michigan Department of Community Health**

Christina Bush, Toxicologist  
Division of Environmental and Occupational Epidemiology

## **Scientific and Technical Support**

### **Michigan Department of Community Health Division of Environmental and Occupational Epidemiology**

Linda D. Dykema, PhD, Manager, Toxicology and Response Section  
Brendan Boyle, Community Involvement Specialist  
Kory Groetsch, Toxicologist  
Erik R. Janus, Toxicologist  
Martha Stanbury, Coordinator, Chemical Terrorism and Emergencies Unit  
Jay Fiedler, Epidemiologist  
Sue Manente, Health Educator

### **ATSDR Region 5 Office**

Mark Johnson, PhD  
Senior Environmental Health Scientist

Michelle Watters, MD  
Environmental Health Medical Officer

### **ATSDR Technical Project Officer**

Trent LeCoultré  
Division of Health Assessment and Consultation  
Superfund Site Assessment Branch

## References

Agency for Toxic Substances and Disease Registry (ATSDR). 1998. ATSDR, Division of Health Assessment and Consultation. Guidance on Including Child Health Issues in Division of Health Assessment and Consultation Documents. July 2, 1998.

Agency for Toxic Substances and Disease Registry (ATSDR). Toxicological profile for vanadium. Atlanta: US Department of Health and Human Services; 1992 July. Report No.: TP-91/29.

EQ Resource Recovery, Inc. (EQRR). Letter to George Bruchmann, Chief, MDEQ Waste and Hazardous Materials Division, from Daniel Belisle, Regulatory Specialist, EQRR, concerning EQRR August 9, 2005 fire incident. August 24, 2005.

healthAIR, Inc. Report concerning Roosevelt-McGrath Elementary School indoor air quality monitoring and bulk sampling investigation. Farmington Hills, Michigan. August 31, 2005.

Lockheed Martin. Analytical report concerning EQ Resource Recovery Emergency Response [Part 1]. Edison, New Jersey. August 31, 2005a.

Lockheed Martin. Analytical report concerning EQ Resource Recovery Emergency Response [Part 2]. Edison, New Jersey. August 31, 2005b.

Michigan Department of Environmental Quality (MDEQ). 2004. Remediation and Redevelopment Division Operational Memorandum No. 1: Part 201 Cleanup Criteria and Part 213 Risk-based Screening Levels. [http://www.deq.state.mi.us/documents/deq-rrd-OpMemo\\_1.pdf](http://www.deq.state.mi.us/documents/deq-rrd-OpMemo_1.pdf)

California Office of Environmental Health Hazard Assessment (OEHHA). Memorandum to David P. Spath, Division of Drinking Water and Environmental Management Branch, Department of Health Services, from Robert A. Howd, Water Toxicology Unit, Pesticide and Environmental Toxicology Section, concerning proposed notification level for vanadium. August 24, 2000. <http://www.oehha.ca.gov/water/pals/vanadium.html>

Rickman, J. E. 2005. ASPECT takes to the air: airborne sensor technology assists emergency responders. Los Alamos National Laboratory, Chemistry Division. <http://pearl1.lanl.gov/external/Research/ASPECT.html>

U.S. Department of Energy (DOE). Revision 21 of AEGLs, ERPGs, and TEELs for chemicals of concern. 11 Oct 2005. [http://www.eh.doe.gov/chem\\_safety/teel.html](http://www.eh.doe.gov/chem_safety/teel.html)

U.S. Environmental Protection Agency (EPA). U.S. EPA Region V Pollution Report No. 1. Prepared by Jon Gulch, On-Scene Coordinator. August 10, 2005a. [http://www.epaosc.net/polrep\\_profile.asp?site\\_id=1785&counter=3090](http://www.epaosc.net/polrep_profile.asp?site_id=1785&counter=3090)

U.S. Environmental Protection Agency (EPA). U.S. EPA Region V Pollution Report No. 3. Prepared by Jon Gulch, On-Scene Coordinator. August 15, 2005.  
[http://www.epaosc.net/polrep\\_profile.asp?site\\_id=1785&counter=3101](http://www.epaosc.net/polrep_profile.asp?site_id=1785&counter=3101)

U.S. Environmental Protection Agency (EPA). U.S. EPA Region V Pollution Report No. 4. Prepared by Jon Gulch, On-Scene Coordinator. August 16, 2005c.  
[http://www.epaosc.net/polrep\\_profile.asp?site\\_id=1785&counter=3115](http://www.epaosc.net/polrep_profile.asp?site_id=1785&counter=3115).

U.S. Environmental Protection Agency (EPA). 2005d. EQ Resource Recovery Fire: Unit #5 – Initial Monitoring Data.  
[http://www.epaosc.net/sites/1785/files/unit%205\\_initial.pdf](http://www.epaosc.net/sites/1785/files/unit%205_initial.pdf)

U.S. Environmental Protection Agency (EPA). 2005e. EQ Resource Recovery Fire: Unit #5 – Final Monitoring Data. <http://www.epaosc.net/sites/1785/files/unit%205-final.pdf>

U.S. Environmental Protection Agency (EPA). 2005f. EQ Resource Recovery Fire: Unit #6 – Initial Monitoring Data.  
[http://www.epaosc.net/sites/1785/files/unit%206\\_initial.pdf](http://www.epaosc.net/sites/1785/files/unit%206_initial.pdf)

U.S. Environmental Protection Agency (EPA). 2005g. EQ Resource Recovery Fire: Unit #6 – Final Monitoring Data. <http://www.epaosc.net/sites/1785/files/unit%206-final.pdf>

U.S. Environmental Protection Agency (EPA). 2005h. EQ Resource Recovery Fire: Unit #8 – Initial Monitoring Data.  
[http://www.epaosc.net/sites/1785/files/unit%205\\_initial.pdf](http://www.epaosc.net/sites/1785/files/unit%205_initial.pdf)

U.S. Environmental Protection Agency (EPA). 2005i. EQ Resource Recovery Fire: Unit #8 – Final Monitoring Data. <http://www.epaosc.net/sites/1785/files/unit%205-final.pdf>

U.S. Environmental Protection Agency (EPA). 2005j. Final report for airborne data collected in support of U.S. EPA Region V, EQ Resources Recovery fire, Romulus, Michigan.  
<http://www.epaosc.net/sites/1785/files/final%20report%20aspect%20data%20eq%20resources.doc>

U.S. Environmental Protection Agency (EPA). 2005k. VOC Surveillance using EPA's Trace Atmospheric Gas Analyzer (TAGA) and ASPECT Aerial Platform FTIR.  
<http://www.epa.gov/earth1r6/6en/a/taga-ecp.pdf>



# EQ Resource Recovery and Greater Detroit Area, Wayne County, Michigan

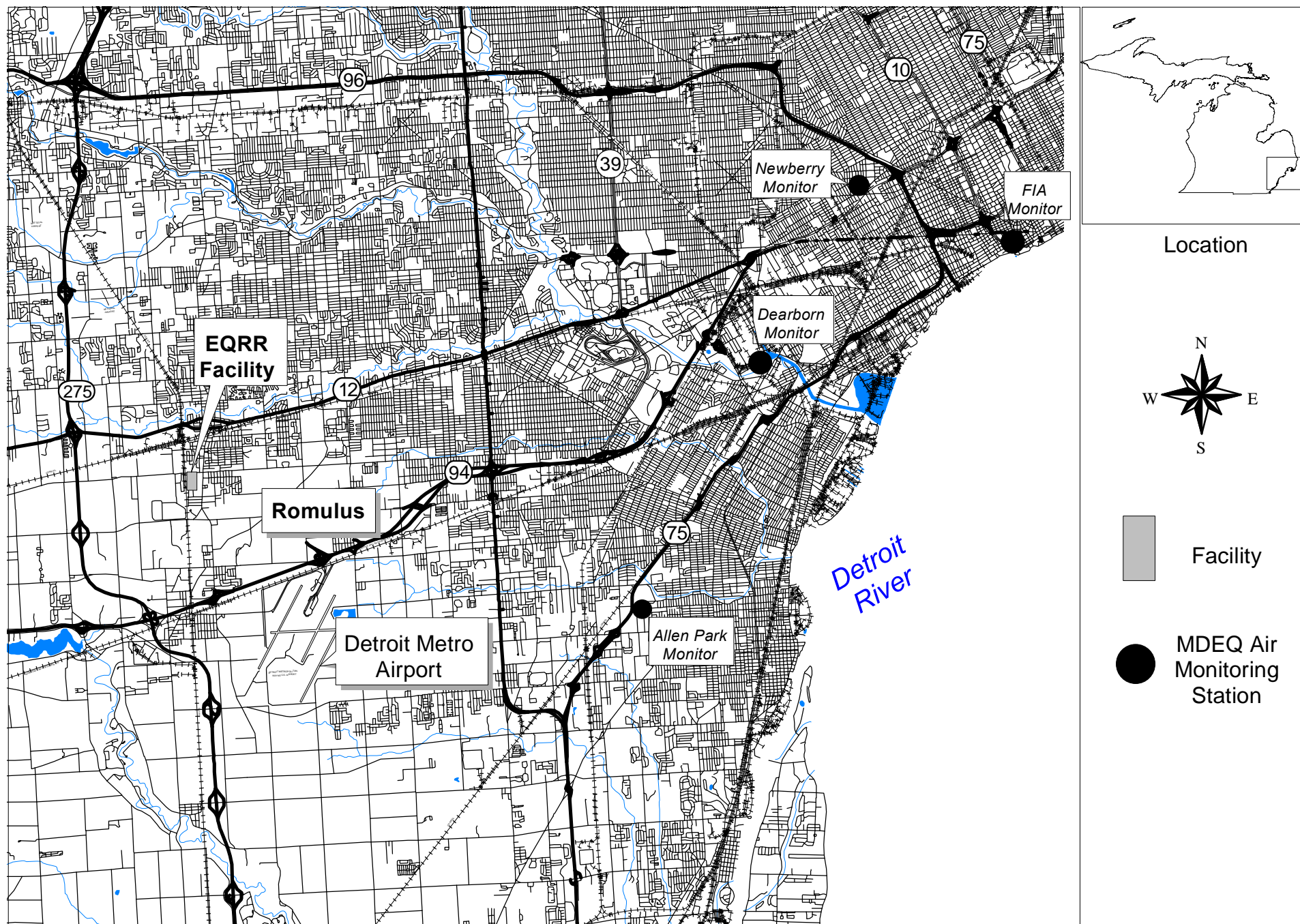


Figure 1a



EQ Resource Recovery plant and vicinity, Romulus, Wayne County, Michigan

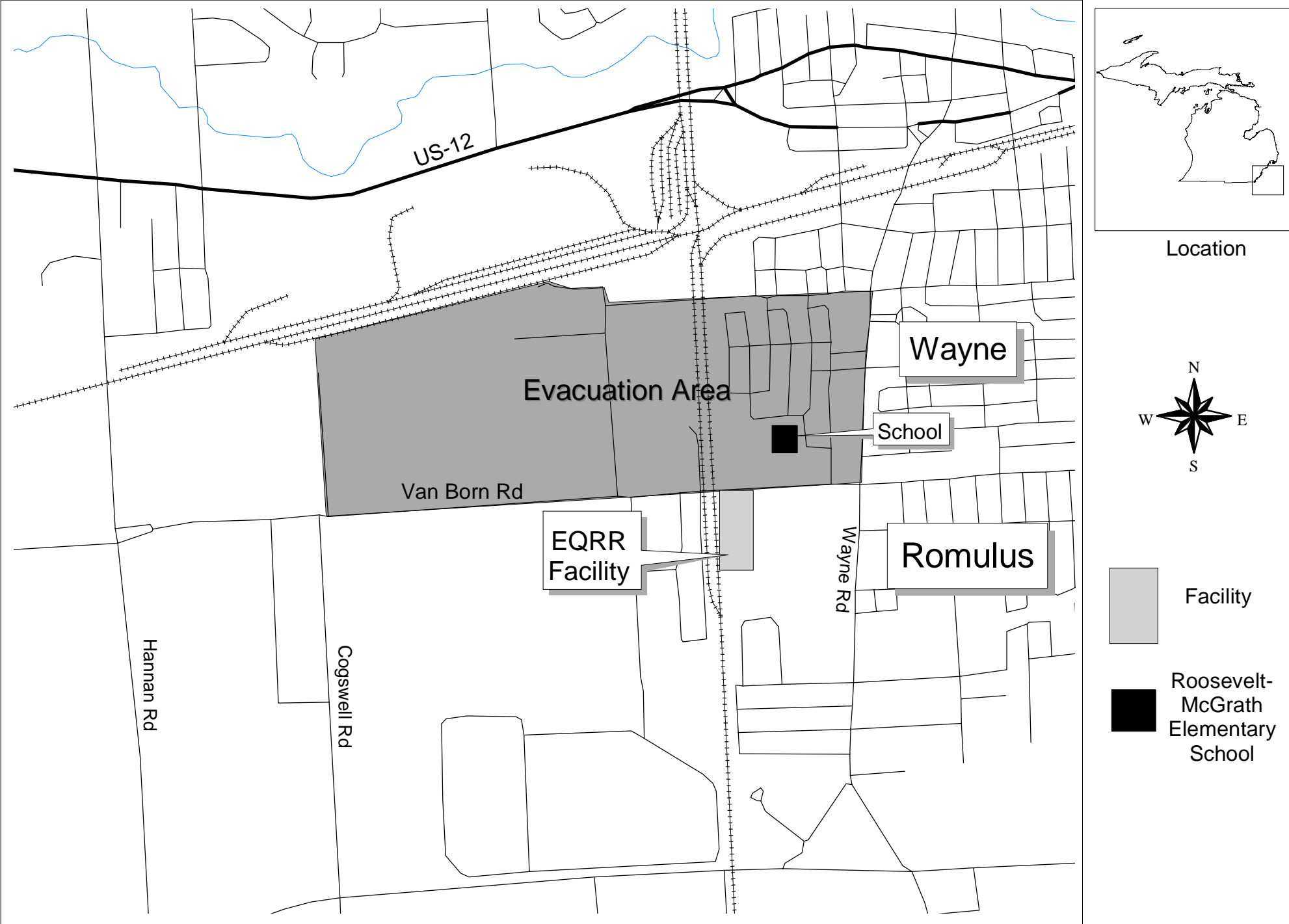





Figure 1b

**WIPE AND BULK SAMPLING  
EQ CHEMICAL SITE**

08/11-08/13/05

-  - WIPE SAMPLES 8/11/05
-  - BULK SAMPLES 08/12/05
-  - WIPE SAMPLES  
(BNA 08/11/05  
METALS 08/12/05)

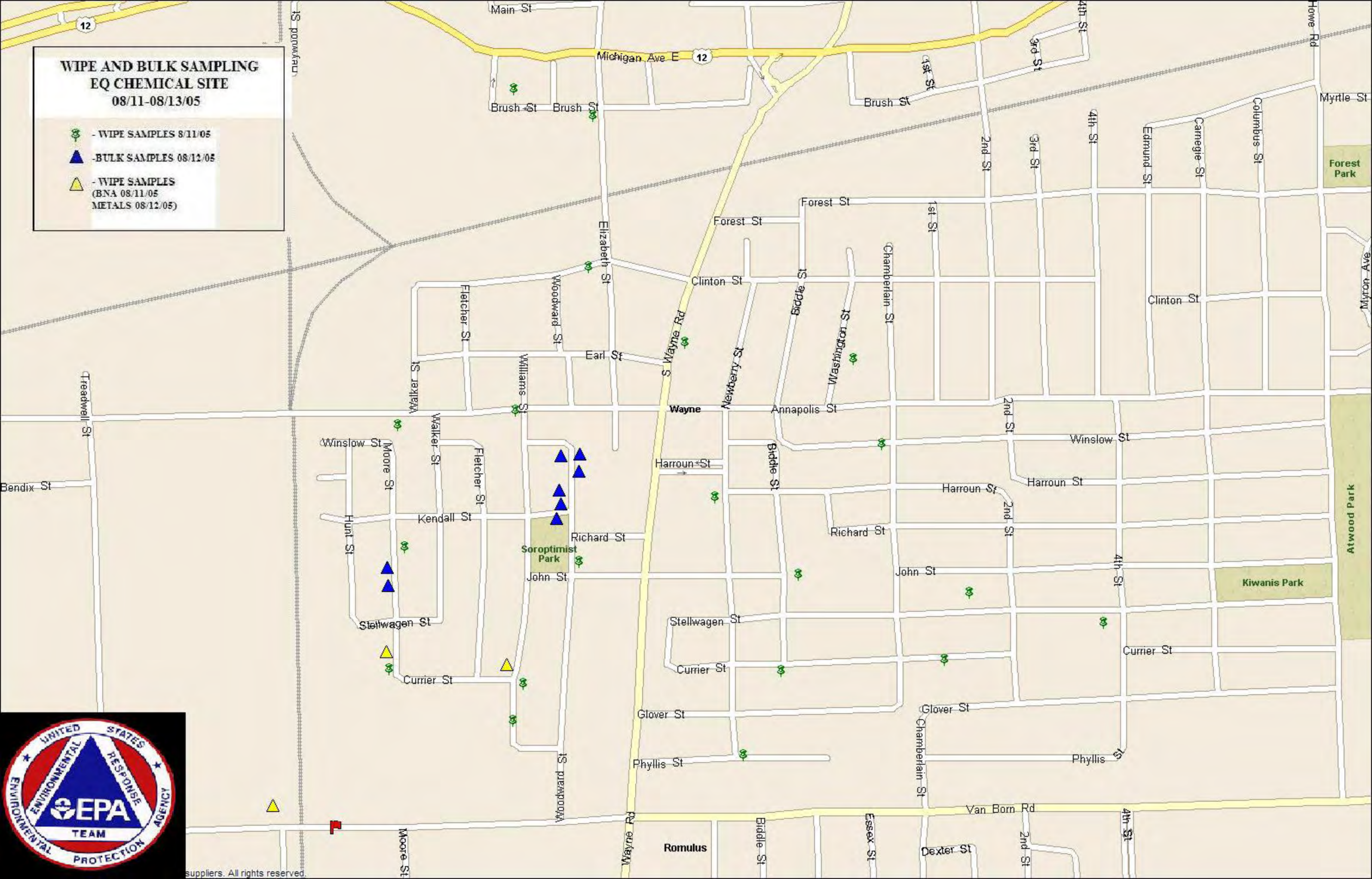


Table 1a. Volatile Organic Compounds Tested for in Air Samples Taken 8/10/05 at EQ Resource Recovery Fire in Romulus, Michigan.

<b>1,1,1-Trichloroethane</b>	Cyclohexane
1,1,2,2-Tetrachloroethane	Dibromochloromethane
1,1,2-Trichloroethane	<b>Dichlorodifluoromethane</b>
<b>1,1-Dichloroethane</b>	Dichlorotetrafluoroethane
1,1-Dichloroethene	<b>Ethyl acetate</b>
<b>1,2,4-Trimethylbenzene</b>	<b>Ethylbenzene</b>
1,2-Dibromoethane	<b>Ethyltoluene</b>
1,2-Dichlorobenzene	<b>Heptane</b>
1,2-Dichloroethane	<b>Hexane</b>
1,2-Dichloropropane	<b>Isopropyl alcohol</b>
<b>1,3,5-Trimethylbenzene</b>	<b>m- &amp; p-Xylene</b>
1,3-Butadiene	<b>Methyl isobutyl ketone</b>
1,3-Dichlorobenzene	Methyl tert butyl ether
1,4-Dichlorobenzene	<b>Methylene chloride</b>
1,4-Dioxane	<b>o-Xylene</b>
<b>2-Butanone</b>	<b>Propylene</b>
<b>2-Hexanone</b>	<b>Styrene</b>
<b>Acetone</b>	<b>Tetrachloroethene</b>
<b>Benzene</b>	<b>Tetrahydrofuran</b>
Bromoform	<b>Toluene</b>
Bromomethane	trans-1,2-Dichloroethene
<b>Carbon tetrachloride</b>	trans-1,3-Dichloropropene
<b>Chlorobenzene</b>	<b>Trichloroethene</b>
Chloroethane	<b>Trichlorofluoromethane</b>
<b>Chloroform</b>	<b>Trichlorotrifluoroethane</b>
<b>Chloromethane</b>	Vinyl acetate
<b>cis-1,2-Dichloroethene</b>	Vinyl chloride
cis-1,3-Dichloropropene	

Note: Those chemicals listed in **bold** were detected in the air samples.



Table 1b. Volatile Organic Compounds Detected in Air Samples Taken 8/10/05 at EQ Resource Recovery Fire in Romulus, Michigan.

Chemical Detected	No. detections / No. samples	Concentration Range (ppbv)	Lowest Acute Screen- ing Level (ppbv) <sup>A</sup>
1,1,1-Trichloroethane	1 / 4	0.2	2,000 <sup>B</sup>
1,1-Dichloroethane	1 / 4	0.08	100,000 <sup>C</sup>
1,2,4-Trimethylbenzene	3 / 4	0.08 - 2.72	25,000 <sup>C</sup>
1,3,5-Trimethylbenzene	1 / 4	0.8	25,000 <sup>C</sup>
2-Butanone	2 / 4	1.64 - 16.2	4,400 <sup>D</sup>
2-Hexanone	1 / 4	0.64	5,000 <sup>C</sup>
Acetone	4 / 4	3.76 - 63.4	26,000 <sup>B</sup>
Benzene	4 / 4	0.08 - 9.36	50 <sup>B</sup>
Carbon tetrachloride	4 / 4	0.08	200 <sup>B</sup>
Chlorobenzene	1 / 4	0.16	30,000 <sup>C</sup>
Chloroform	1 / 4	0.64	31 <sup>D</sup>
Chloromethane	4 / 4	0.52 - 0.72	500 <sup>B</sup>
cis-1,2-Dichloroethene	1 / 4	0.32	140,000 <sup>E</sup>
Dichlorodifluoromethane	4 / 4	0.48 - 0.52	1,000,000 <sup>C</sup>
Ethyl acetate	1 / 4	0.6	400,000 <sup>C</sup>
Ethylbenzene	2 / 4	0.08 - 6.68	100,000 <sup>C</sup>
Ethyltoluene	1 / 4	0.96	40,000 <sup>C</sup>
Heptane	1 / 4	0.08	440,000 <sup>C</sup>
Hexane	3 / 4	0.12 - 0.96	50,000 <sup>C</sup>
Isopropyl alcohol	2 / 4	0.24 - 23.7	1,300 <sup>D</sup>
m- & p-Xylene	3 / 4	0.12 - 22.2	1,000 <sup>B</sup>
Methyl isobutyl ketone	2 / 4	0.04 - 5.72	75,000 <sup>C</sup>
Methylene chloride	4 / 4	0.08 - 4.12	600 <sup>B</sup>
o-Xylene	2 / 4	0.08 - 4.88	1,000 <sup>B</sup>
Propylene	1 / 4	12.9	24,000,000 <sup>C</sup>
Styrene	1 / 4	1.44	4,900 <sup>D</sup>
Tetrachloroethene	1 / 4	0.24	200 <sup>B</sup>
Tetrahydrofuran	1 / 4	0.84	100,000 <sup>C</sup>
Toluene	4 / 4	0.12 - 16.9	1,000 <sup>B</sup>
Trichloroethene	1 / 4	0.72	2,000 <sup>B</sup>
Trichlorofluoromethane	4 / 4	0.24	500,000 <sup>C</sup>
Trichlorotrifluoroethane	4 / 4	0.08 - 0.12	1,000,000 <sup>C</sup>
Source: Lockheed Martin 2005a,b			
Acronyms/Abbreviations:			
ppbv	parts per billion by volume		
ATSDR	Agency for Toxic Substances and Disease Registry		
EMEG	Environmental Media Evaluation Guide		
ERPG	Emergency Response Planning Guideline		
TEEL	Temporary Emergency Exposure Limit		
EPA	Environmental Protection Agency		
REL	Reference Exposure Limit		
AEGL	Acute Exposure Guideline Level.		
Notes:			
A. Most protective value for acute exposure (less than 2 weeks) shown. See Appendix A for discussion of screening levels.			
B. Value is ATSDR acute EMEG for air.			
C. Value is U.S. Department of Energy ERPG/TEEL.			
D. Value is California EPA's acute REL.			
E. Value is U.S. EPA's AEGL.			

Table 2a. Base-Neutral-Acid (BNA) Compounds Tested for in Wipe and Bulk Soot Samples Taken 8/11-12/05 at EQ Resource Recovery Fire in Romulus, Michigan.

1,2,4-Trichlorobenzene	Benzo(g,h,i)perylene
1,2-Dichlorobenzene	<b>Benzo(k)fluoranthene</b>
1,3-Dichlorobenzene	Benzyl alcohol
1,4-Dichlorobenzene	bis(2-Chloroethoxy)methane
2,4,5-Trichlorophenol	bis(-2-Chloroethyl)ether
2,4,6-Trichlorophenol	bis(2-Chloroisopropyl)ether
2,4-Dichlorophenol	<b>bis(2-Ethylhexyl)phthalate</b>
<b>2,4-Dimethylphenol</b>	Butylbenzylphthalate
2,4-Dinitrophenol	Carbazole
2,4-Dinitrotoluene	<b>Chrysene</b>
2,6-Dinitrotoluene	Dibenzo(a,h)anthracene
2-Chloronaphthalene	<b>Dibenzofuran</b>
2-Chlorophenol	Diethylphthalate
2-Methylnaphthalene	Dimethylphthalate
2-Methylphenol	<b>Di-n-butylphthalate</b>
2-Nitroaniline	Di-n-octylphthalate
2-Nitrophenol	<b>Fluoranthene</b>
3,3'-Dichlorobenzidine	<b>Fluorene</b>
3-Nitroaniline	Hexachlorobenzene
4,6-Dinitro-2-methylphenol	Hexachlorobutadiene
4-Bromophenyl-phenylether	Hexachlorocyclopentadiene
4-Chloro-3-methylphenol	Hexachloroethane
4-Chloroaniline	Indeno(1,2,3-cd)pyrene
4-Chlorophenyl-phenylether	Isophorone
<b>4-Methylphenol</b>	<b>Naphthalene</b>
4-Nitroaniline	Nitrobenzene
4-Nitrophenol	N-Nitroso-di-n-propylamine
<b>Acenaphthene</b>	N-Nitrosodiphenylamine
Acenaphthylene	Pentachlorophenol
Anthracene	<b>Phenanthrene</b>
<b>Benzo(a)anthracene</b>	<b>Phenol</b>
<b>Benzo(a)pyrene</b>	<b>Pyrene</b>
<b>Benzo(b)fluoranthene</b>	

Note: Those chemicals listed in **bold** were detected in the samples.

Table 2b. Base-Neutral-Acid (BNA) Compounds Detected in Wipe Samples Taken 8/11-12/05 at EQ Resource Recovery Fire in Romulus, Michigan.						
Chemical Detected	No. detections / No. samples	Concentration Range (ug/100 cm <sup>2</sup> )	Screening Levels (ug/100 cm <sup>2</sup> )			
			Adult		Child	
			Noncancer Effects	Cancer Effects	Noncancer Effects	Cancer Effects
bis(2-Ethylhexyl)phthalate	2 / 45	5.04 - 5.68	332	1,190,000	27.7	98,800
Di-n-butylphthalate	12 / 45	2.55 - 5.99	3,160	NA	229	NA
Source: Lockheed Martin 2005a,b						
Acronyms/Abbreviations:						
ug/100 cm <sup>2</sup>	micrograms per 100 square centimeters					
NA	not applicable					
Notes: See Appendix B for discussion regarding derivation of wipe screening levels.						

Table 2c. Base-Neutral-Acid (BNA) Compounds Detected in Bulk Soot Samples Taken 8/11-12/05 at EQ Resource Recovery Fire in Romulus, Michigan.			
Chemical Detected	No. detections / No. samples	Concentration Range (ppm)	Screening Level (ppm)
2,4-Dimethylphenol	3 / 6	2.58 - 10.9	11,000
4-Methylphenol	3 / 6	6.12 - 28.5	11,000
Acenaphthene	1 / 6	0.973	41,000
Benzo(a)anthracene	1 / 6	1.43	20
Benzo(a)pyrene	1 / 6	1.13	2
Benzo(b)fluoranthene	1 / 6	1.21	20
Benzo(k)fluoranthene	1 / 6	1.19	200
bis(2-Ethylhexyl)phthalate	5 / 6	1.27 - 76.5	2,800
Chrysene	1 / 6	1.81	2,000
Dibenzofuran	1 / 6	1.04	ID
Fluoranthene	1 / 6	5.99	4,600
Fluorene	1 / 6	1.32	27,000
Naphthalene	1 / 6	0.85	16,000
Phenanthrene	1 / 6	8.34	1,600
Phenol	1 / 6	1.08	12,000
Pyrene	1 / 6	4.5	29,000
<u>Source:</u> Lockheed Martin 2005a,b			
<u>Acronyms/Abbreviations:</u>			
ppm	parts per million		
ID	insufficient data to derive a screening level		
<u>Note:</u> The screening levels used for bulk soot samples taken from the ground were the Michigan Department of Environmental Quality Part 201 Residential and Commercial I Direct Contact Criteria (MDEQ 2005). These criteria address long-term dermal exposure to and incidental ingestion of contaminated soil.			

Table 3a. Metals Tested for in Wipe and Debris Samples Taken 8/11-12/05 at the EQ Resource Recovery Fire in Romulus, Michigan.

<b>Aluminum</b>	<b>Cobalt</b>	<b>Potassium</b>
<b>Arsenic</b>	<b>Copper</b>	<b>Selenium</b>
<b>Barium</b>	<b>Iron</b>	<b>Silver</b>
Beryllium	<b>Lead</b>	<b>Sodium</b>
<b>Cadmium</b>	<b>Magnesium</b>	<b>Vanadium</b>
<b>Calcium</b>	<b>Manganese</b>	<b>Zinc</b>
<b>Chromium</b>	<b>Nickel</b>	

Note: Those chemicals listed in **bold** were detected in the samples.



Table 3b. Metals Detected in Wipe Samples Taken 8/11-12/05 at the EQ Resource Recovery Fire in Romulus, Michigan.						
Chemical Detected	No. detections / No. samples	Concentration Range (ug/100 cm <sup>2</sup> )	Screening Levels (ug/100 cm <sup>2</sup> ) <sup>A</sup>			
			Adult		Child	
			Noncancer Effects	Cancer Effects	Noncancer Effects	Cancer Effects
Aluminum	10 / 46	9.05 - 47.8	14,000	NA	1,620	NA
Barium	3 / 46	0.762 - 1.66	1,770	NA	242	NA
Cadmium	2 / 46	0.144 - 0.196	31.6	2,820,000	2.29	614,000
Calcium	25 / 46	56.8 - 835	NC <sup>B</sup>	NC <sup>B</sup>	NC <sup>B</sup>	NC <sup>B</sup>
Chromium	4 / 46	0.149 - 1.72	46.7	422,000	4.1	92,000
Copper	7 / 46	0.263 - 1.61	1,470	NA	102	NA
Iron	23 / 46	4.76 - 258	NC <sup>B</sup>	NC <sup>B</sup>	NC <sup>B</sup>	NC <sup>B</sup>
Lead	8 / 46	0.282 - 2.69	2.69	NA	2.69	NA
Magnesium	17 / 46	10.7 - 329	NC <sup>B</sup>	NC <sup>B</sup>	NC <sup>B</sup>	NC <sup>B</sup>
Manganese	11 / 46	0.872 - 6.35	188	NA	26.5	NA
Nickel	1 / 46	5.54	730	NA	508	NA
Potassium	3 / 46	11 - 18.9	NC <sup>B</sup>	NC <sup>B</sup>	NC <sup>B</sup>	NC <sup>B</sup>
Sodium	2 / 46	75.1 - 102	NC <sup>B</sup>	NC <sup>B</sup>	NC <sup>B</sup>	NC <sup>B</sup>
Zinc	4 / 46	3.18 - 8.54	10,600	NA	745	NA
<u>Source:</u> Lockheed Martin 2005a,b						
<u>Acronyms/Abbreviations:</u>						
ug/100 cm2	micrograms per 100 square centimeters					
NA	not applicable for this chemical (not considered to be a carcinogen via any exposure route)					
NC	not calculated for this chemical					
<u>Notes:</u>						
A. See Appendix B for discussion regarding derivation of wipe screening levels.						
B. Wipe screening levels were not calculated for calcium, iron, magnesium, potassium, and sodium because these chemicals are macronutrients, nutritionally necessary, and should not cause toxicity at the levels detected.						

Table 3c. Metals Detected in Debris Samples Taken 8/11-12/05 at EQ Resource Recovery Fire in Romulus, Michigan.

Chemical Detected	No. detections / No. samples	Concentration Range (ppm)	Screening Level (ppm) <sup>A</sup>	No. exceedances
<b>Aluminum<sup>B</sup></b>	9 / 9	907 - 873,000	50,000	<b>1</b>
Arsenic	4 / 9	1.19 - 2.83	7.6	0
Barium	9 / 9	6.26 - 9,690	37,000	0
Cadmium	1 / 9	2.21	550	0
Calcium	9 / 9	708 - 6,900	NA <sup>C</sup>	0
Chromium	9 / 9	0.621 - 549	2,500	0
Cobalt	8 / 9	1.61 - 36.2	2,600	0
Copper	9 / 9	2.96 - 2,420	20,000	0
Iron	9 / 9	1,980 - 88,300	160,000	0
Lead	9 / 9	1.21 - 52.5	400	0
Magnesium	9 / 9	229 - 4,350	1,000,000	0
Manganese	9 / 9	14.8 - 5,220	25,000	0
Nickel	9 / 9	0.916 - 108	40,000	0
Potassium	9 / 9	178 - 1,640	NA <sup>C</sup>	0
Selenium	2 / 9	0.744 - 1.91	2,600	0
Silver	2 / 9	1.05 - 10.4	2,500	0
Sodium	9 / 9	309 - 1,220	1,000,000	0
<b>Vanadium<sup>B</sup></b>	8 / 9	5.61 - 991	750	<b>5</b>
Zinc	9 / 9	15 - 974	170,000	0
<u>Source:</u> Lockheed Martin 2005a,b				
<u>Acronyms/Abbreviations:</u>				
ppm	parts per million			
NA	not applicable			
<u>Notes:</u>				
A. The screening levels used for debris samples were the Michigan Department of Environmental Quality (MDEQ) Part 201 Residential and Commercial I Direct Contact Criteria (MDEQ 2005). These criteria address long-term dermal exposure to and incidental ingestion of contaminated soil.				
B. Chemicals in bold exceed the MDEQ screening level. See discussion in Toxicological Evaluation section.				
C. There are no MDEQ criteria for calcium and potassium. These chemicals are macronutrients, nutritional requirements, and should not result in toxicity at the levels detected.				

Table 4a. Metals Tested for in Soot/Debris and Indoor Air Samples Taken 8/10/05 by School District-hired Contractor at Roosevelt-McGrath Elementary School in Wayne, Michigan.

<b>Arsenic</b>	<b>Copper</b>	<b>Silver</b>
<b>Barium</b>	<b>Lead</b>	<b>Zinc</b>
<b>Cadmium</b>	Mercury (tested in indoor air only)	
<b>Chromium</b>	<b>Selenium</b>	

Note: Those chemicals listed in **bold** were detected in the debris samples. No chemicals were detected in the indoor air samples.

Table 4b. Metals Detected in Soot/Debris Samples Taken 8/10/05 by School District-hired Contractor at Roosevelt-McGrath Elementary School in Wayne, Michigan.

<b>Chemical Detected</b>	<b>No. detections / No. samples</b>	<b>Concentration Range (ppm)</b>	<b>Screening Level (ppm)</b>		
Arsenic	4 / 4	1.2 - 4.3	7.6		
Barium	4 / 4	10 - 28	37,000		
Cadmium	4 / 4	0.91 - 1.6	550		
Chromium	4 / 4	7.8 - 25	2,500		
Copper	4 / 4	80 - 2,000	20,000		
Lead	4 / 4	11 - 32	400		
Selenium	1 / 4	1.1	2,600		
Silver	1 / 4	3.5	2,500		
Zinc	4 / 4	70 - 450	17,000		
<u>Source:</u> healthAIR Inc. 2005					
<u>Acronyms/Abbreviations:</u>					
ppm	parts per million				

Note: The screening levels used for debris samples taken at the school were the Michigan Department of Environmental Quality Part 201 Residential and Commercial I Direct Contact Criteria (MDEQ 2005). These criteria address long-term dermal exposure to and incidental ingestion of contaminated soil.

Table 5a. Volatile and Semivolatile Organic Compounds (VOCs and SVOCs) Tested for in Soot/Debris and Indoor Air Samples Taken 8/10/05 by School District-hired Contractor at Roosevelt-McGrath Elementary School in Wayne, Michigan.

**VOCs (tested in debris only)**

1,1,1,2-Tetrachloroethane  
 1,1,1-Trichloroethane  
 1,1,2,2-Tetrachloroethane  
 1,1,2-Trichloroethane  
 1,1-Dichloroethene  
 1,1-Dichloroethane  
 1,2,3-Trichlorobenzene  
 1,2,3-Trichloropropane  
 1,2,4-Trichlorobenzene  
 1,2,4-Trimethylbenzene  
 1,2-Dibromo-3-chloropropane  
 1,2-Dibromoethane  
 1,2-Dichlorobenzene  
 1,2-Dichloroethane  
 1,2-Dichloropropane  
 1,3,5-Trimethylbenzene  
 1,3-Dichlorobenzene  
 1,3-Dichloropropane  
 1,4-Dichlorobenzene  
 2,2-Dichloropropene  
 2-Chlorotoluene  
 4-Chlorotoluene  
 Benzene  
 Bromobenzene  
 Bromochloromethane  
 Bromodichloromethane  
 Bromoform  
 Bromomethane  
 Carbon tetrachloride  
 Chlorobenzene  
 Chloroethane  
 Chloroform  
 Chloromethane  
 cis-1,2-Dichloroethene  
 Dibromochloromethane  
 Dibromomethane  
 Ethylbenzene  
 Hexachlorobutadiene

Isopropylbenzene  
 Methy (tert) butyl ether  
 Methylene chloride  
 n-Butylbenzene  
 n-Propylbenzene  
 sec-Butylbenzene  
 Styrene  
 tert-Butylbenzene  
 Tetrachloroethene  
 Toluene  
 trans-1,2-Dichloroethene  
 Trichloroethene  
 Trichlorofluoromethane  
 Vinyl chloride  
 Xylenes

**SVOCs (tested in debris and indoor air)**

2,4,5-Trichlorophenol  
 2,4,6-Trichlorophenol  
 2,4-Dichlorophenol  
**2,4-Dimethylphenol**  
 2,4-Dinitrophenol  
 2,4-Dinitrotoluene  
 2,6-Dinitrotoluene  
 2-Chloronaphthalene  
 2-Chlorophenol  
 2-Methylnaphthalene  
**2-Methylphenol**  
 2-Nitroaniline  
 2-Nitrophenol  
 3,3'-Dichlorobenzidine  
 3,3'-Dimethylbenzidine  
 3-Nitroaniline  
 4,6-Dinitro-2-methylphenol  
 4-Bromophenyl phenyl ether  
 4-Chloro-3-methylphenol  
 4-Chloroaniline  
 4-Chlorophenyl phenyl ether  
**4-Methylphenol**

4-Nitroaniline  
 4-Nitrophenol  
 Acenaphthene  
 Acenaphthylene  
 Anthracene  
 Benzidine  
 Benzo(a)anthracene  
 Benzo(a)pyrene  
 Benzo(b)fluoranthene  
 Benzo(g,h,i)perylene  
 Benzo(k)fluoranthene  
 Bis(2-chloroethoxy)methane  
 Bis(2-chloroethyl) ether  
 Bis(2-Chloroisopropyl) ether  
 Bis(2-ethylhexyl)phthalate  
 Butyl benzyl phthalate  
 Chrysene  
 Dibenzo(a,h)anthracene  
 Dibenzofuran  
 Diethyl phthalate  
 Dimethylphthalate  
 Di-n-butyl phthalate  
 Di-n-octyl phthalate  
 Fluoranthene  
 Fluorene  
 Hexachlorobenzene  
 Hexachlorobutadiene  
 Hexachlorocyclopentadiene  
 Hexachloroethane  
 Indeno(1,2,3-cd)pyrene  
 Isophorone  
 Naphthalene  
 Nitrobenzene  
 N-Nitrosodi-n-propylamine  
 Pentachlorophenol  
 Phenanthrene  
**Phenol**  
 Pyrene

Note: Those chemicals listed in **bold** were detected in the debris samples. No chemicals were detected in the indoor air samples.

Table 5b. Semivolatile Organic Compounds Detected in Soot/Debris Samples Taken 8/10/05 by School District-hired Contractor at Roosevelt-McGrath Elementary School in Wayne, Michigan.

<b>Chemical Detected</b>	<b>No. detections / No. samples</b>	<b>Concentration Range (ppm)</b>	<b>Screening Level (ppm)</b>		
2,4-Dimethylphenol	4 / 4	1.5 - 18	11,000		
2-Methylphenol	4 / 4	18 - 62	11,000		
4-Methylphenol	4 / 4	22 - 80	11,000		
Phenol	3 / 4	4.9 - 39	12,000		
<u>Source:</u> healthAIR Inc. 2005					
<u>Acronyms/Abbreviations:</u>					
ppm	parts per million				

Note: The screening levels used for debris samples taken at the school were the Michigan Department of Environmental Quality Part 201 Residential and Commercial I Direct Contact Criteria (MDEQ 2005). These criteria address long-term dermal exposure to and incidental ingestion of contaminated soil.

## Certification

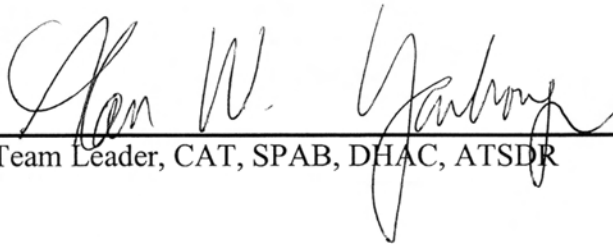
This **EQ Resource Recovery Explosion and Fire** Health Consultation was prepared by the Michigan Department of Community Health under a cooperative agreement with the Agency for Toxic Substances and Disease Registry (ATSDR). It is in accordance with approved methodology and procedures. Editorial review was completed by the cooperative agreement partner.



---

Technical Project Officer, Cooperative Agreement Team (CAT), Superfund Program  
Assessment Branch (SPAB), Division of Health Assessment and Consultation (DHAC),  
ATSDR

The Division of Health Assessment and Consultation, ATSDR, has reviewed this public health consultation and concurs with the findings.



---

Team Leader, CAT, SPAB, DHAC, ATSDR

## **Appendix A. Screening Levels Used When Evaluating Measured Air Emissions from the August 2005 EQRR Fire in Romulus, Michigan**

The Screening Levels used for the evaluation of air emissions from the August 2005 explosion and fire at the EQ Resource Recovery (EQRR) facility in Romulus, Michigan are described below and listed in order of preference.

**California Acute Reference Exposure Levels** (CaRELs), as developed by the California Environmental Protection Agency (CalEPA), are based on the most appropriate and sensitive adverse health effects. CalEPA places a heavy emphasis on available human data when developing these values, as evidenced by 34 of the 51 CaRELs developed being based on observed human health outcomes (CalEPA 1999).

These health-based values are applicable to risk characterization of air releases, defined in California's Health and Safety Code Section 44303, as "including actual or potential spilling, leaking, pumping, pouring, emitting, emptying, discharging, injecting, escaping, leaching, dumping, or disposing of a substance into the ambient air and that results from routine operation of a facility or that is predictable, including, but not limited to continuous and intermittent releases and predictable process upsets or leaks" (CalEPA 1999). This differentiates the CaRELs from AEGLs and ERPGs/TEELs (discussed below), which pertain to emergency releases. Although the explosion and fire at EQRR was not a part of "routine operation," ATSDR/MDCH chose to use the CaRELs as the primary acute screening level because these screening levels generally are more protective (lower in concentration) than the AEGLs and ERPGs/TEELs.

CaRELs are based on a one-hour averaging time for most chemicals. Values with longer averaging times are derived from studies with a reproductive/developmental endpoint. CaRELs are designed to protect the general public, including sensitive subgroups. Exposure to a specific chemical should not exceed its CaREL more than once every two weeks over the course of a year (CalEPA 1999).

If a detected chemical did not have a corresponding CaREL, ATSDR/MDCH compared the detected concentration to the Acute Exposure Guideline Level for that chemical. The U.S. EPA **Acute Exposure Guideline Levels** (AEGLs) are developed by the National Advisory Committee for Acute Exposure Guideline Levels for Hazardous Substances. The committee has members from government, industrial, academic, and private organizations. The primary use of AEGLs is to assist organizations with emergency planning, response, and prevention programs (EPA 2005).

There are three levels of guidelines (EPA 2005):

- AEGL-1 is the airborne concentration of a substance above which it is predicted that the general population, including susceptible individuals, could experience notable discomfort, irritation, or certain asymptomatic nonsensory effects. However, the effects are not disabling and are transient and reversible upon cessation of exposure. Airborne concentrations below AEGL-1 represent exposure levels that can produce mild and



progressively increasing but transient and nondisabling odor, taste, and sensory irritation or certain asymptomatic, nonsensory adverse effects.

- AEGL-2 represents the airborne concentration of a substance above which it is predicted that the general population, including susceptible individuals, could experience irreversible or other serious, long-lasting adverse health effects or an impaired ability to escape.

- AEGL-3 is the airborne concentration of a substance above which it is predicted that the general population, including susceptible individuals, could experience life-threatening health effects or death.

With increasing airborne concentrations above each AEGL, there is a progressive increase in the likelihood of occurrence and the severity of effects described for that level. Although the AEGL values represent threshold levels for the general public (including susceptible subpopulations such as infants, children, the elderly, persons with asthma, and those with other illnesses), EPA recognizes that some individuals could experience the effects described at concentrations below the corresponding AEGL (EPA 2005).

Several averaging times are possible for all three levels: 5, 10, 30, and 60 minutes, and 4 and 8 hours. (In the case of AEGLs, “acute” exposure lasts no longer than 8 hours. [EPA 2005].) ATSDR/MDCH used the most protective averaging time of 8 hours to assess the air emissions from the EQRR fire.

If a detected chemical did not have a corresponding CaREL or AEGL, ATSDR/MDCH compared the detected concentration to the Emergency Response Planning Guideline or Temporary Emergency Exposure Level for that chemical. The American Industrial Hygiene Association developed the **Emergency Response Planning Guidelines** (ERPGs) and **Temporary Emergency Exposure Limits** (TEELs) for the U.S. Department of Energy (DOE) for use in evaluating the effects of accidental chemical releases on the general public. ERPGs and TEELs are estimates of concentration ranges for specific chemicals above which acute exposure would be expected to lead to adverse health effects of increasing severity for each hierarchical step. Because many chemicals of interest lack ERPGs, TEELs are used for those chemicals until final ERPGs are established (DOE 2005).

Human data are given primary consideration, and rat data are preferred over that for other animal species, in deriving ERPGs and TEELs. Inhalation data are preferred over data from other routes of uptake.

There are 3 levels of ERPGs (DOE 2005):

- ERPG-1 represents the maximum concentration in air below which it is believed nearly all individuals could be exposed for up to one hour without experiencing other than mild transient adverse health effects or perceiving a clearly defined objectionable odor.

- ERPG-2 is the maximum concentration in air below which it is believed nearly all individuals could be exposed for up to one hour without experiencing or developing

irreversible or other serious health effects or symptoms that could impair their abilities to take protective action.

- ERPG-3 represents the maximum concentration in air below which it is believed nearly all individuals could be exposed for up to one hour without experiencing or developing life-threatening health effects.

There are 4 levels of TEELs (DOE 2005):

- TEEL-0 is the threshold concentration below which most people will experience no appreciable risk of health effects.

- The definition for TEEL-1 is the same as that for ERPG-1.

- The definition for TEEL-2 is the same as that for ERPG-2.

- The definition for TEEL-3 is the same as that for ERPG-3.

The DOE recommends that, for application of TEELs, the concentration at the receptor point of interest be calculated as the peak 15-minutes time-weighted average concentration (DOE 2005).

Detected chemicals were also compared to their respective ATSDR air Comparison Values. **ATSDR Environmental Media Evaluation Guides** (EMEGs) represent concentrations of substances in an environmental medium to which humans may be exposed during a specified period of time (acute, intermediate, or chronic) without experiencing adverse health effects. The duration of acute exposure, as defined by ATSDR, is 14 days or less. Intermediate exposures are those lasting 15 days to 1 year. Chronic exposures last more than 1 year. For exposures to substances in soil or water, EMEGs consider dose per body weight and differ between adults and children. For exposure to substances in air, EMEGs are expressed as air concentrations and are the same for adults and children (ATSDR 2005).

EMEGs are based on toxicity information that considers noncarcinogenic toxic effects of chemicals, including their developmental and reproductive toxicity. An air EMEG is derived only from inhalation data and does not try to extrapolate data from different exposure routes (ATSDR 2005).

EMEGs are used as screening tools. Substances found at concentrations below EMEGs are not expected to pose public health hazards. Substances found at concentrations above EMEGs require further evaluation before a public health conclusion can be drawn (ATSDR 2005).

References for Appendix A:

Agency for Toxic Substances and Disease Registry (ATSDR). Air comparison values. Atlanta: US Department of Health and Human Services; 17 July 2005.

Agency for Toxic Substances and Disease Registry (ATSDR). Public health assessment guidance manual. Atlanta: US Department of Health and Human Services; 2005.

California Environmental Protection Agency (CalEPA). 1999. Air Toxics Hot Spots Program Risk Assessment Guidelines. Part 1. The Determination of Acute Reference Exposure levels for Airborne Toxicants. Office of Environmental Health Hazard Assessment, Air Toxics and Epidemiology Section. March 1999.  
<http://www.oehha.ca.gov/air/pdf/acuterel.pdf>

U.S. Department of Energy. 2005. Revision 21 of AEGLs, ERPGs, and TEELs for chemicals of concern. [http://www.eh.doe.gov/chem\\_safety//teel.html](http://www.eh.doe.gov/chem_safety//teel.html)

U.S. Environmental Protection Agency (EPA). 2005. The development of acute exposure guideline levels (AEGLs). <http://www.epa.gov/oppt/aegl/index.htm>

## **Appendix B. Deriving Screening Levels for Wipe Samples Taken Following the August 2005 Fire at EQ Resource Recovery in Romulus, Michigan**

State and federal health and environmental protection agencies set screening levels for chemicals found in soil, water, and air samples. To derive screening levels for environmental contaminants and characterize risks, assessors must use either site-specific or default (determined from other studies) values for exposure factors such as body weight, inhalation rate, skin surface area, and frequency and duration of exposure. These values can be subject to debate, however risk assessors typically attempt to make assumptions that protect the most susceptible receptor in a scenario. Assessors also use science-based chemical-specific parameters, such as acceptable (“safe”) doses and degree to which a chemical is absorbed, when deriving screening levels.

Chemicals found in settled soot or dust and sampled via wipes present a challenge to risk assessors in both the derivation of screening levels and the interpretation of sample results. Following the September 11, 2001 attacks on the World Trade Center and the Pentagon (9/11), the U.S. Environmental Protection Agency (EPA) assembled a multi-agency task force to establish health-based “benchmarks” (screening levels) to evaluate the long-term risk of indoor contamination on local residents (WTCWG 2003). In response to the August 9, 2005 explosion and fire at the EQ Resource Recovery (EQRR) facility in Romulus, Michigan, the federal Agency for Toxic Substances and Disease Registry (ATSDR) and the Michigan Department of Community Health (MDCH) considered the wipe-sample methodology used following 9/11 but determined that it was not suited for the EQRR site. The main reason for not using EPA’s methodology was that it was designed to address exposure to indoor residues. The wipe samples for the EQRR fire were taken from outdoor surfaces. Also, the collapse of the World Trade Center and the subsequent fires released tremendous amounts of asbestos, polycyclic aromatic hydrocarbons (PAHs, as soot), and other sources of particulate material that took many days to settle, increasing the likelihood that significant amounts of the dust could enter homes. On the other hand, fallout from the EQRR incident occurred in a much shorter time span and to a lesser degree, making it unlikely that large amounts of soot or dust would enter homes. Lastly, the EPA methodology did not address the possibility of resuspension of the residue into the air and being inhaled. Although the likelihood of resuspension of the soot-like fallout from the EQRR fire is unknown, ATSDR/MDCH felt that the inhalation pathway should be considered as well.

Ultimately, ATSDR/MDCH selected a methodology developed by the U.S. Army Center for Health Promotion and Preventive Medicine (CHPPM). The CHPPM method first determines individual contact rates (CRs) for dermal (skin), ingestion (eating), and inhalation (breathing) exposure, then compares the contact rates with the chemical’s Reference Doses (RfDs) for those exposure pathways, and back-calculates an acceptable surface concentration (May et al. 2002). Discussion of the RfD for each exposure pathway occurs later in this appendix.

The exposure assumptions, parameter values, and wipe screening levels derived for the samples containing aluminum, barium, cadmium, chromium (as hexavalent chromium),

copper, manganese, nickel, zinc, bis(2-ethylhexyl)phthalate (also known as diethylhexyl phthalate), and di-n-butyl phthalate are discussed below. Screening levels were not derived for calcium, iron, magnesium, potassium, or sodium, because these chemicals are macronutrients, necessary for good health, and not likely to result in toxicity at the levels found near the EQRR site. The U.S. Department of Housing and Urban Development (HUD) established a screening level for lead dust in a residential setting of 25 micrograms per square foot ( $\mu\text{g}/\text{ft}^2$ ), or 2.69  $\mu\text{g}$  per 100 square centimeters ( $100\text{ cm}^2$ ) (69 Federal Register 34262). ATSDR/MDCH used the HUD screening level to assess the health threat from lead in the soot-like debris from the EQRR fire.

ATSDR/MDCH selected two possible human receptors:

- an adult male, barefoot, wearing shorts and T-shirt, and
- a male child, initial age of 2 years, barefoot, wearing shorts.

The agencies chose males over females because males generally have a greater skin surface area than do females, which allows for greater potential for exposure.

The dermal contact rate,  $CR_{\text{dermal}}$ , is calculated using the following equation (May et al. 2002):

$$CR_{\text{dermal}} = SA_d \times F_d \times EV \times FT_{ss} \times DAF$$

$SA_d$  is the dermal surface area available for absorption. The adult receptor potentially would be exposing his feet, lower legs, forearms, and hands to surfaces where soot has deposited. Using the 95<sup>th</sup> percentile values for adult males (meaning 95% of the adult male population would have smaller values, making this choice very protective), the  $SA_d$  for an adult male, for this exercise, is 0.731 square meters ( $\text{m}^2$ ) (EPA 1997). The child receptor potentially would be exposing his feet, legs, arms, hands, and trunk to surfaces where soot has deposited. Averaging the 95<sup>th</sup> percentile values for a male child from age 2 to 5 years (to cover an assumed exposure period of 3 years), the  $SA_d$  for a male child, for this exercise, is 0.6584  $\text{m}^2$  (EPA 1997).

$F_d$  is the fraction of available skin that contacts the contaminated surface. In this exercise, it is assumed that the entire surface area of the adult receptor's feet and hands, and one-fourth of the surface area of his lower legs and forearms, contacts the contaminated surface. This amounts to approximately 52% of the available skin, or 0.52. For the child receptor, it is assumed that the entire surface area of his feet, arms, and hands, and half of the surface area of his legs and trunk, contacts the contaminated surface. This amounts to approximately 65% of the available skin, or 0.65.

$EV$  is the contact frequency with the contaminated surface. It is assumed, for this exercise, that the adult contacts the surface twice per day (2/day) and the child contacts the surface four times per day (4/day). The duration of contact is not considered.

$FT_{ss}$  is the fraction of dust transferred from the contaminated surface to the skin. In this exercise, it is assumed, for both receptors, that 25% (0.25) of the dust is transferred. Note that, although this transfer occurs, the surface concentration is assumed to remain the

same for future contacts. Thus, dissipation of the contamination, from contact, washing, or weathering, is not considered. (Assuming a constant surface concentration is more protective than assuming dissipation.) At the end of the assumed exposure duration of 3 years, the concentration becomes zero (the contaminant is gone).

DAF is the dermal absorption efficiency (the percent that absorbs through the skin into the body) of the chemical of interest. Suggested default values, when chemical-specific information is not available, are 1% (0.01) for inorganics, such as metals, and 10% (0.1) for organics, such as volatile organic compounds (VOCs). Chemical-specific parameters are listed in Table A-1, at the end of this appendix.

The ingestion contact rate,  $CR_{ingest}$ , is calculated using the following equation (May et al. 2002):

$$CR_{ingest} = SA_g \times F_g \times EV \times FT_{ss} \times FT_{ftm} \times HTME$$

$SA_g$  is the dermal surface area available for ingestion. This is different from the parameter for surface area available for absorption through the skin ( $SA_d$ , above) in that this surface area also must be accessible to the mouth. For this exercise, it is assumed that the entire surface area of the hands and forearms of the adult receptor,  $0.283 \text{ m}^2$  (EPA 1997), are accessible to his mouth. For the child receptor in this exercise, it is assumed that the entire surface area of the hands and half of the surface area of the arms,  $0.0947 \text{ m}^2$  (EPA 1997), are accessible to his mouth.

$F_g$  is the fraction of available dermal area that contacts the mouth. For this exercise, it is assumed that 2/3 the hand area for each receptor comes into contact with the mouth. For the adult receptor, that is approximately 28% (0.28) of the total available area. For the child receptor, that is approximately 31% (0.31) of the total available area.

EV and  $FT_{ss}$  were discussed earlier and remain the same for each receptor.

$FT_{ftm}$  is the fraction of dust transferred from the skin to the mouth. In this exercise, it is assumed that this value is 50% (0.5) for both receptors.

HTME is the number of hand-to-mouth events, when the receptor touches his mouth with his hand. In this exercise, it is assumed that the adult receptor does this 4 times per day and that the child receptor does this 16 times per day.

The inhalation contact rate,  $CR_{inhale}$ , is calculated using the following equation (May et al. 2002):

$$CR_{inhale} = IR_i \times K$$

$IR_i$  is the inhalation rate. The average adult has an inhalation rate of 16 cubic meters per day ( $\text{m}^3/\text{day}$ ) (EPA 1997). The average six-year-old has an inhalation rate of  $16.74 \text{ m}^3/\text{day}$ . (Although the child receptor assumed for this exercise is younger than 6 years,

this inhalation rate considers various activity levels and is more protective than rates for three- to five-year-olds facing long-term exposures [EPA 1997].)

K, the resuspension factor, is a measure of the amount of dust, per meter of surface area, expected to resuspend into the air after a contaminated surface is disturbed. Various studies have suggested values from 0.01 (1E-2) to 0.00000001 (1E-8), with more strenuous dust-producing activities (such as construction) having a K of about 1E-5 to 1E-4 and lighter activities (such as walking) having a K of about 1E-8 to 1E-7 (May et al. 2002). For this exercise, a K value of 1E-5 per meter (1E-5/m) was assumed.

Once the dermal, ingestion, and inhalation contact rates are calculated, they are inserted into an equation that back-calculates an acceptable wipe screening level,  $C_s$ , for each chemical of interest. The screening level calculation for noncarcinogens (chemicals not expected to cause cancer) is below (May et al. 2002):

$$C_{\text{Snoncarcinogen}} = \left( \frac{THQ}{\left[ \left( \frac{CR_{\text{dermal}}}{RfD_{\text{dermal}}} \right) + \left( \frac{CR_{\text{ingest}}}{RfD_{\text{ingest}}} \right) + \left( \frac{CR_{\text{inhale}}}{RfD_{\text{inhale}}} \right) \right]} \right) \times \left( \frac{BW \times AT \times 365 \text{ days / yr}}{EF \times ED} \right) \times CF$$

THQ is the target hazard quotient. A hazard quotient is the expected dose (CR, in this exercise) divided by the acceptable dose (RfD). If the expected dose is greater than the RfD, the hazard quotient is greater than 1 and further evaluation of the exposure is required. If the expected dose is less than the RfD, the hazard quotient is less than 1 and the exposure is not expected to cause harm. For this exercise, the THQ is 1.

$RfD_{\text{dermal}}$  is the reference dose for dermal exposure to a chemical. An RfD is an estimate of a daily exposure (usually oral) to a substance that is likely to be without a discernable risk of adverse health effects to the general human population, including sensitive subgroups, during a lifetime of exposure. EPA does not establish dermal RfDs ( $RfD_{\text{dermal}}$ s), however the Risk Assessment Information System's Health Effects Assessment Summary Tables (HEAST), established by the Oak Ridge National Laboratory with the University of Tennessee, provides toxicity values for use in risk assessments (RAIS 2005). Chemical-specific parameters are listed in Table A-1.

$RfD_{\text{ingest}}$  is the chemical's oral RfD, as established by EPA or listed on the HEAST. Chemical-specific parameters are listed in Table A-1.

$RfD_{\text{inhale}}$  is similar, in some respects, to the chemical's Reference Concentration (RfC), as established by EPA. An RfC is similar to the EPA oral RfD but refers to a chemical in air and is expressed in units of milligrams per cubic meter ( $\text{mg}/\text{m}^3$ ). EPA does not establish  $RfD_{\text{inhale}}$ s, however the HEAST provides these toxicity values, expressed as milligrams per kilogram body weight per day ( $\text{mg}/\text{kg}/\text{day}$ ), for use in risk assessments (RAIS 2005). Chemical-specific parameters are listed in Table A-1.

BW stands for body weight. The default BW value for an adult is 70 kilograms (kg, about 154 pounds). The average BW value for a male child age 2 to 5 years is 15.7 kg (about 35 pounds) (EPA 1997).

AT is the averaging time, which, for noncarcinogens, is equal to the exposure duration, assumed to be 3 years (discussed below).

EF is the exposure frequency. For this exercise, it is assumed that both receptors are exposed to the contaminated surfaces 90 days per year.

ED is the exposure duration. For this exercise, it is assumed that both receptors are exposed to the contaminated surfaces for 3 years. As discussed earlier, the concentration of the contamination is assumed to remain constant over that time and then, at the end of 3 years, become zero (the contaminant is gone).

CF is a conversion factor so that the screening level units result in micrograms per 100 square centimeters ( $\mu\text{g}/100\text{ cm}^2$ , the units reported for the wipe samples from the EQRR fire) and equals  $10\text{ }\mu\text{g}/100\text{ cm}^2$  per  $\text{mg}/\text{m}^2$ .

The screening level calculation for carcinogens (chemicals known or expected to cause cancer) is below (May et al. 2002):

$$C_{\text{Scurcinogen}} = \frac{TR \times BW \times AT_{\text{lifetime}} \times 365\text{days} / \text{yr} \times CF}{\left[ (CR_{\text{dermal}} \times CSF_{\text{dermal}}) + (CR_{\text{ingest}} \times CSF_{\text{ingest}}) + (CR_{\text{inhale}} \times CSF_{\text{inhale}}) \right] \times EF \times ED}$$

TR stands for target, or acceptable, cancer risk. The risk of developing cancer following exposure to a carcinogen is discussed in terms of excess cancer in an exposed population as compared to an unexposed population, such as 1 in 10,000 ( $1\text{E-}4$ ), 1 in 100,000 ( $1\text{E-}5$ ), or 1 in one million ( $1\text{E-}6$ ). The TR for this exercise is  $1\text{E-}5$ .

BW, body weight, was discussed above and remains the same for both receptors.

$AT_{\text{lifetime}}$  is the averaging time used when considering carcinogens and is equal to the average human lifespan of 70 years. When a chemical is found to be carcinogenic in laboratory animals, the research typically involves a high dose of the chemical given to the animal over a short period of time (although it is typically close to the animal's lifetime). Based on the assumption that a high dose of a carcinogen received over a relatively short period of time results in the same effect as a low dose spread over a person's lifetime, human exposures are calculated by prorating the total cumulative dose over an average person's lifetime.

CF is the conversion factor discussed above and remains the same.

$CSF_{\text{dermal}}$  is the cancer slope factor (CSF) for dermal exposure to a chemical. A CSF is an estimate of the increased cancer risk from a lifetime exposure to a chemical. It is a probability estimate that is used only for comparative purposes. It is not a predictive tool.



EPA does not establish CSF<sub>dermal</sub>s, however the HEAST provides toxicity values for use in risk assessments (RAIS 2005). Chemical-specific parameters are listed in Table A-1.

CSF<sub>ingest</sub> is the chemical's oral CSF, as established by EPA or listed on the HEAST. Chemical-specific parameters are listed in Table A-1.

CSF<sub>inhale</sub> is similar, in some respects, to the chemical's Inhalation Unit Risk Factor (IURF), as established by EPA. An IURF is similar to the EPA oral CSF but refers to a chemical in air and is expressed in units of milligrams per cubic meter, inverted ( $[\mu\text{g}/\text{m}^3]^{-1}$ ). EPA does not establish CSF<sub>inhale</sub>s, however the HEAST provides these toxicity values, expressed as milligrams per kilogram body weight per day, inverted ( $[\text{mg}/\text{kg}/\text{day}]^{-1}$ ), for use in risk assessments (RAIS 2005). Chemical-specific parameters are listed in Table A-1.

EF and ED, exposure frequency and exposure duration, were discussed earlier and remain the same.

Table B-1. Chemical-specific inputs used to derive wipe screening levels for chemicals found in soot-like debris from the August 9, 2005 explosion and fire at the EQ Resource Recovery facility in Romulus, Michigan.

Chemical	DAF <sup>A</sup>	RfD <sub>dermal</sub> <sup>A</sup>	RfD <sub>ingestion</sub> <sup>A,B</sup>	RfD <sub>inhale</sub> <sup>A</sup>	CSF <sub>dermal</sub> <sup>A</sup>	CSF <sub>ingestion</sub> <sup>A,B</sup>	CSF <sub>inhale</sub> <sup>A</sup>
		(mg/kg/day)			(mg/kg/day) <sup>-1</sup>		
Aluminum	0.01	0.1	1	0.00143	NA	NA	NA
Barium	0.01	0.014	0.2	0.000143	NA	NA	NA
Cadmium	0.001	0.00001	0.001	NA	NA	NA	6.3
Chromium	0.01	0.00006	0.003	0.0000286	NA	NA	42
Copper	0.01	0.012	0.04	NA	NA	NA	NA
Manganese	0.01	0.0056	0.02	0.0000143	NA	NA	NA
Nickel	0.01	0.0054	0.02	NA	NA	NA	NA
Zinc	0.01	0.06	0.3	NA	NA	NA	NA
BEHP	0.1	0.0038	0.02	NA	0.0737	0.014	NA
DNBP	0.1	0.1	0.1	NA	NA	NA	NA

Acronyms/Abbreviations:

DAF	dermal absorption factor
RfD	Reference Dose
CSF	Cancer Slope Factor
mg/kg/day	milligrams per kilogram body weight per day
NA	not applicable
BEHP	bis(2-ethylhexyl)phthalate
DNBP	di-n-butyl phthalate

Notes:

- Values taken from Risk Assessment Information System Health Effects Assessment Summary Tables (RAIS 2005).
- Values taken from U.S. Environmental Protection Agency Integrated Risk Information System (EPA 2005).

Table B-2. Receptor-specific inputs used to derive wipe screening levels for chemicals found in soot-like debris from the August 9, 2005 explosion and fire at the EQ Resource Recovery facility in Romulus, Michigan.

Parameter (units)	Adult	Child
SA <sub>d</sub> (m <sup>2</sup> )	0.731	0.6584
F <sub>d</sub> (unitless)	0.52	0.65
EV (day <sup>-1</sup> )	2	4
FT <sub>ss</sub> (unitless)	0.25	0.25
SA <sub>g</sub> (m <sup>2</sup> )	0.283	0.0947
F <sub>g</sub> (unitless)	0.28	0.31
FT <sub>ftm</sub> (unitless)	0.5	0.5
HTME (unitless)	4	16
IR <sub>i</sub> (m <sup>3</sup> /d)	16	16.74
BW (kg)	70	15.7
AT <sub>noncarcinogen</sub> (yrs)	3	3
EF (days/yr)	90	90
ED (yrs)	3	3
AT <sub>lifetime</sub> (yrs)	70	70

Acronyms/Abbreviations:

m <sup>2</sup>	square meters
m <sup>3</sup> /d	cubic meters per day
kg	kilogram
yrs	years

Notes:

A. See earlier discussion for definition of each parameter.

Table B-3. Contact rates and screening levels derived for a male adult receptor exposed to the chemicals found in soot-like debris from the August 9, 2005 explosion and fire at the EQ Resource Recovery facility in Romulus, Michigan.

Chemical	CR <sub>dermal</sub>	CR <sub>ingestion</sub>	CR <sub>inhalation</sub>	C <sub>s(noncarcinogen)</sub>	C <sub>s(carcinogen)</sub>
	(m <sup>2</sup> /day)			(µg/100cm <sup>2</sup> )	
Aluminum	0.001901	0.0708	0.00016	14,000	NA
Barium	0.001901	0.0708	0.00016	1,770	NA
Cadmium	0.00019	0.0708	0.00016	31.6	2,820,000
Chromium	0.001901	0.0708	0.00016	46.7	422,000
Copper	0.001901	0.0708	0.00016	1,470	NA
Manganese	0.001901	0.0708	0.00016	188	NA
Nickel	0.001901	0.0708	0.00016	730	NA
Zinc	0.001901	0.0708	0.00016	10,600	NA
BEHP	0.019006	0.0708	0.00016	332	1,190,000
DNBP	0.019006	0.0708	0.00016	3,160	NA

Acronyms/Abbreviations:

CR	contact rate
C <sub>s</sub>	acceptable surface concentrations
m <sup>2</sup> /day	square meters per day
µg/100cm <sup>2</sup>	micrograms per 100 square centimeters
BEHP	bis(2-ethylhexyl)phthalate
DNBP	di-n-butylphthalate

Table B-4. Contact rates and screening levels derived for a male child receptor exposed to the chemicals found in soot-like debris from the August 9, 2005 explosion and fire at the EQ Resource Recovery facility in Romulus, Michigan.

Chemical	CR <sub>dermal</sub>	CR <sub>ingestion</sub>	CR <sub>inhalation</sub>	C <sub>s(noncarcinogen)</sub>	C <sub>s(carcinogen)</sub>
	(m <sup>2</sup> /day)			(µg/100cm <sup>2</sup> )	
<b>Aluminum</b>	0.00428	0.23486	0.0002	1,620	NA
<b>Barium</b>	0.00428	0.23486	0.0002	242	NA
<b>Cadmium</b>	0.00043	0.23486	0.0002	2.29	614,000
<b>Chromium</b>	0.00428	0.23486	0.0002	4.1	92,000
<b>Copper</b>	0.00428	0.23486	0.0002	102	NA
<b>Manganese</b>	0.00428	0.23486	0.0002	26.5	NA
<b>Nickel</b>	0.00428	0.23486	0.0002	508	NA
<b>Zinc</b>	0.00428	0.23486	0.0002	745	NA
<b>BEHP</b>	0.0428	0.23486	0.0002	27.7	98,800
<b>DNBP</b>	0.0428	0.23486	0.0002	229	NA

Acronyms/Abbreviations:

CR	contact rate
C <sub>s</sub>	acceptable surface concentrations
m <sup>2</sup> /day	square meters per day
µg/100cm <sup>2</sup>	micrograms per 100 square centimeters
BEHP	bis(2-ethylhexyl)phthalate
DNBP	di-n-butylphthalate

#### Appendix B References:

Contaminants of Potential concern (COPC) Committee of the World Trade Center Indoor Air Task Force Working Group (WTCWG). World Trade Center indoor environment assessment: selecting contaminants of potential concern and setting health-based benchmarks. New York (NY): US Environmental Protection Agency; 2003 May. <http://www.epa.gov/WTC>

May LM, Gaborek B, Pitrat T, Peters L. 2002. Derivation of risk based wipe surface screening levels for industrial scenarios. The Science of the Total Environment 288:65-80.

Risk Assessment Information System (RAIS). 2006. Health Effects Assessment Summary Tables: chemical-specific toxicity values. [http://risk.lsd.ornl.gov/tox/tox\\_values.shtml](http://risk.lsd.ornl.gov/tox/tox_values.shtml)

U.S. Department of Housing and Urban Development (HUD). HUD Lead-Safe Housing Rule, 24 CFR 35, Subparts B through R. Federal Register 2004 June 21; 69:34262-34276.

U.S. Environmental Protection Agency (EPA). Exposure Factors Handbook – Volume 1: General Factors. Washington DC: Office of Research and Development; 1997 Aug. Report No.: EPA/600/P-95/002Fa.

## **Appendix C. ATSDR Public Health Hazard Categories**



# Public Health Hazard Categories

Depending on the specific properties of the contaminant, the exposure situations, and the health status of individuals, a public health hazard may occur. Using data from public health assessments, sites are classified using one of the following public health hazard categories:

## **Category 1: Urgent Public Health Hazard**

Sites that pose a serious risk to the public's health as the result of short-term exposures to hazardous substances.

## **Category 2: Public Health Hazard**

Sites that pose a public health hazard as the result of long-term exposures to hazardous substances.

## **Category 3: Potential/Indeterminate Public Health Hazard**

Sites for which no conclusions about public health hazard can be made because data are lacking.

## **Category 4: No Apparent Public Health Hazard**

Sites where human exposure to contaminated media is occurring or has occurred in the past, but the exposure is below a level of health hazard.

## **Category 5: No Public Health Hazard**

Sites for which data indicate no current or past exposure or no potential for exposure and therefore no health hazard.

**Appendix D. Understanding the Results of Sampling From the EQ Fire in Romulus, Michigan (MDCH factsheet)**



## **Understanding the Results of Sampling From the EQ Fire in Romulus, Michigan**

On September 8, 2005, the U.S. Environmental Protection Agency (EPA) released data reports from sampling conducted during the agency's response to the August 9 fire at the EQ Resource Recovery plant in Romulus. The reports included the type of sampling done, what chemicals were found and at what concentrations, and related quality assurance/quality control (QA/QC) information. Since these reports were strictly a summary of the environmental sampling data, they did not include screening levels used by health agencies to determine if the chemicals posed a public health hazard, nor did they include the health agencies' conclusions.

This factsheet describes the steps that the federal Agency for Toxic Substances and Disease Registry (ATSDR) and the Michigan Department of Community Health (MDCH) took to assess the public health impact of the fire at EQ. MDCH will write up the health agencies' response to the fire in a detailed report called a Public Health Consultation. This factsheet provides basic information regarding the sampling results and their interpretation.

### **What chemicals were looked for? Why and how?**

The chemicals of primary concern, which prompted the evacuation of nearby residential areas, were a class of compounds called volatile organic compounds (VOCs). These compounds easily become a gas, especially when heated, and enter the air. VOCs were in the liquid waste materials accepted and stored by EQ. Although VOCs are common chemicals (found in many cleaning and hobby products), high concentrations in the air can cause harm.

EPA tested for VOCs in the air using several types of instruments. First, the agency set AreaRAEs ("area rays," multiple-gas detectors) at three cross streets near the facility shortly after arriving at the scene to monitor total VOCs. Although it does not identify specific compounds, monitoring for total VOCs allows safety personnel to determine whether overall air concentrations of VOCs could pose an immediate risk to response workers or the public. The results of the AreaRAE monitoring are posted at the EPA website, <http://www.epaossc.net/EQResourceRecovery>.

The next way EPA tested for VOCs was by use of the ASPECT aircraft, which can fly over an air release and detect chemicals using infrared technology. The plane, which had been stationed in Texas, arrived in Michigan around 5 AM Wednesday morning and began collecting data around 6 AM. The results of the ASPECT screening are posted at the EPA website, <http://www.epaossc.net/EQResourceRecovery>.

The third method EPA used when testing for VOCs consisted of collecting air samples in SUMMA ("SŪ-mah") canisters. These canisters are sealed under vacuum.

Air samples enter the canisters at a specified flow rate. The analysis can identify about 60 different chemicals at very low concentrations. Although preliminary data have returned from the lab, the data have not yet been validated. Once the data are finalized, they will be publicly available.

Another class of chemicals of public health concern that potentially could have been released during the EQ fire was polyaromatic hydrocarbons (PAHs). These chemicals commonly are formed during incomplete combustion. They can be found in soot, engine exhaust, and grilled food, among other sources. EPA and the health agencies wanted to know to what degree soot from the fire was depositing on neighborhoods. They also wanted to know whether there were chemicals present that would not be expected from what one would consider a normal fire. EPA took wipe samples from windows facing toward the EQ facility and from windows facing away from the facility. This method of sampling would identify the compounds and how much on them were on the wipe. This technology generally is used for industrial hygiene purposes, when employees are working in dusty settings. EPA also sampled soot and debris found on the ground and analyzed it for PAH content. The results for both kinds of PAH testing are listed in the EPA data reports as “BNA” (base-neutral-acid) analyses.

The wipe and soot/debris samples also were analyzed for metal content. Local residents reported metallic debris raining down several minutes after the initial explosion. ATSDR and MDCH were concerned that the granules could contain high concentrations of potentially toxic metals. The size of most of the granules would make them easily swallowed by children. Similar to the PAH sampling, the wipe samples would identify the metals present. Direct sampling of the soot and debris on the ground would identify whether there were concentrations of concern. The results for both kinds of metals testing are listed in the EPA data reports.

Lastly, the soot and debris were analyzed for polychlorinated biphenyls (PCBs). EQ is licensed to handle wastes containing PCBs, and at the time of the fire, it was unclear what the involved tanks contained. No PCBs were detected above the reported detection limit. The results are listed in the EPA data reports.

**What health-based standards were used when evaluating the concentrations found?  
What were the public health conclusions of those evaluations?**

Public health and environmental agencies use scientific information to evaluate potential health effects from chemical exposure that may occur over hours or days to a lifetime. In the case of the EQ fire, health agencies were most concerned with short-term exposure to potentially large amounts of airborne chemicals. The guidelines that ATSDR and MDCH used when evaluating the air concentrations at EQ include the ATSDR Minimum Risk Levels, the California Acute Reference Exposure Levels, the EPA Acute Exposure Guideline Levels, and the U.S. Department of Energy Emergency Response Planning Guidelines/Temporary Emergency Exposure Limits. Other screening levels used include the EPA values for comparison to long-term exposure, called Reference Concentrations (RfCs), for chemicals in air, and Reference Doses (RfDs), for chemicals in soil or water. ATSDR and MDCH compared the air data taken at and around EQ with the various short- and long-term screening levels mentioned above and concluded that the concentrations seen should not be harmful.



Another concern that the health agencies had was regarding the fallout or debris that came down several minutes after the first explosion. As mentioned earlier, people reported that the debris or granules looked metallic. ATSDR and MDCH were concerned that, if the debris contained a high concentration of metals, younger children might eat some dirt containing the debris and potentially expose themselves to harmful levels of heavy metals. The health agencies compared the concentrations found in the debris to the Michigan Department of Environmental Quality (MDEQ) Direct Contact Criteria for residential soils. These criteria address skin contact with and eating of contaminated soil. The agencies found that the concentrations of metals in the debris were less than the Direct Contact Criteria and were close to background (expected) soil concentrations. Therefore, contact with the debris should not cause harm.

MDCH will discuss the health agencies' evaluations and conclusions in further detail in the Public Health Consultation for this site.

**People have reported various health effects - difficulty breathing, burning skin. That would indicate that the chemicals affected them, wouldn't it?**

Yes. It is likely that the initial explosion at EQ released a large amount of chemicals in a short time. Inhaling smoke or chemical vapors when they are released in such a burst can cause immediate and acute effects, such as those described. However, the fire started to consume the chemical vapors (VOCs) immediately and the intensity of the blaze decreased the formation of PAHs (soot). Because exposure was short and has since stopped, the effects people experienced are not expected to be lasting.

**The sampling in the data reports and the other monitoring shown on the EPA website (<http://www.epaosc.net/EQResourceRecovery>) was done some hours after the initial explosion. What was in the air immediately after that first explosion?**

We do not yet know what specific chemicals may have entered the air following the first explosion. EPA and EQ are investigating which tank started the event. Records at EQ will show what chemicals were in the tank. It is unlikely that we will ever know the actual concentration of the chemicals released into the air at the initial stages of the fire. That is because wind speed and direction can vary within a short distance, and the pressure in the tank, the force of the explosion, and the heat of the fire itself might have changed the waste into different chemicals.

**Why didn't EPA sample for other chemicals?**

The first step necessary was looking for the chemicals that are expected from a fire involving solvents (VOCs and PAHs). Although EQ is licensed to handle PCB waste, due to strict environmental rules, the company rarely (if ever) accepted this type of material. Nonetheless, ATSDR and MDCH requested that EPA analyze for those compounds. After careful consideration and discussion, the public health agencies concluded that the chemical levels seen should not cause harm. If the various testing results had indicated that there were concentrations of public-health concern, then further testing, for more chemicals, would have been needed.

There was discussion of testing for dioxins. Dioxins are a family of compounds that can be formed during incineration processes that involve products containing chlorine. Dioxins can be found in extremely small amounts all over the world. ATSDR

and MDCH looked at what chemicals potentially were involved during the fire and considered the results of the PCB analyses to base their decision on whether dioxin testing was necessary. (Some PCBs are dioxin-like compounds. If PCBs had been present, that would have increased the likelihood that dioxins could have been present, however no PCBs were detected.) The health agencies concluded that the incident at EQ would not result in elevated dioxin concentrations in air or in soil.

### **What is the purpose of QA/QC (quality assurance/quality control)?**

QA/QC is necessary to ensure that laboratory results are reliable and defensible. A QA/QC report can help determine whether the contaminants found and the concentrations detected were truly in the item tested (air, water, or soil) or if they might have been introduced during processing of that sample. QA/QC practices include testing blanks, duplicates, and spiked samples.

Blank samples are sample containers that do not hold an environmental sample. The container may be brought to the sampling site and either not opened (a “lot” or “trip” blank) or opened (“field” blank). The container may be left at the lab during the sampling event and then analyzed with the environmental samples, either going through the same preparation steps (“method” blank) or going directly into the machine (“control” or “calibration” blank).

Sampling staff will take duplicate samples in the field, sampling from the same location and using the same identifier for the container, adding a “D” to the number. This process allows a comparison between two “identical” samples. If there is a large difference between the samples, it could mean that there was an error on the sampler’s part or that there actually was more contaminant in one of the samples.

Laboratory staff will test spiked samples, sending a known concentration through the analytical machine to determine how accurately it is reading. There will be a pre-determined margin to determine if the difference between the expected reading and the actual reading is acceptable or if the machine needs adjustment. Duplicates of the spiked sample are read at the same time, to help further calibrate the machine.

### **Who should we call with our questions?**

If a person is experiencing health problems, they should consult with their physician. MDCH can discuss health effects that can be expected after being exposed to a specific chemical. The contact number for MDCH is 1-800-648-6942.

For questions regarding the sampling methods and federal regulatory requirements for this site, contact the EPA at 734-692-7600. For questions regarding state regulatory requirements for this site, contact the Michigan Department of Environmental Quality (MDEQ) Waste and Hazardous Materials Division, 586-753-3842.