



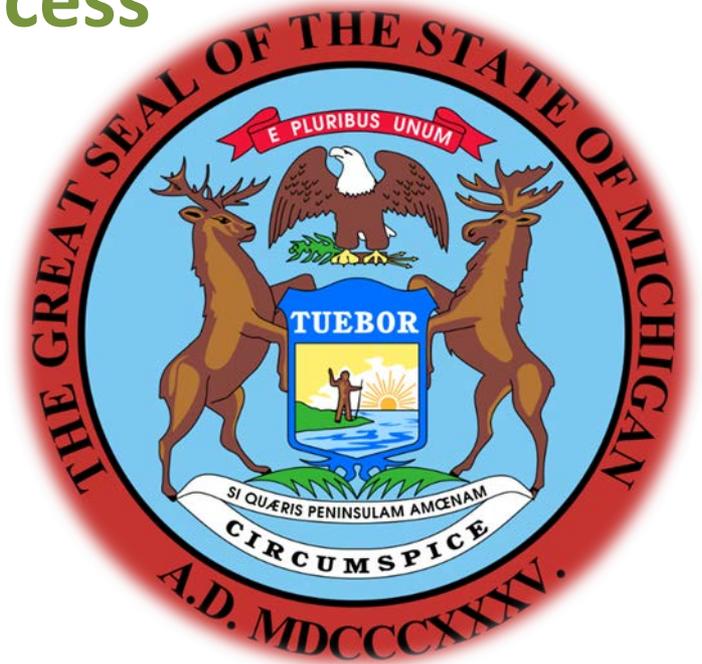
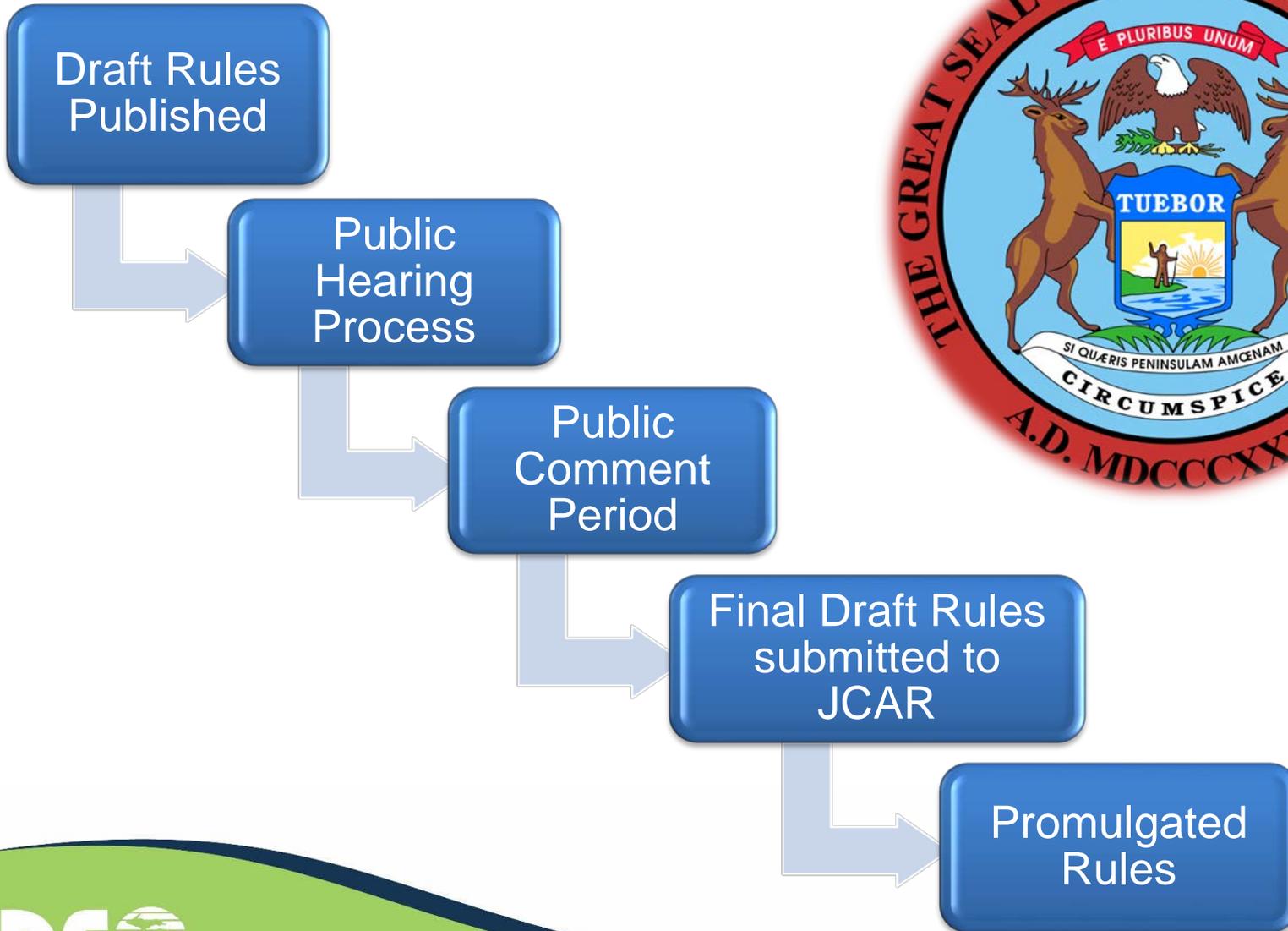
# Cleanup Criteria Rules

2017

## INFORMATION SESSIONS Overview

Susan Leeming, Deputy Director  
Michigan Department of Environmental Quality

# Rules Promulgation Process



# Cleanup Criteria Rules Overview

- Scope of Rule Changes
  1. Revisions & Reorganization
  2. Equations and Inputs
  3. Volatilization to Indoor Air Tiered Approach
- Implementation



# 1. Revisions and Reorganization

- Definitions and terms revised for consistency
- Moved / Consolidated information for transparency - not “new” information
- Included all equations and inputs to ensure reproducible criteria

## 2. Equations and Inputs

- Equation revisions
  - Residential receptor = child & adult 
  - Mutagenic carcinogens equation 
  - Noncarcinogen developmental equation 
- Toxicity 
- Physical & Chemical Properties 
- Exposure Assumptions 

# Residential & Nonresidential Criteria

## *Residential Generic Criteria*

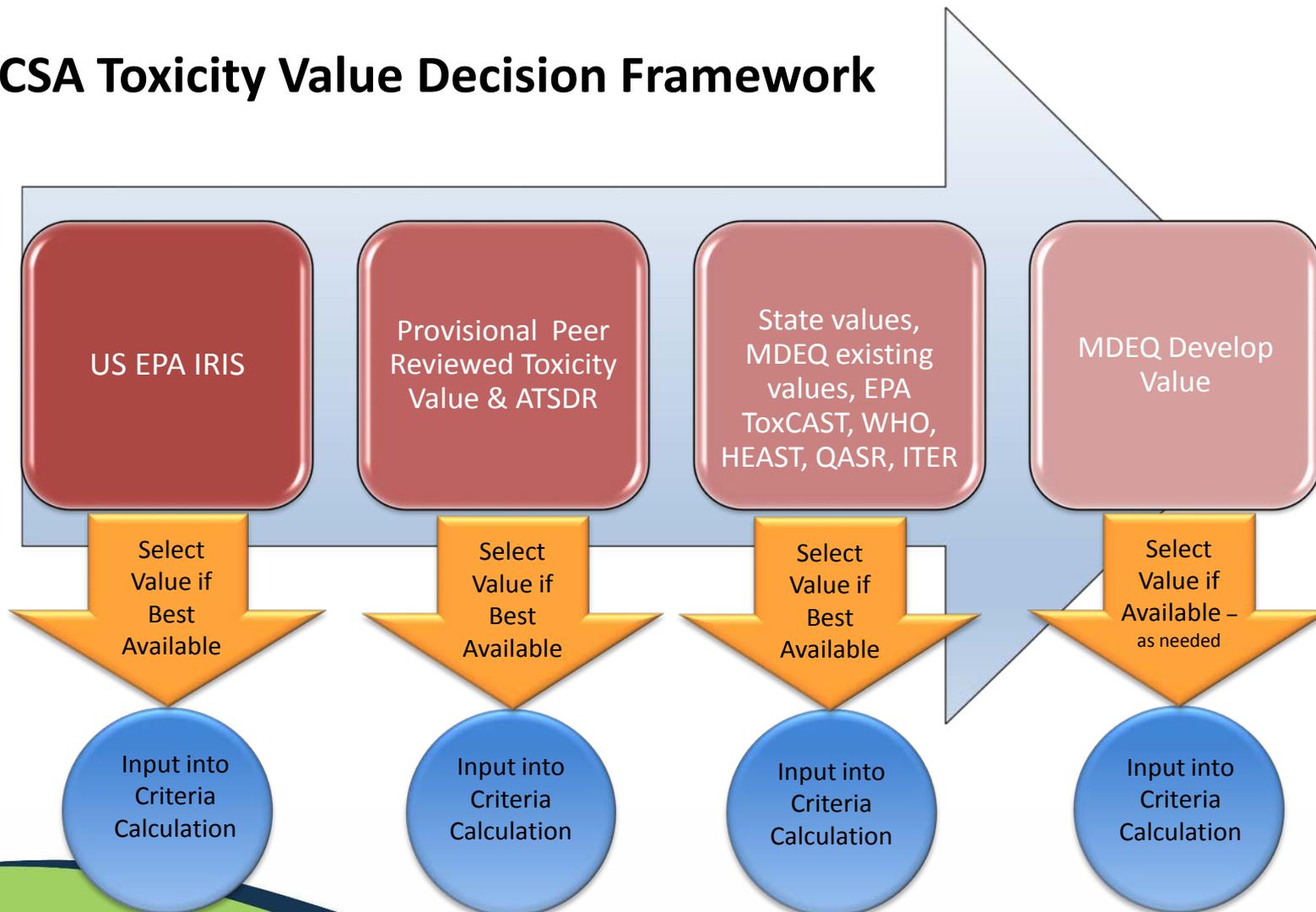
- Receptor is child + adult
- Health-based value is the minimum value calculated
  - Carcinogenic
  - Noncarcinogenic
  - Mutagenic
  - Developmental

## *Nonresidential Generic Criteria*

- Receptor is adult worker
- Indoor or outdoor worker exposure assumptions based on pathway
- Health-based value is the minimum value calculated
  - Carcinogenic
  - Noncarcinogenic
  - Developmental

# Process for Updating the Toxicity Values

## CSA Toxicity Value Decision Framework



# Mutagenic Toxicants



## **CSA Recommendation 1.9**

The CSA recommends that the MDEQ apply age-dependent adjustment factors to toxicity values for those carcinogenic chemicals identified as mutagenic.

# Developmental Toxicants

Footnote (DD) from 2002 and 2013 rules:

- 27 Noncarcinogenic hazardous substances
- Applied only to direct contact criteria
  - Includes child only receptor for residential criteria
  - Includes pregnant female receptor for nonresidential (all single event)
  - Equations are not presented in the 2013 rules

**Existing**



# Developmental Toxicants



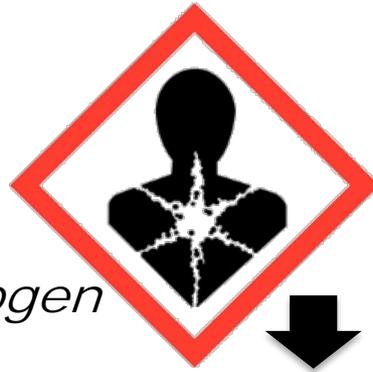
- Process update includes:
  - Residential receptors include pregnant female and child
  - Nonresidential receptor is the pregnant female
  - Relevant to all pathways
  - Developmental equations identified in rule
  - Additional developmental hazardous substances identified



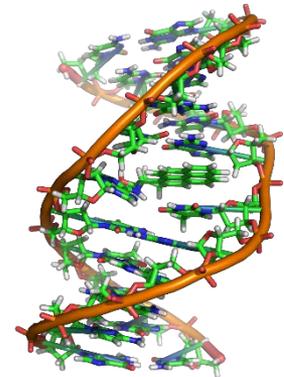
\* Image from riskandinsurance.com

**Lowest Value for A  
Specific Compound  
Becomes the Health  
Based Value**

*Carcinogen*



*Developmental*



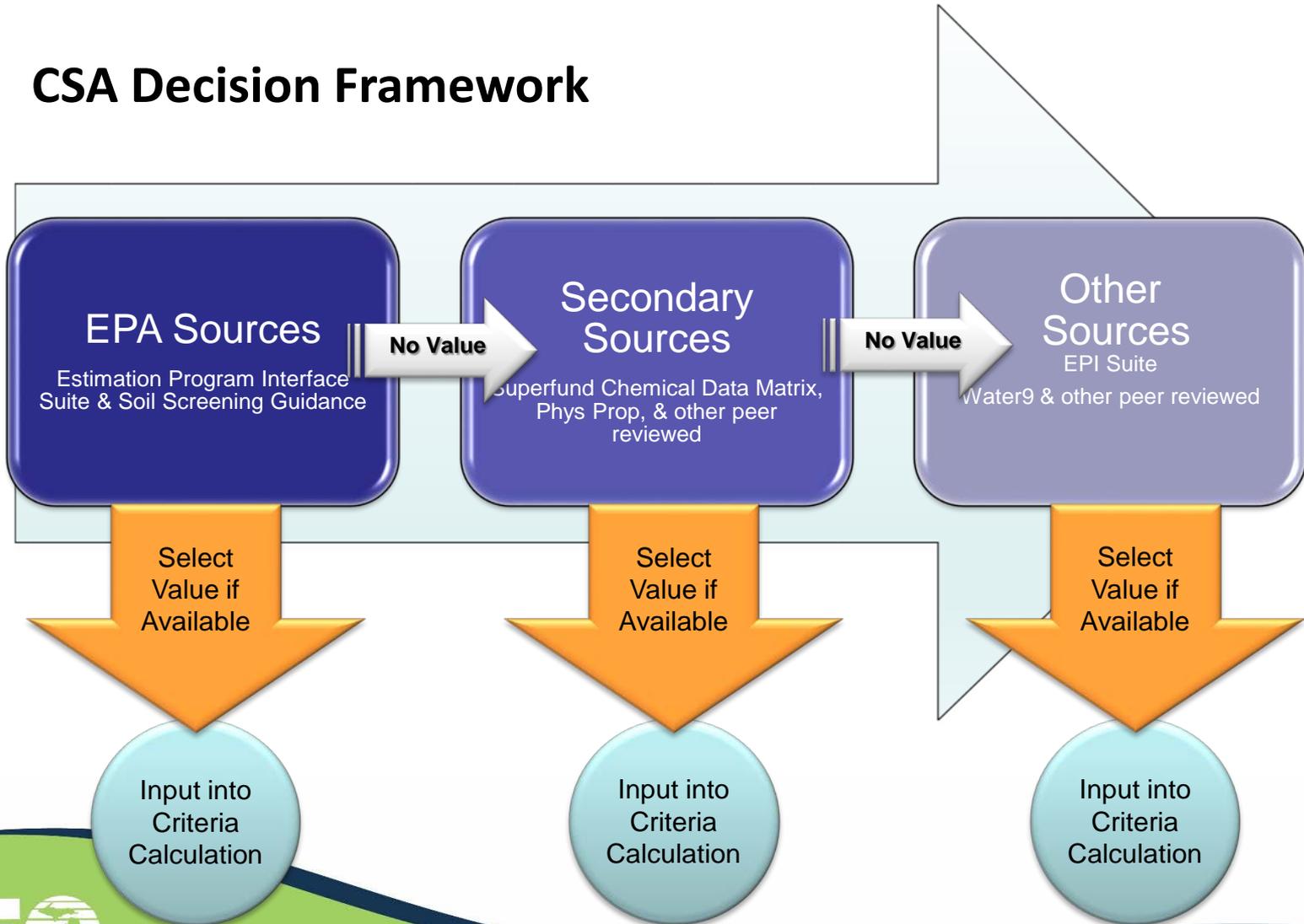
*Mutagenic*



# Physical-Chemical



## CSA Decision Framework



# Rule 50 Tables



**PART 201 GENERIC CLEANUP CRITERIA AND SCREENING LEVELS/PART 213 RISK-BASED SCREENING LEVELS**  
 451, MCL 324.20101 to 324.20142. Scientific notation is represented by E+ or E- a value, for example 200,000 is presented as 2.0E+5.  
 heading. Hazardous substance footnotes are defined in R 299.49. Data sources are as defined in R 299.50(2).

Hazardous Substance	Chemical Abstract Service Number	Oral Reference Dose (mg/kg/day)	RfD Source	Oral Slope Factor (mg/kg/day) <sup>-1</sup>	Chronic Daily Intake (mg/kg/day)
Acenaphthene	83329				
Acenaphthylene	208968				
Acetaldehyde (I)	75070				
Acetate	71501				
Acetic acid (OO)	64197				
Acetone (I)	67641				
Acetonitrile	75058				
Acetophenone (DD)	98862				
Acrolein (I)	107028				
Acrylamide (MM)	79061				
Acrylic acid (DD,OO)	79107				
Acrylonitrile (I)	107131				
Alachlor	15972608				
Aldicarb	116063				
Aldicarb sulfone	1646884				
Aldicarb sulfoxide	1646873				
Aldrin	309002				
Aluminum (B,DD)	7429605				
Ammonia	7664417				
t-Amyl methyl ether (TAME)	994058				
Aniline	62533				
Anthracene	120127				
Antimony	7440360				
Arsenic (B,KK)	7440382				
Asbestos (BB)	1332214				
Atrazine	1912249				
Azobenzene	103333				
Barium (B,KK)	7440393				
Benzene (I,KK)	71432				

**TABLE 2. CHEMICAL-SPECIFIC DATA**  
 PART 201 GENERIC CLEANUP CRITERIA AND SCREENING LEVELS/PART 213 RISK-BASED SCREENING LEVELS  
 451, MCL 324.20101 to 324.20142. Hazardous substance footnotes are defined in R 299.49. Data sources are as defined in R 299.50(4)

Hazardous Substance	Chemical Abstract Service Number	Relative Source Contribution for Drinking (RSCd)	Relative Source Contribution for Soil (RSCs)	Relative Source Contribution for Air (RSCa)	RSCa Source	Ingestion Absorption Efficiency (AEI)	AEI Source	Dermal Absorption Efficiency (AEd)	AEd Source	Gastrointestinal Absorption Efficiency (ABSgi)	ABSgi Source
Acenaphthene	83329										
Acenaphthylene	208968										
Acetaldehyde (I)	75070										
Acetate	71501										
Acetic acid (OO)	64197										
Acetone (I)	67641										
Acetonitrile	75058										
Acetophenone (DD)	98862										
Acrolein (I)	107028										
Acrylamide (MM)	79061										
Acrylic acid (DD,OO)	79107										
Acrylonitrile (I)	107131										
Alachlor	15972608										
Aldicarb	116063										
Aldicarb sulfone	1646884										
Aldicarb sulfoxide	1646873										
Aldrin	309002										
Aluminum (B,DD)	7429605										
Ammonia	7664417										
t-Amyl methyl ether (TAME)	994058										
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Hazardous Substance	Chemical Abstract Service Number	Molecular Weight	MW Source	Physical State at Standard Temperature and Pressure	Physical State Source	Boiling Point	BP Basis	BP Source	Melting Point	MP Basis	MP Source	Log Octanol-Water Partition Coefficient	Log Kow Basis	Log Kow Source
						°C			°C			Log Kow	unitless	
Acenaphthene	83329	154.21	EPI	Solid	MDEQ	279	EXP	EPI	93.4	EXP	EPI	3.92	EXP	EPI
Acenaphthylene	208968	152.20	EPI	Solid	MDEQ	280	EXP	EPI	92.5	EXP	EPI	3.94	EXP	EPI
Acetaldehyde (I)	75070	44.05	EPI	Gas	MDEQ	20.1	EXP	EPI	-123.37	EXP	EPI	-0.34	EXP	EPI
Acetate	71501	59.04402	PC	Liquid	MDEQ	117.9	NA	PC	16.6	EXP	PC	NA	NA	NA
Acetic acid (OO)	64197	60.05	EPI	Liquid	MDEQ	117.9	EXP	EPI	16.6	EXP	EPI	-0.17	EXP	EPI
Acetone (I)	67641	58.08	EPI	Liquid	MDEQ	56	EXP	EPI	-94.8	EXP	EPI	-0.24	EXP	EPI
Acetonitrile	75058	41.05	EPI	Liquid	MDEQ	81.6	EXP	EPI	-43.8	EXP	EPI	-0.34	EXP	EPI
Acetophenone (DD)	98862	120.15	EPI	Liquid	MDEQ	202	EXP	EPI	20	EXP	EPI	1.58	EXP	EPI
Acrolein (I)	107028	56.06	EPI	Liquid	MDEQ	52.6	EXP	EPI	-87.7	EXP	EPI	-0.01	EXP	EPI
Acrylamide (MM)	79061	71.08	EPI	Solid	MDEQ	192.6	EXP	EPI	84.5	EXP	EPI	-0.67	EXP	EPI
Acrylic acid (DD,OO)	79107	72.06	EPI	Liquid	MDEQ	141	EXP	EPI	12.5	EXP	EPI	0.35	EXP	EPI
Acrylonitrile (I)	107131	53.06	EPI	Liquid	MDEQ	77.3	EXP	EPI	-83.5	EXP	EPI	0.25	EXP	EPI
Alachlor	15972608	269.77	EPI	Solid	MDEQ	400	EXP	PC	40	EXP	EPI	3.52	EXP	EPI
Aldicarb	116063	190.26	EPI	Solid	MDEQ	NA	NA	NA	99	EXP	EPI	1.13	EXP	EPI
Aldicarb sulfone	1646884	222.26	EPI	Solid	MDEQ	NA	NA	NA	140	EXP	EPI	-0.57	EXP	EPI
Aldicarb sulfoxide	1646873	206.26	EPI	Solid	MDEQ	NA	NA	NA	NA	NA	NA	-0.78	EST	PP
Aldrin	309002	364.92	EPI	Solid	MDEQ	329.86	EXP	EPA4	104	EXP	EPI	6.50	EXP	EPI
Aluminum (B,DD)	7429605	30.01	EPI	Inorganic	MDEQ	2519	EXP	CRC	660.323	EXP	CRC	NR	NA	NA
Ammonia	7664417	17.03	EPI	Gas	MDEQ	-33.35	EXP	EPI	-77.7	EXP	EPI	0.23	EST	PP
t-Amyl methyl ether (TAME)	994058	102.18	EPI	Liquid	MDEQ	86.3	EXP	EPI	-80	EXP	PC	1.55	EXP	PP
Aniline	62533	93.13	EPI	Liquid	MDEQ	184.17	EXP	EPI	-6.02	EXP	EPI	0.90	EXP	EPI
Anthracene	120127	178.24	EPI	Solid	MDEQ	339.9	EXP	EPI	215	EXP	EPI	4.45	EXP	EPI
Antimony	7440360	124.78	EPI	Inorganic	MDEQ	1635	EXP	PP	630	EXP	PP	NR	NA	NA
Arsenic (B,KK)	7440382	77.95	EPI	Inorganic	MDEQ	NA	NA	NA	NA	NA	NA	NR	NA	NA
Asbestos (BB)	1332214	NA	NA	Inorganic	MDEQ	NA	NA	NA	NA	NA	NA	NR	NA	NA
Atrazine	1912249	215.69	EPI	Solid	MDEQ	NA	NA	NA	173	EXP	EPI	2.61	EXP	EPI
Azobenzene	103333	182.23	EPI	Solid	MDEQ	293	EXP	EPI	68	EXP	EPI	3.82	EXP	EPI
Barium (B,KK)	7440393	137.33	EPI	Inorganic	MDEQ	1600	EXP	PP	710	EXP	PP	NR	NA	NA
Benzene (I,KK)	71432	78.11	EPI	Liquid	MDEQ	80	EXP	EPI	5.5	EXP	EPI	2.13	EXP	EPI



# Sources Identified



Hazardous Substance	Chemical Abstract Service Number	Density	Dens Basis	Dens Source	Vapor Pressure	VP Basis	VP Source	Critical Temperature	T <sub>c</sub> Basis	T <sub>c</sub> Source	Enthalpy of Vaporization	ΔH Basis	ΔH Source
		Dens g/cm <sup>3</sup>			VP (mmHg)			T <sub>c</sub> K			ΔH cal/mol		
n-Hexane	110543	0.6606	EXP	CRC	1.51E+02	EXP	EPI	508.00	EXP	EPA4	6.90E+03	EXP	EPA4
2-Hexanone	591786	0.8113	EXP	CRC	1.16E+01	EXP	EPI	586.7	EXP	CRC	8.69E+03	EXP	CRC
Ink (1,2,3-d) (C,MM)	193395	NA	NA	NA	1.2E-10	EST	PR	1079.34	EXP	EPA1	1.09E+04	EST	EPA1
Iron (E)	7439916	NR	NA	NA	NR	NA	NA	NR	NA	NA	NR	NA	NA
Isobutyl alcohol (C)	388	0.809	EXP	CRC	0.05E+01	EXP	EPI	372.3	EXP	EPA4	1.09E+04	EXP	EPA4
Isophorone (DD)	6	0.925	EXP	CRC	1.5E+00	EXP	EPI	45.00	EXP	EPA1	1.03E+04	EXP	EPA1
Isopropyl alcohol (DD,OC)	6	0.78	EXP	CRC	4.54E+00	EXP	EPI	333.8	EXP	EPA4	1.03E+04	EXP	CRC
Isopropyl benzene	98828	0.864	EXP	CRC	4.50E+00	EXP	EPI	631.10	EXP	EPA4	1.03E+04	EXP	EPA4
Lead (B,L,DD,KK)	7439921	NR	NA	NA	NR	NA	NA	NR	NA	NA	NR	NA	NA
Lindane (KK)	58899	1.87	EXP	PC	4.20E-05	EXP	EPI	839.36	EXP	EPA1	1.50E+04	EST	EPA1
Lithium (B,DD)	7439932	NR	NA	NA	NR	NA	NA	NR	NA	NA	NR	NA	NA
Magnesium	7439954	NR	NA	NA	NR	NA	NA	NR	NA	NA	NR	NA	NA
Manganese (B)	7439965	NR	NA	NA	NR	NA	NA	NR	NA	NA	NR	NA	NA
Mercury (Total) (Z,DD,KK)	Varies												

**TRANSPARENCY**

# Chemical Update Worksheets



## CHEMICAL UPDATE WORKSHEET

Chemical Name: **Benzene**  
Revision Date: December 4, 2015

### SECTION A: CHEMICAL-PHYSICAL PROPERTIES

Property	Part 201 Value
Molecular Weight (g/mol)	78.11
Physical State at ambient temp	Liquid
Melting Point (°C)	279
Boiling Point (°C)	80
Solubility (µg/L)	1.75E+6
Vapor Pressure (mmHg at 25°C)	91.2
HLC (atm-m <sup>3</sup> /mol at 25°C)	5.55E-3
Log Kow (log P; octanol-water)	2.13

Koc (organic carbon)	
Ionizing	
Diffusivity in Air	
Diffusivity in Water	
Soil Water Partition Coefficient (Kd; in	
Flash	
Lower Explosivity Level (LEL)	
Critical Temperature	
Enthalpy of Vaporization	
Density (g/ml)	
EMSOFT Flux (J <sub>s</sub> ) Residential 2 m (g/m <sup>2</sup> -s)	
EMSOFT Flux (J <sub>s</sub> ) Residential 5 m (g/m <sup>2</sup> -s)	
EMSOFT Flux (J <sub>s</sub> ) Nonresidential 2 m (mg/d	
EMSOFT Flux (J <sub>s</sub> ) Nonresidential 5 m (g/m <sup>2</sup> -s)	

## CHEMICAL UPDATE WORKSHEET: BENZENE

### SECTION B: TOXICITY VALUE/BENCHMARKS

Values for:	Part 201 Value	Updated Value	Source/Reference and Date	Comments, Notes, Issues
Reference Dose (RfD) (mg/kg/day)	--	5.0E-4	ATSDR, 2007	Complete
<b>Tier 2 Source:</b> <b>ATSDR:</b> ATSDR is more current than IRIS. ATSDR (December, 2014), chronic oral MRL = 0.0005 (5.0E-4) mg/kg-day. <b>Critical Study:</b> Lan Q, Zhang L, Li G, et al. 2004a. <u>Hematotoxicity</u> in workers exposed to low levels of benzene. Science 306:1774-1776. <b>Methods:</b> based on route-to-route extrapolation of the results of benchmark dose analysis of a hematological end point.				

## CHEMICAL UPDATE WORKSHEET: BENZENE

### SECTION C: CHEMICAL-SPECIFIC ABSORPTION FACTORS

Absorption Factors For:	Part 201 Value
Gastrointestinal absorption efficiency value (ABSGi)	
ABSGi details	
Skin absorption efficiency value (AE <sub>d</sub> )	
AE <sub>d</sub> details	
Ingestion Absorption Efficiency (AE <sub>i</sub> )	
AE <sub>i</sub> Details	
Relative Source Contribution for Water (RSC <sub>w</sub> )	
Relative Source Contribution for Soil (RSC <sub>s</sub> )	
Relative Source Contribution for Air (RSC <sub>a</sub> )	

## CHEMICAL UPDATE WORKSHEET: BENZENE

### SECTION D: RULE 57 WATER QUALITY VALUES AND GSI CRITERIA

Current GSI value (µg/L): 200 (X)  
 Updated GSI value (µg/L): 200 (X)  
 Rule 57 Drinking Water Value (µg/L): 12

	Rule 57 Value (µg/L)	Verification
Human Non-cancer Values- Drinking water source (HNV-drink)	19	07/19
Human Non-Cancer Values- Non-drinking water sources (HNV-Non-drink)	510	07/19
Wildlife Value (WV)	NA	N
Human Cancer Values for Drinking Water Source (HCV-drink)	12	07/19
Human Cancer values for non-drinking water source (HCV-Non-drink)	310	09/09
Final Chronic Value (FCV)	200	09/09
Aquatic maximum value (AMV)	950	09/09
Final Acute Value (FAV)	1900	

Sources: 1. Surface Water Assessment Section Rule 57 [website](#)  
 2. Rule 57 [table](#)

### SECTION E: TARGET DETECTION LIMITS (TDL)

	TDL Value	Ver
Target Detection Limit - Soil (µg/kg)	50	
Target Detection Limit - Water (µg/L)	1	
Target Detection Limit - Air (ppbv)	9.70E-01	
	3.20E+01	



# Exposure Assumptions

**UPDATE!**

$$-V_{eq} \frac{dM}{dt}$$

$$dM = V_{eq} dp$$

$$v du = -V_{eq} dM$$

$$du = -V_{eq} \frac{dM}{M}$$

$$\Delta u = -V_{eq} \ln\left(\frac{m}{m_0}\right)$$

$$\sum_{i=1}^{100} i = \frac{n(n+1)}{2} = \frac{1000+1001}{2} =$$

$$PV = nRT$$

$$\omega = 2\pi f$$

instantaneous mass of rocket  
velocity of rocket  
time

net force = thrust =  $\bar{m} V_{eq}$   
equivalent engine exhaust velocity =  $1 \text{ sp } g$

$$M = \bar{F} d \cos a$$

$$\int \frac{m_1+m_2}{r^2} dx$$

$$\sum_{i=1}^{100} i$$

$$\sum_{i=1}^{100} i^2 = \frac{n(n+1)(2n+1)}{6} = \frac{100(101)(201)}{6}$$

Newton's second law of motion:

$$\frac{dM u}{dt} = F = V_{eq} \frac{dM}{dt}$$

$$M du + u dM = V_{eq} dM$$

$$M du = -V_{eq} dM$$

$$du = -V_{eq} \frac{dM}{M}$$

$$\Delta u = -V_{eq} \ln\left(\frac{m}{m_0}\right)$$

Assume we move with rocket  
 $\rightarrow u = 0$

$$\Delta u = V_{eq} \ln\left(\frac{m_0}{m}\right) = V_{eq} \ln MR = 1 \text{ sp } g$$

$F = \text{net force} = \text{thrust} = \bar{m}$   
 $V_{eq} = \text{equivalent engine exhaust}$

Newton's second law of motion:

$$\frac{dM u}{dt} = F = V_{eq} \frac{dM}{dt}$$

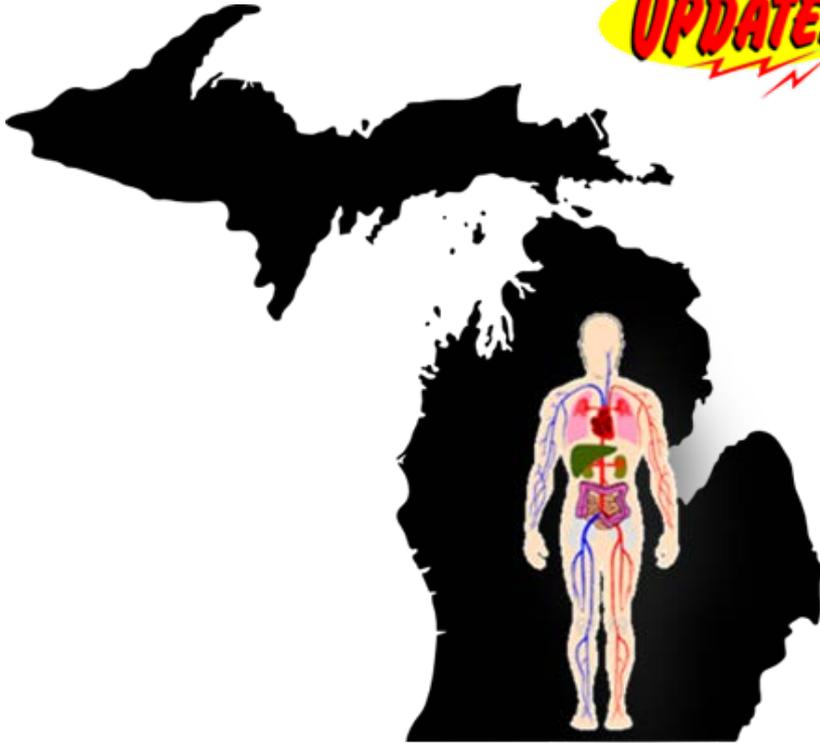
$$M du + u dM = V_{eq} dM$$



\* Image from med.stanford.edu

# Exposure Assumptions

**UPDATE!**



- Body weight
- Drinking water intake rate
- Exposure duration and averaging time
- Skin surface area
- Soil and dust ingestion rate
- Soil dermal adherence factor
- Soil direct contact exposure frequency
- Particulate emission factor (PEF) from wind erosion
- Soil to ambient air volatilization factor (VF)

# Reasonable Maximum Exposure

“ ... The reasonable maximum exposure scenario is “reasonable” because it is a product of factors, such as concentration and exposure frequency and duration, that are an appropriate mix of values that reflect averages and 95<sup>th</sup> percentile distributions.”

- US EPA National Contingency Plan

# Generic Equations

$$DCV_{ca} = \frac{TR \times AT_{ca} \times CF}{(SF_o \times EF_{i,res} \times IF_s \times AE_i) + (SF_d \times EF_{d,res} \times DF \times AE_d)} \quad DWV_{ca} = \frac{TR \times AT_{ca} \times CF}{SF \times EF_{res} \times IF_{dw}}$$

$$FESL = \frac{LEL \times 0.2 \times MW \times P \times CF_1}{HLC \times TAF \times CF_2}$$

$$C_{sat} = \frac{S}{\rho_b} \times [(K_d \times \rho_b) + \theta_w + (H' \times TAF \times \theta_a)]$$

$$SWPV = Cw \left[ K_d + \left( \frac{\theta_w + (H' \times TAF \times \theta_a)}{\rho_b} \right) \right]$$

$$AAV_{ca} = \frac{TR \times AT_{ca}}{IURF \times ED_{res} \times EF_{res}}$$

$$VSIV_{ca} = \frac{TR \times AT_{ca}}{IURF \times ED_{nr} \times EF_{nr} \times \left( \frac{1}{VF_{nr}} \right)}$$

$$PSIV_{ca} = \frac{TR \times AT_{ca}}{IURF \times ED_{res} \times EF_{res} \times \left( \frac{1}{PEF_{res}} \right)}$$

$$VI_{GW} = \frac{AAC}{H'_{TS} \times \alpha \times \left( \frac{1,000 L}{m^3} \right)}$$

$$VI_{sg} = \frac{AAC}{\alpha} \left[ \left( \frac{D_T^{eff} \times A_B}{Q_{building} \times L_T} \right) \times \exp \left( \frac{Q_{soil} \times L_{crack}}{D_{crack} \times A_{crack}} \right) \right]$$

$$\alpha = \frac{1}{\left[ \exp \left( \frac{Q_{soil} \times L_{crack}}{D_{crack} \times A_{crack}} \right) + \left( \frac{D_T^{eff} \times A_B}{Q_{building} \times L_T} \right) + \left( \frac{D_T^{eff} \times A_B}{Q_{soil} \times L_T} \right) \left[ \exp \left( \frac{Q_{soil} \times L_{crack}}{D_{crack} \times A_{crack}} \right) - 1 \right] \right]}$$

# Generic Equation Inputs

(16) Table 1 of this rule reads as follows:

TABLE 1  
Generic Input Values

Scenario	VI Tier 1 Screening Levels	VI Tier 2 Generic criteria	VI Tier 3A Generic criteria
	Unrestricted Residential	Unrestricted Residential	Limited Residential & Limited Nonresidential
Temperature (99.7)	10°C or 283.15K	For sand: 10°C or 283.15K or county specific temperature if < 10°C For all other soil types: County-specific value	VI Tier 2 values
Soil and Vapor:		Soil and Vapor: 1 cm or 0.01 m Shallow Groundwater: VI Tier 1 value Groundwater: When actual depth to groundwater > depth of building considering capillary zone, depth of footings, and	Soil: 1 cm or 0.01 m Vapor: 1 cm or 0.01 m when the vapor source is ≤ to 1 m vertically from the structure 100 cm or 1 m when the vapor source is > 1 m vertically from the structure Shallow Groundwater:

TABLE 1. TOXICOLOGICAL DATA  
PART 201 GENERIC CLEANUP CRITERIA AND SCREENING LEVELS/PART 213 RISK-BASED SCREENING LEVELS  
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Hazardous Substance	Chemical Abstract Service Number	Oral Reference Dose mg/kg-day	RID Source	Oral Slope Factor SF	Chronic Inhalation Reference Concentration RfC	RID Source	Inhalation Unit	Relative	Ingestion	AEI	Dermal Absorption Efficiency	AED Source	Gastrointestinal Absorption Efficiency ABSg	ABSg Source
Acenaphthene														
Acenaphthylene	83329	6.0E-02	RID											
Acetaldehyde (I)	208968	6.0E-02	IRIS											
Acetate	75070	1.3E-02	TCFOS											
Acetic acid (OO)	71500													
Acetone (I)														
Acetonitrile														
Acetophenone (DD)														

TABLE 2. CHEMICAL-SPECIFIC DATA  
PART 201 GENERIC CLEANUP CRITERIA AND SCREENING LEVELS/PART 213 RISK-BASED SCREENING LEVELS  
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TABLE 3. CHEMICAL-PHYSICAL DATA  
PART 201 GENERIC CLEANUP CRITERIA AND SCREENING LEVELS/PART 213 RISK-BASED SCREENING LEVELS  
451, MCL 324.20101 to 324.20142. Scientific notation is represented by E+ or E- a value, for example 200,000 is presented as 2.0E+5. Units are as indicated in each column heading. The data set for each hazardous substance consists of 17 columns (excluding basis and source columns) across 4 pages. Review all 17 columns when evaluating data for a specific hazardous substance. Hazardous substance footnotes are defined in R 299.49. The data basis and sources are defined in R 299.50(6).

Hazardous Substance	Chemical Abstract Service Number	Molecular Weight MW	MW Source	Physical State at Standard Temperature and Pressure	Physical State Source	Boiling Point BP	BP Basis	BP Source	Melting Point MP	MP Basis	MP Source	Log Octanol-Water Partition Coefficient Log K <sub>ow</sub>	Log
Acenaphthene	83329	154.21	EPI	Solid									
Acenaphthylene	208968	152.20	EPI	Solid									
Acetaldehyde (I)	75070												
Acetate	71500												
Acetic acid (OO)	64												
Acetone (I)	67												
Acetonitrile	750												
Acetophenone (DD)	988												
Acrolein (I)	1070												
Acrylamide (MM)	7906												
Acrylic acid (DD,OO)	79107												
Acrylonitrile (I)	107131												
Alachlor	1597260												
Aldicarb	116063												
Aldicarb sulfone	1646894												
Aldicarb sulfoxide	1646873												
Aldrin	309002												
Aluminum (B,DD)	7429005												
Ammonia	7664417												
t-Amyl methyl ether (TAME)	994058												
Aniline	62533												
Anthracene	120127												
Antimony	7440360												
Arsenic (B,KK)	7440382												
Asbestos (BB)	1332214												
Atrazine	1912249												
Azobenzene	103333												
Barium (B,KK)	7440393												
Benzene (I,KK)	71432												

TABLE 2.  
Generic Input Values for USDA Soil Conservation Service Soil Textures

Soil Texture (USDA)	Soil Texture Abbreviation (USDA)	Soil Total Porosity <sub>so</sub> (cm <sup>3</sup> /cm <sup>3</sup> )	Saturated Water Content <sub>sw</sub> (cm <sup>3</sup> /cm <sup>3</sup> )	Residual Water Content <sub>rw</sub> (cm <sup>3</sup> /cm <sup>3</sup> )	Soil Water-Filled Porosity <sub>swf</sub> (cm <sup>3</sup> /cm <sup>3</sup> )	Soil Air-Filled Porosity <sub>soa</sub> (cm <sup>3</sup> /cm <sup>3</sup> )	van Genuchten p
Clay	C	0.459	0.459	0.098	0.215	0.244	0.01496
Clay loam	CL	0.442	0.442	0.079	0.168	0.274	0.01112
Loam	LS	0.399	0.399	0.061	0.148	0.251	0.03475
Loamy sand	SL	0.489	0.489	0.049	0.076	0.314	0.00658
Silt	SIL	0.439	0.439	0.065	0.167	0.259	0.06506
Silty loam	SIL	0.481	0.481	0.09	0.18	0.259	0.01622
Silty clay	SIC	0.482	0.482	0.053	0.054	0.321	0.03342
Silty clay loam	SICL	0.375	0.375	0.117	0.197	0.188	0.02109
Sand	S	0.385	0.385	0.063	0.146	0.238	0.02467
Sandy clay	SC	0.384	0.384	0.039	0.103	0.284	0.02467
Sandy clay loam	SCL	0.387	0.387	0.039	0.103	0.284	0.02467
Sandy loam	SL	0.387	0.387	0.039	0.103	0.284	0.02467

A - From USEPA, 2004. User's Guide for Evaluating Subsurface Vapor Intrusion into Buildings. United States Environmental Protection Agency, Washington, DC.

B - Hers, I. June 3, 2002 Technical Memorandum to Debbie Newberry, USEPA OSW. Input Parameters for OSWER Risk Assessment. EPA/600/R-02/001.

C - Saturated water content is assumed to be equal to the water soil total porosity because the saturated water between soil particles is assumed to be equal to the soil total porosity.

D - The air-filled porosity is calculated as the total porosity minus soil water-filled porosity.

E - Nielson, K. K., and V. C. Rogers. 1990. Radon transport properties of soil classes for estimating indoor radon entry from the environment. Indoor Radon and Lung Cancer: Reality or Myth? Part 1. Battelle Press, Richland, Washington.

- IF<sub>dw,mut</sub> (Age-adjusted drinking water ingestion factor) = 3.6 L-year/kg-day
- IR<sub>dw,age <2</sub> (Drinking water ingestion rate, age <2 years) = 0.82 L/day
- ED<sub>age <2</sub> (Exposure duration) = 2 years
- BW<sub>age <2</sub> (Body weight, age <2 years) = 9.6 kg
- ADAF<sub><2</sub> (Age-dependent adjustment factor for cancer potency, age <2 years) = 10, unitless
- IR<sub>dw,age 2-6</sub> (Drinking water ingestion rate, age 2-6 years) = 0.76 L/day
- ED<sub>age 2-6</sub> (Exposure duration, age 2-6 years) = 4 years
- BW<sub>age 2-6</sub> (Body weight, age 2-6 years) = 17 kg
- ADAF<sub>2-6</sub> (Age-dependent adjustment factor for cancer potency, age 2-6 years) = 3, unitless
- IR<sub>dw,age 6-16</sub> (Drinking water ingestion rate, age 6-16 years) = 1.3 L/day
- ED<sub>age 6-16</sub> (Exposure duration, age 6-16 years) = 10 years



# Criteria Basis Identified



**TABLE 2. SOIL: RESIDENTIAL**

**PART 201 GENERIC CLEANUP CRITERIA AND SCREENING LEVELS/PART 213 RISK-BASED SCREENING LEVELS**

All criteria, unless otherwise noted, are expressed in units of parts per billion (ppb). One ppb is equivalent to 1 microgram per kilogram ( $\mu\text{g}/\text{kg}$ ). Criteria with 6 or more digits are expressed in scientific notation. For example, 200,000 is presented as 2.0E+5. A footnote is designated by one or more letters in parentheses and is defined in R 299.49(1). The abbreviation beneath the value represents the basis for the criterion. When the health-based value is less than the target detection limit (TDL), the TDL is the criterion (MCL 324.20120a(10)).

Hazardous Substance	Chemical Abstract Service Number	Statewide Default Background Level	Groundwater Protection	Ambient Air (C, D, M, Y)			Contact	Csat	
			Residential Drinking Water Protection Criteria	Infinite Source Volatile Soil Inhalation Criteria (VSIC)	Finite VSIC for 2 Meter Source Thickness	Finite VSIC for 5 Meter Source Thickness	Particulate Soil Inhalation Criteria	Direct Contact Criteria	Soil Saturation Concentration Screening Levels
Dimethyl phthalate	131113	NA	12,000 20x	NA	NA	NA	2.6E+09 nc	2.5E+07 (C) nc	3.8E+05
N,N-Dimethylacetamide	127195	NA	3,000 20x	2.2E+07 nc	2.2E+07 nc	2.2E+07 nc	5.2E+09 nc	6.2E+06 nc	3.9E+07
N,N-Dimethylaniline	121697	NA	240 20x	28,000 ca	38,000 ca	26,000 ca	1.1E+08 ca	1.2E+05 ca	2.8E+05
Dimethylformamide (I)	68122	NA	12,000 20x	7.5E+05 nc	7.5E+05 nc	7.5E+05 nc	3.7E+08 nc	2.5E+07 nc	3.5E+07
2,4-Dimethylphenol	105679	NA	2,400 20x	NA	NA	NA	3.7E+09 nc	5.0E+06 nc	NA
2,6-Dimethylphenol	576261	NA	72 (M) 20x	NA	NA	NA	1.0E+08 nc	1.5E+05 nc	NA
3,4-Dimethylphenol	95658	NA	120 (M) 20x	NA	NA	NA	1.8E+08 nc	2.5E+05 nc	NA
Dimethylsulfoxide	67685	NA	1.2E+05 20x	NA	NA	NA	1.0E+09 nc	1.0E+08 (C, D) max	3.7E+07
2,4-Dinitrophenol	51285	NA	240 (M) 20x	NA	NA	NA	3.7E+08 nc	5.0E+05 nc	NA
2,4-Dinitrotoluene (KK)	121142	NA	22 20x	NA	NA	NA	1.4E+07 ca	9,100 ca	NA
Dinoseb (DD)	88857	NA	870 swpv	NA	NA	NA	2.1E+08 nc	66,000 (DD) dev	NA

# 3. Volatilization to Indoor Air Pathway



## NEW PROCESS

- Tiered Approach
- Screening Levels →
  - Generic Criteria
    - Shallow Groundwater Generic Criteria
    - Soil Gas (vapor) Generic Criteria

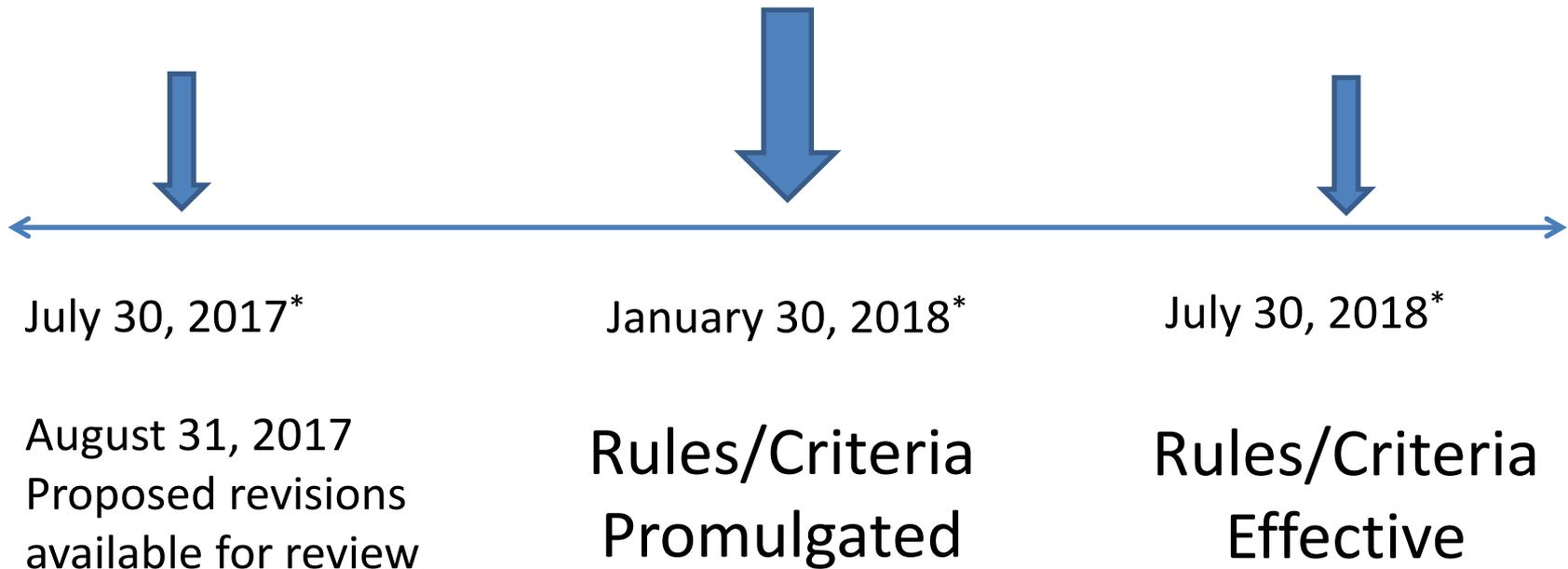
# Implementation



- Extended effective date for rules [6 months after promulgated]
- “Grace Period”
  - Part 201 NFA reports and Part 213 Closure Reports submitted 6 months before promulgation up to the effective date will be reviewed under 2013 criteria unless DEQ Director determines the actions taken are no longer protective

# Implementation

## Effective Date & Grace Period



\*Note: Dates for demonstration purposes only

# Future Land Use Assumptions



# Brownfield Redevelopment

**BAE Systems – Sterling Heights**



Photo courtesy of CrainsDetroit.com

New construction  
with mitigation



# On-Going Process





LAND

Remediation

BEAs

Due Care

Enforcement &

Response Activity

Leaking Underground

Storage Tanks

Program

Site Investigation and

Remediation

Superfund Program

Vapor Intrusion

Remediation

Oil & Gas

Mining

Mineral Wells

Dunes

Soil Erosion and

Construction Storm

Water

DEQ / LAND / REMEDIATION / SITE INVESTIGATION AND REMEDIATION

## Generic Cleanup Criteria Proposed Rules Revisions

To receive information updates, please join our [RRD News & Info Listserv](#).

### COMPREHENSIVE CLEANUP CRITERIA RULES UPDATE 2017

The DEQ, Remediation and Redevelopment Division (RRD), has prepared a revised comprehensive update to Part 201 Cleanup Criteria Rules that reflects revisions from previous public comments and stakeholder discussions.

The [proposed rules document](#) with the newly incorporated revisions highlighted in yellow is provided for review.

A [comparison of the proposed cleanup criteria rules with the 2013 rules](#) is included with the latest iteration.

The DEQ has also prepared a [preliminary version of the response to comments received](#) to assist in explanation of the revisions.

### 2017 PUBLIC INFORMATION MEETINGS

The DEQ is inviting the public to attend an informal information session at one of three being offered during the month of October 2017. Sessions have been scheduled as follows.

The public information meetings are designed to provide an overview of the overall changes and give the participants an opportunity to speak with RRD staff about the proposed changes to the Cleanup Criteria Rules. The meetings will also include more detail regarding the Volatilization to Indoor Air Pathway (VIAP) revisions, including an opportunity for participants to observe how the VIAP Tiered Process addresses facility-specific site conditions.

There will be an additional meeting scheduled in Lansing at a later date. Information regarding the Lansing session will be provided in the future.

Preregistration is requested for planning purposes, but there is no cost to attend:

[Register Now!](#)

DATE	TIME	LOCATION
October 11, 2017	6:00 pm - 8:00 pm	Holiday Inn Ann Arbor 3600 Plymouth Road Ann Arbor, MI 48105
		Grand Traverse Resort



Watch  
for  
Updates

# Remediation and Redevelopment Division

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[www.michigan.gov/deqrrd](http://www.michigan.gov/deqrrd)

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