Health Consultation

SCHWARTZMAN COMPANY INC. (SCI) SITE

ANOKA COUNTY, MINNESOTA

DECEMBER 17, 2008

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.

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HEALTH CONSULTATION

SCHWARTZMAN COMPANY INC. (SCI) SITE

ANOKA COUNTY, MINNESOTA

Prepared By:

Minnesota Department of Health
Under a cooperative agreement with the
U.S. Department of Health and Human Services
Agency for Toxic Substances and Disease Registry

Health Consultation

SCI Recycling Services Site

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The conclusions and recommendations presented in this public health assessment are the result of site specific analyses and are not to be cited or quoted for other evaluations or health consultations.

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Foreword

This document summarizes health concerns associated with the Schwartzman Company Inc. (SCI) Recycling Services site in Anoka, Minnesota. It is based on a formal site evaluation prepared by the Minnesota Department of Health (MDH) in collaboration with the Agency for Toxic Substances and Disease Registry (ATSDR) and Minnesota Pollution Control Agency (PCA). A number of steps are necessary to do such an evaluation:

- Evaluating exposure: MDH scientists begin a site evaluation by reviewing available information about environmental contamination at the site, or emitted from the site. The first task is to find out how much contamination is present, where it is found, and how people might be exposed to it. Usually, MDH does not collect its own environmental sampling data; instead MDH relies on information provided by the Minnesota Pollution Control Agency (PCA), and other government agencies, businesses, and the general public.

- Evaluating health effects: If there is evidence that people are being exposed—or could be exposed—to hazardous substances, MDH scientists will take steps to determine whether that exposure could be harmful to human health. The report focuses on public health i.e., the health impact on the community as a whole and is based on existing scientific information.

- Developing recommendations: In the evaluation report, MDH, PCA, and ATSDR outline their conclusions regarding any potential health threat posed by a site and offers recommendations for reducing or eliminating human exposure to contaminants. The role of MDH in dealing with individual sites is primarily advisory. For that reason, the evaluation report will typically recommend actions to be taken by other agencies—including PCA, or local government. However, if an immediate health threat exists, MDH will issue a public health advisory warning of the danger and will work to resolve the problem.

- Soliciting community input: The evaluation process is interactive. MDH starts by soliciting and evaluating information from various government agencies, the organizations responsible for cleaning up the site, and the community surrounding the site. Any conclusions about the site are shared with these groups and organizations that provided the information. Once an evaluation report has been prepared, MDH seeks feedback from the public. *If you have questions or comments about this report, you are encouraged to contact MDH.*

Please write to:
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Site Assessment and Consultation Unit
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121 East Seventh Place/Suite 220
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Or call: (651) 215-0916 *or* 1-800-657-3908
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Website: www.health.state.mn.us

Table of Contents

Introduction

The Minnesota Pollution Control Agency (PCA) asked the Minnesota Department of Health (MDH) to evaluate the potential off-site human health hazards from chemical emissions generated during a fire on September 9, 2002 at the Schwartzman Company Inc (SCI) facility. Concern has been raised in several reports and letters stating that residents were and continue to be exposed to toxic levels of dioxins and furans generated during the fire that may have settled on residential soils (3,4,5,11).

Background

SCI is a metal salvage/recycling business located on approximately 12.4 acres at 2905 North Ferry Street in Anoka, Minnesota. SCI shreds automobiles and appliances into scrap metal and non-metal (fluff) piles. The northern boundary is State Highway 47 (Ferry St) and the Anoka County Fairgrounds; on the east is State Hwy 47 (Ferry St.) and the Rum River (approximately 300 ft east of site). The southern boundary includes railroad tracks, Enich Kindergarten School and county offices (Anoka-Hennepin Distribution Complex). A residential area is located on the northwest (see Attachment 1). This site was first used to store wood in the late 1800s, followed by manufacturing of autos in early 1900s, and grain grinder manufacturing in the 1930s. In the early 1950s, the site was a woodworking facility, a print making shop, and was home to the Minnesota Pipe and foundry. The metal salvage operation began in the late 1950s.

Discussion

Automobile, Appliance and Materials Processing

Most scrap metal purchased from homeowners, municipalities, and commercial clients is brought to the facility on trucks. Automobiles and appliances are two large sources of scrap metal for the facility. Automobiles brought to the site that are not already crushed, have all the fluids, batteries, and tires removed prior to crushing and shredding. During automobile processing, mercury switches and polychlorinated biphenyl (PCBs) containing devices are supposed to be removed, segregated and collected by a vendor for off-site recycling/disposal. Appliances are dismantled indoors within the decommissioning area where mercury switches, Freon, and PCB containing devices are supposed to be removed prior to baling or shredding the appliance.

On-site Fire

On September 9, 2002 a fire occurred on-site that involved a pile of crushed vehicles awaiting placement into the shredder. It is assumed that all fluids and tires had been removed from the vehicles. The fire did not spread to other areas of the site; and did not involve any buildings. The burn area was approximately 250 ft in length by 150 ft in width (see Attachments 2 and 3), and burned from approximately 5 pm to 3 am the following day. The cause of the fire is unknown. The number of crushed vehicles involved is estimated between 600 to 1000 cars based on insurance claims. The plume from the fire was videotaped from the ground and from a helicopter for a short period of time on the afternoon of September 9 by a local television news station. From the video footage, the plume appeared to rise to a height of about 350 meters at a downwind distance of some 500 meters (27). This estimate applies to the early, presumably hotter period of the fire and likely does not reflect later conditions as the fire was being extinguished. Observers reported that smoke rose 60-75 feet and traveled south, and did not produce any ground-level concentrations of pollutants that would be of concern to nearby residents (10). Based on video footage of the fire, the smoke plume appeared to rise and pass over any nearby structures including the Anoka-Hennepin Distribution Complex/Enich

Kindergarten School (27). An article in the Anoka County Union stated the plume of smoke rose so high that it could be seen 30 miles away (9).

In order to estimate the dispersion and deposition of pollutants emitted during the fire it is necessary to know the meteorological conditions and the emission rate, and to be able to characterize the conditions of the release. In the late afternoon of September 9, 2002, temperatures were in the 80s, skies were clear with scattered cloudiness, and winds were light from the north-northwest. During the evening, winds became calm for a few hours and then a light breeze picked up from the east. Eventually during the night the surface winds turned southerly and westerly and began to increase. The Blaine Airport (11 miles from the site) wind directions reported for the day of the fire are slight NW winds at 5:56 pm, slight N winds at 7:56 pm, calm from 8:56 – 10:56 pm, and slight ENE winds from 10:56 – 11:56 pm (12). The fire was under control by 10 pm, but remained burning for several more hours as a crane started lifting burning cars and placing them in a constructed water pit (10). The next day from midnight to 1 am, a slight wind was blowing out of the south and then it begins blowing out of the WNW till 3am (12). (See Appendix for photos of the fire.) This high variability in the wind direction means that the plume was likely to have been widely dispersed in a variety of directions over the course of the burn. It is clear from the description of the event that the combustion conditions changed dramatically during the fire. Pollutant formation rates and the thermal buoyance of the plume likely changed dramatically over the course of the event as the combustion conditions changed. Late in the evening as the fire became less intense it is possible that the plume became less buoyant and remained closer to the ground. Unfortunately, there is no empirical evidence upon which to estimate the plume rise other than at the time of the videotape.

Dilution of smoke plume contaminants will occur as the smoke plume migrates off-site and contaminants settle to the ground. Anecdotal evidence of the smoke plume height, measured wind speeds, and directions, are factors that aid determination of contaminant dispersion and dilution from the site. Characterizing off-site soil contaminant levels and their distribution away from the site will be challenging due to the dispersion and dilution of the smoke plume. Weather conditions support the idea that plume contaminants will start to fallout approximately a couple of blocks from the site. Nevertheless, the ubiquitous presences of plume contaminants in soil make it challenging to attribute contamination to the fire, versus other potential sources found in the environment (see attachment 4). However, a carefully designed soil sample study may provide information about an off-site hazard from accumulation of environmental dioxin and furan compounds.

Potential Contaminants from Automobile Combustion

1) Automobile Chlorine Content

The average car consists of approximately 70-80% metal, 10-20 % plastic, 5 % rubber, and 3 % glass, plus anti-corrosion substances, paint, noise-reduction material, textiles, and fiberboard (1). In modern shredding processes, metals, (about 75-80% of the mixed waste) can be recovered (1). Approximately 350 pounds of shredder residue remains after the metal has been removed (2). The shredder residue contains approximately 20 pounds of polyvinylchloride (PVC), and is typically 50% chlorine by weight (2). Other plastic, rubber, and foam materials contain chlorine to a lesser extent. The total percent of chlorine present per vehicle is not known and will likely vary with the model and model year. The uncontrolled burning of materials containing chlorine often leads to the generation of numerous hazardous pollutants including dioxins, furans and polychlorinated biphenyls (PCBs).

2) Chlorinated Dioxins (CDDs) and Chlorinated Furans (CDFs)
It is probable that CDDs and CDFs were created during the Schwartzman September 2002 fire that occurred on-site. The synthesis of CDDs and CDFs compounds have been documented in test burns of non-metallic automobile shredder residue (fluff) (7). EPA conducted 3 test burns of shredder fluff; each consisting of approximately 25 lbs. Approximately 45% of the fluff mass placed in the combustion apparatus was burned during the 200 minute test (7). The tetra, penta, hexa, hepta, and octa homologues were measured from smoke emissions for both dioxins and furans. A homologue group consists of all the possible different congeners for a given number of chlorines. For example, the tetra-CDD homologue group contains 22 different congeners. Table 2 lists the total number of possible congeners for each homologue.

Table 2 Dioxin and Furan Homologues

Dioxin Homologues		Furan Homologues	
Homologue	Congeners	Homologue	Congeners
tetra-Dioxin	22	tetra-Furan	38
penta-Dioxin	14	penta-Furan	28
hexa-Dioxin	10	hexa-Furan	16
hepta-Dioxin	2	hepta- Furan	4
octa-Dioxin	1	octa- Furan	1
Total Number of Possible Congeners	75*	Total Number of Possible Congeners	135*

* = includes the mono, di, and tri homologues that are not relevant to the 2,3,7,8 substitutions

The measurement of homologues instead of individual congeners does not give sufficient information to characterize TCDD (2,3,7,8-tetrachlorodibenzo-p-dioxin) toxic equivalence risk. The test burns did result in significant tetra-furans and penta-furans (see Figure 2 in Appendix).

An important consideration is the mass of shredder fluff that burned. It is estimated that 600-1000 automobiles burned in the SCI fire, each auto containing approximately 300 lbs of fluff. Therefore, approximately 90-150 tons of shredder material was potentially involved in the fire. The actual amount that burned is not known. The EPA test burns included three 25 lbs batches that each produced emissions of dioxin and furan homologues. However, we do not know how much of the congeners 2,3,7,8-TCDD and 1,2,3,7,8-PeCDD were present in these homologues.

Not all dioxins and furans are as toxic as 2,3,7,8-TCDD, but all that have chlorine in the 2,3,7,8 positions are thought to cause adverse effects through the same mechanisms. To estimate the toxicity of dioxin and furan mixtures, a series of toxicity equivalence factors (TEFs) have been developed that compare the toxicity of other dioxin and furan congeners that also have chlorines in the 2,3,7, and 8 positions to 2,3,7,8-TCDD. The overall toxicity of a mixture can then be calculated in terms of total 2,3,7,8-TCDD equivalents (toxicity equivalence quotient, TEQ). The World Health Organization (WHO) published the TEFs used in this health consultation. For more detailed discussion of TEQs (see Appendix Table 2).

3) Polychlorinated biphenyls (PCBs)
The scientific literature does not contain reports of direct measurements of PCB emissions from automobile shredder fluff fires. However, while researching technologies to reduce automobile

shredder fluff wastes land filled in Korea, scientists documented the formation of dioxins, furans, and PCBs in pyrolyzed/burned fluff char and slag (21, 22). Although PCB emissions have not been documented in automobile shredder waste fires, it is reasonable to assume that if they appear in the char and slag they will likely be found in the fluff emissions. The chemical composition of the PCBs is similar to dioxin and furans (see Appendix). The presence of PCB emissions in shredder fluff fires would add to the dioxin TEQ value because PCBs are similar chemically and toxicologically to dioxins. PCB contaminated wastes are common at metal recycling centers and the Schwartzman facility contained PCB contaminated soils. These contaminated on-site soils are likely the result of improper management of PCB containing waste and not fire generated.

4) Polyaromatic Hydrocarbons (PAHs)

PAHs are a group of hundreds of organic chemicals with similar structures. Generally, PAHs are products of fossil fuel or organic combustion (pyrogenic). They may also be found in non-combusted fossil fuels (petrogenic). PAHs are always found in the environment as complex mixtures. The toxicity of individual PAHs to humans is quantified for only a few of these compounds. A number of PAHs have been identified as probable human carcinogens (cPAHs) by the EPA, the International Agency for Research on Cancer, and the California EPA Office of Environmental Health Hazard Assessment. MDH considers 25 different PAHs to be probable or possible cancer causing agents (http://www.health.state.mn.us/divs/eh/risk/guidance/pahmemo.html). The dark thick plumes of smoke emanating from the fire did contain particulate composed of PAHs and semivolatiles. EPA auto shredder fluff test burn emissions for particulate, vapor-phase semivolatiles and volatiles were reported as 125.22, 79.38, and 45.46 g/kg respectively (7). It is likely that most of the particulate will consist of carbon and PAHs. Some of the vapor-phase semivolatiles will condense onto particulates as they cool. A significant amount of PAHs were likely generated in the fire and distributed with the smoke plume. Because not all PAHs have the same potential to cause cancer, MDH has adopted California EPA's methodology of assessing PAH cancer risk. See Appendix Table 3 for a list of PAH compounds assigned potency equivalence factors that standardize cancer potency to benzo[a]pyrene. The EPA shredder fluff fire emissions studies did not measure carcinogenic PAH compounds.

5) Heavy Metals

Lead, copper and zinc are associated with auto shredder fluff fire emissions. EPA test burn measurements produced lead and copper emissions of 600, and 400 mg/kg respectively (7). See Appendix Figure 3 for metal emissions test results. As with dioxins, there are many potential sources for any measured metals in environmental (e.g., soil) samples.

Soil Samples

1) On-Site Soil Contaminants

Samples collected from within the fire-impacted area included four ash grab samples. The ash samples were analyzed for dioxin (TEQ) and compared to the then-current Minnesota Pollution Control Agency (PCA) residential and industrial dioxin Soil Reference Values (SRVs; 200, and 350 ng/kg respectively). The 4 grab samples included a 0-6 inch sample interval, and the results ranged from 22 – 63 ng/kg. The SRV for dioxin was reduced by an order of magnitude in Fall 2005. When compared to the SRVs currently in effect, three of the 4 onsite grab samples of ash slightly exceeded the dioxin industrial SRV (35 ng/kg). The SRV is based on MDH dioxin risk assessment advice, including use of a dioxin cancer potency slope of 1.4 $(\text{pg/Kg-day})^{-1}$ (see reference 28). The Agency for Toxic Substances and Disease Registry (ATSDR) utilizes 50 ng/kg dioxin in soil as an Environmental Media Exposure Guide (EMEG). The dioxin soil EMEG is calculated using the 1 picogram/kilogram/day minimal risk level based on non-cancer effects.

Fire area soils were also tested for the following Resource Conservation and Recovery Act (RCRA) metals:

Arsenic
Barium
Cadmium
Chromium
Lead
Mercury
Selenium
Silver

The sample intervals included 0-0.5, 0-1 and 2-4 feet below ground surface. The soil metal concentrations were compared to the PCA industrial SRVs. Lead and chromium Toxicity Characteristic Leaching Procedure (TCLP) tests were conducted to determine if the soil was potentially hazardous, for the purpose of landfill disposal. Many of the onsite soil samples collected from the 0-0.5 and 0-1 ft intervals had elevated levels of lead with results as high as 88,000 mg/kg. The PCA industrial lead SRV is 700 mg/kg. Many TCLP analyses conducted on these samples exceeded the lead TCLP limit of 5.0 mg/l. Soil within the fire-impacted area was excavated in June 2004 and transported to appropriate landfills for disposal. Soil confirmation samples collected from the floor of the excavation showed residual contamination to be less than Residential SRVs. Approximately 90% of the fire area soils have been removed and land-filled off-site. Attachment 3 shows the preliminary soil removal; a more complete map will be available in the pending Response Action Implementation Report.

A large pile of shredder fluff was present in the northeast portion of the site and a shredder fluff/earthen berm was located along the southern, western and northern property boundary (15). The PCA concluded that the pile of shredder fluff represented improper disposal of waste material and that the shredder fluff used as berm material was not acceptable reuse of a waste material. The PCA ordered SCI to investigate the characteristics of the fluff in preparation for removal and off-site disposal. Between September 2003 and February 2004, 4,869.47 tons of fluff were removed and disposed in appropriate landfills. The earthen berm under the fluff materials contained PCB and lead levels requiring remediation. In fact, the vast majority of the accessible areas at the site have already been excavated and contaminated soil has been disposed in permitted landfills. Per a consent decree with SCI, the pending Response Action Implementation Report will document this work. The onsite excavations included the construction of a storm water retention pond that will collect surface water runoff from the site (See Attachment 5).

2) Off-site Playground Soil Samples

The Anoka-Hennepin Distribution Complex /Enich Kindergarten playground (see Attachment 1) was sampled for several classes of surface soil contaminants including RCRA metals, PCBs, and PAHs in June 2002 (i.e., before the fire). The sampling event also included 3 wipe samples collected on the playground equipment and submitted for RCRA metals and PCB analysis. A total of 15 soil samples were collected that included 2 duplicates and 1 background sample collected approximately 5000 ft north-northeast of the site on the opposite side of the Rum River at the Anoka High School baseball field. Only 1 soil sample (P-2) exceeded the PCA Residential lead SRV (300 mg/kg). Soil sample P-2 had a lead concentration of 352 mg/kg. It is important to note that MN law defines lead contaminated bare soil as any value above 100 mg/kg (MN Rules 4761.2510 subpart 3) if the property is a school (MN Rules 4761.2000 subpart 4). The P-2 lead result appears to be an isolated case because none of the other soil results were over 100 mg/kg and wipe samples did not exceed any state standard.

In August 2002, an additional 7 soil samples were collected and analyzed for RCRA metals. Results did not exceed any Residential SRVs or 100 mg/kg lead. Playground equipment wipe tests (3 wipes) were also collected. The top of tube/bridge (wipe 3) contained 3.7 ug of lead. The wipe area was 100 cm^2 (15.5 in^2) and if converted to a $1ft^2$ area, the lead content is 34.4 µg/wipe. The standard methodology for the MDH Lead Program is to wipe a minimum of 0.5 –1.0 ft^2 area of the floor or windowsill inside a home and compare the result to the floor or sill criteria (40, and 250 ug respectively).

After the fire in September 2002, five surface soil samples were collected and analyzed for RCRA metals, PCBs, and PAHs. These are indicator chemicals for fire effects. Dioxin analysis is expensive, and in the absence of increases in other chemicals, sampling for dioxin was deemed an unwise use of resources. The 5 sample results did not exceed any Residential SRVs, or 100 mg/kg lead.

In February 2004, six more surface soil samples were collected and analyzed for RCRA metals, PCBs, and PAHs. The 6 sample results did not exceed any Residential SRVs, or 100 mg/kg lead.

Off-site Exposure

Dioxins formed in the fire would initially be present as gases but would rapidly condense onto particles in the plume as the plume cooled. This condensation process is a complex function of the particle size distribution in the plume. In addition, the particle size distribution will strongly affect the deposition of particles downwind. The potential level of variability in deposition rate covers is approximately an order of magnitude across the range of particle sizes that could be expected. Unfortunately, there is no data on the particle sizes in this plume, and very little information about particle sizes in open burns in general.

Over the range of particle sizes that might be expected to act as dioxin condensation sites in a fire like this (0.1 to 10 um) the primary deposition mechanism is impaction on surfaces such as leaves, structures, and other surface roughness elements. Once deposited, the particles may remain attached until leaf fall and then be incorporated into the soil over a period of time. Alternatively, the particles may be redistributed downwind in subsequent gusts that are strong enough to dislodge the particles. They may also be washed off of surfaces during precipitation events and then incorporated into soils or transported away from the site in surface flow. At present these process can only be modeled with certainty over large spatial and temporal scales. The state of the science is not adequate to model these phenomena for a single event. Attachment 4 contains more detailed discussion on the challenges of SCI fire air dispersion modeling. The MPCA has concluded (Attachment 4) that there is insufficient data to model off-site contamination for the fire.

Potential Off-site Exposure Routes

Area residents have to come into physical contact or *be exposed* to the hazardous materials emanating from the SCI site to cause adverse health effects. For residents to come into contact with these chemicals there must be a *completed exposure pathway*. A completed exposure pathway consists of *five factors* that must be present for exposure to the chemicals to occur. These include:

- A source of the toxic chemicals of concern (chemical releases and spills);
- Environmental transport which allows the chemical to move from the site and bring it into contact with people (soil, air, groundwater, surface water, subsurface gas);

- point of exposure which is the place where people come into direct contact with the chemical;
- A route of exposure which is how a person comes into contact with the chemical (drinking it, eating it, breathing it, touching it); and
- A population at risk includes people who may come into physical contact with site-related chemicals.

Exposure pathways can also be characterized by when the exposure occurred or might occur in the *past, present,* or *future.* Physical contact with a chemical contaminant in and by itself *does not* necessarily result in adverse health effects. A chemical's ability to affect a person's health is also controlled by a number of other factors including:

- How much of the chemical a person is exposed to (the *dose*).
- How long a person is exposed to the chemical (duration of exposure).
- How often a person is exposed to the chemical (acute versus chronic).
- The chemical's toxicity and how it impacts the body.

Other factors affecting a chemical's likelihood of causing adverse health effects upon contact include a person's:

- History of past exposure to chemicals;
- Smoking, drinking alcohol, or taking certain medicines or drugs;
- Current health status;
- Sensitivity to certain substances;
- Age and sex; and,
- Medical history.

The potential off-site routes of exposure to SCI related contaminants include:

- Ingestion of contaminated soil;
- Dermal (skin) exposure to contaminated soil, and
- Inhalation of airborne particulates

If the top 3 inches of soil are un-vegetated, then soil ingestion, soil dermal exposure, and inhalation of soil particulates are more probable. A potential exposure pathway exists for off-site contaminants found in the top 3 inches of soil. Soil ingestion is the most relevant exposure pathway pertaining to SCI site related contamination. It is estimated that ingestion represents greater than 95 % of the potential exposure to soil contaminants including dioxins, PAHs, and metals dispersed by the fire. Inhalation represents approximately 5% of the potential exposure (24). Dermal exposure is not considered an important exposure pathway because dioxin and the other fire contaminants that are attached to soil particles do not readily pass through the skin.

1) Ingestion

The ingestion of contaminated soil is the primary means of exposure to non-volatile contaminants in soil, such as dioxin. Such ingestion of soil is usually incidental, and occurs from hand-to-mouth contact while gardening or engaging in other work activities (in the case of adults) or outdoor play activities (in the case of children) (10). An extreme case of hand-to-mouth behavior (pica) occurs in small children who habitually ingest relatively large amounts of soil in one event (as much as 5000 mg/day). Pica may occur at this site due to the number of small children in the area and the potential for numerous bare soil areas.

The amount of contaminant absorbed by the body from incidental soil ingestion and available to cause an adverse effect is dependent on a number of variables, including but not limited to (10):

- Soil ingestion rate;
- Oral bioavailability of soil contaminant, and
- Contaminant concentrations in accessible soil.

Determining the soil contamination exposure dose via ingestion is challenging. The frequency and amount of soil ingestion are usually estimated using default exposure assumptions. The amount of contaminant absorbed is assumed to be 100% or is based on animal absorption studies. Most screening exposure scenarios utilize a residential setting, where exposure to soil could be assumed to occur on a regular basis. People who have frequent contact with soil, such as gardeners, tend to ingest more soil. Behaviors that involve frequent hand to mouth contact, such as smoking, can lead to higher soil ingestion rates. The EPA typically utilizes default ingestion rates of 100 mg/day and 200 mg/day in risk assessments for adults and children, respectively. The Minnesota Pollution Control Agency utilizes ingestion values of 100 and 50 mg/day in its derivation of the Soil Reference Values for children and adults respectively (3). Use of the child exposure scenario generally results in lowers clean up levels.

It has been estimated that as much as 32% of indoor dust could originate from outdoor soil through foot tracking or other transport mechanisms (9). For young children indoor dust can be a significant source of exposure due to hand to mouth and object to mouth activity.

2) Inhalation

The inhalation of particulates contaminated with dioxins, PAHs, and metals is plausible. However, it is presently a very minor exposure pathway based on exposure models used in standard risk assessments for contaminated soils (24). Inhalation of contaminants during the fire was a one time event that is not addressed in this document. During respiration, particles greater than 5-30 µm are captured by mucus lining the upper respiratory tract and then swallowed. Therefore, inhalation exposure to contaminated dust/particulate is mostly an ingestion exposure. Only the smallest particles ($\leq$ 1 µm) will be inhaled into the deep lung.

Agency for Toxic Substance and Disease Registry (ATSDR) Child Health Considerations

ATSDR recognizes that the unique vulnerabilities of infants and children make them of special concern to communities faced with contamination of their water, soil, air, or food. Children are at greater risk than adults from certain kinds of exposures to contaminants at hazardous waste sites. A child’s behavior and lifestyle will influence exposure. Children can be additionally exposed to environmental dioxins because children play in the dirt, put things in their mouth, and they ingest inappropriate items. Children often bring food into contaminated areas risking cross contamination when they eat items that have fallen to the ground or floor. In general, children ingest more soil than adults. Children often spend significant time outdoors with little or no clothing. A child’s exposure to dioxins starts during their gestational development and continues with the ingestion of contaminated breast milk. The developing body systems of children can sustain permanent damage if exposures occur during critical growth stages. Children drink more fluids, eat more food, breath more air per kilogram of body weight than adults resulting in higher doses of chemical exposure per body weight. Children have a larger skin surface in proportion to their body volume than adults. Children have different eating habits and food preferences. Most importantly, children depend completely on adults for risk identification and management decisions, housing decisions, and access to medical care.

Conclusions

- The Anoka-Hennepin Distribution Complex/Enich Kindergarten playground does not appear to have been impacted by SCI fire related metals, PCBs, and PAHs.
- Based on the off-site soil investigation limited to the school grounds, no apparent public health hazard exists.
- In the absence of evidence of fire impacts on concentrations of an array of indicator chemicals at the school, it is unlikely that dioxin compounds exist in these soils.
- If more off-site sampling is conducted at other locations, it may not be possible to determine contaminant attribution.
- In response to community concerns, PCA may wish to conduct more off-site soil sampling.
- There is an indeterminate public health hazard for other off-site areas because of a lack of soil data for these areas.

Recommendations

- Any off-site soil measurements should be compared to background concentrations.

Public Health Action Plan

- MDH will assist MPCA in reviewing and interpreting any SCI off-site soil sampling plans and data results.
- MDH will disseminate this report to interested parties.

References:

1. L. Aae Redin, M. Hjelt, and S. Marklund: Co-combustion of Shredder Residues and Municipal Solid Waste in a Swedish Municipal Solid Waste Incinerator. Waste Management Research 2001; 19; 518.
2. California Environmental Protection Agency: Evaluation of Shredder Residue as Cement Manufacturing Feedstock. March 2006.
3. SCI Recycling Services Site Investigation Technical / Risk Analysis Review. STS Consulting, LTD. STS Project 200601528. May 2006.
4. L.A. Jones: Residents Exposed to Dioxins From SCI Recycling? Anoka County Union. May 3, 2007
5. B. Bomier: The SCI-Schwartzman Facility and Health Risk To The Anoka Community. April 2007.
6. Weston Solutions, Letter to Assistant County Attorney Re: Updated Final Report Assessment of SCI Recycling Service Site PCB Issues. April 2006
7. EPA, Characterization of Emissions from the Simulated Open-Burning of Non-Metallic Automobile Shredder Residue, Ryan, J.V., Lutes, C. May 1993.
8. MPCA, Automobile Shredder Residue Report. June 1995.
9. T. Johnson: Fire Destroys Scrap Vehicles at Schwartzman Property. Anoka County Union. September 11, 2002.
10. J. Adams: Salvage Yard Fire Darkens Anoka Sky; Star Tribune. September 10, 2002.
11. Environmental Resource Council. Letter to City of Anoka Mayor Bjorn Skogquist Re: SCI/Schwartzman. Authored by B. Bomier. October 20, 2006.
12. Historic weather reports for Anoka County at www.wunderground.com
13. ATSDR. Toxicological Profile for Chlorinated Dibenzo-p-Dioxins. Agency for Toxic Substances and Disease Registry, December 1998.
14. Wenck: Phase I Environmental Site Assessment. Prepared for SCI Recycling Service. October 2004.
15. Wenck: Supplemental Phase II Remedial Investigation Report and Response Action Plan. Prepared for SCI Recycling Service. October 2006.
16. Nation Center for Environmental Assessment: Exposure and Human Health Reassessment of 2,3,7,8-Tetrachlorodibenzo-*p*-Dioxin (TCDD and Related Compounds) (SAB Draft), Chapter 9, September 2000.
17. M. Van den Berg , L. S. Birnbaum, et al. The 2005 World Health Organization Re-evaluation of Human and Mammalian Toxic Equivalence Factors for Dioxins and Dioxin-like Compounds. Toxicological Sciences, July 2006.
18. Wenck: Fire Area Response Action Implementation Report. Prepared for SCI Recycling Service. December 2004.
19. EPA. Exposure and Human Health Reassessment of 2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD) and Related Compounds, SAB Review Draft. U.S. Environmental Protection Agency, September 2000. Document No. EPA/600/P-00/001Bg.
20. Wenck: Emergency Management Plan. Prepared for SCI Recycling Service. July 2006.
21. H.T, Joung., Y.C, Seo., K.H, Kim., et al. Effects of Oxygen, Catalyst and PVC On The Formation of PCDDs, PCDFs, and Dioxin-like PCBs in Pyrolysis Products of Automobile Residues. Chemoshere 65. (2006). pgs 1481-89.
22. H.T, Joung., Y.C, Seo., K.H, Kim. Distribution of Dioxin, Furans, and Dioxin-like PCBs in Solid Products Generated by Pyrolysis and Melting of Automobile Shredder Residues. Chemosphere 68. (2007). Pgs 1636-41.
23. Anoka County Environmental Services Department Letter: To CSI Inc. Re: Fire and Emergency Plan. May 10, 2006.

References continued

24. Minnesota Pollution Control Agency. Residential Soil Reference Values, http://www.pca.state.mn.us/publications/risk-tier1srv.xls
25. EPA. OWER Memo 920.4-26: Approach for Addressing Dioxin In Soil at CERCLA and RCRA Sites. April 13, 1998.
26. MDH. Polycyclic Aromatic Hydrocarbons: Methods for Estimating Health Risks from Carcinogenic PAHs., http://www.health.state.mn.us/divs/eh/risk/guidance/pahmemo.html . July 2004
27. KSTP Channel 5 News video footage of the SCI September 9, 2002 fire.
28. MDH. Risk Assessment/Guidance: Methods for Estimating the Carcinogenic Health Risks from Dioxin-Like Compounds., http://www.health.state.mn.us/divs/eh/risk/guidance/dioxinmemo1.html . Oct. 2006

Certification

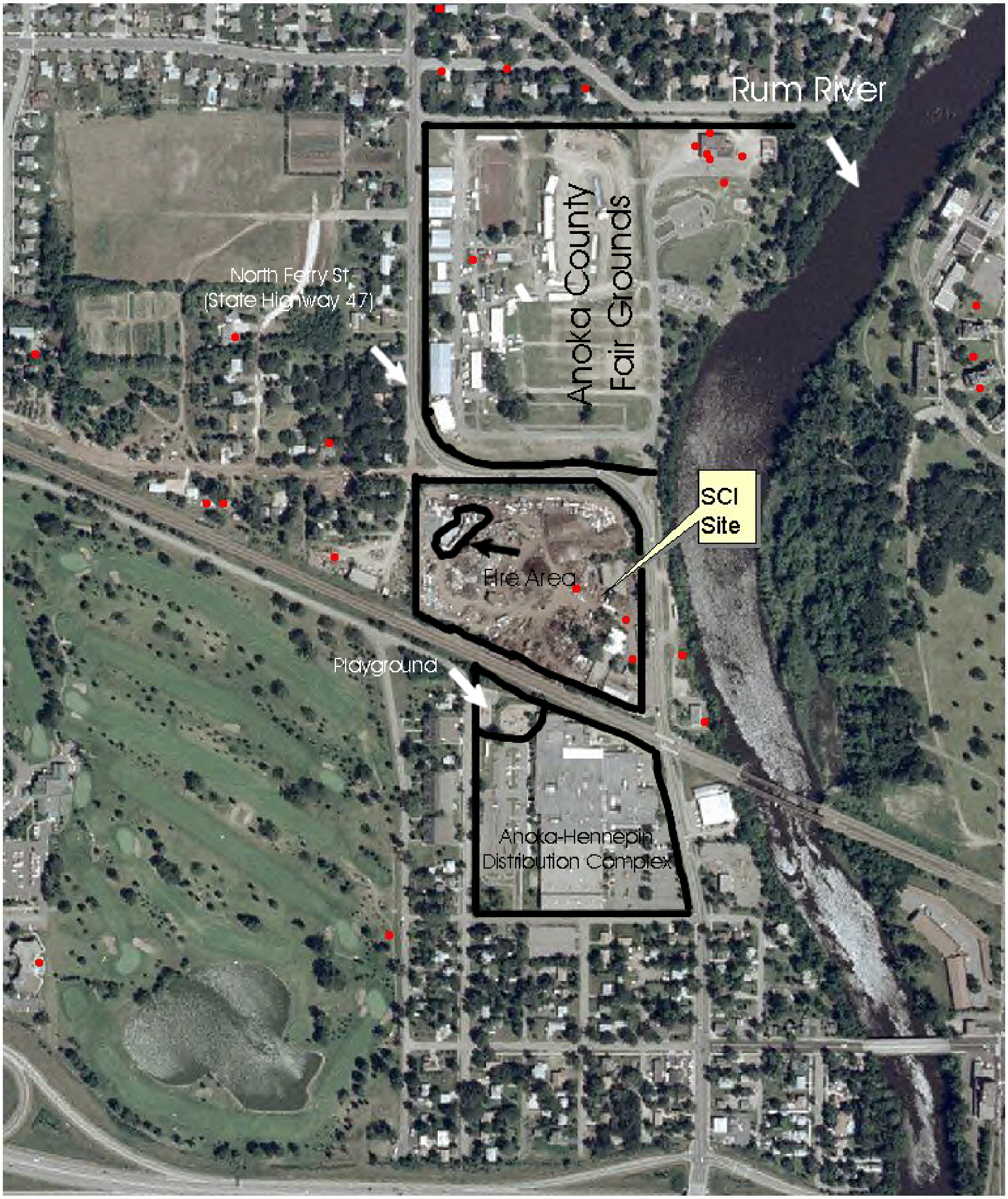
The Minnesota Department of Health prepared this Health Consultation, SCI Recycling Services Site, under a cooperative agreement with the Agency for Toxic Substances and Disease Registry (ATSDR). At the time this Health Consultation was written, it was in accordance with the approved methodologies and procedures. Editorial review was completed by the Cooperative Agreement partner.

Technical Project Officer, Cooperative Agreement Team, CAPEB, DHAC, ATSDR

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

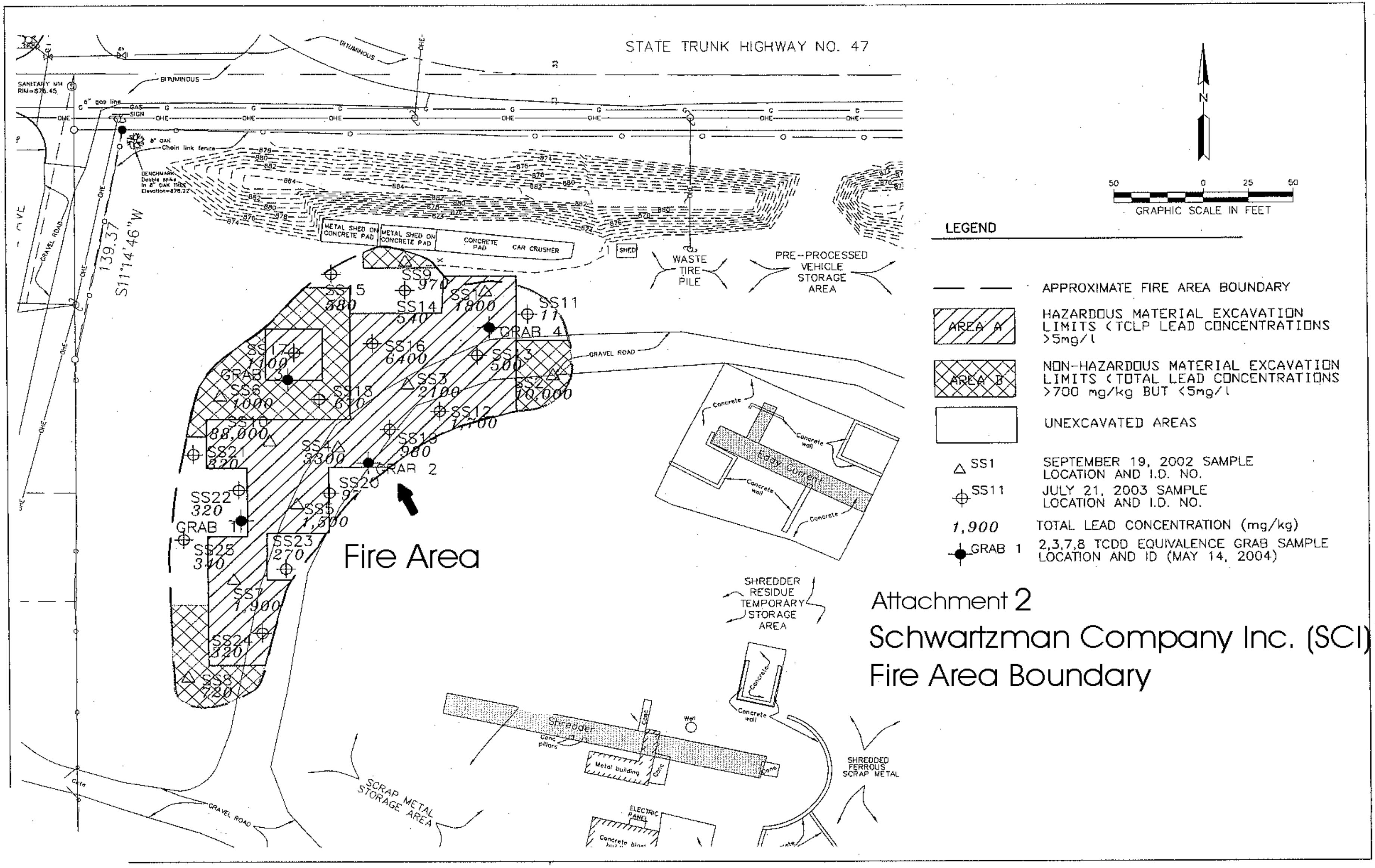
Team Leader, Cooperative Agreement Team, CAPEB, DHAC, ATSDR

Attachments



Attachment 1

Schwartzman Company Inc. (SCI) Site and Vicinity

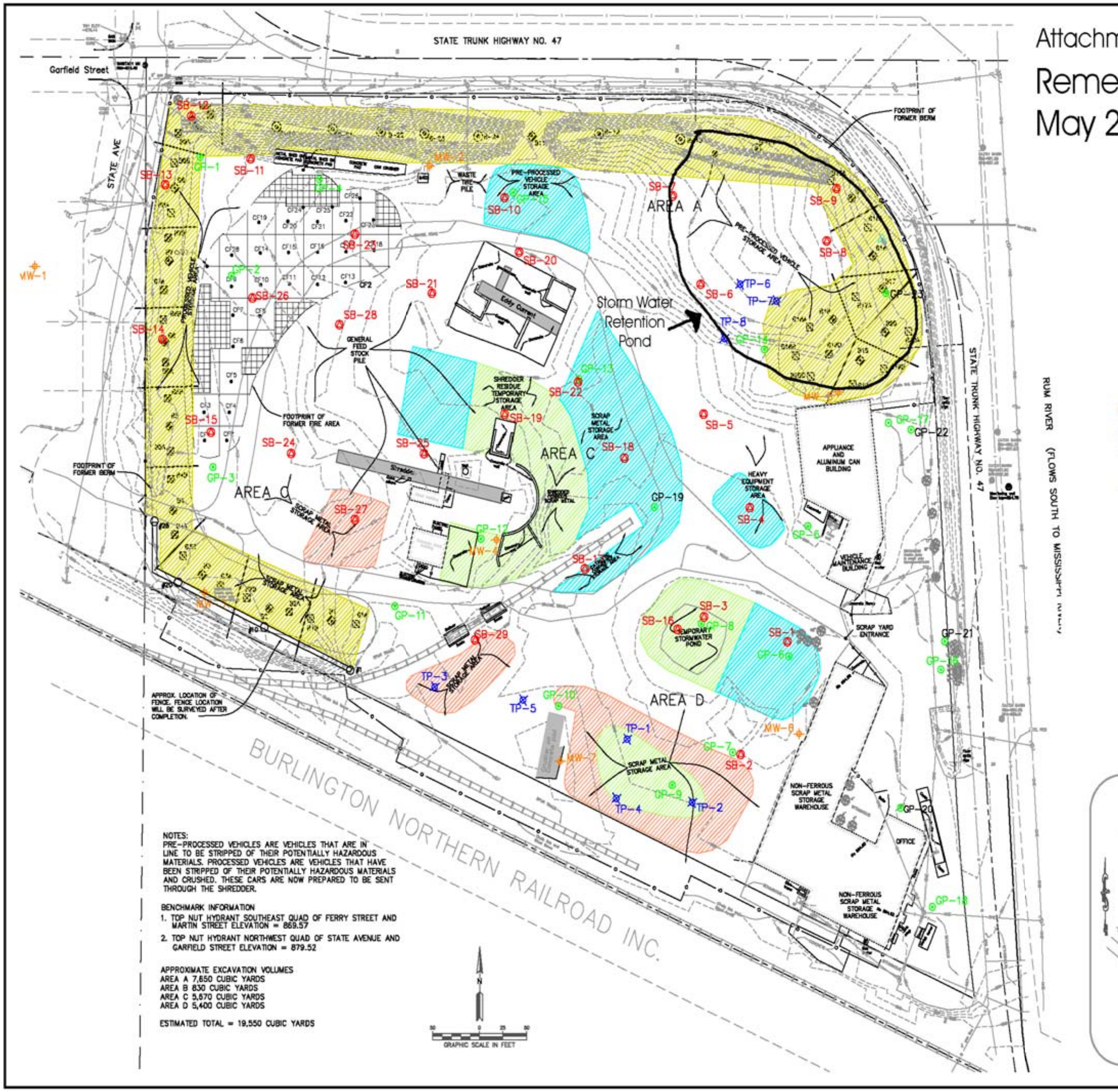


Attachment 2

Schwartzman Company Inc. (SCI)

Fire Area Boundary

Attachment 3
Remedial Excavation Limits
May 2006



NOTES:
PRE-PROCESSED VEHICLES ARE VEHICLES THAT ARE IN LINE TO BE STRIPPED OF THEIR POTENTIALLY HAZARDOUS MATERIALS. PROCESSED VEHICLES ARE VEHICLES THAT HAVE BEEN STRIPPED OF THEIR POTENTIALLY HAZARDOUS MATERIALS AND CRUSHED. THESE CARS ARE NOW PREPARED TO BE SENT THROUGH THE SHREDDER.

BENCHMARK INFORMATION
1. TOP NUT HYDRANT SOUTHEAST QUAD OF FERRY STREET AND MARTIN STREET ELEVATION = 869.57
2. TOP NUT HYDRANT NORTHWEST QUAD OF STATE AVENUE AND GARFIELD STREET ELEVATION = 879.52

APPROXIMATE EXCAVATION VOLUMES
AREA A 7,650 CUBIC YARDS
AREA B 830 CUBIC YARDS
AREA C 5,670 CUBIC YARDS
AREA D 5,400 CUBIC YARDS

ESTIMATED TOTAL = 19,550 CUBIC YARDS

LEGEND

= SANITARY SEWER MANHOLE
= HYDRANT
= STORM SEWER MANHOLE
= CATCH BASIN
= ELECTRIC BOX
= LIGHT
= SIGNAL POLE
= DENOTES WATER LINE
= DENOTES SANITARY SEWER LINE
= DENOTES STORM SEWER LINE
● = DENOTES IRON MONUMENT FOUND
○ = IRON MONUMENT SET AND MARKED WITH LICENSE NO. 18420.
= DENOTES UNDERGROUND TELEPHONE LINE
= DENOTES UNDERGROUND ELECTRIC LINE
= DENOTES OVERHEAD ELECTRIC LINE
= DENOTES OVERHEAD TELEPHONE LINE
= DENOTES GAS MAIN
= DENOTES TELEPHONE PEDESTAL
= DENOTES ELECTRIC TRANSFORMER
= DENOTES CABLE TV BOX
= DENOTES UTILITY POLE GUYWIRE
= DENOTES GATE VALVE
= DENOTES UTILITY POLE
= DENOTES DECIDUOUS TREE
= DENOTES CONIFEROUS TREE
SB-15 = FEBRUARY 2005 SOIL BORING LOCATION AND ID NO.
GP-1 = NOVEMBER 2003 AND MARCH 2006 PUSH – PROBE LOCATION AND I.D. NO.
MW-1 = GROUND WATER MONITORING WELL LOCATION AND I.D. NO.
CF2 ● = JUNE 2004 CONFIRMATION SOIL SAMPLE LOCATION AND I.D. NO.
B16A ☒ = MARCH AND APRIL 2004 BERM REMOVAL SOIL SAMPLE LOCATION AND I.D. NO.
#20 ○ = DECEMBER 2004 POST HOLE SOIL SAMPLE LOCATION AND I.D. NO.
B-10 ⊙ = FEBRUARY 2003 BERM SAMPLE LOCATION AND I.D. NO.
TP-1 ☒ = TEST PIT LOCATION AND I.D.

APPROXIMATE EXCAVATION DEPTHS

🟩 6 FEET
🟦 4 FEET
🟧 2 FEET
🟨 1 FOOT

Attachment 4
Hadiaris, Amy
From: Pratt, Gregory
Sent: Friday, November 16, 2007. 3:53 PM
To: Hadiaris, Amy
Cc: ‘Jensen, Patrice’; ‘Dan Pena (Daniel.Pena@state.mn.us)’; Burman, Shelley
Subject: RE: Schwartzman air dispersion model
Amy,
I have been working on this issue over the past couple of weeks, and .1 would like to share with you the conclusions I have reached arid the thinking behind my conclusions. I read the draft Health Consultation, the EPA characterization of emissions from open burning of automobile shredder residue, some news reports, and other documents. I obtained the hourly meteorological data from the Anoka County Airport in Blaine (the nearest site with hourly data available from the National Climatic Data Center). I also viewed and studied carefully the CD with video tape news coverage of the fire.

I will cut to the chase and start by giving you .my conclusion. I believe it is not possible to provide a reliable estimate o dioxin release, dispersion, and deposition that will be useful to inform sampling activities.

In order to estimate the dispersion and deposition of pollutants emitted during the fire it is necessary to know the meteorological conditions, the emission rate, and to be able to characterize the conditions of the release, We have, reasonably representative data on the meteorological conditions at the time of the study, and I have attached a spreadsheet with those data. In the late afternoon of September 9, 2002, temperatures were in the 80s, skies were clear with scattered cloudiness, and winds were light from the north-northwest. During the evening winds became calm for a few hours and then a light breeze picked up from the east. Eventually during the night the surface winds turned southerly and westerly and began to pick up. This high variability in the wind field means that the plume was likely to have been widely dispersed in a variety of directions over the course of the burn.

Unlike the met data, the available information on the emission rate and the conditions of the release are inadequate. The EPA document on the characterization of emissions from open-burning of automobile shredder residue shows that emissions of dioxins may vary by an order of magnitude from one event to the next. It is clear from the description of the event that the combustion - conditions changed dramatically during the fire. The dioxin emission rate and the thermal bouyance of the plume likely changed dramatically over the course of the event as the combustion conditions changed.

Early on the fire was likely quite hot judging from the video. The hot plume resulted in fairly dramatic plume rise. From the video, I’ve estimated that the plume rise due to the initial thermal buoyancy resulted in a plume centerline height of about 350 meters at about 500 meters downwind from the point of combustion, This plume height is consistent with the report in the Anoka County Union that the plume could be seen 30 miles away. It is not consistent with the statement in the draft Health Consultation that “[w]eather conditions support the idea that plume contaminants will start to fall out approximately a couple of blocks from the site.” However, later in the evening as the fire became less intense it is possible that the plume became less buoyant and remained closer to the ground. Unfortunately, there is no empirical evidence upon which to estimate the plume rise other than at the time of the videotape.

While these points could be further elaborated, at this point I will simply state that we are facing a situation with highly variable meteorological conditions resulting in considerable dispersion of the plume. Compounding the uncertainty is the estimate of emissions that could vary by an order of magnitude. Further confounding the issue is the lack of knowledge of the plume rise over the course of the event. A difference of 300 meters in the plume rise, a level of variability that may have occurred over the course of the fire, could introduce 1-2 orders of magnitude in the estimated concentration and deposition of pollutants.

Dioxins formed in the fire would initially be present as gases but would rapidly condense onto particles in the plume as the plume cooled. This condensation process is a complex function of the particle size distribution in the plume. In addition, the particle size distribution will strongly affect the deposition of particles downwind. Again, we are talking about order of magnitude variability in deposition across the range of particle sizes that could be expected. Unfortunately, we have no information about the particle sizes in this plume, and very little information about particle sizes in open burns in general. Over the range of particle sizes that might be expected to act as dioxin condensation sites in a fire like this (0.1 to 10 um) the primary deposition mechanism is impaction on surfaces such as leaves, structures, and other surface roughness elements. Once deposited, the particles may remain attached until leaf fall and then be incorporated into the soil over a period of time. Alternatively, the particles may be redistributed downwind in subsequent gusts that are strong enough to dislodge the particles. They may also be washed off of surfaces during precipitation events and then incorporated into soils or transported away from the site in surface flow. At present these process can only be modeled with certainty over large spatial and temporal scales. The state of the science is not adequate to model these phenomena for a single event.

The final point I would make is that the variability of dioxins in soils ranges over at least an order of magnitude. The uncertainties in our ability to estimate dioxin emissions, dispersion, deposition, and subsequent movements in the environment from this fire event is surely much more than one order of magnitude. Were sampling to be done, my opinion is that it would be impossible to distinguish the impact of this fire from the natural variability.

Sorry to be the bearer of bad news, but this is my best judgment on the issue. I would be happy to elaborate on any of the points in my arguments if that would be useful to you.

Greg
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Minnesota Pollution Control Agency
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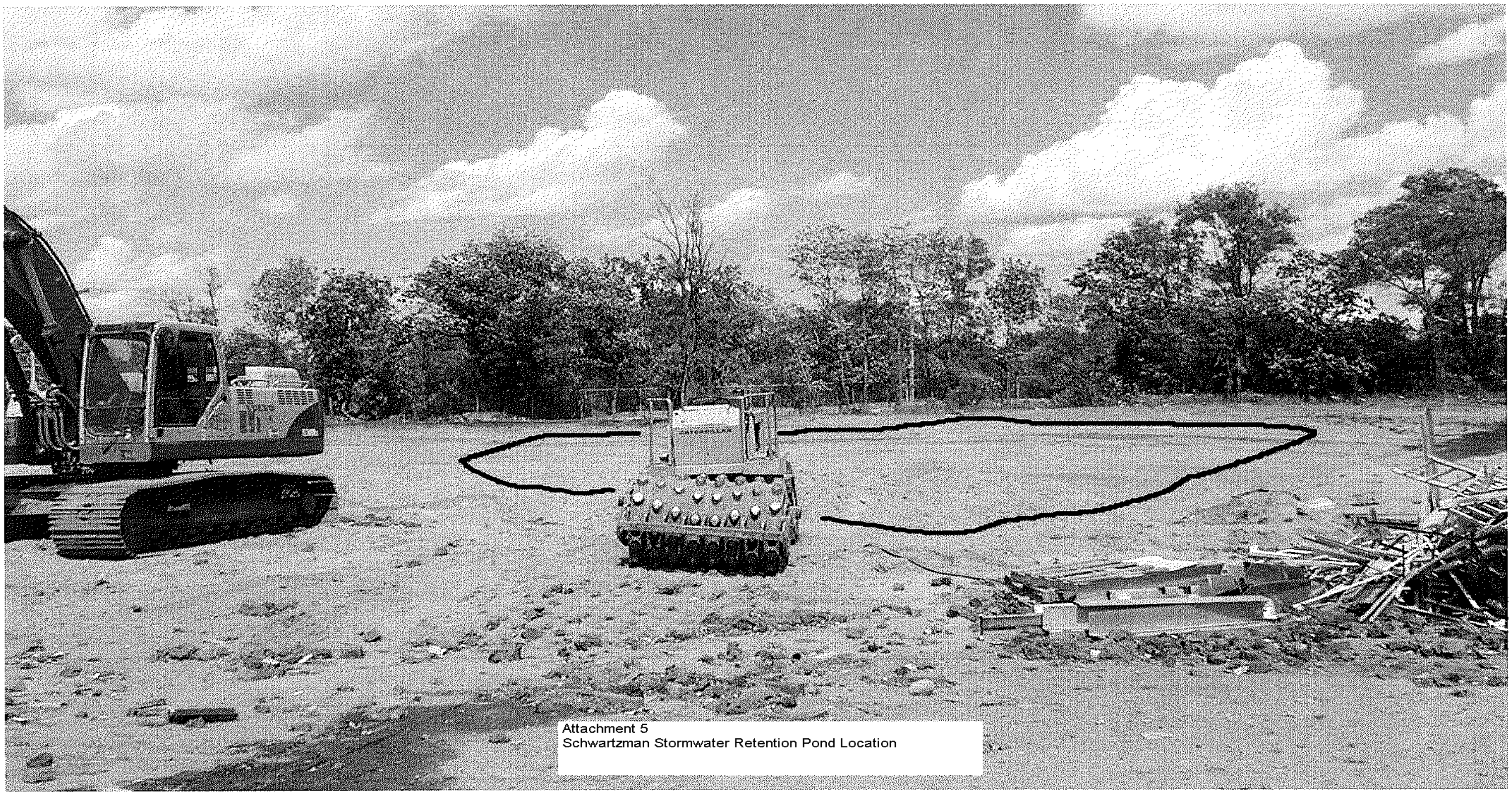


Attachment 5
Schwartzman Stormwater Retention Pond Location

Appendix 1

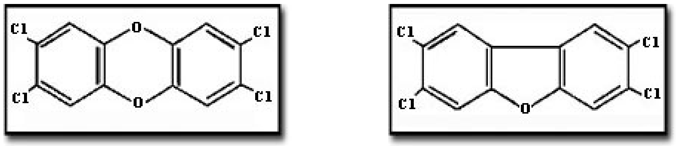
Organic compounds and Metals Associated with Automobile Shredding and Fluff Fire Emissions

Chlorinated dibenzo-p-dioxins (CDDs) and dibenzofurans (CDFs) Environmental Sources

It is well documented that during the combustion of solid waste, including the combustible components of automobiles, toxic compounds known as dioxins and furans may be formed (13). The polychlorinated dibenzo-p-dioxins (CDDs) include 75 individual compounds, and the polychlorinated dibenzofurans (CDFs) include 135 individual compounds. These individual compounds are referred to as congeners. Only 7 of the 75 congeners of CDDs are thought to have dioxin-like toxicity; these are ones with chlorine substitutions in, at least, the 2,3,7, and 8 positions. Only 10 of the 135 possible congeners of CDFs are thought to have dioxin-like toxicity; these also are ones with substitutions in the 2,3,7, and 8 positions. The 17 CD and CF congeners with dioxin like toxicity (i.e. chlorine in the 2,3,7, 8 positions) are collectively referred to as dioxins.

The names of individual dioxin compounds denote both the number and position of the chlorine (Cl) atoms. Furans differ from dioxins structurally by the lack of one of the two oxygen (O) atoms between the benzene (six-carbon atom, circle-shaped) ring structures. The chemical structures of 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD) and 2,3,7,8-tetrachlorodibenzo-p-furan (TCDF) are shown Figure 1:

Figure 1 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD) and
2,3,7,8-tetrachlorodibenzo-p-furan (TCDF)



TCDD TCDF

Dioxins and furans are formed as a result of the incomplete combustion of fossil fuels, organic matter, and waste materials, during the bleaching of paper in pulp and paper mills, and as a by-product in the production of other chemicals such as the wood preservative pentachlorophenol (PCP), and the herbicide 2,4,5-T (13). By far the greatest unintentional production and release of CDDs and CDFs into the environment occurs during combustion processes (e.g., from burn barrels, burning of municipal solid waste, medical waste, industrial hazardous waste, and fossil fuel and wood combustion); during the production, use, and disposal of certain chemicals (e.g., PCBs, chlorinated benzenes, chlorinated pesticides); during the production of bleached pulp by paper mills; and during the production and recycling of several metals (13). Areas close to highways and railroad tracks can accumulate higher levels of combustion by-products including dioxins, and polyaromatic hydrocarbons (PAHs). In the environment, dioxins and furans always occur as various combinations of possible congeners. In soil, dioxins tend to bind to small particles or organic matter. They do not volatilize easily into air or dissolve in water (hydrophobic). As a result, they tend to settle out of the air or water as they attach to organic particulate and end up in soils or sediments. Dioxins in soil can be transported to surface water bodies via runoff, where humans and animals may be exposed to them through indirect ingestion or dermal contact. Dioxins accumulate in organisms (bioconcentration) because they do not metabolically breakdown and they are lipophilic (dissolve into fat).

On the surface of soil, dioxins may be broken down by sunlight, a process known as photodegradation. This process is only effective in the top few millimeters of soil where ultraviolet light can penetrate. Burials in place (by the constant accumulation of airborne dust and dirt, erosion, and the buildup of organic matter) or erosion to surface water bodies are likely the main environmental fate of dioxins in soil. Once buried (i.e. in the sub-soil), TCDD has been shown to have a half-life of up to 100 years, and becomes tightly bound to soil organic matter (13).

As a result of natural and man-made processes, dioxins are found nearly everywhere in the environment. Most people are exposed to very small background levels of dioxins when they breath air, consume food or milk, or have skin contact with materials contaminated with dioxins. However, ingestion is the most common route of exposure. For the general population, more than 90% of the daily intake of dioxin-like compounds comes from food, primarily meat, dairy products, and fish. Dioxins may be present at much lower levels in fruits and vegetables. The actual intake of dioxin from food for any one person will depend on the amount and type of food consumed and the level of contamination. Higher levels may be found in foods from areas contaminated with chemicals, such as pesticides or herbicides, containing dioxins as impurities. This indicates that exposure is widespread, and is likely occurring through the food supply. Foods containing animal fat, such as meat, fish, and dairy products are the most common dietary sources.

According to an EPA summary of available studies, background levels of dioxins in soils in rural areas in North America average 2.5 parts per trillion (ppt, or 0.0025 ppb) as expressed using toxicity equivalence factors (TEFs, see Table 3), with a range of between 0.1 to 6 ppt (16). The EPA dioxin action level for soil removal is 1000 ppt and the current Minnesota Pollution Control Agency (PCA) Dioxin Soil Reference Value (SRV) for industrial and residential land use are 35 and 20 ppt respectively (25, 24). When concentrations of contaminants are equal or less than the SRVs, PCA and MDH do not consider there to be a health concern. If contaminant levels are above the SRVs, than further assessment of potential impacts may be warranted.

EPA dioxin emission estimates are shown in Table 1. Total dioxin emissions decreased from 13,965 TEQ in 1987 to 1,422 TEQ in 2000. Backyard barrel burning was the largest source in 2000.

Table 1 Estimated Dioxin Emissions

RANK	1987			1995			2000		
	Source	Amount (TEQ)	% Total	Source	Amount (TEQ)	% Total	Source	Amount (TEQ)	% Total
1	Municipal Waste Combustion	8905	63.80%	Municipal Waste Combustion	1394	40.50%	Backyard Barrel Burning	498.5	35.10%
2	Medical Waste Incineration	2570	18.40%	Backyard Barrel Burning	628	18.20%	Medical Waste Incineration	378	26.60%
3	Secondary Copper Smelting	983	7.00%	Medical Waste Incineration	487	14.10%	Municipal Wastewater Treatement Sludge	89.7	6.30%
4	Backyard Barrel Burning	604	4.30%	Secondary Copper Smelting	271	7.90%	Municipal Waste Combustion	83.8	5.90%
5	Bleached Pulp & Paper Mills	370	2.60%	Cement Kilns	156	4.50%	Coal-fired Utility Boilers	69.5	4.90%
6	Cement Kilns	118	0.80%	Municipal Wastewater Treatement Sludge	133	3.90%	Diesel Heavy-duty Trucks	65.4	4.60%
7	Municipal Wastewater Treatement Sludge	85	0.60%	Coal-fired Utility Boilers	60	1.70%	Industrial Wood Combustion	41.5	2.90%
8	Coal-fired Utility Boilers	51	0.40%	EDC/VCM Production	36	1.00%	Diesel Off-road Equipment	33.1	2.30%
9	Automobiles Using Leaded Gasoline	38	0.30%	Diesel Heavy-duty Trucks	33	1.00%	EDC/VCM Production	30	2.10%
10	2,4-d	33	0.20%	Bleached Pulp & Paper Mills	30	0.90%	Sintering Plants	27.6	1.90%
	OTHER	208	1.50%	OTHER	216	6.30%	OTHER	104.9	7.40%
	TOTAL	13,965	100%	TOTAL	3,444	100%	TOTAL	1,422	100%

Source: U.S. EPA (Environmental Protection Agency). 2006. An inventory of sources and environmental releases of dioxin-like compounds in the United States for the years 1987, 1995, and 2000. National Center for Environmental Assessment, Washington, DC; EPA/600/P-03/002F. (http://cfpub.epa.gov/ncea/cfm/recordisplay.cfm?deid=159286)

Toxic Equivalence Factors (TEFs) for CDDs and CDFs

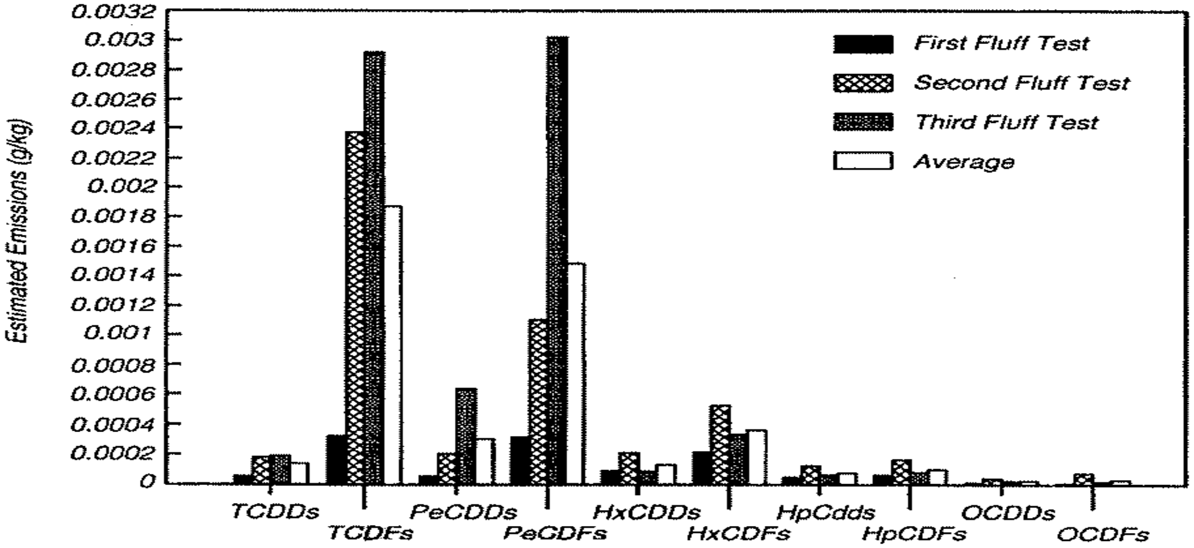
The TEFs are based on existing toxicological data on individual dioxin and furan congeners, or are estimated using a number of different methodologies. They are intended to be used pending additional research on specific dioxin and furan compounds. Table 2 lists the World Health Organization TEFs for dioxin and furan congeners (17 different compounds).

Table 2 World Health Organization (WHO 2005) Dioxin/Furan Toxicity Equivalence Factors (TEFs)

Dioxin (D) Congener	TEF	Furan (F) Congener	TEF
2,3,7,8-TCDD	1.0	2,3,7,8-TCDF	0.1
1,2,3,7,8-PeCDD	1.0	1,2,3,7,8-PeCDF	0.03
1,2,3,4,7,8-HxCDD	0.1	2,3,4,7,8-PeCDF	0.3
1,2,3,6,7,8-HxCDD	0.1	1,2,3,4,7,8-HxCDF	0.1
1,2,3,7,8,9-HxCDD	0.1	1,2,3,6,7,8-HxCDF	0.1
1,2,3,4,6,7,8-HpCDD	0.01	1,2,3,7,8,9-HxCDF	0.1
1,2,3,4,6,7,8,9-OCDD	0.0003	2,3,4,6,7,8-HxCDF	0.1
		1,2,3,4,6,7,8-HpCDF	0.01
		1,2,3,4,7,8,9-HpCDF	0.01
		1,2,3,4,6,7,8,9-OCDF	0.0003

Based on analytical results from EPA shredder fluff test burns, tetra-CDF homologues were produced about 10 times more than the tetra-CDD homologues (see Figure 2). The penta-CDF homologues were approximately 5 times more likely to be generated than penta-CDD homologues (7). In general, the combustion of shredder fluff appears to generate more furans than dioxins. Depending on the congener, the dioxin like CDF compounds are 30 to 3000 times less toxic than the 2,3,7,8-TCDD (see Table 2) (16, 17). The penta-CDD emissions were 2 times higher then the TCDD homologue. The 2,3,7,8-TCDD, and 1,2,3,7,8-PeCDD compounds are equally toxic congeners (TEF = 1, see Table 2) found in the tetra and penta CDD homologue groups respectively. Because the emissions of individual congeners were not measured in the test burn, it is difficult to estimate the 2,3,7,8-TCDD toxic equivalence (TEQ).

Figure 2 Fluff Combustion Dioxin and Furan Emissions



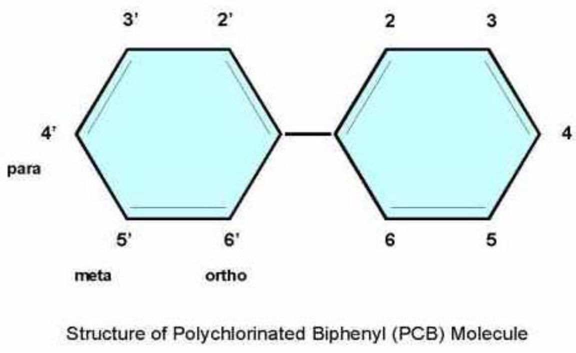
An important consideration is the mass of shredder fluff that burned. It is estimated that 600-1000 automobiles burned in the SCI fire, each auto containing approximately 300 lbs of fluff. Therefore, approximately 90-150 tons of shredder material was potentially involved in the fire. The actual amount that burned is not known. The EPA test burns included three 25 lbs batches that each produced emissions of dioxin and furan homologues. However, we do not know how much of the congeners 2,3,7,8-TCDD and 1,2,3,7,8-PeCDD were present in these homologues. The combined average mass of the TCDD and PeCDD homologues produced in the test burn of 25 lbs (11.4 kg) is approximately 0.0006 g/kg (600,000 parts per trillion, ppt). If we assume equal amounts of all 36 possible congeners (22 TCDD and 14 PeCDD compounds) were synthesized (0.0006/36), than approximately 16,666 ppt (ng/kg) of each congener is present. Therefore 2,3,7,8-TCDD, and the 1,2,3,7,8-PeCDD combine to equal 33,332 ppt TEQ per kg burned fluff. If 100,000 kg of fluff burned, then possibly 33,000,000,000 ng (33g) of TCDD equivalence was produced and dispersed with the smoke. This crude calculation does not take into account the other 15 dioxin and furan congeners found in the plume mixture that increase the total dioxin toxic equivalence (TEQ) concentration.

Dilution of smoke plume contaminants will occur as the smoke plume migrates off-site and contaminants settle to the ground. Anecdotal evidence of the smoke plume height, measured wind speeds, and directions, are factors that aid contaminant dispersion and dilution from the site. Characterizing off-site soil contaminant levels and their distribution from the site will be challenging due to the dispersion and dilution of the smoke plume. Weather conditions support the idea that plume contaminants will start to fallout approximately a couple of blocks from the site. The ubiquitous presence of these contaminants would make it difficult to attribute any measured dioxin contamination to the fire, versus other potential sources found in the environment (see attachment 4). However, a carefully designed soil sample study may provide information about an off-site hazard from accumulation of dioxin and furan compounds.

Polychlorinated Biphenyls (PCBs)

The stereo chemistry of PCBs is very similar to dioxins and furans (see figure 4). There are 209 possible combinations of PCBs. Table 3 lists the chlorine containing congeners that have dioxin like toxicity and their respective toxic equivalence factors.

Figure 4



Structure of Polychlorinated Biphenyl (PCB) Molecule

Table 3 Dioxin Toxicity Equivalence Factors for Use with Polychlorinated Biphenyls

Type	**Congener**		**TEF**
	IUPAC No.	Structure	
Non-*ortho*	77	3,3',4,4'-TetraCB	0.0001
	81	3,4,4',5-TetraCB	0.0003
	126	3,3',4,4',5-PeCB	0.1
	169	3,3',4,4',5,5'-HxCB	0.03
Mono-*ortho*	105	2,3,3',4,4'-PeCB	0.00003
	114	2,3,4,4',5-PeCB	0.00003
	118	2,3',4,4',5-PeCB	0.00003
	123	2',3,4,4',5-PeCB	0.00003
	156	2,3,3',4,4',5-HxCB	0.00003
	157	2,3,3',4,4',5'-HxCB	0.00003
	167	2,3',4,4',5,5'-HxCB	0.00003
	189	2,3,3',4,4',5,5'-HpCB	0.00003
Di-*ortho**	170	2,2',3,3',4,4',5-HpCB	0.0001
	180	2,2',3,4,4',5,5'-HpCB	0.00001

Adapted from reference 7

Polyaromatic Hydrocarbons (PaHs)

Table 4 lists MDH’s potency equivalence factors for PaHs.

Table 4: Potency Equivalence Factors*

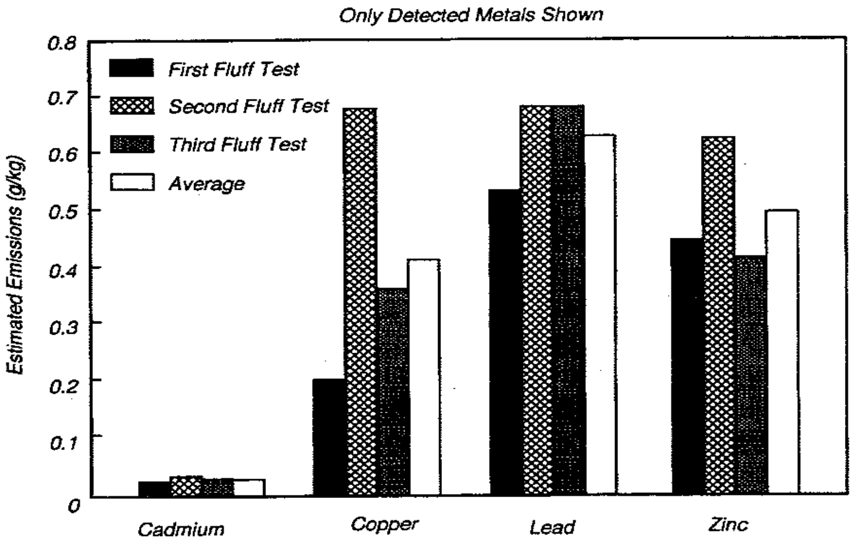
PAH (or PAH Derivative)	Potency Equivalence Factors	PAH (or PAH Derivative)	Potency Equivalence Factors
Benzo[a]pyrene**	1.0	Dibenzo[a,l]pyrene	10
Benz[a]anthracene	0.1	Indeno[1,2,3-c,d]pyrene	0.1
Benzo[b]fluoranthene	0.1	5-Methylchrysene	1.0
Benzo[j]fluoranthene	0.1	1-Nitropyrene	0.1
Benzo[k]fluoranthene	0.1	4-Nitropyrene	0.1
Dibenz[a,j]acridine	0.1	1,6-Dinitropyrene	10
Dibenz[a,h]acridine	0.1	1,8-Dinitropyrene	1.0
7H-Dibenzo[c,g]carbazole	1.0	6-Nitrochrysene	10
Dibenzo[a,e]pyrene	1.0	2-Nitrofluorene	0.01
Dibenzo[a,h]pyrene	10	Chrysene	0.01
Dibenzo[a,i]pyrene	10		

*Source: Reference 26

Heavy Metals

Lead, copper and zinc are associated with auto shredder fluff fire emissions. EPA test burn measurements produced lead, and copper emissions of 600, and 400 mg/kg respectively (7). See Figure 3 for metal emissions test results. The residential SRVs for lead, and copper are 300, and 11 mg/kg respectively. As with dioxins, there are many potential sources for any measured metals in environmental (e.g., soil) samples.

Figure 3 Metal Emissions from Fluff Combustion



Appendix 2

Fire Photos

DEPARTMENT OF HEALTH & HUMAN SERVICES

Public Health Service

Agency for Toxic Substances and Disease Registry
Mailstop E-60
1600 Clifton Road, NE
Atlanta, GA 30333

Date December 18, 2008

From Division of Health Assessment and Consultation, ATSDR

Subject Health Consultation
SCI Recycling Services Site

To Mark Johnson
Senior Regional Representative, ATSDR, Region V

Enclosed please find a copy of the December 17, 2008 Health Consultation on the following site prepared by the Minnesota Department of Health under cooperative agreement with the Agency for Toxic Substances and Disease Registry (ATSDR).

SCHWARTZMAN COMPANY INC. (SCI) SITE
ANOKA COUNTY, MINNESOTA

The Division of Health Assessment and Consultation requires copies of all letters used to transmit this document to the agencies, departments, or individuals on your distribution list. The copy letters will be placed into the administrative record for the site and serve as the official record of distribution for this health consultation.

Please address correspondence to the Agency for Toxic Substances and Disease Registry (ATSDR) Records Center, 1600 Clifton Road, NE (F09), Atlanta, Georgia 30333.

Freda Dumas
Manager, ATSDR Records Center

Enclosures
cc: W. Cibulas, Jr. R. Gillig T. LeCoultre L. Luker L. Daniel