

S. Eisenreich/J.Reinfelder

Page 1

September 18, 2000

**MONITORING OF PCB, Hg and PAH AIR EMISSIONS IN SITES RECEIVING  
STABILIZED HARBOR SEDIMENT**

**Revised Scope of Work- Revised 09/2000**

By

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**Revised September 2000 to incorporate Hg Emissions**

**Hg ADDENDUM Pages 13-16**

Submitted to:

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and

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## Introduction

The prohibition of ocean disposal of dredged sediment has encouraged placement of these materials in construction at overland sites. The sediment is stabilized by mixing with stabilization agents (cement, lime etc.) and is placed as controlled fill in construction projects. Concerns have been raised recently with the potential of volatilization of PCBs and other SVOCs at sites receiving stabilized sediment with traces of organic contaminants. PCBs are documented to be carcinogenic and are also implicated in permanent reduction in IQ and altered behavior in developing fetuses and children exposed to the mother's contaminant body burden in utero (Jacobsen J. and Jacobsen S., 1996). Animal studies have recently shown that ortho-substituted, lower chlorinated congeners that are more soluble and volatile are implicated in these neurotoxic effects (Maier W. et al, 1994).

Past field and laboratory studies have clearly demonstrated PCB volatilization from sediments. A study of PCB concentration in the air above a landfill of PCB contaminated dried sediment of a small lake in Sweden mixed with fibers (Bremle G. and L. Larsson, 1998) showed an elevated PCB concentration in the air during landfilling. Vorhees et al (1997) report high PCB concentration in indoor and outdoor air at homes surrounding New Bedford Harbor during dredging of highly contaminated harbor sediments. Laboratory studies with samples of St. Lawrence river sediment have shown that sediment samples suspended in double deionized water lost 74 - 76% of their initial PCB concentration in a 7-day period (Chiarenzelli et al, 1996, Chiarenzelli et al, 1997, Chiarenzelli et al, 1998). Field studies of other SVOCs such as pesticides have also shown that volatilization may be an important mechanism for loss from the soil to the atmosphere (Nash and Gish, 1989, Majewski et al., 1993, Baker et al., 1996).

Volatilization of organic compounds from soils and sediments depends on several parameters including climatic conditions (temperature, relative humidity, wind speed), physicochemical properties (solubility, octanol-water partitioning coefficients, Henry's Law constant) and soil properties (grain size, moisture content, vegetation cover, wetting-drying cycles). The above studies suggest that under certain conditions the volatile loss of PCBs from wet soils and sediments may be rapid and substantial. There is a strong correlation between water evaporation and PCB volatilization, meaning that PCBs can be released during drying of contaminated soils. PCB volatilization is enhanced by environmental transformations of parent compounds yielding lower chlorinated congeners that are more soluble and volatile (Chiarenzelli et al, 1998).

Mercury in harbor sediments is mainly in the inorganic form and can be enriched near dredge spoil islands (Mason and Lawrence, 1999). Land-deposited sediments could emit elemental Hg<sup>0</sup> and gaseous reactive forms of

S. Eisenreich/J.Reinfelder

Page 3

September 18, 2000

Hg(II) as well as particle-bound Hg. Emissions of volatile Hg from stabilized dredge sediment are unmeasured at the present time. As part of this proposal, we propose to add total gaseous Hg to the analysis list to determine background and stabilized sediment-impacted releases of Hg at the Bayonne OENJ site.

The literature review performed by the principal investigators has not revealed any monitoring studies or field data in PCB or PAH volatilization resulting from the placement and compaction of stabilized sediment. Certainly there is no Hg emission data available. The purpose of this study is to obtain such data.

### **Study Objectives**

The objectives of the proposed study are to:

1. Develop and execute a field monitoring program to estimate the rate of vertical PCB volatilization, at a site in New Jersey where placement and compaction of treated sediment from the NY/NJ Harbor region is taking place.
2. Develop and execute a field monitoring program to estimate the rate of volatilization and horizontal PCB, PAH, and Hg transport at the same site.
3. Based on the results of the monitoring program estimate PCB, PAH and Hg fluxes to the atmosphere at the site in the form of gaseous and particulate PCBs, under different climatic conditions and to assess the relative impact of such fluxes to local and regional atmospheric concentrations.

### **Study Methodology**

Our study will investigate PCB, PAH and Hg volatilization at the Bayonne golf course site, which will be developed by OENJ with cement-stabilized sediment from the NY/NJ Harbor. The study consists of four basic elements:

1. The determination of background ambient air PCB and PAH concentrations in Bayonne before, during and after the placement of stabilized sediment.
2. The determination of vertical fluxes of PCBs from stabilized sediment during placement.
3. The determination of atmospheric PCBs, PAHs and Hg emitted and transported during stabilized sediment operations and placement
4. The assessment of the relative contribution of stabilized sediment placement operations on the local atmospheric concentrations and in the immediate vicinity of the site.

#### **1. Ambient Community Air Quality Monitoring**

An atmospheric air monitoring station has been installed at a selected location in

S. Eisenreich/J.Reinfelder

Page 4

September 18, 2000

Bayonne NJ. The location of the monitoring station was selected by the principal investigators in collaboration with Bayonne City authorities. The purpose of this station is to collect background ambient air samples before the sediment placement operations commence and during sediment placement. This station is equipped with a modified High Volume Air Sampler (HVAS) for collection of particulate and gaseous PCBs and PAHs, and sensors for temperature, relative humidity and wind speed and direction.

## **2. Vertical PCB Flux Monitoring**

The purpose of this monitoring effort is to measure vertical fluxes of PCBs emanating from the site during various phases of stabilized sediment placement.

### Data Acquisition Methods

The site will include four monitoring stations as follows:

Station 1&2: These stations will be located within the aeration area that receives treated sediment for drying before compaction. The monitoring will commence immediately upon placement of the treated sediment.

Station 3: This station will be located within an area that compacted sediment is placed. Monitoring will commence immediately after compaction of the sediment has been completed.

Station 4: This station will be located on an area that receives untreated raw sediment and will serve as a control to compare volatilization rate differences between treated and raw sediment.

Monitoring will be performed at the four stations of each site for three seasons summer, fall and winter. The duration of each monitoring event will be determined on the basis of a calibration run that will be performed before the monitoring program begins.

Monitoring will consist of measurement of PCB, PAH and Hg concentrations (gaseous and particulate) and climatic conditions prevailing at the site. A schematic of the monitoring station is shown in Figure 1. The monitoring station consists of two modules:

a) *Air contaminant sample collection module*: This module consists of a dual HVAS assembly. Samples will be collected simultaneously at two different heights to establish a contaminant concentration gradient, which will be used in the computation of contaminant fluxes. The lower sampling port will be located at approximately 0.15 - 0.25 meters and the upper port at approximately 1.5-1.8 meters from the ground surface. Contaminant samples will be collected in two phases, following a procedure similar to the USEPA TO-9A method, particulate

S. Eisenreich/J.Reinfelder

Page 5

September 18, 2000

matter will be trapped in a 2 micron quartz-fiber filter and gaseous contaminants will be adsorbed on polyurethane foam (PUF) adsorbent. An air stream will be drawn via a metering pump at a flow rate to be determined by field calibration.

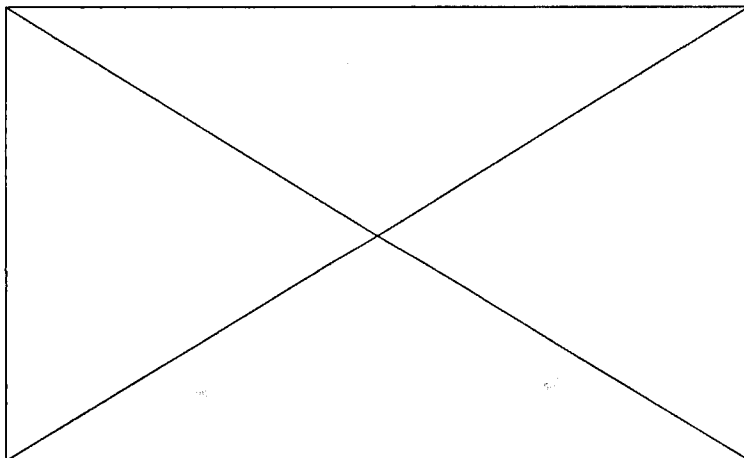


Figure 1. Schematic of monitoring station (1: air inflow ports, 2: quartz-fiber filters, 3,4: polyurethane foam columns, 5: air metering pumps, 6: effluent ports, 7: climatic sensors, air speed, temperature, relative humidity), 8: soil moisture probe, 9: data acquisition system)

b) *Climatic data collection module*: This module consists of climatic sensors for temperature, relative humidity and wind speed and direction located at the same height as the contaminant sampling inlets. Data will be stored in a data logger and will be retrieved at the end of each sampling event. A soil moisture probe will also be installed at each monitoring site to collect data on soil moisture. Climatic data are needed for the estimation and correlation of contaminant fluxes.

S. Eisenreich/J.Reinfelder

Page 6

September 18, 2000

The entire instrument assembly will be enclosed in a waterproof chamber for deployment in the field.

#### Data Acquisition and Analysis

The determination of vertical PCB fluxes entails the following tasks:

*Monitoring Station Construction and Calibration:* This task entails the construction and calibration of the monitoring stations. Since these stations are not off-the-shelf items they will be assembled at our laboratory. Calibration entails an optimization of the air flow rates and the appropriate duration between replacement of the quartz filter and PUF adsorption columns of the contaminant sampling module. Calibration of the air flow will be performed in the field. An unsaturated flow mass transport model developed by the principal investigator (Korfiatis and Talimcioglu, 1994) will be used to estimate surface fluxes on the basis of PCB sediment concentration. These estimates will be used as the starting point of the calibration process. Calibration runs will be performed at a single sampling location. We plan to vary three sampling parameters, flow rate, duration and sampling heights. We plan to perform the flow rate/duration calibration first. Two monitoring stations will be set side by side to sample the same air stream. The calibration run matrix is shown below:

Rate/Sampling period	24hrs	72 hours	168 hrs
10 liters/min	14,400 L	43,200 L	100,800 L
100 liters /min	144,000 L	432,000 L	1,008,000 L

The two sampling heights for these runs will be 0.15 m and 1.5 m. Depending on the results of these runs and the wind velocity and PCB concentration gradients an assessment will be made if a sampling height calibration run is to be conducted.

*Execution of Monitoring Program:* The monitoring program will consist of installation and monitoring of the four stations at the site. The duration of each sampling event will be determined in the calibration runs. The monitoring stations will be installed at the site immediately after a fresh layer of sediment is spread or compacted. A total of three samples will be collected from each station at three time intervals. Climatic conditions will be measured continuously and the data will be stored in a data logger. The monitoring at each site will be repeated eight times, twice per season (spring, summer, fall and winter) to capture seasonal variations.

*Computation of Vertical Surface Fluxes:* The mass flux PCBs will be computed by the Aerodynamic Gradient (AG) method. The AG method is the most frequently used technique for measuring pesticide emission rates from soils surfaces. It is based on a modified form of the Thornthwaite-Holtzman equation corrected for atmospheric stability (Majewski et al., 1993).

S. Eisenreich/J.Reinfelder

Page 7

September 18, 2000

The equation is:

$$F = \kappa^2 (C_{z1} - C_{z2}) (U_{z2} - U_{z1}) / \phi_m \phi_p [\ln(z_1/z_2)]^2 \dots\dots\dots \text{Eq. (1)}$$

Where:  $\kappa$  is the von Karman constant

$C_{z1}$ -  $C_{z2}$  are the average concentrations of a contaminant at distances  $z_1$  and  $z_2$  from the ground surface

$U_{z1}$ -  $U_{z2}$  are the average wind speeds at distances  $z_1$  and  $z_2$  from the ground surface

$\phi_m$ ,  $\phi_p$  are atmospheric stability correction functions

Climatic data will be averaged over the sampling period and will be used for the computation. Contaminant fluxes will be correlated with soil moisture, contaminant sediment concentrations and estimated water vapor fluxes. Sediment concentrations will not be measured. The investigators will rely on existing sediment concentration data. The results will be presented as time histories of volatilization rates at each station. Correlation of the data between stations will also be made.

### **3. Monitoring of Horizontal PCB fluxes**

The purpose of this element of the project is to measure PCB and Hg concentrations at the perimeter of the site and compare PCB and Hg fluxes entering the site with those exiting the site. Accounting for vertical dispersion, the amount of PCBs and Hg volatilized over a specific area and time may be calculated. The monitoring program will consist of four stations located at the perimeter of the site. Each station will be equipped with modified HVASs and sensors for relative humidity, temperature and wind speed and direction.

The Hg analyses will consist of continuous measurements of total gaseous Hg at the central meteorological tower during the entire time period of the intensive experiments. The Hg monitoring system is capable of measuring total gaseous Hg (elemental Hg<sup>0</sup> plus reactive gaseous Hg species such as HgCl<sub>2</sub>) with a detection limit of < 0.1 ng m<sup>-3</sup> at a rate of 1 each 2.5 min., thereby providing a continuous record of Hg concentrations under all relevant air flow conditions. Since the meteorological data are being generated at a similar rate(?), it will be possible to determine an extensive data set on Hg concentrations (perhaps 1000 measurements) during periods when winds derive from all quadrants. An additional added value of continuous measurement with the Tekran Model 2537A Continuous Ultra-Trace Mercury Vapour Analyzer is a data set of unmatched robustness for the NY-NJ Harbor area. With appropriate statistical evaluations, we may BE able to delineate source areas and perhaps even

S. Eisenreich/J.Reinfelder

Page 8

September 18, 2000

sources. These measurements will be linked to the PCB and PAH concentrations and flux estimates to provide potential Hg fluxes from drying stabilized sediment at this site.

#### **4. Chemical Analysis**

Chemical analysis will be performed on the PUFs and quartz filters retrieved from the modified HVASs. A summary of the sampling/analysis methodology is provided below:

Air Sampling: General Metal Works high volume air samplers will be used to collect atmospheric gas and particulate-phase PCBs. Air is first passed through a glass fiber filter (GFF) (Whatman EP 2000, 20 x 25 cm) to collect particulate matter, followed by a polyurethane foam (PUF) adsorbent (0.05 g/cm<sup>3</sup> density, 8 cm diameter x 10 cm height) to trap gaseous SOCs. Air samples will be taken every 12 hours (0800 to 2000 hrs and 2000 to 0800 hrs corresponding to a day and night cycle, respectively) at calibrated flow rates of 0.5 to 0.8 m<sup>3</sup>/min at each site. The full sampling procedure can be found in Simcik et al.(1997) and Zhang (1996).

Two PUF plugs will be occasionally positioned in series to assess breakthrough of gas-phase PCBs. After sampling, PUF plugs will be stored in sealed glass jars, while QFFs were placed in aluminum foil pouches.

Analytical Procedure: Surrogate standards (10 or 25 ng) containing 3,5-dichlorobiphenyl (IUPAC # 14), 2,3,5,6-tetrachlorobiphenyl (IUPAC # 65) and 2,3,4,4',5,6-hexachlorobiphenyl (IUPAC # 166) will be added to the QFFs and PUF plugs in the field or soon after the samples are taken back to the laboratory.

The PUF plugs will be extracted in a Soxhlet apparatus with 4:1 (v/v) mixture of petroleum ether and dichloromethane for 24 hours. The extracts will be concentrated in a Buchi rotavap apparatus where solvent will be exchanged to hexane and cleaned up and fractionated on a 4 g 3% H<sub>2</sub>O-deactivated) alumina column. The PCB fraction (1<sup>st</sup> fraction – hexane as solvent) will be eluted and then concentrated to about 1mL. The PAH fraction (2<sup>nd</sup> fraction – Hex-DCM) will also be analyzed for gas phase compounds numbering 34. Details of a similar procedure may be found in Simcik et al. (1997), Zhang (1996) and Gigliotti et al (2000). The internal standards used in this study will be 2,3,5,6-tetrachlorobiphenyl (IUPAC # 30) and 2,2',3,4,4',5,6,6'-octachlorobiphenyl (IUPAC # 204). The final extract will be concentrated to 0.1 to 0.2 ml under N<sub>2</sub> and analyzed on a HP 5890 gas chromatograph (GC) equipped with a <sup>63</sup>Ni electron capture detector (ECD) or by ENCIMS, a HP autosampler, and a HP 3365 ChemStation on a 60 m 5% DB-5 capillary column (0.32 mm id.) with 0.25 μm film thickness (J & W Scientific). Concentrations of the individual PCB congeners were calculated using the internal standard method.



S. Eisenreich/J.Reinfelder

Page 9

September 18, 2000

**Quality Control and Quality Assurance:** Three types of PUF blanks will be obtained in this study: laboratory blanks, field blanks and 12-hour field blanks. The laboratory blanks are clean filters and PUFs left in the laboratory freezer. Field blanks are filters and PUFs transported to the field and exposed to the field atmosphere. The PUF loaded in an inoperable air sampler for 12 hours in the field is defined as a 12-hour field blank. All samples will be corrected on a congener basis by the mass in the field blanks by season. Overall procedural recovery is assessed for each sample by adding known quantities of surrogate standards to samples prior to extraction. The recovery of surrogate standard PCB 166 is usually quantitative (100%) and the air samples are thus not usually corrected for surrogate recovery.

Gas-phase PCB breakthrough through the high density PUF is usually < 3% of total PCB in the summer and <<0.3% in the winter. Breakthrough of individual PCB congeners is not generally significant. Two HVASs operated simultaneously during a previous field campaign showed no significant difference ( $\alpha=0.05$  Student t-test; n = 6) in total PCB concentrations (rsd < 3%).

Analysis will be performed for the following PCB congeners (#s with + signs are chromatographically unresolved although one congener is dominant):

18, 17+15, 16+32, 31, 28, 21+33+53, 22, 46, 52+43, 49, 47+48, 44, 37+42, 41+71, 64, 40, 74, 70+76, 66+95, 91, 56+60+89, 92+84, 101, 83, 97, 87+81, 85+136, 110+77, 82, 151, 135+144+147+124, 149+123+107, 118, 146, 153+132, 141, 137+176+130, 163+138, 158, 178+129, 187+182, 183, 185, 174, 177, 202+171+156, 180, 193, 199, 170+190, 201, 203+196, 195+208, 194, 206.

The estimated numbers of samples to be analyzed are:

Sampling Point	Stations	Seasons	Sampling Events	Number of Samples
Equipment Calibration	-	-	-	15
Vertical Flux Monitoring	5	4	2	80
Horizontal Flux Monitoring	4	3	6	96
Ambient Community Station	1	6	4	24
			<b>Total</b>	<b>215</b>

##### **5. Assessment of PCB Impacts from Placement of Stabilized Sediment**

The results of the monitoring program will be used to determine:

1. The amount and rate of PCB, PAH and Hg mass emission to the atmosphere, in the gaseous phase, resulting from processing and placement of cement stabilized sediment at the site.

2. The relative impact that potential PCB, PAH and Hg emissions have in the air quality of the local community and the region. This is possible because of the atmospheric sampling campaign ongoing as part of the New Jersey Atmospheric Deposition Network operated by S.J. Eisenreich and J. Reinfelder

All data, correlations, computations, methods description and conclusions of the study will be reported in a final report. One or more papers will be prepared for publication in a peer reviewed journal.

**6. Public Outreach**

The results of the monitoring program will be disseminated by the investigators to the public and public interest groups that have expressed interest in the issue of potential PCB emissions. At least four public meetings will be planned and executed where the public will be presented the results of the study and will have the chance to ask questions. These meetings will be advertised by direct mailing and public announcements.

**Project Timeline**

The estimated schedule per task is as follows:

Month	02	04	06	08	10	12	14	16	18	20	22	24	28
Task													
Order Equipment													
Station Installation Calibration													
Monitoring													
Analysis													
Report													
Public Outreach													

**Project Teams and Responsibilities**

The project will be executed by a Stevens-Rutgers team of researchers, the public outreach program will be developed and executed by NJIT:

Stevens Team:

Dr. George P. Korfiatis has over 18 years experience in research and consulting in the environmental engineering field and has participated in over 60 large-scale research projects funded by government, and the private sector . His expertise is in the area of fate and transport of contaminants in soils and sediments, investigation and modeling of soil-water-contaminant interactions and remediation of contaminated soil, water and sediment. He has published over 75 papers in the open literature on these topics.

Dr. Chris Christodoulatos is an associate professor of environmental engineering with over 10 years research and consulting experience. His expertise is in the areas of physicochemical and biological contaminant interactions and processes in water, soil and air and statistical and regression techniques

Dr. Richard I. Hires is a professor with over 25 years experience in field investigations of ocean, estuarine and water-atmosphere dynamics and transport processes. Dr. Hires has worked extensively with consultants in these areas.

Dr. Thomas Herrington is a research assistant professor with expertise on meteorological instrumentation and monitoring of near-surface climatic parameters. His responsibilities include equipment and instrument acquisition, development of a field monitoring protocol, field installation of monitoring stations and data acquisition.

Rutgers Team:

Dr. Steven J. Eisenreich will be the PI at Rutgers University. He has extensive experience in the transport, transformations and fate of PCBs and PAHs in the atmospheric, aquatic and terrestrial environments.

One graduate student, one undergraduate student and one technician will perform the day to day activities of sample preparation, analysis, and with Dr. Eisenreich, prepare progress and final reports, and literature publications. Cari Gigliotti will be the laboratory project manager.

Dr. John Reinfelder is actively involved in Hg measurements at NJADN sites in New Jersey including at sites in the NY-NJ Harbor Estuary. He and a graduate student will be responsible for collecting the Hg and analyzing air samples for total gaseous Hg and assisting in overall sampling during the intensive campaigns.

Task Break-Down and Responsibilities:

S. Eisenreich/J.Reinfelder

Page 12

September 18, 2000

The following is a break-down of the project tasks and team responsibilities

<b>Project Task</b>	<b>Lead Team</b>	<b>Support Team</b>
Project Design and Planning	Stevens	Rutgers
Vertical Flux Monitoring (equipment procurement, installation)	Stevens	Rutgers
Horizontal Flux and Community Monitoring (equipment procurement, installation)	Rutgers	Stevens
Field Monitoring at Site	Stevens	Rutgers
Field Monitoring at Bayonne Urban Site	Rutgers	
Chemical Analysis (PCBs and Hg)	Rutgers	Stevens
Data Analysis and Report Production Met data; PCB vertical fluxes	Stevens	Rutgers
Data Analysis and Report Production PCB and Hg Fluxes (Horiz) and Concentrations	Rutgers	Stevens
Public Outreach	NJIT	Rutgers/Stevens

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S. Eisenreich/J.Reinfelder

Page 13

September 18, 2000

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## **ADDENDUM: Hg Work Plan**

### **Introduction**

Among large East Coast urban estuaries, the lower Hudson River has the highest average concentration of Hg in its sediments (EPA, 1997). The primary form of Hg in estuarine sediments is oxidized Hg(II) bound in sulfide solids or adsorbed to organic-rich mineral phases, with monomethylmercury ( $\text{CH}_3\text{Hg}$ ) accounting for < 2% of the total (Mason and Lawrence, 1999). The processing of harbor sediments and their placement on land could lead to the volatilization of gaseous Hg or the release of Hg-containing fine particles. Gaseous Hg may be released from dredged sediments during stabilization and compaction due heat build up or chemical production of volatile forms of inorganic mercury including  $\text{Hg}^\circ$  and  $\text{HgCl}_2(\text{g})$ . Sediment-bound Hg may become volatile upon exposure to air and sunlight as a result of the photoreduction of Hg(II) to  $\text{Hg}^\circ$ . The emission of Hg from processed and land-applied sediments has not been studied and could be important in evaluating the environmental impact of various uses of dredge materials from urban harbors.

**Overall Goal:** Determine the effects of the processing and land application of harbor sediments on Hg concentrations in the atmosphere adjacent to the NY/NJ Harbor.

### **Objectives**

1. Assess the impact of sediment processing and land application on the concentration of total gaseous Hg at the Bayonne site.
2. Assess the impact of sediment processing and land application on the concentration of fine particle-bound Hg at the Bayonne site.
3. Determine the vertical flux of gaseous Hg from land-applied sediments.

### **Approach**

The emissions of Hg from dredged sediments during processing and land-application will be assessed primarily through the analysis of total gaseous Hg (TGM) concentrations at the central meteorological tower of the Bayonne site during the entire time period of the intensive experiments and periodically during non-campaign intervals. High frequency TGM analyses (1 measurement every 3 min.) will be coupled with meteorological data to provide a first-order indication of the importance of land-applied sediments to atmospheric Hg in the NY/NJ harbor and, with appropriate statistical evaluations, may be used to delineate source areas and perhaps seven specific sources. Fine aerosol Hg concentrations will be measured at the central sampling site during the intensive field campaigns to

S. Eisenreich/J.Reinfelder

Page 15

September 18, 2000

assess the importance of aeolian stripping of particulate Hg from the land-applied

sediments. In addition to the overland samples, gaseous and particulate Hg samples will be collected in the vicinity of the pug mill to evaluate Hg inputs to the atmosphere during sediment processing. The continuous Hg analyzer will also be used to estimate vertical fluxes of gaseous Hg from the land-applied sediment. The simultaneous collection of high frequency measurements of TGM and meteorological parameters as part of this project, and the NJDEP's measurements of atmospheric oxidants (O<sub>3</sub>, NO<sub>x</sub>) in western Bayonne, will generate a unique data set for the evaluation of Hg cycling in the atmosphere of the NY-NJ Harbor.

### Work Plan

#### 1. Continuous total gaseous mercury analysis

The concentrations of total gaseous Hg (TGM, Hg<sup>0</sup> and reactive gaseous Hg species) will be analyzed using the Tekran Model 2537A Continuous Ultra-Trace Mercury Vapour Analyzer. This Hg monitoring system is capable of measuring TGM with a detection limit of < 0.1 ng m<sup>-3</sup> at a maximum analysis rate of 1 measurement every 2.5 min. thereby providing a continuous record of Hg concentrations under all relevant air flow conditions. The Tekran continuous Hg analyzer features dual gold amalgam Hg traps for uninterrupted sample collection, high precision mass flow controllers, an internal Hg standard source for automatic calibration in the field, and cold vapor atomic fluorescence spectrometry (CVAFS) analysis. The Hg monitoring system will be linked to a portable computer for data logging and will be powered by gas generator.

We plan to locate the continuous Hg analyzer at the central meteorological tower of the study site. Continuous TGM measurements will be made at high frequency (1 measurement every 3 min.) during the entire time period of intensive experiments yielding about 480 measurements each day. Lower sample analysis frequencies (1 measurement every 30 - 60 min.) will be used for intervening periods (between intensive campaigns) for characterization of TGM levels under all seasonal and meteorological conditions.

#### 2. Concentration of Hg in fine particles

Fine particles (PM 2.5) will be collected at the central meteorological tower during intensive campaigns. Air will be drawn through a vortical particle impactor with a size cutoff of 2.5 μm and particles will be collected on 1 μm Teflon filters held in acid-cleaned, polypropylene cartridges. Air will be pumped for 24 h or sufficient time to sample 20 m<sup>3</sup> of air. Total particle-bound Hg will be analyzed by CVAFS after acid digestion in Teflon vials.

#### 3. Hg emissions at the sediment processing site

S. Eisenreich/J.Reinfeldler

Page 16

September 18, 2000

TGM and fine particulate Hg will be sampled from the air in the vicinity of the sediment processing operations during stabilization and compaction. TGM will be collected using continuous Hg monitoring system which will be transported to the pug mill and housed in a small site vehicle. Fine particles will be collected and analyzed as described above. Air samples will be collected from the sediment processing area over two days, four times a year during the first year of the study and as needed in the second year.

#### 4. Vertical flux of gaseous Hg from land applied sediments

The vertical flux of gaseous Hg will be determined during intensive sampling campaigns in the winter and summer. The inlet line of the continuous Hg analyzer will be modified to permit sampling of TGM at two heights above the ground surface and the vertical flux of Hg from soils and sediments will be determined by the Aerodynamic Gradient method as described above for PCBs. Measurements for the estimation of vertical Hg fluxes will be made before and after the application of sediments in order to compare pre- and post-sediment application fluxes.

#### **Expected Results/Data Analysis**

The primary results will be directionally and temporally resolved atmospheric Hg concentrations during the sediment stabilization and placement process. These data will be combined with wind speed and direction data to construct wind rose plots in which Hg concentrations are plotted vs. wind direction on a polar graph. The wind rose plots will indicate the wind directions, and potential local sources associated with elevated Hg concentrations. Hg concentrations in the air at the sediment-processing site will be compared with those collected at the inland site to assess the importance of the pug mill operations to atmospheric Hg over a wider area. Additional data on the flux of Hg from soils and sediments at various stages of the construction of the Bayonne golf course will also be generated. We expect to find that a pulse of gas phase Hg is emitted from newly land-applied sediment and that vertical fluxes from sediment/soil mixtures are somewhat elevated relative to those over native soils. Vertical fluxes of Hg will likely attenuate with time after land application.

#### **Value Added-Coupling of Hg and Oxidant Concentrations in the NY/NJ Harbor Atmosphere**

Atmospheric Hg concentrations and fluxes measured in this study will be supported by those being collected as part of the New Jersey Atmospheric Deposition Network (NJADN) in Jersey City, Sandy Hook, and New Brunswick. Thus the fine time scale atmospheric Hg concentrations measured at Bayonne will be studied in the context of rain-water and fine aerosol Hg concentrations from NJADN sites near the NY/NJ Harbor.

The atmospheric deposition of Hg depends on the oxidation of gas-phase



S. Eisenreich/J.Reinfelder

Page 17

September 18, 2000

elemental Hg to Hg(II) which is scavenged by rain. O<sub>3</sub> and N<sub>ox</sub> are potentially important oxidants of elemental Hg in the atmosphere. Since these chemicals are already being sampled by the NJDEP at a site along Newark Bay in western Bayonne, the location of a continuous Hg analyzer near that site is a unique opportunity to obtain fine time scale, synoptic measurements of these atmospheric pollutants.

#### Literature Cited

Mason R.P. & Lawrence A.L. Concentration, distribution, and bioavailability of mercury and methylmercury in sediments of Baltimore Harbor and Chesapeake Bay, Environ. Toxicol. Chem. 18(11):2438-2447, 1999 Nov.

U.S. EPA (1997) The incidence and severity of sediment contamination in surface waters of the United States. Report 823-R-67-006. Washington, DC.

**PCB, PAH and Hg Volatilization from Stabilized Harbor Sediment**  
(Funded by the NJ DOC)

*PIs:* Steven J. Eisenreich

*co-PI:* John Reinfelder

Department of Environmental Sciences

Rutgers - The State University of New Jersey

**Budget Addendum**

Revised 5/31/2000

	2000-01	2001-02	Total Added 2000-02
<b>1. PERSONNEL</b>			
a. PI: SJ Eisenreich 0.5 mo summer	5200	2500	7700
b. Co-PI: J Reinfelder, 1 mo summer	5700	5700	11400
c. Postdoc.: None	0	0	0
d. Graduate Research Assistant (1.5 @ 12 mos and 50% t	23250	23250	46500
e. Technician: 1	15000	15000	30000
f. Undergrad. Res. Assistant	5000	3000	8000
g. <b>TOTAL</b>	<b>54150</b>	<b>49450</b>	<b>103600</b>
<b>2. FRINGE BENEFITS</b>			0
a. 24 % - PI	1248	600	1848
b. 24%-co-PI	1368	1368	2736
c. 16.5%-Postdoc	0	0	0
d. 16.5%-GRA	3836	3836	7673
e. 24%-Technician	3600	3600	7200
f. 7.5%-Undergrad. Student Res. Assist.	375	225	600
g. <b>Subtotal</b>	<b>10427</b>	<b>9629</b>	<b>20057</b>
<b>3. Salary + Fringe Benefits</b>	<b>64577</b>	<b>59079</b>	<b>123657</b>
<b>4. TRAVEL</b>			0
a. Domestic			0
a1. In support of field sampling	2000	1000	3000
a2. Attendance at Project Mtgs, Prof. Scien. Mtgs, etc.	1000	1500	2500
b. Foreign	0	0	0
c. <b>Subtotal</b>	<b>3000</b>	<b>2500</b>	<b>5500</b>
<b>5. EQUIPMENT</b>			0
a. Computer + printer for data management	2200	0	2200
b. Total gaseous Hg Monitoring System	39,000	0	39000
c. Power Generator - 1	2,000	0	2000
d. <b>Subtotal</b>	<b>43200</b>	<b>0</b>	<b>43200</b>
<b>6. SUPPLIES</b>			0
a. SJE Laboratory	1000	1000	2000
b. JR Laboratory	5000	5000	10000
c. <b>Subtotal</b>	<b>6000</b>	<b>6000</b>	<b>12000</b>
(includes office/computer supplies, software, misc. costs, paper, laboratory chemicals such as gase chromatographic columns, misc items to support lab and field operations)			0
<b>7. OTHER</b>			0
a. Tuition (Graduate Res.) (2 @ \$10,000/yr)	20000	10000	30000
b. Publishing Costs			0
b1. Interim and Final Reports	300	300	600
b2. Scientific Papers	700	800	1500
c. Computer Services Fee	1500	1000	2500
d. GC & GC-MS Maintenance	1000	700	1700
e. <b>Subtotal</b>	<b>23500</b>	<b>12800</b>	<b>36300</b>
<b>8. SUB-CONTRACTS</b>	0	0	0
<b>9. TOTAL DIRECT COSTS</b>	<b>140277</b>	<b>80379</b>	<b>220657</b>
<b>10. INDIRECT COSTS (10% of (9))</b>	<b>14028</b>	<b>8038</b>	<b>22066</b>
<b>11. TOTAL COSTS</b>	<b>154305</b>	<b>88417</b>	<b>242722</b>