MECC
MICHIGAN ENVIRONMENTAL COMPLIANCE CONFERENCE

Review of Compliance Options for the Groundwater-Surface Water (GSI) Pathway on Contaminated Sites.

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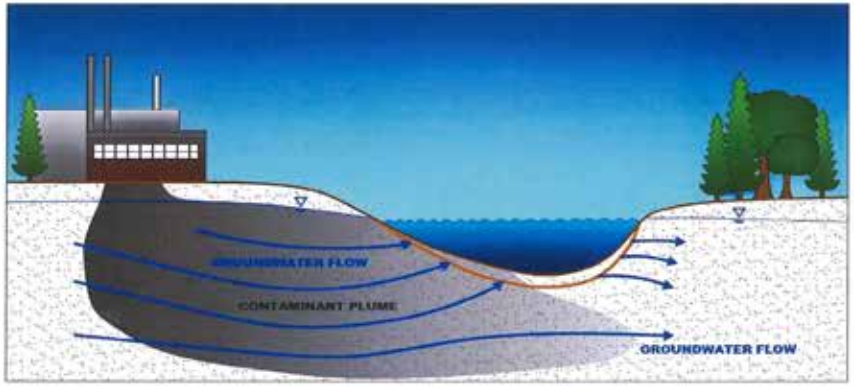
GROUNDWATER-SURFACE WATER INTERFACE PATHWAY COMPLIANCE OPTIONS

REMEDIATION AND REDEVELOPMENT DIVISION
RESOURCE MATERIALS



Adapted from US EPA, Proceedings of the Groundwater/Surface-Water Interactions Workshop, EPA/542/R-00/007, July 2000

Prepared by:
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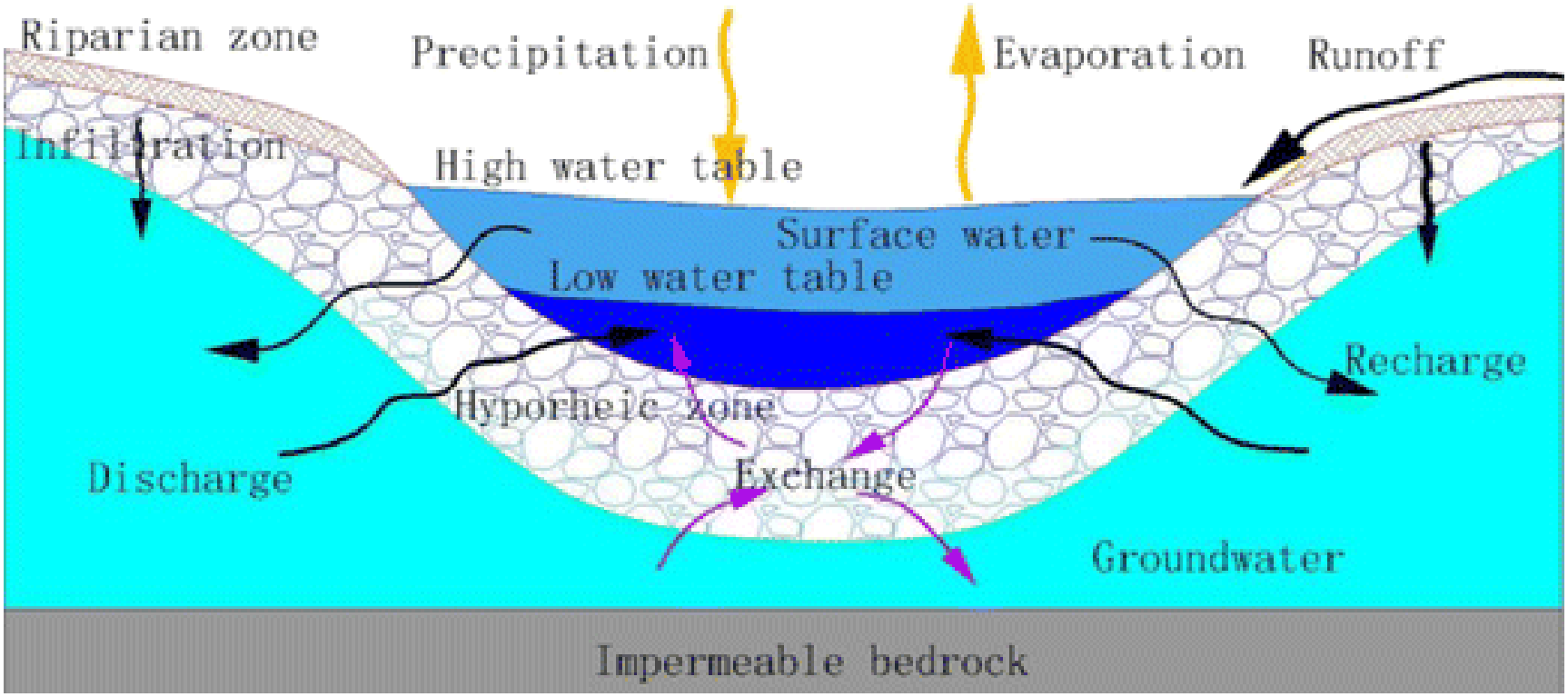
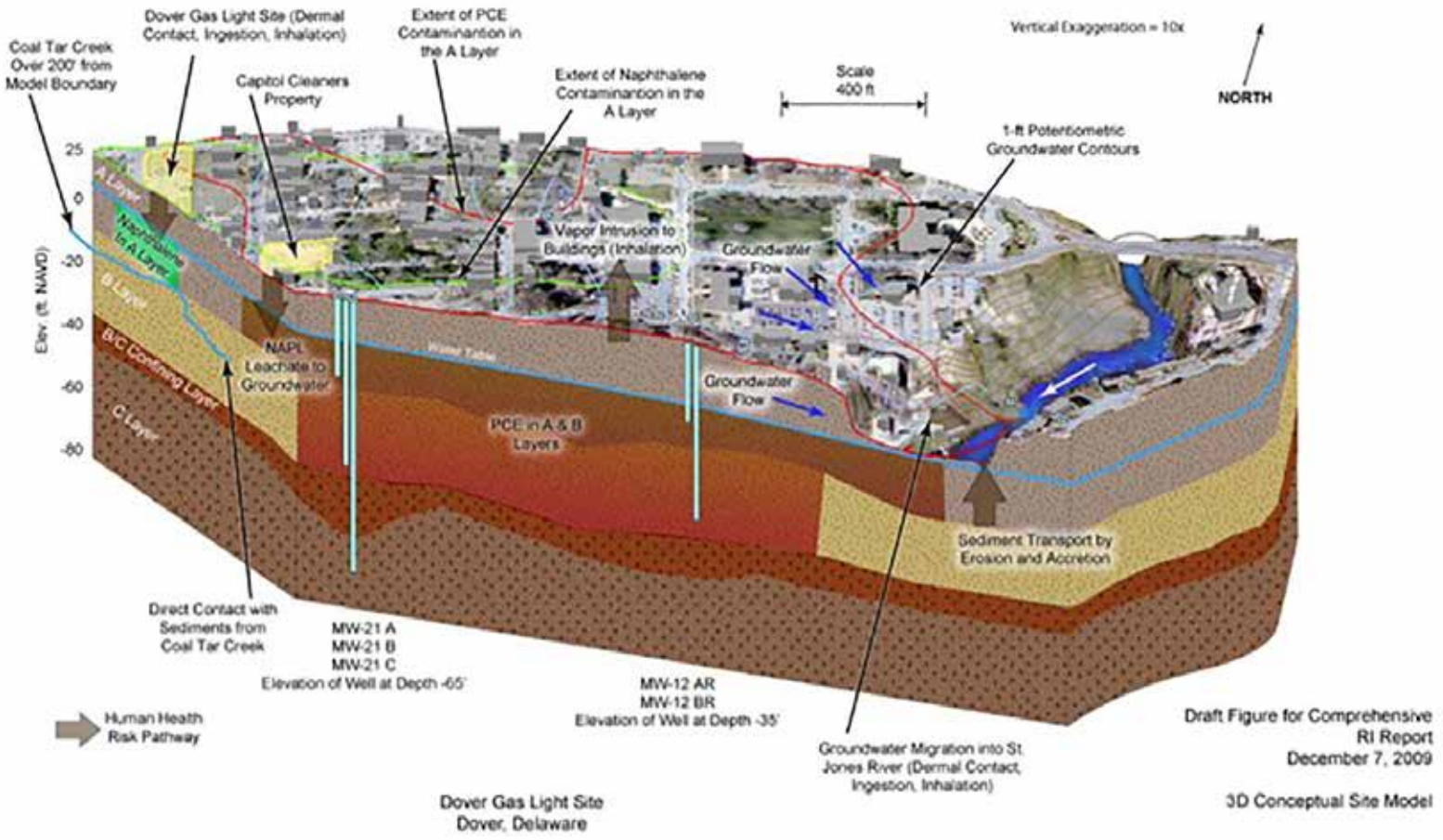
RRD-RESOURCE MATERIALS
March 2018

What is the Groundwater Surface Water Interface?



Relevancy


Coal Tar Creek Over 200' from Model Boundary
Dover Gas Light Site (Dermal Contact, Ingestion, Inhalation)
Capitol Cleaners Property
Extent of PCE Contamination in the A Layer
Extent of Naphthalene Contamination in the A Layer
Vertical Exaggeration = 10x
Scale 400 ft
NORTH
1-ft Potentiometric Groundwater Contours
Elev. (ft. NAVD)
25
0
-20
-40
-60
-80
A Layer
Naphthalene in A Layer
B Layer
B/C Confining Layer
C Layer
Vapor Intrusion to Buildings (Inhalation)
Groundwater Flow
NAPL Leachate to Groundwater
Water Table
Groundwater Flow
PCE in A & B Layers
Sediment Transport by Erosion and Accretion
Direct Contact with Sediments from Coal Tar Creek
MW-21 A
MW-21 B
MW-21 C
Elevation of Well at Depth -65'
MW-12 AR
MW-12 BR
Elevation of Well at Depth -35'
Groundwater Migration into St. Jones River (Dermal Contact, Ingestion, Inhalation)
Human Health Risk Pathway
Dover Gas Light Site
Dover, Delaware
Draft Figure for Comprehensive RI Report
December 7, 2009
3D Conceptual Site Model

"Waters of the State"

The **Water Resources Division** of the DEQ determines whether a body of water meets criteria for being classified as waters of the State.

Intermittent or ephemeral streams, drains, creeks, brooks, ditches and wetlands including UNREGULATED wetlands.

Remember – It must be designated a "Water of the State" and have a hydraulic connection with groundwater for the GSI Pathway to be relevant and regulated.

Water Quality Standards
- or putting a toe in the weeds -

NOTES:
All chemical specific values are in ug/L and expressed as total unless otherwise indicated
EXP = exponent in log base e
H = hardness (in mg/L)
ID = insufficient data to derive value
NLS = no literature search has been conducted
NA = not applicable
@ = Bioaccumulative Chemical of Concern
# = carcinogen
* = the lowest HNV, WV, HCV or FCV given for this chemical will adequately protect the uses identified with an ID* or *
CFa = acute conversion factor for cadmium = 1.136672-[(lnH)(0.041838)]
CFb = chronic conversion factor for cadmium = 1.101672-[(lnH)(0.041838)]
CFc = acute and chronic conversion factor for lead = 1.46203-[(lnH)(0.145712)]
D = value is expressed as dissolved
Modifications/additions to this spreadsheet compared to the previous one dated 10/21/2016 are shaded.

Rule 57 Water Quality Values
Surface Water Assessment Section
Michigan DEQ

8/15/2018

CAS #	PARAMETER NAME	HNV Drink Value	verif date	HNV Non-drink Value	verif date	WV Value	verif date	HCV Drink Value	verif date	HCV Non-drink Value	verif date	FCV Value	verif date	AMV Value	verif date	FAV Value	verif date
50000	Formaldehyde	5000	1200906	390000	1200906	NA		NA		NA		180	2201305	790	2201305	1600	2201305
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	201003	ID	201003	ID	201003
51285	2,4-Dinitrophenol	35	1199707	2800	1199707	NA		NA		NA		19	2200301	130	2200301	270	2200301
53703	Dibenzo(a,h)anthracene #	NLS		NLS		NA		NLS		NLS		ID	199712	ID	199712	ID	199712
56235	Carbon tetrachloride #	18	1201709	140	1201709	NA		4.7	1201709	38	1201709	77	2201709	690	2201709	1400	2201709
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		ID	201501	ID	201501	ID	201501
57125	Cyanide, free	600	1199707	48000	1199707	NA		NA		NA		5.2	1199707	22	1199707	44	1199707
57410	Phenytoin #	790	1201004	11000	1201004	NA		61	1201004	89	1201004	120	2200606	1100	2200606	2200	2200606
57556	Propylene glycol	580000	1200202	47000000	1200202	NA		NA		NA		290000	2200203	1000000	2200203	2100000	2200203
57749	Chlordane # @	0.0014	1199707	0.0014	1199707	NLS		0.00025	1199707	0.00025	1199707	0.029	2199705	0.27	2199705	0.53	2199705
58899	Lindane # @	0.47	1199707	0.5	1199707	0.028	1199869	0.025	2199809	0.027	2199809	0.07	2199706	0.65	1199707	1.9	1199707
58902	2,3,4,6-Tetrachlorophenol	120	2200301	150	2200301	NA		NA		NA		1.2	2200301	11	2200301	22	2200301
59507	4-Chloro-3-methylphenol	6900	1200103	39000	1200103	NA		NA		NA		7.4	2200103	67	2200103	130	2200103
60297	Ethyl ether	14000	1199707	1090000	1199707	NA		NA		NA		ID	201310	ID	201310	ID	201310
60571	Dieldrin # @	0.00041	1199707	0.00041	1199707	0.000071	1199784	0.0000065	1199707	0.0000065	1199707	0.056	1199707	0.24	1199707	0.48	1199707
62533	Aniline #	190	1199809	13000	1199809	NA		21	1199809	1500	1199809	1	2201412	10	2201412	21	2201412
62737	Dichlorvos	NLS		NLS		NA		NA		NA		0.0040	2201708	0.038	2201708	0.076	2201708
63252	Carbaryl	NLS		NLS		NA		NA		NA		0.52	2201704	2.5	2201704	4.5	2201704
64175	Ethanol	1500000	1199810	120000000	1199810	NA		NA		NA		NLS		NLS		NLS	
64186	Formic acid	38000	1199905	3160000	1199905	NA		NA		NA		ID	199905	ID	199905	ID	199905
64197	Acetic acid (includes acetate)	16000	2199807	1360000	2199807	NA		NA		NA		EXP(0.2732*(pH) + 7.0862)	2200506	EXP(0.2732*(pH) + 9.2333)	2200506	EXP(0.2732*(pH) + 9.9265)	2200506
67561	Methanol	14000	1199810	1160000	1199810	NA		NA		NA		590000	2200307	1300000	2200307	2700000	2200307
67630	2-Propanol	28000	1200202	2200000	1200202	NA		NA		NA		57000	2200203	500000	2200203	1000000	2200203
67641	Acetone	5600	1199710	430000	1199710	NA		NA		NA		1700	2199711	15000	1199711	30000	1199711
67663	Chloroform #	330	1201309	11000	1201309	NA		*	201309	*	201309	630	2201309	2700	1201309	11000	1201309
67685	Dimethylsulfoxide	830000	1199807	67000000	1199807	NA		NA		NA		190000	2199709	1700000	2199709	3400000	2199709
67721	Hexachloroethane #	8	1199707	7.6	1199707	NA		5.3	1199707	6.7	1199707	11	2200512	130	2200512	210	2200512
71363	n-Butanol	3500	1201107	230000	1201107	NA		NA		NA		9800	2201108	88000	2201108	180000	2201108
71432	Benzene #	10	1199707	510	1199707	NA		12	1199707	310	1199707	LISTED CRITERIA IN PART 201	200	2201511	950	2201511	1900	2201511
71501	Acetate (includes acetic acid)	16000	2199807	1360000	2199807	NA		NA		NA		EXP(0.2732*(pH) + 7.0862)	2200407	EXP(0.2732*(pH) + 9.2333)	2200407	EXP(0.2732*(pH) + 9.9265)	2200407
71556	1,1,1-Trichloroethane	62000	1201208	1360000	1201208	NA		NA		NA		89	2201709	800	2201709	1600	2201709

Water Quality Standards & Current Part 201 Criteria

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TABLE 1. GROUNDWATER: RESIDENTIAL AND NONRESIDENTIAL PART 201 GENERIC CLEANUP CRITERIA AND SCREENING LEVELS;

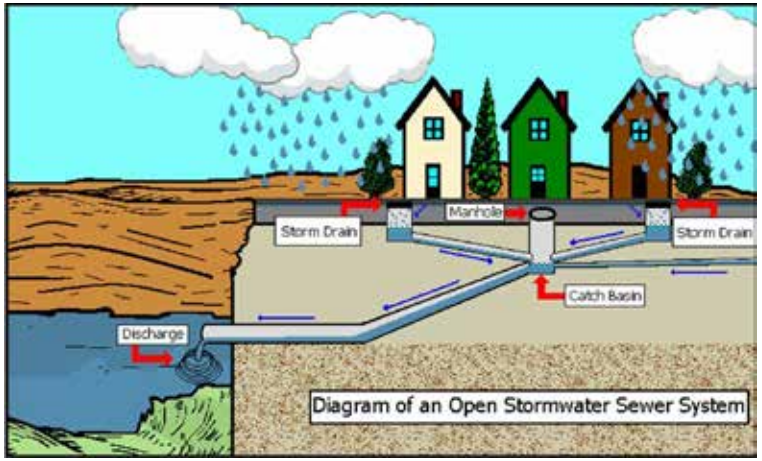
All criteria, unless otherwise noted, are expressed in units of parts per billion (ppb). One ppb is equivalent to 1 microgram per liter (ug/L). Criteria with 6 or more digits are expressed in scientific notation. For example, 200,000 is presented as 2.0E+5. A footnote is designated by a letter in parentheses and is explained in the footnote pages that follow the criteria tables. When the risk-based criterion is less than the target detection limit (TDL), the TDL is listed as the criterion (§324.20120a(10)). In these cases, 2 numbers are present in the cell. The first number is the criterion (i.e., TDL), and the second number is the risk-based or solubility value, whichever is lower.

Hazardous Substance	Chemical Abstract Service Number	Residential Drinking Water Criteria	Nonresidential Drinking Water Criteria	Groundwater Surface Water Interface Criteria	Residential Groundwater Volatilization to Indoor Air Inhalation Criteria	Nonresidential Groundwater Volatilization to Indoor Air Inhalation Criteria	Water Solubility	Flammability and Explosivity Screening Level
Benzene (I)	71432	5.0 (A)	5.0 (A)	200 (X)	5,600	35,000	1.75E+6	68,000
Benzidine	92875	0.3 (M); 0.0037	0.3 (M); 0.015	0.3 (M); 0.073	NLV	NLV	5.20E+5	ID

PART 201 GENERIC GSI CRITERIA FOR BENZENE

Municipal Separate Storm Sewers (MS4)

- MS4's are NOT WWTP's or Combined Sewers ONLY for Storm Water.
- MS4's are cities with certain population thresholds and from certain urban areas that are regulated with a NPDES permit.
- All of MDOT's storm sewers are considered MS4's.
- The discharge of ANY groundwater contamination into an MS4 is considered an illicit discharge according to the Clean Water Act even if it may be entering the MS4 at or below GSI Criteria.



Options to address illicit discharges to an MS4 include:

- Line the sewer
- Lower the water table
- Move the sewer
- Obtain a NPDES Discharge Permit
- Treat the Groundwater
- Develop a plan with the municipality to eliminate the discharge.

MS4's Aside

- Contaminated groundwater vents into a storm sewer (not an MS4) that discharges to a surface water..
- Complying with the GSI Pathway in storm sewers:
  - The point of compliance is at the outfall prior to reaching the surface water.
  - MW's can be installed adjacent to the sewer.
  - Request Mixing Zone Based Criteria for the receiving water body.
  - Demonstrate natural attenuation in the sewer prior to the outfall.
  - Monitor the contaminant plume where it enters the sewer, downstream from where it enters but upstream of the outfall or at the outfall prior to discharge.

GSI Compliance Options

Approaches for Demonstrating GSI Compliance:

- Direct Measurement of Contamination in Venting Groundwater

- Indirect Methods that use the Line of Evidence Approach to demonstrate that venting groundwater does not require remediation.

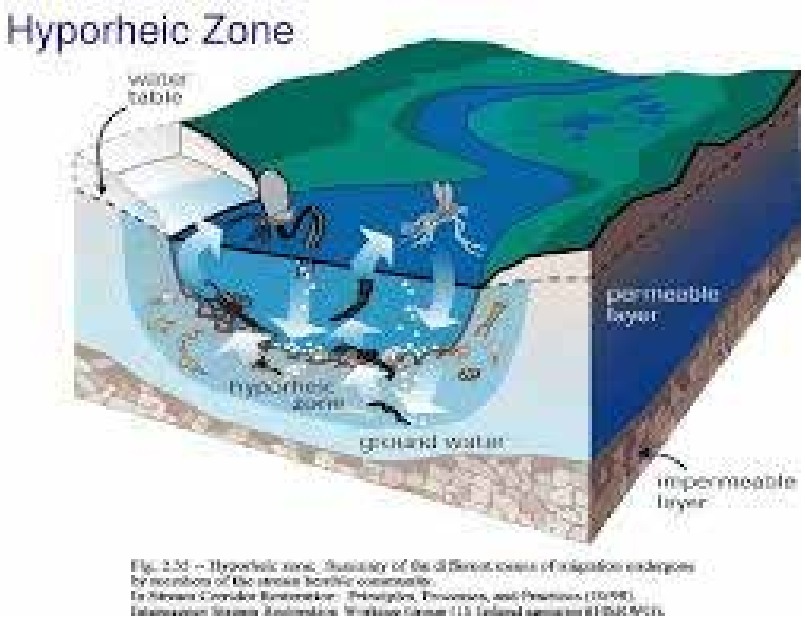
Achieve GSI Criteria

- Completing Response Actions that achieve GSI Criteria in groundwater monitoring wells or alternate monitoring points prior to discharging to surface water is STILL an option under the law!

Alternate Monitoring Points

Collecting groundwater samples from and below the Hyporheic Zone or Transition Zone with Alternate Monitoring Points to demonstrate GSI Compliance.

- The primary function of the Hyporheic Zone include habitat for a number of species, spawning habitat, nutrient circulation, biogeochemical processes and riparian exchange.



Remember - Indigenous aquatic life is a protected designated use for all Waters of the State!

Alternate Monitoring Points

- Samples collected from AMP's can be compared to criteria, mixing zone based criteria in combination with upland vertical wells.
- AMP's are expected to be designed to allow for the collection of samples representative of venting groundwater at the GSI and representative of the higher concentrations of the contaminants venting to surface water.
- Hydraulic head conditions, geochemical parameters such as DO, temperature and conductivity are necessary to document that the water being sampled is **venting groundwater in the hyporheic zone**

The Trifecta of Alternate Monitoring Points

Request Mixing Zone Based GSI Criteria

If compliance with generic GSI criteria cannot be achieved **Mixing Zone Based GSI Criteria** can be requested.

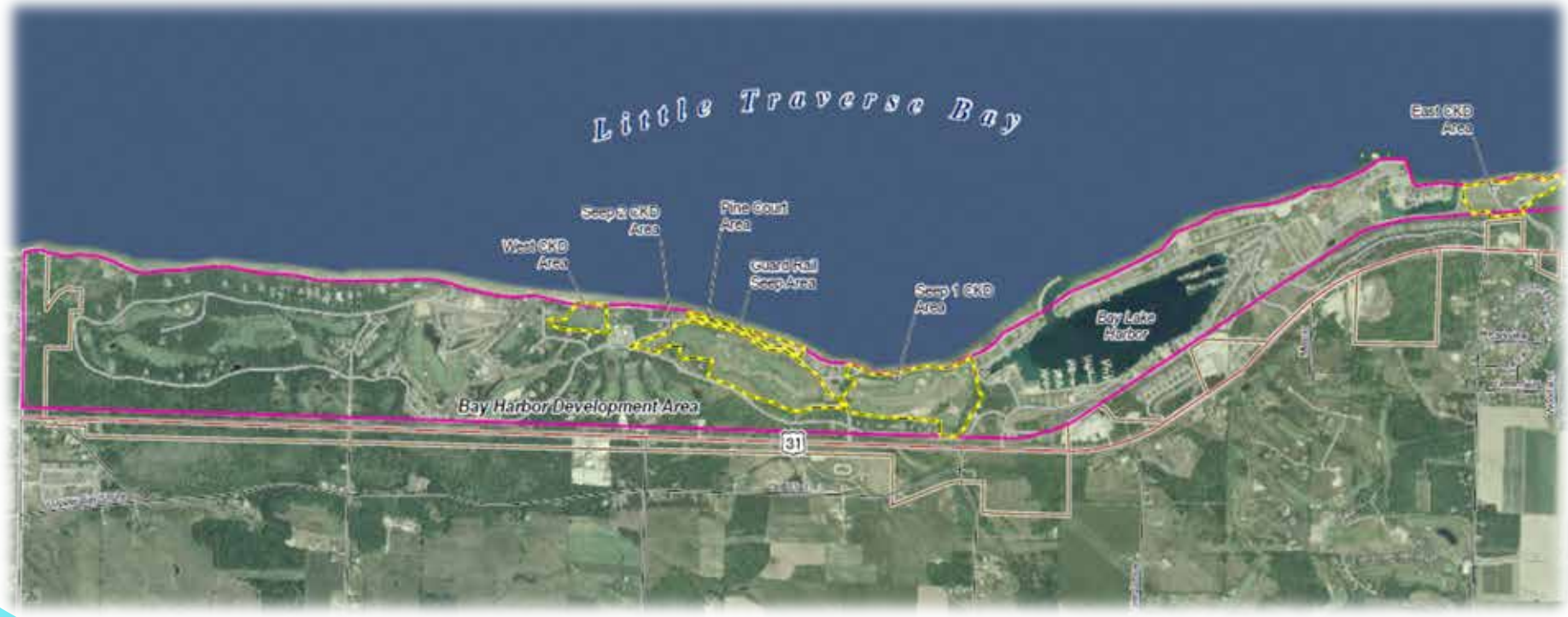
MZ Based Criterion are developed by WRD of the DEQ and considers:

- The surface water body where the discharge is occurring.
- Location, Nature and Chemical Characteristics of past and current sources.
- Concentrations of contaminants in the groundwater at the GSI & upgradient.
- The discharge rate in cubic feet per second of the groundwater that exceeds criteria.
- If the venting groundwater is a new or increased discharge to the waters of the State or an existing loading.
- MZ Based criteria can be requested early in the remedy evaluation of Part 201 & 213 sites to develop targeted goals and response actions to address groundwater contamination.

- The Procedure for requesting MZ Based Criteria is an attachment in the GSI Resource Materials Document.

Variance

If the conditions that have created the GSI exceedance cannot be remedied without creating more environmental damage and it can be demonstrated that criteria is not achievable a variance can be granted.



Variance -continued

Considerations for a Variance include:

- Must conform to the anti-degradation requirements.
- Characterize any increased risk to Human Health & Environment associated with the variance.
- Public Notice is required of the preliminary decision & all other Great Lake States are notified.
- Variances are re-issued every five years and it is expected that progress toward attaining water quality standards would be demonstrated.

Ecological Assessments (EA)

The GSI statutory provisions allow for the use of EA's to evaluate and determine compliance with the pathway using scientific valid methods.

EA's are used to understand why & how organisms behave, survive and reproduce.

EA's are most effective when information on trends over space & time provide the necessary background for an appropriate assessment.

Important!

An EA should only be conducted when the GSI criterion are based on aquatic life or wildlife value and **DOES NOT exceed human health values**.

For Example……

Ecological Assessments (EA)
back into the weeds

TABLE 1. GROUNDWATER: RESIDENTIAL AND NONRESIDENTIAL
PART 201 GENERIC CLEANUP CRITERIA AND SCREENING LEVELS;

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1,1,2,2-Tetrachloroethane	79345	8.5	35	78 (X)	12,000	77,000	2.97E+6	ID
Tetrachloroethylene	127184	5.0 (A)	5.0 (A)	60 (X)	25,000	1.7E+5	2.00E+5	ID
Tetrahydrofuran	109999	95	270	11,000 (X)	6.9E+6	1.6E+7	1.00E+9	60,000
Tetranitromethane	509148	ID	ID	NA	580	3,200	85,000	ID
Thallium (B)	7440280	2.0 (A)	2.0 (A)	3.7 (X)	NLV	NLV	NA	ID

Part 201 GSI Cleanup Criteria for PCE

Ecological Assessments (EA)
back into the weeds

CAS #	PARAMETER NAME	HNV Drink Value	verif date	HNV Non-drink Value	verif date	WV Value	verif date	HCV Drink Value	verif date	HCV Non-drink Value	verif date	FCV Value	verif date	AMV Value	verif date
108678	1,3,5-Trimethylbenzene	2000	1200101	4200	1200101	NA		NA		NA		45	2200102	410	2200102
108872	Methylcyclohexane	ID	200910	ID	200910	NA		NA		NA		ID	200910	ID	200910
108883	Toluene	5600	1199707	51000	1199707	NA		NA		NA		270	2201307	1300	1201307
108907	Chlorobenzene	470	1199707	3200	1199707	NA		NA		NA		25	2201511	220	2201511
108952	Phenol	1100	2200310	1200	2200310	NA		NA		NA		450	2200303	3400	1200303
109739	Butylamine	ID	199805	ID	199805	NA		NA		NA		57	2199805	510	2199805
109897	Diethylamine	310	1199712	24000	1199712	NA		NA		NA		20	2199807	180	2199807
109999	Tetrahydrofuran	350	2199802	26000	2199802	NA		NA		NA		11000	2199806	74000	2199806
110816	Diethyl disulfide	ID	199710	ID	199710	NA		NA		NA		ID	199710	ID	199710
110827	Cyclohexane	ID	200607	ID	200607	NA		NA		NA		ID	200607	ID	200607
111444	Bis(2-chloroethyl)ether #	ID*	200012	ID*	200012	NA		0.79	2200012	15	2200012	ID*	200012	ID	200012
111466	Diethylene glycol	170000	1199708	14000000	1199708	NA		NA		NA		ID	199801	ID	199801
111922	Dibutylamine	ID	199712	ID	199712	NA		NA		NA		ID	199802	ID	199802
112265	1,2-Bis(2-chloroethoxy)ethane	ID	200012	ID	200012	NA		NA		NA		1500	2200012	13000	2200012
115297	Endosulfan	85	1200103	170	1200103	NA		NA		NA		0.029	2200107	0.13	1200107
117817	Bis(2-ethylhexyl)phthalate #	120	1199711	160	1199711	NA		14	1201402	18	1201402	ID*	199809	285	2199809
117840	Di-n-octyl phthalate	240	2199902	300	2199902	NA		NA		NA		ID	199808	ID	199808
118741	Hexachlorobenzene # @	0.046	1199707	0.046	1199707	0.0003	1199704	0.00045	1199707	0.00045	1199707	ID*	199801	ID	199801
120127	Anthracene	1900	2199901	2400	2199901	NA		NA		NA		ID	201411	ID	201411
120821	1,2,4-Trichlorobenzene	80	1201002	99	1201002	NA		NA		NA		130	2201006	420	1201006
120832	2,4-Dichlorophenol	220	1200609	1100	1200609	NA		NA		NA		11	2200807	92	2200807
120956	2,4-Di-tert-pentylphenol	ID	199712	ID	199712	NA		NA		NA		NLS		NLS	
121448	Triethylamine	4000	1199708	230000	1199708	NA		NA		NA		260	2199710	1100	2199710
121824	RDX #	83	1199908	6100	1199908	NA		5.8	1199908	420	1199908	85	2199908	400	2199908
122349	Simazine	140	1200604	4000	1200604	NA		NA		NA		17	2200604	160	2200604
123911	1,4-Dioxane #	890	1201611	72000	1201611	NA		3.5	1201611	280	1201611	22000	2199806	200000	2199806
124174	Diethylene glycol butyl ether acetate	330	1200501	13000	1200501	NA		NA		NA		260	2200501	2300	2200501
124481	Dibromochloromethane #	570	1201408	12000	1201408	NA		6.8	1201408	150	1201408	ID	201408	ID	201408
126727	Tris(2,3-dibromopropyl)phosphate #	ID*	200908	ID*	200908	NA		0.31	1200908	13	1200908	ID	200908	ID	200908
126863	2,4,7,9-Tetramethyl-5-decyne-4,7-diol	ID	200112	ID	200112	NA		NA		NA		350	2200410	3100	2200410
127184	Tetrachloroethylene #	320	1199705	1800	1199705	NA		11	1199705	60	1199705	190	2201510	1400	1201510
127195	N,N-dimethylacetamide	700	1199711	57000	1199711	NA		NA		NA		4100	2199709	37000	2199709

Rule 57 Values for PCE

Ecological Assessments (EA)

- EA's are based upon site specific physical, chemical and ecological data and will by their very nature be very complex, involved and costly!
- Reach out early to District Office staff if considering an EA to demonstrate compliance with the GSI pathway.
- Aquatic Biologists from WRD will need to be involved in the process.

De Minimus

The statute allows for a demonstration of “De Minimus Effect” on surface water in determining if a response action is necessary to address the pathway.

This term is not defined in statute or rules, but is a concept that refers to some discharges that may be so small or of such short duration as to have no or little effect on the surface water.

If a De Minimus determination is requested, the DEQ will rely on the CSM for the facility to determine:

- mass flow of contaminants
- maximum concentrations at the GSI
- expected duration of the discharge
- former source area contaminant contribution if any

De Minimus continued

Important Reminders for De Minimus:

The EXISTING condition of an already degraded water body does not serve as a line-of-evidence for determining whether a contribution is de minimus.

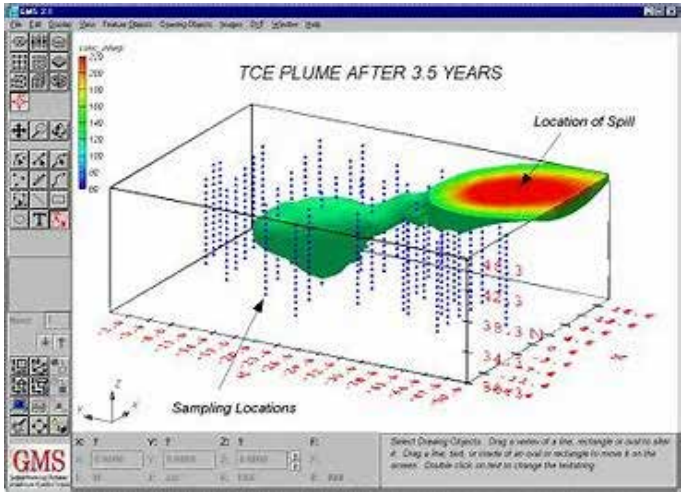
Bioaccumulative Chemicals of Concern ≠ De Minimus (Mercury Exception)

Final Acute Values Exceedances ≠ De Minimus

OTHER COMPLIANCE OPTIONS

Other Compliance Options for the GSI Pathway that are in the Resource Materials Document include:

- Modeling
- Technical Impracticability Waivers – Published Guidance by EPA
- Natural Attenuation
- Use Attainability Analysis
  for Wetlands Only –
  Requires EPA & MDEQ Approval



RESOURCES FOR YOU

First Line of Contact:
District Office Staff involved with your 201 or 213 facility. Lansing Staff in Superfund or RCRA Program.

GSI Technical Assistance & Program Support Team

- Representative from each RRD District Office and Lansing staff (Superfund, WRD, WMRPD).
- Review GSI Issues and offer compliance options for facilities at the request of District staff.
- Provides recommendations to District Staff.
- Outside parties and consultants are welcome to attend and present facility information.