



# Contaminated Sediments News



## Tiered Testing Issues for Freshwater and Marine Sediments

A workshop cosponsored by the Office of Water and the Office of Research and Development was held September 16-18 in Washington, DC. The workshop provided a forum for experts in sediment toxicology and staff from EPA's Regional and Headquarters program offices to discuss the development of standard freshwater and marine sediment bioassay procedures. The results of discussions held at the workshop were used to focus ongoing research and to develop technical guidance for conducting acute and chronic sediment bioassays and bioaccumulation tests. The guidance documents are expected to be available next Fall for use by all of the Agency's program offices. For more information contact Tom Armitage at (202) 260-5388.

## Sediment Activities Around the Country

### EPA Headquarters

#### National Inventory of Contaminated Sediment Sites

For the past several years, EPA's Office of Science and Technology (OST) has been working toward the development of a national inventory of contaminated sediment sites for both freshwater and marine environments. The initial call for the development of this inventory originated from EPA's Draft Contaminated Sediment Management Strategy. More recently, Congress passed the Water Resources Development Act (WRDA) of 1992, which requires EPA, with assistance from NOAA and the COE, to develop a National Inventory of Contaminated Sediment Sites by 1994.

Based on experiences gained from pilot contaminated sediment inventories in Regions 4 and 5 and the Gulf of Mexico

Program, OST is currently nearing completion of the proposed Framework for the Design of an Inventory of Contaminated Sediment Sites, which will fulfill both the objectives of the National Strategy and the mandates of WRDA. The Framework report includes a discussion of the overall purpose of the Inventory with specifics on how each EPA Program Office plans to use the Inventory. The report begins with a review of background studies and pilot inventories, as well as alternative design options. Next, the chosen approach is described in detail, including categories of monitoring data to be collected (e.g., data included must be in electronic format), and proposed data collection and data entry processes. Approaches to be used in evaluating the data in order to determine national areas of concern are currently under consideration. It is anticipated that the Detailed Monitoring Database will be housed on EPA's mainframe, with the results of the evaluation of the detailed monitoring data available in a PC-compatible format. Approaches for data evaluation are currently under consideration and will be developed further as data gathering proceeds.

*(continued on p. 2)*

## Contaminated Sediment Activities Timeline

**April 12-16, 1993.** ARCS Technology Transfer Course. Madison, WI. The course will provide instruction in the application of the sediment assessment methods identified and demonstrated during the ARCS Program, as well as early results from the treatment technology demonstrations. Contact Rick Fox, GLNPO, at (312) 353-7979.

**April 27-29, 1993.** Meeting of ASTM Subcommittee on Sediment Toxicology (E47.03). Atlanta, GA. Contact Chris Ingersoll at (314) 875-5399.

**June 6-10, 1993.** International Association for Great Lakes Research Annual Meeting. DePere, WI. Contact John Kennedy, Green Bay Metropolitan Sewerage District, at (414) 432-4893.

**June 14-16, 1993.** International Association on Water Quality. Milwaukee, WI. 1st International Specialized Conference on Contaminated Aquatic Sediments: Historical Records, Environmental Impacts, and Remediation. Contact Erik Christensen at (414) 229-5422.

**CS News is produced by EPA-OST to exchange information on contaminated sediments and to increase communication among interested parties. To obtain copies of this report or to contribute information, contact Beverly Baker, EPA HQ, at (202) 260-7037.**



Compilation of the National Inventory of Contaminated Sediment Sites will begin early next year as soon as comments on the Framework report are received and incorporated into the design. For more information or to receive a copy of the Framework report, contact Catherine Fox, OST, at (202) 260-1327.

### **Standard Methods for Sediment Collection, Handling, and Spiking Under Development**

EPA has formed a committee of experts to reach consensus on standard methods for sediment collection, handling, and spiking. A number of guides for collecting and handling sediment have been developed. EPA's Environmental Research Laboratory in Newport, Oregon, has developed a sediment spiking procedure; an ASTM guide for sediment collection, storage, characterization, and manipulation has been developed; and Environment Canada will soon be releasing a guidance document on sediment collection, handling, transport, storage, manipulation, and spiking. All of these guides will be used by EPA's group of experts to develop a methods document describing procedures that may be adopted as EPA standard methods. The methods document developed by the group will be ready next November for both EPA approval and ASTM subcommittee review at the SETAC meeting in Houston. For more information contact Tom Armitage, OST, at (202) 260-5388.

### **Science Advisory Board Completes Review of Sediment Criteria**

The Science Advisory Board (SAB) has completed the second and most recent review of the Equilibrium Partitioning (EqP) approach for generating sediment criteria. The SAB Sediment Quality Subcommittee of the Ecological Process and Effects Committee reaffirmed that "the EqP is scientifically sound" and concluded that "EPA should proceed according to the following sequence of events: (1) establish criteria on the basis of present knowledge within the bounds of uncertainty discussed in this report; (2) improve the present knowledge so as to improve the procedures for establishing criteria; and (3) periodically revisit the criteria to make them more consistent with conditions in the natural environment."

In May 1992, the Office of Water asked the SAB to evaluate the Agency's progress in reducing the uncertainties associated with the EqP approach in light of how the Agency intends to use sediment quality criteria. The review was conducted on June 10-11, 1992, and was attended by scientists from academia, industry, public interest groups, and other government agencies. Presentations by EPA focused on intended uses of sediment criteria, technical aspects of the methodology, and what was done to respond to specific recommendations identified by the SAB in the first review of the criteria. In addition, a methodology was presented for modifying sediment criteria based on site-specific conditions (e.g., species sensitivity, partitioning, or both). Presentations followed from industry, public interest groups, and other federal agencies both supporting and challenging aspects of the criteria.

The SAB's review of the criteria was very positive. The SAB found that the scientific basis for the EqP approach was valid and "supports the EqP concept to develop sediment criteria where the conditions of equilibrium among the various phases of sediments are likely." It commended EPA for addressing the recommendations of the SAB from earlier reviews. They concluded that the methodology is sufficiently valid to be used in a regulatory context, provided that the uncertainties associated with the methodology are clearly stated and considered in the process. The SAB did state that they would like to see the continued collection of field data and that users of the criteria will have to determine the appropriate use of the criteria within their programs. EPA agrees with both of these points.

### **Next Steps**

The five draft sediment criteria documents provided to the SAB for review will be updated and will undergo both a formal internal Agency red border review and formal public review and comment via the *Federal Register*. To increase the scope of these reviews, four supplemental documents will accompany the criteria documents as part of the review:

- a proposed methodology for conducting site-specific sediment criteria modifications to be used when field conditions suggest that modification of the criteria may be warranted;
- a technical support document that articulates the technical basis of the criteria and identifies minimum data requirements needed to derive sediment criteria;
- a document outlining probable intended uses of sediment criteria; and
- a copy of the recent SAB report that reviewed the EqP approach for generating sediment criteria.

In addition, a user's manual that will help ensure appropriate application of sediment criteria is being prepared. EPA plans to issue two or three new sediment criteria each year and to periodically review criteria documents to incorporate new science.

### **Calculating Sediment Criteria**

Some have had difficulty calculating sediment criteria. To make this task a little easier, EPA has prepared Lotus and Excel (continued on p. 3)

### ***Sediment Classification Methods Compendium Available***

Limited copies of the final *Sediment Classification Methods Compendium* are now available through the OST Resource Center. If you requested a copy and haven't received it by December 18, contact Maureen Lynch of the Resource Center at (202) 260-7786. The document can also be obtained through NTIS (PB 93-115186). The cost is \$36.50 in print and \$17.50 for microfiche. The Educational Resources Information Center (ERIC) will also sell the compendium (101-D) for \$19.50 in print. For more information call ERIC at (614) 292-6717.

spreadsheets. The user needs only to plug in organic carbon levels (dry weight or percent) and fresh and marine sediment criteria values and confidence limits will be automatically calculated for the five draft criteria compounds. The spreadsheets are located on the Nonpoint Source Program electronic bulletin board, (301) 589-0205. To obtain a copy of these spreadsheets, EPA employees or persons working with or for EPA can download the file SQCCALC.ZIP. Note: Final chronic values and  $K_{ow}$ s may be slightly different from those contained in current draft criteria documents. When this is the case, use the spreadsheet values because they are more recent. The spreadsheet values will be updated as needed.

### **Sediment Criteria for Metals**

In 1993 EPA is planning to present a proposed methodology for deriving sediment criteria for metal contaminants to the SAB for review. The proposed methodology focuses on divalent metals and anoxic sediments. For sediments contaminated with other metals or when metals are found in sediments that are oxic, an interim approach will be recommended. This interim approach is being developed to help provide scientists and environmental program managers with recommendations on sediment analysis until a criteria methodology can be developed. Absolute clean concentrations and sediment assessment methodologies will be recommended.

## **Regional Activities**

### **Region 2**

#### ***Regional Implementation Manual for Dredged Material Disposal***

Region 2 and the New York District Corps of Engineers have developed a regional implementation manual for the evaluation of dredged material proposed for ocean disposal. This manual implements the revised national "Green Book" guidance on ocean disposal specifically for dredging projects proposed in the New York/New Jersey Harbor area. For more information contact (212) 264-1302.

### ***Sediment Inventory Planned for New York/New Jersey Harbor***

Region 2 sediment inventory projects are planned for this fiscal year to assess New York/New Jersey Harbor sediments. The New York Harbor Estuary Program and Environmental Services Division are cooperating on a R-EMAP study of sediment quality characteristics in New York Harbor that will look at chemistry, benthic community structure, and amphipod (*Ampelisca abdita*) toxicity. In addition, NOAA is providing resources for a sediment bio-effects assessment for portions of the harbor that will include collection of sediments for chemical analysis and *A. abdita* toxicity tests. This effort follows a more comprehensive assessment performed in 1991 by NOAA and the EPA Environmental Research Laboratory at Narragansett. Contact Joel O'Connor at (212) 264-5356 or Darvene Adams at (908) 321-6700 regarding the R-EMAP study; contact Eric Stern at (212) 264-5283 regarding the NOAA study.

#### ***Decontamination Technology Program under WRDA***

Decontamination technologies will be assessed for their effectiveness and suitability in the development of a decontamination program that will be jointly recommended by EPA and the Corps of Engineers for New York/New Jersey Harbor. Resources for this program are being provided through section 405 of the Water Resources Development Act (WRDA) of 1992. Investigations will be based on efforts initiated by the Corps under WRDA of 1990; other necessary aspects of a complete decontamination program will also be considered. These can include removal and pretreatment and posttreatment technologies, as well as siting and economic investigations. For more information contact Audrey Massa at (212) 264-8118 or Alex Lechich at (212) 264-1302.

### **Region 6**

Region 6 recently completed a report entitled *Trends in Selected Water Quality Parameters for the Houston Ship Channel*. This report documents temporal changes in water column concentrations for 21 parameters at five locations in the inland portion

of the Ship Channel. In addition, it evaluates the more limited data set for heavy metals and PCBs in bottom sediments and discusses available data on ambient toxicity and the aquatic community. The sediment data suggest dramatic reductions in heavy metals over time at the Turning Basin, the inland extent of the dredged channel. There were no significant changes in sediment PCB concentrations over time at any of the stations investigated. Copies of the report are available from the Regional Office. For more information contact Phil Crocker, Region 6, at (214) 655-6644.

## **ORD Activities**

### **ERL-Duluth**

In a cooperative effort, ERL-Duluth and the U.S. Fish and Wildlife Service are developing standardized test methods for three organisms to help assess contaminated sediments. Researchers will develop test conditions and culture conditions for *Hyalella azteca*, *Chironomus tentans*, and *Lumbriculus variegatus*. EPA hopes to release the document by the end of this fiscal year.

Ongoing research efforts being conducted to support this effort include:

- Testing the relative sensitivity of the test organisms to some common sediment contaminants (e.g., metals, pesticides);
- Evaluating the toxicity of ammonia at various pHs to the test organisms;
- Determining the effects of abiotic factors on test (e.g., particle size) results;
- Evaluating the kinetics of bioaccumulation of contaminants by *L. variegatus*; and
- Developing a reference sediment.

In addition, researchers from 10 to 12 government, contract, and university labs will perform round-robin testing using *Hyalella azteca* and *Chironomus tentans*. Both short-term water only exposure tests and long-term sediment tests will be conducted. For more information contact Gary Ankley, ERL-Duluth, at (218) 720-5603.

## Great Lakes National Program Office

### *ARCS Pilot Demonstrations Completed*

The final three of five pilot-scale demonstrations of sediment treatment technologies to be performed by the Assessment and Remediation of Contaminated Sediments (ARCS) Program were initiated or completed this past summer. The bioremediation of 2,700 cubic yards of PCB-contaminated sediment from the Sheboygan River, Wisconsin, was initiated in May, with sampling continuing through spring 1993. This project is being done jointly by USEPA ERL-Athens for the ARCS Program and Blasland, Bouck and Lee for the Superfund Potentially Responsible Party (PRP), Tecumseh Products.

A solvent extraction demonstration was conducted in July at the Grand Calumet River, Indiana. The Basic Extractive Sludge Technology (BEST) process, developed by the Resources Conservation Company, was set up at the US Steel Gary Works, where it was used to treat 300 gallons of PAH- and PCB-contaminated sediments. This demonstration was a joint effort of the ARCS Program and the Superfund Innovative Technology Evaluation (SITE) Program. A final report is expected in the summer of 1993.

A thermal desorption unit developed by Remediation Technologies was demon-

strated on 15 cubic yards of sediments from the Ashtabula River in September. The unit is being monitored to test its ability to remove PCBs and other chlorinated organics from sediments. A final report is expected in the summer of 1993. For more information on these demonstration projects, contact Steve Garbaciek, GLNPO, at (312) 353-0117.

### *Conference on the Remediation of Sediments*

A conference on the remediation of sediments was held on November 17-18, 1992, in East Brunswick, New Jersey. Rutgers Institute of Marine and Coastal Sciences sponsored the conference in conjunction with the Port Authority of New York and New Jersey. This conference was a follow-up session to a similar conference on bioremediation techniques for sediments held in May.

Staff from the Great Lakes National Program Office's (GLNPO) ARCS program made presentations on treatment technology test results. Representatives from Holland, Belgium, Germany, and England presented the results of similar research programs in their countries. Additional presentations were made on sediment dynamics and the use of underwater borrow pits for the disposal of dredged materials from New York and New Jersey harbors. Conference proceedings will be published early next year. For more information contact Mike De Luca, Rutgers Institute of Marine and Coastal Sciences, at (908) 932-6555.

### ***Contaminated Sediment Assessment and Remediation Course Planned***

The ARCS Program and the Department of Engineering Professional Development of the University of Wisconsin are planning a technology transfer course to be held April 12-16, 1993, in Madison, Wisconsin. The course will provide instruction in the application of the sediment assessment methods identified and demonstrated during the ARCS Program, as well as early results from the treatment technology demonstrations. The course will be geared to state agency personnel and other supporters of Great Lakes Remedial Action Plans (RAPs). For more information contact Rick Fox, GLNPO, at (312) 353-7979.

## Army Corps of Engineers

### *Development of "Second Generation" Sediment Toxicity Tests*

Scientists at the USACE Waterways Experiment Station (WES) in Vicksburg, MS, are developing a new generation of sediment toxicity tests. These new toxicity tests are designed to assess the potential long-term or "chronic" sublethal effects of contaminated sediments. A primary objective of this research effort is to develop tests that are technically sound yet simple enough for routine regulatory application.

To date, research has focused on developing tests to evaluate the sublethal effects of dredged material on growth and reproduction in benthic infaunal test species. This effort has resulted in a proposed 28-day growth bioassay with a marine polychaete worm, *Neanthes (Nereis) arenaceodentata*. In addition, similar research with saltwater amphipods is ongoing.

A key element in developing these tests is providing technically strong interpretative guidance. First-generation toxicity tests measure acute lethality, and interpretation of mortality is fairly straightforward (i.e., either the test organism survives or it does not). Results from chronic sublethal sediment toxicity tests, however, are more enigmatic. Consequently, much of the research by the Corps has focused on (1) the development of interpretative guidance for a growth endpoint by linking growth to subsequent reproductive success and (2) the use of population dynamics models to evaluate changes in individual growth and reproduction at the population level.

One use of these chronic sublethal toxicity tests may be in the USEPA/USACE effects-based tiered testing approach for evaluating the suitability of dredged material for ocean disposal (i.e., the Green Book). For more information contact Dr. David Moore, WES, at (601) 634-2910.

### *Bioaccumulation of Toxic Substances in Aquatic Organisms*

A computer database has been created to provide users with numerical and descrip-

(continued on p. 5)

tive information for interpreting the environmental significance of dioxin and furan analytical data. The database emphasizes dioxins and furans in sediments, aquatic biota, and fish-eating birds. Both field and bioassay data are included. Presently, more than 2500 entries from both the refereed literature and less easily accessible government reports have been entered. The database is accessible to users familiar with dBASE IV at the USACE Waterways Experiment Station, Vicksburg, MS, or by request to Victor A. McFarland, at (601) 634-2489.

### ***Genotoxicity of Contaminated Dredged Material***

In March 1990 a sediment genotoxicity workshop was held at WES to develop a strategy for testing the mutagenic, carcinogenic, and teratogenic potential of contaminated sediments. The approach recommended by the workshop attendees combines *in vitro* and *in vivo* biomarkers of exposure or of effect with long-term bioassays in a tiered application. The Ames *Salmonella* mutagenicity assay has now been successfully adapted for use with sediments as part of a first-tier screen for genotoxicity. Complementing screening assays under evaluation or development include the rat hepatoma H4IIE *in vitro* assay testing CYP1A1 mixed-function oxidase (MFO) induction and the single-cell gel assay for *in vivo* DNA damage to selected cells. Second-tier procedures are intended to have greater specificity for particular compounds and include DNA-carcinogen adducts, bile metabolites, and cytogenetic indicators such as micronuclei. A long-range objective of the research is to determine the levels of uncertainty associated with biomarkers and short-term bioassays used as predictors of genotoxic potential by correlating results with developmental abnormalities and cancer in fish models. For more information contact Victor A. McFarland, WES, at (601) 634-3721.

### ***Relationships Between Sediment Geochemistry and Biological Impacts***

The organic carbon (OC) fraction of sediments is commonly used as a basis for expressing the concentration of chemical contaminants such as PCBs, PAHs, dioxins, furans, and chlorinated pesticides. OC normalization is useful in making predictive assessments of the potential for such

chemicals to bioaccumulate in aquatic organisms. Additionally, OC normalization is fundamental to the equilibrium partitioning-based sediment quality criteria proposed by EPA. However, many sediments of concern have very low OC content, and the lower limit of applicability of OC normalization is not known. Scientists at WES are evaluating a kinetic model involving a fish-suspended sediment system to address this problem. The design eliminates most of the sources of variability inherent in long-term studies in which empirical rather than predicted steady state concentrations are used as the endpoint. For more information contact Victor A. McFarland, WES, at (601) 634-3721.

## **State of Florida**

### **Florida Develops Preliminary Effects-Based Sediment Quality Assessment Guidelines for Coastal Waters**

The Florida Department of Environmental Regulation (FDER) has initiated a project to develop and validate preliminary effects-based sediment quality assessment guidelines (SQAGs). These informal guidelines are needed to provide screening tools for assessing the potential biological effects associated with sediment-sorbed contaminants. At present, these SQAGs are intended for use in such applications as identifying priority stormwater controls, designing wetlands restoration projects, and monitoring trends in environmental contamination.

A number of approaches have been used to develop SQAGs in various jurisdictions throughout the United States. A review of the major approaches used to assess sediment contamination revealed that no single approach was likely to satisfy all the needs for SQAGs. Of the eight approaches evaluated, the weight-of-evidence approach (WEA) developed by the National Oceanic and Atmospheric Administration (see NOAA Technical Memorandum NOS OMA 52) is considered to respond most

directly to Florida's immediate need for reliable and cost-effective SQAGs. Environment Canada (EC) is also using this approach to derive SQAGs. Critical evaluation of this procedure suggests that, while the WEA has limitations that could influence the applicability of the guidelines, it will support the derivation of preliminary guidelines for Florida coastal waters that are scientifically defensible.

Using the recommended procedure, data derived from a wide variety of methods, approaches, and locations in North America were assembled and evaluated to derive preliminary SQAGs for 25 priority contaminants in Florida coastal waters. These numerical SQAGs are used to define three ranges of concentrations for each of the contaminants, including a probable effects range, a possible effects range, and a no effects range. These ranges of contaminant concentrations are considered to be more effective assessment tools than single numerical guideline values because they explicitly recognize the inherent uncertainty in sediment quality assessments. In addition, the ranges are considered to provide more flexibility in the application of the guidelines in various environmental programs.

A subjective assessment of the accuracy of these management tools indicates that a high level of confidence should be placed on the guidelines derived for 11 substances. A somewhat lower level of confidence should be placed on the guidelines for the remaining 14 substances. The results of this assessment suggest that the preliminary guidelines should be fully evaluated and

**SQAGs will be used as screening tools to assess biological impacts at contaminated sediment sites.**

refined, as necessary, using the results of investigations conducted in Florida and elsewhere. Studies are under way in Tampa Bay, St. Andrews Bay, and Pensacola Bay that will provide information directly relevant to the evaluation of these guidelines. It is anticipated that revised SQAGs will be available in late 1993.

The numerical SQAGs and general advice  
(continued on p. 11)

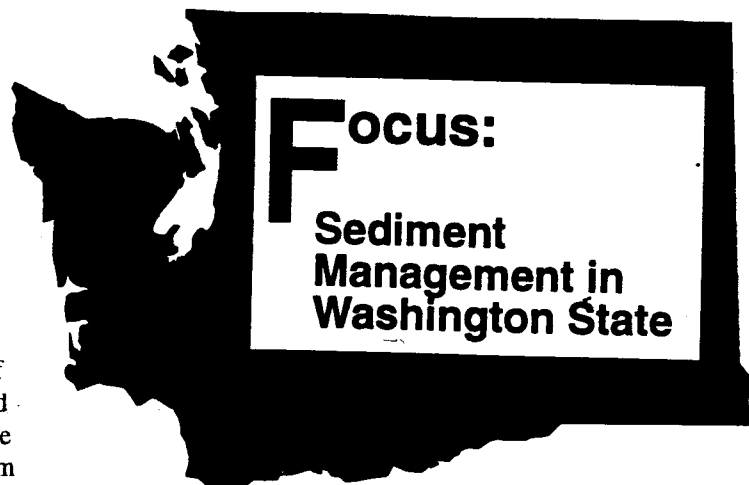
**T**he State of Washington has addressed sediment contamination in a comprehensive management program established in cooperation with state and federal agencies. The management program includes limits on ongoing discharge sources of sediment contamination, methods to dredge and dispose of contaminated sediment, and sediment cleanup. Much of the program's framework came from the Puget Sound Comprehensive Conservation and Management Plan, a product of Puget Sound's designation as an estuary of national significance. The Plan's sediment strategy included the following steps:

- 1) adopt standards that define sediment contamination;
- 2) control the sources of sediment contamination;
- 3) manage dredging and dredged material disposal in consideration of contaminant levels;
- 4) proceed with sediment cleanup where it is needed and can be accomplished; and
- 5) provide opportunities for public involvement and education throughout the process.

### Sediment Management Standards

The cornerstone of Washington's program is the Sediment Management Standards (SMS) (Chapter 173-204 WAC), adopted in March 1991. These standards include:

- *Sediment Quality Standards* — establishes effects-based narrative standards statewide, as well as chemical and biological criteria for 47 contaminants in the marine surface sediments of Puget Sound.
- *Source Control* — provides a method to control the sources of contamination by applying sediment quality standards to existing source control programs (e.g., NPDES permits).
- *Sediment Cleanup* — establishes a sediment clean-up decision process that identifies, ranks, and prioritizes contaminated sediment sites, and specifies sediment clean-up standards.



## Focus: Sediment Management in Washington State

The SMS are the result of an extensive public involvement and technical development process that began in the early 1980s. The standards also contain reserved sections for further development of freshwater and human health criteria (see below). The SMS were approved by EPA in 1991 as part of the state's water quality standards under section 303 of the Clean Water Act.

### Technical Approach

Sediment quality is evaluated using a tiered testing approach. If there are no chemical criteria exceedances in the initial chemistry tier, then the sediment is assumed to not cause biological effects. If there are exceedances, a second biological tier is available to address the findings of the chemistry tier. If biological tests are done, the biological test interpretation will govern the final decision on the sediment quality. This second tier requires the use of:

- two approved "acute effects" bioassays: a 10-day amphipod mortality (*Rhepoxynius abronius*) and one of four larval mortality/abnormality tests (*Crassostrea gigas*, Pacific oyster; *Mytilus edulis*, blue mussel; *Strongylocentrotus purpuratus*, purple sea urchin; or *Dendraster excentricus*, sand dollar) and
- one of three approved "chronic effects" tests: field benthic infaunal abundance; 20-day juvenile polychaete biomass (*Neanthes arenaceodentata*); or saline-extract bacterial bioluminescence ("Microtox").

### Ongoing Criteria Development

The SMS contain reserved sections for further development and improvement of the rule. The state is currently developing

human health criteria and freshwater sediment criteria. Pending budget appropriations, human health and freshwater criteria are planned for adoption as an amendment to the SMS in 1994.

*Human Health Sediment Criteria Development* — Work on human health sediment criteria development was initiated in late 1991. The criteria are currently envisioned as a two-tier process. Tier 1 is intended to be a straightforward

application of chemical criteria that are developed using conservative (protective) assumptions. The Tier 1 criteria will be designed to identify significant health threats. Acceptable sediment chemical concentrations are calculated using the chemical's potency and predicted human exposure values. Tier 2 will provide a more thorough analysis of chemicals and exposures on a site-specific basis.

The Washington effort to date has focused primarily on Tier 1 and has produced several draft technical and policy documents ranging from a literature review of seafood consumption rates in Puget Sound to analysis of a probability distribution model to derive criteria. Continuing efforts include evaluation of an age-dependent food web model to derive bioaccumulation factors, and policy determinations of appropriate risk levels and the population to be protected. Tier 2 development work will begin in June 1993 and will incorporate a methodology for site-specific sediment and human health evaluations.

### Freshwater Sediment Criteria

*Development* — Also initiated in 1991, Washington's freshwater sediment quality criteria development work has primarily focused on three areas to date: a literature search, compilation of a database for Washington freshwater sediment chemical concentrations, and limited bioassay comparison studies using field projects in Washington State with known contamination levels. From these study areas the following reports are available to the public:

- **FSEDCRIT** — a summary of freshwater sediment chemical criteria or guidelines issued by agencies in the U.S. and Canada; (continued on p. 7)

- **FSEDBIB** — a bibliographic database of freshwater sediment literature, guidelines, and methods that serves as a foundation for ongoing criteria development activities;

- **FSEDLIST** — a database of historic freshwater sediment chemical data for Washington State sediment samples;

- **Status Report** — Freshwater Sediment Criteria Development Project, a summary review of the Department of Ecology's development work in the above studies and site status and bioassay test conclusions and recommendations from four freshwater contaminated sediment site projects; and

- **A Review of Interpretation Methods for Freshwater Benthic Invertebrate Survey Data Used by Selected State and Federal Agencies** — a description of freshwater benthic infaunal assessment methodologies from 22 states.

Finally, with the assistance of EPA Region 10 grant monies, Washington currently plans to complete a regional freshwater sediment quality database by September 1993. This database will be the key step toward the initial identification of freshwater sediment chemical criteria.

#### ***Regulatory Application of Sediment Criteria***

The SMS establish two levels of criteria — a "no-effects" level that serves as the long-term goal for contaminant levels in sediments, and a "minor-effects" level that is the maximum allowable level for sediment contamination.

The two levels of criteria provide a range within which regulatory decisions are made. The regulatory selection of a level for a specific discharge permit or clean-up site is made as close as practicable to the lower limit but recognizes that other factors such as engineering feasibility, cost, or natural recovery may require allowing a higher level of contamination. For those areas in which permitted discharges or clean-up activities exceed the "no-effects" level, the state can authorize "sediment dilution zones." For source control activities, these take the form of "sediment impact zones" and are available only to dischargers that

operate the permitted facility meeting all current technology requirements. In clean-up actions, a "sediment recovery zone" is established that takes into account factors such as natural recovery and engineering/cost feasibility considerations. In all cases, the maximum permitted level in these zones is the upper "minor adverse effects" level.

#### ***Dredged Material Management***

Several elements of the state's comprehensive sediment management program address dredged material.

**Puget Sound Dredged Disposal Analysis (PSDDA)** — the PSDDA program was initiated in 1985 to manage the unconfined, open-water disposal of relatively clean material dredged for navigation purposes in Puget Sound. The eight PSDDA disposal sites are jointly managed by the U.S. Army Corps of Engineers, U.S. EPA, and the State of Washington, and were federally

designated via the Corps/EPA advanced identification process pursuant to 40 CFR 230.80. Washington's SMS rule explicitly recognizes the PSDDA process and reaffirms the approach used in the PSDDA program. The two programs use similar technical interpretations to assess sediment quality, and the PSDDA-approved dredged material disposal sites are being established as approved "sediment impact zones" under the SMS rule.

**Dredged Material Management Standards (DMMS)** — Washington is developing a rule that will establish requirements for dredging, transporting, and disposing of contaminated sediments, and will provide design and monitoring requirements for disposal in water, along the shore, and on land. A guidance manual summarizing current technical requirements for dredged material management is being written, and the rule is scheduled to be drafted in 1993. *(continued on p. 8)*

## ***Reports Available***

The development and implementation of the State of Washington's sediment management program have resulted in a library of more than 30 documents related to various areas of the program. These include:

- Sediment Management Standards Rule (Chapter 173-204 WAC)
- Sediment Management Standards Part V: Sediment Cleanup Standards — Guidance Document (\$9.90 — please call for ordering information)
- Multiuser Confined Disposal Sites Program Study

For copies of these documents, or for a complete list of available documents, contact:

Barb Patrick, Sediment Management Unit  
Department of Ecology  
P.O. Box 7703  
Olympia, WA 98504-7703  
(206) 459-6013

Answer from p. 11: *Batillipes noerrevangii*, a marine interstitial tardigrade.



**Multiuser Confined Disposal Sites —**  
Washington is working to establish multiuser confined disposal sites for Puget Sound that would provide safe disposal environments for contaminated sediments dredged from both navigation and clean-up projects.

### **Key Program Feature: Regulatory Integration**

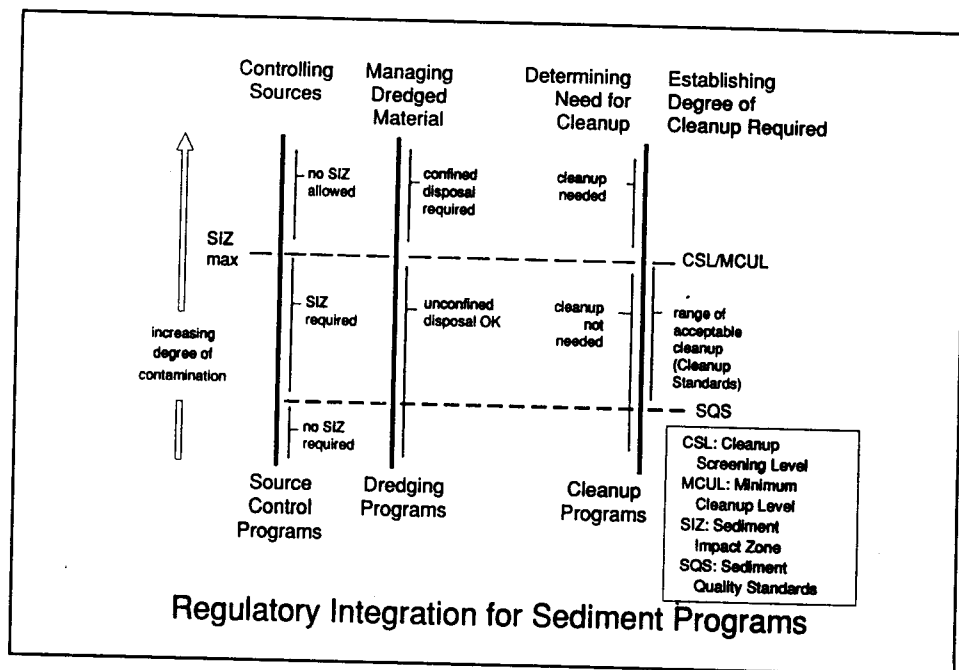
The SMS were designed to provide regulatory consistency among all key government programs that address sediment contamination. Each of these programs uses the same quality standards to determine regulatory decisions regarding sediments. The sediment contaminant levels allowed as a result of a permitted discharge do not exceed the disposal guidelines established for the PSDDA disposal sites. This ensures that permitted discharges do not result in increased disposal costs and liabilities for navigation dredging projects and state-owned disposal sites. Also, the contaminant levels permitted in a discharge permit or at a dredged material disposal site are set so they do not exceed "cleanup triggers." This ensures that regulatory managers are not permitting ongoing discharges or establishing dredged material disposal sites that would result in future clean-up sites.

### **Continuing Challenge — Sediment Liability from Ongoing Discharges**

During development of the SMS rule, there was extensive discussion of how to manage ongoing discharge contamination and associated liability in sediments located on private and public aquatic lands. Though the contamination is due to the discharge, current laws allocate the responsibility for any needed contamination cleanup jointly and severally to both the discharger and the landowner.

To address this concern, the state considered requiring landowner approval of discharge impacts on aquatic lands. However, there would be no effective way to prevent a landowner from asking a discharger for unreasonable compensation or from unreasonably withholding approval. There were also legal concerns regarding delegating regulatory decisions to private parties.

As a partial response to this issue, the SMS rule:



- recognizes proprietary interests by stating that regulatory actions (e.g., discharge permitting) do not address any proprietary requirements;
- aligns the sediment standards so discharges do not create new clean-up sites; and
- assigns accountability to the dischargers for sediment effects.

In addition, during ongoing implementation of the SMS, state agencies are working together to coordinate regulatory actions (e.g., NPDES permits) and proprietary actions (e.g., outfall leases on aquatic lands) for upcoming discharge authorizations.

Though the above responses may be adequate to address discharges that are under individual permits and accountable scrutiny, they may not be adequate for stormwater discharges with many outfalls and limited control systems. In recognition of the difficulty for stormwater discharges to achieve immediate compliance with sediment standards, the SMS rule allows the state to authorize extended compliance time frames for certain stormwater discharges. Though the rule notes that the discharger may be accountable for future cleanup of the discharge, the current legal requirements also ascribe this liability to the owner of aquatic lands affected by the discharge.

The advent of NPDES permits that address municipal stormwater discharges further underscores the potential liabilities for

aquatic landowners and may be the basis for legal challenges that seek relief from the discharger or from the permitting agency. Concern regarding clean-up liability may result in additional legal challenges associated with the discharge being out of compliance with Clean Water Act standards (which include sediment standards in this state).

To address stormwater and sediment liability concerns, Washington is currently conducting a study to better define the liability issues and to document potential administrative and legislative solutions, as recommended by various agencies, business interests, and environmental groups. The study is scheduled for completion in January 1993. For more information contact Keith Phillips, DOE, at (206) 459-6143, or John Malek, Region 10, at (206) 553-1286.

### **Other Contacts for Region 10 Sediment Activities:**

Human Health Sediment Criteria Development: Rachel Friedman-Thomas, (206) 493-9356.

Freshwater Sediment Criteria Development: Brett Betts, (206) 459-6824.

Dredged Material Management Standards: Tom Elwell, (206) 459-6053.



## NOAA

As part of its National Status and Trends Program, NOAA is conducting a series of regional surveys of sediment toxicity in selected bays and estuaries. These surveys are accompanied by measures of biomarkers and bioaccumulation in resident bivalve molluscs and demersal fish. Collectively, the results are used to identify the spatial extent and severity of biological effects associated with toxicants.

In the sediment toxicity surveys, samples are collected throughout each study area to provide a representation of conditions in all major components of each area. A battery of toxicity tests are performed on the samples, usually accompanied by chemical analyses of the samples. Sediment toxicity tests were first used as a bioeffects assessment tool in a 1990 survey of San Francisco Bay. The results were published in NOAA Technical Memorandum NOS ORCA 64. Since then, a number of other surveys have been initiated.

### **Hudson-Raritan Estuary (NY/NJ) -**

In Phase I of this survey, sediments from 117 locations were tested for toxicity with solid-phase amphipod survival tests, liquid-phase clam larvae survival and development tests, and organic extract Microtox bioluminescence tests. These tests demonstrated that toxicity was widespread in this area. High toxicity was apparent in the East River, Newark Bay, Arthur Kill, western Raritan Bay, and Sandy Hook Bay. Chemical analyses of many of the samples are under way. In Phase II, scheduled to begin in January 1993, 60 samples will be collected from Newark Bay, the lower Passaic River, the lower Hackensack River, and the northern part of Arthur Kill. Amphipod survival tests, dioxin potency bioassays with rat hepatoma cells, and chemical analyses of sediment samples will be conducted.

### **Bays of Long Island Sound (NY/CT) -**

Sediments from 60 locations in the bays and harbors adjoining Long Island sound were tested with the same tests used in the Hudson-Raritan Estuary survey. Also, chemical analyses of all samples were performed. Nearly all the samples were toxic to the amphipods. The results are being evaluated.

### **Tampa Bay (FL) -**

Sediments from 90 locations throughout the Tampa Bay Estuary were collected in Phase I. They were tested with a solid-phase amphipod survival test, a pore water sea urchin egg fertilization test, and an organic extract Microtox bioluminescence test. Chemical analyses of most of the samples were performed. In Phase II an additional 78 samples were collected in four regions in which toxicity had been detected in the first phase: Northern Hillsborough Bay, western Old Tampa Bay, Bear Creek/lower Boca Ciega Bay, and along the St. Petersburg municipal shoreline. These samples were collected in August 1992 and the analyses are under way.

### **Southern California (CA) -**

This study area stretches from Los Angeles south to the United States/Mexico border and focuses on the coastal bays and harbors. In Phase I of this survey, samples from 99 locations were collected in Los Angeles/Long Beach Harbor, San Pedro Bay, Anaheim Bay, Alamitos Bay, and Huntington Harbor. They were tested with a solid-phase amphipod survival test and a pore water abalone larvae development test. The pore water will also be tested later with the sea urchin egg fertilization test. In Phase II of this survey, samples will be collected in San Diego Bay, Tijuana Slough Estuary, San Diego River, and Mission Bay. In Phase III, additional samples from Oceanside Harbor, Newport Bay, and numerous coastal lagoons will be tested.

The results of all surveys will be published in NOAA technical memoranda and made available. These reports will include summaries of historical sediment toxicity data and the results of the NOAA-supported surveys. For more information contact Ed Long, NOAA, at (206) 526-6317.

## ASTM Update

The ASTM Subcommittee on Sediment Toxicology (E47.03) met Saturday, November 7, 1992, before the 13th Annual SETAC meeting in Cincinnati, OH.

During the meeting, the scope of the Subcommittee was expanded to include developing Test Methods in addition to Guides for sediment testing. A Guide is defined by ASTM as a series of options with no recommended course of action, while a Test Method is defined as a definitive procedure for measuring characteristics of a material. EPA's Office of Science and Technology is interested in balloting the proposed USEPA sediment methods listed below as ASTM Test Methods. The documents would need to be written in ASTM format, and any negatives during balloting would be addressed following ASTM procedures.

1. Freshwater tests: (a) *Hyalella azteca*: 10-d survival; (b) *Chironomus tentans* and *Chironomus riparius*: 10-d survival and growth; and (c) *Lumbriculus variegatus*: 28-d bioaccumulation.
2. Saltwater tests: (a) *Rhepoxynius*, *Ampelisca*, *Leptocheirus*, *Eohaustorius*: 10-d survival; (b) *Ampelisca*: 20-d growth; (c) *Leptocheirus*: 28-d (or longer) survival, growth, reproduction, intrinsic rate of natural increase; and (d) *Macoma*: 28-d bioaccumulation.
3. Sediment spiking.
4. Sediment collection.
5. Experimental design and statistics.

For more information contact Chris Ingersoll, ASTM, at (314) 875-5399.

## Thank You!

Thank you to everyone who takes the time to write articles for each issue of *CS News*. The feedback we have received from this publication has been tremendous and it is because of you. We would like to have many more contributors for the next issue, targeted for April, so if you have any news please call Bev Baker at (202) 260-7037.

## Environment Canada

### Canada's Great Lakes Cleanup Fund

The Great Lakes Cleanup Fund, one of three components of the Government of Canada's Great Lakes Action Plan, will provide \$55 million over the next several years to help develop and demonstrate innovative clean-up technologies and remedial programs in the 17 Canadian Great Lakes Areas of Concern (AOCs). One of the priorities of the Cleanup Fund is the remediation of contaminated sediments. Through the Cleanup Fund, Environment Canada is demonstrating techniques for the assessment, removal, and in-place and off-site treatment of contaminated sediments.

Projects supported by the Cleanup Fund contribute to the restoration of beneficial uses in the AOCs in support of the Canada/Ontario Remedial Action Plan process. In each AOC, a joint federal/provincial team is developing and implementing a Remedial Action Plan.

#### Assessment

Samples of sediment from all demonstration sites, collected both before and after remediation, are submitted for biological assessment. Following the establishment of cultures of the candidate invertebrate species, and protocols for the tests, four standard bioassays have been developed. The four organisms include *Hyallozoe azteca*, *Hexagenia limbata*, *Chironomus riparius*, and *Tubifex tubifex*.

#### Removal

All of the sediment removal techniques being demonstrated are designed to remove sediment with minimal resuspension of sediments and disturbance of the water column. Most recently, the Cleanup Fund demonstrated the use of a cable-arm bucket, which removed 250 cubic meters of contaminated sediment from a boat slip in Toronto's inner harbor. The cable-arm bucket is a precision, sealed clamshell bucket that removes only the layer of contaminated material without digging a hole as a conventional bucket does. The bucket uses cables instead of the fixed arms and opening counterweights of a conventional

bucket. This reduces the overall weight by 40 percent and provides an extremely low profile.

#### Treatment

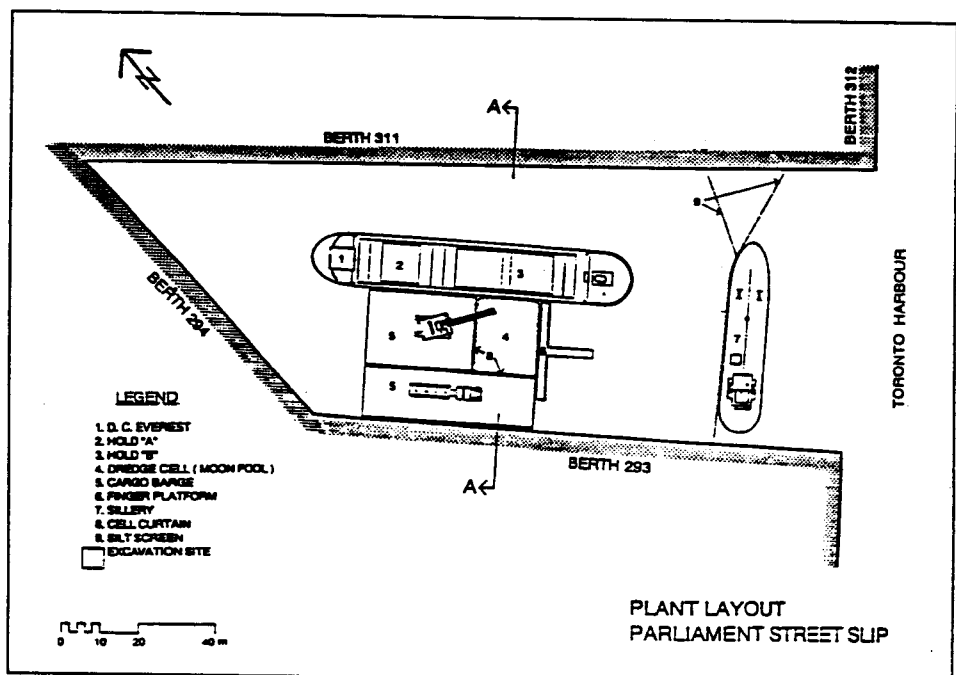
Another technique being investigated is in-place treatment of contaminated sediments. Scientists at EC's National Water Research Institute have developed a system to inject an oxidant, either ferric chloride or calcium nitrate, into sediments. The oxidants reduce the levels of hydrogen sulfide and acute toxicity in anaerobic sediments, allowing bacteria to break down organic contaminants. The technique has proven quite promising in the St. Mary's River AOC, where about 30,000 square meters of river bottom have been treated at depths up to 5 meters. In-place treatment using calcium nitrate was also carried out this summer in deeper water (approximately 20 meters) in Hamilton Harbor.

Under the off-site sediment treatment program, a pilot-scale demonstration of EcoLogic's high-temperature thermal destruction process was conducted using sediments from Hamilton Harbor. This technology is based on the theory that at elevated temperatures hydrogen in the gas phase reacts with organic molecules to produce smaller, lighter, and less toxic molecules. Except for incinerators, there are currently no other commercially available viable technologies worldwide that can achieve as significant a destruction of toxic organic substances. (Other technologies

simply transfer the toxins to another phase, bind them in a structural matrix, or destroy them to a limited extent.) Sediments from the Toronto Harbor cable-arm bucket demonstration are undergoing treatment at the Toronto Harbor Commissioner's Soil Recycling Facility. The sediment will be washed under high water pressure and size separated. Then inorganic materials, primarily metals, will be removed using a leaching process. Finally, the organic contaminants will be treated using a bioremediation process.

At the bench-scale level, 11 innovative technologies have been tested on sediment samples from the Welland River, Thunder Bay, and Hamilton Harbor. Results are being assessed to determine whether pilot-scale testing is feasible.

Field demonstrations in support of clean-up activities are also under way in areas of combined sewer overflow control, stormwater management, and fish and wildlife habitat rehabilitation. In its first 2 years, the Cleanup Fund has allocated about \$12 million to 34 projects in AOCs throughout the Great Lakes system. Approximately one-third of these resources were allocated in support of demonstrations in sediment assessment, removal, and treatment. Cleanup Fund resources are enhanced by contributions from other federal departments, provincial and municipal agencies, the private sector, and public interest groups. For more information contact John Shaw, EC, at (416) 336-6231.



## Relevant Literature

Casas, A.M: 1992. The relationship between acid volatile sulfide and the toxicity of zinc, lead, and copper in marine sediments. Master's thesis. School of Fisheries, University of Washington. Seattle, WA.

USEPA. 1992. *Proceedings of the EPA's Contaminated Sediment Management Strategy Forums*. EPA 823-R-92-007. Contact OST Resource Center at (202) 260-7786.

USEPA. 1992. *Sediment Classification Methods Compendium*. EPA 823-R-92-006. Contact OST Resource Center at (202) 260-7786.

## Sediment Criteria Documents

Sediment criteria documents can now be obtained through the Office of Water Resource Center. To obtain copies of any of the documents listed below, simply contact the Resource Center at (202) 260-7786.

- 1) Technical Basis for Establishing Sediment Quality Criteria for Non-ionic Chemicals Using Equilibrium Partitioning (Environ. Toxicol. & Chem. 10. 1991).
- 2) Sediment Quality Criteria for the Protection of Benthic Organisms: Acenaphthene (draft)
- 3) Sediment Quality Criteria for the Protection of Benthic Organisms: Dieldrin (draft)
- 4) Sediment Quality Criteria for the Protection of Benthic Organisms: Endrin (draft)
- 5) Sediment Quality Criteria for the Protection of Benthic Organisms: Fluoranthene (draft)
- 6) Sediment Quality Criteria for the Protection of Benthic Organisms: Phenanthrene (draft)
- 7) Briefing Report to the EPA Science Advisory Board on the Equilibrium Partitioning Approach to Generating Sediment Quality Criteria
- 8) Analytical Method for Determination of Acid Volatile Sulfide in Sediment (final draft)
- 9) An SAB Report: *Review of Sediment Criteria Development Methodology for Non-ionic Organic Contaminants* - September 1992

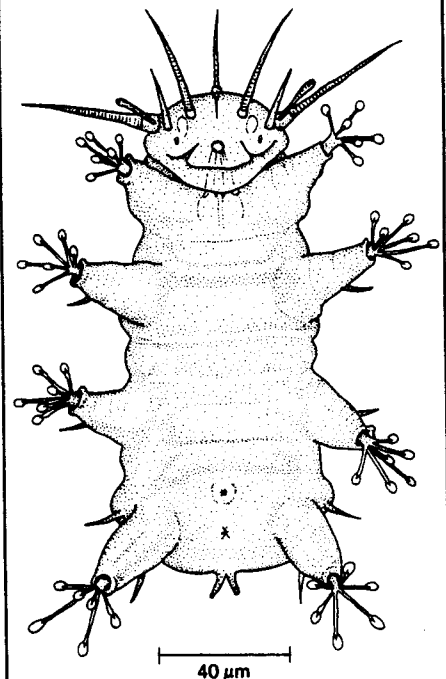
For additional information on sediment criteria or related topics, contact Mary Reiley at (202) 260-9456 or Chris Zarba at (202) 260-1326.

(continued from p. 5)

on their use are reported in a guidance document that has been prepared for FDER. This report indicates that SQAGs should be used primarily as screening tools for establishing priorities with respect to sediment quality management. However, they should not be used in lieu of water quality criteria or sediment quality criteria, but in conjunction with other tools to conduct comprehensive and reliable assessments. To assist potential users, a simple framework for assessing sediment quality on a site-specific basis is presented in the guidance document. This framework illustrates the roles of the metals interpretive tool (described in Issue 4 of *Contaminated Sediments News*) and various bioassessment tools (e.g., toxicity and bioaccumulation tests) in assessing the quality of Florida's coastal sediments. For more information on the Florida SQAGs, contact Fred Calder or Gail Sloane, FDER, at (904) 488-0784.

## Creature Feature

Who lives in the sediment anyway?



Answer on p. 7

United States  
Environmental Protection  
Agency (WH-585)  
Washington, DC 20460

Official Business  
Penalty for Private Use  
\$300