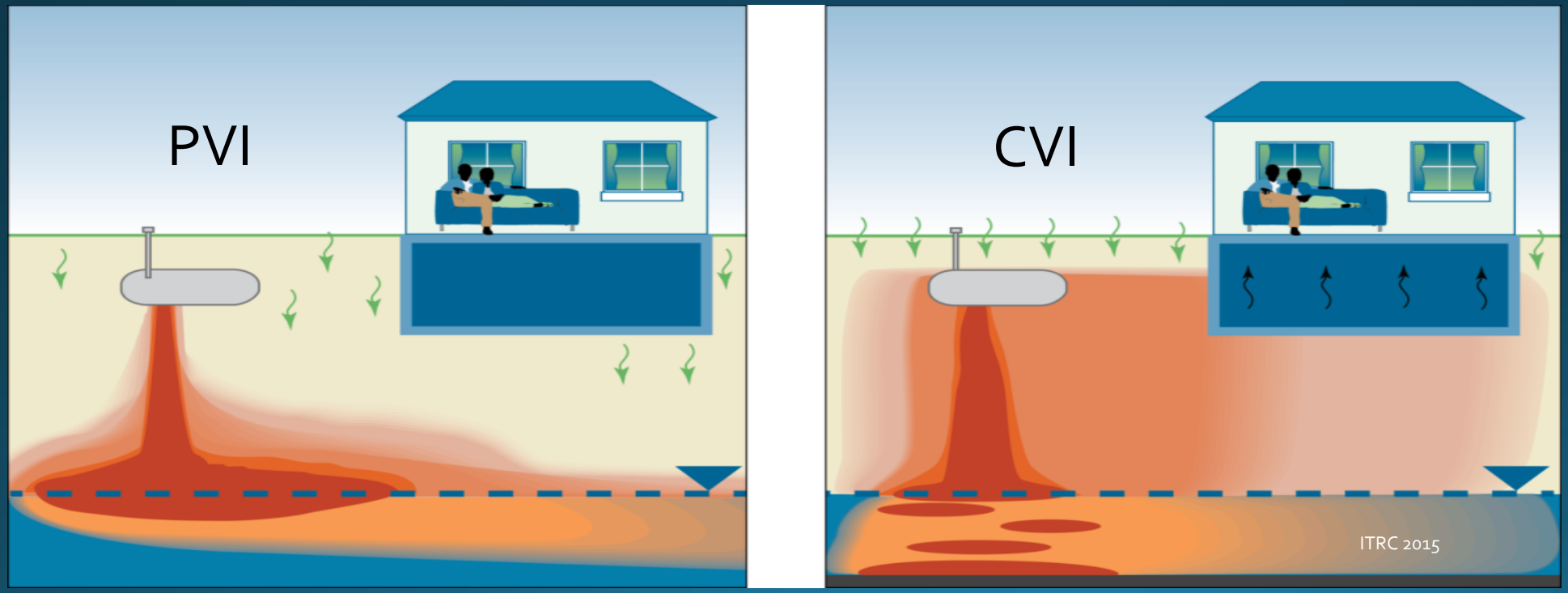
Lisa Quiggle MDHHS

Vapor Intrusion

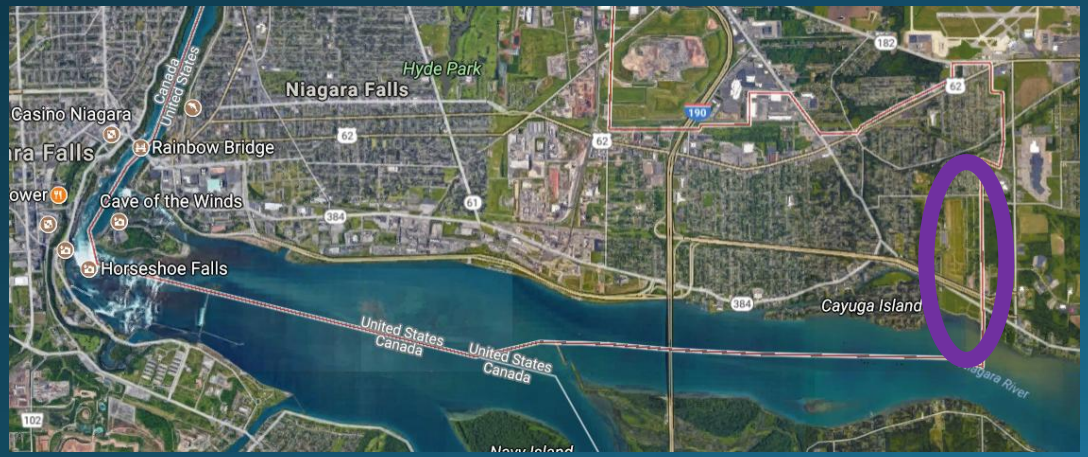
Types of Vapor Intrusion

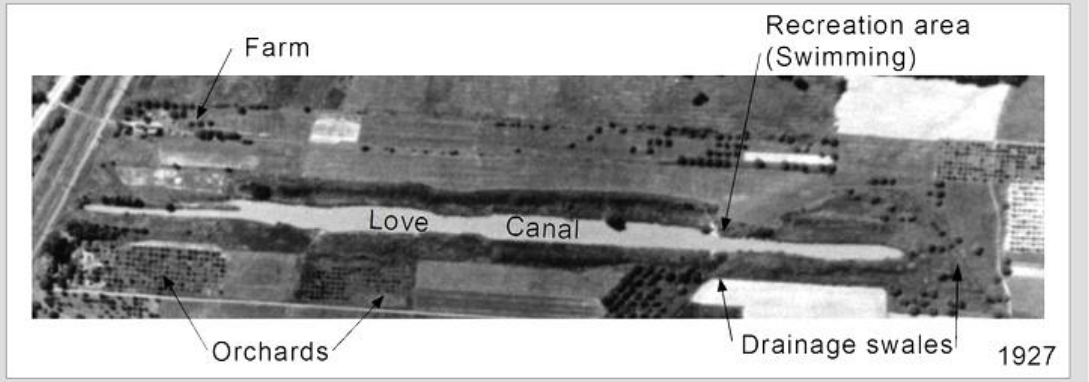
- Petroleum Vapor Intrusion (PVI)
- Chlorinated Vapor Intrusion (CVI)

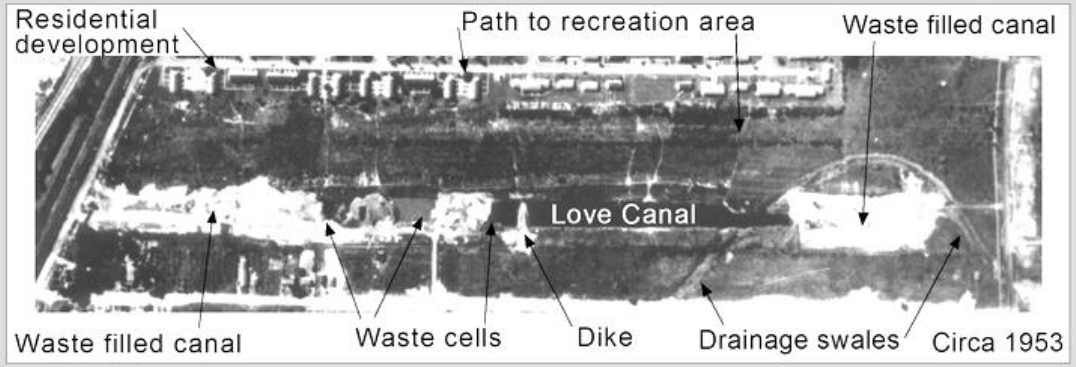


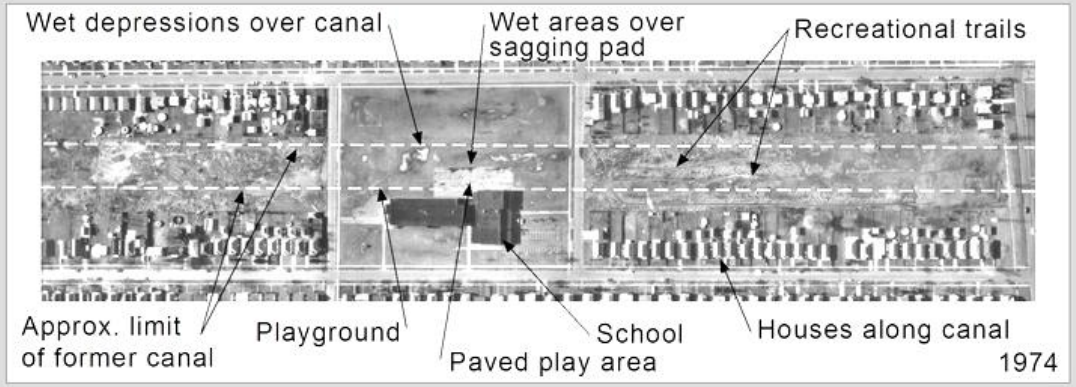
Why Now?

Love Canal



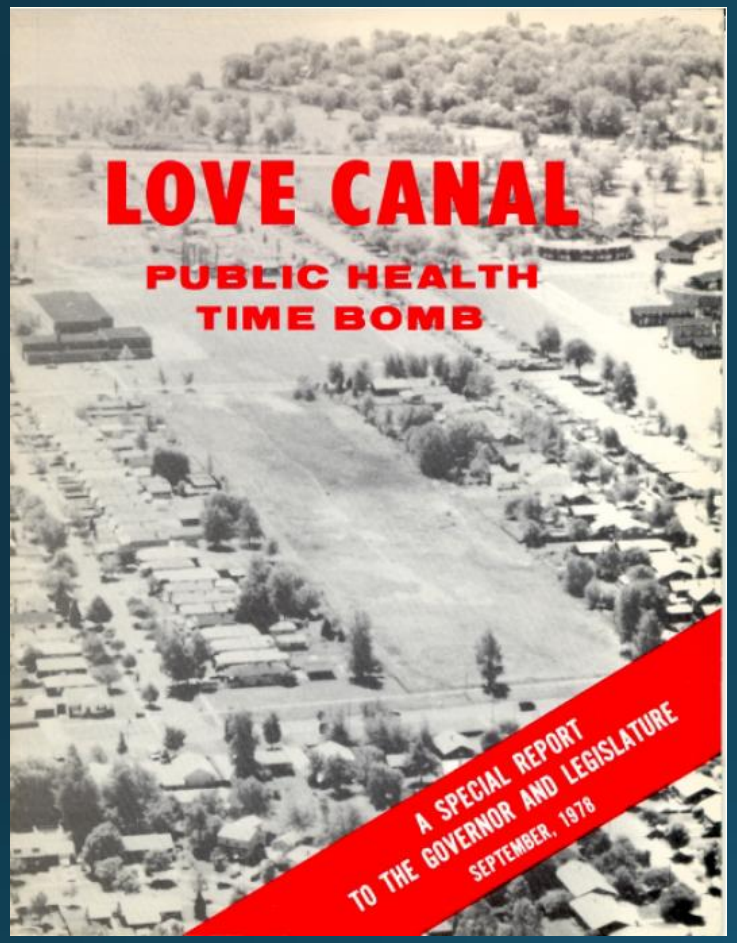






Aerial photographs interpreted by expert witness, Dr. Sam Gowan, on behalf of Occidental/Hooker during Love Canal trial, 1991.

Love Canal



Report prepared by:

THE OFFICE OF PUBLIC HEALTH
Roger C. Herdman, M.D., Director

State of New York
Hugh L. Carey
Governor

...erns prompted the Health Department to give priority to evaluating basement air samples from all homes contiguous to the Canal, before ground and surface water samples, to minimize the risk of chemicals entering the human body by inhalation.

As data flowed in, it became evident that unacceptable levels of toxic vapors associated with more than 80 compounds were emanating from the basements of many homes in the first ring directly adjacent to the Love Canal. (See Figure 1) Ten of the most prevalent and most toxic compounds - including benzene, a known human carcinogen - were selected for evaluation purposes and as indicators of the presence of other chemical constituents.

19. Air samples to monitor 10 selected compounds were taken by the Division of Laboratories and Research of the State Health Department in July 1978 from the basements of 88 houses peripheral to those built adjacent to the landfill site with the following results:

COMPOUNDS	NO. OF TIMES FOUND IN HOUSES	PERCENT OF TOTAL HOUSES SAMPLED	HIGHEST VALUE OBSERVED
Chloroform	23	26	24 ug/m3
Benzene	20	23	270 ug/m3
Trichloroethene	74	84	73 ug/m3
Toluene	54	61	570 ug/m3
Tetrachloroethene	82	93	1140 ug/m3
Chlorobenzene	6	7	240 ug/m3
Chlorotoluene	32	36	6700 ug/m3
m+p xylene	35	40	140 ug/m3
o-xylene	17	19	73 ug/m3
Trichlorobenzene	11	13	74 ug/m3

6.0 ug/m3

In Response

December 1970

The US Environmental Protection Agency was created by executive order

October 21, 1976

Resource Conservation and Recovery Act (RCRA)

- Set requirements for landfills
- Requirements for hazardous wastes “Cradle to Grave”
- Regulated underground storage tanks

In Response

December 1980

The Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) –

- Created Superfund – “Joint and Several”
- Triggers from mismanagement of wastes
- Authorizes EPA to respond to chemical releases or a contaminant that presents an imminent and substantial treat to human health

Recent Changes

- 2011 - USEPA's Integrated Risk Information System (IRIS) established a lower *trichloroethylene* (TCE) Inhalation Reference Concentration for short term exposures
- December 2012 – USEPA issued a directive that all Superfund sites would be reviewed for VI during the five year review cycle

Reproductive Toxicology 65 (2016) 321–358

Contents lists available at ScienceDirect

Reproductive Toxicology

journal homepage: www.elsevier.com/locate/reprotox

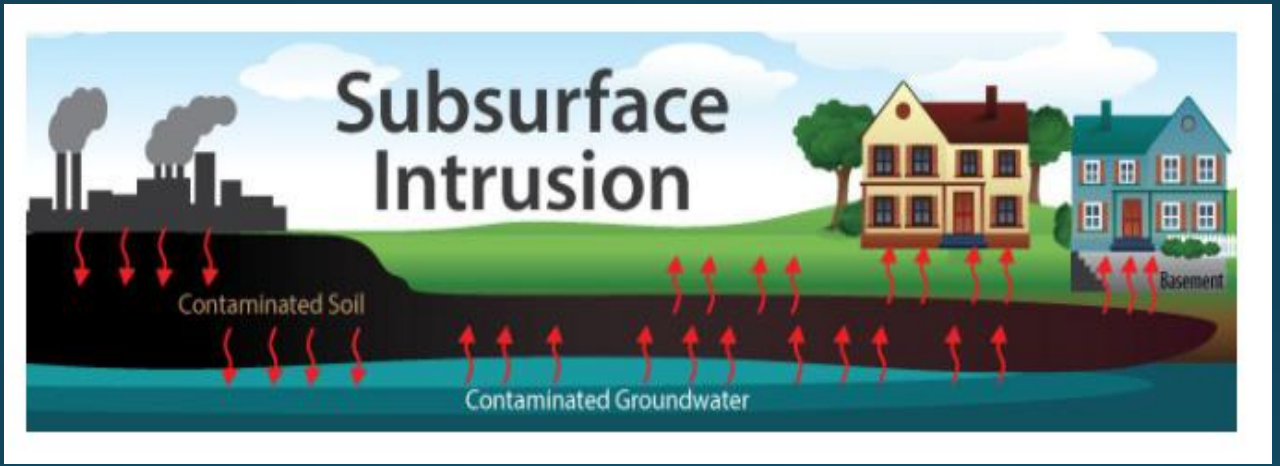
Review

A systematic evaluation of the potential effects of trichloroethylene exposure on cardiac development

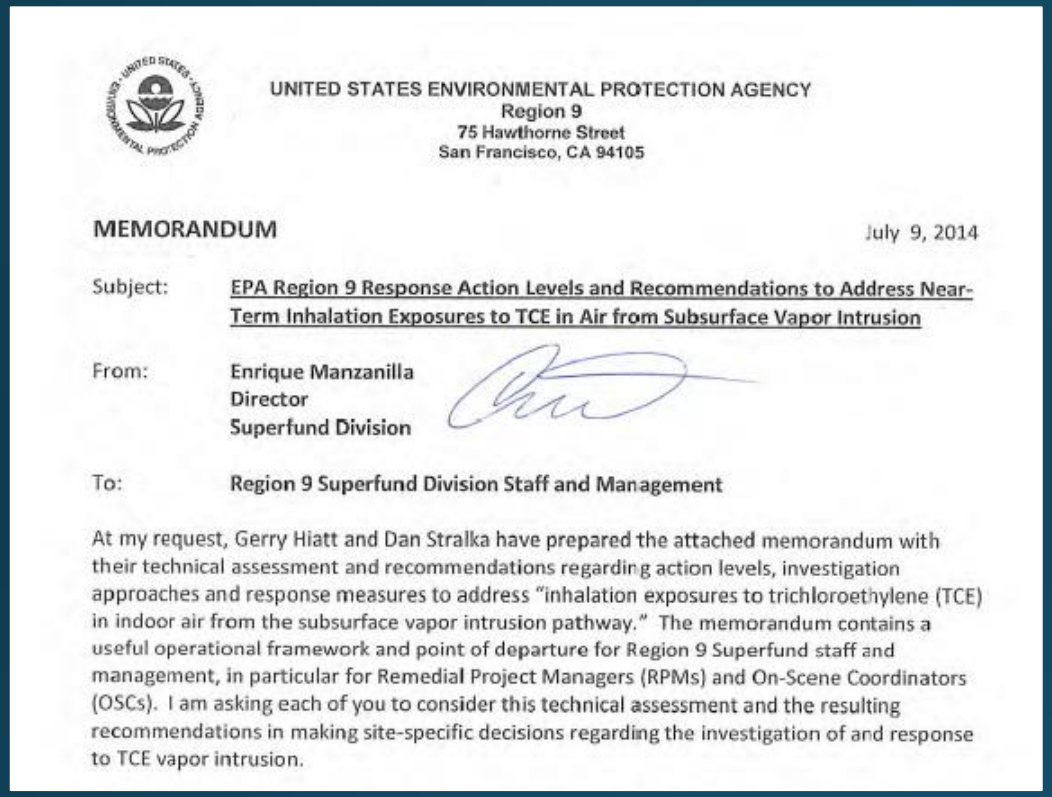
Susan L. Makris[a,*], Cheryl Siegel Scott[a], John Fox[a], Thomas B. Knudsen[d],

A hypothesis-driven weight-of-evidence analysis of epidemiological, toxicological, in vitro, in ovo, and mechanistic/AOP data concluded that TCE has the potential to cause cardiac defects in humans when exposure occurs at sufficient doses during a sensitive window of fetal development. The study by Johnson et al. [51] was reaffirmed as suitable for hazard characterization and reference value derivation, though acknowledging study limitations and uncertainties.

Hazard Ranking System Subsurface Intrusion Component



- May 22, 2017 – US EPA rules took effect to include a VI evaluation in new Superfund listings.



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
Region 9
75 Hawthorne Street
San Francisco, CA 94105

MEMORANDUM

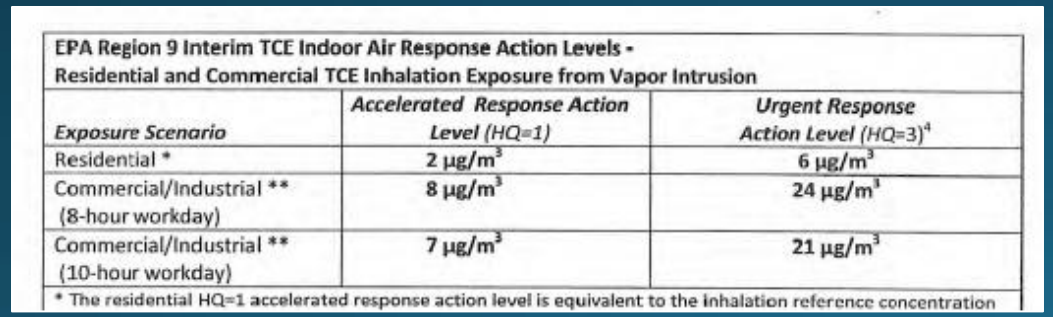
July 9, 2014

Subject: EPA Region 9 Response Action Levels and Recommendations to Address Near-Term Inhalation Exposures to TCE in Air from Subsurface Vapor Intrusion

From: Enrique Manzanilla
Director
Superfund Division

To: Region 9 Superfund Division Staff and Management

At my request, Gerry Hiatt and Dan Stralka have prepared the attached memorandum with their technical assessment and recommendations regarding action levels, investigation approaches and response measures to address "inhalation exposures to trichloroethylene (TCE) in indoor air from the subsurface vapor intrusion pathway." The memorandum contains a useful operational framework and point of departure for Region 9 Superfund staff and management, in particular for Remedial Project Managers (RPMs) and On-Scene Coordinators (OSCs). I am asking each of you to consider this technical assessment and the resulting recommendations in making site-specific decisions regarding the investigation of and response to TCE vapor intrusion.



EPA Region 9 Interim TCE Indoor Air Response Action Levels - Residential and Commercial TCE Inhalation Exposure from Vapor Intrusion		
Exposure Scenario	*Accelerated Response Action Level (HQ=1)*	*Urgent Response Action Level (HQ=3)*[4]
Residential *	2 µg/m^3	6 µg/m^3
Commercial/Industrial ** (8-hour workday)	8 µg/m^3	24 µg/m^3
Commercial/Industrial ** (10-hour workday)	7 µg/m^3	21 µg/m^3

* The residential HQ=1 accelerated response action level is equivalent to the inhalation reference concentration

July 9, 2014 – US EPA issued guidance to take an *accelerated* response and an *urgent* response for TCE from vapor intrusion.

What is a Hazard Quotient (HQ)

- Trichloroethylene (TCE) as an example:
  - TCE has an uncertainty (safety) factor used in deriving an MRL
  - The uncertainty factor is 90
    - A factor of 10 for the use of a lowest observed adverse effect level
    - A factor of 3 for interspecies extrapolation (rat study to human)
    - A factor of 3 for human variability
- At HQ of 1 the uncertainty factor is 90
- At HQ of 3 the uncertainty factor is 30

EPA Vapor Intrusion Screening Level (VISL) Calculator

OSWER VAPOR INTRUSION ASSESSMENT

Vapor Intrusion Screening Level (VISL) Calculator Version 3.4, November 2015 RSLs

The primary objective of risk-based screening is to identify sites or buildings unlikely to pose a health concern tion pathway. Generally, at properties where subsurface concentrations of vapor-forming chemicals (e.g., groundwater or "near source" soil gas concentratio levels (i.e., VISLs), no further action or study is warranted, so long as the exposure assumptions match those taken into account by the calculations and the site nd assumptions of the generic conceptual model underlying the screening levels. In a similar fashion, the results of risk-based screening can help the data revie uildings, and/or chemicals that can be eliminated from further assessment. The generic conceptual model underlying these screening levels is described in OSW 154 (OSWER Technical Guide for Assessing and Mitigating the Vapor Intrusion Pathway From Subsurface Vapor Sources to Indoor Air) (EPA 2015; Section 6.5)

Parameter	Value	Instructions
Exposure Scenario	Residential	Select residential or commercial scenario from pull down list
Target Risk for Carcinogens	1.00E-05	Enter target risk for carcinogens
Target Hazard Quotient for Non-Carcinogens	1	Enter target hazard quotient for non-carcinogens
Average Groundwater Temperature (°C)	25	Enter average of the stabilized groundwater temperature to cor

View All Chemicals

View Checked Chemicals

	CAS	Chemical Name	Does the chemical meet the definition for volatility? (HLC>1E-5 or VP>1) Yes/No	Does chemical have inhalation toxicity data? (IUR and/or RfC) Yes/No	Sufficiently Volatile and Toxic to Pose Inhalation Risk Via Vapor Intrusion from Groundwater Source? Chc > Cia,target? Yes/No	Target Indoor Air Conc. @ TCR = 10E-06 or THQ = 1 MIN(Cia,c;Cia,n (ug/m³)	Toxicity Basis C/NC	Target Sub-Slab and Exterior Soil Gas Conc. @ TCR = 10E-06 or THQ = 1 Csg (ug/m³)	Target Ground Water Conc. @ TCR = 10E-06 or THQ = 1 Cgw (ug/L)
x	127-18-4	Tetrachloroethylene	Yes	Yes	Yes	4.2E+01	NC	1.4E+03	5.8E+01
x	79-01-6	Trichloroethylene	Yes	Yes	Yes	2.1E+00	NC	7.0E+01	5.2E+00

DHHS & DEQ Action & Trigger Levels

Table of Action and Trigger Levels for vapor intrusion sites (pending MDHHS & MDEQ consensus interim values)

	Residential, Mixed Use, Sensitive Populations			Commercial		
Analyte	Indoor air (µg/m³)/ppbv	Subslab soil gas (µg/m³)/ppbv	Groundwater (µg/L)	Indoor air (µg/m³)/ppbv	Subslab soil gas (µg/m³)/ppbv	Groundwater (µg/L)
1,4-Dichlorobenzene	(2.6)/0.43	(85)/14	26	(11)/1.8	(370)/62	110
	(2.6)/0.43	(85)/14	26	(11)/1.8	(370)/62	110
cis-1,2 Dichloroethene[1]	(8.3)/2.0	(280)/71	50	(35)/8.8	(1,200)/300	210
	(25)/6.3	(830)/210	150	(100)/26	(3,500)/880	620
trans-1,2 Dichloroethene[1]	(83)/21	(2,800)/710	220	(350)/88	(11,700)/3,000	920
	(250)/63	(8,300)/2,100	660	(1,100)/260	(35,000)/8,800	2,800
Tetrachloroethylene (PCE)	(42)/6.0[2]	(1,400)/206	58	(180)/27	(5,800)/860	240
	(110)/16	(3,600)/530	150	(470)/69	(16,000)/2,360	650
1,2,3-Trimethylbenzene, 1,2,4-Trimethylbenzene, and 1,3,5-Trimethylbenzene	(63)/13	(2,100)/420	170	(260)/53	(9,000)/1,800	730
	(188)/38	(6,300)/1,300	520	(790)/160	(26,000)/5,300	2,200
1,1,1-Trichloroethane	(5,200)/950	(170,000)/31,000	7,400	(22,000)/4,000	(730,000)/130,000	31,000
	(16,000)/2,900	(520,000)/95,000	22,000	(66,000)/12,100	(2,200,000)/400,000	93,000
Trichloroethylene (TCE)	(2.1)/0.4	(70)/13	5.2	(8.8)/1.6	(290)/54	22
	(4.8)/0.89	(160)/30	12	(26)/4.8	(880)/160	65
Vinyl Chloride (VC)	(1.7)/0.67	(56)/22	1.5	(28)/11	(930)/360	25
	(1.7)/0.67	(56)/22	1.5	(28)/11	(930)/360	25

Calculated using the USEPA OSWER Vapor Intrusion Assessment Calculator unless noted.
Peach/orange (top line for each chemical) = Action level: No Further Action if sub-slab is below, collect indoor air if sub-slab is above, mitigation if indoor air is above; based on ELCR 1 in 100,000 HQ of 1
Yellow (bottom line for each chemical) = Trigger level: Evacuation if indoor air is above; ELCR 1 in 100,000 HQ of 3

Notes:

1. Calculated using the U.S. EPA RSL calculator for indoor air with MDEQ-derived Reference Concentrations (8 µg/m³ for cis and 80 µg/m³ for trans); indoor air values were adjusted using the attenuation factor of 0.03 for subslab soil gas levels; groundwater levels were calculated using the equation provided in the U.S. EPA's Vapor Intrusion Screen Level Calculator User Guide. (Groundwater screening level = Indoor air levels /[Henry's Law Constant x attenuation factor groundwater x 1000L/m³]).
2. Adjusted to match the Agency for Toxic Substances and Disease Registry inhalation acute, intermediate, and chronic Minimal Risk Levels for tetrachloroethylene (PCE)

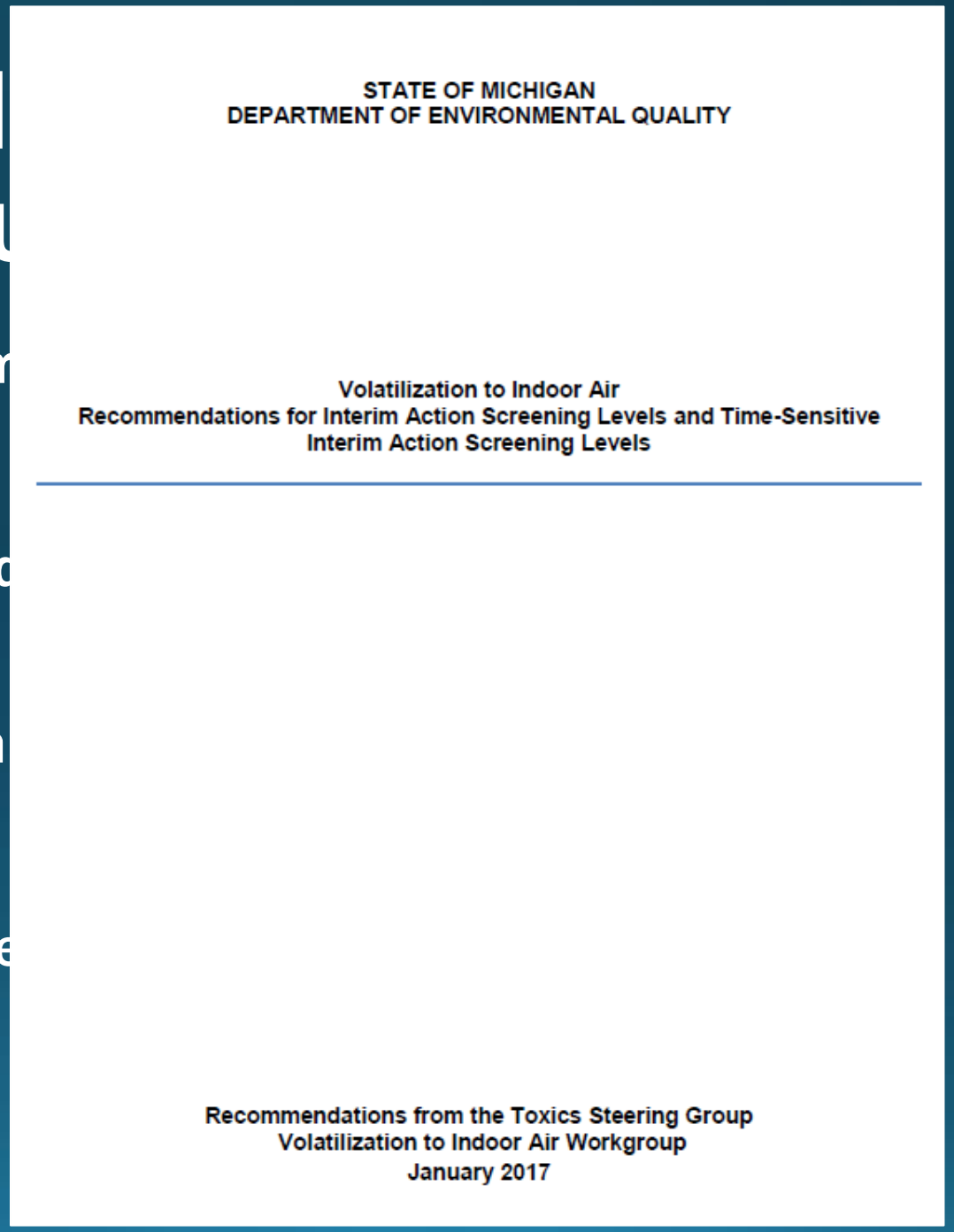
DH
Consensu

**Recommended Interim
(RIASLs)**

- If RIASLs are exceed
  within a few days

**Time-Sensitive Interim
(TSRIASLs)**

- If TSRIASLs are exce
  be taken, up to and



STATE OF MICHIGAN
DEPARTMENT OF ENVIRONMENTAL QUALITY

Volatilization to Indoor Air
Recommendations for Interim Action Screening Levels and Time-Sensitive Interim Action Screening Levels

Recommendations from the Toxics Steering Group
Volatilization to Indoor Air Workgroup
January 2017

VI Sampling

Begin with groundwater

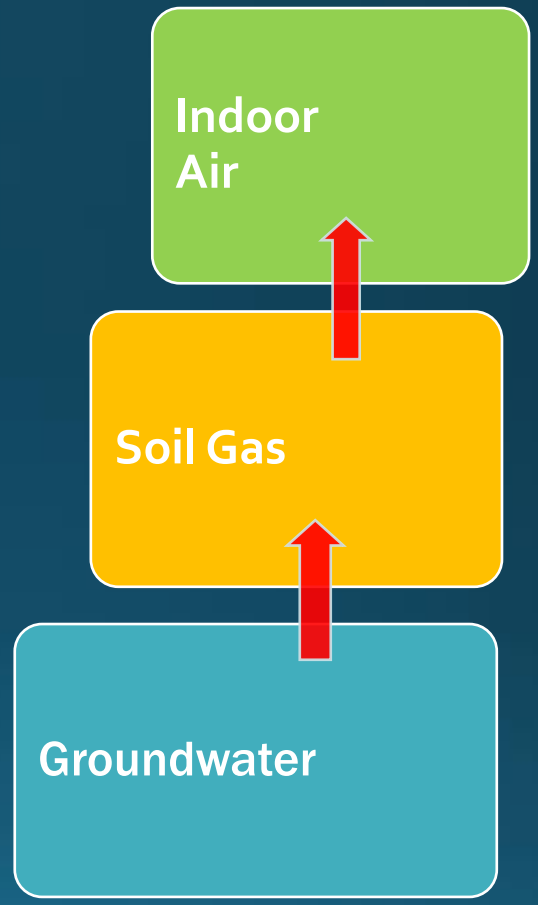
- Above RIASL, test soil gas

Test soil gas

- Above RIASL, test indoor air

Use indoor air results for public health decisions

- Above RIASL take actions within a few days
- Above TSRIASL take immediate actions



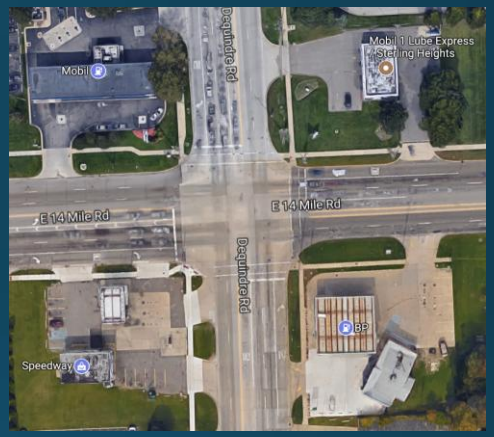
MICHIGAN

Michigan Unique Issues

Manufacturing boom in 1900's – many smaller industrial buildings adjacent to residential areas

Large proportion of single family homes

Automobile economy



Google Maps

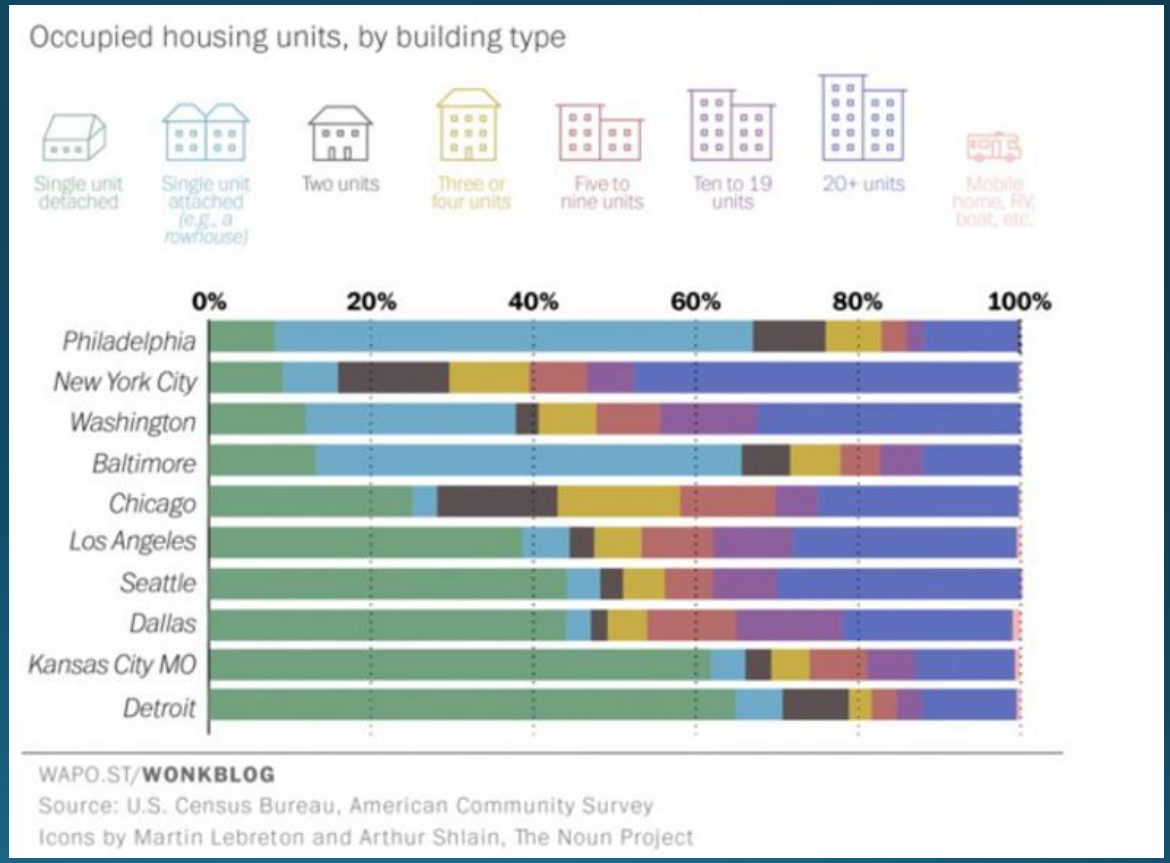
Manufacturing sites spread throughout the state due to the abundant groundwater

Geology - Clay in southeast Michigan, sand in west

Michigan Unique Issues

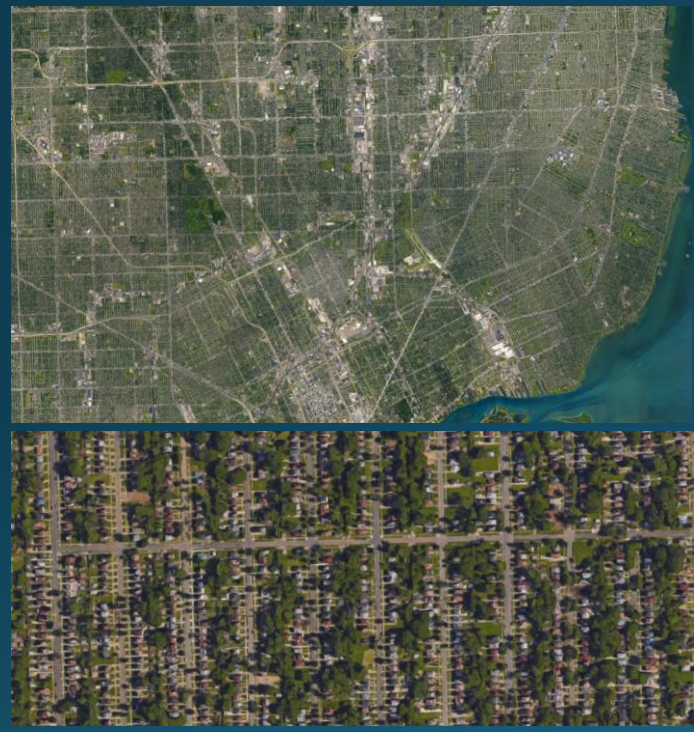
High Percentage of Single Family Homes

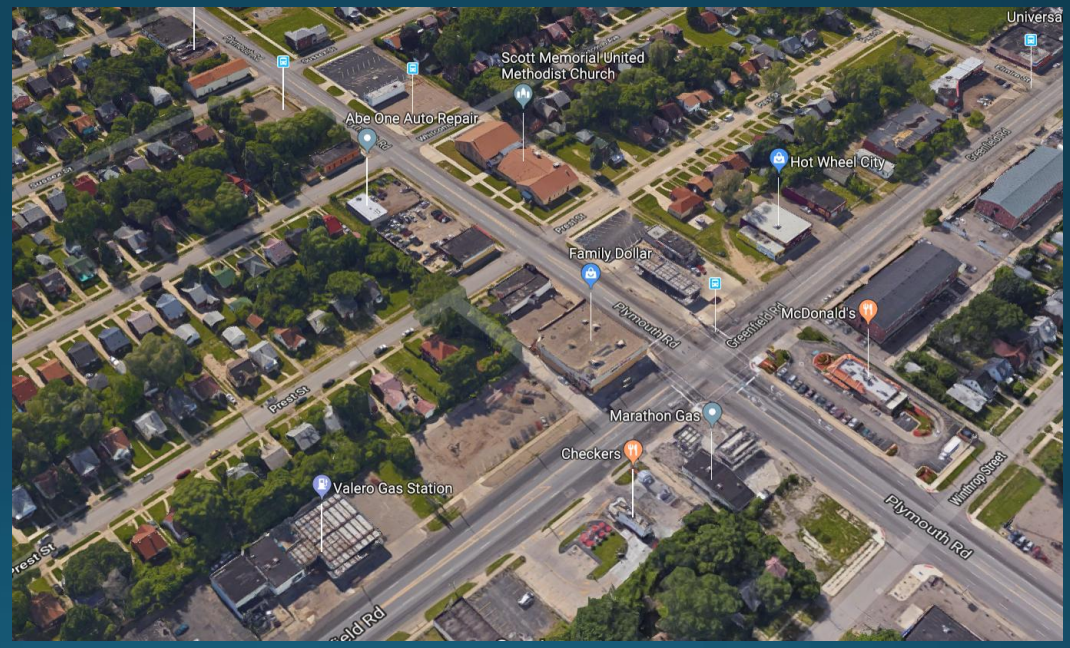
US Population Rank	City	1950 Population
1	New York	7,891,957
2	Chicago	3,620,962
3	Philadelphia	2,071,605
4	Los Angeles	1,970,358
5	Detroit	1,849,568
6	Baltimore	949,708



Michigan Unique Issues

High Percentage of Single Family Homes

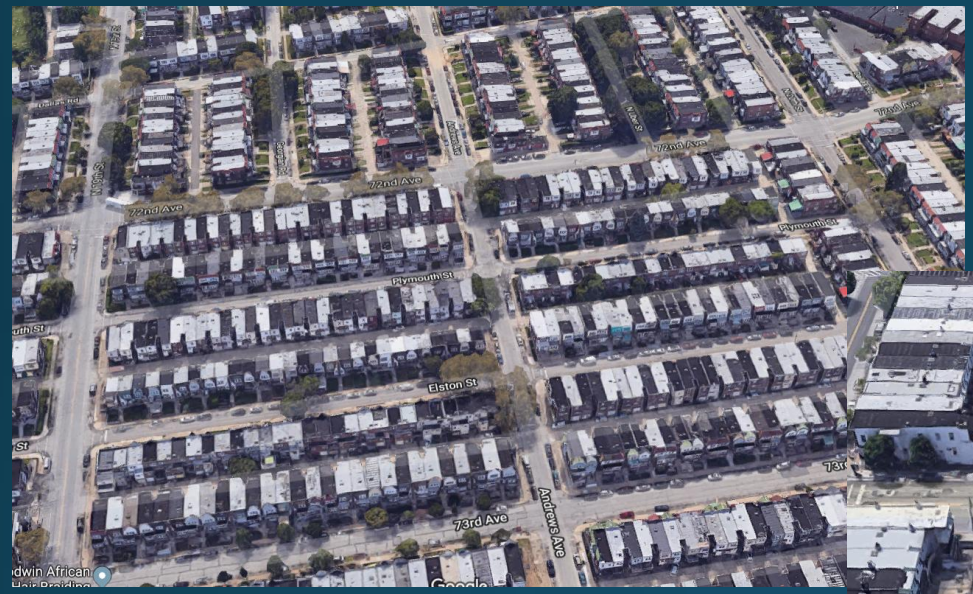




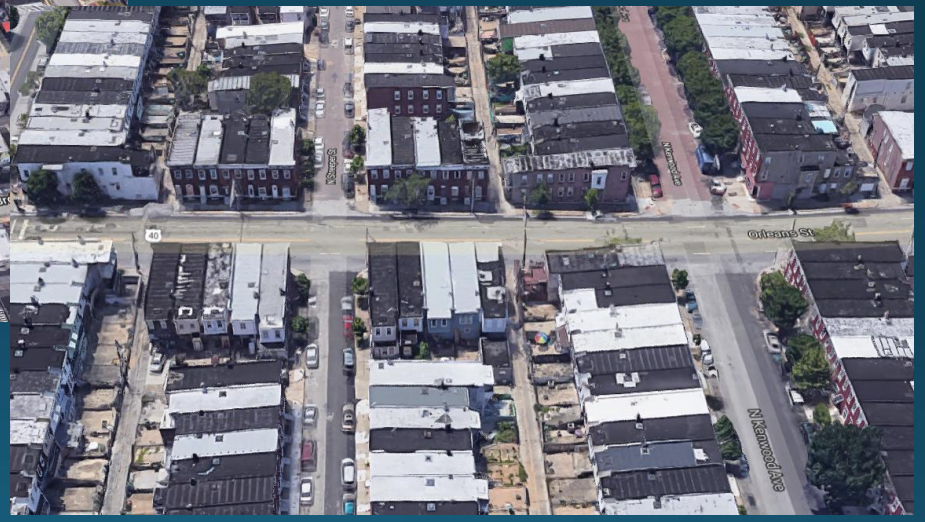
From Google Maps

Detroit

Michigan Unique Issues



Philadelphia

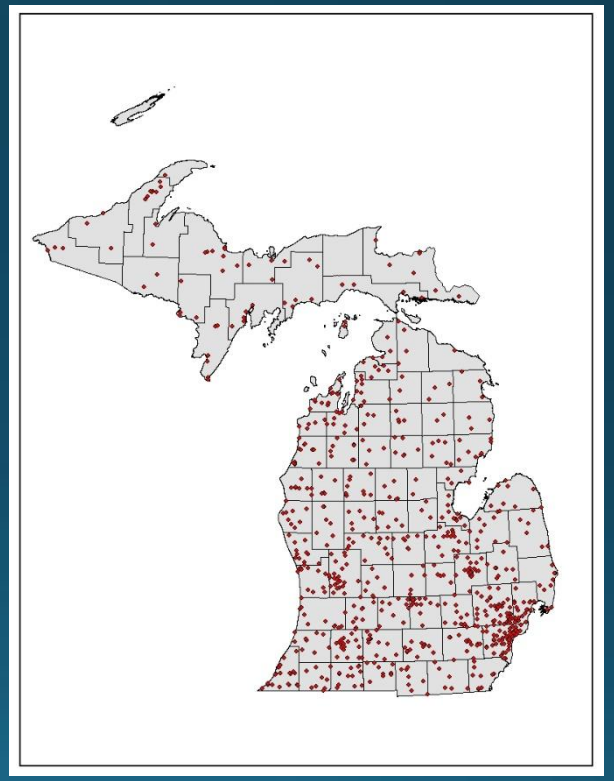


From Google Maps

Baltimore

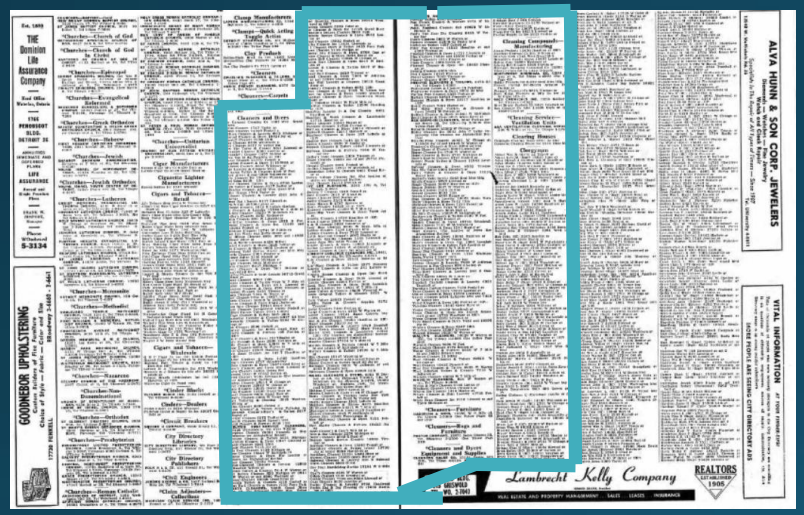
Michigan - Known Sites of Reported Chlorinated and Petroleum Releases

- Between 3,000 and 4,000 *reported* releases
- Over 200 regulated hazardous waste facilities
- 65 Superfund Sites



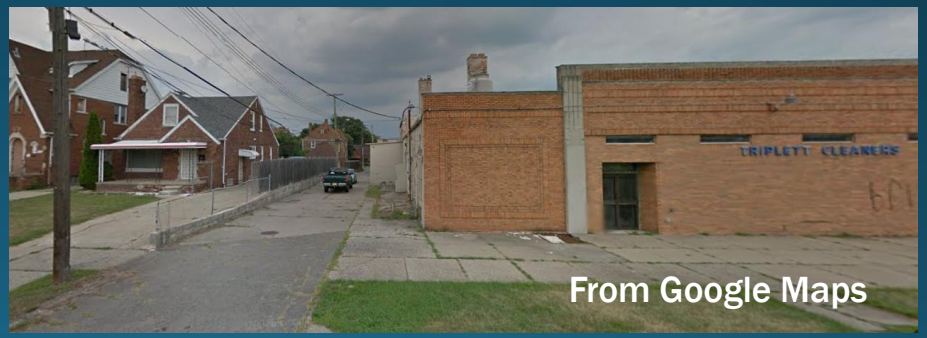
Michigan Unique Issues

Polk City Directory –
Detroit 1958 – West side



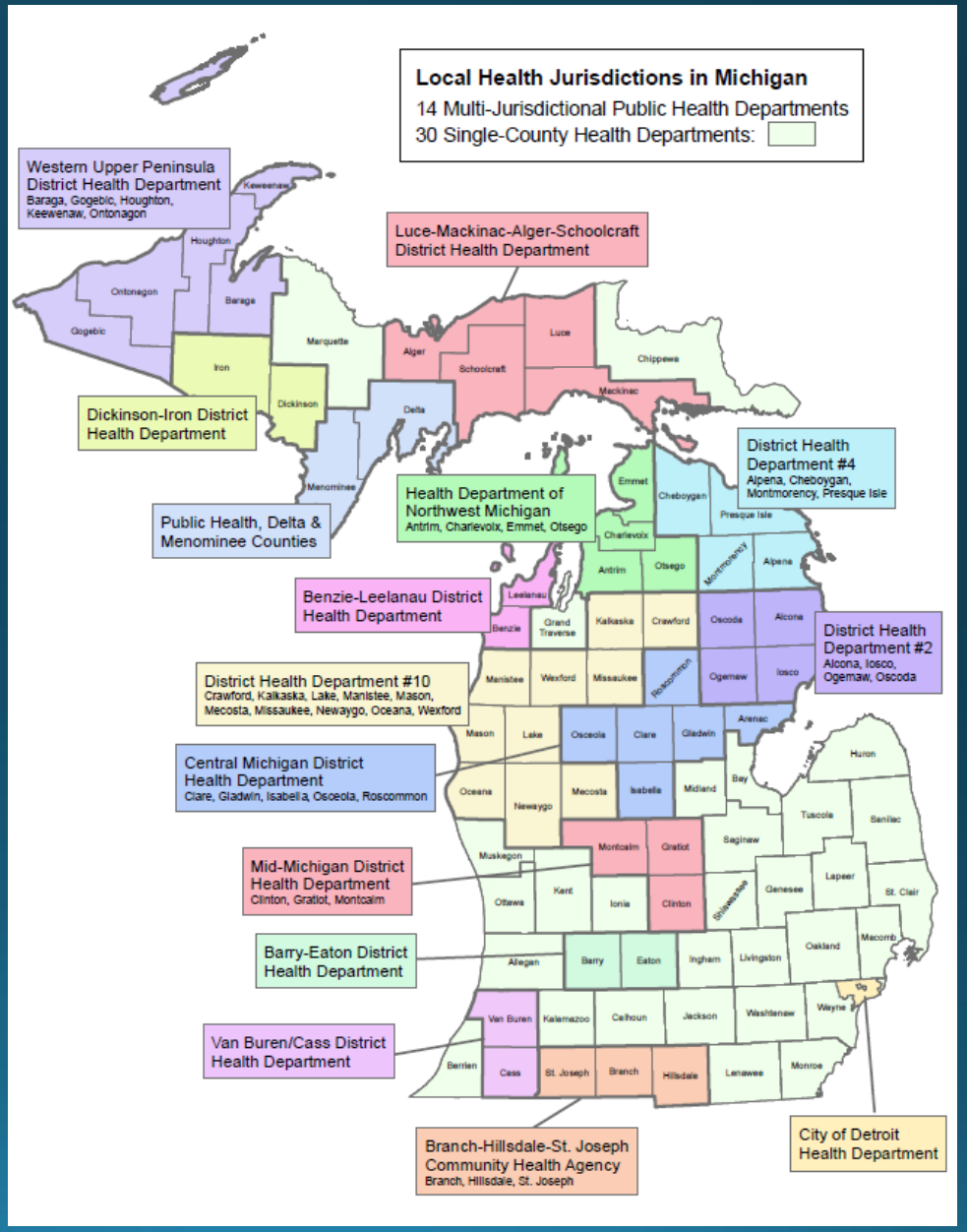
Source: DB Stephens & Associates

Over 300 dry cleaners on the west side of Detroit in 1958!!!



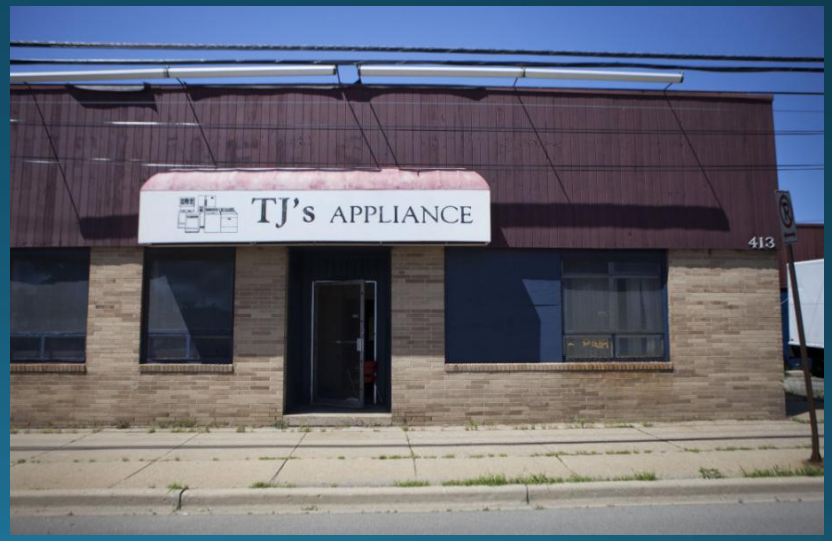
Public Health Role

Michigan Local Health Departments



Evacuations

- Local Health Department has the authority to issue evacuation orders
- Use of the public health code
- Occupancy restrictions



Public Health Code

PUBLIC HEALTH CODE (EXCERPT)
Act 368 of 1978

333.2433 Local health department; powers and duties generally.

Sec. 2433.

(1) A local health department shall continually and diligently endeavor to prevent disease, prolong life, and promote the public health through organized programs, including prevention and control of environmental health hazards; prevention and control of diseases; prevention and control of health problems of particularly vulnerable population groups; development of health care facilities and health services delivery systems; and regulation of health care facilities and health services delivery systems to the extent provided by law.

Public Health Code

PUBLIC HEALTH CODE (EXCERPT)
Act 368 of 1978

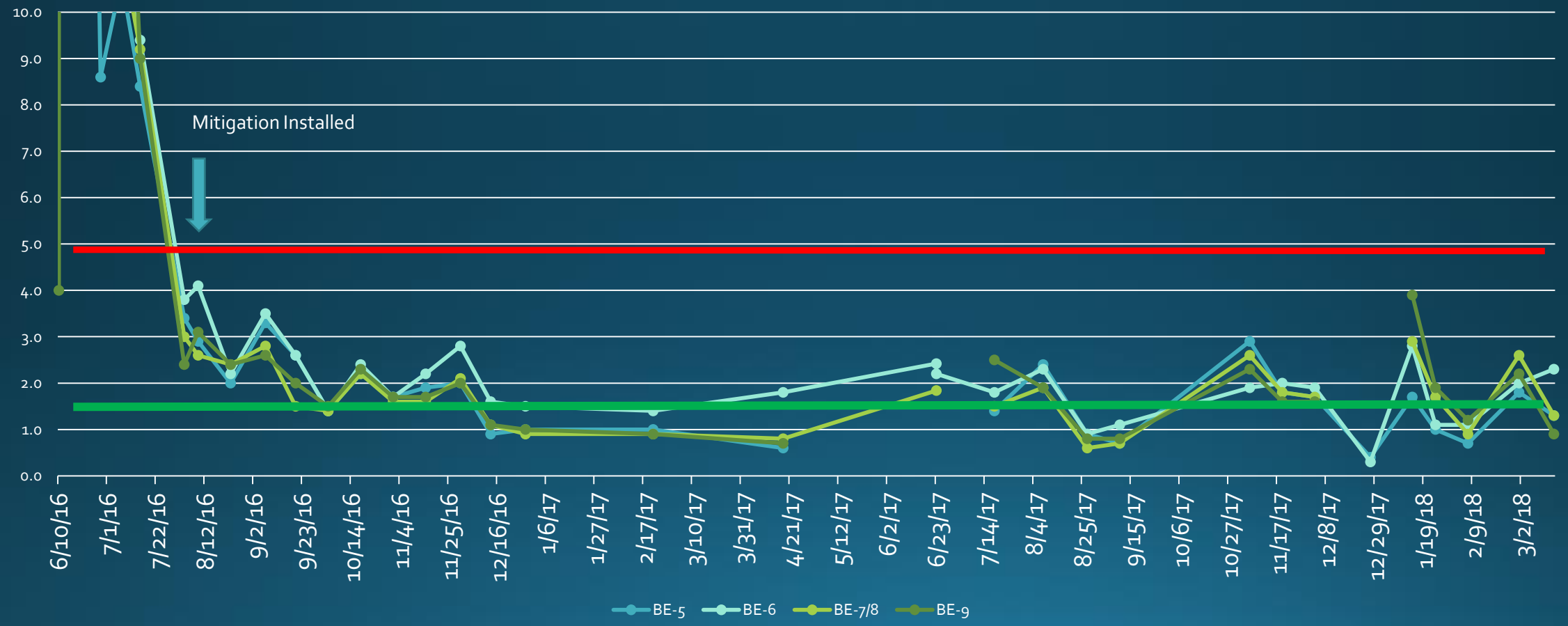
333.2455 Building or condition violating health laws or constituting nuisance, unsanitary condition, or cause of illness; order; noncompliance; warrant; assessment and collection of expenses; liability; judicial order; other powers not affected.

Sec. 2455.

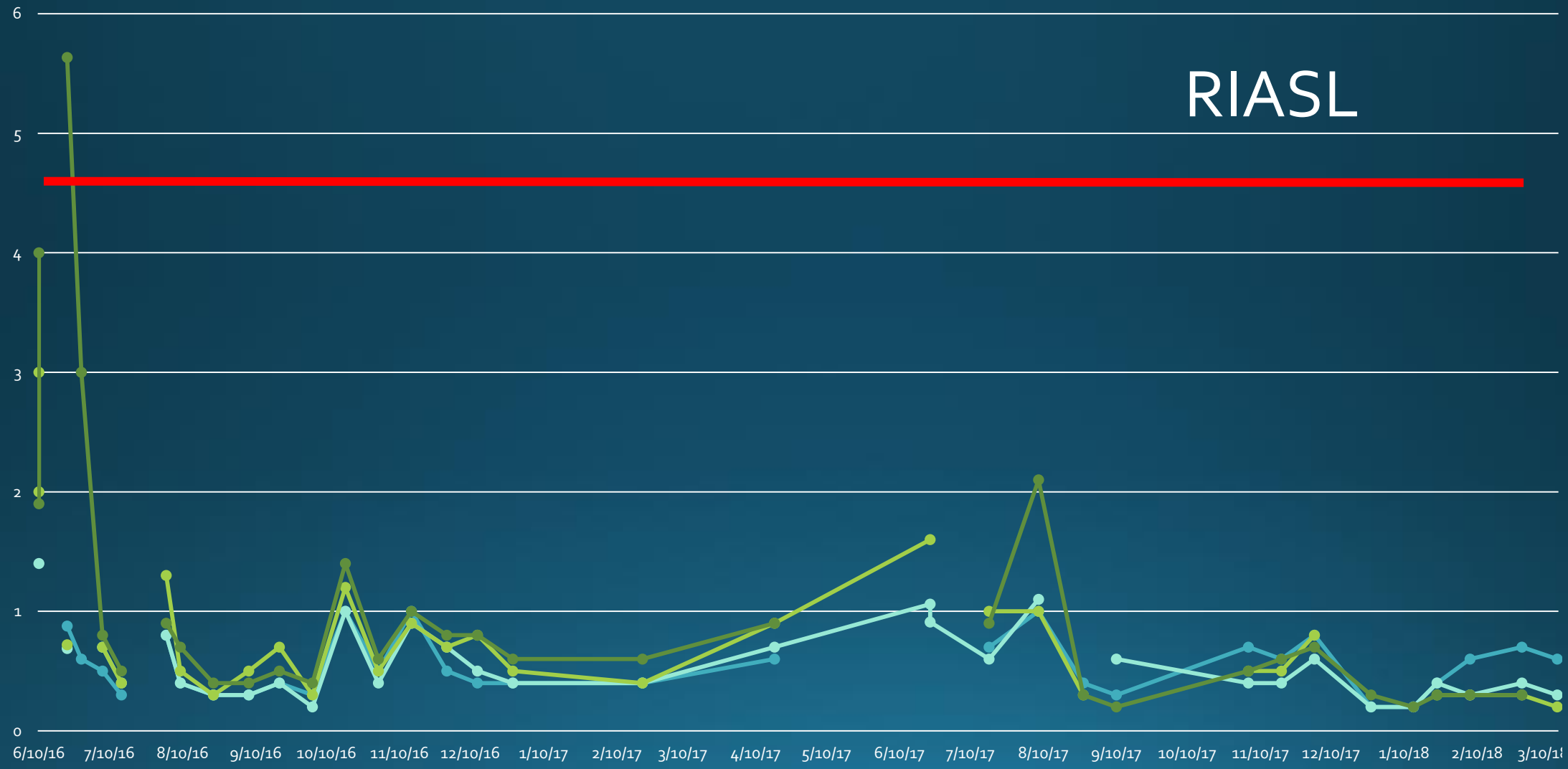
(1) A local health department or the department may issue an order to avoid, correct, or remove, at the owner's expense, a building or condition which violates health laws or which the local health officer or director reasonably believes to be a nuisance, unsanitary condition, or cause of illness.

Data Trends

TCE Commercial Building Mitigation System Installed ppb



Benzene Background in Commercial Building in ppb



Questions?