DETROIT AIR TOXICS INITIATIVE
RISK ASSESSMENT UPDATE
TECHNICAL SUMMARY

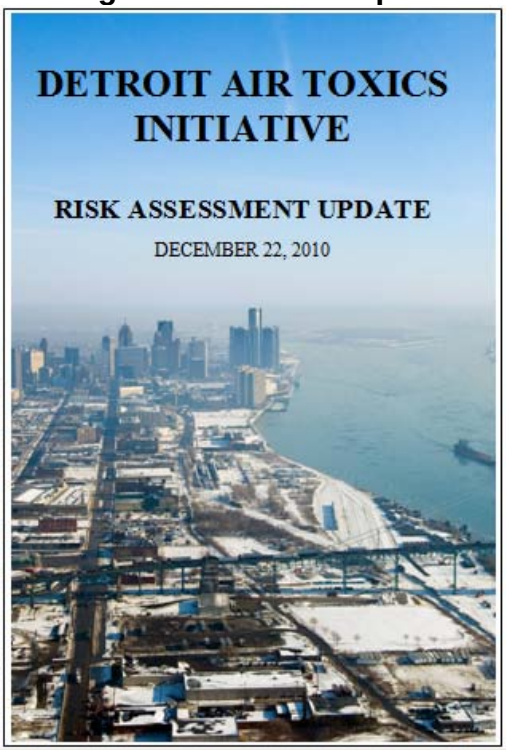
December 2010

Introduction

The "Detroit Air Toxics Initiative (DATI) Risk Assessment Update" ("DATI-2") has been designed to provide a more current analysis of concentrations and potential health risks associated with air toxics in the Detroit area five years after the original DATI study (DATI-1). The full risk assessment report is available at http://www.michigan.gov/air and select Air Toxics, then DATI. This document provides a Technical Summary of the DATI-2 report.

DATI-2 is a project initiated by the Michigan Department of Natural Resources and Environment (DNRE) Air Quality Division (AQD) and is funded by a grant from the U.S. Environmental Protection Agency (USEPA). The DATI-2 Risk Assessment Update evaluates "air toxics" in the Detroit area five years after DATI-1. As in DATI-1, the current assessment of Detroit's air includes ambient air measurements of air pollutants such as benzene, formaldehyde, chromium, manganese, and others. Air toxics are a group of air pollutants different from the USEPA's "criteria pollutants," such as lead, particulate matter, and ozone. Criteria pollutants were not evaluated in the DATI-1 or DATI-2 projects. Air toxics do not have national air quality standards as do the criteria pollutants, but they may still pose significant public health concerns depending on their air concentrations.

Figure 1: DATI-2 Report



A Stakeholder Group assisted the DNRE with determining a communication strategy for the DATI-2 project. The Stakeholder Group consists of representatives from environmental and community groups, government, industry, and academia. The purpose of the Stakeholder Group was to review and comment on draft reports and to help communicate the findings to others.

Background

The DATI Risk Assessment Report (DATI-1) was the first of its kind in Michigan. It provided a risk characterization for air toxics based on air concentrations monitored in the Detroit area. The DATI-2 update provides an evaluation five years after the first DATI project. The DATI-1 project evaluated air toxics at seven sites in the Detroit area for a full year, during April 2001 to April 2002. The DATI-2 update project evaluates monitoring data from February 2006 to February 2007. Monitoring was also done outside the Detroit area at Ypsilanti and Houghton Lake for comparison.

Figure 2. Detroit Air Monitoring Locations

The DATI-2 monitoring sites were in the same locations as DATI-1, except for the Southfield site, which was decommissioned after DATI-1 (see **Figure 2**). These sites are believed to have air toxics levels attributable to a variety of sources (e.g., residential, vehicles, and industries) that are both local and distant. Not all pollutants were sampled at all sites, and some pollutants were sampled more or less frequently from one site to the next. For instance, certain pollutants were sampled every 6 days at Dearborn and every 12 days at Ypsilanti. Fewer compounds were monitored during the DATI-2 time frame due to study design and budgetary constraints as shown in **Table 1**. A complete list of all pollutants monitored, sampling frequency by site, and the levels measured, can be found in the full DATI-1 and DATI-2 Risk Assessment Reports.

Table 1. Air Sampling Locations Used for DATI-1 and DATI-2

Site Name	VOC	Carbonyl	Metal	Cr +6	SVOC
Allen Park	DATI-1	DATI-1	**1 & 2**	DATI-1	DATI-1
Dearborn	**1 & 2**	**1 & 2**	**1 & 2**	**1 & 2**	DATI-1
Houghton Lake	**DATI-2**	**1 & 2**	**1 & 2**		
N. Delray (SWHS)	**1 & 2**	**1 & 2**	**1 & 2**		DATI-1
NE Detroit		DATI-1	**1 & 2**		DATI-1
River Rouge	DATI-1	**1 & 2**	**1 & 2**	DATI-1	DATI-1
S. Delray	DATI-1	DATI-1	**1 & 2**		DATI-1
Ypsilanti	**DATI-2**	**1 & 2**	**1 & 2**		
Southfield (Lodge)	DATI-1	DATI-1	DATI-1	DATI-1	DATI-1

Methods

The DATI-2 Risk Assessment Update provides estimates of health risks based on the exposures that people may have from breathing the measured levels in the air over time. It does not include an evaluation of air pollutants that may deposit to the ground or to lakes, which (for some pollutants such as mercury) could lead to additional exposure from soil, water, or food. Health risks for both cancer and non-cancer effects were evaluated. The DATI risk assessment does not include estimated health risks from exposure to compounds which were not monitored or did not have a health benchmark.

Acrolein was not sampled and analyzed as part of DATI-2 because sampling and analytical techniques have been shown to be unreliable. Diesel particulate matter (DPM) could not be directly measured due to sampling and analytical inadequacies. Furthermore, the US EPA and MDNRE have not developed a cancer potency estimate for DPM. Nonetheless, DPM levels and cancer risks can be estimated by using measurements of elemental carbon and a cancer potency estimate provided by the California EPA. Although highly uncertain, the cancer risk of DPM was calculated and is reported below.

Exposure levels for determining lifetime cancer risks were based on the monitored levels averaged over a year (the annual average). These exposure levels were used to estimate the risk of cancer per million people exposed to each carcinogenic air pollutant separately and in total. The inhalation cancer risk estimates in DATI are based only on exposure to outdoor air toxics and should not be confused with overall cancer rates.

Selection of the acceptable level of cancer risk resulting from pollution is a matter of public policy, and has not been established for air toxics in ambient air. This makes it difficult to interpret the acceptability of the cancer risk estimates in the DATI reports. For comparison purposes, some USEPA and DNRE regulatory programs regard a cancer risk of 1 in one million per substance as acceptably small and not a health concern when determining if the emission from an individual source is allowable.

Potential non-cancer effects were evaluated for long-term (chronic) exposure. Chronic non-cancer health effects were evaluated by comparing the annual average concentration to health reference levels developed by the DNRE or USEPA. The chronic health reference levels are exposure levels that do not pose significant hazards of non-cancer health effects. Long-term exposure to levels below the health reference levels are assumed to produce no harmful effects. Exposures above these levels do not necessarily mean that harmful effects will occur, but depending on the exposure level, length of time, and sensitivity of individuals, there is some potential for adverse effects. That concern increases as the exposure level increases.

Air concentrations during DATI-2 were compared to other studies in the US that provided similar air measurements. These findings of the studies in other parts of the US were taken from data obtained on-line from state-run web sites.

Results

Based on the DATI-2 data, the DNRE has derived upper bound lifetime cancer risk estimates from breathing the monitored air toxics in the Detroit area. The measured air concentrations were also compared to monitored levels in other cities. This evaluation represents a “snapshot” in time, and does not necessarily reflect past or future risks or concerns from exposure to air toxics.

Some of the most important findings of DATI-2 include:

1. Wherever formaldehyde was monitored, including Houghton Lake, it comprised a significant portion of total cancer risk as shown in Figure 3. This agrees with US EPA's nationwide studies indicating that some carcinogenic air toxics are present virtually everywhere, at levels well above a 1 in one million risk level. Concentrations, and associated risk estimates, decreased from the DATI-1 time frame.

2. Benzene levels at all fours sites that monitored for VOCs during DATI-2 (Dearborn, N. Delray, Ypsilanti and Houghton Lake) also showed that it is a major risk driver. Concentrations, and associated risk estimates, decreased from the DATI-1 time frame.

3. Carbon tetrachloride showed very little variation between sites and sampling times (DATI-1 and DATI-2). The stability of the levels is as expected since most uses of carbon tetrachloride have been discontinued, but the chemical persists for a long time in the environment.

4. The estimated nickel cancer risk was elevated in the more industrialized areas of Detroit and lower at Allen Park, NE Detroit and Ypsilanti, and was lowest at the rural background site of Houghton Lake.

5. The ambient air levels of 9 pollutants were associated with increased cancer risks of greater than 1 in one million at one or more monitoring sites. These 9 substances and their highest estimated risk at any one site are shown in **Table 2**. Seven carcinogens (1,4-dichlorobenzene, acrylonitrile, arsenic, benzene, methylene chloride, naphthalene

Table 2. Risk Bin Changes from DATI-1 to DATI-2

Incremental Increase in Lifetime Cancer Risk	Pollutants from DATI-1	Pollutants from DATI-2
100 to 400 in one million	methylene chloride naphthalene benzene	
10 to 100 in one million	acrylonitrile formaldehyde 1,4-dichlorobenzene arsenic	formaldehyde benzene
1 to 10 in one million	carbon tetrachloride 1,3-butadiene acetaldehyde cadmium nickel	arsenic cadmium* acetaldehyde* 1,3-butadiene* carbon tetrachloride chloroform naphthalene**
0 to 1 in one million	hexavalent chromium chloroform	hexavalent chromium nickel 1,4-dichlorobenzene acrylonitrile methylene chloride

*Although in the same risk bin, concentrations and risks declined from DATI-1
** Not sampled during DATI-2 period. Risk is based on 2005 annual average air concentration

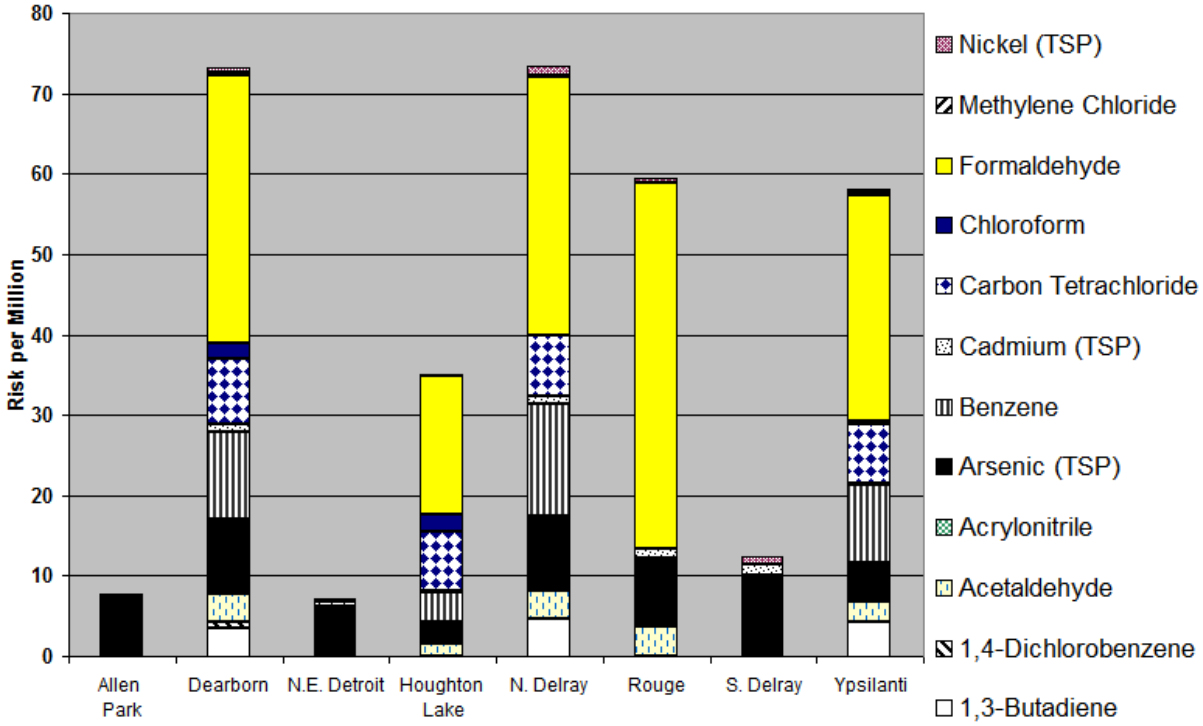
Table 3. Additive Cancer Risk by Monitoring Site

	Cancer Risk per Million	
	DATI-1*	DATI-2
Allen Park	469	8**
S. Delray	296	12**
N. Delray	**221**	**73**
Rouge	125	60**
Southfield	109	*ns*
Dearborn	**94**	**73**
N.E. Detroit	48**	7**
Ypsilanti	35**	58
Houghton Lake	27**	35

* DATI-1 risks shown here do not include those risks attributed to naphthalene exposure (naphthalene was not monitored during DATI-2).
These sites monitored for a more **limited set of air toxics (volatile organic compounds were not measured), and therefore the total air toxics cancer risks for these sites **should not be directly compared** to the total air toxics cancer risks for the other sites.
ns = not sampled

and nickel) showed annual average air concentration decreases during DATI-2 that resulted in their placement in lower risk bins compared to DATI-1. Total (additive) cancer risks for twelve carcinogens ("risk drivers") varied across the Detroit area sites as shown in **Table 3** and **Figure 3**.

Figure 3. DATI-2 Additive Cancer Risk



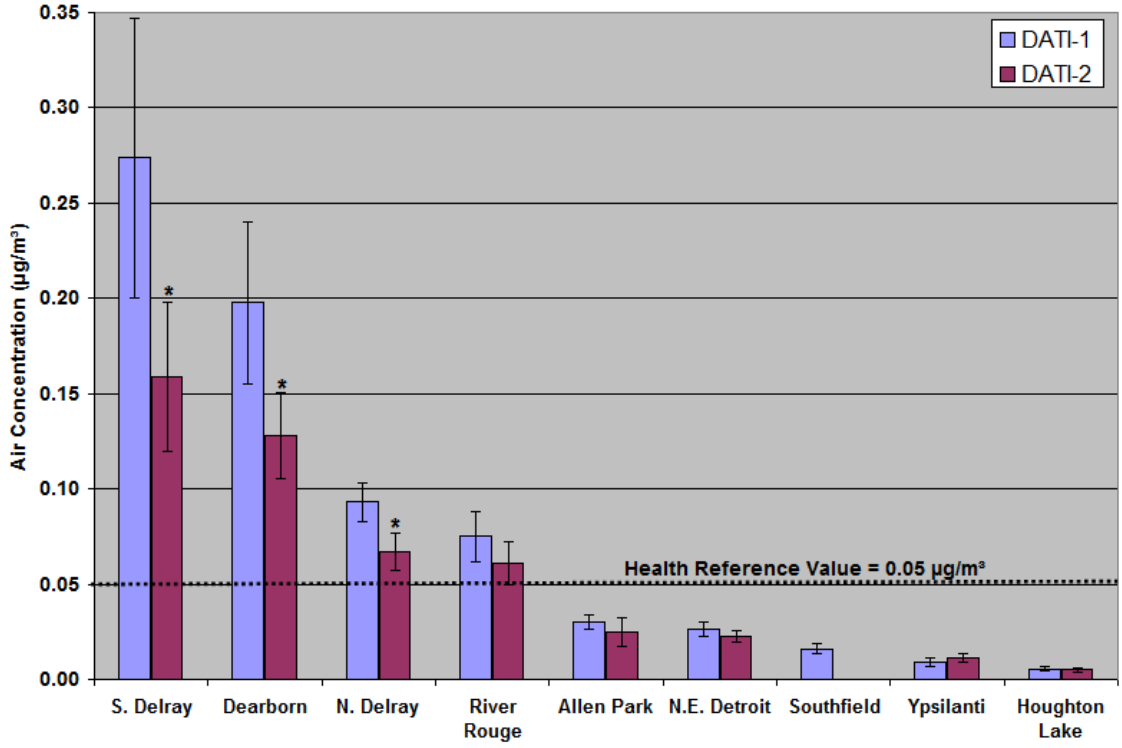
Notes: Not all compounds were sampled at some locations. Allen Park, NE Detroit and S.Delray did not have sampling for VOCs and carbonyls. Site to site comparisons should be made with caution.
The estimates of cancer risk should not be viewed as actual cancer cases resulting from air pollution, but as upper bound estimates of extra risk based on lifetime exposure.

6. Although VOCs were not monitored at South Delray during DATI-2, limited monitoring from October 2004 to October 2005 indicated that the annual average air concentration of benzene at South Delray had decreased from 21 micrograms per cubic meter (µg/m³) during DATI-1 to approximately 8 µg/m³ during this 12-month period.

7. For those pollutants with chronic non-cancer health reference levels, only manganese (in Total Suspended Particulate, TSP) was found at levels above the health reference level. The annual average concentrations of manganese exceeded the chronic non-cancer health reference level at four sites: South Delray, North Delray, Dearborn, and River Rouge. **Figure 4** shows the manganese level at each site in comparison to the health reference level.

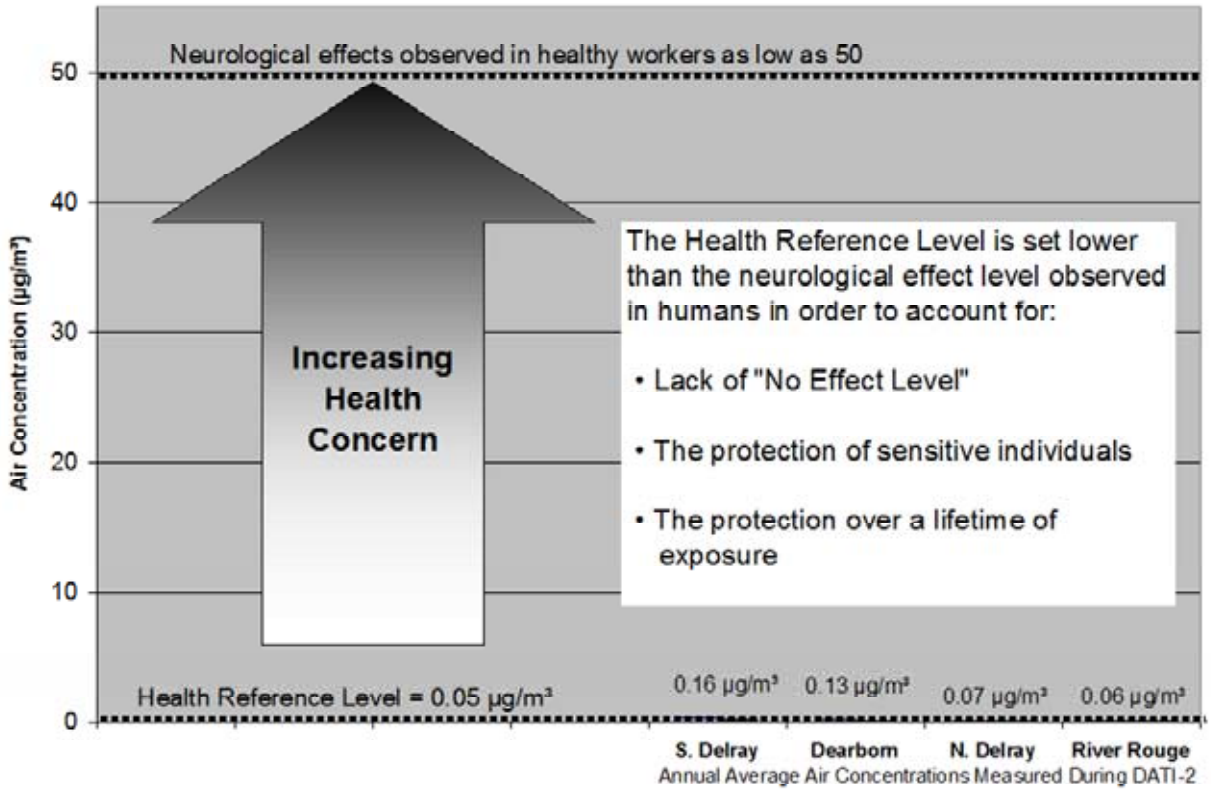
8. Inhalation of manganese at high enough concentrations causes effects to the nervous system. The health reference level is set far enough below the harmful level to help ensure the protection of all people, including sensitive subpopulations (see **Figure 5**). The highest manganese levels observed in the Detroit area are a cause for concern because they are higher than the health reference level, although they are still well below the levels at which effects have been observed in occupational exposure and health studies.

Figure 4. TSP Manganese Air Concentrations During DATI-1 and DATI-2



* Significantly decreased ($p<0.05$) annual air concentration compared to DATI-1.

Figure 5. DATI-2 Exposure Levels and Effects Levels of Manganese



9. Although not found at high enough concentrations in Detroit to be considered a "risk driver", hexavalent chromium (the carcinogenic form of chromium) concentrations were reported. The carcinogenic risk estimated from hexavalent chromium levels was found to be below 1 in one million. Hexavalent chromium constituted 1% of the measured total chromium at Dearborn for both DATI-1 and DATI-2. Based on that finding, chromium and hexavalent chromium levels do not appear to pose a significant public health risk in Detroit.

10. The Detroit-area monitoring data were compared to the findings of other air toxics monitoring initiatives for other cities in the U.S. The comparison indicates that the risk driver pollutants from DATI-2 are similar to other cities across the US.

11. Diesel particulate matter (DPM) was also identified as a compound of concern for the Detroit area due to potential carcinogenic effects. The risks from DPM were not included in the estimates shown in **Tables 2** and **3** and **Figure 3** because of the limited number of sites with monitoring data, and the uncertainty associated with determining DPM concentrations and estimating risks. Nonetheless, cancer risk was estimated at Allen Park based on elemental carbon levels for both DATI-1 and DATI-2. Using a cancer risk estimate from California EPA, the risk from DPM dropped from 300 per million to 200 per million over the DATI-1 – DATI-2 time period.

Continuing Activities

The DNRE will use the results of the DATI-1 and DATI-2 studies to help characterize the air toxics concerns for the public, and for the staff of DNRE and other agencies. The DNRE is continuing to monitor air toxics in the Detroit area in response to the DATI findings. This ongoing monitoring effort will continue to provide the public with air quality measurements, track air quality trends and assist in the development of air pollution abatement strategies.

Conclusions

The risk assessment for the DATI started with monitoring data for over 200 chemicals. From this list of chemicals, thirteen compounds were identified as contributing the most to potential health risks in the Detroit area. These compounds included twelve carcinogenic chemicals (formaldehyde, benzene, arsenic, cadmium, acetaldehyde, 1,3-butadiene, carbon tetrachloride, chloroform, nickel, 1,4-dichlorobenzene, acrylonitrile, and methylene chloride) and one non-carcinogen (manganese). This DATI-2 risk assessment covers 60 chemicals at the same monitoring locations (except the Southfield site), five years after the original DATI project.

The current report shows that levels of most monitored air toxics in the Detroit area declined since the first DATI project, including compounds producing the greatest potential health risks. These chemicals included acrylonitrile, benzene, manganese, methylene chloride and naphthalene. Three reasons are suggested for the decline in air concentrations and subsequent health risks: improved regulatory compliance by industries; decreased vehicle emissions; and, reduced industrial emissions due to the economic downturn. Manganese levels continue to pose a concern since they exceed the health reference value at some sites, although they are well below the levels at which effects have been observed in scientific studies. Diesel particulate matter levels have declined from the DATI-1 to the DATI-2 time periods, yet they still appear to pose a significant cancer risk based on a risk estimation method which is relatively uncertain.

The DATI-1 and DATI-2 Risk Assessment Reports provide useful information, however, it should be noted that risk estimates in these studies represent a "snapshot" in time, and do not reflect risks from past or future exposures to air toxics. Furthermore, there are uncertainties in the estimation of exposure levels and with the limited information available on potential health effects of air toxics alone and in combination with other air pollutants. These studies help identify air toxics of greatest concern in the Detroit area, and are useful for prioritizing future risk reduction efforts.