

# MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY

## Development of Mixing Zone Recommendations for Venting Groundwaters

### Application to Karn Weadock Plumes

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- Determine need for limitations (“reasonable potential” evaluation)
- Provide recommendations to Waste and Hazardous Materials Division
- 5 Year re-evaluation cycle

## Part 4 and Part 8 rules:

- **Part 4 - Water Quality Standards**
  - *used to establish ambient water quality requirements*
- **Part 8 - Water Quality-Based Effluent Limit Development for Toxic Substances**
  - *used to implement the Part 4 Water Quality Standards via NPDES permits*

# Part 4. Water Quality Standards

- Purpose - establishes the minimum water quality requirements by which the surface waters of the state are managed
- The WQS are made up of rules designed to accomplish the purpose
- Rule 323.1057 – “Rule 57”  
Toxic Substances
- Rule 323.1082- “Rule 82”  
Mixing Zones

# Definitions

- “Mixing zone” means that portion of a water body where a point source discharge or venting groundwater is mixed with the receiving water
- “Venting groundwater” means groundwater that is entering a surface water of the state from a facility, as defined in Sec. 20101 of Part 201.

# Rule 57 Overview

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- For other chemicals, it details procedures for calculating criteria:
  - acute water quality criteria
  - chronic water quality criteria
- **Criteria are tiered (Tier I, II, III)**
  - Tiers based on amount of toxicity data
  - more data = less uncertainty = Tier I

# Two types of Water Quality criteria

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- **Chronic** – protects against adverse effects (e.g. cancer) that occur due to long-term exposure to a toxicant (e.g. months, years)

# Rule 57 Criteria

- Acute criteria
  - Aquatic final acute value (FAV)
  - Acute limitations are independent of mix

# Rule 57 Criteria

- **Acute criteria**

- Aquatic final acute value (FAV)

- **Chronic criteria**

- Human noncancer value (HNV)

- Human cancer value (HCV)

- Wildlife value (WV)

- Aquatic final chronic value (FCV)

# Rule 57 Criteria

- **Acute criteria**
  - Aquatic final acute value (FAV)
- **Chronic criteria**
  - Human noncancer value (HNV)
  - Human cancer value (HCV)
  - Wildlife value (WV)
  - Aquatic final chronic value (FCV)
- **Chronic criteria are developed for both drinking and non-drinking receiving waters**

# Chronic Limits: flowing waters

- Chronic limit =  $\frac{Z (Q_e + Q_r) - (Q_r)(C_r)}{Q_e}$
- 
- Where:
  - $Z$  = Rule 57 chronic water quality criteria
  - $Q_e$  = venting groundwater flow
  - $Q_r$  = receiving water flow allocated for mixing per R 323.1082
  - $C_r$  = background concentration of toxic substance

# Chronic Limits: lakes

- Chronic limit =  $Z (1 + Q) - (Cr)(Q)$
- Where:
  - $Z$  = Rule 57 chronic water quality value
  - $Q$  = # of parts of receiving water allocated for mix per R 323.1082
  - $Cr$  = background concentration of toxic substance

# Rule 82 - Mixing zones

- Allows use of mixing zones for point source discharges or venting groundwater in the surface waters of the state
- Generally,  $\leq 25\%$  of a stream design flow is used to calculate a chronic limit for a toxic substance
- MZs for Great Lakes and inland lakes are allowed no greater than 1 part effluent to 10 parts receiving water unless a larger volume is acceptable
  - No mixing zones for BCCs in waters not attaining WQS for that BCC

# Rule 57 Criteria for Boron

Endpoint	New R. 57 Value (µg/L)	Verification Date (vd)	Old R. 57 Value (µg/L)	Verification Date (vd)
FCV	<b>5000</b>	2200707	<b>1900</b>	2199903
HNV	1900	1199711	1900	1199711
FAV	<b>55000</b>	1200707	<b>31000</b>	2199903

- New Boron toxicity data. Criteria update conducted.
- 7/07 update resulted in revisions to Boron FAV and FCV criteria.

# Put it all together

## ➤ Conduct Potential Effluent Limitation (PEL)

- Use site specific conditions for effluent and receiving waters.

- ID and analyze parameters of interest

*Boron (B), Arsenic (As), Mercury (Hg), Phosphorus (TP)*

# Put it all together

## ➤ Conduct Potential Effluent Limitation (PEL)

- Use site specific conditions for effluent and receiving waters.

- ID and enter parameters of interest

*Boron (B), Arsenic (As), Mercury (Hg), Phosphorus (TP)*

## ➤ Endpoints protected through this review:

- Boron: acute is aquatic, chronic is human (HNV)

- Arsenic: chronic is human (HNV)

- Mercury: chronic is wildlife (WV)

- Phosphorus: chronic is enrichment

# PEL - Parameter ID, Rule 57 Criteria

EXAMPLE OF RULE 57 TABLE SHOWING RANGE OF CRITERIA ENDPOINTS

CAS #	PARAMETER NAME	HNV		HNV		WV		HCV		HCV		FCV		AMV		FAV	
		Drink		Non-drink				Drink		Non-drink							
		Value	verif date	Value	verif date	Value	date	Value	date	Value	date	Value	date	Value	date	Value	date
50000	Formaldehyde	5000	1200906	390000	1200906	NA		NA		NA		120	2199707	1000	2199707	2100	2199707
50293	DDT # @	0.002	1199707	0.002	1199707	0.000011	1199707	0.00015	1199707	0.00015	1199707	0.0032	2199708	0.029	2199708	0.057	2199708
50328	Benzo(a)pyrene #	NLS		NLS		NA		NLS		NLS		ID	199712	ID	199712	ID	199712
51285	2,4-Dinitrophenol	55	1199707	2800	1199707	NA		NA		NA		19	2200301	130	2200301	270	2200301
53703	Dibenz(a,h)anthracene #	NLS		NLS		NA		NLS		NLS		ID	199712	ID	199712	ID	199712
56235	Carbon tetrachloride #	18	1200709	140	1200709	NA		5.6	1200709	45	1200709	77	2200709	690	2200709	1400	2200709
56382	Parathion	NLS		NLS		NA		NA		NA		0.013	1199707	0.065	1199707	0.13	1199707
56553	Benzo(a)anthracene	NLS		NLS		NA		NLS		NLS		2.6	3200002	23	3200002	46	3200002

All chemical specific values are in ug/L

NLS = a literature search has not been conducted

NA = not applicable

EXP = exponent in log base e

ID = insufficient data to derive value

@ = Bioaccumulative Chemical of Concern

# = carcinogen

\* See criteria files

# PEL – Spreadsheet

## REASONABLE POTENTIAL: CHEMICAL SPECIFIC (p. 2 of 2)

\*concentration values in ug/L except as noted; loads in lb/d

Facility:	0	Disch. Rate	0.00 cfs	95% Ex. Flow:	0 cfs				Conc.	Load (lbs/day)
Outfall:	000			H. Mean Flow:	0 cfs	<i>Hg Loading Calculated based on LCA (ng/L) of</i>				0
Date:	1/0/1900			90Q10 Flow:	0 cfs	<i>TP Loading based on concentration (mg/L) of:</i>				0

Parameter	Monthly Average PEL								Daily Max PEL		PEQ		DECISION	
	FCV	load	HNV	load	HCV	load	WV	load	conc	load	Avg	Max	Avg	Max
#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	0	0		
#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	0	0		
#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	0	0		

# PEL Evaluation Process

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- Separate PEL for river and bay discharges
- Both PEL reviews afforded drinking water protection
- Evaluate the range of PEL limitations calculated based on site and g-water data
- Recommend most protective limitations; concentration and loading

# Recommendations

- **March 2007**

- River discharge

  - Acute limits: Boron (B)

  - Chronic limits: Mercury (Hg), Phos (TP)

- Bay discharge

  - Chronic limits: Arsenic (As), B, Hg, TP

- **August 2009**

- River: Same types of limits

- Bay: Same types of limits.

- **Some values changed in 2009 Rec's (As, B)**

# What Changed in 2009 Review?

- Boron Criteria Updated
  - *Changed the FAV and FCV criteria used in the River and Bay discharge PEL reviews*
- Receiving water flow error for Bay discharge was corrected (*no Bay mix was allocated in 2007 review*)
- TP & Mercury recommendations unchanged
- No Limits Were Dropped

# Numerical Changes to [Limits]

- River Discharge

- Boron acute: 31,000 ug/l → 55,000 ug/l
- *based on FAV criteria change; now Tier I*

# Numerical Changes to [Limits]

## ■ River Discharge

- Boron acute: 31,000 ug/l → 55,000 ug/l
- *based on FAV criteria change*

## ■ Bay Discharge

- Arsenic chronic: 50 ug/l → 540 ug/l (HNV)
- *based on inclusion of mix conditions*

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## ■ River Discharge

- Boron acute: 31,000 ug/l → 55,000 ug/l
  - *based on FAV criteria change*

## ■ Bay Discharge

- Arsenic chronic: 50 ug/l → 540 ug/l (HNV)
  - *based on inclusion of mix conditions*
- Boron chronic: 1,900 ug/l → 21,000 ug/l (HNV)
  - *based on inclusion of mix conditions*
  - *HNV more restrictive so FCV change not a factor*

# SUMMARY -Timeline

- March 2007: WB recommendations to WHMD
- July 2007: Boron Criteria Updated
- August 12, 2009: Consumers noted Bay receiving flow discrepancy
- August 25, 2009: PEL conducted; revised B and As recommendations to WHMD
  - 2009 PEL analyses captured the updated B criteria

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- Revised limits reflect updates in criteria and inclusion of appropriate Bay flow.
- Revisions in recommendations were not the result of external pressures on MDEQ.