EPA United States Environmental Protection Agency

EPA Response to BP Spill in the Gulf of Mexico

Water Quality Benchmarks for Aquatic Life

On this page:

You will need Adobe Reader to view some of the files on this page. See EPA's PDF page to learn more.

Water Quality Benchmarks for Aquatic Life by Chemical

CHEMICAL	CAS Number	Acute Benchmark (µg/L)	Chronic Benchmark (µg/L)	Citation
Metals, µg/L				
Nickel	7440-02-0	74	8.2	1
Vanadium	7440-62-2		50	2
Mixtures, µg/L				
Total Petroleum Hydrocarbons GRO	--	None	None	--
Total Petroleum Hydrocarbons DRO	--	None	None	--
Oil Range Organics ORO	--	None	None	--

CHEMICAL	CAS Number	Acute Potency Divisor (µg/L)	Chronic Potency Divisor (µg/L)	Citation
PAH Mixtures (Oil-Related Organic Compounds), µg/L** Explanation and example of PAH benchmark calculations (PDF) (6pp, 200K)				
PAH Mixtures	--	see NOTE	see NOTE	--
Benzene	71-43-2	27,000	5,300	3
Cyclohexane	110-82-7	1,900	374	3
Ethylbenzene	100-41-4	4,020	790	3
Isopropylbenzene	98-82-8	2,140	420	3
Total xylene	108-38-3	3,560	700	3
Methylcyclohexane	108-87-2	463	91.0	3
Toluene	108-88-3	8,140	1,600	3
Naphthalene	91-20-3	803	193	4
C1-Naphthalenes	--	340	81.7	4
C2-Naphthalenes	--	126	30.2	4
C3-Naphthalenes	--	46.1	11.1	4
C4-Naphthalenes	--	16.9	4.05	4
Acenaphthylene	208-96-8	1,280	307	4
Acenaphthene	83-32-9	232	55.8	4
Fluorene	86-73-7	164	39.3	4
C1-Fluorenes	--	58.1	14.0	4
C2-Fluorenes	--	22.0	5.30	4
C3-Fluorenes	--	7.99	1.92	4
Phenanthrene	85-01-8	79.7	19.1	4

Government Response

- RestoreTheGulf.gov: official federal government site for spill response and recovery
  - File a claim
  - Report a concern
  - Volunteer
  - Hotlines and phone numbers

Other federal government information:

- Worker health and safety:
  - from OSHA
  - from CDC
- CDC review of EPA data for possible adverse health effects
- OSHA sampling data
- White House response site
- NASA satellite imagery of the spill
- Sign up for text message alerts

Connect with us:

Facebook: EPA

Twitter: EPA

Photos: BP Spill | more photos

Get email updates

Measuring temperature, PH and salinity near Grand Isle State Park, Grand Isle Louisiana.

Anthracene	120-12-7	86.1	20.7	4
C1-Phenanthrenes#	--	31.0	7.44	4
C2-Phenanthrenes#	--	13.3	3.20	4
C3-Phenanthrenes#	--	5.24	1.26	4
C4-Phenanthrenes#	--	2.33	0.559	4
Fluoranthene	206-44-0	29.6	7.11	4
Pyrene	129-00-0	42.0	10.1	4
C1-pyrene/fluoranthenes	--	20.3	4.89	4
Benz(a)anthracene	56-55-3	9.28	2.23	4
Chrysene	218-01-9	8.49	2.04	4
C1-Chrysenes^	--	3.56	0.856	4
C2-Chrysenes^	--	2.01	0.483	4
C3-Chrysenes^	--	0.699	0.168	4
C4-Chrysenes^	--	0.294	0.0706	4
Perylene	198-55-0	3.75	0.901	4
Benzo(b)fluoranthene	205-99-2	2.82	0.677	4
Benzo(k)fluoranthene	207-08-9	2.67	0.642	4
Benzo(e)pyrene	192-97-2	3.75	0.901	4
Benzo(a)pyrene	50-32-8	3.98	0.957	4
Indeno(1,2,3-cd)pyrene	193-39-5	1.14	0.275	4
Dibenz(a,h) anthracene	53-70-3	1.17	0.282	4
Benzo(g,h,i)perylene	191-24-2	1.83	0.439	4

+ This includes m-, o-, and p-xylenes

These include phenanthrene/anthracenes

^ These include benzanthracene/chrysenes

****NOTE:** Oil Related Organic Compounds are assessed jointly through a mixture approach because they all have the same type of effect on aquatic organisms. Potency divisors are not chemical-specific benchmarks, but are intermediates used in calculating the aggregate toxicity of the mixture. To assess the potential hazard to aquatic organisms, the sum of the calculated values is compared to a hazard index of 1. A value greater than 1 (>1) indicates that the sample has the potential to cause an acute or chronic effect on aquatic life like fish, crabs, and clams.

CITATIONS

1. National Recommended Water Quality Criteria. Office of Water and Office of Science and Technology

2.
- NOAA Screening Quick Reference Tables (PDF)
- British Columbia Water Quality Guideliness
- Australian and New Zealand Guidelines for Fresh and Marine Water Quality: Volume 2 - Aquatic Ecosystems - Rationale and Background Information (PDF)

3. U.S. EPA. 2008. Procedures for the Derivation of Equilibrium Partitioning Sediment benchmarks (ESBs) for the Protection of Benthic Organisms (PDF). Compendium of Tier 2 Values for Nonionic Organics. U.S. Environmental Protection Agency, Office of Research and Development: Washington DC. EPA/600/R-02/016. PB2008-107282. March 2008.

4. U.S. EPA. 2003. Procedures for the Derivation of Equilibrium Partitioning Sediment benchmarks (ESBs) for the Protection of Benthic Organisms (PDF). PAH Mixtures. EPA-600-R-02-013. Office of Research and Development. Washington, DC.

Questions and Answers about Water and Sediment Benchmarks

- **General information about benchmarks**
  - What are benchmarks?
  - What does EPA do with the chemical information from its sediment and water

General information about benchmarks:

What are benchmarks?

A benchmark is a chemical concentration, specific to either water or sediment, above which there is the possibility of harm or risk to the humans or animals in the environment. Benchmarks are designed to provide risk assessors with an efficient tool to identify contaminants of concern when evaluating data. EPA is providing benchmark values on the website to aid in the assessment of potential risk to fish and other marine life that may come into contact with oil spill associated chemicals in the water column or sediment. These are not reflective of direct contact with oil. Benchmark values are also available for human health. Benchmarks are meant to be used **for screening purposes only**; they are **not** regulatory standards, site-specific cleanup levels, or remediation goals. These screening benchmarks are presented with the EPA data to help the public understand the condition of the environment as it relates to the oil spill.

What does EPA do with the chemical information from its sediment and water samples?

EPA has approximately 280 sampling stations in the Gulf waters near Louisiana, Mississippi, Alabama and Florida. Samples are collected periodically from the water column and sediments. Analysis of samples takes 7 to 10 days. Once water and sediment samples are analyzed in a lab, the results of the chemical analyses are sent to EPA. EPA compares the data received to various numbers, called benchmarks, that have been developed for each chemical. If the concentration of a chemical is less than its benchmark value, this suggests that it poses little risk to aquatic life or human health. Likewise, a chemical concentration that is greater than its benchmark value suggests that there is potential risk to aquatic life or human health.

Do all contaminants found in crude oil have ambient water quality criteria or standards?

There are chemicals related to the BP oil spill for which EPA does not have readily available ambient water quality 304(a) criteria or other established criteria or guidelines. Therefore, toxicity study data and scientific information regarding the toxicity of these chemicals are being used to develop these screening benchmarks. Given the urgency of the BP spill, all available data are used but may not encompass all data necessary for establishing Ambient Water Quality Criteria and/or Standards. Methods for developing sediment benchmarks include use of "Effects Range Low or Median" (ERL or ERM), as well as equilibrium partitioning and narcosis theory.

Water and Sediment Benchmark Development and Interpretation:

Water

What are Ambient Water Quality Criteria (AWQC)?

Ambient Water Quality Criteria (AWQC) are the scientific foundation for state surface water quality standards. Section 304(a)(1) of the Clean Water Act (CWA) requires EPA to develop and publish, and, from time to time, revise water quality criteria (WQC) to accurately reflect the latest scientific knowledge. Section 304(a) criteria provide guidance to States and Tribes in adopting water quality standards. There are separate AWQC for aquatic life and human health. Aquatic life WQC developed under section 304(a) are based on data from aquatic toxicity tests and best scientific judgments. Human health WQC are developed using data on effects of laboratory animals, standard risk assumptions, and safety factors to ensure protection of human health.

EPA compares data to criterion to assess both **acute** and **chronic** aquatic toxicity. **Acute toxicity** describes adverse effects resulting from a substance in a short space of time such as hours. **Chronic toxicity** describes adverse effects from a substance over a long period of time such as years. For determining acute toxicity the data is compared to criterion called the Criterion Maximum Concentration. For determining chronic toxicity the data is compared to criterion called the Criterion Continuous Concentration.

What is the Criterion Maximum Concentration (CMC)?
The Criterion Maximum Concentration (CMC) is also known as the "acute" aquatic life ambient water quality criterion. These criteria use toxicity tests from 8 different taxonomic families of marine/estuarine aquatic life in which mortality or immobility was the test endpoint. Acute criteria represent the highest one-hour average concentration that should not result in unacceptable effects on aquatic organisms.

What is the Criterion Continuous Concentration (CCC)?
The Criterion Continuous Concentration (CCC) is also known as the "chronic" aquatic life ambient water quality criterion. These criteria use toxicity tests from the same types of aquatic life used for acute toxicity testing, but these tests measure effects on long-term survival, growth and reproduction of marine/estuarine aquatic life. Chronic criteria represent the highest 4-day average concentration that should not result in unacceptable toxicity during a long time event.

Source: http://www.epa.gov/waterscience/criteria/library/85guidelines.pdf

What is a toxicity test?
Toxicity tests are methods for determining the impact of a chemical or an effluent on living organisms and measure the degree of response using commonly tested species. Many different kinds of tests can be used to identify potential toxic effects but since toxic effects differ, comparing the toxicity of one to another may not be appropriate.

Why and how are metals associated with the spill being measured?
Two metals, nickel and vanadium, are associated with the oil spill and are being assessed in water and sediments. The analysis is performed using a methodology that quantifies the total amount of a specific metal present. The benchmarks are expressed as dissolved metals, since this is the fraction of the total metals that is biologically available to aquatic organisms. The amount of total metal in a sample needs to be adjusted using a metal-specific translator to compare total metals to dissolved metals. This translator is available for nickel, but not for vanadium. For vanadium, the total metal is being compared to the benchmark(s).

What is the basis of the vanadium water and sediment benchmarks?
The basis of this benchmark is from the NOAA Screening Quick Reference Tables (PDF) (SQuiRT). The resulting guideline is 50 ug/L, and is based on the 99th percentile of the available data due to the lack of data for fish. There were 6 chronic data points for 4 taxa – 3 aquatic alga; 3 invertebrate taxa (crustaceans, mollusks, annelids) – no fish toxicity data is available. The data were from one paper (Miramand & Unsal 1978). In addition, the data was quality screened before being accepted for use for threshold value (TV) derivation. The vanadium TV is considered a "high reliability" TV and is based on a species sensitivity distribution approach similar to the methodology that the EPA uses to derive water quality criteria.

Sediment

What are Effects Range Low (ERL) guidelines and how do these help EPA to understand risks to aquatic life from chemicals in sediment?
These sediment quality guidelines are based upon data primarily of marine sediment chemistry paired with sediment toxicity bioassay data. The ERL (effects range low) is not a sediment quality standard; rather, an ERL is simply a point on a continuum of bulk chemical concentrations in sediment that roughly relates to a low probability of sediment toxicity. To calculate an ERL for a given analyte, concentration data obtained from studies are ranked from lowest (least toxic) to highest (more toxic) concentrations. The 10th percentile of the ranked data is identified as the ERL. The ERL is indicative of concentrations below which adverse effects rarely occur.

What are Effects Range Medium (ERM) guidelines and how do these help EPA to understand risks to aquatic life from chemicals in sediment?
These sediment quality guidelines are also based upon a database primarily of marine sediment chemistry data paired with sediment toxicity bioassay data. The ERM (effects range median) is also not a sediment quality standard, rather, an ERM is simply a point on a continuum of bulk chemical concentrations in sediment that roughly relates to the median probability of sediment toxicity. To calculate an ERM for a given analyte, concentration data obtained from studies are ranked from lowest (least toxic) to highest (more toxic). The

50th percentile of the ranked data is identified as the ERM. The ERM is indicative of concentrations above which adverse effects frequently occur.

Why are background levels from the National Coastal Assessment (NCA) included?
Background levels from the NCA are not risk-based thresholds, but reflect the historical or background conditions from data collected in Gulf of Mexico coastal waters from 2000-2006. The NCA baseline information provides us with Gulf-wide estuarine information on the condition of water, sediment, and ecological indicators such as sediment-dwelling organisms and fish contamination prior to the spill. This background information can be used to evaluate changes that occurred following the spill and to determine how successful remediation efforts are over time. This summer, samples will be taken as part of the next round of the NCA, entitled the National Coastal Condition Assessment (NCCA), which can provide information on post-spill conditions in the Gulf.