DOTS Webinar:
Overview of Dredged Material Testing and Evaluation

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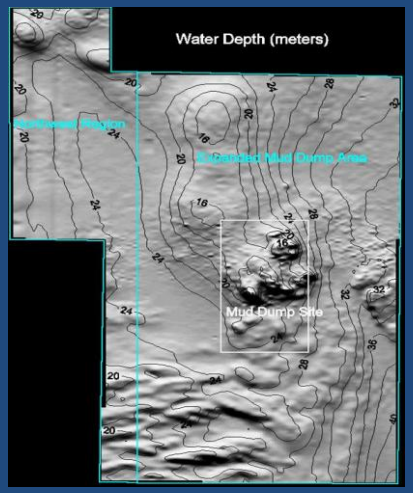
Outline

- Background for evaluations
- Dredged material evaluation guidance
- Tiered Process
  - Exclusions and background information
  - Screening methods
  - Bioassays and analytical tools
  - New and future tools
- Regional guidance

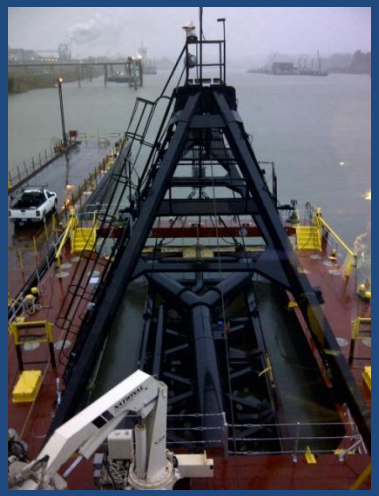
Dredging

- FY12 around 240 million CY dredged (Mr. Thomas Verna, June 26 Webinar)
- Dredged material placed in water or managed upland
- Evaluate environmental effects of contaminants is required by law (Mr. Joe Wilson, May 29)

USACE Hopper Dredge Wheeler, MVN



Ocean placement site, NAN



USACE Dustpan Dredge Jadwin, MVK

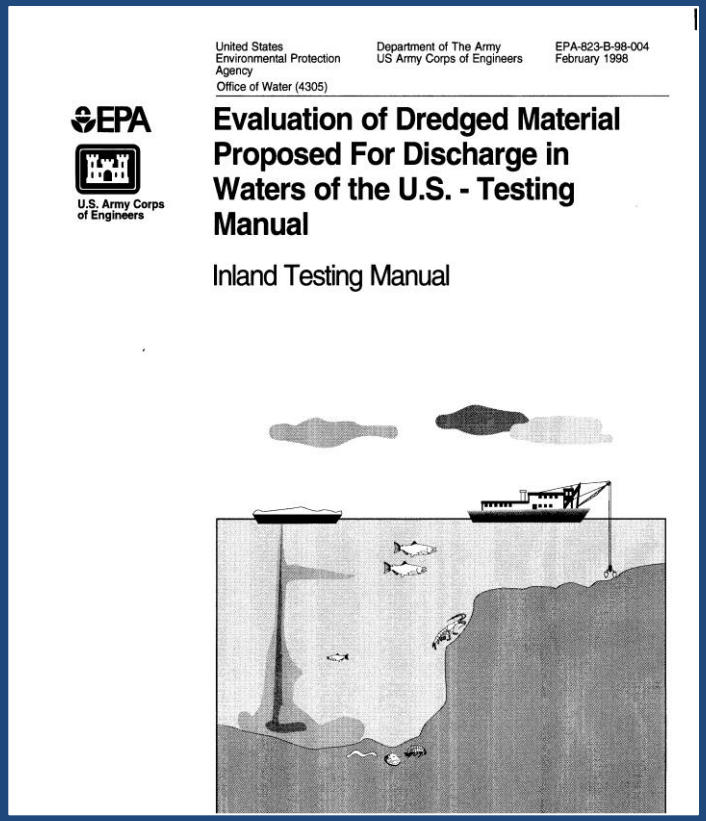
Guidance Documents for Management of Dredged Material

National Technical Guidance

- Technical Framework
- Inland Testing Manual
- Ocean Testing Manual
- Upland Testing Manual
- Ocean Site Designation Manual
- Site Management & Monitoring

Found at:
el.erdc.usace.army.mil/dots/guidance.html

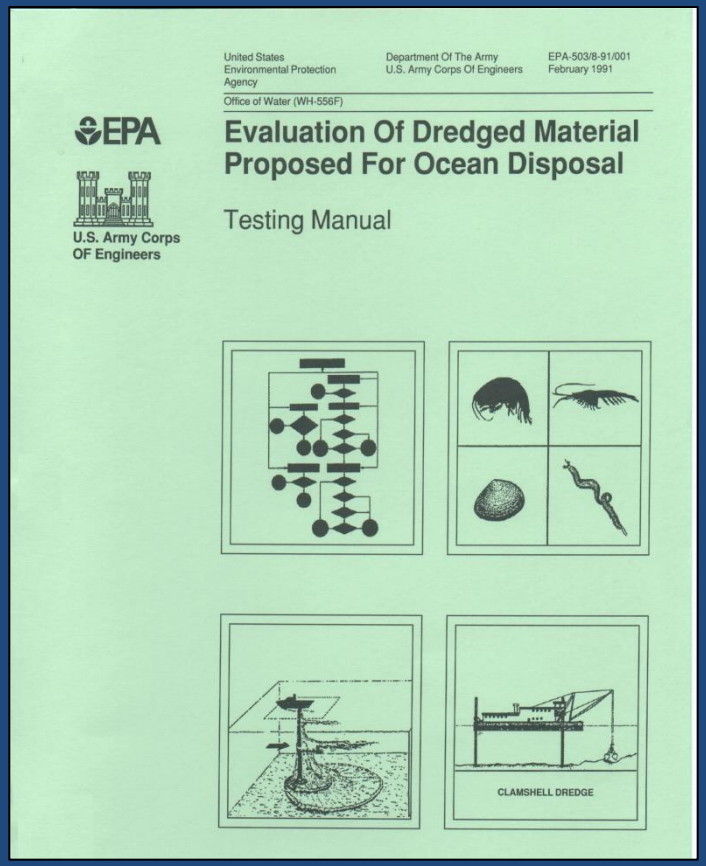
Inland Testing Manual



- Addresses CWA
- Interim guidance in 1976, updated in 1998
- Included:
  - Effects-based testing
  - Sequenced > Tiered

DM placement *"will not cause "an unacceptable adverse impact"*

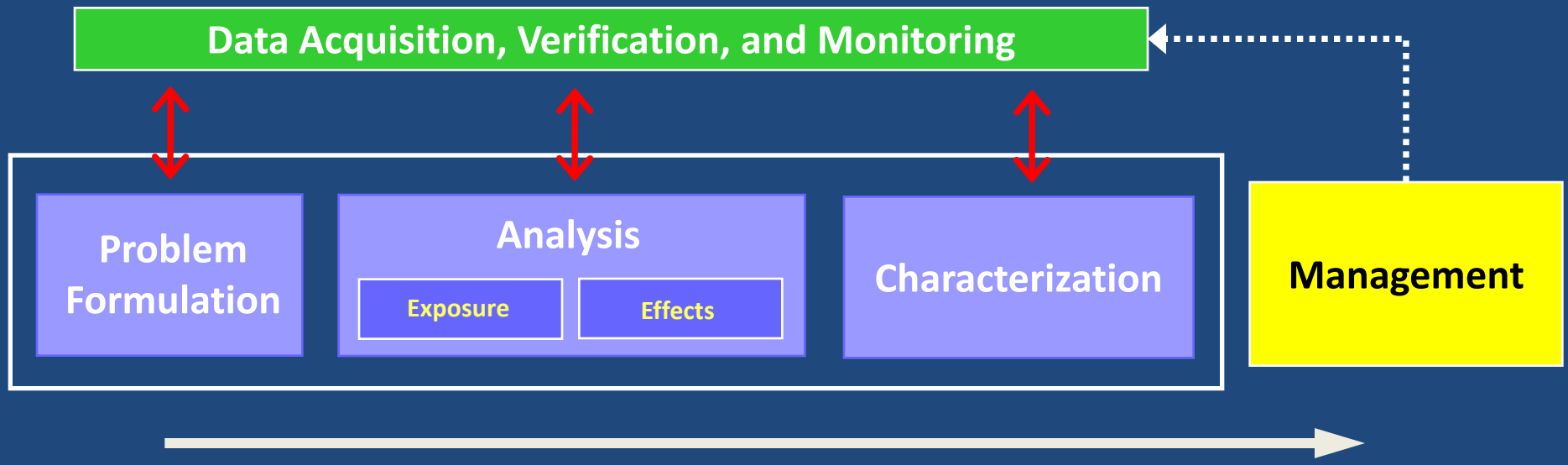
Ocean Testing Manual



- Addresses MPRSA
- Originally developed in 1977, updated in 1991
- Included:
  - Effects-based testing
  - Bioaccumulation
  - Sequenced >Tiered

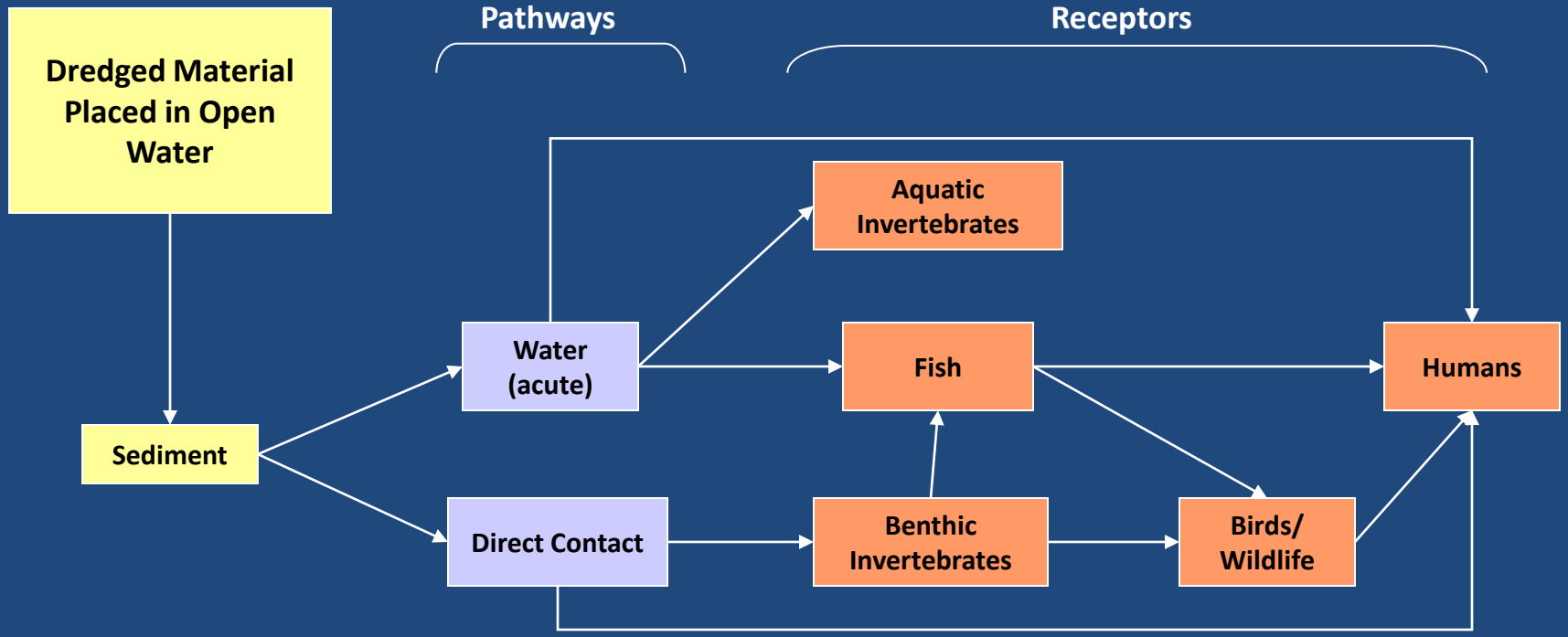
DM placement in ocean will not *"unreasonably degrade or endanger: human health, welfare, or amenities, marine environment, ecological systems, or economic potentialities"*

Risk Assessment and Management



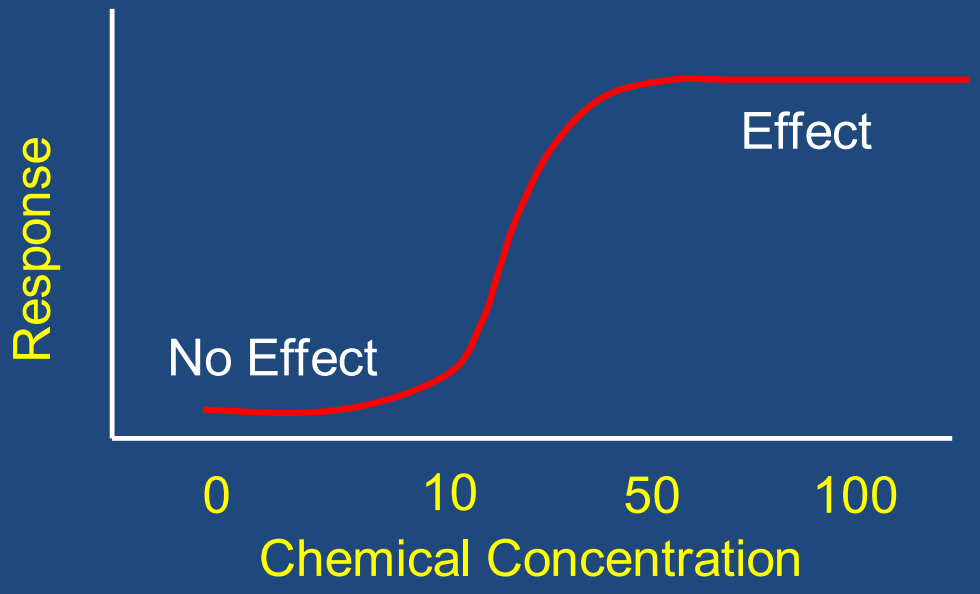
- Process that evaluates the likelihood that adverse effects may occur or are occurring as a result of exposure to one or more stressors (USEPA 1997).
- Risk management is an approach to consider the outcome and uncertainty of an assessment and mitigate risk through a range of alternatives.

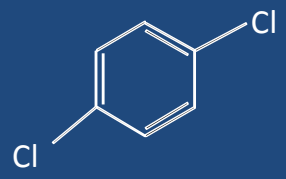
Conceptual Model: Open Water Placement of DM



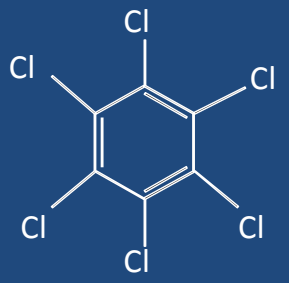
Identify Contaminants of Concern

At what concentration will an adverse effect will occur?





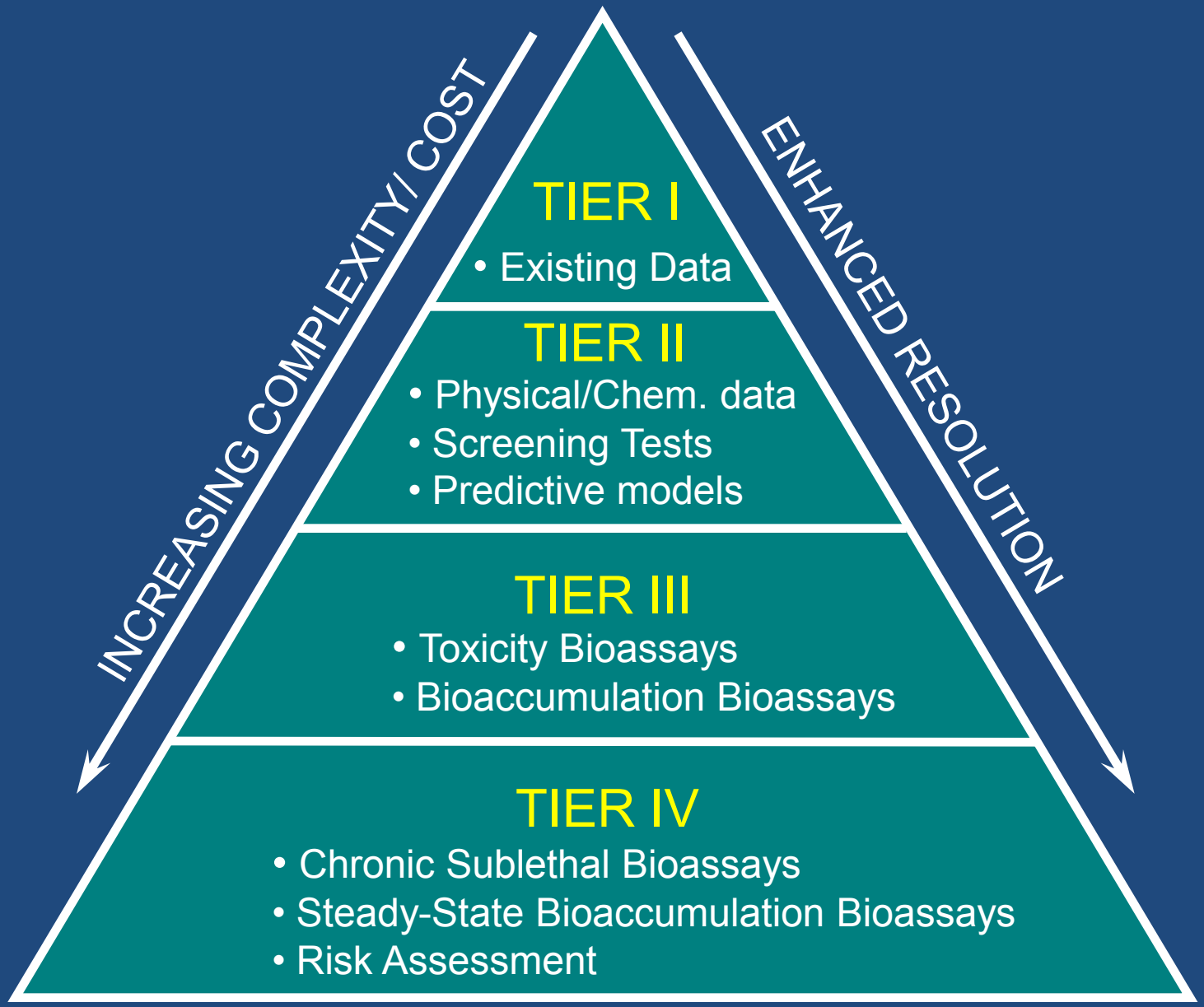
Dichlorobenzene
Half life = 10 days



Hexachlorobenzene
Half life = 6 years

Important Factors

- Chemical properties: mobility, bioavailability, persistence
- Toxicological significance (Cr^{6+} vs Cr^{3+})
- Potential to bioaccumulate


INCREASING COMPLEXITY/ COST
ENHANCED RESOLUTION
TIER I
• Existing Data
TIER II
• Physical/Chem. data
• Screening Tests
• Predictive models
TIER III
• Toxicity Bioassays
• Bioaccumulation Bioassays
TIER IV
• Chronic Sublethal Bioassays
• Steady-State Bioaccumulation Bioassays
• Risk Assessment

Tier I: Existing Information

- Examine existing information
  - Contaminant sources
    - Pathways of contaminant sources
    - Spill information
  - Physical characteristics of site
    - Bathymetry, currents, deposition, time since last dredging was required
  - Prior physical monitoring

Tier I: Exclusions

Purpose: To "rule out" need for evaluating contaminant effects if sediments are unlikely to degrade environment

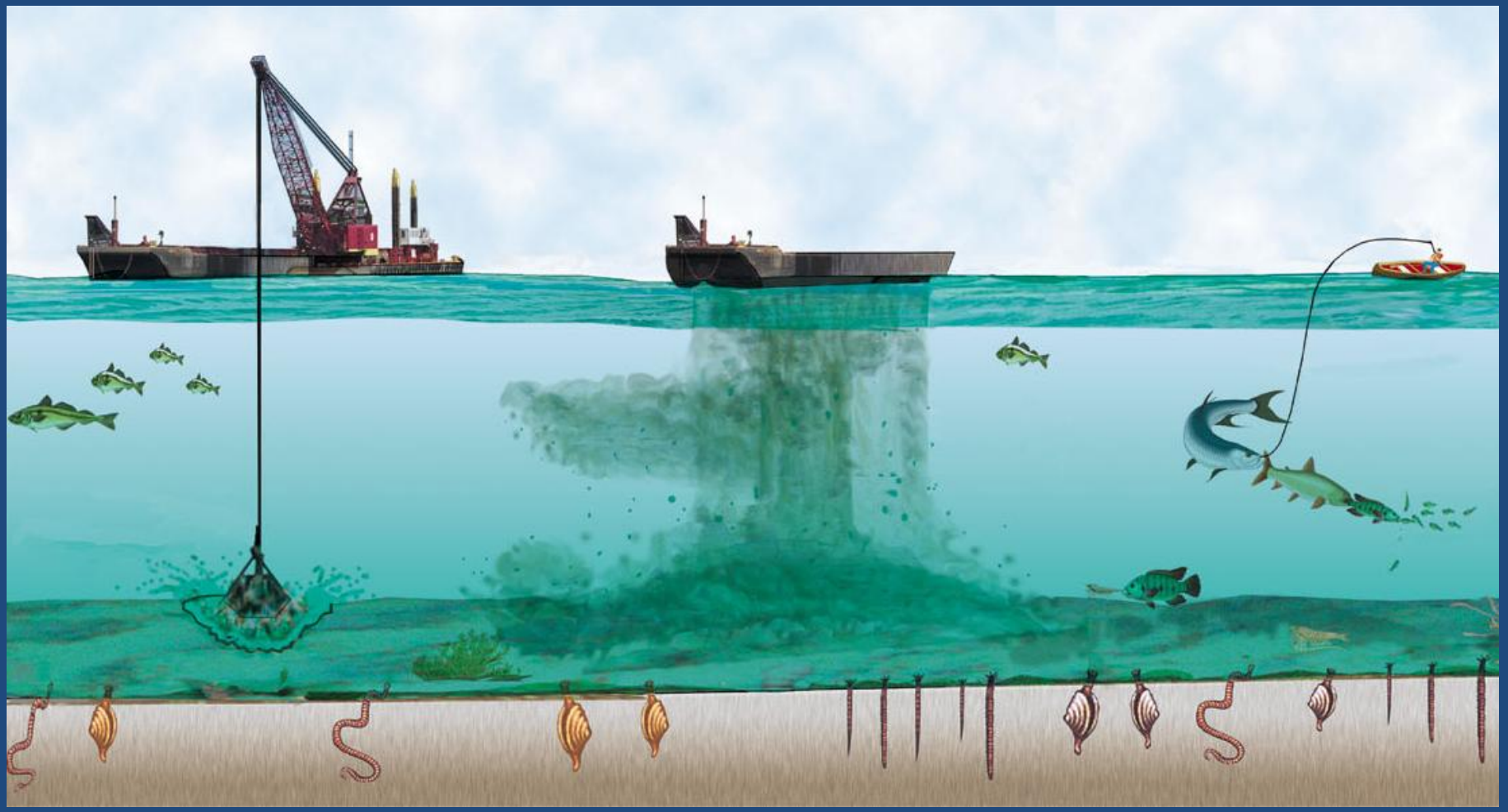
Exclusions:

- Unlikely to contain contaminants
  - Contains sand, gravel, rock; High energy
  - No evidence of contamination; "far removed from sources"
- If contaminants are present….
  - Previous data provides evidence adverse effects unlikely
  - Placement is nearby
  - Contaminants can be managed

Beach placement/nourishment, C. Frabotta, SWG

Slight differences between MPRSA and CWA

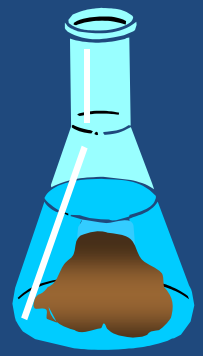
What is the Potential for Adverse Effects?

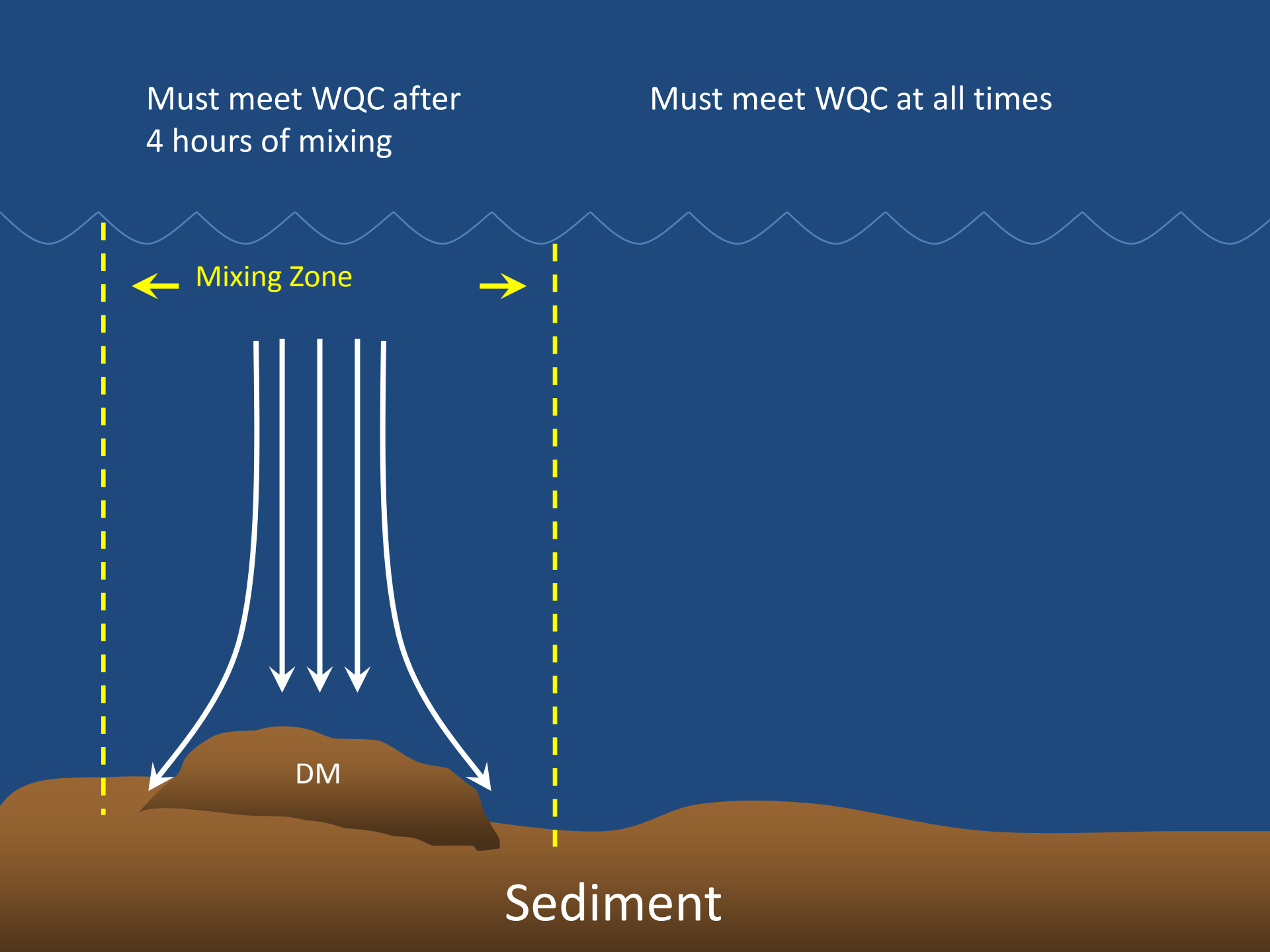


Tier II: Water Column Effects

- Predictive models to determine water column effects
  - Use sediment and elutriate chemistry to determine compliance with relevant water quality criteria/standards
- Screening step: chemical analysis data used for conservative estimate of release to water
  - assumes 100 % of all contaminants measured in sediment are released to water column
- Chemical analysis step: Use chemical analysis of elutriate to estimate releases to water column

4 parts water *
1 part DM
(volume)




Must meet WQC after
4 hours of mixing
Must meet WQC at all times
Mixing Zone
DM
Sediment

Tier III: Water Column Effects

- Conduct elutriate bioassays:
  - Tier I and II evaluation suggests the DM may contain contaminants that might result in adverse effects

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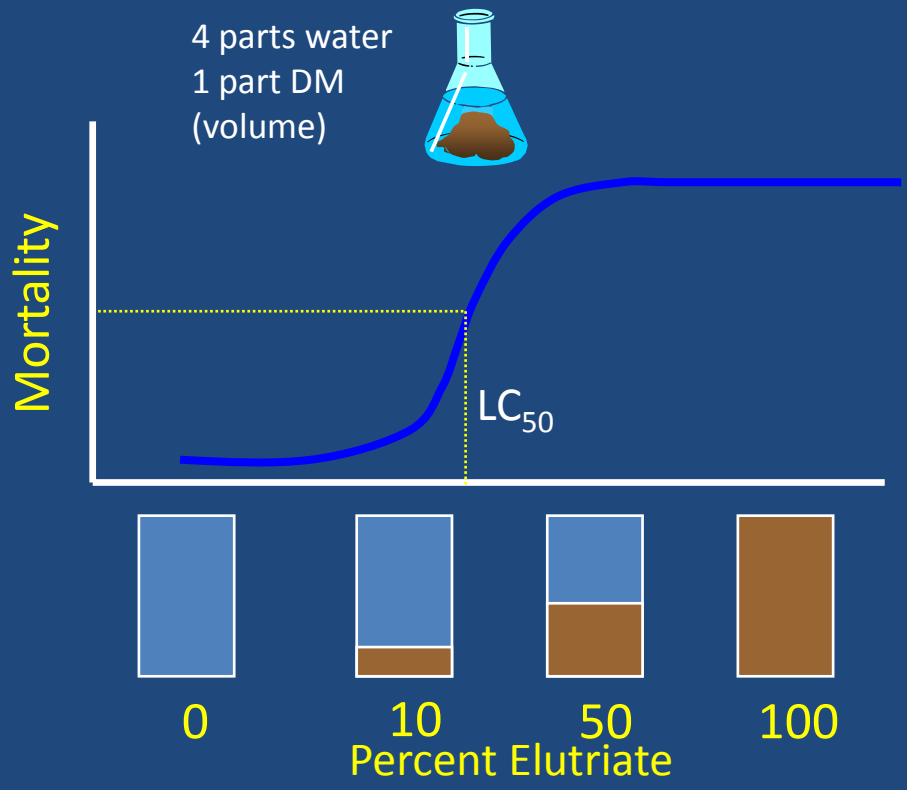
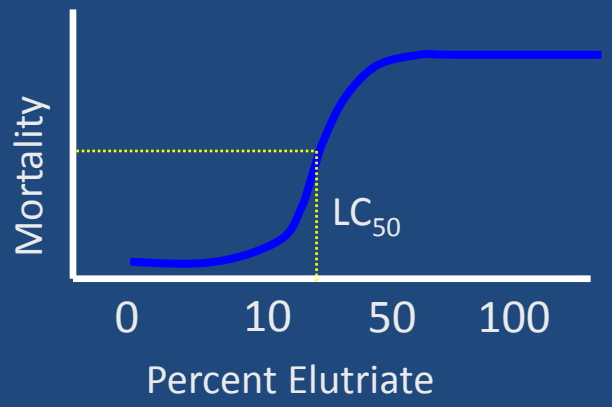
Menidia beryllina



Tier III: Elutriate Bioassay Results

1. Determine LC_{50}



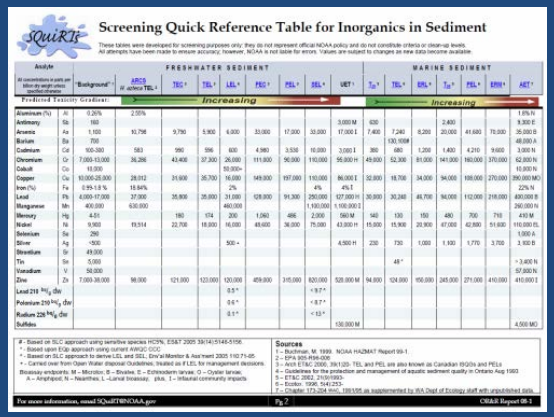
LC50 is 40%

Limiting permissible concentration (LPC) is the effect value (or 100% concentration) multiplied by an application factor (0.01)
For example, LPC = 40% x 0.01 = 0.4%

2. Model dilution of effluent from CDF or suspended DM in mixing zone; Compare the modeled concentration to the LPC

Tier II: Sediment Toxicity Screening

- Sediment quality guideline values (screening values) are available
- Not used to make decisions
  - SQG from one part of US cannot be applied to another part of US
  - SQG do not address mixtures of contaminants
  - High rate of false positives and negatives
- Can be used to determine a material is unlikely to be contaminated or help to interpret bioassay results


Screening Quick Reference Table for Inorganics in Sediment

These tables were developed for screening purposes only; they do not represent official NOAA policy and do not constitute criteria or clean-up levels.
All attempts have been made to ensure accuracy; however, NOAA is not liable for errors. Values are subject to changes as new data become available.

Analyte		FRESHWATER SEDIMENT								MARINE SEDIMENT						
All concentrations in parts per billion dry weight unless specified otherwise		"Background" [1]	ARCS @ adverse TEL [2]	TEC [2]	TEL [2]	LEL [3]	PEC [2]	PEL [2]	SEL [3]	UET [3]	T_{25} [4]	TEL [2]	ERL [3]	T_{25} [4]	PEL [2]	ERM [3]	AET [3]
Predicted Toxicity Gradient:				Increasing										Increasing			
Aluminum (%)	Al	0.26%	2.00%														1.0% N
Antimony	Sb	160								3,000 M	620			2,400			9,300 E
Arsenic	As	1,100	10,796	9,790	5,900	6,000	33,000	17,000	33,000	17,000 E	7,400	7,240	8,200	20,000	41,600	70,000	35,000 B
Barium	Ba	790									130, 1038						48,000 A
Cadmium	Cd	100-380	583	990	596	600	4,980	3,530	10,000	3,000 E	360	680	1,200	1,400	4,210	9,600	3,000 N
Chromium	Cr	7,000-13,000	36,286	43,400	37,300	26,000	111,800	90,000	110,000	55,900 H	49,600	52,300	81,000	941,000	160,000	370,000	62,000 N
Cobalt	Co	10,000				50,000+											11,000 N
Copper	Cu	10,000-25,000	28,012	31,600	35,700	16,000	149,000	197,000	110,000	86,000 E	32,000	18,700	34,000	94,000	108,000	270,000	390,000 MO
Iron (%)	Fe	0.95-1.8 %	18.84%			.2%			4%	4% T							22% N
Lead	Pb	4,000-17,000	37,000	35,800	35,000	31,000	128,000	91,300	250,000	127,000 H	30,000	30,240	46,700	94,000	112,000	218,000	400,000 B
Manganese	Mn	400,000	630,000			460,000			1,100,000	1,100,000 E							260,000 N
Mercury	Hg	4.61		180	174	200	1,060	486	2,000	560 M	140	130	150	480	700	710	410 M
Nickel	Ni	9,900	19,514	22,700	18,000	16,000	48,600	36,000	75,000	43,000 H	15,000	15,900	20,900	47,000	42,800	51,600	110,000 EL
Selenium	Se	290															1,000 A
Silver	Ag	<500				500 +				4,500 H	230	730	1,000	1,100	1,770	3,700	2,100 B
Strontium	Sr	49,000															
Tin	Sn	5,000										48 *					> 3,400 N
Vanadium	V	58,000															57,000 N
Zinc	Zn	7,000-38,000	98,000	121,000	123,000	120,000	459,000	315,000	820,000	526,000 M	94,000	124,000	150,000	245,000	271,000	410,000	410,000 E
Lead-210 $^{Bq}/_{g}$ dw						0.5 *			> 9.7 *								
Polonium-210 $^{Bq}/_{g}$ dw						0.6 *			< 8.7 *								
Radium-226 $^{Bq}/_{g}$ dw						0.1 *			< 1.3 *								
Sulfides										130,000 M							4,500 MO

- Based on SLC approach using sensitive species HC5%, ES&T 2005 39(14):5146-5156.
* - Based upon EQp approach using current AWQC EDC
* - Based on SLC approach to derive LEL and SEL, Env'l Monitor & Assmnt 2005 110:71-95.
+ - Carried over from Open Water disposal Guidelines, treated as if LEL for management decisions.

Bioassay endpoints: M – Microtox; B – Bivalve; E – Echinoderm larvae; O – Oyster larvae;
A – Amphipod; N – Neanthes; L –Larval bioassay; plus, I – Influxinal community impacts.

Sources
1 – Buchman, M. 1999. NOAA HAZMAT Report 99-1
2 – Ingersoll, 2000 EPA/600/R-00/080
3 – Arch ETAC 2000, 39(1)20. TEL and PEL are also known as Canadian WQGs and PELs
4 – Guidelines for the protection and management of aquatic sediment quality in Ontario Aug 1993
5 – ETAC 2002, 21(9):1953-
6 – Ecotox. 1996, 5(4):253-
7 – Chapter 173-204 WAC, 1991/95 as supplemented by WA Dept of Ecology staff with unpublished data

For more information, email SQuiRT@NOAA.gov

http://response.restoration.noaa.gov/sites/default/files/SQuiRTs.pdf

Tier III: Benthic Toxicity Bioassay

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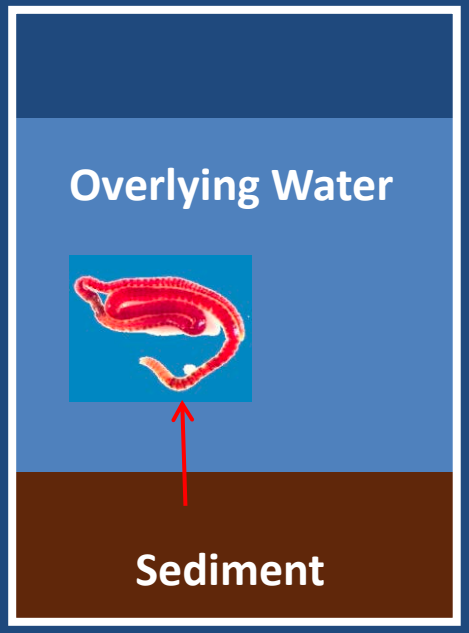
Tier II: Bioaccumulation Screening

Thermodynamically Based Bioaccumulation Potential

- Used to estimate the concentration of chemicals such as PCB and oil in tissue or invertebrates

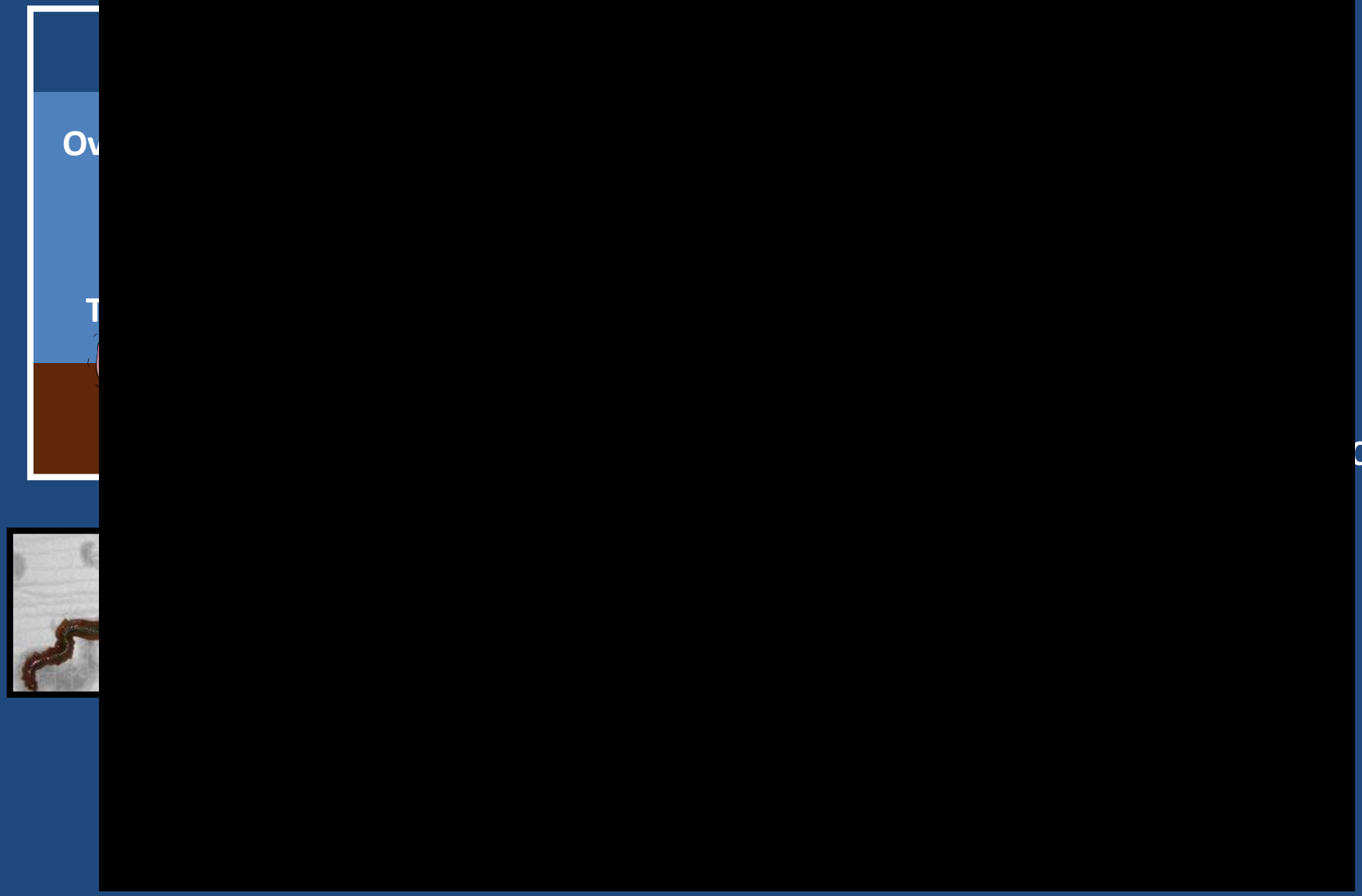


$$C_t = BSAF \times \frac{C_s}{\%TOC} \times \%L$$

BSAF Database

http://el.erdc.usace.army.mil/dots/database.html

Tier III: Benthic Bioaccumulation Bioassay



Regional Guidance

- Region specific guidance
  - Process
  - Reference locations
  - Acceptable bioassays
  - Contaminants of concern
  - Target detection levels
  - Established for most EPA Regions

EPA
U.S. Environmental Protection Agency
Region 6

US Army Corps of Engineers
Galveston District
New Orleans District

OCEAN DREDGED MATERIAL DISPOSAL PROGRAM

REGIONAL IMPLEMENTATION AGREEMENT

FOR
TESTING AND REPORTING REQUIREMENTS
FOR OCEAN DISPOSAL OF DREDGED MATERIAL
OFF THE LOUISIANA AND TEXAS COASTS
UNDER SECTION 103 OF
THE MARINE PROTECTION, RESEARCH AND SANCTUARIES ACT

July, 2003

http://www.epa.gov/region6/water/ecopro/em/ocean/odmd_sites.html

Questions

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