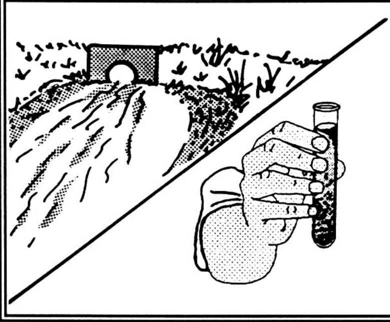
Environmental Indicator Profile Sheet



Indicator Profile No. 5

Sediment Contamination

(Constitutent/toxicity analysis)

Category: **Water Quality**

Tools Used to Measure Indicator:

- Constituent Concentrations
- Sediment Quality Assessment Guidelines
- Spectrophotometry
- Chromatography

Description:

Many pollutants found in stormwater runoff, such as metals, organic toxins, and aromatic compounds, become attached to sediments and settle to the bottom in slower receiving waters, wetlands, and stormwater retention and detention basins. The presence and mass concentration of pollutants can be determined through spectrometric and chromatographic analyses of sediment samples.

Sampling may be conducted in natural water bodies (e.g. streams, lakes, estuaries) or artificial basins (e.g. detention ponds). To determine whether sediments are contaminated by anthropogenic sources, samples are often compared to a reference water body where human impacts are minimal or nonexistent. The mass of contaminant is often cross-referenced with the distance from the suspected pollutant discharge location (e.g., stormwater outfall) or source (e.g., urban area).

Sediment may adversely impact the aquatic community. Benthic organisms feed and dwell in the bottom sediments. Nonbenthic organisms are potentially exposed to sediment contaminants through re-suspension, ingested benthic organisms, and exposure to the sediment as it settles to the bottom.

In order to identify potential ecological effects, contaminant concentrations may be compared to sediment quality assessment guidelines. Ecological impacts may also be assessed through analysis of the associated interstitial (pore) water and water immediately overlying the sediment. This water can be collected and analyzed for conventional pollutants. Acute and chronic toxicity testing of the water immediately overlying the sediment may be conducted either in the field or in the laboratory. Toxicity testing of the interstitial water and the sediment elutriates (recreated sediment suspensions) are performed in the laboratory.

Indicator Useful for Assessing:

* Aquatic Integrity of:	
Lakes	●
Streams	◖
Estuaries	●
* Land Use Impacts	◖
* Stormwater Mgmt Programs	◖
* Whole Watershed Quality	◖
* Industrial Sites	◖
* Municipal Programs	◖

Key:

Very Useful	●
Mod. Useful	◖
Not Useful	○

Indicator Advantages

* Geographic Range	◖
* Baseline Control	◖
* Reliable	◖
* Accuracy	◖
* Low cost	○
* Repeatable	◖
* All Watershed Scale	○
* Familiar to Practitioners	●
* Easy to use & Low training	◖

Key

Very Advantageous	●
Mod. Advantageous	◖
Not Advantageous	○

Cost

See Table 3.3A

Utility of Indicator to Assess Stormwater Impacts:

- Analysis of the sediment within urban embayments can provide an indication of the level of contamination and, by proximity, the probable source of contamination in the drainage area.
- Analysis of samples taken within and/or immediately upstream and downstream of stormwater management facilities can be used to evaluate the performance of BMPs.
- Trends in sediment pollutant levels over time can reveal long-term changes in pollutant loadings.
- Can be used to evaluate local stormwater management efforts for the control of particular pollutant sources over the long term.

Advantages of Method:

- The relatively static nature of this indicator may increase public interest and involvement in stormwater issues.
- The likelihood that sediment pollutants come from nearby sources promotes local accountability thereby reducing the potential for jurisdictions to blame problems on others and instead encouraging them to assume responsibility for restoration.

Disadvantages of Method:

- There are few criteria or standards against which ambient sediment pollutant concentrations may be compared.
- Levels of concern and the long-term impact of sediment pollutant concentrations with respect to ecological impacts are still being studied and are not clearly defined.
- The method requires numerous samples (both spatially and at various depths) to determine whether pollutants come from anthropogenic sources.
- The method is useful only for pollutants that become adsorbed to dense particulates.
- Since sedimentation occurs primarily in low-energy embayments, the indicator is less appropriate for use in free-flowing channels.
- The usefulness of this indicator for "real-time" assessment of current pollutant reduction measures is limited due to resuspension of sediments, dredging, and other activities which inhibit the short-term settlement of pollutants.
- Several decades may be necessary to accumulate sufficient data for trend analysis.
- Industrial spills, wastewater discharges, illicit connections, atmospheric deposition and runoff from agricultural and industry sources can all deliver pollutants to sediments, making it very difficult to trace the actual source.
- While suspended in the water column, pollutants may undergo differential chemical behavior, microbial degradation, and photo-degradation. Correlation of the original pollutant source to pollutants identified in the sediment may, therefore, be difficult.

Case Study: Byrne, C.J.; DeLeon, I.R. 1987
Contributions of Heavy Metals from Municipal Runoff to the Sediments of Lake Pontchartrain, Louisiana
Chemosphere, Vol. 16, Nos. 10-12: 2579-2583, 1987.

The authors analyzed sediment samples from eight stations along the northern and southern shorelines of Lake Pontchartrain to determine the distribution and sources of heavy metal pollutants. Sampling sites were at stormwater runoff canals, the mouth of a highly industrialized canal, and the mouths of two lake tributaries. The authors used atomic absorption spectrometry to determine sediment concentrations of barium, copper, nickel, lead, and zinc. Metal concentrations tended to increase with increasing population densities, with the most highly impacted areas being adjacent to the metropolitan area of New Orleans. Lower metal concentrations were found in suburban/residential areas, with the lowest levels observed at the rural, low-density station.

Method References:

- Chemical Monitoring: Taylor, G.F. 1990. *Quantity and Quality of Stormwater Runoff from Western Daytona Beach, Florida, and Adjacent Areas.* USGS Water-Resources Investigations Report 90-4002.
- Toxicity testing: ASTM. 1995. Standard Guide for Collection, Storage, Characterization and Manipulation of (Freshwater/Saltwater) Sediments for Toxicological Testing. in Annual Book of ASTM Standards, Section II. Water and Environmental Technology. Vol 11.05.
- Biological monitoring/bioassays: Dermott, R.; M. Munawar. 1992. A Simple and Sensitive Assay for Evaluation of Sediment Toxicity Using *Lumbriculus variegatus* (Mueller). In: Hart, B.T.; Sly, P.G. (eds). *Sediment-Water Interactions*. Vol. 235-6, pp. 407-414.
- Contaminated sediment: U.S. EPA. 1994. EPA's Contminated Sediment Management Strategy-Reinventing Bovernment to Streamline Dicision-making. Washington, DC 151p. EPA/823/R-94/001