Abstracts for the mini-conference on

Characteristics and Reuse Potential of Illinois River Sediments

March 1, 2007

Illinois Waste Management and Research Center
Stephen Warner Conference Room
One E. Hazelwood Drive, Champaign
www.wmrc.uiuc.edu

Characteristics and Reuse Potential of Illinois River Sediments mini-conference

March 1, 2007 10 a.m. – 3:30 p.m.

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10:00	**Marvin Piwoni, WMRC**	***Welcome***
10:05	**John Marlin, WMRC**	***Introduction; The Illinois River Sediment Project: An Overview***
10:30	**Jim Slowikowski, ISWS**	***Sediments and Sediment Sampling for the Illinois River***
11:00	**Richard Cahill, ISGS**	***Assessment of Sediment Quality and Sedimentation Rates in Lakes Associated with the Illinois River: An Update based on 2002 Vibracores***
11:30	**Mike Machesky, ISWS**	***The Potential Toxicity of Recent Peoria Lake Sediment Pore Waters***
Noon	**Lunch – at WMRC**	
1:00	**Karl Rockne, UIC**	***Active Capping Sediment Remediation in the Chicago River***
1:30	**Robert Darmody, UIUC**	***Potential Use of Illinois River Sediment as Topsoil at Brownfields and Other Sites***
2:00	**Stephen Ebbs, SIU**	***Cultivation of Garden Vegetables in Peoria Pool Sediments from the Illinois River: A Case Study in Trace Element Accumulation and Dietary Exposures***
2:30	**John Kelly, Loyola Univ.**	***Assessment of Soil Microbial Communities in Surface Applied Illinois River Sediments***
3:00	**John Marlin**	***Wrap-up and discussion***

The Illinois River Sediment Project: An Overview

John Marlin
Illinois Waste Management and Research Center, One Hazelwood Dr., Champaign, IL 61820

The degradation of the Illinois River and its floodplain has been discussed for over a century. The development of the *Integrated Management Plan for the Illinois River Watershed* in 1997 launched the latest effort to identify and address problems and plan for the meeting the economic and ecological needs of the watershed. The loss of backwater depth due to sedimentation was identified as a major impact on the river's ecological and recreational functions.

Over the past 200 years the watershed has experienced dramatic changes in urbanization, agricultural practices, and industrial development all of which contributed in some way to the quality or volume of sediment inputs. Additionally structural features contributed to major changes in the river's hydrology.

The sediment project was launched in 1998 with funds provided by the General Assembly. Over the years funds from a variety of sources have supported numerous efforts to collect and analyze data, develop restoration concepts, and gain an understanding of the physical and chemical nature of the river sediments. Other work addressed sediment removal technology and finding potential beneficial uses for dredged material.

Numerous public and private agencies and organizations contributed to the sediment project. Today we will hear from a number of researchers. Some have worked on large reaches of the river, others on sediment from small areas. The ultimate goal is to understand how the sediment varies over the length of the river and what uses are compatible with its chemical and physical properties.

Sediments and Sediment Sampling for the Illinois River

Jim Slowikowski
Illinois State Water Survey, 2204 Griffith Dr., Champaign, Illinois 61820

Excessive sedimentation has been documented in most of the backwater and side channel areas along the Illinois River resulting in a significant loss of habitat and contributing to the overall environmental degradation of the Illinois River. Future instream restoration efforts on the Illinois River are likely to involve the removal of accumulated sediments from backwater and side channel areas using various dredging techniques. However before dredging activities can take place, sediments will need to be adequately characterized. This characterization provides not only chemical information necessary to ascertain if sediments meet applicable permitting requirements but also provides important geotechnical information. These data are crucial in allowing resource managers, design personnel and entrepreneurs to plan, develop and implement new strategies for the use of dredged materials that improve a project's benefit cost determination by providing intrinsic economic and environmental benefits.

To help meet the need for sampling and characterizing deep sediments, the Illinois State Water Survey developed a vibrocoring capability and methodologies to handle long sediment cores. This presentation will provide an overview of the Illinois State Water Survey's vibrocoring efforts as well as the techniques for sampling and sample processing that have evolved to date.

Assessment of Sediment Quality and Sedimentation Rates in Lakes Associated with the Illinois River: An update based on 2002 Vibracores.

Richard A. Cahill
Illinois State Geological Survey, 615 E. Peabody Dr., Champaign, IL 61820

Sediments of lakes associated with the Illinois River contain trace metals and organic compounds that record the industrial and land-use history of immediate watershed, as well as the influence of the diversion of waters from Lake Michigan that began in the early 1900's. The Illinois State Geological Survey has been studying the chemical composition of sediments in the Illinois River since 1971. Numerous studies (up to 1998) were conducted on the trace element distribution of sediments that were based on surface sediment samples, or short <1.0 m cores. In 1998, the first set of long vibracores (up to 2.4 m) were collected in Peoria Lake, but budget constraints prevented detailed sampling of the cores for chemical analysis. In 2002, three studies were conducted using the newly developed ISWS vibracorer on the Illinois River. A total of 61 vibracores were collected in research sponsored by WMRC, IDNR and US Army COE. The results from the detailed analysis of the chemical composition of these sediment cores and sedimentation rate estimates obtained from ^{137}Cs dating provide insight to when contaminants were deposited and what are realistic background concentrations.

The Potential Toxicity of Recent Peoria Lake Sediment Pore Waters

Mike Machesky
Illinois State Water Survey, 2204 Griffith Dr., Champaign, IL 61820

This presentation will summarize results of completed WRMC-funded research concerned with the pore water composition of recent (0-30 cm) Peoria Lake sediments, and will highlight the need for expanded future studies, including in other reaches along the Illinois River. Our completed work has shown that at certain times, pore water dissolved ammonia concentrations (and/or possibly those of hydrogen sulfide) may be high enough to impair the widespread reestablishment of fingernail clam populations within Peoria Lake. Moreover, since this impairment could continue even after planned restoration efforts such as dredging are completed, more research is needed to determine spatial and temporal trends in the concentrations of pore water ammonia, hydrogen sulfide and other potential toxicants in recent Illinois River sediments.

Active Capping Sediment Remediation in the Chicago River

Karl J. Rockne
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Active Capping is a new potentially low cost treatment for in situ treatment of contaminated sediments developed by researchers at UIC, University of Texas-Austin, Stanford University, University of New Hampshire, Louisiana State University and elsewhere. Our research group at UIC is collaborating with the Metropolitan Water Reclamation District of Greater Chicago, the Wetlands Initiative, and the City of Chicago to install a field scale active capping demonstration project in Collateral Channel and Turning Basin of Bubbly Creek in the Chicago River. The capping will be carried out in conjunction with an overlaying wetland to remove nutrients and pollutants from a combined sewage outflow. Active cap amendments will be evaluated in the one/four acre area, which will include metal sequestration (a thin active cap of apatite mineral) and hydrophobic organic contaminant sequestration (blended granular activated carbon). Sampling of Collateral Channel and Turning Basin of Bubbly Creek was performed to get a large background dataset in September and October 2005. Levels of toxic heavy metals, polycyclic aromatic hydrocarbons (PAHs) and polychlorinated biphenyls (PCBs) were compared at the same location from sampling in the past. In Collateral Channel, organic pollutant levels were high throughout core samples dating back to the 1800s. Contaminants were not significantly changed since 1995, suggesting natural attenuation is not occurring. Based on our results, we are focusing our active capping design on the extensive characterization of the organic matter content coupled with the very high levels of PAHs suggesting the importance of organic sequestration. In the Turning Basin of Bubbly Creek, no significant differences were found between the characteristics in the Turning Basin and the whole creek, which means the whole creek presents relatively similar characteristics. Predicted gas ebullition rates of these sediments from Chicago River suggested the need for collection, particularly in the summer months. The capping design is innovative by inclusion of an overlaying wetland to remove nutrients from the adjoining Chicago River and provide a public space. The support for the wetland will overlay a sand layer to bring biogenically – produced gas to collectors through an innovative support grid.

Use of Illinois River Sediment as Topsoil at Brownfields and Other Sites

Robert G. Darmody
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We have conducted a series of experiments and demonstrations to assess the value of Illinois River sediment as topsoil. Because Illinois River sediment is, in part, misplaced Illinois topsoil, which is about the best in the world, sediment holds great promise as topsoil. Sediment from the Lower Peoria Lake reach of the river is composed primarily of silt-sized particles, which is associated with good plant moisture storage. Coarse fragments, rocks and gravel, are rare, sand is only common in delta deposits, and clay, which would be detrimental for topsoil if present at excessive amounts, is generally within an acceptable range. Sediment generally also has organic matter content similar to productive Illinois agricultural topsoils, and other favorable chemical properties such as good macro (Ca, Mg, K, P, S), and micro (Zn, Fe, Mn, Cu, B, Mo) nutrient content.

These favorable properties of Illinois River dredged sediment only emerge after it dewaters and goes through some soil formation processes. When initially applied to the land, sediment is very wet mud. As it dries, it hardens, cracks, and eventually, after weathering or tillage, forms more favorable and familiar granular soil structure. However, there remain some unknowns about utilization of sediment as topsoil. While our lab is currently evaluating sediment from other backwater lakes between Beardstown and Hennepin, most of our samples are from a relatively limited reach of the river. So far, we have not encountered sediments with exceptionally high metal content or other chemical constituents that would necessarily preclude its use as topsoil, although we have found some metals and organics contents to be somewhat elevated. In summary, our field and greenhouse studies to date have been consistent. Sediment from the portions of the Illinois River we have studied can make excellent topsoil after it dewaters and forms favorable soil structure. It can be used as a soil amendment or to cover brownfields or other areas in need of reclamation with rich topsoil that will support vigorous vegetation.

Cultivation of Garden Vegetables in Peoria Pool Sediments from the Illinois River: A Case Study in Trace Element Accumulation and Dietary Exposures

Stephen Ebbs[1], Jonathan Talbott[2], and Renuka Sankaran[1]
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The use of reclaimed lake sediment as a growth media for vegetable production was evaluated in a pot study which also projected whether accumulation of micronutrients and heavy metals in the vegetables would impact human nutrition or health, respectively. Five plant species, bean, broccoli, carrot, pepper, and tomato, were grown in pots containing either reclaimed sediment from the Illinois River or a reference soil. Tomato and pepper grown in sediment showed significantly greater biomass and yield as compared plants from the reference soil. Elemental analysis of the tissues revealed that Zn and Mo were the only elements that were significantly greater in sediment-grown plants on a consistent basis. While significant, Zn concentrations were no more than 3-fold higher than those in plants from the reference soil. The same trend was observed for Mo, except for bean tissues, which showed a 10-fold greater concentration in sediment-grown plants. The projected dietary intake of Cu, Mo, and Zn from consumption of sediment-grown vegetable tissues was significantly higher than for soil-grown plants, although the contribution to the recommended dietary allowances (RDAs) for these elements was substantial only for Mo. Intake of sediment-grown beans would have provided 500% of the dietary Mo RDA. While this is below the lowest observable adverse effect level (LOAEL) value for this element, there is no evidence to indicate that there would be a nutritional or therapeutic benefit from the consumption of bean containing this level of Mo. The dietary exposures to Cd and Pb would have been below the pertinent limits for all age and gender groups with the exception of the cumulative dietary Cd exposure to the 1-3 year age group. The results from this study suggest that this reclaimed sediment, and sediment materials with similar physicochemical characteristics and elemental concentrations, can be utilized for the production of vegetables intended for human consumption.

Assessment of Soil Microbial Communities in Surface Applied Illinois River Sediments

John J. Kelly
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Microorganisms are critical to the health of soils and the growth of plants due to their roles in the soil carbon and nitrogen cycles and their contributions to the development of soil structure. Many human activities, such as the release of pollutants and changes in land use, can negatively impact soil ecosystems and can prevent or limit microbial activity and plant growth. Previous work has demonstrated that Illinois River sediment can be used as a soil amendment to remediate degraded soils, but the impacts of this sediment on soil microbial communities have not been examined. We have investigated the impacts of land application of Illinois River sediment on soil microbial communities at two field sites in Chicago, the Paxton-1 landfill site and the U.S. Steel site. At the Paxton site we examined experimental plots containing various mixtures of sediment and biosolids and found that mixtures of sediment and biosolids had higher nutrient content than sediment alone and lower salinity and heavy metal content than biosolids alone. Mixtures of sediment and biosolids also showed higher levels of microbial biomass and activity and supported a microbial community that was distinct in composition from either sediment or biosolids alone. These data suggest that a mixture of sediment and biosolids is preferable to either sediment or biosolids alone. At the U.S. Steel site we have collected soil samples annually from plots which received sediment in Spring/Summer 2004. Preliminary results indicate that microbial biomass and microbial activity have not changed significantly since 2004, however microbial community composition has changed significantly each year since the sediment was land applied. Further analysis will provide more detailed information on the shifts in microbial community composition which have occurred.