Letter Health Consultation

MID-AMERICA STEEL DRUM COMPANY, INC.

SAINT FRANCIS, WISCONSIN

MAY 23, 2019

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Agency for Toxic Substances and Disease Registry
Division of Community Health Investigations
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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LETTER HEALTH CONSULTATION

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Prepared By:

U.S. Department of Health and Human Services
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DEPARTMENT OF HEALTH & HUMAN SERVICES

Public Health Service

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and Disease Registry
Atlanta GA 30333

May 23, 2019

Tinka Hyde, Land and Chemicals Division, Division Director
Edward Nam, Air and Radiation Division, Division Director
U.S. Environmental Protection Agency, Region 5
77 W. Jackson (SE-5J)
Chicago, IL 60604

Dear Ms. Hyde and Mr. Nam,

I am writing to follow up on your letter dated July 5, 2017 requesting our review of limited outdoor air and soil samples collected around the Mid-America Steel Drum (MASD) facility in St. Francis, Wisconsin. Your letter referenced odor complaints from the community and the fact that EPA civil investigators "experienced immediate, but temporary, physical reactions potentially related to their exposure around the facilities" [EPA 2017d]. We have concluded that soil contaminants do not pose a hazard to workers on-site or residents near MASD. We were unable to draw conclusions about potential health impacts from air exposures because monitoring data were limited, and air emissions are expected to vary significantly day-to-day. The facility has recently installed an air emissions control system that is expected to significantly reduce air contaminants and associated odors. The potential need for additional air monitoring to assess health risks depends on EPA's determination on whether MASD has adequately addressed its air releases.

MASD is located at 3950 South Pennsylvania Avenue. The facility reconditions 55-gallon drums that have contained hazardous chemicals using a washing technique to remove the residual chemicals. Steel drums undergo multiple wash cycles, are acid washed to remove rust, shot blasted to remove paint and labels, then repainted. MASD is only allowed to process drums that are "empty", i.e. they contain an inch or less of residue in the bottom. Non-empty containers are termed "heavies" and must be sent back to the vendor [EPA 2017b]. EPA cited MASD St. Francis for multiple violations of the Clean Air Act and the Resource Conservation and Recovery Act, including unlawful storage of hazardous waste; EPA found a "heavy" drum on-site with ignitable hazardous waste and one with corrosive hazardous waste [EPA 2017e,f].

In our letter response dated August 25, 2017, ATSDR indicated that air samples collected to date were not sufficient to make a conclusive health hazard determination. ATSDR recommended that EPA require the company to perform long-term fenceline air monitoring [ATSDR 2017c]. We also engaged the St. Francis Health Department (SFHD) to log odor complaints and collect air samples when air pollutants are suspected to be elevated. Although EPA collected additional air samples and performed air dispersion modeling, we still do not have adequate data to make a conclusion regarding health risks associated with breathing contaminants from MASD. The facility processes containers from a variety of sources, with residues that can vary day-to-day in their chemical content, including several volatile organic compounds, acids, and bases. It is reasonable to suspect that "heavies" containing hazardous waste have been processed at the facility, given that EPA inspectors reported that operations appeared to be "staged" to give the appearance of compliance during a previous inspection [USDOJ 2017] and that the MASD facility in Oak Creek, under the same management, was observed putting "heavies" containing hazardous waste onto a conveyor belt leading to their furnace [EPA 2017f]. We do have adequate soil data to make a health determination for on-site workers and nearby residents.

EPA has provided ATSDR with multiple datasets, which we have evaluated together with our cooperative agreement partners in the Wisconsin Department of Health Services (WDHS). We have come to the following conclusions:

1) Residential exposures to contaminants in surface soil are not expected to harm people's health.
2) Worker exposures to surface soil contaminants at MASD are not expected to harm their health.
3) Air monitoring data were not adequate to assess health risks associated with breathing contaminants released from MASD. The primary limitation of the air dataset is its inability to capture the day-to-day variability in air emissions from MASD, given that the facility handles drums contaminated with a wide range of chemicals. ATSDR and WDHS conducted a screening analysis to determine whether acute or chronic health comparison levels were exceeded on the days that EPA performed air sampling. MASD has since installed a pollution control device that is expected to significantly reduce air emissions.
4) Nuisance odors have been a persistent issue for residents near MASD, as documented by SFHD, WDHS, and regulatory agencies. EPA's air modeling indicates the likelihood that maximum contaminant levels near MASD were above odor thresholds. Air modeling was based on a single emissions testing event and does not necessarily reflect the highest long-term exposures near MASD and associated odors and potential health impacts.

MASD installed a regenerative thermal oxidizer to control air emissions in March 2019 [EPA 2019]. According to EPA, this type of control device is effective for abating solvent fumes and odors, with a volatile organic compound (VOC) destruction efficiency range from 95 to 99% [EPA 1998]. This anticipated reduction in VOC releases in St. Francis is intended to mitigate residents' odor concerns and reduce their exposures to contaminants in air. ATSDR recommends continued oversight by EPA to determine whether the emissions controls are operating properly and whether odor and VOC emissions issues have been resolved. Details of ATSDR and WDHS's evaluation are provided in this letter.

Exposure Pathways and Available Environmental Data

ATSDR and WDHS reviewed environmental data associated with these exposure pathways:

Residential and Worker Dermal Contact and Incidental Ingestion of Contaminants in Soil

- Nearby residents exposed to surface soil in their yards (past, current, future). ATSDR and WDHS evaluated EPA soil sampling for locations off-site of MASD collected in July 2017.
- On-site workers exposed to surface soil while working on the site (past, current, future). EPA provided soil sampling results collected on-site at MASD in May 2018.

Nearby Residents and Workers Inhaling Contaminants in Air

- EPA-reported ambient air VOC data collected off-site on three occasions by EPA inspectors in 2017 and by SFHD staff in 2018. ATSDR and WDHS reviewed the results and found them insufficient to evaluate inhalation of VOCs in ambient air and make a health determination.
- Air testing results as conducted by the Milwaukee Journal Sentinel in November 2017 and by the St. Francis School District in December 2017 were reviewed and found to lack the sampling methodology required for ATSDR to make a health determination.
- EPA air dispersion modeling results (i.e. ambient estimated VOCs, based on MASD stack testing conducted in September 2017) were reviewed as part of this assessment. ATSDR does not use modeling results alone as the basis for a health determination. Air emissions are expected to be significantly reduced by the installation of a control device in March 2019.

ATSDR and WDHS did not have data to evaluate past air exposures. We also did not evaluate health effects associated with drinking groundwater potentially contaminated by MASD. This is not a completed exposure pathway, given that St. Francis receives drinking water from Lake Michigan via the City of Milwaukee.

Soil Data Health Screening and Assessment

EPA provided ATSDR with results of surface soil sampling collected from 0-2 inches at 7 locations near MASD on July 17, 2017. A map is shown on Figure 1 with the location of the MASD facility and land use of adjacent properties. One soil sample was collected at a background site 1/4-mile north of MASD (not shown on map). The remaining samples were collected at commercial and residential properties west and northwest of MASD along Pennsylvania Street, between Norwich Street and Howard Avenue. Distances range from 50 to 500 feet from MASD.

A comparison of surface soil sampling results with ATSDR chronic health screening levels and typical background soil levels are shown on Table 1 [ATSDR 2017b]. Surface soil concentrations that are above health screening levels are shaded gray. The metals concentrations are generally similar across all soil samples, including the background site (S7, ¼-mile north of MASD), the site closest to MASD (S6), and other locations. Selenium and silver were analyzed, but concentrations were below detection limits in all samples and are not shown on the table.

Figure 1. Map of Mid-America Steel Drum location and surrounding land use

All surface soil samples, including the background sample (S7), exceeded ATSDR's health-based screening level for hexavalent chromium. EPA analyzed soil for total chromium and did not report hexavalent chromium content, thus ATSDR's screening is conservative. Total chromium levels were below regional background. One surface soil sample slightly exceeded the screening level for cadmium. Potential health effects from these exposures are discussed below. ATSDR does not have health screening values for lead and mercury in soil. However, lead and mercury levels (shown on Table 1) were typical for background and small urban communities [USGS 2001, ATSDR 2007a]. The Centers for Disease Control and Prevention states that "No safe blood lead level in children has been identified. Even low levels of lead in blood have been shown to affect IQ, ability to pay attention, and academic achievement. [CDC 2012]". Although soil lead concentrations near MASD are relatively low, it should be noted that lead in soil may add to environmental exposures from other sources, including lead-based paint and drinking water.

Chromium- ATSDR took a closer look at potential health risks associated with chronic chromium exposures, as concentrations in all soil samples exceeded our interim (draft) soil Cancer Risk Evaluation Guide (CREG). The interim CREG is derived from the California EPA oral cancer slope factor (CSF) of 0.5 micrograms per kilogram per day (mg/kg/day^{-1}), based on a study that showed increases in oral and stomach tumors in mice following hexavalent chromium administration in drinking water [CalEPA 2011].

Table 1. Surface soil testing off-site near Mid-America Steel Drum facility, parts per million (ppm)

Metal	Site1*	Site2	Site3	Site4	Site5†	Site6‡	Site7§	Health screening levels	Background soil level¶
Arsenic	BDL**	3.6	BDL	BDL	6.0	BDL	4.6	17††	4-6
Barium	38	43	39	40	110	59	40	11,000††	400-700
Cadmium	3.6	2.7	2.6	2.7	5.9‡‡	3.4	3.6	5.7††	0.3-2.0
Chromium	19	13	19	15	24	25	17	0.24; 86,000§§	40-60
Lead	14	28	28	26	25	21	37	-	10-58¶¶
Mercury	0.053	0.14	0.091	0.28	0.04	0.15	0.038	17***	0.08-0.25

* Samples 1-4 were collected on residential property
† Commercial property about 150 feet from Mid-America Steel Drum
‡ Sample collected on publicly-accessible parkway in front of Mid-America Steel Drum
§ Background residential site located ¼-mile north of Mid-America Steel Drum
¶ Source: USGS 2001. Geochemical Landscapes of the Conterminous United States—New Map Presentations for 22 Elements. N. Gustavsson et al. U.S. Geological Survey Professional Paper 1648. 2001.
** BDL = below laboratory detection limits
†† ATSDR Environmental Media Evaluation Guide (EMEG) or Reference Dose Media Evaluation Guides (RMEG) for children's chronic exposure.
‡‡ Soil concentrations above health screening level shaded gray.
§§ Cancer Risk Evaluation Guide (CREG) for hexavalent chromium; RMEG for trivalent chromium.
¶¶ Source: ATSDR. Toxicological Profile for Lead. 2007.
*** ATSDR applied screening level for mercuric chloride.

Chromium is a naturally-occurring element found in rocks, animals, plants, and soil. While trivalent chromium occurs naturally and is ubiquitous in the environment, the principal source of hexavalent chromium in the environment is anthropogenic pollution. Hexavalent chromium is found in low concentrations in nature due to its affinity to react with organic matter and other reducing substances [EC 1996, WHO 2000]. Chromium is widely used in manufacturing processes to make various metal alloys such as stainless steel and is released from industries that use chromium, such as electroplating, leather tanning, textile production, and the manufacture of chromium-based products. Chromium can also be released into the environment from the burning of natural gas, oil, or coal. Background soil levels of total chromium in the United States range from 1 to 2,000 parts per million (ppm), with a mean level of 37 ppm. [ATSDR 2012b].

ATSDR does not expect surface soils near MASD to be notably enriched by industrial hexavalent chromium. Although chemicals handled at MASD vary over time, the drums stored and processed onsite primarily contain solvents, organics, acids, and bases. EPA tested drum residues during a hazardous waste inspection on May 4, 2017 and collected 17 samples for laboratory analysis. EPA reported total chromium in one of these samples at a level of 0.2 ppm and the remaining 16 samples were below detection limits [EPA 2017c]. The soil concentration of total chromium shown on Table 1 is about 100 times higher. Further, the State of Wisconsin reported that MASD released only 0.03 pounds of total chromium to the air in 2015 [WDNR 2017].

ATSDR previously conducted a health investigation near chromium-contaminated sites in New Jersey where soil samples were analyzed for total chromium and the hexavalent form. On average, 3% of the total chromium was found to be hexavalent and the highest level was 14% [ATSDR 2008]. ATSDR also evaluated soil sampling results at a chrome plating facility in Massachusetts. The hexavalent fraction of total chromium was less than 1% at samples collected onsite; offsite, total chromium levels ranged from 12-46 ppm and hexavalent chromium was below detection limits [ATSDR 2007b].

Given that MASD is not a significant source of hexavalent chromium, ATSDR considers the trivalent chromium RMEG to be the appropriate screening level for residential soils in this community. Soil results are well below the Reference Dose Media Evaluation Guides (RMEG) for trivalent chromium and no further evaluation is warranted.

Cadmium- The cadmium concentration in surface soil that exceeded the ATSDR health screening level (S5, 5.9 ppm), was collected at a commercial property which may handle cadmium-containing batteries; markedly elevated levels of cadmium may occur in topsoil near sources of contamination [ATSDR 2012a]. Because this property is adjacent to residences and is not secured with a fence, ATSDR evaluated this sample under a residential trespasser scenario. We considered adolescent children aged 6-16 who access the site one day per week, 26 weeks out of the year. The exposure dose considers dermal contact and incidental ingestion of contaminated soil. The reasonable maximum exposure (RME) dose for children aged 6-11 was calculated as 0.003 ug/kg/day [ATSDR 2005].

ATSDR developed an MRL for cadmium based on workers studies that measured impaired kidney function. Specifically, cadmium causes tubular proteinuria (increased excretion of low molecular weight proteins), which can be quantified by measuring the protein creatinine in urine. ATSDR’s MRL is derived from a point of departure (POD) of 0.33 ug/kg/day, the level where 10% of workers had a measurable increase of creatinine in urine. The calculated dose for a trespasser at Site S5 (0.003 ug/kg/day) is 110 times less than the POD [ATSDR 2012a]. Adolescent trespassers are not expected to experience health effects due to cadmium soil exposure at this site.

Worker exposures to contaminants in soil

EPA also provided ATSDR with results of 3 composite surface soil samples collected on MASD property, in the storage yard to the north and east of the building, on May 1, 2018. The samples were collected in the top 2 inches of soil following a multiple increment sampling methodology, each sample representing a 100-150 foot linear transect. Samples were analyzed for metals, VOCs, and polycyclic aromatic hydrocarbons (PAHs). Results for metals and VOCs, together with ATSDR chronic health screening levels, are shown on Table 2.

Chromium concentrations exceeded the CREG for hexavalent chromium. However, as noted above, MASD is not known to release hexavalent chromium. The RMEG for trivalent chromium is the appropriate screening level and total chromium soil concentrations were below the RMEG. All other metals and VOCs were below health screening levels. The following metals were below detection limits in all samples and are not shown in the table: antimony, silver, and thallium. Several naturally-occurring elements, considered to be essential nutrients, do not have health screening levels and are also not shown: calcium, iron, magnesium, potassium, and sodium.

Table 2. Composite surface soil samples tested for metals and volatile organic compounds on Mid-America Steel Drum property, parts per million (ppm)

Contaminant	SP-1	SP-2	SP-3	Health screening level *
Aluminum	1,100	1,200	1,300	800,000
Arsenic	1.5	1.7	1.8	240
Barium	10	11	12	160,000
Beryllium	0.11	0.10	0.098	1,600
Cadmium	0.15	0.25	0.20	80
Chromium	8.7[†]	9.2	11	0.24[‡,§]; 1,200,000[¶**]
Cobalt	1.6	1.6	1.7	8,000[¶]
Copper	7.8	7.8	9.0	8,000[¶]
Lead[††]	9.0	7.4	13	-
Manganese	300	300	300	40,000
Mercury[‡,‡,]	0.016	0.018	0.017	240
Nickel	5.0	4.9	6.1	16,000
Selenium	0.32	BDL[§§]	BDL	4,000
Vanadium	5.4	5.4	5.8	8,000[¶]
Zinc	22	27	26	240,000
Methylene chloride	0.12	0.11	0.140	60[‡]
Naphthalene	0.032	0.049	0.045	16,000
Toluene	0.035	0.029	0.048	64,000

* ATSDR Environmental Media Evaluation Guide (EMEG) or Reference Dose Media Evaluation Guides (RMEG) for adult chronic exposure (over 365 days).

† Soil concentrations above health screening level shaded gray.

‡ Cancer Risk Evaluation Guide (CREG)

§ Health comparison value assumes all chromium is hexavalent.

¶ ATSDR EMEG or RMEG for adult intermediate exposure (14 to 364 days).

** Health comparison value assumes all chromium is trivalent.

†† Lead levels are below or within range of background in urban soil, which is 10-58 ppm. [ATSDR 2017]

‡‡ ATSDR applied screening level for mercuric chloride.

§§ Below laboratory detection limits

PAHs are formed during the incomplete burning of coal, oil, gas, wood, garbage, or other organic substances. PAHs in urban soils result from accumulation over many decades from various non-industrial sources, including wood-burning stoves and on-road vehicle emissions, and from industrial sources like industrial boilers, electric power plants, and petroleum refineries. Composite surface soil analysis results for PAHs collected on MASD property, ATSDR chronic health screening levels, background levels in urban soil, and the benzo(a)pyrene toxic equivalent (BaP-TE) are shown on Table 3.

Table 3. Composite surface soil samples tested for semi-volatile organic compounds on MASD property, parts per million (ppm)

Contaminant	**SP-1**	**SP-2**	**SP-3**	**Health Screening Level ***	**Background Level in Urban Soil†**
2-Methylnaphthalene	BDL‡	0.54	BDL	3,200	NA§
Acenaphthene	BDL	1.1	BDL	48,000	NA
Anthracene	BDL	3.1	BDL	240,000	NA
Benzo(a)anthracene	0.87	3.6	1.2	¶	0.17 - 59
Benzo(b)fluoranthene	1.3	3.4	1.6	¶	15 - 62
Benzo(k)fluoranthene	BDL	1.2	BDL	¶	0.3 - 26
Benzo(a)pyrene	0.99	2.5	1.2	¶	0.17 - 0.22
Chrysene	0.93	3.4	1.2	¶	0.25 - 0.64
Fluoranthene	1.8	8.7	2.6	32,000	0.2 - 166
Fluorene	BDL	1.9	BDL	32,000	NA
Indeno(1,2,3)pyrene	BDL	1.2	BDL	¶	8 - 61
Naphthalene	BDL	0.48	BDL	16,000	NA
Pyrene	1.4	6.2	2.0	24,000	0.15 - 147
Benzo(a)pyrene Toxic Equivalent	1.6**	3.5	1.8	0.12††	NA

* ATSDR Environmental Media Evaluation Guide (EMEG) or Reference Dose Media Evaluation Guides (RMEG) for adult chronic exposure (over 365 days).
† Source: Toxicological Profile for Polycyclic Aromatic Hydrocarbons (PAHs).1995
‡ BDL = below laboratory detection limits
§ No data available
¶ Toxicity of these compounds is incorporated in Benzo(a)pyrene Toxic Equivalent
**Soil concentrations above health screening level shaded gray.
††Cancer Risk Evaluation Guide (CREG) equivalent to 1 cancer case per million exposed individuals.

Several polycyclic aromatic hydrocarbons do not have their own health screening levels, but rather their toxicity is indexed relative to the most harmful chemical in this group – benzo(a)pyrene (BaP). ATSDR multiplied chrysene concentrations by a factor of 0.01, as this compound is considered to have $1/100^{th}$ the toxicity of BaP. Other compounds were multiplied by 0.1, given that they are estimated to be $1/10^{th}$ as toxic as BaP: benzo(a)anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene, and indeno(1,2,3-cd)pyrene. ATDSR substituted half of the laboratory reporting limit for benzo(k)fluoranthene and indeno(1,2,3-cd)pyrene concentration that were below reporting limits in samples SP-1 and SP-3. ATSDR summed the adjusted concentrations, together with the reported levels of BaP, producing a benzo(a)pyrene toxic equivalent for each sample location. ATSDR followed the BaP-TE methodology as developed by California EPA [CalEPA 1993]. As compared to typical background concentrations in urban soil (noted on Table 3), onsite concentrations of benzo(a)pyrene and chrysene at MASD are up to ten times the background level, suggesting there is an industrial contribution from on-site activities [ATSDR 1995].

The BaP-TE for all three samples exceeded ATSDR's health screening level, suggesting to ATSDR that a closer evaluation was warranted as part of this assessment. ATSDR used reasonable maximum exposure assumptions for an adult worker to calculate a long-term exposure dose for a person working at MASD for 5 days per week, 50 weeks per year, over a 25-year period. The exposure dose considers both dermal contact and incidental ingestion of contaminated soil in the most contaminated sample (SP-2), with low-intensity soil contact, resulting in an exposure dose of 3.9×10^{-6} mg/kg/day. ATSDR derived cancer risk estimates using the oral cancer slope factor for benzo(a)pyrene, 1.0 $(mg/kg/day)^{-1}$, multiplying it by the calculated exposure dose and duration of exposure averaged over a lifetime of 78 years [ATSDR 2016a,b,c,d].

ATSDR's calculated cancer risk associated with worker exposures to PAHs in the most contaminated soil sample is 1×10^{-6}, or approximately 1 excess case per million people. ATSDR and WDHS consider this a low increased risk of cancer.

The reported levels of PAHs in soils shown on Table 3 were below non-cancer health screening levels for 2-methylnaphthalene, acenaphthene, anthracene, fluoranthene, fluorene, naphthalene, and pyrene. The BaP-TE concentrations were also below ATSDR's non-cancer screening level (240 ppm, chronic adult RMEG), based on EPA's Reference Dose (RfD) for benzo(a)pyrene's developmental effects. The RfD is derived from a point of departure (POD) dose of 0.092 mg/kg/day, based on rat studies showing abnormal behavior in three separate tests: Morris water maze, elevated plus maze, and open field tests [EPA 2017a]. The POD corresponds to the lower end of the range of benchmark doses (0.092−0.16 mg/kg-day) for the three health endpoints, i.e. the lower 95% confidence limit on the dose associated with a change of 1 standard deviation from the controls. ATSDR's calculated BaP-TE dose at MASD is 1.9×10^{-5} mg/kg/day, which is 4,842 times below the POD. The concentrations of PAHs that workers are exposed to in soil at MASD are not expected to cause non-cancer health effects.

EPA Air Monitoring and Health Screening

EPA collected air samples adjacent to MASD on May 5, July 17, and August 30, 2017. Results for VOCs known to be emitted by MASD, i.e. those modeled by EPA, are shown on Table 4 in comparison with acute health screening, odor threshold, and chronic health screening levels.

The first sampling event yielded 5 instantaneous grab samples (M1-M5). In July EPA collected 4-hour averaged samples (J1, J2, J3, J5 in the morning and J6-J9 in the afternoon). In August EPA collected 8-hour averaged samples.

Table 4. EPA air samples compared with health screening and odor threshold levels, micrograms per cubic meter (ug/m³)

	Ethyl-benzene	Hexanes	Methylene chloride	Methanol	Styrene	Toluene	Xylenes
Acute Health Screen*	**22,000**	**-**	**2,100**	**-**	**21,000**	**7,500**	**8,700**
Odor Threshold†	**-**	**229,108**	**4,169**	**4,290**	**20**	**79**	**352**
Chronic Health Screen‡	**260**	**700§**	**63¶**	**20,000§**	**850**	**3,800**	**100§**
M1**††	0.22	0.18	1.2	3.8	0.22	1.7	0.43
M2	0.22	0.18	43	76	0.22	3.4	0.43
M3	0.22	0.72	33	43	0.22	4.5	0.43
M4	4.1	6.6	13	37	0.60	20	14
M5	0.22	0.18	0.8	4.2	2.2	0.39	0.43
J1	2.0	5.3	36	29	0.65	11	8.0
J2	0.65	0.53	108	42	0.65	10	1.3
J3	0.65	0.53	26	17	0.65	5.1	1.3
J4††	0.32	0.26	0.26	4.0	0.32	0.29	0.6
J5	3.3	0.70	14	23	0.86	15	13
J6	0.65	0.53	52	26	0.65	8.6	1.3
J7	0.65	0.53	148	57	0.65	22	1.3
J8	0.65	0.53	47	26	0.65	9.0	1.3
J9	0.65	0.53	12	12	0.65	2.5	1.3
A1	0.22	0.36	2.7	NR§§	0.11	2.6	0.65
A2	0.23	0.37	8.1	NR	0.11	3.4	0.77
A3	0.52	0.56	11	NR	0.39	6.9	1.8
A4	0.53	0.54	12	NR	0.39	7.2	1.8
A5	0.28	0.41	2.5	NR	0.11	3.3	0.86
A6	0.11	0.31	0.6	NR	0.11	2.3	0.55
A7	0.22	0.41	1.6	NR	0.11	2.4	0.65
A8	0.34	0.37	1.9	NR	0.11	2.8	1.1
A9††	0.11	0.28	0.49	NR	0.11	1.8	0.44

* ATSDR Environmental Media Evaluation Guide (EMEG) or Reference Dose Media Evaluation Guides (RMEG) for acute exposure (1-14 days).
† AIHA Odor Thresholds for Chemicals with Established Occupational Health Standards, 1989
‡ ATSDR Environmental Media Evaluation Guide (EMEG) or Minimal Risk Level (MRL)
§ EPA Reference Concentration (RfC)
¶ Cancer Risk Evaluation Guide equivalent to 1 case per million people exposed. Shaded results exceed screen.
** Sample sites coded "M" for samples collected on May 5th, "J" collected July 17th, and "A" collected August 30th
†† Background sample
§§ NR = not reported

ATSDR and WDHS do not have enough ambient air data to assess potential health effects associated with acute (1-14 days), intermediate (15-364 days), or chronic (365 or more days) exposures. Several weeks or months of routine air sampling would be needed to reliably characterize ambient air exposures. The available data are not adequate to calculate average concentrations to represent chronic exposures with confidence intervals to account for day-to-day variability in air emissions from MASD. Nor are the data appropriate to characterize the likely variability in acute exposures. The short-term limited data shown on Table 4 are presented as a data screen and to determine whether the findings indicate a potential for acute health effects limited to the dates of sampling. The reported concentrations do not exceed acute health screening and odor threshold levels. Chronic health screening values are intended for comparison with long-term averages of air contaminant concentrations, which cannot be derived for the short-term limited dataset. Chronic screening levels are notably lower than the acute screening levels and are shown on Table 4 for additional context.

The methylene chloride chronic screening level for cancer was exceeded in two short-term samples (4-hour averages) collected on Norwich Avenue in July. ATSDR and WDHS would need long-term air monitoring at this location to assess cancer risks associated with methylene chloride. Acute and chronic exposures for the VOCs shown on Table 4 could not be evaluated based on the limited dataset and due to the anticipated day-to-day variability in air emissions from MASD.

In ATSDR's initial review of EPA air sampling results in 2017, we indicated potential chronic risks associated with exposure to several other VOCs: acrolein, acrylonitrile, benzene and chloroform. These compounds have not been confirmed to be emitted by MASD, per the stack testing discussed in the below section; these are common VOCs and their presence in air may be the result of automobile exhaust or other sources. The final datasets received from EPA indicated that all chloroform results were below data reporting limits. Acrolein, acrylonitrile, and benzene were below acute health screening levels. However, ATSDR cannot evaluate acute and chronic health effects associated with these exposures without long-term air monitoring.

To be responsive to community reports of odor events, EPA, ATSDR, and WDHS partnered with the St. Francis Health Department (SFHD). Local health officials were provided with and trained on operating VOC samplers in January 2018. If they received odor complaints and confirmed them in person, SFDH staff could collect one to three air samples in the field. The samples were mailed overnight to the EPA Chicago Regional Laboratory for analysis. SFHD collected a total of 6 samples on January 31, February 14, and March 2. ATSDR screened the results against acute health-based comparison values and odor thresholds listed on Table 4. None of the samples exceeded screening levels or odor thresholds. Reported concentrations were at the lower end of the range of VOC levels in the samples collected by EPA in the summer of 2017.

Air Modeling Health Screening and Assessment

EPA used air modeling, a site-specific computer simulation of how pollutants disperse into the air, to estimate air contaminant levels around MASD. ATSDR can use air modeling results in conjunction with a robust air monitoring dataset to draw conclusions about potential health effects from air contaminants. However, the available air monitoring results and the modeling data are too limited, since they do not reflect day-to-day changes in emissions from MASD resulting from a heterogenous mix of chemical residues in the drums processed onsite. Although ATSDR cannot draw health conclusions about air contaminants released from MASD, EPA's modeling results can help us understand how VOCs disperse in ambient air and what areas around MASD are most likely impacted. EPA developed emission estimates for MASD's primary scrubber stack and for two smaller emissions points: the paint spray booth exhaust stack and paint bake oven exhaust stack. EPA modeled compounds, selected in consultation with ATSDR, based on the existence of health screening levels and documented odor thresholds for compounds emitted by MASD. EPA used AERMOD version 16216r with 5 years (2011-15) of surface meteorological data from Milwaukee Airport and Green Bay upper air data. EPA accounted for complex topography in the area by using National Elevation Data contained in AERMAP. EPA modeled the maximum air concentrations at each geographic location for acute (1-hour, 8-hour, and 24-hour) and chronic (5-year) exposure periods.

Air modeling accounted for the fact that MASD raised the scrubber stack from 8 meters to 14 meters in the Fall of 2017 to reduce ground-level pollutant concentrations. Based upon this change, EPA modeled stack emissions for both a pre-modification and post-modification scenario. Maximum long-term modeled air concentrations around the MASD facility are shown on Table 5.

Table 5. Maximum long-term (chronic) modeled air concentration pre- and post-modification of emissions stack, compared with health screening levels, micrograms per cubic meter (ug/m^3)

Contaminant	Maximum modeled concentration		Chronic health screening level*
	Pre-modification	Post-modification	
2-butoxy ethanol	85	85	970
Ethylbenzene	3.2	2.1	260
Hydrochloric acid	0.26	0.26	20†
Hexanes	26	17	700†
Methylene chloride	17	17	63‡
Methyl ethyl ketone	15	10	5,000†
Methanol	3.7	3.7	20,000†
Methyl isobutyl ketone	1.6	1.1	3,000†
Styrene	1.8	1.1	850
Toluene	12	8.9	3,800
Triethylamine	0.18	0.18	7†
Xylenes	5.6	3.6	100†

* ATSDR Environmental Media Evaluation Guide (EMEG) or Minimal Risk Level (MRL)
† EPA Reference Concentration (RfC)
‡ Cancer Risk Evaluation Guide (CREG) equivalent to 1 cancer case per million exposed people.

Emissions from the two smaller stacks did not change when the main stack was raised. EPA provided ATSDR with modeling outputs, which we summed by air pollutant and across the three stacks. Some air contaminants had lower estimated air concentrations after the industrial stack was modified. However, all concentrations, both pre- and post-modification were below chronic health screening levels.

Maximum short-term modeled air concentrations around the MASD facility are shown on Table 6. The highest 24-hour concentrations were compared to their respective ATSDR acute health screening levels. Maximum 8-hour and 1-hour concentrations were compared to the lowest documented threshold where people can smell the contaminant. The modeled contaminants did not exceed acute screening levels, either before or after stack modification. Peak 1-hour and 8-hour concentrations of 2-butoxy ethanol and toluene were higher than the lowest odor threshold. Styrene was also predicted to exceed the odor threshold at the 1-hour peak level prior to stack modification. Toluene, 2-butoxy ethanol, and styrene all reportedly have an odor that is sweet and chemical-like (paint or petroleum type odors). Health screening levels for 1-hour and 8-hour averaging times are orders of magnitude higher than the modeled concentrations for the given contaminants and are not shown on the table.

Table 6. Maximum short-term (acute) modeled air concentrations pre- and post-modification of facility, compared to health screening level and odor threshold, micrograms per cubic meter (ug/m^3)

Contaminant	Maximum modeled 24-hour concentration		Acute Health Screening levels*	Maximum modeled 8-hour concentration		Maximum modeled 1-hour concentration		Odor Threshold†
	Pre	Post		Pre	Post	Pre	Post	
2-butoxy ethanol	622	622	29,000	846‡	846	1,315	1,315	485
Ethylbenzene	31	19	22,000	32	20	36	23	-
Hydrochloric acid	1.9	1.9	-	2.6	2.6	4.1	4.1	357
Hexanes	251	156	-	264	164	292	183	229,108
Isopropanol	17	17	-	24	24	37	37	2,450
Methylene chloride	130	125	2,100	173	167	262	256	4,169
Methyl ethyl ketone	146	91	-	153	95	170	107	737
Methanol	27	27	-	37	37	58	58	4,290
Methyl isobutyl ketone	16	10	-	16	10	18	11	410
Styrene	17	11	21,000	18	11	20	12	20
Toluene	104	75	7,500	118	88	147	112	79
Triethylamine	1.3	1.3	-	1.8	1.8	2.8	2.8	414
Xylenes	54	34	8,700	57	35	63	40	352

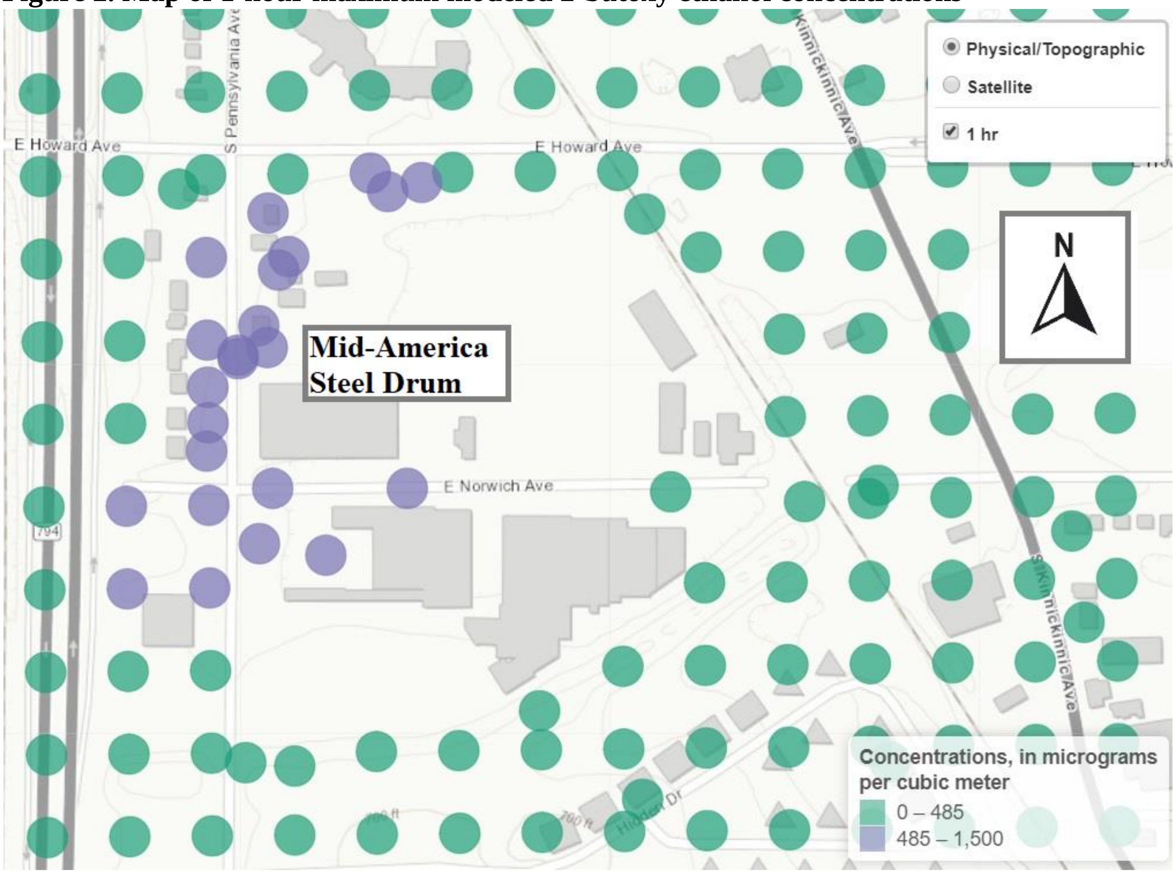
*ATSDR Environmental Media Evaluation Guide (EMEG) or Reference Dose Media Evaluation Guides (RMEG) for acute exposure (1-14 days).

†American Industrial Hygiene Association, Odor Thresholds for Chemicals with Established Occupational Health Standards, 1989

‡Concentrations above the odor threshold are shaded in gray.

One of the compounds with concentrations above the odor threshold, 2-butoxy ethanol, is only emitted by the smaller stacks. Thus, the modeled estimates did not change in the two scenarios, pre- and post-modification. As shown on Figure 2, receptor points up to 500 feet away, depicted with purple dots, had an estimated 2-butoxy ethanol concentration higher than the odor threshold of 485 micrograms per cubic meter. Several homes and commercial properties to the west, north, and south of MASD are expected to have levels of 2-butoxy ethanol that can be smelled by residents and workers during certain meteorological conditions.

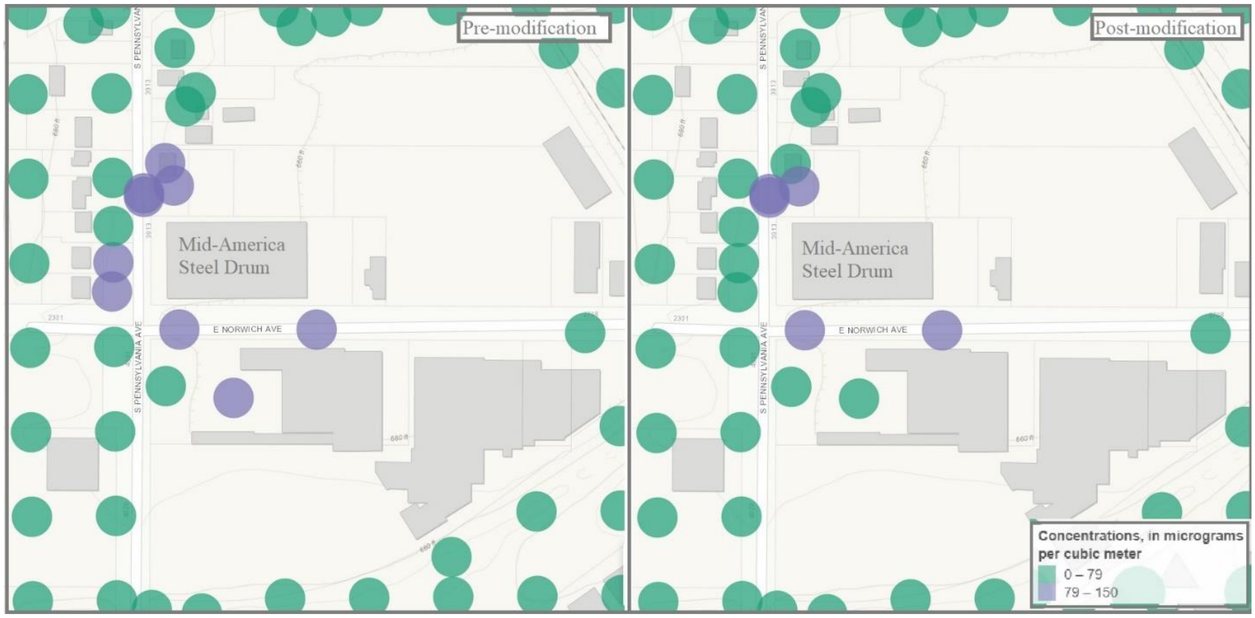
Figure 2. Map of 1-hour maximum modeled 2-butoxy ethanol concentrations



Source: EPA air modeling results mapped by ATSDR.

Toluene is emitted by the main stack and the smaller stacks, thus total emissions were different in the pre- and post-modification scenario. As shown below on Figure 3, there were residential locations that were above the odor threshold of 79 micrograms per cubic meter (ug/m^3), both before and after the main stack was raised. However, the odor is likely to have affected a smaller area after the stack was modified.

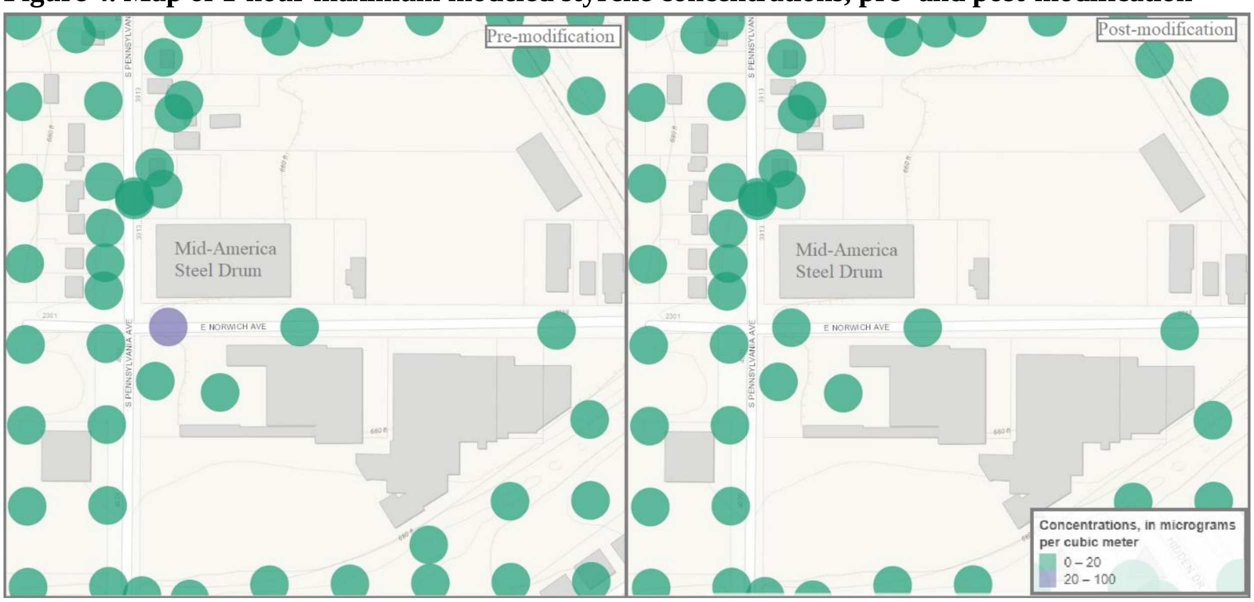
Figure 3. Map of 1-hour maximum modeled toluene concentrations, pre- and post-modification



Source: EPA air modeling results mapped by ATSDR.

Styrene is emitted only from the scrubber stack and there are differences in the pre- and post-stack modification modeling results. As shown on Figure 4, there was one residential location with concentrations above the odor threshold of 20 ug/m^3 before the main stack was raised and none after modification.

Figure 4. Map of 1-hour maximum modeled styrene concentrations, pre- and post-modification



Source: EPA air modeling results mapped by ATSDR.

Some residents expressed concerns that raising the stack caused air contaminants to have a greater impact on homes south of MASD, where the terrain is elevated. Styrene and toluene modeling results suggest that this is not the case. The pre- and post-modification results show that peak contaminant concentrations were lower and closer to MASD even after the stack was raised.

Other Sources of Air Monitoring Data

ATSDR and WDHS evaluated air data collected by the Milwaukee Journal Sentinel newspaper and by St. Francis School District. These data were not collected using EPA-recommended methods for ambient air and are too limited in scope for our use in drawing health conclusions. A description of these investigations is provided for informational purposes.

Milwaukee Journal Sentinel (MJS): MJS hired an environmental contractor to monitor on residential properties near MASD during November 13-18, 2017. MJS monitored VOCs, particulate matter, metals, inorganic acids, and semi-volatile organics. They collected 24-hour samples at 4 locations near MASD. Most of the VOC results for compounds associated with MASD were below detection limits. The week of sampling was characterized by windy conditions and interviewed residents indicated that "they smelled little from the plant, which is unusual". MJS results for metals, inorganic acids, and semi-volatile compounds indicated that essentially all results were below detection limits [MJS 2017a,b]. Metals, minerals, and PAHs are common pollutants expected to be detectable in an urban environment. Thus, it appears that the analytical plan implemented by MJS did not incorporate sufficiently low detection limits for an ambient air investigation of metals and PAHs. ATSDR was unable to conduct a health risk screening due to these data quality issues.

MJS reported 24-hour averages of particulate matter smaller than a 10-micron diameter (PM_{10}), noting that all results were below EPA's 24-hour National Ambient Air Quality Standard (NAAQS) of 150 ug/m^3. The peak 24-hour values (approximately 65 ug/m^3) exceeded the health screening level that ATSDR applies - the World Health Organization (WHO) Air Quality Guideline for PM_{10} of 50 ug/m^3 which is associated with respiratory and cardiovascular morbidity, such as aggravation of asthma, respiratory symptoms, and an increase in hospital admissions. Similarly, summary data for particulate matter smaller than 2.5-microns ($PM_{2.5}$) was below the EPA NAAQS and above the WHO screening level (25 ug/m^3 for a 24-hour mean) [WHO 2000]. The data varied day-to-day but not significantly between sites, suggesting that the MJS study was capturing region-wide trends in PM concentrations and not MASD-specific emissions.

St. Francis School District (SFSD): SFSD hired a firm to sample inside and outside of Willow Glen Elementary School on December 12, 2017. SFSD tested air in two classrooms and at an outside bench for acids, polychlorinated biphenyls, pesticides, formaldehyde, and total volatile organic compounds. All results were below detection limits [SFSD 2017].

The contractor employed industrial hygiene sampling methods with detection limits that are higher than the health screening levels applied by ATSDR; EPA methods for a residential ambient air investigation would be more appropriate. ATSDR and WDHS could not draw any health conclusions from SFSD's dataset due to the methodological limitations.

Community Concerns

With technical support from ATSDR and WDHS, the SFHD kept a log of odor complaints near MASD beginning in December 2017 and collected air samples on multiple occasions when residents reported odors, as discussed above. Previously odor issues were reported to multiple different government agencies and not systematically reviewed. SFHD recorded 39 complaints between December 11, 2017 and May 24, 2018. The most common adjectives given to describe the odors were "chemical", "paint", "solvent", and "sweet". These descriptions are consistent with the scent of toluene and other VOCs known to be emitted by MASD.

In about half of the reports, the complainant indicated physical symptoms associated with the odor. The most common symptoms were burning of the eyes, nose, or throat, as well as nausea and headache. These symptoms are associated with exposure to VOCs. However, the air levels that are defined as an "irritating concentration" are orders of magnitude higher than odor thresholds. For example, toluene is documented as an irritant at 750,000 ug/m^3 [AIHA 1986]. Toluene has an odor threshold of 79 ug/m^3 [AIHA 1989]. Toluene was modeled by EPA with a maximum 1-hour peak of 147 ug/m^3 and the highest level in air samples collected by EPA and SFHD, respectively, were 22 and 5 ug/m^3.

Limitations

ATSDR and WDHS noted significant limitations in our ability to characterize community exposures to soil and air contaminants near the MASD facility. They are:

1) Soil analyses for metals did not distinguish between different species of chromium compounds. Hexavalent chromium is the most toxic form. ASTDR did not find evidence of hexavalent chromium releases at MASD and thus assumed that chromium in soil was in the less toxic trivalent form for this assessment.
2) EPA's air samples were collected on three separate dates that do not necessarily correspond to days of higher VOC emissions at MASD or odor events. ATSDR and WDHS could not reliably assess chronic or acute health effects over time near the MASD facility. The new air emissions control system installed by MASD is expected to reduce VOCs by up to 99%.
3) Air modeling performed by EPA is based on a stack test conducted by MASD on one specific date and may not represent maximum air emissions over time, given the day-to-day variability in chemical residues. Thus, there are VOCs that may have been emitted at a higher rate than EPA estimated and other chemicals that may not have been modeled at all, as they were absent on the day of the stack test.

4) Except for hydrochloric acid, which was estimated in the MASD stack test and subsequent air modeling, EPA did not characterize corrosive compounds that are processed at MASD. Acids and bases can cause the eye, nose, and throat irritation reported by residents. ATSDR and WDHS could not evaluate health effects associated with these potential exposures. Emissions of these compounds are expected to be addressed by the new air pollution controls implemented by MASD.

Conclusions and Recommendations

Based on the available data ATSDR and WDHS conclude:

1) Residential exposures to contaminants in surface soil are not expected to harm people's health.
2) Worker exposures to surface soil contaminants at MASD are not expected to harm their health.
3) Air monitoring data were not adequate to assess health risks associated with breathing contaminants released from MASD. The primary limitation of the air dataset is its inability to capture the day-to-day variability in air emissions from MASD, given that the facility handles drums contaminated with a wide range of chemicals. ATSDR and WDHS conducted a screening analysis to determine whether acute or chronic health comparison levels were exceeded on the days that EPA performed air sampling. MASD has since installed a pollution control device that is expected to significantly reduce air emissions.
4) Nuisance odors have been a persistent issue for residents near MASD, as documented by SFHD, WDHS, and regulatory agencies. EPA's air modeling indicates the likelihood that maximum contaminant levels near MASD were above odor thresholds. Air modeling was based on a single emissions testing event and does not necessarily reflect the highest long-term exposures near MASD and associated odors and potential health impacts.

ATSDR and WDHS recommend these next steps:

1) EPA should confirm proper operation of the regenerative thermal oxidizer installed by MASD. EPA should take appropriate regulatory action if the VOC controls are not properly installed and functioning.
2) SFHD should continue tracking reports of odor events. ATSDR and WDHS will provide technical support to determine whether the situation has improved after MASD installed new emissions controls.

Please contact ATSDR if you require any additional assistance and do not hesitate to contact me at 312-886-0267 if you have any questions regarding this letter.

Sincerely,

Motria Caudill, PhD
Environmental Health Scientist
Agency for Toxic Substances and Disease Registry
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