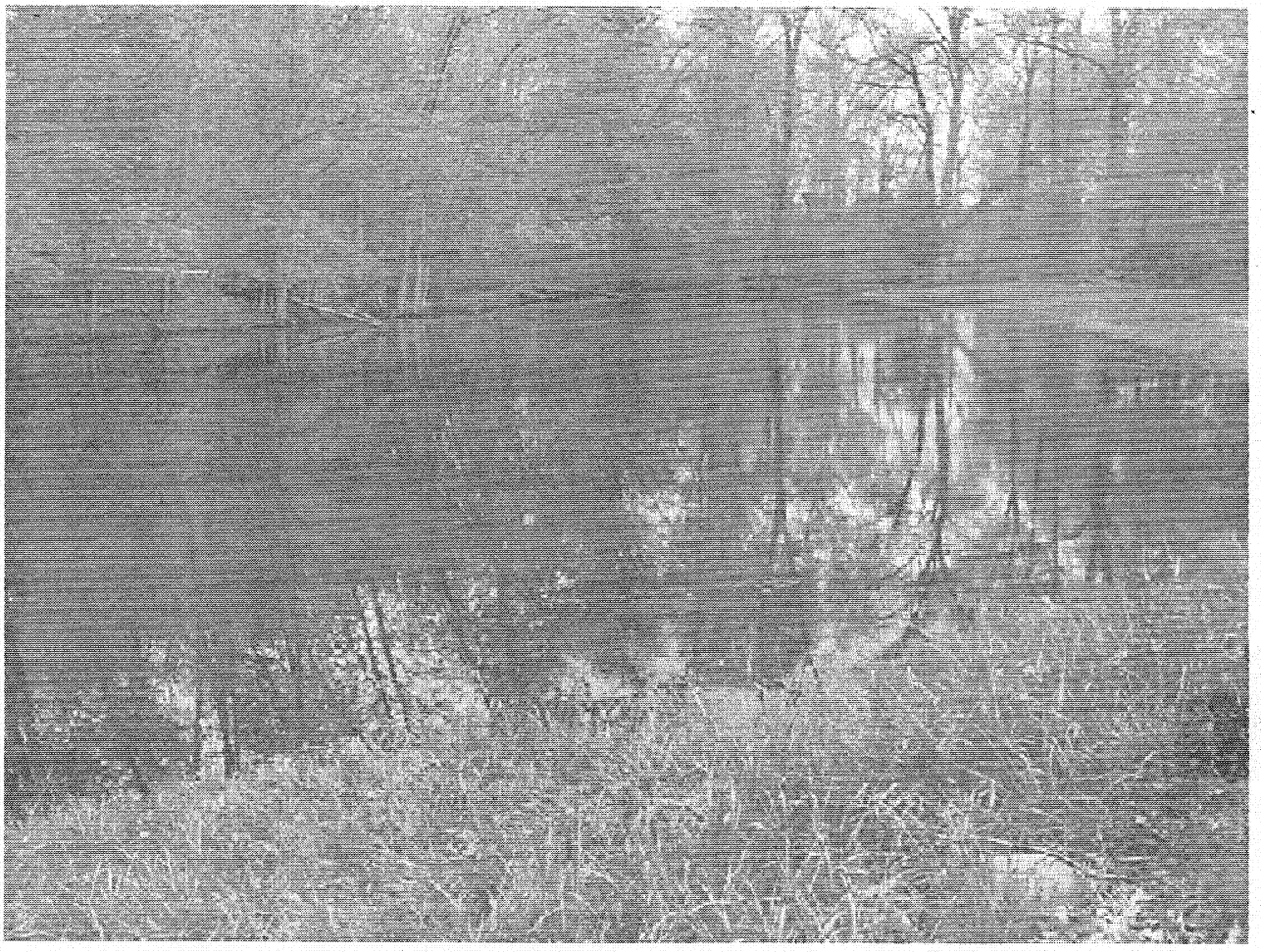
ANNEX D
PHOTO OF THE SAMPLING EVENT

ANNEX D-1
PHOTO OF THE POND
SEDIMENT SAMPLING EVENT

The pond in this picture is located southwest of Nepera Chemical Site and south of the abandoned railway. The Beaverdam Brook run south through the pond to Otter Kill. The residence of Mr Tanner is approximately 50 feet west of the pond. The pond is approximately 200 feet long by 75 feet wide, depth was not measure but in some point the depth was greater than five feet.

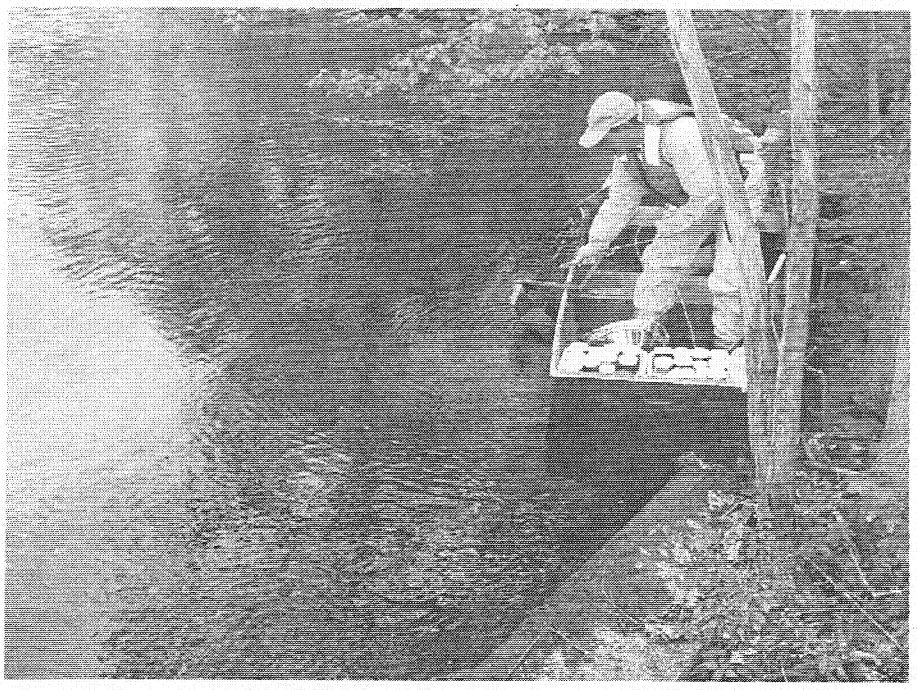


There were a total of 12 samples taken. SE-01 was taken approximately 100 feet downstream of the pond. SE-12 was taken approximately 70 feet upstream of the pond. Samples SE-02 thru SE-11 were taken in the pond. The pond was sampled for TAL metals, cyanides, VOAs, BNAs, PCBs, pesticides, and pyridine compounds. Detected in the pond were arsenic, copper, lead, manganese, selenium, silver, acetone, anthracene, benzo-type compounds, bis(2-ethylhexyl)phthalate, chrysene, fluoranthene, indeno(1,2,3-CD)pyrene, phenathrene, pyrene, 2-butanone, and 4,4'DDE.

SE-01

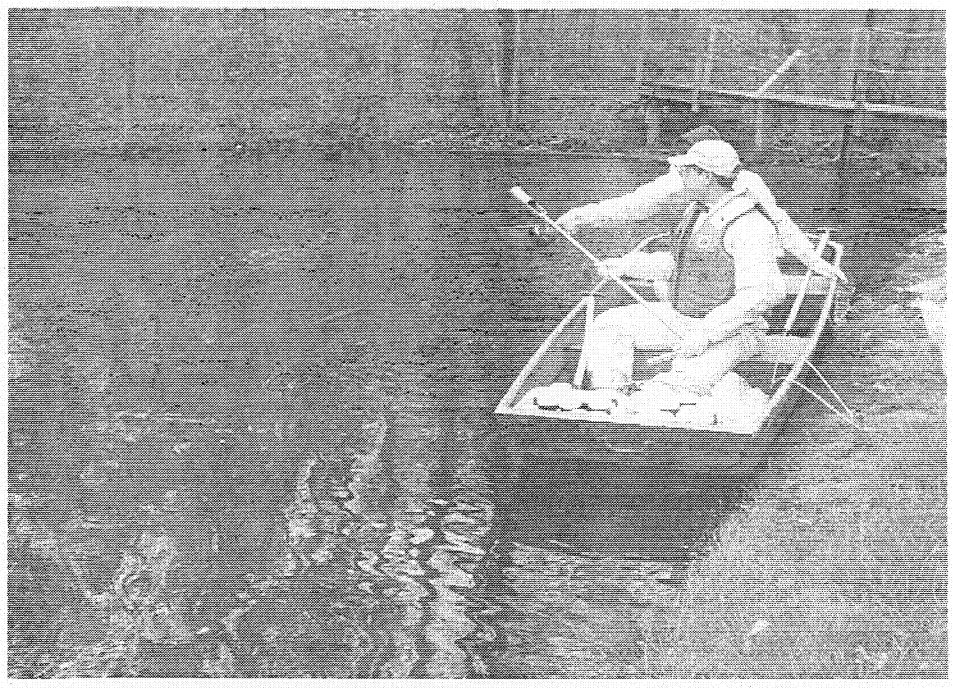
Sample was taken approximately 100 feet downstream of the pond. The picture shows the general location were SE-01 sample was taken.

SE-02



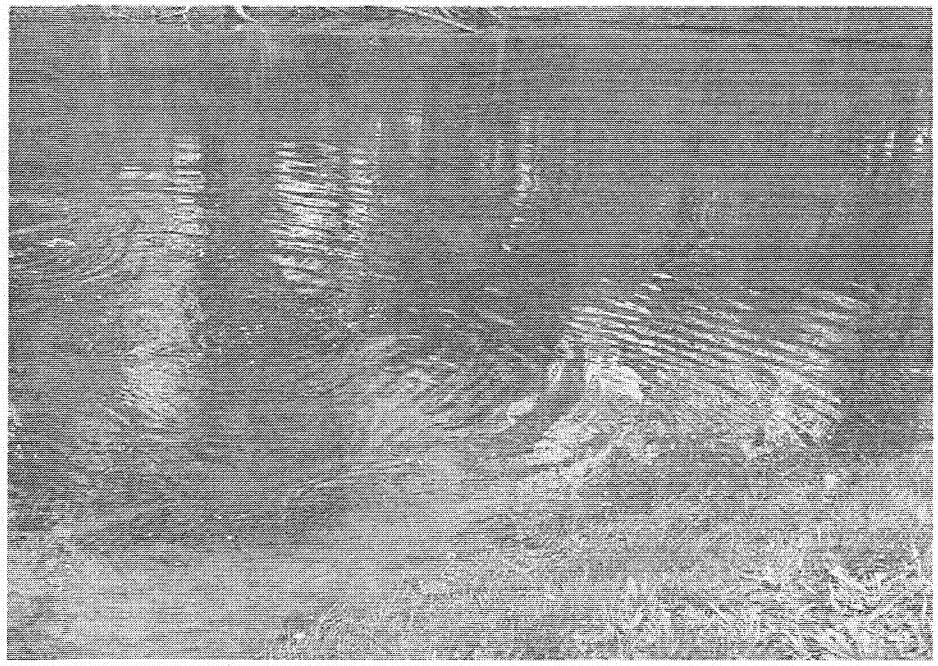
Sample was taken on the east side of the pond next to the foot bridge at the downstream side of the pond.

SE-03



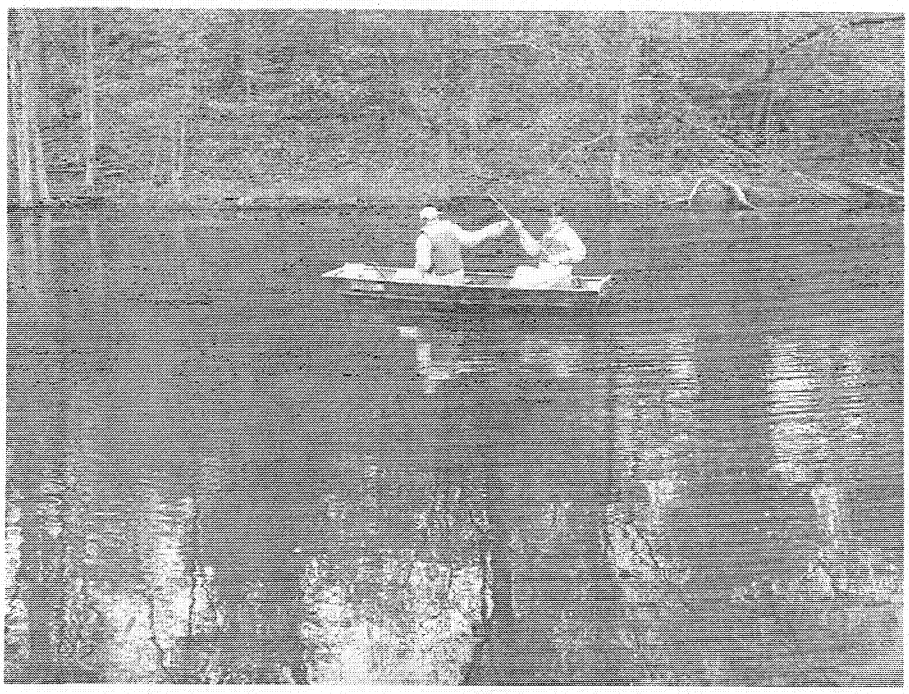
Sample was taken on the west side of the pond approximate 21 feet from the foot bridge at the downstream side of the pond.

SE-04



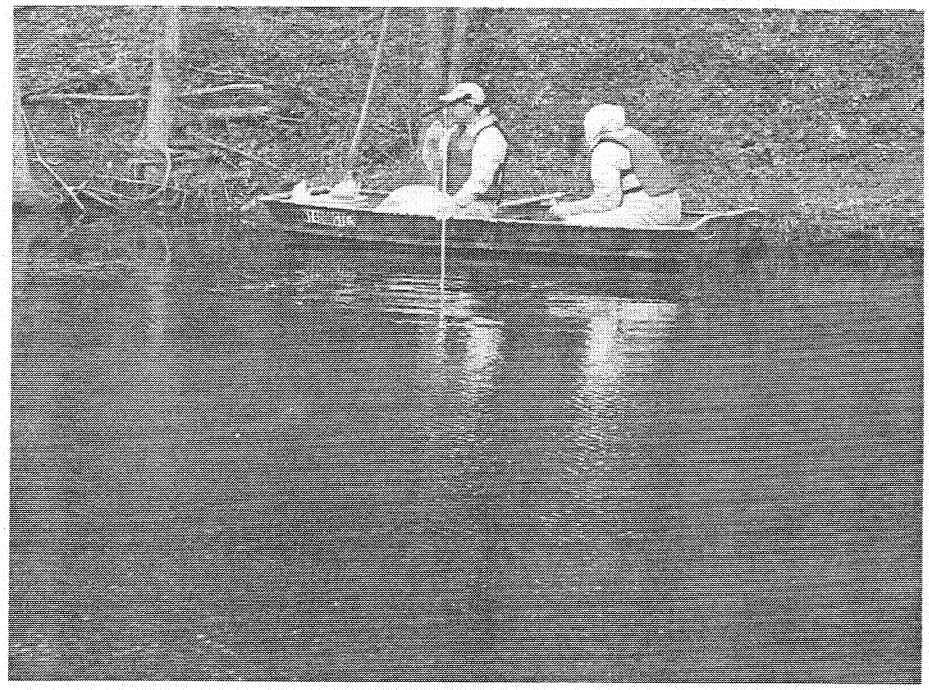
Sample was taken on the west side of the pond approximate 72 feet from the foot bridge at the downstream side of the pond. The photo below is a picture of the sampling location moments after sampling

SE-05



Sample was taken in the center of the pond approximate 72 feet from the foot bridge at the downstream side of the pond.

SE-06



Sample was taken on the east side of the pond approximate 100 feet from the walk bridge at the downstream of the pond.

SE-07

Sample was taken on the west side of the pond approximate 121 feet from the walk bridge at the downstream of the pond.

SE-08

Sample was taken on the east side of the pond approximate 124 feet from the walk bridge at the downstream of the pond.

SE-09

Sample was taken on the center of the pond approximate 130 feet from the walk bridge at the downstream of the pond.

SE-10

Sample was taken on the east side of the pond approximate 180 feet from the walk bridge at the downstream of the pond.

SE-11

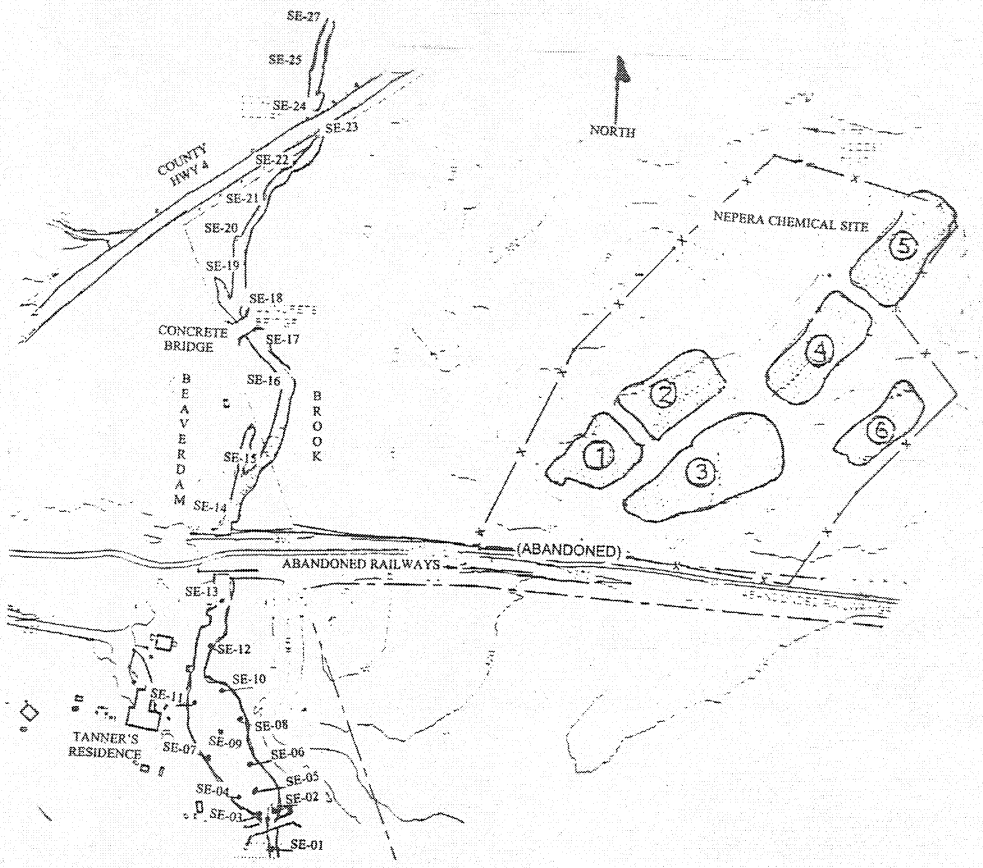
Sample was taken on the west side of the pond approximate 190 feet from the walk bridge at the downstream of the pond.

SE-12

Sample was taken on the upstream of the pond approximate 100 feet from the pond.

ANNEX D-2
PHOTO OF THE BEAVERDAM BROOK
SEMIDENT SAMPLING EVENT

Beaverdam Brook is located approximately 400 feet west of Nepera Chemical Site. The brook travel from north to south flowing through the pond sampled above into Otter Kill. The area of Beaverdam Brook which was sampled was between County Hwy 4 and approximately 50 feet south of the abandonded railways. The length of the brook covered was approximately 700 feet. Eleven sampling point were sampled along the 700 feet length of the brook next to the site. Three addition samples were taken north of County Hwy 4. Three samples were the upstream (Background) samples. Samples were taken from the banks or from the middle of the brook.



There were a total of 14 samples taken. SE-13 was taken approximately 50 feet south of the abandonded railways. SE-24, SE-25, & SE-27 were taken approximately 50 feet apart north of County Hwy 4. These three are considered background samples. Samples SE-14 thru SE-23 were taken in or off the banks of the brook. The brook was sampled for TAL metals, cyanides, VOAs, BNAs, PCBs, pesticides, and pyridine compounds. Detected in the sediment were arsenic, manganese, selenium, silver, Anthracene, benzo-type compounds, chrysene, fluoranthene, indeno(1,2,3-CD)pyrene, phenathrene, pyrene, and toluene.

SE-13

PHOTO NOT AVAILABLE

Sample was taken on the center of the brook approximate 50 feet south of the abandoned Railway.

SE-14

PHOTO NOT AVAILABLE

Sample was taken on the center of the brook approximate 40 feet north of the abandoned Railway.

SE-15

PHOTO NOT AVAILABLE

Sample was taken off the westside bank the brook approximate 150 feet north of the abandoned Railway.

SE-16

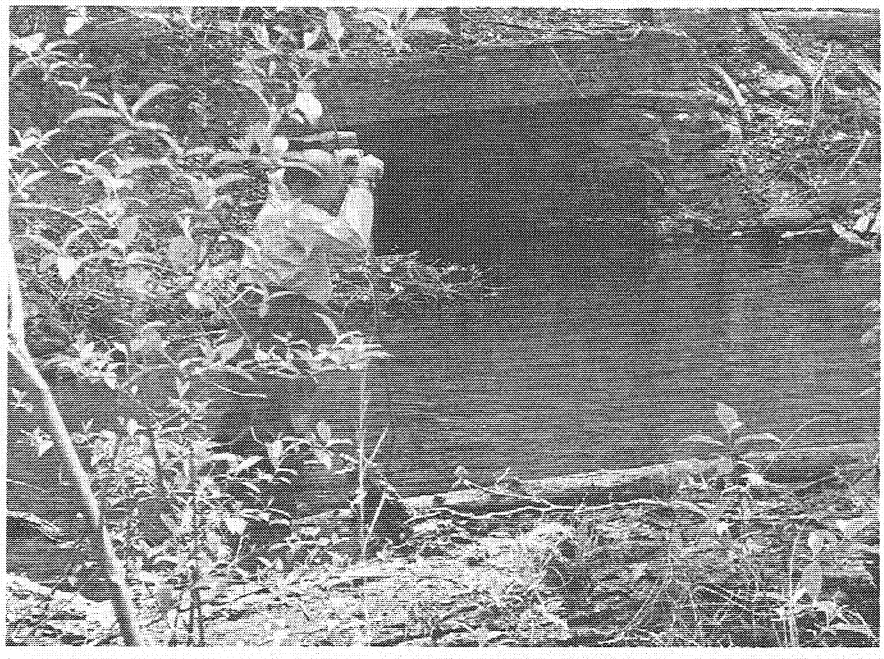
PHOTO NOT AVAILABLE

Sample was taken off the center of the brook approximate 260 feet

SE-17

Sample was taken off the westside bank the brook approximate 335 feet north of the abandoned Railway, just south the concrete bridge.

SE-18

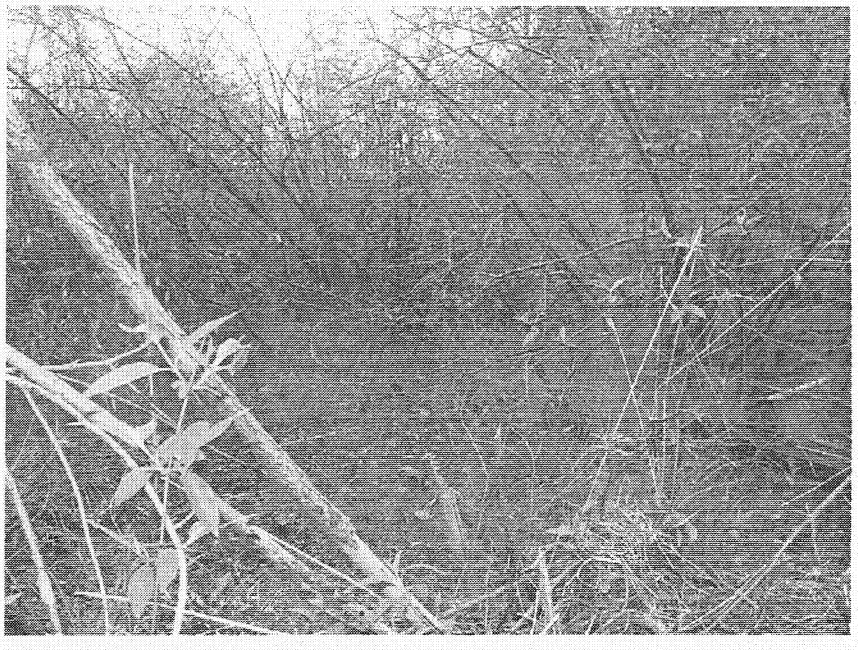


Sample was taken in the brook approximate 405 feet north of the abandoned Railway and just north of concrete bridge.

SE-19

Sample was taken in the brook approximate 460 feet north of the abandoned Railway.

SE-20



Sample was taken off the westside bank the brook approximate 520 feet north of the abandoned Railway.

SE-21

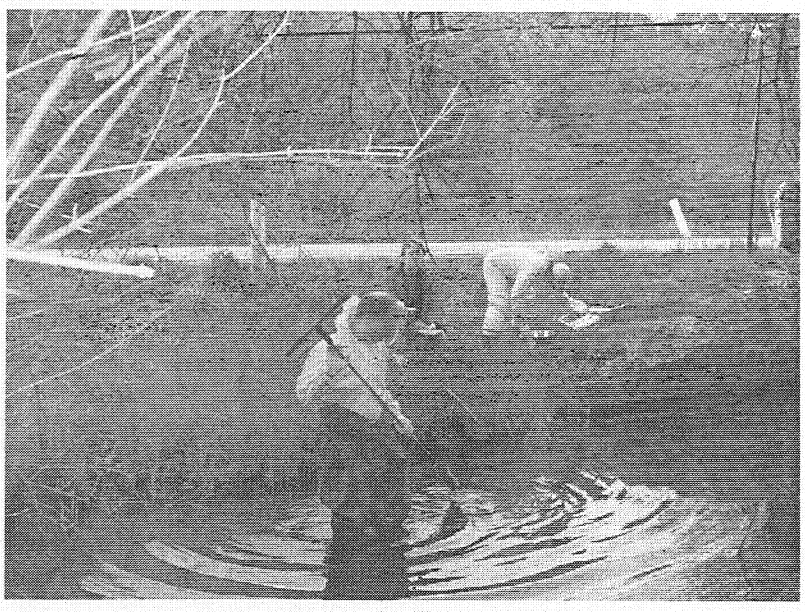
Sample was taken off the north side bank in the brook approximate 580 feet north of the abandoned Railway and next to County Hwy 4

SE-22

PHOTO NOT AVAILABLE

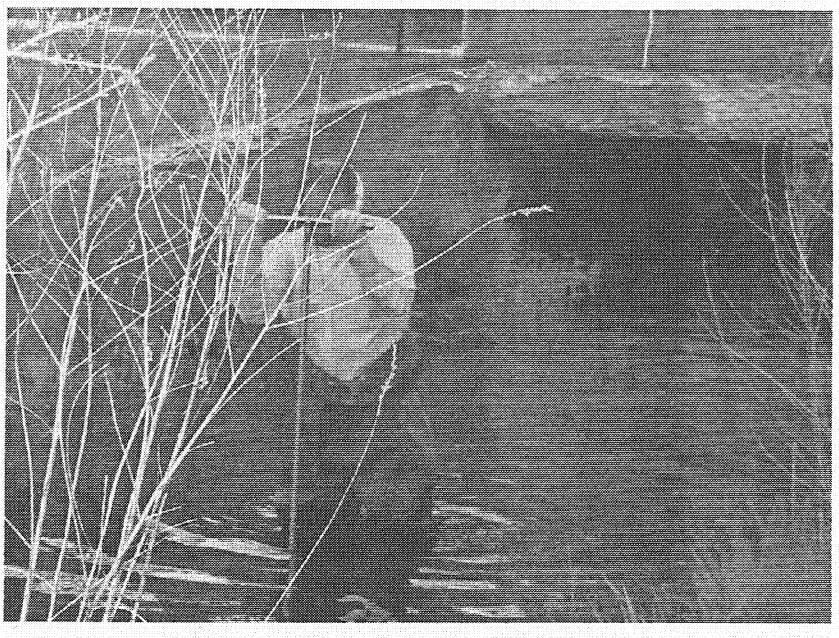
Sample was taken off the north side bank in the brook approximate 640 feet north of the abandoned Railway and next to County Hwy 4

SE-23



Sample was taken off the north side bank in the brook approximate 700 feet north of the abandoned Railway and next to County Hwy 4

SE-24



Sample was in the center of the brook next to and north of County Hwy 4.

SE-25

Sample was in the center of the brook north of County Hwy 4.

SE-27

Sample was in the center of the brook next to and north of County Hwy 4.

REFERENCE -1

New York State
Department of Environmental Conservation
Division of Fish, Wildlife, and Marine Resources
Technical Guidance for Screening Contaminated Sediments
JAN 99

New York State
Department of Environmental Conservation

Division of Fish, Wildlife and Marine Resources

Technical Guidance for Screening Contaminated Sediments

January 1999

GEORGE E. PATAKI, *Governor*

JOHN P. CAHILL, *Commissioner*

New York State Department of Environmental Conservation
Division of Fish, Wildlife and Marine Resources

Technical Guidance for Screening Contaminated Sediments

Change Sheet for January 25, 1999

This document is a reprint of the original "Technical Guidance for Screening Contaminated Sediments" that was first printed in November 1993, and subsequently reprinted in July 1994 and March 1998, with the following changes noted:

- Additional sediment screening values have been added to Table 1 for benzene, toluene, ethylbenzene, xylene, and nine polycyclic aromatic hydrcarbon compounds. The 13 new substances have not been integrated alphabetically into table 1. They are listed separately as an aditional page (page 25).

In all other respects, this edition is an exact reprint of the editions dated November 1993, July 1994, and March 1998 w/changes

New York State Department of Environmental Conservation
Division of Fish, Wildlife and Marine Resources

Technical Guidance for Screening Contaminated Sediments

Change Sheet for March 2, 1998

This document is a reprint of the original "Technical Guidance for Screening Contaminated Sediments" that was first printed in November 1993, and reprinted in July 1994, with the following changes noted:

- The Division of Fish and Wildlife and the Division of Marine Resources were merged into a single entity, the Division of Fish, Wildlife and Marine Resources

- New tables have been added for screening marine and estuarine sediments only. The new tables have been taken from Long et al (1995), and are included as appendix 4. These tables have been distributed with earlier editions of this document as an addendum since April 25, 1996. Wherever the current text makes reference to Table 2 for screening sediments for metals contamination, Table 3 in Appendix 4 should be used instead if the sediments are in marine or estuarine water bodies.

In all other respects, this edition is an exact reprint of the November 1993 and July 1994 document.

New York State Department of Environmental Conservation
Division of Fish and Wildlife
Division of Marine Resources

Technical Guidance for Screening Contaminated Sediment

22 November 1993

(reprinted July 1994, March 1998, January 1999)

This document describes the methodology used by the Division of Fish and Wildlife and the Division of Marine Resources for establishing sediment criteria for the purposes of identifying contaminated sediments. Sediments with contaminant concentrations that exceed the criteria listed in this document are considered to be contaminated, and potentially causing harmful impacts to marine and aquatic ecosystems. These criteria do not necessarily represent the final concentrations that must be achieved through sediment remediation. Comprehensive sediment testing and risk management are necessary to establish when remediation is appropriate and what final contaminant concentrations the sediment remediation efforts should achieve.

- ORIGINAL SIGNED -
Kenneth F. Wich
Director
Division of Fish and Wildlife

- ORIGINAL SIGNED -
Gordon Colvin
Director
Division of Marine Resources

Table of Contents

1. Executive Summary

The Department of Environmental Conservation originally proposed sediment criteria in 1989, as an appendix of a Cleanup Standards Task Force Report. These criteria were controversial because the proposed methodology, equilibrium partitioning, had not yet been endorsed by the U.S. Environmental Protection Agency (EPA) Science Advisory Board, and because the criteria themselves were perceived as remediation target concentrations. This revised sediment criteria document was prepared to incorporate scientific literature published since 1989, and to establish the purpose of sediment criteria for screening; that is, to identify areas of sediment contamination and to make a preliminary assessment of the risk posed by the contamination to human health and the environment. Criteria are developed for two classes of contaminants - non-polar organic contaminants and metals. Non-polar organic contaminant criteria are derived using the equilibrium partitioning approach, which has now been endorsed by the EPA Science Advisory Board. This approach estimates the biological impacts that a contaminant may cause based on it's affinity to sorb to organic carbon in the sediment. The concentration of biologically available contaminant is predicted and related to potential toxicity and bioaccumulation by using existing criteria established for the water column. New York State water quality standards and guidance values are used to derive sediment criteria. EPA water quality criteria are used only when New York State has not published a standard or guidance value for a particular compound. Water quality criteria for bioaccumulation proposed by the Divisions of Fish and Wildlife and Marine Resources are used when no New York State water quality standard or guidance value for bioaccumulation has been developed. Metals criteria are derived from Ministry of Ontario guidelines and NOAA data that make use of the screening level approach. This methodology measures the concentration of contaminants present in areas where ecological impacts have been noted, and correlates the contaminant concentration with the severity of the impact. Toxicity mitigating conditions such as acid volatile sulfides are not considered because with the screening level approach, the metal concentrations present are correlated directly to a measurable ecological impact. Finally, this document discusses risk management for contaminated sediment, and makes recommendations for implementing sediment criteria. Table 1 lists sediment criteria for 64 non-polar organic compounds or classes of compounds, and Table 2 lists sediment criteria for 12 metals.

II. Background and Objectives

The Department of Environmental Conservation originally proposed draft sediment criteria in December 1989 as Appendix D to the Draft Clean Up Standards Task Force Report (DEC 1991). These criteria were based on the EPA equilibrium partitioning (EP) model, which had at that time just been submitted to the EPA Science Advisory Board for review. Two problems developed relative to these criteria. The first was that the equilibrium partitioning model did not receive a complete endorsement by the EPA Science Advisory Board (EPA SAB 1990). The SAB raised questions about the degree of uncertainty, sources of variability, and applicability of EP-based sediment criteria. Secondly, the New York State sediment criteria were published in the context of a clean-up standards report for contaminated sediment remediation. The perception of the reviewers and potential users was that the criteria represented mandatory clean-up levels that must be achieved by remediation methodologies. Appendix D of the Draft Clean-up Standards Task Force Report did state that risk management decisions were necessary and appropriate in the application of the sediment criteria, but the perception remained that the low concentrations described therein were in fact the primary target levels for sediment remediation. This issue was further clouded by real-world environmental problems such as dioxin in the New York-New Jersey Harbor area. Dredging and dredge spoil disposal is necessary for continued harbor operation, but attainment of the dioxin sediment criterion described in Appendix D could be economically unachievable.

There were three objectives for revising the sediment criteria document. The first objective was simply to clarify the document, make it easier to read, and provide greater scientific documentation to support the information presented.

The second objective was to incorporate scientific literature that has been published since 1989. This revision will be based primarily upon an EPA Proposed Technical Support Document (TSD) for the Development of Sediment Quality Criteria (EPA 1991). The EPA TSD was also published verbatim in peer-reviewed scientific literature (DiToro et al., 1991). The revised sediment criteria document will also incorporate a new EPA Science Advisory Board Report that endorses the equilibrium partitioning methodology and commends the EPA for satisfactorily addressing many of the concerns noted in the original SAB review (EPA SAB 1992). Also, this revision incorporates the 1992 Ministry of Ontario Guidelines for the Protection and Management of Aquatic Sediment Quality in Ontario, for metals concentrations in sediment (Persaud et al., 1992). These guidelines were only draft in 1989, when the first sediment criteria document was produced.

The final objective of the revised document was to establish the role of EP-based sediment criteria as screening criteria; that is, for identifying areas of sediment contamination, and providing an initial assessment of potential adverse

impacts. While attainment of the EP-based sediment criteria will provide the maximum assurance of environmental protection, it is not necessary in all cases and at all times to achieve these criteria through remediation efforts. Risk assessment, risk management, and the results of further biological and chemical tests and analyses are vital tools for managing sediment contamination. To view sediment criteria in a one-dimensional, go/no go context is to miss potential opportunities for resource utilization through appropriately identified and managed risk.

III. Need, Basis, and Concept of Sediment Criteria

Sediments can be loosely defined as a collection of fine-, medium-, and course- grain minerals and organic particles that are found at the bottom of lakes [and ponds], rivers [and streams], bays, estuaries, and oceans (Adams et al., 1992). Sediments are essential components of aquatic [and marine] ecosystems. They provide habitat for a wide variety of benthic organisms as well as juvenile forms of pelagic organisms. The organisms in sediments are in constant contact with the sediments, and therefore, constant contact with any contaminants that may be adsorbed to the sediment particles. Potential impacts to benthic organisms include both acute and chronic toxicity with individual-, population-, and community- level affects, bioaccumulation of contaminants, and the potential to pass contaminants along to predators of benthic species (Adams, et al, 1992; Marcus, 1991; Milleman and Kinney, 1992).

Potential to harm benthic organisms is not the only adverse impact of contaminated sediments. They serve as diffuse sources of contamination to the overlying waterbody; slowly releasing the contaminant back into the water column (Marcus, 1991; DEC, 1989).

Contamination is a concept that is not always clearly defined relative to sediments. The mere presence of a foreign substance in a sediment could be construed as contamination. However, the presence of a foreign substance does not necessarily mean it is harmful. Metals can be present in naturally occurring concentrations (background levels) in species, or forms, that are not harmful to aquatic life. While there are no naturally occurring background concentrations for synthetic organic compounds, the presence of a synthetic organic compound does not necessarily imply harm. Some evaluation must be made to estimate the potential risk to aquatic life or human health that the compound will have.

The EPA has defined a contaminant as: "Any solid, liquid, semisolid, dissolved solid, gaseous material, or disease-causing agent which upon exposure, ingestion, inhalation, or assimilation into any organism, either directly from the environment or indirectly by ingestion through food chains, may . . . pose a risk of or cause death, disease, behavioral abnormalities, cancer, genetic mutations,

physiological malfunctions . . . or physical deformations, in the organism or their offspring" (EPA, 1992). This definition clearly explains that a contaminant is not simply the presence of a foreign substance, but an element of harm to some organism, species, population, or community must be involved.

The EPA defines sediment criteria in the following manner: A sediment criterion is a specific level of protection from the adverse effects of sediment associated pollutants, for beneficial uses of the environment, for biota, or for human health . . . (EPA, 1992). A sediment criterion, then, must relate to the element of harm that the contaminant possesses by specifying an appropriate level of protection. To develop sediment criteria, it is necessary to identify the potential elements of harm to the various organisms, populations, and communities that could be affected. The criterion must then specify the level of protection necessary to balance each identified element of harm.

A corollary of the EPA definition is that if the specified level of protection is not attained, then a certain level of risk exists. The concentration of a contaminant in sediment can be compared to a number of criteria and their associated levels of protection, to determine the overall potential risk posed by that particular contaminant concentration to various exposed organisms. Only if the contaminant concentration is less than all of the available criteria can exposure to the sediment, or to organisms that inhabit the sediment, be considered to be without significant risk from those contaminants (risk could still result from other sources, such as contaminants for which criteria have not yet been derived). This is the concept of screening criteria. By comparing the contaminant concentration to various criteria and their associated levels of protection, the resource manager can begin to identify the appropriate tests, studies, and procedures to quantify and refine the level of risk; set remediation goals; prioritize remediation actions; and select risk management and communications options.

EP-based sediment criteria are tied to water quality standards, guidance values, (DEC, 1991) and criteria (EPA, 1991)[1]. Within the framework of New York State water quality regulations, five primary levels of protection are identified (6NYCRR, 1991) from which sediment criteria can be derived. These are:

---

[1]Water quality standards and guidance values are New York State regulatory terms that are essentially synonymous with the EPA term criterion. A standard is a water quality criterion that has been adopted into regulation. A guidance value is a water quality criterion that has been derived in the same manner as a standard, but has not yet been adopted into regulation, or subjected to public review and comment. When referring to water quality in this document, the use of the general term criteria will mean either a New York standard or guidance value.

A. Protection of human health from acute or chronic toxicity;

B. Protection of human health from toxic effects of bioaccumulation;

C. Protection of aquatic life from acute toxicity;

D. Protection of aquatic life from chronic toxicity;

E. Protection of wildlife from toxic effects of bioaccumulation.

Other levels of protection include fish flesh tainting, and aesthetics (taste, odor, or appearance). Human health-based criteria can be further subdivided into oncogenic (cancer causing) effects and non-oncogenic effects (6NYCRR, 1991). Unfortunately, water quality standards or guidance values do not usually exist for all five levels of protection simultaneously.

This document will identify a series of screening criteria concentrations for a number of contaminants that can be used to identify areas of sediment contamination, and evaluate the potential risk that the contaminated sediment may pose to human health or the environment. A contaminated sediment can be identified as one in which the concentration of a contaminant in the sediment exceeds any of the sediment criteria for that contaminant. Once a sediment has been identified as contaminated, a site-specific evaluation procedure must be employed to quantify the level of risk, establish remediation goals, and determine the appropriate risk management actions. The site-specific evaluation might include for example: additional chemical testing; sediment toxicity testing; or sediment bioaccumulation tests.

Sediment contaminants primarily consist of heavy metals and persistent organic compounds (EPA, 1990). Sediment criteria for non-polar organic compounds are derived using equilibrium partitioning methodology (EPA, 1991, DiToro, et al., 1991). This document will derive sediment criteria for non-polar organic contaminants listed in the TOGS 1.1.1. (DoW, 1991), using the water quality standards and guidance values listed there. If a water quality criterion for a particular contaminant is not identified in TOGS 1.1.1., an EPA water quality criterion is used. These criteria are annotated with the suffix (E). Proposed water quality criteria for the protection of human health and piscivorous wildlife from bioaccumulative affects are derived using procedures identified in Appendix 1; Newell et al. (1987); and 6NYCRR Parts 702.8 and 702.13. These criteria are annotated with the suffix (P). With the exception of PCBs, these water quality guidance values are not yet listed in TOGS 1.1.1.

Sediment criteria for metals are based upon procedures and data developed by the Ministry of Ontario (Persaud et al., 1992), and the National Oceanic and

Atmospheric Agency (NOAA) (Long and Morgan, 1990). Sediment criteria for polar organic compounds are not derived. Instead, contaminant concentrations in pore water should be compared directly to surface water quality criteria; see section V. Some polar organics such as phenolic compounds behave as non-polar compounds under conditions of neutral pH. For these compounds, EP-based sediment criteria can be derived. Both the equilibrium partitioning methodology and the Ministry of Ontario procedures are discussed below.

IV. Derivation of Sediment Quality Criteria for Non-polar Organic Compounds using Equilibrium Partitioning.

A. Characteristics of Non-polar Organics

Non-polar organic compounds are substances that contain carbon, and do not exhibit a net electrical (ionic) charge (Nebergall, et al. 1968). Non-polar organic contaminants tend to be of low solubility in water. Otherwise they would dissolve and not accumulate in sediments (Manahan, 1991). Many non-polar contaminants are highly soluble in lipids, and thus can be bioaccumulated. They are persistent, meaning they do not break down or degrade rapidly, and can remain in sediments for long periods of time. The International Joint Commission defines persistent compounds as compounds with a half life greater than 56 days (IJC, 1978). Some contaminants such as pesticides can cause direct, acute toxicity to exposed benthic organisms in low concentrations. Others such as DDT, PCB, and dioxin are more insidious, and bioaccumulate over time to cause chronic toxicity affects such as reproductive failure, either in populations exposed directly to the contaminated sediment or to organisms further up the food chain (Rand and Petrocelli, 1985).

B. Fundamentals of Equilibrium Partitioning (EP)

The basis for the EP methodology for deriving sediment criteria is that the toxicity of a contaminant in a sediment is attributable to the fraction of the contaminant that dissolves in the interstitial pore water, and is considered to be freely biologically available. The EP methodology predicts the concentration of contaminant that will dissolve in the interstitial pore water from three factors: 1) the concentration of contaminant in the sediment; 2) the concentration of organic carbon in the sediment; and 3) the affinity of the contaminant for organic carbon in the sediment.

The affinity of a contaminant for sediment organic carbon can be directly measured. The sediment/water partition coefficient, or K_p is a measure of the concentration of a contaminant sorbed to the sediment divided by the concentration dissolved in water (measured in l/kg), after mixing. The K_p is only useful as a site specific measure because the K_p will vary with different sediment

samples. The EPA (1991) reported that the organic carbon content of a sediment accounts for most of the variation in the uptake of the contaminant by the sediment. The K_{oc}, or sediment organic carbon/water partition coefficient is a measure of the concentration of contaminant that adsorbs to the organic carbon content of the sediment divided by the concentration dissolved in water, after mixing (measured in l/kg). When normalized for organic carbon, concentrations of a contaminant in different sediment samples are comparable. Another partition coefficient that is closely correlated with K_{oc} and is useful for predicting soil adsorption is the octanol/water partition coefficient, or K_{ow} (Kenaga, 1980). Voice, et al. (1983) citing Karickhoff (1979), reports that the relationship between the three coefficients can be described in two equations:

$$K_{oc} = K_p/f_{oc}$$

and

$$\log_{10}K_{oc} = \log_{10}K_{ow} - 0.21 \quad \text{(also in Kenaga, 1980)}$$

where f_{oc} is the fraction of solids by weight that is comprised of organic carbon.

The EPA (1991) refers to DiToro (1985) to define the relationship between K_{oc} and K_{ow} as:

$$\log_{10}K_{oc} = 0.00028 + 0.983\log_{10}K_{ow}$$

Using the DiToro (1985) relationship, the K_{oc} very nearly equals the K_{ow}. Using either relationship, it can be readily seen that the K_{oc} and K_{ow} for a given non-polar organic compound are very similar, and vary in direct proportion. In their initial review of the equilibrium partitioning methodology, the EPA SAB considered the equating of K_{oc} and K_{ow} to be a source of uncertainty (EPA SAB 1990). In their 1992 review, the EPA SAB states that uncertainties have diminished largely as a result of more accurate determination's of K_{ow}s, and that occasionally the K_{ow} may not be a good predictor of the K_{oc} (EPA SAB 1992).

When a non-polar organic contaminant enters the sediment, it will partition between the sediment and pore water in three compartments: a fraction will adsorb to the organic carbon in the sediment; another fraction will adsorb to dissolved organic carbon in the interstitial pore water; and a third fraction will dissolve in the pore water. An equilibrium will be established so that any change in the contaminant concentration in one compartment will result in a corresponding change in the contaminant concentration in other compartments. For example, if some of the contaminant dissolved in the pore water is removed, some of the contaminant adsorbed to the sediments will desorb to balance the loss from the pore water. If dissolved contaminant is added to the pore water, it will not all

remain in the pore water, but some will adsorb to dissolved organic carbon and sediment organic carbon, re-establishing the equilibrium. Interestingly, the EPA (1991) noted that an increase in the volume of dissolved organic carbon in the pore water causes contaminant sorbed to the sediment to desorb and in turn sorb to the dissolved organic carbon. The freely dissolved fraction of the contaminant remains practically unchanged.

Equilibrium partitioning methodology contends that sediment toxicity is attributable to the concentration of contaminant dissolved in the interstitial pore water and considered to be biologically available (EPA 1989, EPA 1991). It can be inferred, then, that a water quality criterion developed to protect aquatic life from contaminants dissolved in the water column should also protect benthic aquatic life from contaminant concentrations dissolved in pore water. The EPA (1991) compared the sensitivity of benthic organisms to the sensitivity of water column organisms to toxicity from the same chemicals, and found that they were very similar. Therefore the prediction that exceeding a water column-based criterion in sediment pore water would harm benthic organisms was considered valid.

C. Derivation of Sediment Criteria using Equilibrium Partitioning

To derive an organic carbon normalized sediment criterion, two items of information are required:

A. An ambient water quality criterion for a particular contaminant;

B. the K_{ow} partition coefficient for the contaminant;

For example, the PCB water quality criterion (see footnote 1 on page 4) for the protection of piscivorous wildlife from bioaccumulation is 0.001 μg/l. The K_{ow} for PCB is $10^{6.14}$, or 1,380,384.3 l/kg. The organic carbon normalized PCB sediment criterion (SC_{oc}) would be:

$$SC_{oc} = WQC * K_{ow}$$

$$PCB\ SC_{oc} = 0.001\ \mu g/l * 1{,}380{,}384.3\ l/kg * 1\ kg/1{,}000\ gOC =$$

$$1.38\ (\approx 1.4)\ \mu g/gOC$$

1 kg/1,000 gOC is a conversion factor.

The meaning of the criterion is: based on the equilibrium partitioning characteristic of PCBs, in order not to exceed the water quality criterion of 0.001 μg/l in the pore water, the concentration of PCB in the sediment must not exceed 1.4 μg for each gram of organic carbon in the sediment.

To apply this SC_{oc} on a site specific basis, the concentration of organic carbon in the sediment at the site must be known. If a sediment sample was known to contain 3% organic carbon, the site specific sediment criterion (SC) for PCB could be derived:

$$SC = SC_{oc} * f_{oc}$$

$$f_{oc} = 3\% \text{ OC/kg sediment} = 30 \text{ gOC/kg}$$

$$\text{PCB SC} = 1.4 \ \mu\text{g/gOC} * 30 \text{ gOC/kg} = 42 \ \mu\text{g PCB/kg sediment}$$

This criterion states that: if there are less than 42 μg PCB/kg of sediment in a sediment containing $\geq$ 3% organic carbon, there is no appreciable risk to piscivorous wildlife from consuming fish or other aquatic life from the waterbody over the contaminated sediment.

D. Limitations of Equilibrium Partitioning Derived Sediment Criteria

There are several limitations to the application of EP-based criteria:

1. EP-based criteria are only applicable to non-polar organic compounds, or other substances that behave as non-polar organic compounds in the sediment and prevailing environmental conditions, such as pH.

2. EP-based criteria apply only to the specific level of protection identified in the criterion. In the example above, the 42 μg/kg PCB concentration in the 3% sediment sample does not pose appreciable risk to wildlife, however, it may or may not pose a risk to human beings. A sediment criterion derived from a human health-based water quality criterion must be compared to make that determination.

3. EP-based criteria should only be derived for sediments with organic carbon fractions between approximately 0.2 - 12% (EPA SAB, 1992). Outside of this range, other factors that the EP methodology does not account for may influence contaminant partitioning.

4. The equilibrium partitioning method should not be applied to broad classes of compounds or mixtures if one K_{ow} value is used to represent the entire class or the mixture (EPA SAB, 1992). In this respect, PCB congeners would not be considered a broad class of compounds; they are a narrow class of quite similar compounds.

5. For compounds with a K_{ow} less than 100 ($\log_{10}K_{ow} \leq 2$), the water quality criterion can be greater than the site specific sediment quality

criterion. This implies that virtually all of the contaminant is biologically available. Since the water quality criterion delineates the concentration that is harmful to aquatic life, it is not reasonable that a smaller concentration in the sediments would be harmful to benthic organisms, especially considering that some fraction of the contaminant will be sorbed to the sediment and not biologically available. For these compounds, the organic carbon normalized sediment criterion should be derived in the manner described above. However, when determining the site specific criterion, compare the product of the SC_{oc} * f_{oc} with the water quality criterion, converted from a volumetric to mass units (μg/l * l/kg = μg/kg). If the water criterion is greater than the site specific sediment quality criterion, use the water quality criterion as the sediment criterion. For example, the $\log_{10}K_{ow}$ of benzidine is 1.4. The SC_{oc} for the protection of benthic life (chronic toxicity), based on a TOGS 1.1.1. water quality criterion of 0.1 μg/l is 0.003 μg/gOC. If the sediment contained 3% organic carbon, the site specific SC would be 0.09 μg/kg. The water quality criterion (converted from a volumetric measure to a mass measure) of 0.1 μg/kg is greater, so the site specific sediment criterion should be 0.1 μg/kg. If the site contained 5% organic carbon the site specific sediment criterion would be 0.15 μg/kg, which is greater than the water quality criterion of 0.1 μg/l. In this instance, the 0.15 μg/kg would be the appropriate criterion to use.

6. Derivation of EP-based criteria assumes that an equilibrium between the sediment/pore water compartments has been achieved. Rand and Petrocelli (1985) indicate that the sorption-desorption equilibria are achieved rapidly, usually in a few minutes to several hours. Voice et al. (1983) found that in laboratory studies, equilibria were generally achieved in about 4 hours. In investigating contamination of stable sediments with long term exposure to a contaminant, it is likely that equilibrium has been achieved. However for spill sites, and areas with unstable sediments, attainment of the equilibrium condition may be questionable. The EPA SAB (1992) recommends that EP-based criteria not be used in areas of rapid deposition or erosion (e.g. > 10 cm/yr), such as active dredge disposal areas, areas of heavy boat and barge traffic, and some river channels.

7. The EP methodology is not a highly accurate procedure in and of itself. Several related sampling and analysis procedures could introduce additional variation and uncertainty into the results. Some of these factors include: the value of the K_{ow} used and how it was derived; how the sediment sample was taken and analyzed for contaminant content; and how the organic content of the sediment sample (f_{oc}) was determined. For consistent application of sediment criteria, these factors must be considered systematically and consistently. ASTM (1993) recommendations should be followed for the proper collection, storage, and analysis techniques when

applying EP-based sediment criteria. The analysis method is particularly important for determination of sediment total organic carbon, because there are several methods available that may give variable results. The authors and EPA (1992b) recommend the use of catalytic combustion with nondispersive infrared carbon dioxide detection (Leonard, 1991) when developing total organic carbon-normalized criteria for non-polar organic compounds. However, unless the "true" K_{ow} differs by a factor of 10, or the "true" f_{oc} differs by 50 - 100% from the K_{ow} and f_{oc} values used to derive the sediment criteria, the level of imprecision introduced into the criteria calculation will be minor. An EP-based criterion applies to a single sediment sample. Results obtained from composite samples may be misleading in that the contaminant concentration at a single point or depth might be diluted with uncontaminated samples. Conversely, a contaminated sample mixed with uncontaminated samples from other points or depths might cause a greater area appear to be contaminated than actually is.

8. There are still a number of uncertainties related to equilibrium partitioning-derived sediment criteria. These include such factors as particle size, particle density, organic carbon content, K_{ow}/K_{oc} relationship, route of exposure, the impact of dissolved organic carbon, and the uncertainty of extrapolating laboratory data to field conditions (EPA, 1991; EPA SAB, 1992). Despite these uncertainties, the EPA has found that sediment toxicity from laboratory experiments generally falls within a factor of 5 of the toxicity predicted by equilibrium partitioning. EP-based criteria are considered to be valid for screening and assessment. These preliminary assessments can be followed up with further testing if necessary to more accurately quantify risk.

Table 1 lists 52 non-polar organic compounds or classes of compounds for which sediment criteria have been derived using the equilibrium partitioning methodology. The derivation procedure is the same as that recommended by the EPA (1991). The only difference is that New York State water quality standards and guidance values are used instead of EPA ambient water quality criteria. EPA criteria have been used to derive a sediment quality criterion only when a New York standard or guidance value is not available. Four criteria, corresponding to four of the five levels of protection, are listed for each contaminant whenever possible. Sediment criteria are not derived for the protection of human health from toxicity, because that type of exposure would constitute human consumption of the interstitial pore water within the contaminated area, which is an unreasonable assumption. A sediment is considered to be contaminated if the contaminant concentration exceeds <u>any</u> of the criteria listed. The table also identifies the K_{ow} and the water quality criterion used to derive the sediment criterion. Water quality criteria are from DoW TOGS 1.1.1., unless suffixed with an (E), which indicates an EPA water quality criterion. Proposed water quality criteria for the protection of

human health and piscivorous wildlife from bioaccumulative effects are used when no TOGS 1.1.1. criterion for bioaccumulation has been developed. These criterion are annotated with the suffix (P), and are derived according to the method described in Appendix 1 and Newell et al. (1987).

V. Polar Organics - Application of Water Quality Criteria to Pore Water via Direct Measurement of Pore Water

For polar organics (except for phenols) no algorithms have been developed yet for sediment criteria that account for sediment characteristics which may affect substance toxicity. However, in order to screen sediments for potential impacts from polar organic compounds, interstitial (pore) water from sediment samples should not exceed existing water quality standards and guidance values for polar organics in TOGS 1.1.1.

The application of these criteria to pore water is complicated by dissolved organic carbon (DOC) in pore water that is generally much higher than DOC in the water column. DOC tends to reduce toxicity and bioaccumulation of chemicals by reducing their availability for uptake by the organism. However, even though water column DOC is usually low, water quality criteria are not modified to account for the effects of DOC. If the partitioning coeficient between DOC and water for a contaminant is known, that coefficient could be used to account for the effect of DOC on toxicity or bioaccumulation in the application of water quality criteria to pore water. The bioaccumulation of contaminants with low K_{ow} is generally not suppressed by water column DOC, indicating that the effects of DOC can probably be ignored. In any case, a conservative risk assessment is assured if the effects of DOC in pore water are ignored during a preliminary screening. In follow-on assessments, DOC affects should be evaluated. As a consequence, the water quality criteria becomes the pore water criteria, and sediment criteria per se are not derived for these compounds.

VI. Derivation of Sediment Quality Criteria for Metals

A. Characteristics of Metals as Sediment Contaminants

A wide variety of metals in a wide variety of forms can be found in marine and aquatic sediments. Some concentrations occur naturally, while others have been introduced through man's activities. Very low concentrations of most metals are required nutrients for living organisms, but in excess concentrations, metals can be harmful (Rand and Petrocelli, 1985). The properties that metals exhibit in water depend largely on the form in which the metal occurs (Manahan, 1991). In waterbodies, metals are typically found (Demayo et. al, 1978):

1. Dissolved as free ions and complexes;

2. As particulates:

    a. inorganic precipitates such as hydroxides, sulphides, carbonates, and sulphates;

    b. sorbed onto or complexed with high molecular weight organic compounds or clay particles;

3. Mixed or sorbed to bottom sediments;

4. Incorporated into the tissues of biota.

The toxicity and bioavailability of metals in water [and sediment] vary with the form of the metals (EPA 1992a). The form of the metal, and thereby the toxicity of a metal, are highly influenced by environmental conditions such as pH, alkalinity, REDOX potential, and the availability of complexing ions or ligands. Very generally, it can be said that the dissolved fraction of metals seems to account for most toxicity, however, some particulate forms of some metals also exhibit toxicity (EPA 1992a).

Metals in water can generally be measured as total (total recoverable) dissolved metal. Currently, the EPA recommends using water effects ratios for evaluating the impact of metals on surface water quality (EPA 1993). Conduct toxicity tests using water from a specified site, and compare the toxicity with reference toxicity tests in relatively pure water. The resulting "water effects ratio" can then be used to adjust either a total recoverable metal criterion or effluent limitation, or dissolved metals water quality criterion (preferred in areas of highly variable suspended solids concentrations) to account for local conditions.

In sediments, metals exhibit the same variety of forms as in water; they can dissolve as ions or soluble complexes in the interstitial pore water, precipitate as organic or inorganic compounds, or sorb to binding sites in the sediment. The complexity of metals behavior in water and sediments makes it impossible to accurately predict the levels at which toxic effects will occur. For metals, the primary concern in sediments is toxicity to benthic organisms. Metals can bioaccumulate in organisms. Bioaccumulation of metals is highly variable and dependent on the form of the metal and how it enters the organism (Doull et al., 1980). Different organs and tissues will have different affinities for different metals and species of metals. Metals can be absorbed by an organism but be bound by protiens known as metallothioneins into relatively harmless forms. Toxicity of metals are dependent on many environmental conditions and are difficult at best to predict consistantly.

B. Establishing Screening Level Concentrations

Because of the inability to predict biological affects from metals concentrations in sediment, the best alternative is to identify adverse ecological effects that are attributable to sediment-borne metals concentrations, and measure what concentration caused the adverse effect. The Ontario Ministry of the Environment issued metals guidelines derived by the "Screening Level Concentration" approach. This is an effects-based approach which uses field data on co-occurrence of benthic animals and contaminants (Persaud et al., 1992). The Ontario guidelines span background, lowest effect levels and severe effect levels. The methods used to derive these guidelines do not account for the effects of organic content, acid volatile sulfide concentration, particle size distribution or iron and manganese oxide content, or other toxicity-mitigating factors on the bioavailability of metals within the sediments, because the total metals concentration is related directly to an observed, measureable ecological effect. It is possible that this methodology might not discern toxicity from other compounds besides metals.

Long and Morgan (1990) reviewed and categorized chemical effects data in sediments according to low and median toxic effects ["Effects Range-Low (ER-L)"and "Effects Range-Median (ER-M)" concentrations] and "Overall Apparent Effects Thresholds" for benthic organisms observed in field studies across the nation. Effects levels reported were associated with bulk sediment concentrations without normalizing for any toxicity mitigating factors. For metals, effects levels in Long and Morgan (1990) may be compared with effects levels taken from Persaud et al. (1992). Both are based on a selection of observed effects from field studies, although Persaud et al. (1992) is restricted to Great Lakes data while Long and Morgan (1990) used both fresh and salt water data. For six metals (arsenic, cadmium, chromium, copper, lead and nickel), the lowest effects levels described by Persaud et al. (1992) are lower than the ER-L (effects range-low) from Long and Morgan (1990). This could be because in the relatively pure waters of Lake Ontario, fewer ligands were available to complex metal ions, so biological affects were noted at lower metals concentrations. The Long and Morgan (1990) study included more eutrophic waters, wherein, metals could be complexed to a greater extent into biologically unavailable forms. Exposed organisms were able to tolerate higher total metals concentrations because the greater fraction of metal present was biologically unavailable.

To establish screening criteria for sediments in New York State, two levels of protection as a basis sediment quality screening criteria were established, following the Ministry of Ontario Guidlines definitions. These are the Lowest Effect Level and the Severe Effect Level. The Lowest Effect Level indicates a level of sediment contamination that can be tolerated by the majority of benthic organisms, but still causes toxicity to a few species. The Severe Effect Level indicates the concentration at which pronounced disturbance of the sediment

dwelling community can be expected (Persaud et al. 1992). The ER-L and ER-M from Long and Morgan (1990) were compared with the Lowest Effect Level and Severe Effect Level from Persaud et al. (1990). The lowest concentration in each of the two effect levels was selected as the New York sediment screening criteria. These sediment criteria for metals are listed in Table 2. If a total metals concentration in a sediment sample is less than the Lowest Effect Level listed in Table 2, the effects of the metal in the sediment are considered to be acceptable. If the concentration is greater than the lowest effect level but less than the severe effect level concentration, the sediment is considered to be contaminated, with moderate impacts to benthic life. If the concentration is greater than the severe effect level, the sediment is contaminated and significant harm to benthic aquatic life is anticipated.

Background concentrations described in Persaud et al. (1992) were not used to establish criteria. For some metals, cadmium and copper for example, Persaud lists a Lowest Effect Level that exceeds the typical background concentration. Because a metal concentration in sediment is considered to be naturally occurring, or background, does not mean that the concentration is not causing an adverse ecological effect.

As noted above, metals guidelines from Persaud et al. (1992) are based on freshwater sediments only, and effects levels in Long and Morgan (1990) reflect data from both fresh and salt water. Although differences in the bioavailability of metals in fresh and salt water sediments may be elucidated in the future, at this time, the sediment criteria identified in Table 2 are considered suitable for identifying areas of metal contaminated sediment, assessing potential risk, and identifying suitable follow-up tests, studies, and risk management options in both fresh and salt water sediments.

C. Limitations to Sediment Criteria for Metals

There are limitations to the application of the metals sediment quality criteria listed in Table 2:

1. Persaud et al. (1992) values are based on oligotrophic waters with low concentrations of metals-complexing ligands. These criteria are possibly over-protective when applied to more eutrophic waters. However, many streams and ponds in New York are oligotrophic, and the low effects concentrations are justified. These criteria are intended to be used for screening; that is, to identify potentially contaminated sites and provide a qualitative estimate of risk. Once a site is found to be contaminated with metals, further studies are necessary to quantify risk and determine if remediation actions are necessary. Remediation should not be based solely on exceedances of these criteria.

2. These criteria have limited applicability to mixtures of metals. Metals criteria are most clearly applicable to sediments with high concentrations of a single metal, or situations where one metal has a disproportionatly greater abundance in a sediment sample than any other metal. The presence of one metal can significantly affect the impact that another metal has on an organism. The effect can be synergistic, additive, or antagonistic (Eisler, 1993). A reasonable level of protection can be expected if none of the criteria are exceeded for metals that are present, however, effects may be present if the sum of the fractions of criteria over sediment concentrations exceed one, for all of the metals present. For example, in a sediment sample, four metals are detected. The concentration of each metal in the sediment sample is 0.3 of its corresponding sediment criterion. The sum of the fractions would be 1.2. In this case, further testing is warranted.

3. Total metals, or the bulk metals concentration should be measured in sediment samples.

VII. Use of Sediment Criteria in Risk Management Decisions

Once it has been determined that a sediment criterion is exceeded, more information is required to determine if remediation is necessary and what actual risks to the environment are present. The volume and location of sediment exceeding a criterion, which levels of protection are exceeded, the persistence of the contaminant, the uncertainty about the criteria, and the results of more detailed, site specific sediment tests all play a role in making decisions about how, and how much sediment to clean up in order to eliminate or minimize adverse effects. If the volume of sediment that exceeds sediment criteria is small and the sediment is fairly accessible, the remediation of all contaminated sediment may be the most expedient action. If volumes of sediment are large and/or difficult to remediate either because of accessibility, sensitivity of the impaired habitat, or lack of efficacious technology, further risk management evaluations are warranted. In general the areal extent of the contaminated sediments should be a factor in considering the need for, and method of remediation.

Once the source of contaminants to sediments is terminated, the length of time a particular area of sediments remain contaminated will depend on the persistence of the chemicals, and the site-specific characteristics of the sediment such as: rate of sedimentation; resuspension; and biological and chemical degradation. If a contaminant is not persistent (e.g. contaminant concentrations would be expected to fall to acceptable levels within six months to a year), and the effect of the contaminant is not severe, then sediment remediation may not be necessary. Even for a persistent contaminant, it may not be necessary to re-mediate the sediments if the contaminated area is a deposition zone, and the natural burying of the contaminated sediments beneath the zone of biological

activity and availability would be expected to occur within a short time, and resuspension of the contaminants was unlikely.

EPA SAB (1992) examined a number of factors relating to the uncertainty of EP based sediment criteria, including sediment composition variability, measurement variation and K_{ow} - K_{oc} correlations and measurements. They report that all these variabilities amount to an estimated uncertainty factor of five. This suggests with good confidence that sediment criteria exceeded by a factor of five will result in the onset of toxicity. Toxicity could also result from sediment contaminant concentrations just below the sediment criterion. The EPA SAB (1992) identifies the range of concentrations from 1/5 - 5 times an EP-derived sediment criterion as a "grey" area, where observable impacts may or may not occur. Based on the statistical analysis of EP-derived sediment criteria, there is a high degree of confidence that contaminant concentrations $\leq$ 1/5 of a sediment criterion pose little or no risk. Similarly, if a contaminant concentration in sediment exceeds an EP-derived sediment criterion by a factor of 5, there is little or no doubt that adverse ecological impacts are occurring. Within the range in-between, the actual occurrence of effects is unknown. However, to avoid making the criteria excessively overprotective or underprotective, the best use of the factor of 5 is in interpreting the results of sediment screening, not to modify the criteria.

The onset of chronic toxicity may be difficult to detect in natural systems. Water quality criteria designed to prevent acute toxicity are generally about ten times greater than comparable chronic criteria. Therefore, in general, sediments with contaminants at 50 times chronic toxicity sediment criteria concentrations (a factor of five for uncertainty and a factor of ten based on acute to chronic toxicity ratios), will result in the onset of acute toxicity to benthic animals with a high degree of confidence.

It must also be noted that with this uncertainty the possibility exists that the sediment criteria may be somewhat underprotective as well as than overprotective.

Sediment criteria for metals are based on empirical evidence from both lab and field studies without an attempt to normalize for any toxicity mitigating factors in the sediment. Variability of toxicity from metals in any given sediment is evident (Appendix 2). Many of the Lowest Effect Levels from Persaud et al. (1992) are lower than the mean background concentrations in Great Lake sediments. This suggests that in some sediments relatively low levels of metals, even below mean background, are toxic, whereas in other sediments fairly high levels, up to and possibly even above background, may not be toxic. For all metals, the Severe Effect Level criteria exceeds mean background considerably; consequently, significant and noticeable toxicity is expected in all sediments that exceed that level of protection.

VIII. Implementation of Sediment Criteria for Screening

Implementation guidance can be outlined in a strategy to apply sediment criteria for screening areas suspected of sediment contamination and recommending actions to take if they are exceeded.

1. Compare sediment contaminant concentrations with sediment criteria

   a. Quantify the area and volume of sediment wherein the criteria is exceeded; determine whether biota are exposed to contaminated sediment, e.g. deeply buried sediments may be below active biological zones.

   b. Describe the significance of exceedances in terms of the predicted effects. For example, would bioaccumulation or toxicity be the predominant impact. Based on the levels of protection exceeded, evaluate whether impacts are expected to be isolated or widespread through the ecosystem of concern. Consider the potential for transport of contaminants by natural processes to other areas.

2. For naturally occurring substances such as metals, compare sediment concentrations in the area of interest with local background concentrations in areas known to be unaffected by anthropogenic sources of contamination. Evaluate sediments relative to sediment criteria to identify contaminated sites. Compare suspected contaminated sites with uncontaminated sites, looking for adverse ecological impacts.

3. If sediment concentrations of a compound are less than all of the sediment criteria for that substance, aquatic resources can be considered to be not at risk (from that compound). However, additional testing would be warranted if the concentration of numerous contaminants were just below the criteria thresholds.

4. If sediment contaminant concentrations exceed criteria, and especially if widespread in the area of interest, steps may be taken to verify the need for remediation:

   a. For sediments with non-persistent, non-polar organic contaminants that are not causing observable acute or significant chronic toxicity, further remedial investigation or sediment remediation is not necessary if the source of contamination will be eliminated and the sediment will cleanse itself. Many chemicals with $\log_{10}K_{ow} < 3$ can be expected to be non-persistent in sediments. If it is decided not to remediate sediments contaminated with non-persistent chemicals, then,

assurance must be made that water quality standards in offsite waters will not be contravened, and the public is informed of risks related to the contamination.

b. For sediments exceeding criteria based on aquatic life toxicity, including metals Lowest Effect Levels:

1. Assess the degree of impairment to the benthic community; compare site specific impairment with sediment contaminant concentrations; correlate site specific level of impairment with other known level of impairments and contaminant concentrations.

2. Collect sediment samples and conduct acute and chronic toxicity tests with fish and benthic invertebrates; correlate toxicity test results with sediment contaminant concentrations. It is important to follow established toxicity identification evaluation (TIE) techniques to ensure correct identification of the cause of toxicity, e.g. ammonia is a common cause of toxicity to benthic animals that can be mistakenly attributed to other toxics. Similarly, dissolved oxygem depletion in organically enriched sites such as wetlands could be confused with acute toxicity from contaminants.

3. For non-polar organic contaminants, exceedance of sediment criteria based on aquatic life chronic toxicity by a factor of 50 in a significantly large area indicates that biota are probably impaired and to achieve restoration of the ecosystem will require remediation of organic contaminants present.

4. For metals, if Severe Effect Levels are exceeded in significant portions of the ecosystem of concern, biota are most likely impaired and to achieve restoration of the ecosystem would likely require remediation of metals present.

c. For sediments exceeding criteria based on human health concerns:

1. Collect data on residues in edible, resident biota from the areas of concern and compare with tolerances, action levels, guidance values, or 1×10^{-6} cancer risk levels, or

2. Collect sediment samples, expose representative edible biota to sediments, measure residue in biota.

d. For sediment contaminant concentrations exceeding sediment criteria for the protection of piscivorous wildlife:

1. Collect data on residues in resident prey of piscivorous wildlife and compare with fish flesh criteria for protection of wildlife.

2. Expose wildlife food supply to contaminated sediment and measure residues in the food supply; compare with food supply residue levels known to be toxic to wildlife.

If sediment concentrations and criteria are less than analytical detection limits, ecological assessments are necessary to measure toxicity of sediments or residues in organisms exposed to sediments suspected of contamination. Generally, it is reasonable to predict that some, possibly high, levels of toxicity or bioaccumulation may associated with contaminants in sediments below analytical detection.

Table 1. Sediment criteria for non-polar organic contaminants. Water quality criteria used are taken from Togs 1.1.1. If a water quality criterion was not listed in TOGS 1.1.1., then an EPA criterion was used. These are annotated with the suffix (E). EPA criteria were extracted from the "Water Quality Criteria Summary" chart (EPA, 1991). EPA water quality criteria for the protection of human health (bioaccumulation) were taken from the "Recalculated Values - Organisms Only" column. Wildlife (bioaccumulation) and Human Health (bioaccumulation) protection criteria were derived in Appendix 1, unless TOGS 1.1.1. (bioaccumulation) criteria already existed. Although these criteria are only proposed, they are useful as guidance for estimating potential human health risks. These criteria are annotated with a suffix (P), for "Proposed criteria values".

			Levels of Protection							
			Human Health Bioaccumulation		Benthic Aquatic Life Acute Toxicity		Benthic Aquatic Life Chronic Toxicity		Wildlife Bioaccumulation	
Contaminant	$LogK_{ow}$	Fresh-FW Salt -SW Both -FS	Water Qual Criteria µg/l	Sediment Criteria µg/gOC	Water Qual Criteria µg/l	Sediment Criteria µg/gOC	Water Qual Criteria µg/l	Sediment Criteria µg/gOC	Water Qual Criteria µg/l	Sediment Criteria µg/gOC
Acenapthene	4.33	FW SW						140(E)[1] 240(E)[1]		
Aldrin & Dieldrin	5.0	FS	0.001	0.1					0.0077 (P)	0.77
Azinphosmethyl	2.4	FW SW					0.005 0.01	0.001 0.003		
Azobenzene	3.82	FS	0.16 (P)	1.0						
Benzene	2.0	FS	6.0	0.6						
Benzo(a)pyrene[2]	6.04	FW SW	0.0012 0.0006	1.3 0.7						

[1]EPA proposed sediment quality criterion for the protection of benthic organisms.

[2]These values also apply to benz(a)anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, indeno(1,2,3-cd)pyrene, and methylbenz(a)anthracene.

Contaminant	$LogK_{ow}$	Fresh-FW Salt -SW Both -FS	Levels of Protection							
			Human Health Bioaccumulation		Benthic Aquatic Life Acute Toxicity		Benthic Aquatic Life Chronic Toxicity		Wildlife Bioaccumulation	
			Water Qual Criteria µg/l	Sediment Criteria µg/gOC	Water Qual Criteria µg/l	Sediment Criteria µg/gOC	Water Qual Criteria µg/l	Sediment Criteria µg/gOC	Water Qual Criteria µg/l	Sediment Criteria µg/gOC
Benzidine	1.4	FW			0.1	0.003	0.1	0.003		
Bis(2-chloroethyl) ether	1.73	FS	0.5 (P)	0.03						
Bis(2-ethylhexyl) phthalate	5.3	FW					0.6	199.5		
Carbofuran	2.26	FW			10.0	1.82	1.0	0.2		
Carbon tetrachloride	2.64	FS	1.3 (P)	0.6						
Chlordane	2.78	FW SW	0.002 0.002	0.001 0.001	2.4 (E) 0.09 (E)	1.4 0.05	0.043 (E) 0.004 (E)	0.03 0.002	0.01 (P) 0.01 (P)	0.006 0.006
Chlorobenzene	2.84	FS			50.0	34.6	5.0	3.5		
Chloro-o-toluidine	~2.0	FS	6.5 (P)	0.65						
Chlorpyrifos	5.11	FW SW			0.083 (E) 0.011 (E)	10.7 1.4	0.041 (E) 0.0056 (E)	5.3 0.72		
DDT, DDD, & DDE[1]	6.0	FW SW	0.00001 (P) 0.00001 (P)	0.01 0.01	1.1 (E) 0.13 (E)	1100 130	0.001 (E) 0.001 (E)	1.0 1.0	0.001 0.001	1.0 1.0
Diazinon	1.92	FW					0.08	0.007		
Dichlorobenzenes	3.38	FS			50.0	120.0	5.0	12.0		
1,2 Dichloroethane	1.48	FS	24.0 (P)	0.7						
1,1 Dichloroethylene	1.48	FS	0.8 (P)	0.02						

[1]Criteria for acute and chronic benthic toxicity apply to DDT only.

Contaminant	$LogK_{ow}$	Fresh-FW Salt -SW Both -FS	Levels of Protection: Human Health Bioaccumulation Water Qual Criteria µg/l	Human Health Bioaccumulation Sediment Criteria µg/gOC	Benthic Aquatic Life Acute Toxicity Water Qual Criteria µg/l	Benthic Aquatic Life Acute Toxicity Sediment Criteria µg/gOC	Benthic Aquatic Life Chronic Toxicity Water Qual Criteria µg/l	Benthic Aquatic Life Chronic Toxicity Sediment Criteria µg/gOC	Wildlife Bioaccumulation Water Qual Criteria µg/l	Wildlife Bioaccumulation Sediment Criteria µg/gOC
Dieldrin	5.0	FW SW	0.001 0.001	0.1 0.1				9.0 (E)[1] 17.0 (E)		
Diphenylhydrazine	3.03	FS	0.54 (E)	0.58						
Endosulfan	3.55	FW SW			0.22 0.034	0.78 0.12	0.009 0.001	0.03 0.004		
Endrin	5.6	FW SW	0.002	0.8				4.0 (E)[1] 0.73 (E)[1]	0.0019 (P)	0.8
Fluoranthene	5.19	FW SW						1020 (E)[1] 1340 (E)[1]		
Heptachlor & Heptachlor Epoxide	4.4	FW SW	0.00003 (P) 0.00003 (P)	0.0008 0.0008	0.52 (E) 0.053 (E)	13.1 1.3	0.0038(E) 0.0036(E)	0.1 0.09	0.001	0.03
Hexachlorobenzene	6.18	FW	0.0001 (P)	0.15	6.0 (E)	9081	3.68 (E)	5570	0.008 (P)	12
Hexachlorobutadiene	3.74	FW SW	0.06 (P) 0.06 (P)	0.3 0.3	10.0 3.0	55.0 16.4	1.0 0.3	5.5 1.6	0.7 (P) 0.7 (P)	4 4

[1]EPA proposed sediment quality criteria for the protection of benthic organisms.

Contaminant	$LogK_{ow}$	Fresh-FW Salt -SW Both -FS	Levels of Protection							
			Human Health Bioaccumulation		Benthic Aquatic Life Acute Toxicity		Benthic Aquatic Life Chronic Toxicity		Wildlife Bioaccumulation	
			Water Qual Criteria µg/l	Sediment Criteria µg/gOC	Water Qual Criteria µg/l	Sediment Criteria µg/gOC	Water Qual Criteria µg/l	Sediment Criteria µg/gOC	Water Qual Criteria µg/l	Sediment Criteria µg/gOC
Hexachlorocyclohexanes	3.8	FW SW	0.009 (P) 0.009 (P)	0.06 0.06	2.0 0.16	12.6 1.0	0.01 0.004	0.06 0.03	0.23 (P) 0.23 (P)	1.5 1.5
Hexachlorocyclopentadiene	3.99	FW SW			4.5 0.7	44.0 6.8	0.45 0.07	4.4 0.7		
Isodecyldiphenyl phosphate	5.4	FW			22	5526	1.7	427		
Linear Alkyl Benzene Sulfonates	3.97	FW					40	373		
Malathion	2.2	FS					0.1	0.02		
Methoxychlor	4.3	FS					0.03	0.6		
Mirex	5.83	FS	0.0001 (P)	0.07			0.001	0.7	0.0055 (P)	3.7
Octachlorostyrene	≈6.0	FS							0.0005 (P)	0.5
Parathion and Methyl Parathion	2.5	FW			0.065 (E)	0.02	0.008	0.003		
Pentachlorophenol	5.0	FW			1.0	100	0.4	40		
Phenanthrene	4.45	FW SW						120 (E)[1] 160 (E)[1]		
Phenols, total chlorinated	2.75	FW					1.0	0.6		

[1]EPA proposed sediment quality criteria for the protection of benthic organisms.

Contaminant	$LogK_{ow}$	Fresh-FW Salt -SW Both -FS	Levels of Protection: Human Health Bioaccumulation Water Qual Criteria µg/l	Human Health Bioaccumulation Sediment Criteria µg/gOC	Benthic Aquatic Life Acute Toxicity Water Qual Criteria µg/l	Benthic Aquatic Life Acute Toxicity Sediment Criteria µg/gOC	Benthic Aquatic Life Chronic Toxicity Water Qual Criteria µg/l	Benthic Aquatic Life Chronic Toxicity Sediment Criteria µg/gOC	Wildlife Bioaccumulation Water Qual Criteria µg/l	Wildlife Bioaccumulation Sediment Criteria µg/gOC
Phenols, total unchlorinated	2.0	FW					5.0	0.5		
PCB	6.14	FW SW	0.0000006 0.0000006	0.0008 0.0008	2.0 (E) 10.0 (E)	2760.8 13803.8	0.014 (E) 0.03 (E)	19.3 41.4	0.001 0.001	1.4 1.4
2,3,7,8-TCDD	7.0	FS	0.000001	0.01					$2x10^{-8}$ (P)	0.0002
1,1,2,2-Tetrachloroethane	2.56	FS	0.7 (P)	0.3						
Tetrachloroethylene	2.88	FS	1.0	0.8						
o-Toluidine	1.4	FS	18.0 (P)	0.5						
Toxaphene	3.3	FW SW	0.009 (P) 0.009 (P)	0.02 0.02	1.6 0.07	3.2 0.14	0.005 0.005	0.01 0.01		
Trichlorobenzenes	4.26	FS			50	910	5	91		
1,1,2-Trichloroethane	2.17	FS	4.0 (P)	0.6						
Trichloroethylene	2.29	FS	11.0	2.0						
Triphenyl phosphate	4.59	FW			40	1556	4	156		
Vinyl Chloride	0.6	FS	18.0 (P)	0.07						

Contaminant	$LogK_{ow}$	Fresh-FW Salt -SW Both -FS	Levels of Protection							
			Human Health Bioaccumulation		Benthic Aquatic Life Acute Toxicity		Benthic Aquatic Life Chronic Toxicity		Wildlife Bioaccumulation	
			Water Qual Criteria µg/l	Sediment Criteria µg/gOC	Water Qual Criteria µg/l	Sediment Criteria µg/gOC	Water Qual Criteria µg/l	Sediment Criteria µg/gOC	Water Qual Criteria µg/l	Sediment Criteria µg/gOC
Anthracene	4.45	FW			35	986	3.8	107		
Benz(a)anthracene	5.61	FW			0.23	94	0.03	12		
Benzene	2.13	FW SW			760 670	103 90	210 190	28 26		
Ethylbenzene	3.15	FW SW			150 41	212 58	17 4.6	24 6.4		
Fluorene	4.18	FW SW			4.8 23	73 348	0.54 2.5	8 38		
Isopropylbenzene (cumeme)	3.66	FW			23	105	2.6	12		
2-methylnaphthalene	3.86	FW SW			42 48	304 348	4.7 4.2	34 30		
Naphthalene	3.37	FW SW			110 140	258 328	13 16	30 38		
Pyrene	5.32	FW			42	8775	4.6	961		
Toluene	2.69	FW SW			480 430	235 211	100 92	49 45		
1,2,4-trimethylbenzene	3.75	FW SW			290 170	1631 956	33 19	186 107		
Xylene	3.15	FW SW			590 170	833 240	65 19	92 27		

Table 2. Sediment Criteria for Metals. Two levels of risk have been established for metals contamination in sediments. These are the Lowest Effect Level and the Severe Effect Level. The Lowest Effect Level for each metal is the lowest of either the Persaud et al. (1992) Lowest Effect Level or the Long and Morgan (1990) Effect Range-Low. Similarly, the Severe Effect Level for each metal is the lowest of either the Persaud et al. (1992) Severe Effect Level or the Long and Morgan (1990) Effect Range-Moderate. A sediment is considered contaminated if either criterion is exceeded. If both criteria are exceeded, the sediment is considered to be severely impacted. If only the Lowest Effect Level criterion is exceeded, the impact is considered moderate. The units are µg/g, or ppm, except for iron, which is listed as a percentage. An "L" following a criterion means that it was taken from Long and Morgan (1990); a "P" following a criterion indicates that it is from Persaud et al. (1992). Complete tables from both sources can be found in appendix 2.

Metal	Lowest Effect Level µg/g (ppm)	Severe Effect Level µg/g (ppm)
Antimony	2.0 (L)	25.0 (L)
Arsenic	6.0 (P)	33.0 (P)
Cadmium	0.6 (P)	9.0 (L)
Chromium	26.0 (P)	110.0 (P)
Copper	16.0 (P)	110.0 (P)
Iron (%)	2.0% (P)	4.0% (P)
Lead	31.0 (P)	110.0 (L)
Manganese	460.0 (P)	1100.0 (L)
Mercury	0.15 (L)	1.3 (L)
Nickel	16.0 (P)	50.0 (L)
Silver	1.0 (L)	2.2 (L)
Zinc	120.0 (P/L)	270.0 (L)

Appendix 1. Basis for the Water Quality Criteria Used for Deriving Sediment Criteria for the Protection of Human and Health and Piscivorous Wildlife from Bioaccumulation Effects.

This appendix provides the basis and calculations for ambient water quality criteria in Table 1 with the suffix (P), which were developed by the Divisions of Fish and Wildlife and Marine Resources for use in calculation of sediment criteria.

Human health (bioaccumulation) based criteria in Table 1 with the (P) suffix are derived according to the method in 6NYCRR 702.8.

$$\text{Water Quality Criterion, ug/l} = \frac{\text{ADI, ug/d}}{\text{0.033 kg/d x BF}}$$

where

ADI, ug/d = acceptable daily intake for humans taken from fact sheets supporting drinking water standards and guidance values in TOGS 1. 1. 1

0.033 kg/d = the human daily intake from fish consumption cited in Part 702.8, and

BF = bioaccumulation factor

Wildlife residue based criteria in Table 1 with the (P) suffix are derived according to the method in 6NYCRR 702.13.

$$\text{Water Quality Criterion, ug/l} = \frac{\text{A, mg/kg}}{\text{BF}}$$

where

A = a fish flesh criterion for protection of piscivorous wildlife taken from Newell et a[(1987), and

BF = Bioaccumulation Factor

BFs for human health based criteria are about 3% lipid based, whereas the BCF's for wildlife based criteria are about 10% lipid based. BFs were determined as a best judgement from review of available information in EPA water quality criteria documents, EPA (1 979), and other scientific literature.

Aldrin and Dieldrin

Wildlife Residue Based Criterion

$$0.0077 \text{ mg/l} = \frac{0.12 \text{ mg/kg}}{15570}$$

Azobenzene

Human Health Residue Based Criterion

$$0.16 \text{ ug/l} = \frac{1 \text{ ug/d}}{0.033 \text{ kg/d} \times 179}$$

Bis (2-chloro-ethyl) ether

Human Health Residue Based Criterion

$$0.5 \text{ ug/l} = \frac{0.06 \text{ ug/d}}{0.033 \text{ kg/d} \times 4}$$

Carbon tetrachloride

Human Health Residue Based Criterion

$$1.3 \text{ ug/l} = \frac{0.8 \text{ ug/d}}{0.033 \text{ kg/d} \times 19}$$

Chlordane

Wildlife Residue Based Criterion

$$0.01 \text{ ug/l} = \frac{0.5 \text{ mg/kg}}{47020}$$

Chloro-o-toluidine

Human Health Residue Based Criterion

$$6.5 \text{ ug/l} = \frac{1.4 \text{ ug/d}}{0.033 \text{ kg/d} \times 15}$$

DDT, DDD & DDE

Human Health Residue Based Criterion

$$0.00001 \text{ ug/l} = \frac{0.02 \text{ ug/d}}{0.033 \text{ kg/d} \times 53610}$$

1,2-Dichloroethane

Human Health Residue Based Criterion

$$24 \text{ ug/l} = \frac{1.6 \text{ ug/d}}{0.033 \text{ kg/d} \times 2}$$

1,1-Dichlorethylene

Human Health Residue Based Criterion

$$0.8 \text{ ug/l} = \frac{0.14 \text{ ug/d}}{0.033 \text{ kg/d} \times 2}$$

Endrin

Wildlife Residue Based Criterion

$$0.0019 \text{ ug/l} = \frac{0.025 \text{ mg/kg}}{13240}$$

Heptachlor & Heptachlor Epoxide

Human Health Residue Based Criterion

$$0.00003 \text{ ug/l} = \frac{0.018 \text{ ug/d}}{0.33 \text{ kg/d} \times 15666}$$

Hexachlorobenzene

Human Health Residue Based Criterion

$$0.0001 \text{ ug/l} = \frac{0.04 \text{ ug/d}}{0.033 \text{ kg/d} \times 12000}$$

Wildlife Residue Based Criterion

$$0.008 \text{ ug/l} = \frac{0.33 \text{ mg/kg}}{40000}$$

Hexachlorobutadiene

Human Health Residue Based Criterion

$$0.06 \text{ ug/l} = \frac{1 \text{ ug/d}}{0.033 \text{ kg/d} \times 545}$$

Wildlife Residue Based Criterion

$$0.7 \text{ ug/l} = \frac{1.3 \text{ mg/kg}}{1818}$$

Hexachlorocyclohexanes

Human Health Residue Based Criterion

$$0.009 \text{ ug/l} = \frac{0.04 \text{ ug/d}}{0.033 \text{ kg/d} \times 130}$$

Wildlife Residue Based Criterion

$$0.23 \text{ ug/l} = \frac{0.1 \text{ mg/kg}}{433}$$

Mirex

Human Health Residue Based Criterion

$$0.0001 \text{ ug/l} = \frac{0.08 \text{ ug/d}}{0.033 \text{ kg/d} \times 18100}$$

Wildlife Residue Based Criterion

$$0.0055 \text{ ug/l} = \frac{0.33 \text{ mg/kg}}{60333}$$

Octachlorostyrene

Wildlife Residue Based Criterion

$$0.0005 \text{ ug/l} = \frac{0.02 \text{ mg/kg}}{40000}$$

2,3,7,8-Tetrachlorodibenzodioxin

Wildlife Residue Based Criterion

$$2 \times 10\text{-}8 \text{ ug/l} = \frac{0.000003 \text{ mg/kg}}{150{,}000}$$

1,1,2,2-Tetrachloroethane

Human Health Residue Based Criterion

$$0.7 \text{ ug/l} = \frac{0.4 \text{ ug/d}}{0.033 \text{ kg/d} \times 17}$$

O-Toluidine

Human Health Residue Based Criterion

$$18 \text{ ug/l} = \frac{1.2 \text{ ug/d}}{0.033 \text{ kg/d} \times 2}$$

Toxaphene

Human Health Residue Based Criterion

$$0.009 \text{ ug/l} = \frac{0.02 \text{ ug/d}}{0.033 \text{ kg/d} \times 67}$$

1,1,2-Trichloroethane

Human Health Residue Based Criterion

$$4 \text{ ug/l} = \frac{1.2 \text{ ug/d}}{0.033 \text{ kg/d} \times 9}$$

inyl Chloride

Human Health Residue Based Criterion

$$18 \text{ ug/l} = \frac{0.6 \text{ ug/d}}{0.033 \text{ kg/d} \times 1}$$

Appendix 2. The following tables are photocopied directly from Long and Morgan (1990) and Persaud et. al. (1992). They are presented here to provide further information about the metals criteria developed in Table 2., and the text above.

Copied directly from Persuad et. al. (1992)

Table 1: Provincial Sediment Quality Guidelines for Metals and Nutrients.
(values[a] in ug/g (ppm) dry weight unless otherwise noted)

METALS	No Effect Level	Lowest Effect Level	Severe Effect Level
Arsenic	-	6	33
Cadmium	-	0.6	10
Chromium	-	26	110
Copper	-	16	110
Iron (%)	-	2	4
Lead	-	31	250
Manganese	-	460	1100
Mercury	-	0.2	2
Nickel	-	16	75
Zinc	-	120	820
NUTRIENTS			
TOC (%)	-	1	10
TKN	-	550	4800
TP	-	600	2000

[a] - values less than 10 have been rounded to 1 significant digit. Values greater than 10 have been rounded to two significant digits except for round numbers which remain unchanged (e.g., 400).

"-" - denotes insufficient data/no suitable method.

TOC - Total Organic Carbon TKN - Total Kjeldahl Nitrogen TP - Total Phosphorus

(June 1992)

Copied Directly from Long and Morgan (1990)

Table 70. Summary of ER-L, ER-M, and overall apparent effects thresholds concentrations for selected chemicals in sediment (dry weight).

Chemical Analyte	ER-L Concentration	ER-M Concentration	ER-L:ER-M Ratio	Overall Apparent Effects Threshold	Subjective Degree of Confidence in ER-L/ER-M Values
Trace Elements (ppm)					
Antimony	2	25	12.5	25	Moderate/moderate
Arsenic	33	85	2.6	50	Low/moderate
Cadmium	5	9	1.8	5	High/high
Chromium	80	145	1.8	Nb	Moderate/moderate
Copper	70	390	5.6	300	High/high
Lead	35	110	3.1	300	Moderate/high
Mercury	0.15	1.3	8.7	1	Moderate/high
Nickel	30	50	1.7	NSD*	Moderate/moderate
Silver	1	2.2	2.2	1.7	Moderate/moderate
Tin	NA	NA	NA	NA	NA
Zinc	120	270	2.2	260	High/high
Polychlorinated Biphenyls (ppb)					
Total PCBs	50	400	7.6	370	Moderate/moderate
DDT and Metabolites (ppb)					
DDT	1	7	7	6	Low/low
DDD	2	20	10	NSD	Moderate/low
DDE	2	15	7.5	NSD	Low/low
Total DDT	3	350	117	Nb	Moderate/moderate
Other Pesticides (ppb)					
Lindane	NA	NA	NA	NSD	NA**
Chlordane	0.5	6	12	2	Low/low
Heptachlor	NA	NA	NA	NSD	NA
Dieldrin	0.02	8	400	Nb	Low/low
Aldrin	NA	NA	NA	NSD	NA
Endrin	0.02	45	2250	NSD	Low/low
Mirex	NA	NA	NA	NSD	NA
Polynuclear Aromatic Hydrocarbons (ppb)					
Acenaphthene	150	550	4.3	150	Low/low
Anthracene	85	960	11.3	300	Low/moderate
Benzo(a)anthracene	230	1600	7	550	Low/moderate
Benzo(a)pyrene	400	2500	6.2	700	Moderate/moderate
Benzo(e)pyrene	NA	NA	NA	NSD	NA
Biphenyl	NA	NA	NA	NSD	NA
Chrysene	400	2800	7	900	Moderate/moderate
Dibenz(a,h)anthracene	60	260	4.3	100	Moderate/moderate
2,6-dimethylnaphthylene	NA	NA	NA	NSD	NA
Fluoranthene	600	3600	6	1000	High/high
Fluorene	35	640	18.3	350	Low/low
1-methylnaphthalene	NA	NA	NA	NSD	NA
2-methylnaphthalene	65	670	10.3	300	Low/moderate
1-methylphenanthrene	NA	NA	NA	NSD	NA
Naphthalene	340	2100	6.2	500	Moderate/high
Perylene	NA	NA	NA	NSD	NA
Phenanthrene	225	1380	6.1	260	Moderate/moderate
Pyrene	350	2200	6.3	1000	Moderate/moderate
2,3,5-trimethylnaphthalene	NA	NA	NA	NSD	NA
Total PAH	4000	35000	8.8	22000	Low/low

* NSD = not sufficient data
** NA = not available

Appendix 3. Literature Cited

6NYCRR. 1991. New York Compilation of Codes, Rules, and Regulations, Volume 6, Section 703.5. The five primary levels of protection are not explicitly stated, but can be derived from table 2; Basis for Establishment of Standards.

Adams, W.J., Kimerle, R.A., and J.W. Barnett, Jr., 1992. Sediment Quality and Aquatic Life Assessment. Environmental Science and Technology 26(10):1865-1875.

ASTM, 1993. Standard Guide for Collection, Storage, Characterization, and Manipulation of Sediments for Toxicological Testing (El 391-93), American Society for Testing and Materials, Philadelphia, PA.

DEC, 1989. Nonpoint Source Assessment Report. New York Department of Environmental Conservation, Division of Water, Bureau of Water Quality Management.

DEC, 1991. New York Department of Environmental Conservation, DRAFT Cleanup Policy and Guidelines, Volume II-Appendix, Appendix D: Clean-up Criteria for Aquatic Sediments. Cleanup Standards Task Force.

Demayo, A., Davis, A.R., and M.A. Forbes, 1978. Forms of Metals in Water. Scientific Series No. 87, Fisheries and Environment Canada, Inland Water Directorate, Water Quality Branch, Ottawa, Canada.

DiToro, D.M., 1985. A Particle Interaction Model of Reversible Organic Chemical Sorption. Chemosphere 14:1503-1538.

DiToro, D.M., Zarba, C.S., Hansen, D.J., Berry, W.J., Swartz, R.C., Cowan, C.E., Pavlou, S.P., Allen, H.E., Thomas, N.A., and P.R. Paquin, 1991. Technical Basis for Establishing Sediment Quality Criteria for Nonionic Organic Chemicals by Using Equilibrium Partitioning. Environmental Toxicology and Chemistry, 10(l 2):l 541 - 1586.

Doull, J., Klassen, C.D., and M.O. Amdur, 1980. Toxicology: The Basic Science of Poisons. Macmillan Publishing Co., Inc., New York.

DoW, 1991. New York Department of Environmental Conservation, Division of Water, Technical and Operational Guidance Series Ambient Water Quality Standards and Guidance Values (Originator: John Zambrano) dated November 15, 1991.

Eisler, R. 1993. Zinc Hazards to Fish, Wildlife, and Invertebrates: a Synoptic Review. US Fish and Wildlife Service Biological Report 10 dated April 1993, Publications Unit, USFWS, 1849 C St., N.W., Mail Stop 130, Webb Building, Washington, D.C., 20240.

EPA, 1989. Briefing Report to the EPA Science Advisory Board on the Equilibrium Partitioning Approach to Generating Sediment Quality Criteria. US Environmental Protection Agency, EPA 440/5-89-002, Washington D.C.

EPA, 1990. Managing Contaminated Sediments. US Environmental Protection Agency, Sediment Oversight Technical Committee, EPA 506/6-90/002, Washington, D.C.

EPA, 1991. Proposed Technical Basis for Establishing Sediment Quality Criteria for Nonionic Organic Chemicals Using Equilibrium Partitioning. US Environmental Protection Agency, Office of Science and Technology, Health and Ecological Criteria Division, Washington, D.C. 20460.

EPA, 1992. Draft Outline, EPA's Contaminated Sediment Management Strategy: A Proposal for Discussion. US Environmental Protection Agency, Sediment Steering Committee.

EPA, 1992a. Interim Guidance on Interpretation and Implementation of Aquatic Life Criteria for Metals. U.S. Environmental Protection Agency, Health and Ecological Criteria Division, Office of Science and Technology.

EPA, 1992b. Sediment Classification Methods Compendium. US Environmental Protection Agency, Office of Science and Technology, Sediment Oversight Technical Committee, Washington, D.C.

EPA, 1993. Memorandum, from Martha G. Prothro, Acting Assistant Administrator for Water, subject: Office of Water Policy and Technical Guidance on Interpretation and Implementation of Aquatic Life Metals Criteria, dated 1 Oct 93.

EPA SAB, 1990. Evaluation of the Equilibrium Partitioning (EqP) Approach for Assessing Sediment Quality. US Environmental Protection Agency Science Advisory Board, Report of the Sediment Criteria Subcommittee of The Ecological Process and Effects Committee. EPA-SAB-EPEC-90-006.

EPA SAB, 1992. An SAB Report: Review of Sediment Criteria Development Methodology for Non-Ionic Organic Contaminants. U.S. Environmental Protection Agency Science Advisory Board, Sediment Quality Subcommittee of the Ecological Process and Effects Committee. EPA-SAB-EPEC-93-002.

IJC, 1978. Great Lakes Water Quality Agreement of 1978. International Joint Commission, Canada and the United States, Ottawa, Canada.

Karickhoff, S.W., Brown, D.S., and T.A. Scott, 1979. Water Res. 13, p 241.

Kenaga, E.E., and C.A.I. Goring, 1980. Relationship Between Water Solubility, Soil Sorbtion, Octanol-Water Partitioning, and Concentration of Chemicals in Biota. in Aquatic Toxicology, Proceedings of the Third Annual Symposium on Aquatic Toxicology, Eaton, Parrish, and Hendricks, editors. ASTM STP 707, Philadelphia, Pa.

Leonard, E., 1991. Standard Operating Procedures for Total Organic Carbon Analysis of Sediment Samples. US Environmental Protection Agency, Office of Research and Development, Environmental Research Laboratory, Duluth, MN.

Long, E.R., and L.G. Morgan, 1990. The Potential for Biological Effects of Sediment-Sorbed Contaminants Tested in the National States and Trends Program. National Oceanic Atmospheric Administration (NOAA) Technical Memorandum No.
5, OMA52, NOAA National Ocean Service, Seattle, Washington.

Manahan, S.E., 1991. Environmental Chemistry. Lewis Publishers, Inc., 121 South Main St., Chelsea, Michigan 48118.

Marcus, W.A., 1991. Managing Contaminated Sediments in Aquatic Environments: Identification, Regulation, and Remediation. Environmental Law Reporter, 21 ELR 10020-10032

Millemann, B. and E. Kinney, 1992. Getting to the Bottom of it: Threats to Human Health and the Environment from Contaminated Underwater Sediments. Coast Alliance.

Nebergall, W.H., Schmidt, F.C., and H.F. Holtclaw, Jr., 1968. General Chemistry. D.C. Heath and Company, Lexington, Massachusetts

Newell, A.J., Johnson, D.W., and L.K. Allen, 1987. Niagara River Biota Contamination Project: Fish Flesh Criteria for Piscivorous Wildlife. New York Department of Environmental Conservation, Division of Fish and Wildlife, Bureau of Environmental Protection, Technical Report 87-3.

Persaud, D., Jaagumagi, R., and A. Hayton, 1992. Guidelines for the Protection and Management of Aquatic Sediment Quality in Ontario. Ontario Ministry of the Environment, Queen's Printer for Ontario.

Rand, G.M., and S.R. Petrocelli, 1985. Fundamentals of Aquatic Toxicology. Hemisphere Publishing Corporation.

Voice, T.C., Rice, C.P., and W.J. Weber, Jr., 1983. Effects of Solids Concentration on the Sorptive Partitioning of Hydrophobic Pollutants in Aquatic Systems. Environmental Science and Technology 17(9):513-517.

Appendix 4. Change in the Guidance for Marine and Estuarine Sediments

The 22 November 1993, Technical Guidance for Screening Contaminated Sediments (reprinted July 1994) makes use of the sediment guidance values from a number of sources, including the ER-L and ER-M guidance values from Long and Morgan (1990). Long, MacDonald, Smith, and Calder (1995) further refined and enhanced the marine and estuarine data used by Long and Morgan (1990) and published new ERL and ERM specifically for marine and estuarine sediments. **For evaluation of risk from contaminants in marine and estuarine sediment,** the Division of Fish, Wildlife and Marine Resources will now use the Long et al (1995) guidance values rather than the Long and Morgan (1990) values. For non-polar organic compounds not listed in Long et al (1995) (Table 4, below), the equilibrium partitioning-derived values in Table 1. (pp 20-24 above) for saltwater should be used. The following Tables 3 and 4 are reproduced directly from:

Long, E.R., MacDonald, D.D., Smith, S.L., and F.D. Calder, 1995. "Incidence of Adverse Biological Effects Within Ranges of Chemical Concentrations in Marine and Estuarine Sediments". Environmental Management 19(1):81-97.

Table 3. ERL and ERM guideline values for trace metals (ppm, dry wt.) and percent incidence of biological effects in concentration ranges defined by the two values.

	Guidelines		Percent (ratios) incidence of effects[a]		
Chemical	ERL	ERM	<ERL	ERL-ERM	>ERM
Arsenic	8.2	70	5.0 (2/40)	11.1 (8/73)	63.0 (17/27)
Cadmium	1.2	9.6	6.6 (7/106)	36.6 (32/87)	65.7 (44/67)
Chromium	81	370	2.9 (3/102)	21.1 (15/71)	95.0 (19/20)
Copper	34	270	9.4 (6/64)	29.1 (32/110)	83.7 (36/43)
Lead	46.7	218	8.0 (7/87)	35.8 (29/81)	90.2 (37/41)
Mercury	0.15	0.71	8.3 (4/48)	23.5 (16/68)	42.3 (22/52)
Nickel	20.9	51.6	1.9 (1/54)	16.7 (8/48)	16.9 (10/59)
Silver	1.0	3.7	2.6 (1/39)	32.3 (11/34)	92.8 (13/14)
Zinc	150	410	6.1 (6/99)	47.0 (31/66)	69.8 (37/53)

[a]Number of data entries within each concentration range in which biological effects were observed divided by the total number of entries within each range.

Table 4. ERL and ERM guideline values for organic compounds (ppb, dry wt) and percent incidence of biological effects in concentration ranges defined by the two values.

	Guidelines		Percent (ratios) incidence of effects[a]		
Chemical	ERL	ERM	<ERL	ERL-ERM	>ERM
Acenaphthene	16	500	20.0 (3/15)	32.4 (11/34)	84.2 (16/19)
Acenaphthylene	44	640	14.3 (1/7)	17.9 (5/28)	100 (9/9)
Anthracene	85.3	1100	25.0 (4/16)	44.2 (19/43)	85.2 (23/27)
Fluorene	19	540	27.3 (3/11)	36.5 (19/52)	86.7 (26/30)
2-Methyl naphthalene	70	670	12.5 (2/16)	73.3 (11/15)	100 (15/15)
Naphthalene	160	2100	16.0 (4/25)	41.0 (16/39)	88.9 (24/27)
Phenanthrene	240	1500	18.5 (5/27)	46.2 (18/39)	90.3 (28/31)
Low-molecular weight PAH	552	3160	13.0 (3/23)	48.1 (13/27)	100 (16/16)
Benz(a)anthracene	261	1600	21.1 (4/19)	43.8 (14/32)	92.5 (25/27)
Benzo(a)pyrene	430	1600	10.3 (3/29)	63.0 (17/27)	80.0 (24/30)
Chrysene	384	2800	19.0 (4/21)	45.0 (18/40)	88.5 (23/26)
Dibenzo(a,h)anthracene	63.4	260	11.5 (3/26)	54.5 (12/22)	66.7 (16/24)
Fluoranthene	600	5100	20.6 (7/34)	63.6 (28/44)	92.3 (36/39)
Pyrene	665	2600	17.2 (5/29)	53.1 (17/32)	87.5 (28/32)
High molecular weight PAH	1700	9600	10.5 (2/19)	40.0 (10/25)	81.2 (13/16)
Total PAH	4022	44792	14.3 (3/21)	36.1 (13/36)	85.0 (17/20)
p,p'-DDE	2.2	27	5.0 (1/20)	50.0 (10/20)	50.0 (12/24)
Total DDT	1.58	46.1	20.0 (2/10)	75.0 (12/16)	53.6 (15/28)
Total PCBs	22.7	180	18.5 (5/27)	40.8 (20/49)	51.0 (25/49)

[a]Number of data entries within each concentration range in which biological effects were observed divided by the total number of entries within each range.

REFERENCE -2

Canadian Council of Ministers of the Environment
Canadian Sediment Quality Guidelines
for the Protection of Aquatic Life
1998

APPENDIX L.7

GROUNDWATER – RESIDENTIAL WELLS

- NOVEMBER 2001
- MARCH 2002
- FEBRUARY 2003
- AUGUST 2003
- FEBRUARY 2004

ANALYTICAL DATA ASSESSMENT AND VALIDATION
GROUNDWATER SAMPLING
FORMER LAGOON SITE
HAMPTONBURGH, NEW YORK
NOVEMBER 2001

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1.0 INTRODUCTION

The following document details an assessment and validation of analytical results reported by H2M Labs, Inc. (H2M) for groundwater samples collected at the Former Lagoon Site in Hamptonburgh, New York (Site) during November 2001. For sample identification, a sampling and analysis summary is presented in Table 1.

Samples were analyzed as specified in Table 1. A summary of the analytical methodology is presented in Table 2.

A summary of the analytical data is presented in Table 3. The Quality Assurance/Quality Control (QA/QC) criteria by which these data have been assessed are outlined in the analytical methods and the USEPA Region II Data Validation Standard Operating Procedures (SOP HW-6, Rev. 11, SOW 3/90, Revision XI).

The Site-Specific Quality Assurance Project Plan (QAPP) (March 2001) was also utilized in the data assessment.

Deliverables as specified in the QAPP were provided by the laboratory for the analyses. The data quality assessment and validation presented in the following subsections were performed based on the sample results and supporting QA/QC provided.

2.0 SAMPLE HOLDING TIMES

The QAPP holding time criteria are summarized in Table 2.

All sample extractions and analyses were performed within the required holding times. All samples were properly preserved and cooled to 4°C (±2°C) after collection. All samples were received by the laboratory in good condition within 2 days of sample collection.

3.0 GAS CHROMATOGRAPH/MASS SPECTROMETER (GC/MS) TUNING AND MASS CALIBRATION - VOLATILES AND SEMI-VOLATILES

Prior to analysis, GC/MS instrumentation is tuned to ensure optimization over the mass range of interest. To evaluate instrument tuning, ASP Methods 95-4 and 95-2 require the analysis of the specific tuning compounds bromofluorobenzene (BFB) and decafluorotriphenylphosphine (DFTPP), respectively. The resulting spectra must meet the criteria cited in the method before analysis is initiated. Analysis of the tuning compound must then be repeated every 12 hours throughout sample analysis to ensure the continued optimization of the instrument.

All instrument tuning data were reviewed. Tuning compounds were analyzed at the required frequency throughout the volatile organic compound (VOC) and semi-volatile organic compound (SVOC) analyses periods. All tuning criteria were met for the analyses, indicating proper optimization of the instrumentation.

4.0 INSTRUMENT CALIBRATION

4.1 GC/MS CALIBRATION - VOLATILES AND SEMI-VOLATILES

4.1.1 INITIAL CALIBRATION

To quantify compounds of interest in samples, calibration of the GC/MS over a specific concentration range must be performed. Initially, a five-point calibration curve containing all compounds of interest is analyzed.

Linearity of the curve and instrument sensitivity were evaluated against the following criteria:

i) all relative response factors (RRFs) must be greater than or equal to 0.05; and

ii) percent relative standard deviation (%RSD) values must not exceed 30 percent.

The initial calibration data for VOCs and SVOCs were reviewed. All %RSDs and RRFs met the criteria for VOCs and SVOCs.

4.1.2 CONTINUING CALIBRATION

To ensure that instrument calibration is acceptable throughout the sample analysis period, continuing calibration standards must be analyzed and compared to the initial calibration curve every 12 hours.

The following criteria were employed to evaluate continuing calibration data:

i) all RRF values must be greater than or equal to 0.05; and

ii) percent difference (%D) values must not exceed 25 percent.

All RRFs and %Ds for the compounds of interest were acceptable. The VOC surrogate %D values showed variability. All surrogate recoveries were acceptable, and no qualification of the data was necessary.

4.2 METALS CALIBRATION

4.2.1 INITIAL CALIBRATION

Initial calibration of the instruments ensures that they are capable of producing satisfactory quantitative data at the beginning of a series of analyses. For trace inductively coupled plasma (ICP) analysis, a calibration blank and at least one standard must be analyzed at each wavelength to establish the analytical curve. For atomic absorption (AA) analyses, a calibration blank and a minimum of four standards must be analyzed to establish the analytical curve. Resulting correlation coefficients for the curve must be at least 0.995.

After the analyses of the calibration curves, an initial calibration verification (ICV) standard must be analyzed to verify the analytical accuracy of the calibration curves. All analyte recoveries from the analyses of the ICVs must be within the following control limits:

Analytical Method	*Inorganic Species*	*Control Limits (Percent)*
ICP	Metals	90 - 110
Cold Vapor AA	Mercury	80 - 120

Upon review of the data, it was determined that all inorganic calibration curves and ICVs were analyzed at the proper frequencies and that all of the above-specified criteria were met. The laboratory effectively demonstrated that instrumentation used for these analyses were properly calibrated prior to sample analyses.

4.2.2 CONTINUING CALIBRATION

To ensure that instrument calibration is acceptable throughout the sample analysis period, continuing calibration verification (CCV) standards are analyzed on a regular basis. Each CCV is deemed acceptable if all analyte recoveries are within the control limits specified above for the ICVs. If some of the CCV analyte recoveries are outside the control limits, samples analyzed before and after the CCV, up until the previous and proceeding CCV analyses, are affected.

For this study, CCVs were analyzed at the proper frequency. All analyte recoveries reported for the CCVs were within the specified limits.

4.2.3 CONTRACT REQUIRED DETECTION LIMIT (CRDL) STANDARD ANALYSES

To verify the linearity of the ICP calibration near the CRDL, a standard must be analyzed which contains specified ICP analytes at a concentration of two times the CRDL, or twice the instrument detection limit (IDL), whichever is greater. This standard must be analyzed at the beginning and end of each sample analysis run or a minimum of twice per eight hour working shift.

General control limits of 80 to 120 percent were used to evaluate the ASP data for metals. Most recoveries were within acceptable limits.

Results impacted by outlying recoveries were qualified as estimated (see Table 4).

5.0 SURROGATE SPIKE RECOVERIES

In accordance with the methods employed, all samples, blanks, and standards analyzed for VOCs and SVOCs were spiked with surrogate compounds prior to sample extraction and/or analysis. Surrogate recoveries provide a means to evaluate the effects of individual sample matrices on analytical efficiency. Surrogate recovery evaluations were performed as specified in the validation SOPs.

5.1 VOLATILES

All surrogate recoveries reported for the VOC analyses were within the method control limits, indicating good analytical efficiency.

5.2 SEMI-VOLATILES

All sample surrogate recoveries met the criteria, indicating good analytical efficiency.

6.0 INTERNAL STANDARD RECOVERIES - VOLATILES AND SEMI-VOLATILES

To ensure that changes in GC/MS response and sensitivity do not affect sample analysis results, internal standard compounds are added to all samples, blanks, and spike samples prior to VOC and SVOC analyses. All results are calculated as a ratio of the internal standard response. The criteria by which the internal standard results are assessed are as follows:

i) internal standard area counts must not vary by more than a factor of two (-50 percent to +100 percent) from the associated calibration standard; and

ii) the retention time of the internal standard must not vary more than ±30 seconds from the associated calibration standard.

All internal standard recoveries and retention times were acceptable, demonstrating good analytical performance.

7.0 LABORATORY BLANK ANALYSES

The purpose of assessing the results of laboratory blank analyses is to determine the existence and magnitude of sample contamination introduced during analysis. Laboratory blanks are prepared from deionized water and analyzed as samples.

For this study, laboratory blanks were analyzed at a minimum frequency of one per 20 investigative samples and/or one per analytical batch.

7.1 VOLATILES

All blank results were non-detect for the VOCs of interest, indicating that contamination was not a factor in this analysis.

7.2 SEMI-VOLATILES

All blank results were non-detect for the SVOCs of interest, indicating that contamination was not a factor in this analysis.

7.3 METALS ANALYSES

Upon review of the initial calibration blanks, continuing calibration blanks, and preparation blanks, it was noted that metal concentrations were detected above the IDL in the calibration and preparation blanks associated with the samples collected for this project.

In accordance with the validation SOPs, all sample results greater than the instrument detection limit but less than five times the amount detected in the associated blank were qualified as non-detect (see Table 5). All remaining investigative samples associated with contaminated laboratory blanks yielded either non-detect concentrations or concentrations greater than five times the associated laboratory blank concentrations for the analytes of interest. Qualification of the remaining sample data was not required on this basis.

Further, all absolute values of all negative metal concentrations in the laboratory blanks were less than or equal to the CRDL. Corrective action was not required by the laboratory and qualification of the associated sample data was not necessary on this basis.

8.0 BLANK SPIKE ANALYSES - ORGANICS

Blank spikes are prepared and analyzed as samples to assess the analytical efficiencies of the method employed, independent of sample matrix effects. Blank spikes were performed for all analyses.

8.1 VOLATILES

All blank spike sample analyses yielded recoveries within the method control limits, indicating acceptable analytical accuracy.

8.2 SEMI-VOLATILES

All blank spike sample analyses yielded recoveries within the method control limits, indicating acceptable analytical accuracy.

9.0 LABORATORY CONTROL SAMPLE ANALYSES - METALS

The Laboratory Control Sample (LCS) serves as a monitor of the overall performance of all steps in the analysis, including the sample preparation. LCSs were analyzed using the same sample preparation, analytical methods, and QA/QC procedures employed for the investigative samples.

All LCS samples yielded recoveries within the established control limits, indicating acceptable overall laboratory performance.

10.0 MATRIX SPIKE/MATRIX SPIKE DUPLICATE (MS/MSD) ANALYSES - ORGANICS

The recoveries of MS/MSD analyses are used to assess the analytical accuracy achieved on individual sample matrices. The relative percent difference (RPD) between the MS and MSD is used to assess analytical precision.

The sample chosen for MS/MSD analyses is specified in Table 1.

10.1 VOLATILES

All recoveries and RPDs were acceptable, indicating good laboratory accuracy and precision.

10.2 SEMI-VOLATILES

All recoveries and RPDs were acceptable, indicating good laboratory accuracy and precision.

11.0 MATRIX SPIKE ANALYSES - METALS

To evaluate the effects of sample matrices on the digestion, measurement procedures, and accuracy of a particular analysis, samples are spiked with a known concentration of the analyte of concern and analyzed as MS samples. The established control limits for inorganic matrix spike recoveries are 75 to 125 percent. Per the validation SOPs, qualification of metals data is not required if the sample result exceeds four times the spike concentration added. The sample chosen for spike analyses is specified in Table 1.

All MS recoveries were acceptable, demonstrating good analytical accuracy.

12.0 DUPLICATE SAMPLE ANALYSES - METALS

For inorganic parameters, analytical precision is evaluated based on the analysis of duplicate samples. For this study, a duplicate sample was prepared and analyzed by the laboratory as specified in Table 1.

In accordance with the validation SOPs, laboratory duplicate results should have a maximum RPD of 20 percent for groundwater samples. Metals sample results less than five times the CRDL are evaluated based on the difference between the sample and duplicate results, which should not exceed the CRDL.

All duplicate analyses met the above criteria, demonstrating acceptable analytical precision.

13.0 ICP SERIAL DILUTION

The serial dilution determines whether significant physical or chemical interferences exist due to sample matrix. A minimum of one per 20 investigative samples is analyzed at a five-fold dilution. For samples yielding analyte concentrations greater than 50 times the IDL, the serial dilution results must agree within 10 percent of the original results.

A serial dilution was performed on the sample chosen as the MS sample. All analyses met the above criteria except for the potassium analysis. The associated sample result was qualified as estimated (see Table 6).

14.0 ICP INTERFERENCE CHECK SAMPLE ANALYSIS (ICS)

To verify that proper inter-element and background correction factors have been established by the laboratory, ICSs are analyzed. These samples contain high concentrations of aluminum, calcium, magnesium, and iron and are analyzed at the beginning and end of each sample analysis period.

ICS analysis results were evaluated for all samples. All ICS recoveries were within the established control limits of 80 to 120 percent. Some false positives were detected, but the associated sample did not have comparable interferent levels and further evaluation was not necessary.

15.0 FIELD QA/QC

15.1 FIELD DUPLICATES

To assess the analytical and sampling protocol precision, one field duplicate (as identified in Table 1) was collected and submitted "blind" to the laboratory. All data demonstrated acceptable agreement.

15.2 FIELD BLANKS

To assess contamination from field equipment cleaning activities, one field blank was collected as identified in Table 1. All sample results were non-detect, demonstrating that field contamination was not a factor for this investigation.

15.3 TRIP BLANKS

Three trip blanks were submitted for VOC analysis. All results were non-detect, demonstrating that ambient contamination was not a factor for the VOC analyses.

16.0 CONCLUSION

Based on the assessment detailed in the foregoing, the data produced by H2M are acceptable with the specific qualifications noted within.

TABLES

TABLE 1

SAMPLING AND ANALYSIS SUMMARY
GROUNDWATER SAMPLING
FORMER LAGOON SITE
HAMPTONBURGH, NEW YORK
NOVEMBER 2001

Sample I.D.	*Sample Location*	*Date*	*Parameters* [1]	*Comments*
GW-3698-DD-110601-01	MW-9D-01	11/06/01	Volatiles, Semi-Volatiles, TAL Metals	MS/MSD/Dup
GW-3698-DD-110601-02	MW-10U-01	11/06/01	Volatiles, Semi-Volatiles	
GW-3698-DD-110601-03	MW-10U-01	11/06/01	Volatiles, Semi-Volatiles	Field Duplicate
GW-3698-DD-110601-04	-	11/06/01	Volatiles, Semi-Volatiles	Field Blank
GW-3698-DD-110601-05	MW-10D-01	11/06/01	Volatiles, Semi-Volatiles	
GW-3698-DD-110601-06	MW-9U-01	11/06/01	Volatiles, Semi-Volatiles	
GW-3698-DD-110601-11	MW-8U-95	11/06/01	Volatiles, Semi-Volatiles	
GW-3698-DD-110601-12	MW-5U-95	11/06/01	Volatiles, Semi-Volatiles	
GW-3698-DD-110601-13	MW-5D-5	11/06/01	Volatiles, Semi-Volatiles	
GW-3698-DD-110601-14	MW-13D-01	11/06/01	Volatiles, Semi-Volatiles	
GW-3698-DD-110701-17	MW-11D-01	11/07/01	Volatiles, Semi-Volatiles	
GW-3698-DD-110701-18	MW-11U-01	11/07/01	Volatiles, Semi-Volatiles	
GW-3698-DD-110701-22	MW-12D-01	11/07/01	Volatiles, Semi-Volatiles	
GW-3698-DD-110801-30	SW-9	11/08/01	Volatiles, Semi-Volatiles	

Notes:

(1) Volatiles - benzene, toluene, ethylbenzene, and xylenes.
Semi-Volatiles - pyridine, 2-aminopyridine, and alpha-picoline.

Dup Duplicate.
MS Matrix Spike.
MSD Matrix Spike Duplicate.
TAL Target Analyte List.

TABLE 2

SAMPLE HOLDING TIMES CRITERIA AND ANALYTICAL METHODS SUMMARY
FORMER LAGOON SITE
HAMPTONBURGH, NEW YORK
NOVEMBER 2001

Parameter	*Matrix*	*Analytical Method*	*VTSR to Extraction (Days)*	*VTSR to Analysis (Days)*
Volatiles [2]	Groundwater	95-4 [1]	-	10
Semi-Volatiles [3]	Groundwater	95-2 [1]	5	40
TAL Metals (except mercury)	Groundwater	200.7 CLP-M [1]	-	180
Mercury	Groundwater	245.1 CLP-M [1]	-	26

Notes:

[1] Referenced from New York State Department of Environmental Conservation (NYSDEC) Analytical Services Protocol (ASP), 10/95 Edition.

[2] Benzene, toluene, ethylbenzene, and xylenes.

[3] Pyridine, 2-aminopyridine, and alpha-picoline.

TAL Target Analyte List

VTSR Verified Time of Sample Receipt

TABLE 3

ANALYTICAL RESULTS SUMMARY
GROUNDWATER SAMPLING
FORMER LAGOON SITE
HAMPTONBURGH, NEW YORK
NOVEMBER 2001

Sample Location:		*MW-5D-95*	*MW-5U-95*	*MW-8U-95*	*MW-9D-01*	*MW-9U-01*	*MW-10U-01*	*MW-10U-01*
Sample ID:		*GW-3698-DD-110601-13*	*GW-3698-DD-110601-12*	*GW-3698-DD-110701-11*	*GW-3698-DD-110601-01*	*GW-3698-DD-110601-06*	*GW-3698-DD-110601-02*	*GW-3698-DD-110601-03*
Sample Date:		*11/6/2001*	*11/6/2001*	*11/8/2001*	*11/6/2001*	*11/6/2001*	*11/6/2001*	*11/6/2001* *Duplicate*
Parameter	*Unit*							
Volatiles								
Benzene	ug/L	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Ethylbenzene	ug/L	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Toluene	ug/L	1.1	1 U	1 U	1 U	1 U	1 U	1 U
Xylene (total)	ug/L	1 J	2 U	2 U	2 U	2 U	2 U	2 U
Semi-Volatiles								
2-Aminopyridine	ug/L	10 U	10 U	10 U	5 J	10 U	10 U	10 U
2-Picoline	ug/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Pyridine	ug/L	10 U	10 U	10 U	10 U	10 U	10 U	10 U
TAL Metals								
Aluminum	ug/L	-	-	-	28.3	-	-	-
Antimony	ug/L	-	-	-	4.6 U	-	-	-
Arsenic	ug/L	-	-	-	7.3	-	-	-
Barium	ug/L	-	-	-	186	-	-	-
Beryllium	ug/L	-	-	-	0.86	-	-	-
Cadmium	ug/L	-	-	-	0.96	-	-	-
Calcium	ug/L	-	-	-	69700	-	-	-
Chromium	ug/L	-	-	-	1.8	-	-	-
Cobalt	ug/L	-	-	-	2.6 U	-	-	-
Copper	ug/L	-	-	-	2.5	-	-	-
Iron	ug/L	-	-	-	284	-	-	-
Lead	ug/L	-	-	-	0.80 U	-	-	-
Magnesium	ug/L	-	-	-	14900	-	-	-
Manganese	ug/L	-	-	-	303	-	-	-
Mercury	ug/L	-	-	-	0.12 U	-	-	-
Nickel	ug/L	-	-	-	2.2	-	-	-
Potassium	ug/L	-	-	-	1290 J	-	-	-
Selenium	ug/L	-	-	-	2.0 U	-	-	-
Silver	ug/L	-	-	-	0.80 U	-	-	-
Sodium	ug/L	-	-	-	71500	-	-	-
Thallium	ug/L	-	-	-	3.3 U	-	-	-
Vanadium	ug/L	-	-	-	1.7 U	-	-	-
Zinc	ug/L	-	-	-	8.7	-	-	-

Notes:

-	Not applicable.
J	Estimated.
TAL	Target Analyte List.
U	Non-detect at associated value.

TABLE 3

ANALYTICAL RESULTS SUMMARY
GROUNDWATER SAMPLING
FORMER LAGOON SITE
HAMPTONBURGH, NEW YORK
NOVEMBER 2001

	Sample Location:	*MW-10D-01*	*MW-11D-01*	*MW-11U-01*	*MW-12D-01*	*MW-13D-01*	*SW-9*
	Sample ID:	*GW-3698-DD-110601-05*	*GW-3698-DD-110701-17*	*GW-3698-DD-110701-18*	*GW-3698-DD-110701-22*	*GW-3698-DD-110601-14*	*GW-3698-DD-110801-30*
	Sample Date:	*11/6/2001*	*11/7/2001*	*11/7/2001*	*11/7/2001*	*11/6/2001*	*11/8/2001*
Parameter	*Unit*						
Volatiles							
Benzene	ug/L	1 U	1 U	1 U	1 U	1 U	1 U
Ethylbenzene	ug/L	1 U	1 U	1 U	1 U	1 U	1 U
Toluene	ug/L	1 U	1 U	1 U	1 U	1 U	1 U
Xylene (total)	ug/L	2 U	2 U	2 U	2 U	2 U	2 U
Semi-Volatiles							
2-Aminopyridine	ug/L	10 U	10 U	10 U	10 U	10 U	2 J
2-Picoline	ug/L	10 U	10 U	10 U	10 U	10 U	10 U
Pyridine	ug/L	10 U	10 U	10 U	10 U	10 U	10 U
TAL Metals							
Aluminum	ug/L	-	-	-	-	-	-
Antimony	ug/L	-	-	-	-	-	-
Arsenic	ug/L	-	-	-	-	-	-
Barium	ug/L	-	-	-	-	-	-
Beryllium	ug/L	-	-	-	-	-	-
Cadmium	ug/L	-	-	-	-	-	-
Calcium	ug/L	-	-	-	-	-	-
Chromium	ug/L	-	-	-	-	-	-
Cobalt	ug/L	-	-	-	-	-	-
Copper	ug/L	-	-	-	-	-	-
Iron	ug/L	-	-	-	-	-	-
Lead	ug/L	-	-	-	-	-	-
Magnesium	ug/L	-	-	-	-	-	-
Manganese	ug/L	-	-	-	-	-	-
Mercury	ug/L	-	-	-	-	-	-
Nickel	ug/L	-	-	-	-	-	-
Potassium	ug/L	-	-	-	-	-	-
Selenium	ug/L	-	-	-	-	-	-
Silver	ug/L	-	-	-	-	-	-
Sodium	ug/L	-	-	-	-	-	-
Thallium	ug/L	-	-	-	-	-	-
Vanadium	ug/L	-	-	-	-	-	-
Zinc	ug/L	-	-	-	-	-	-

Notes:

-	Not applicable.
J	Estimated.
TAL	Target Analyte List.
U	Non-detect at associated value.

TABLE 4

QUALIFIED SAMPLE RESULTS DUE TO OUTLYING CRDL RECOVERIES
FORMER LAGOON SITE
HAMPTONBURGH, NEW YORK
NOVEMBER 2001

Analyte	*Control Limits (percent)*	*Percent Recovery*	*Associated Samples*	*Sample Results*	*Qualifier*	*Units*
Thallium	80-120	123	GW-3698-DD-110601-01	3.3	J	ug/L

Note:
J Estimated.

TABLE 5

QUALIFIED SAMPLE RESULTS DUE TO ANALYTE CONCENTRATIONS IN THE LABORATORY BLANKS
FORMER LAGOON SITE
HAMPTONBURGH, NEW YORK
NOVEMBER 2001

Parameter	*Analysis Date*	*Analyte*	*Blank Result*	*Sample ID*	*Sample Result*	*Qualified Result*	*Units*
Metals	11/28/01 CCB 4	Thallium	4.4	GW-3698-DD-110601-01	3.3	3.3 U	ug/L
	11/27/01 CCB 3	Mercury	0.1	GW-3698-DD-110601-01	0.12	0.12 U	ug/L

Note:
U Non-detect at associated value.

TABLE 6

QUALIFIED SAMPLE RESULTS DUE TO OUTLYING SERIAL DILUTIONS
FORMER LAGOON SITE
HAMPTONBURGH, NEW YORK
NOVEMBER 2001

Analyte	*Sample ID*	*%D*	*Control Limits (percent)*	*Sample Results*	*Qualifier*	*Units*
Potassium	GW-3698-DD-110601-01	23	0-10	1290	J	ug/L

Notes:
%D Percent Difference.
J Estimated.

ANALYTICAL DATA ASSESSMENT AND VALIDATION
GROUNDWATER SAMPLING
FORMER LAGOON SITE
HAMPTONBURGH, NEW YORK
MARCH 2002

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1.0 INTRODUCTION

The following document details an assessment and validation of analytical results reported by H2M Labs, Inc. (H2M) for groundwater samples collected at the Former Lagoon Site in Hamptonburgh, New York (Site) during March 2002. For sample identification, a sampling and analysis summary is presented in Table 1.

Samples were analyzed as specified in Table 1. A summary of the analytical methodology is presented in Table 2. Tentatively Identified Compounds (TICs) were reported for Method 95-2.

A summary of the analytical data is presented in Table 3. The Quality Assurance/Quality Control (QA/QC) criteria by which these data have been assessed are outlined in the analytical methods and the USEPA Region II Data Validation Standard Operating Procedures (SOP HW-6, Rev. 11, SOW 3/90, Revision XI).

The Site-Specific Quality Assurance Project Plan (QAPP) (March 2001) was also utilized in the data assessment.

Deliverables as specified in the QAPP were provided by the laboratory for the analyses. The data quality assessment and validation presented in the following subsections were performed based on the sample results and supporting QA/QC provided.

2.0 SAMPLE HOLDING TIMES

The QAPP holding time criteria are summarized in Table 2.

All sample extractions and analyses were performed within the required holding times.

All samples were properly preserved and cooled to 4 C(±2°) after collection. All samples were received by the laboratory in good condition within two days of sample collection.

3.0 GAS CHROMATOGRAPH/MASS SPECTROMETER (GC/MS) TUNING AND MASS CALIBRATION - VOLATILES AND SEMI-VOLATILES

Prior to analysis, GC/MS instrumentation is tuned to ensure optimization over the mass range of interest. To evaluate instrument tuning, ASP Methods 95-4 and 95-2 require the analysis of the specific tuning compounds bromofluorobenzene (BFB) and decafluorotriphenylphosphine (DFTPP), respectively. The resulting spectra must meet the criteria cited in the method before analysis is initiated. Analysis of the tuning compound must then be repeated every twelve hours throughout sample analysis to ensure the continued optimization of the instrument.

All instrument tuning data were reviewed. Tuning compounds were analyzed at the required frequency throughout the volatile organic compound (VOC) and semi-volatile organic compound (SVOC) analyses periods. All tuning criteria were met for the analyses, indicating proper optimization of the instrumentation.

4.0 INSTRUMENT CALIBRATION

4.1 GC/MS CALIBRATION - VOLATILES AND SEMI-VOLATILES

4.1.1 INITIAL CALIBRATION

To quantify compounds of interest in samples, calibration of the GC/MS over a specific concentration range must be performed. Initially, a five-point calibration curve containing all compounds of interest is analyzed.

Linearity of the curve and instrument sensitivity were evaluated against the following criteria:

i) all relative response factors (RRFs) must be greater than or equal to 0.05; and

ii) percent relative standard deviation (%RSD) values must not exceed 30 percent.

The initial calibration data for VOCs and SVOCs were reviewed. All %RSDs met the above criteria for VOCs and SVOCs.

4.1.2 CONTINUING CALIBRATION

To ensure that instrument calibration is acceptable throughout the sample analysis period, continuing calibration standards must be analyzed and compared to the initial calibration curve every 12 hours.

The following criteria were employed to evaluate continuing calibration data:

i) all RRF values must be greater than or equal to 0.05; and
ii) percent difference (%D) values must not exceed 25 percent.

All RRFs and %Ds were acceptable.

5.0 SURROGATE SPIKE RECOVERIES

In accordance with the methods employed, all samples, blanks, and standards analyzed for VOCs and SVOCs were spiked with surrogate compounds prior to sample extraction and/or analysis. Surrogate recoveries provide a means to evaluate the effects of individual sample matrices on analytical efficiency. Surrogate recovery evaluations were performed as specified in the validation SOPs.

5.1 VOLATILES

All surrogate recoveries reported for the VOC analyses were within the method control limits, indicating good analytical efficiency.

5.2 SEMI-VOLATILES

All sample surrogate recoveries met the criteria, indicating good analytical efficiency.

6.0 INTERNAL STANDARD RECOVERIES - VOLATILES AND SEMI-VOLATILES

To ensure that changes in GC/MS response and sensitivity do not affect sample analysis results, internal standard compounds are added to all samples, blanks, and spike samples prior to VOC and SVOC analyses. All results are calculated as a ratio of the internal standard response. The criteria by which the internal standard results are assessed are as follows:

i) internal standard area counts must not vary by more than a factor of two (-50 percent to +100 percent) from the associated calibration standard; and

ii) the retention time of the internal standard must not vary more than ±30 seconds from the associated calibration standard.

All internal standard recoveries and retention times were acceptable, demonstrating good analytical performance.

7.0 LABORATORY BLANK ANALYSES

The purpose of assessing the results of laboratory blank analyses is to determine the existence and magnitude of sample contamination introduced during analysis. Laboratory blanks are prepared from deionized water and analyzed as samples.

For this study, laboratory blanks were analyzed at a minimum frequency of one per analytical batch.

7.1 VOLATILES

All blank results were non-detect for the VOCs of interest, indicating that contamination was not a factor for this analysis.

7.2 SEMI-VOLATILES

All blank results were non-detect for the SVOCs of interest, indicating that contamination was not a factor in this analysis.

8.0 BLANK SPIKE ANALYSES

Blank spikes are prepared and analyzed as samples to assess the analytical efficiencies of the method employed, independent of sample matrix effects. Blank spikes were performed for all analyses.

8.1 VOLATILES

All blank spike sample analyses yielded recoveries within the method control limits, indicating acceptable analytical accuracy.

8.2 SEMI-VOLATILES

All blank spike sample analyses yielded recoveries within the control limits, indicating acceptable analytical accuracy.

9.0 MATRIX SPIKE/MATRIX SPIKE DUPLICATE (MS/MSD) ANALYSES - ORGANICS

The recoveries of MS/MSD analyses are used to assess the analytical accuracy achieved on individual sample matrices. The relative percent difference (RPD) between the MS and MSD is used to assess analytical precision.

The sample chosen for MS/MSD analyses is specified in Table 1.

9.1 VOLATILES

All recoveries and RPDs were acceptable, indicating good laboratory accuracy and precision.

9.2 SEMI-VOLATILES

All recoveries and RPDs were acceptable, indicating good laboratory accuracy and precision.

10.0 TICS

Chromatographic peaks recorded during semi-volatile sample analyses which are not target compounds, surrogates, or internal standards, are potential TICs. The 20 largest TICs for semi-volatiles that exhibit areas greater than 10 percent of the area of the nearest internal standard are tentatively identified and quantified.

TICs which were present in laboratory blanks or were identified as aldol condensation products were rejected.

The compound 9-octadecenamide was detected at an estimated concentration of 11 micrograms per liter (µg/L) in sample GW-3698-031902-BC11. Unknown compounds were reported for several other wells at estimated concentrations ranging from 2 to 27 µg/L.

11.0 FIELD QA/QC

11.1 FIELD DUPLICATES

To assess the analytical and sampling protocol precision, one field duplicate (as identified in Table 1) was collected and submitted "blind" to the laboratory. All results demonstrated acceptable agreement.

11.2 RINSE BLANKS

To assess contamination from field equipment cleaning activities, one rinse blank was collected as identified in Table 1. All sample results were non-detect for the analytes of interest.

12.0 CONCLUSION

Based on the assessment detailed in the foregoing, the data produced by H2M are acceptable without qualification.

TABLES

TABLE 1

GROUNDWATER SAMPLE KEY
FORMER LAGOON SITE
HAMPTONBURGH, NEW YORK
MARCH 2002

			Semi-Annual Monitoring Program	
Overburden Wells	*Collection Date*	*Sample ID* [1]	*Monitoring Well Network*	*Analytical Parameters*
MW-1	03/19/02	14 (BTEX only)	yes	(2)
MW-5U-95	03/19/02	11	yes	(2)
MW-8U-95	03/19/02	7	yes	(2)
MW-9U-01	03/20/02	12	yes	(2)
MW-10U-01	03/19/02	9 (MS/MSD)	yes	(2)
MW-11U-01	03/19/02	2/3 (Dup), 1 (rinse blank)	yes	(2)
SW-9	-	Dry	yes	(2)
Bedrock wells				
MW-5D-95	03/19/02	10	yes	(2)
MW-9D-01	03/20/02	13	yes	(2)
MW-10D-01	03/19/02	8	yes	(2)
MW-11D-01	03/19/02	4	yes	(2)
MW-12D-01	03/19/02	5	yes	(2)
MW-13D-01	03/19/02	6	yes	(2)
T-2	-	Dry	yes	(2)
Total Wells		14		

Notes:
(1) Only the last two numbers of the sample ID included.
(2) Analytical parameters include BTEX and site-specific pyridines (pyridine, 2-aminopyridine, and alpha-picoline).
Dup Field duplicate.
MS Matrix spike.
MSD Matrix spike duplicate.
BTEX Benzene, toluene, ethylbenzene, and xylenes.

TABLE 2

SAMPLE HOLDING TIMES CRITERIA AND ANALYTICAL METHODS SUMMARY
FORMER LAGOON SITE
HAMPTONBURGH, NEW YORK
MARCH 2002

Parameter	*Matrix*	*Analytical Method*	*VTSR to Extraction (Days)*	*VTSR to Analysis (Days)*
Volatiles [2]	Groundwater	95-4 [1]	-	10
Semi-Volatiles [3]	Groundwater	95-2 [1]	5	40

Notes:

(1) Referenced from New York State Department of Environmental Conservation (NYSDEC) Analytical Services Protocol (ASP), 10/95 Edition.

(2) Benzene, toluene, ethylbenzene, and xylenes.

(3) Pyridine, 2-aminopyridine, and alpha-picoline plus Tentatively Identified Compounds (TICs).

VTSR Verified Time of Sample Receipt

TABLE 3
ANALYTICAL RESULTS SUMMARY
GROUNDWATER SAMPLING
FORMER LAGOON SITE
HAMPTONBURGH, NEW YORK
MARCH 2002

Sample Location:		*MW-1*	*MW-5D-95*	*MW-5U-95*	*MW-8U-95*	*MW-9D-01*
Sample ID:		*GW-3698-031902-DD-14*	*GW-3698-031902-BC-10*	*GW-3698-031902-BC-11*	*GW-3698-031902-DD-7*	*GW-3698-032002-BC-13*
Sample Date:		*3/19/2002*	*3/19/2002*	*3/19/2002*	*3/19/2002*	*3/20/2002*
Parameter	***Unit***					
Volatiles						
Benzene	ug/L	1 U	1 U	1 U	1 U	1 U
Toluene	ug/L	1 U	1 U	1 U	1 U	1 U
Ethylbenzene	ug/L	1 U	1 U	1 U	1 U	1 U
m/p-Xylene	ug/L	2 U	1 J	2 U	2 U	2 U
o-Xylene	ug/L	1 U	0.6 J	1 U	1 U	1 U
Semi-Volatiles						
2-Aminopyridine	ug/L	-	10 U	10 U	10 U	2 J
alpha-Picoline	ug/L	-	10 U	10 U	10 U	10 U
Pyridine	ug/L	-	10 U	10 U	10 U	10 U

Notes:
J - Estimated.
U - Non-detect at associated value.
- - Not applicable.

TABLE 3
ANALYTICAL RESULTS SUMMARY
GROUNDWATER SAMPLING
FORMER LAGOON SITE
HAMPTONBURGH, NEW YORK
MARCH 2002

Sample Location:		*MW-9U-01*	*MW-10D-01*	*MW-10U-01*	*MW-11D-01*
Sample ID:		*GW-3698-032002-BC-12*	*GW-3698-031902-BC-8*	*GW-3698-031902-BC-9*	*GW-3698-031902-DD-4*
Sample Date:		*3/20/2002*	*3/19/2002*	*3/19/2002*	*3/19/2002*
Parameter	*Unit*				
Volatiles					
Benzene	ug/L	1 U	1 U	1 U	1 U
Toluene	ug/L	1 U	1 U	1 U	1 U
Ethylbenzene	ug/L	1 U	1 U	1 U	1 U
m/p-Xylene	ug/L	2 U	2 U	2 U	2 U
o-Xylene	ug/L	1 U	1 U	1 U	1 U
Semi-Volatiles					
2-Aminopyridine	ug/L	10 U	10 U	10 U	10 U
alpha-Picoline	ug/L	10 U	10 U	10 U	10 U
Pyridine	ug/L	10 U	10 U	10 U	10 U

Notes:
J - Estimated.
U - Non-detect at associated value.
- - Not applicable.

TABLE 3
ANALYTICAL RESULTS SUMMARY
GROUNDWATER SAMPLING
FORMER LAGOON SITE
HAMPTONBURGH, NEW YORK
MARCH 2002

Sample Location:		*MW-11U-01*	*MW-11U-01*	*MW-12D-01*	*MW-13D-01*
Sample ID:		*GW-3698-031902-DD-2*	*GW-3698-031902-DD-3*	*GW-3698-031902-DD-5*	*GW-3698-031902-DD-6*
Sample Date:		*3/19/2002*	*3/19/2002* *(Duplicate)*	*3/19/2002*	*3/19/2002*
Parameter	*Unit*				
Volatiles					
Benzene	ug/L	1 U	1 U	1 U	1 U
Toluene	ug/L	1 U	1 U	1 U	1 U
Ethylbenzene	ug/L	1 U	1 U	1 U	1 U
m/p-Xylene	ug/L	2 U	2 U	2 U	2 U
o-Xylene	ug/L	1 U	1 U	1 U	1 U
Semi-Volatiles					
2-Aminopyridine	ug/L	10 U	10 U	10 U	10 U
alpha-Picoline	ug/L	10 U	10 U	10 U	10 U
Pyridine	ug/L	10 U	10 U	10 U	10 U

Notes:
J - Estimated.
U - Non-detect at associated value.
- - Not applicable.

ANALYTICAL DATA ASSESSMENT AND VALIDATION
GROUNDWATER SAMPLING
FORMER LAGOON SITE
HAMPTONBURGH, NEW YORK
AUGUST 2002

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(Following Text)

1.0 INTRODUCTION

The following document details an assessment and validation of analytical results reported by H2M Labs, Inc. (H2M) for groundwater samples collected at the Former Lagoon Site in Hamptonburgh, New York (Site) during August 2002. For sample identification, a sampling and analysis summary is presented in Table 1.

Samples were analyzed as specified in Table 1. A summary of the analytical methodology is presented in Table 2.

A summary of the analytical data is presented in Table 3. The Quality Assurance/Quality Control (QA/QC) criteria by which these data have been assessed are outlined in the analytical methods and the United States Environmental Protection Agency (USEPA) Region II Data Validation Standard Operating Procedures (SOP HW-6, Rev. 11, SOW 3/90, Revision XI).

The Site-Specific Quality Assurance Project Plan (QAPP) (March 2001) was also utilized in the data assessment.

Deliverables as specified in the QAPP were provided by the laboratory for the analyses. The data quality assessment and validation presented in the following subsections were performed based on the sample results and supporting QA/QC provided.

2.0 SAMPLE HOLDING TIMES

The QAPP holding time criteria are summarized in Table 2.

All sample extractions and analyses were performed within the required holding times.

All samples were properly preserved and cooled after collection. All samples were received by the laboratory in good condition within 2 days of sample collection.

3.0 GAS CHROMATOGRAPH/MASS SPECTROMETER (GC/MS) TUNING AND MASS CALIBRATION - VOLATILES AND SEMI-VOLATILES

Prior to analysis, GC/MS instrumentation is tuned to ensure optimization over the mass range of interest. To evaluate instrument tuning, ASP Methods 95-4 and 95-2 require the analysis of the specific tuning compounds bromofluorobenzene (BFB) and decafluorotriphenylphosphine (DFTPP), respectively. The resulting spectra must meet the criteria cited in the method before analysis is initiated. Analysis of the tuning compound must then be repeated every 12 hours throughout sample analysis to ensure the continued optimization of the instrument.

All instrument tuning data were reviewed. Tuning compounds were analyzed at the required frequency throughout the volatile organic compound (VOC) and semi-volatile organic compound (SVOC) analyses periods. All tuning criteria were met for the analyses, indicating proper optimization of the instrumentation.

4.0 INSTRUMENT CALIBRATION

4.1 GC/MS CALIBRATION - VOLATILES AND SEMI-VOLATILES

4.1.1 INITIAL CALIBRATION

To quantify compounds of interest in samples, calibration of the GC/MS over a specific concentration range must be performed. Initially, a five-point calibration curve containing all compounds of interest is analyzed.

Linearity of the curve and instrument sensitivity were evaluated against the following criteria:

i) all relative response factors (RRFs) must be greater than or equal to 0.05; and

ii) percent relative standard deviation (%RSD) values must not exceed 30 percent.

The initial calibration data for VOCs and SVOCs were reviewed. All %RSDs met the above criteria for VOCs and SVOCs.

4.1.2 CONTINUING CALIBRATION

To ensure that instrument calibration is acceptable throughout the sample analysis period, continuing calibration standards must be analyzed and compared to the initial calibration curve every 12 hours.

The following criteria were employed to evaluate continuing calibration data:

i) all RRF values must be greater than or equal to 0.05; and

ii) percent difference (%D) values must not exceed 25 percent.

All RRFs and %Ds were acceptable.

5.0 SURROGATE SPIKE RECOVERIES

In accordance with the methods employed, all samples, blanks, and standards analyzed for VOCs and SVOCs were spiked with surrogate compounds prior to sample extraction and/or analysis. Surrogate recoveries provide a means to evaluate the effects of individual sample matrices on analytical efficiency. Surrogate recovery evaluations were performed as specified in the validation SOPs.

5.1 VOLATILES

All surrogate recoveries reported for the VOC analyses were within the method control limits, indicating good analytical efficiency.

5.2 SEMI-VOLATILES

All sample surrogate recoveries met the criteria, indicating good analytical efficiency.

6.0 INTERNAL STANDARD RECOVERIES - VOLATILES AND SEMI-VOLATILES

To ensure that changes in GC/MS response and sensitivity do not affect sample analysis results, internal standard compounds are added to all samples, blanks, and spike samples prior to VOC and SVOC analyses. All results are calculated as a ratio of the internal standard response. The criteria by which the internal standard results are assessed are as follows:

i) internal standard area counts must not vary by more than a factor of two (-50 percent to +100 percent) from the associated calibration standard; and

ii) the retention time of the internal standard must not vary more than ±30 seconds from the associated calibration standard.

All internal standard recoveries and retention times were acceptable, demonstrating good analytical performance.

7.0 LABORATORY BLANK ANALYSES

The purpose of assessing the results of laboratory blank analyses is to determine the existence and magnitude of sample contamination introduced during analysis. Laboratory blanks are prepared from deionized water and analyzed as samples.

For this study, laboratory blanks were analyzed at a minimum frequency of one per analytical batch.

7.1 VOLATILES

All blank results were non-detect for the VOCs of interest, indicating that contamination was not a factor for this analysis.

7.2 SEMI-VOLATILES

All blank results were non-detect for the SVOCs of interest, indicating that contamination was not a factor in this analysis.

8.0 BLANK SPIKE ANALYSES

Blank spikes are prepared and analyzed as samples to assess the analytical efficiencies of the method employed, independent of sample matrix effects. Blank spikes were performed for all analyses.

8.1 VOLATILES

All blank spike sample analyses yielded recoveries within the method control limits, indicating acceptable analytical accuracy.

8.2 SEMI-VOLATILES

All blank spike sample analyses yielded recoveries within the control limits, indicating acceptable analytical accuracy.

9.0 MATRIX SPIKE/MATRIX SPIKE DUPLICATE (MS/MSD) ANALYSES - ORGANICS

The recoveries of MS/MSD analyses are used to assess the analytical accuracy achieved on individual sample matrices. The relative percent difference (RPD) between the MS and MSD is used to assess analytical precision.

The sample chosen for MS/MSD analyses is specified in Table 1.

9.1 VOLATILES

All recoveries and RPDs were acceptable, indicating good laboratory accuracy and precision.

9.2 SEMI-VOLATILES

All recoveries and RPDs were acceptable, indicating good laboratory accuracy and precision.

10.0 SAMPLE QUANTITATION

The 2-aminopyridine and alpha-picoline results for sample GW-82802-14 exceeded the linear range. The sample was diluted to get the 2-aminopyridine result into the linear range. However, the alpha-picoline was non-detect in the dilution analysis. Based on these results, the original alpha-picoline result was accepted. The result is qualified as estimated based on the linear range exceedance (see Table 4).

11.0 FIELD QA/QC

11.1 FIELD DUPLICATES

To assess the analytical and sampling protocol precision, one field duplicate (as identified in Table 1) was collected and submitted "blind" to the laboratory. All results demonstrated acceptable agreement.

11.2 RINSE BLANKS

To assess contamination from field equipment cleaning activities, one rinse blank was collected as identified in Table 1. All sample results were non-detect for the analytes of interest.

12.0 CONCLUSION

Based on the assessment detailed in the foregoing, the data produced by H2M are acceptable with the qualification noted.

TABLES

TABLE 1

SAMPLE COLLECTION AND ANALYSIS SUMMARY
SEMI-ANNUAL GROUNDWATER SAMPLING
FORMER LAGOON SITE
HAMPTONBURGH, NEW YORK
AUGUST 2002

Sample No.	*Well ID*	*Date Collected*	*Time Collected*	*Sample Type*	*Analyses*	*Comments*
GW-082802-RR-10	MW-8-U	08/28/02	9:35	Groundwater	SSPL VOCs and SVOCs	
GW-082802-RR-12	MW 12-D	08/28/02	13:55	Groundwater	SSPL VOCs and SVOCs	
GW-082802-RR-11	MW-11-U	08/28/02	16:40	Groundwater	SSPL VOCs and SVOCs	
GW-82802-RR-13	MW-11-D	08/28/02	17:30	Groundwater	SSPL VOCs and SVOCs	
GW-82802-14	SW-9	08/28/02	17:35	Groundwater	SSPL VOCs and SVOCs	
GW-82802-09	MW-13-D	08/28/02	16:10	Groundwater	SSPL VOCs and SVOCs	
GW-82802-08	MW-5-D	08/28/02	12:00	Groundwater	SSPL VOCs and SVOCs	
GW-82802-06	MW-5-U	08/28/02	10:35	Groundwater	SSPL VOCs and SVOCs	
GW-82802-07	MW-5-U	08/28/02	10:55	Groundwater	SSPL VOCs and SVOCs	Field duplicate
GW-82702-01	MW-10-D	08/27/02	12:05	Groundwater	SSPL VOCs and SVOCs	
GW-82702-02	MW-10-U	08/27/02	13:30	Groundwater	SSPL VOCs and SVOCs	MS/MSD
GW-82702-04	MW-9-U	08/27/02	16:30	Groundwater	SSPL VOCs	
GW-82802-04	MW-9-U	08/28/02	8:30	Groundwater	SSPL SVOCs	
GW-82702-03	MW-9-D	08/27/02	15:20	Groundwater	SSPL VOCs and SVOCs	
GW-82702-05	-	08/27/02	15:10	Groundwater	SSPL VOCs and SVOCs	Rinse blank

Notes:

MS	Matrix Spike.
MSD	Matrix Spike Duplicate.
SSPL	Site-Specific Parameter List.
SVOCs	Semi-Volatile Organic Compounds.
VOCs	Volatile Organic Compounds.

TABLE 2

SAMPLE HOLDING TIMES CRITERIA AND ANALYTICAL METHODS SUMMARY
FORMER LAGOON SITE
HAMPTONBURGH, NEW YORK
AUGUST 2002

Parameter	*Matrix*	*Analytical Method*	*VTSR to Extraction (Days)*	*VTSR to Analysis (Days)*
Volatiles [2]	Groundwater	95-4 [1]	-	10
Semi-Volatiles [3]	Groundwater	95-2 [1]	5	40

Notes:

[1] Referenced from New York State Department of Environmental Conservation (NYSDEC) Analytical Services Protocol (ASP), 10/95 Edition.

[2] Benzene, toluene, ethylbenzene, and xylenes.

[3] Pyridine, 2-aminopyridine, and alpha-picoline by Selective Ion Monitoring (SIM).

VTSR Verified Time of Sample Receipt.

TABLE 3

ANALYTICAL RESULTS SUMMARY
SEMI-ANNUAL GROUNDWATER SAMPLING
FORMER LAGOON SITE
HAMPTONBURGH, NEW YORK
AUGUST 2002

	Location:	*MW-10D-01*	*MW-10U-01*	*MW-11D-01*	*MW-11U-01*	*MW-12D-01*	*MW-13D-01*	*MW-5D-95*
	Sample Name:	*GW-82702-01*	*GW-82702-02*	*GW-82802-RR-13*	*GW-82802-RR-11*	*GW-82802-RR-12*	*GW-82802-09*	*GW-82802-08*
	Sample Date:	*08/27/2002*	*08/27/2002*	*08/28/2002*	*08/28/2002*	*08/28/2002*	*08/28/2002*	*08/28/2002*
Parameters	*Units*							
Volatiles								
Benzene	µg/L	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Ethylbenzene	µg/L	1 U	1 U	1 U	1 U	1 U	1 U	1 U
o-Xylene	µg/L	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Toluene	µg/L	1 U	1 U	1 U	1 U	1 U	1 U	1 U
m/p-Xylene	µg/L	0.7 J	2 U	2 U	2 U	2 U	2 U	2 U
Semi-Volatiles								
2-Aminopyridine	µg/L	1 U	1 U	1 U	1 U	1 U	1 U	0.5 J
alpha-Picoline	µg/L	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Pyridine	µg/L	1 U	1 U	1 U	1 U	1 U	1 U	1 U

	Location:	*MW-5U-95*	*MW-5U-95*	*MW-8U-95*	*MW-9D-01*	*MW-9U-01*	*MW-9U-01*	*SW-9*
	Sample Name:	*GW-82802-06*	*GW-82802-07*	*GW-82802-RR-10*	*GW-82702-03*	*GW-82702-04*	*GW-82802-04*	*GW-82802-14*
	Sample Date:	*08/28/2002*	*08/28/2002*	*08/28/2002*	*08/27/2002*	*08/27/2002*	*08/28/2002*	*08/28/2002*
			Duplicate					
Volatiles								
Benzene	µg/L	1 U	1 U	1 U	1 U	1 U	-	190
Ethylbenzene	µg/L	1 U	1 U	1 U	0.6 J	0.5 J	-	1 U
o-Xylene	µg/L	1 U	1 U	1 U	0.6 J	1 U	-	1 U
Toluene	µg/L	1 U	1 U	2	1	0.6 J	-	1 U
m/p-Xylene	µg/L	2 U	2 U	1 J	1 J	1 J	-	2 U
Semi-Volatiles								
2-Aminopyridine	µg/L	1 U	0.3 J	130	4	-	1 U	3900
alpha-Picoline	µg/L	1 U	1 U	1 U	1 U	-	1 U	35 J
Pyridine	µg/L	1 U	1 U	1 U	1 U	-	1 U	0.8 J

Notes:

- Not analyzed.
J Estimated.
U Non-detect at associated value.

TABLE 4

QUALIFIED SAMPLE RESULTS DUE TO RESULTS EXCEEDING THE LINEAR RANGE
SEMI-ANNUAL GROUNDWATER SAMPLING
FORMER LAGOON SITE
HAMPTONBURGH, NEW YORK
AUGUST 2002

Parameter	*Sample ID*	*Associated Analytes*	*Sample Result*	*Qualifier*	*Units*
SVOCs	GW-82802-14	alpha-Picoline	35	J	µg/L

Notes:
J Estimated.
SVOCs Semi-Volatile Organic Compounds.

ANALYTICAL DATA ASSESSMENT AND VALIDATION
GROUNDWATER SAMPLING
FORMER LAGOON SITE
HAMPTONBURGH, NEW YORK
FEBRUARY 2003

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1.0 INTRODUCTION

The following document details an assessment and validation of analytical results reported by H2M Labs, Inc. (H2M) for groundwater samples collected at the Former Lagoon Site in Hamptonburgh, New York (Site) during February 2003. For sample identification, a sampling and analysis summary is presented in Table 1.

Samples were analyzed as specified in Table 1. A summary of the analytical methodology is presented in Table 2.

A summary of the analytical data is presented in Table 3. The Quality Assurance/Quality Control (QA/QC) criteria by which these data have been assessed are outlined in the analytical methods and the United States Environmental Protection Agency (USEPA) Region II Data Validation Standard Operating Procedures (SOP HW-6, Rev. 11, June 1996).

The Site-Specific Quality Assurance Project Plan (QAPP) (March 2001) was also utilized in the data assessment.

Deliverables as specified in the QAPP were provided by the laboratory for the analyses. The data quality assessment and validation presented in the following subsections were performed based on the sample results and supporting QA/QC provided.

2.0 SAMPLE HOLDING TIMES

The QAPP holding time criteria are summarized in Table 2.

All sample extractions and analyses were performed within the required holding times.

All samples were properly preserved and cooled after collection. All samples were received by the laboratory in good condition within 2 days of sample collection.

3.0 GAS CHROMATOGRAPH/MASS SPECTROMETER (GC/MS) TUNING AND MASS CALIBRATION - VOLATILES AND SEMI-VOLATILES

Prior to analysis, GC/MS instrumentation is tuned to ensure optimization over the mass range of interest. To evaluate instrument tuning, ASP Methods 95-4 and 95-2 require the analysis of the specific tuning compounds bromofluorobenzene (BFB) and decafluorotriphenylphosphine (DFTPP), respectively. The resulting spectra must meet the criteria cited in the method before analysis is initiated. Analysis of the tuning compound must then be repeated every 12 hours throughout sample analysis to ensure the continued optimization of the instrument.

All instrument tuning data were reviewed. Tuning compounds were analyzed at the required frequency throughout the volatile organic compound (VOC) and semi-volatile organic compound (SVOC) analyses periods. All tuning criteria were met for the analyses, indicating proper optimization of the instrumentation.

4.0 INSTRUMENT CALIBRATION

4.1 GC/MS CALIBRATION - VOLATILES AND SEMI-VOLATILES

4.1.1 INITIAL CALIBRATION

To quantify compounds of interest in samples, calibration of the GC/MS over a specific concentration range must be performed. Initially, a minimum of a five-point calibration curve containing all compounds of interest is analyzed.

Linearity of the curve and instrument sensitivity were evaluated against the following criteria:

i) all relative response factors (RRFs) must be greater than or equal to 0.05; and

ii) percent relative standard deviation (%RSD) values must not exceed 30 percent.

The initial calibration data for VOCs and SVOCs were reviewed. All %RSDs met the above criteria for VOCs and SVOCs.

4.1.2 CONTINUING CALIBRATION

To ensure that instrument calibration is acceptable throughout the sample analysis period, continuing calibration standards must be analyzed and compared to the initial calibration curve every 12 hours.

The following criteria were employed to evaluate continuing calibration data:

i) all RRF values must be greater than or equal to 0.05; and

ii) percent difference (%D) values must not exceed 25 percent.

All RRFs and %Ds were acceptable.

5.0 SURROGATE SPIKE RECOVERIES

In accordance with the methods employed, all samples, blanks, and standards analyzed for VOCs and SVOCs were spiked with surrogate compounds prior to sample extraction and/or analysis. Surrogate recoveries provide a means to evaluate the effects of individual sample matrices on analytical efficiency. Surrogate recovery evaluations were performed as specified in the validation SOPs.

5.1 VOLATILES

All surrogate recoveries reported for the VOC analyses were within the method control limits, indicating good analytical efficiency.

5.2 SEMI-VOLATILES

All sample surrogate recoveries met the criteria, indicating good analytical efficiency.

6.0 INTERNAL STANDARD RECOVERIES - VOLATILES AND SEMI-VOLATILES

To ensure that changes in GC/MS response and sensitivity do not affect sample analysis results, internal standard compounds are added to all samples, blanks, and spike samples prior to VOC and SVOC analyses. All results are calculated as a ratio of the internal standard response. The criteria by which the internal standard results are assessed are as follows:

i) internal standard area counts must not vary by more than a factor of two (-50 percent to +100 percent) from the associated calibration standard; and

ii) the retention time of the internal standard must not vary more than ±30 seconds from the associated calibration standard.

All internal standard recoveries and retention times were acceptable, demonstrating good analytical performance.

7.0 LABORATORY BLANK ANALYSES

The purpose of assessing the results of laboratory blank analyses is to determine the existence and magnitude of sample contamination introduced during analysis. Laboratory blanks are prepared from deionized water and analyzed as samples.

For this study, laboratory blanks were analyzed at a minimum frequency of one per analytical batch.

7.1 VOLATILES

All blank results were non-detect for the VOCs of interest, indicating that contamination was not a factor for this analysis.

7.2 SEMI-VOLATILES

All blank results were non-detect for the SVOCs of interest, indicating that contamination was not a factor in this analysis.

8.0 BLANK SPIKE ANALYSES

Blank spikes are prepared and analyzed as samples to assess the analytical efficiencies of the method employed, independent of sample matrix effects. Blank spikes were performed for all analyses.

8.1 VOLATILES

All blank spike sample analyses yielded recoveries within the method control limits, indicating acceptable analytical accuracy.

8.2 SEMI-VOLATILES

Most blank spike sample analyses yielded recoveries within the control limits, indicating acceptable analytical accuracy. A high pyridine recovery was reported. All associated data were non-detect and were not impacted by the indicated high bias.

9.0 MATRIX SPIKE/MATRIX SPIKE DUPLICATE (MS/MSD) ANALYSES - ORGANICS

The recoveries of MS/MSD analyses are used to assess the analytical accuracy achieved on individual sample matrices. The relative percent difference (RPD) between the MS and MSD is used to assess analytical precision.

The sample chosen for MS/MSD analyses is specified in Table 1.

9.1 VOLATILES

All recoveries and RPDs were acceptable, indicating good laboratory accuracy and precision.

9.2 SEMI-VOLATILES

All recoveries and RPDs were acceptable, indicating good laboratory accuracy and precision.

10.0 FIELD QA/QC

10.1 FIELD DUPLICATES

To assess the analytical and sampling protocol precision, one field duplicate (as identified in Table 1) was collected and submitted "blind" to the laboratory. All results demonstrated acceptable agreement.

10.2 RINSE BLANKS

To assess contamination from field equipment cleaning activities, rinse blanks were collected as identified in Table 1. All sample results were non-detect for the analytes of interest.

12.0 CONCLUSION

Based on the assessment detailed in the foregoing, the data produced by H2M are acceptable without qualification.

TABLES

TABLE 1

SAMPLE COLLECTION AND ANALYSIS SUMMARY
SEMI-ANNUAL GROUNDWATER SAMPLING
FORMER LAGOON SITE
HAMPTONBURGH, NEW YORK
FEBRUARY 2003

Sample Number	*Well ID*	*Date Collected*	*Time Collected*	*Sample Type*	*Analyses*	*Comments*
GW369 021903BC008	MW-1	02/19/03	15:30	Groundwater	SSPL VOCs and SVOCs	
GW3698021903BC006	MW-5U-95	02/19/03	12:15	Groundwater	SSPL VOCs and SVOCs	
GW3698021903RR011	MW-8U-95	02/19/03	15:35	Groundwater	SSPL VOCs and SVOCs	
GW3698021903RR009	MW-9U-01	02/19/03	11:25	Groundwater	SSPL VOCs and SVOCs	MS/MSD
GW3698021803RR001	MW-10U-01	02/18/03	14:50	Groundwater	SSPL VOCs and SVOCs	
GW3698021803RR003	MW-10U-01	02/18/03	15:30	Groundwater	SSPL VOCs and SVOCs	Field Duplicate
GW3698022003RR013	MW-11U-01	02/20/03	11:15	Groundwater	SSPL VOCs and SVOCs	
GW3698022003RR017	SW-9	02/20/03	15:30	Groundwater	SSPL VOCs and SVOCs	
GW3698021803RR002	MW-5D-95	02/18/03	16:05	Groundwater	SSPL VOCs and SVOCs	
GW3698021903RR007	MW-9D-01	02/19/03	9:40	Groundwater	SSPL VOCs and SVOCs	
GW3698021803RR005	MW-10D-01	02/18/03	17:05	Groundwater	SSPL VOCs and SVOCs	
GW3698022003RR015	MW-11D-01	02/20/03	12:10	Groundwater	SSPL VOCs and SVOCs	
GW3698022003BC14	MW-12D-01	02/20/03	13:05	Groundwater	SSPL VOCs and SVOCs	
GW3698022003BC012	MW-13D-01	02/20/03	10:30	Groundwater	SSPL VOCs and SVOCs	
GW3698021903BC010	T-2	02/19/03	17:05	Groundwater	SSPL VOCs and SVOCs	
GW3698021803RR004	Rinse Blank	02/18/03	17:00	Water	SSPL VOCs and SVOCs	Rinse Blank
GW3698021803BC004	Rinse Blank	02/18/03	17:00	Water	SSPL SVOCs	Rinse Blank

Notes:

MS	Matrix Spike.
MSD	Matrix Spike Duplicate.
SSPL	Site-Specific Parameter List.
SVOCs	Semi-Volatile Organic Compounds.
VOCs	Volatile Organic Compounds.

TABLE 2

SAMPLE HOLDING TIMES CRITERIA AND ANALYTICAL METHODS SUMMARY
FORMER LAGOON SITE
HAMPTONBURGH, NEW YORK
FEBRUARY 2003

Parameter	*Matrix*	*Analytical Method*	*VTSR to Extraction (Days)*	*VTSR to Analysis (Days)*
Volatiles [2]	Groundwater	95-4 [1]	-	10
Semi-Volatiles [3]	Groundwater	95-2 [1]	5	40

Notes:

[1] Referenced from New York State Department of Environmental Conservation (NYSDEC) Analytical Services Protocol (ASP), 10/95 Edition.

[2] Benzene, toluene, ethylbenzene, and xylenes.

[3] Pyridine, 2-aminopyridine, and alpha-picoline by Selective Ion Monitoring (SIM).

VTSR Verified Time of Sample Receipt.

TABLE 3

ANALYTICAL RESULTS SUMMARY
GROUNDWATER SAMPLING
FORMER LAGOON SITE
HAMPTONBURGH, NEW YORK
FEBRUARY 2003

Location:	*MW-1*	*MW-5D-95*	*MW-5U-95*	*MW-8U-95*	*MW-9D-01*	*MW-9U-01*	*MW-10D-01*	*MW-10U-01*
Sample ID:	*GW369821903BC008*	*GW3698021803RR002*	*GW369821903BC006*	*GW369821903RR011*	*GW369821903RR007*	*GW369821903RR009*	*GW3698021803RR005*	*GW3698021803RR001*
Sample Date:	*02/19/2003*	*02/18/2003*	*02/19/2003*	*02/19/2003*	*02/19/2003*	*02/19/2003*	*02/18/2003*	*02/18/2003*
Parameter	***Units***							
Volatiles								
Benzene	µg/L	1 U	1 U	1 U	2	1	1 U	1 U	1 U
Ethylbenzene	µg/L	5	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Toluene	µg/L	4	1 U	0.7 J	1 U	1 U	1 U	1 U	1 U
m/p-Xylene	µg/L	22	2 U	2 U	2 U	2 U	2 U	2 U	2 U
o-Xylene	µg/L	12	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Semi-Volatiles								
2-Aminopyridine	µg/L	0.9 J	1 U	1 U	75	1 U	1 U	1 U	1 U
2-Picoline	µg/L	1 U	1 U	1 U	3	1 U	1 U	1 U	1 U
Pyridine	µg/L	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U

Notes:

J Estimated.

U Non-detect at associated value.

TABLE 3

ANALYTICAL RESULTS SUMMARY
GROUNDWATER SAMPLING
FORMER LAGOON SITE
HAMPTONBURGH, NEW YORK
FEBRUARY 2003

	Location:	*MW-10U-01*	*MW-11D-01*	*MW-11U-01*	*MW-12D-01*	*MW-13D-01*	*SW-9*	*T-2*
	Sample ID:	*GW3698021803RR003*	*GW3698022003RR015*	*GW3698022003RR013*	*GW3698022003BC14*	*GW3698022003BC012*	*GW3698022003RR017*	*GW369821903BC010*
	Sample Date:	*02/18/2003*	*02/20/2003*	*02/20/2003*	*02/20/2003*	*02/20/2003*	*02/20/2003*	*02/19/2003*
		Duplicate						
Parameter	*Units*							
Volatiles								
Benzene	µg/L	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Ethylbenzene	µg/L	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Toluene	µg/L	1 U	1 U	1 U	1 U	1 U	1 U	1 U
m/p-Xylene	µg/L	2 U	2 U	2 U	2 U	2 U	2 U	2 U
o-Xylene	µg/L	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Semi-Volatiles								
2-Aminopyridine	µg/L	1 U	1 U	1 U	1 U	1 U	1 U	0.6 J
2-Picoline	µg/L	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Pyridine	µg/L	1 U	1 U	1 U	1 U	1 U	1 U	1 U

Notes:
J Estimated.
U Non-detect at associated value.

TABLE 4

QUALIFIED SAMPLE RESULTS DUE TO RESULTS EXCEEDING THE LINEAR RANGE
SEMI-ANNUAL GROUNDWATER SAMPLING
FORMER LAGOON SITE
HAMPTONBURGH, NEW YORK
AUGUST 2002

Parameter	*Sample ID*	*Associated Analytes*	*Sample Result*	*Qualifier*	*Units*
SVOCs	GW-82802-14	alpha-Picoline	35	J	µg/L

Notes:
J Estimated.
SVOCs Semi-Volatile Organic Compounds.

ANALYTICAL DATA ASSESSMENT AND VALIDATION
SEMI-ANNUAL GROUNDWATER SAMPLING
FORMER LAGOON SITE
HAMPTONBURGH, NEW YORK
AUGUST 2003

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1.0 INTRODUCTION

The following document details an assessment and validation of analytical results reported by H2M Labs, Inc. (H2M) for groundwater samples collected at the Former Lagoon Site in Hamptonburgh, New York (Site) during August 2003. Due to instrument problems associated with the black-out in the Northeast United States, H2M subcontracted the volatile organic compound (VOC) analyses to Ecology and Environment, Inc. (E&E). For sample identification, a sampling and analysis summary is presented in Table 1.

Samples were analyzed as specified in Table 1. A summary of the analytical methodology is presented in Table 2.

A summary of the analytical data is presented in Table 3. The quality assurance/quality control (QA/QC) criteria by which these data have been assessed are outlined in the analytical methods and the United States Environmental Protection Agency (USEPA) Region II Data Validation Standard Operating Procedures (SOP HW-6, Rev. 12, March 2001).

The Site-Specific Quality Assurance Project Plan (QAPP) (March 2001) was also utilized in the data assessment.

Deliverables as specified in the QAPP were provided by the laboratory for the analyses. The data quality assessment and validation presented in the following subsections were performed based on the sample results and supporting QA/QC provided.

2.0 SAMPLE HOLDING TIMES

The QAPP holding time criteria are summarized in Table 2.

All sample extractions and analyses were performed within the required holding times.

All samples were properly preserved and cooled after collection. All samples were received by H2M in good condition within 2 days of sample collection.

Due to the black-out, H2M lost power for several hours. During this time, the laboratory cooler temperatures ranged from 6°C to 10°C. Since the temperature exceedance was marginal, the samples were analyzed and reported with reference to the exceedance in the laboratory report.

When H2M subcontracted the VOC samples to E&E, the laboratory did not use enough ice to properly chill the sample cooler. Based on this temperature exceedance, all sample VOC results were qualified as estimated (see Table 4).

3.0 GAS CHROMATOGRAPH/MASS SPECTROMETER (GC/MS) TUNING AND MASS CALIBRATION - VOLATILES AND SEMI-VOLATILES

Prior to analysis, GC/MS instrumentation is tuned to ensure optimization over the mass range of interest. To evaluate instrument tuning, Analytical Services Protocol (ASP) Methods 95-4 and 95-2 require the analysis of the specific tuning compounds bromofluorobenzene (BFB) and decafluorotriphenylphosphine (DFTPP), respectively. The resulting spectra must meet the criteria cited in the method before analysis is initiated. Analysis of the tuning compound must then be repeated every 12 hours throughout sample analysis to ensure the continued optimization of the instrument.

All instrument tuning data were reviewed. Tuning compounds were analyzed at the required frequency throughout the VOC and semi-volatile organic compound (SVOC) analyses periods. All tuning criteria were met for the analyses, indicating proper optimization of the instrumentation.

4.0 INSTRUMENT CALIBRATION

4.1 GC/MS CALIBRATION - VOLATILES AND SEMI-VOLATILES

4.1.1 INITIAL CALIBRATION

To quantify compounds of interest in samples, calibration of the GC/MS over a specific concentration range must be performed. Initially, a minimum of a five-point calibration curve containing all compounds of interest is analyzed.

Linearity of the curve and instrument sensitivity were evaluated against the following criteria:

i) all relative response factors (RRFs) must be greater than or equal to 0.05; and

ii) percent relative standard deviation (%RSD) values must not exceed 30 percent.

The initial calibration data for VOCs and SVOCs were reviewed. All %RSDs met the above criteria for VOCs and SVOCs.

4.1.2 CONTINUING CALIBRATION

To ensure that instrument calibration is acceptable throughout the sample analysis period, continuing calibration standards must be analyzed and compared to the initial calibration curve every 12 hours.

The following criteria were employed to evaluate continuing calibration data:

i) all RRF values must be greater than or equal to 0.05; and

ii) percent difference (%D) values must not exceed 25 percent.

All RRFs and %Ds were acceptable.

5.0 SURROGATE SPIKE RECOVERIES

In accordance with the methods employed, all samples, blanks, and standards analyzed for VOCs and SVOCs were spiked with surrogate compounds prior to sample extraction and/or analysis. Surrogate recoveries provide a means to evaluate the effects of individual sample matrices on analytical efficiency. Surrogate recovery evaluations were performed as specified in the validation SOPs.

5.1 VOLATILES

Most surrogate recoveries reported for the VOC analyses were within the method control limits, indicating good analytical efficiency. One low recovery was reported and the associated sample results were qualified a estimated (see Table 5).

5.2 SEMI-VOLATILES

Most sample surrogate recoveries met the criteria, indicating good analytical efficiency. One high surrogate recovery was reported for three samples. All associated sample results were non-detect and were not impacted by the indicated high bias.

6.0 INTERNAL STANDARD RECOVERIES - VOLATILES AND SEMI-VOLATILES

To ensure that changes in GC/MS response and sensitivity do not affect sample analysis results, internal standard compounds are added to all samples, blanks, and spike samples prior to VOC and SVOC analyses. All results are calculated as a ratio of the internal standard response. The criteria by which the internal standard results are assessed are as follows:

i) internal standard area counts must not vary by more than a factor of two (-50 percent to +100 percent) from the associated calibration standard; and

ii) the retention time of the internal standard must not vary more than ±30 seconds from the associated calibration standard.

All internal standard recoveries and retention times were acceptable, demonstrating good analytical performance.

7.0 LABORATORY BLANK ANALYSES

The purpose of assessing the results of laboratory blank analyses is to determine the existence and magnitude of sample contamination introduced during analysis. Laboratory blanks are prepared from deionized water and analyzed as samples.

For this study, laboratory blanks were analyzed at a minimum frequency of one per analytical batch.

7.1 VOLATILES

All blank results were non-detect for the VOCs of interest, indicating that contamination was not a factor for this analysis.

7.2 SEMI-VOLATILES

All blank results were non-detect for the SVOCs of interest, indicating that contamination was not a factor in this analysis.

8.0 BLANK SPIKE ANALYSES

Blank spikes are prepared and analyzed as samples to assess the analytical efficiencies of the method employed, independent of sample matrix effects. Blank spikes were performed for all analyses.

8.1 VOLATILES

All blank spike sample analyses yielded recoveries within the method control limits, indicating acceptable analytical accuracy.

8.2 SEMI-VOLATILES

Most blank spike sample analyses yielded recoveries within the control limits, indicating acceptable analytical accuracy. A high 2-picoline recovery was reported. All associated detected data were qualified as estimated based on the indicated high bias (see Table 6).

9.0 MATRIX SPIKE/MATRIX SPIKE DUPLICATE (MS/MSD) ANALYSES - ORGANICS

The recoveries of MS/MSD analyses are used to assess the analytical accuracy achieved on individual sample matrices. The relative percent difference (RPD) between the MS and MSD is used to assess analytical precision.

The sample chosen for MS/MSD analyses is specified in Table 1.

9.1 VOLATILES

All recoveries and RPDs were acceptable, indicating good laboratory accuracy and precision.

9.2 SEMI-VOLATILES

All recoveries and RPDs were acceptable, indicating good laboratory accuracy and precision.

10.0 FIELD QA/QC

10.1 FIELD DUPLICATES

To assess the analytical and sampling protocol precision, one field duplicate (as identified in Table 1) was collected and submitted "blind" to the laboratory. All results demonstrated acceptable agreement.

10.2 RINSE BLANKS

To assess contamination from field equipment cleaning activities, one rinse blank was collected as identified in Table 1. All sample results were non-detect for the analytes of interest.

10.3 TRIP BLANKS

Two trip blanks were submitted with the VOC analyses to assess contamination from sample bottles, preservation, and storage. All results were non-detect for the VOCs of interest.

11.0 CONCLUSION

Based on the assessment detailed in the foregoing, the data produced by H2M are acceptable with the noted qualifications.

TABLES

TABLE 1

SAMPLE COLLECTION AND ANALYSIS SUMARY
SEMI-ANNUAL GROUNDWATER SAMPLING
FORMER LAGOON SITE
HAMPTONBURGH, NEW YORK
AUGUST 2003

Sample Number	*Well ID*	*Date Collected*	*Time Collected*	*Sample Type*	*Analyses*	*Comments*
GW-3698-81203-RR-009	MW-1	08/12/03	17:30	Groundwater	SSPL VOCs and SVOCs	
GW-81203-BC-06	MW-5U-95	08/12/03	14:35	Groundwater	SSPL VOCs and SVOCs	MS/MSD
GW-3698-81303-BC-14	MW-8U-95	08/13/03	9:05	Groundwater	SSPL VOCs and SVOCs	
GW-3698-81203-RR-007	MW-9U-01	08/12/03	16:40	Groundwater	SSPL VOCs and SVOCs	
GW-81203-BC-02	MW-10U-01	08/12/03	11:10	Groundwater	SSPL VOCs and SVOCs	
GW-81203-BC-08	MW-10U-01	08/12/03	0:00	Groundwater	SSPL VOCs and SVOCs	Field Duplicate
GW-3698-81303-RR-013	MW-11U-01	08/13/03	11:40	Groundwater	SSPL VOCs and SVOCs	
GW-3698-81303-RR-015	SW-9	08/13/03	14:05	Groundwater	SSPL VOCs and SVOCs	
GW-3698-81203-BC-10	MW-5D-95	08/12/03	16:20	Groundwater	SSPL VOCs and SVOCs	
GW-3698-81203-RR-005	MW-9D-01	08/12/03	13:15	Groundwater	SSPL VOCs and SVOCs	
GW-81203-BC-04	MW-10D-01	08/12/03	13:05	Groundwater	SSPL VOCs and SVOCs	
GW-3698-81303-RR-011	MW-11D-01	08/13/03	9:50	Groundwater	SSPL VOCs and SVOCs	
GW-3698-81303-BC-16	MW-12D-01	08/13/03	10:55	Groundwater	SSPL VOCs and SVOCs	
GW-3698-81203-BC-12	MW-13D-01	08/12/03	18:00	Groundwater	SSPL VOCs and SVOCs	
GW-3698-81203-RR-001	T-2	08/12/03	12:15	Groundwater	SSPL VOCs and SVOCs	
GW-3698-81203-RR-003	Rinse Blank	08/12/03	14:55	Water	SSPL VOCs and SVOCs	Rinse Blank

Notes:

MS	Matrix Spike.
MSD	Matrix Spike Duplicate.
SSPL	Site-Specific Parameter List.
SVOCs	Semi-Volatile Organic Compounds.
VOCs	Volatile Organic Compounds.

TABLE 2

SAMPLE HOLDING TIMES CRITERIA AND ANALYTICAL METHODS SUMMARY
SEMI-ANNUAL GROUNDWATER SAMPLING
FORMER LAGOON SITE
HAMPTONBURGH, NEW YORK
AUGUST 2003

Parameter	*Matrix*	*Analytical Method*	*VTSR to Extraction (Days)*	*VTSR to Analysis (Days)*
Volatiles [2]	Groundwater	95-4 [1]	-	10
Semi-Volatiles [3]	Groundwater	95-2 [1]	5	40

Notes:

[1] Referenced from New York State Department of Environmental Conservation (NYSDEC) Analytical Services Protocol (ASP), 10/95 Edition.

[2] Benzene, toluene, ethylbenzene, and xylenes.

[3] Pyridine, 2-aminopyridine, and alpha-picoline by Selective Ion Monitoring (SIM).

VTSR Verified Time of Sample Receipt.

TABLE 3

ANALYTICAL RESULTS SUMMARY
SEMI-ANNUAL GROUNDWATER SAMPLING
FORMER LAGOON SITE
HAMPTONBURGH, NEW YORK
AUGUST 2003

Sample Location:		*MW-1*	*MW-5D-95*	*MW-5U-95*	*MW-8U-95*	*MW-9D-01*	*MW-9U-01*	*MW-10D-01*	*MW-10U-01*
Sample ID:		*GW-3698-081203-RR-009*	*GW-3698-81203-BC-10*	*GW-81203-BC-06*	*GW-3698-81303-BC-14*	*GW-3698-081203-RR-005*	*GW-3698-081203-RR-007*	*GW-81203-BC-04*	*GW-81203-BC-02*
Sample Date:		*8/12/2003*	*8/12/2003*	*8/12/2003*	*8/13/2003*	*8/12/2003*	*8/12/2003*	*8/12/2003*	*8/12/2003*
Parameter	*Units*								
Volatiles									
Benzene	µg/L	1.00 UJ	1.00 UJ	1.00 UJ	1.74 J	2.36 J	1.00 UJ	1.00 UJ	1.00 UJ
Ethylbenzene	µg/L	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ
m&p-Xylene	µg/L	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ
o-Xylene	µg/L	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ
Toluene	µg/L	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ
Semi-Volatiles									
2-Aminopyridine	µg/L	1 U	1 U	1 U	69	4	1 U	1 U	1 U
2-Picoline	µg/L	1 U	1 U	1 U	0.4 J	0.3 J	1 U	1 U	1 U
Pyridine	µg/L	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U

Sample Location:		*MW-10U-01*	*MW-11D-01*	*MW-11U-01*	*MW-12D-01*	*MW-13D-01*	*SW-9*	*T-2*
Sample ID:		*GW-81203-BC-08*	*GW-3698-081303-RR-011*	*GW-3698-081303-RR-013*	*GW-3698-81303-BC-16*	*GW-3698-81203-BC-12*	*GW-3698-081303-RR-015*	*GW-3698-081203-RR-001*
Sample Date:		*8/12/2003*	*8/13/2003*	*8/13/2003*	*8/13/2003*	*8/12/2003*	*8/13/2003*	*8/12/2003*
		Duplicate						
Volatiles								
Benzene	µg/L	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	0.651 J	1.00 UJ
Ethylbenzene	µg/L	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ
m&p-Xylene	µg/L	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ
o-Xylene	µg/L	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ
Toluene	µg/L	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ	1.00 UJ
Semi-Volatiles								
2-Aminopyridine	µg/L	1 U	1 U	1 U	5	1 U	1	1 U
2-Picoline	µg/L	1 U	1 U	1 U	1 U	1 U	1 U	1 U
Pyridine	µg/L	1 U	1 U	1 U	1 U	1 U	1 U	1 U

Notes:

J Estimated.

U Non-detect at associated value.

UJ The analyte was not detected above the sample quantitation limit. The reported quantitation is an estimated quantity.

TABLE 4

QUALIFIED SAMPLE RESULTS DUE TO INADEQUATE PRESERVATION - TEMPERATURE
SEMI-ANNUAL GROUNDWATER SAMPLING
FORMER LAGOON SITE
HAMPTONBURGH, NEW YORK
AUGUST 2003

Parameter	*Analyte*	*Temp. Upon Receipt at Laboratory*	*Required Temperature*	*Associated Sample ID*	*Qualifier*
VOCs	All VOCs	15°C	4°C +/- 2°C	GW-81203-BC-02	UJ
				GW-81203-BC-06	UJ
				GW-81203-BC-08	UJ
				GW-3698-81203-BC-10	UJ
				GW-3698-081203-RR-001	UJ
				GW-3698-081203-RR-005	J/UJ
				GW-3698-081203-RR-007	UJ
				GW-3698-081203-RR-009	UJ
				GW-81203-BC-04	UJ
				GW-3698-81203-BC-12	UJ
				GW-3698-81303-BC-14	J/UJ
				GW-3698-81303-BC-16	UJ
				GW-3698-081303-RR-011	UJ
				GW-3698-081303-RR-013	UJ
				GW-3698-081303-RR-015	J/UJ

Notes:

C Celsius.
J Estimated.
Temp. Temperature.
UJ The analyte was not detected above the sample quantitation limit. The reported quantitation is an estimated quantity.
VOCs Volatile Organic Compounds.

TABLE 5

QUALIFIED SAMPLE RESULTS DUE TO OUTLYING SURROGATE RECOVERIES
SEMI-ANNUAL GROUNDWATER SAMPLING
FORMER LAGOON SITE
HAMPTONBURGH, NEW YORK
AUGUST 2003

Parameter	*Sample ID*	*Surrogate*	*Surrogate Recovery (percent)*	*Control Limits (percent)*	*Associated Compounds*	*Sample Result*	*Qualifier*	*Units*
VOCs	GW-3698-81203-BC-12	4-Bromofluorobenzene	72	80-120	Ethylbenzene	1.00 U	J	µg/L
					Toluene	1.00 U	J	µg/L
					Benzene	1.00 U	J	µg/L
					o-Xylene	1.00 U	J	µg/L
					m&p-Xylene	1.00 U	J	µg/L

Notes:

J Estimated.
U Non-detect at associated value.
VOCs Volatile Organic Compounds.

TABLE 6

QUALIFIED SAMPLE RESULTS DUE TO OUTLYING BLANK SPIKE RESULTS
SEMI-ANNUAL GROUNDWATER SAMPLING
FORMER LAGOON SITE
HAMPTONBURGH, NEW YORK
AUGUST 2003

Parameter	*BS Date*	*Analyte*	*Percent Recovery*	*Control Limits*	*Associated Sample ID*	*Sample Results (ug/L)*	*Qualifier*
SVOCs	08/14/03	2-Picoline	102	24-100	GW-3698-81303-BC-14	0.4	J
					GW-3698-081203-RR-005	0.3	J

Notes:
BS Blank Spike.
J Estimated.
SVOCs Semi-Volatile Organic Compounds.

ANALYTICAL DATA ASSESSMENT AND VALIDATION
SEMI-ANNUAL GROUNDWATER SAMPLING
FORMER LAGOON SITE
HAMPTONBURGH, NEW YORK
FEBRUARY 2004

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1.0 INTRODUCTION

The following document details an assessment and validation of analytical results reported by H2M Labs, Inc. (H2M) for groundwater samples collected at the Former Lagoon Site in Hamptonburgh, New York (Site) during February 2004. For sample identification, a sampling and analysis summary is presented in Table 1.

Samples were analyzed as specified in Table 1. A summary of the analytical methodology is presented in Table 2.

A summary of the analytical data is presented in Table 3. The quality assurance/quality control (QA/QC) criteria by which these data have been assessed are outlined in the analytical methods and the United States Environmental Protection Agency (USEPA) Region II Data Validation Standard Operating Procedures (SOP HW-6, Rev. 12, March 2001).

The Site-Specific Quality Assurance Project Plan (QAPP) (March 2001) was also utilized in the data assessment.

Deliverables as specified in the QAPP were provided by the laboratory for the analyses. The data quality assessment and validation presented in the following subsections were performed based on the sample results and supporting QA/QC provided.

2.0 SAMPLE HOLDING TIMES

The QAPP holding time criteria are summarized in Table 2.

All sample extractions and analyses were performed within the required holding times.

All samples were properly preserved and cooled after collection. All samples were received by the laboratory in good condition within 2 days of sample collection.

3.0 GAS CHROMATOGRAPH/MASS SPECTROMETER (GC/MS) TUNING AND MASS CALIBRATION - VOLATILES AND SEMI-VOLATILES

Prior to analysis, GC/MS instrumentation is tuned to ensure optimization over the mass range of interest. To evaluate instrument tuning, ASP Methods 95-4 and 95-2 require the

analysis of the specific tuning compounds bromofluorobenzene (BFB) and decafluorotriphenylphosphine (DFTPP), respectively. The resulting spectra must meet the criteria cited in the method before analysis is initiated. Analysis of the tuning compound must then be repeated every 12 hours throughout sample analysis to ensure the continued optimization of the instrument.

All instrument tuning data were reviewed. Tuning compounds were analyzed at the required frequency throughout the volatile organic compound (VOC) and semi-volatile organic compound (SVOC) analyses periods. All tuning criteria were met for the analyses, indicating proper optimization of the instrumentation.

4.0 INSTRUMENT CALIBRATION

4.1 GC/MS CALIBRATION - VOLATILES AND SEMI-VOLATILES

4.1.1 INITIAL CALIBRATION

To quantify compounds of interest in samples, calibration of the GC/MS over a specific concentration range must be performed. Initially, a minimum of a five-point calibration curve containing all compounds of interest is analyzed.

Linearity of the curve and instrument sensitivity were evaluated against the following criteria:

i) all relative response factors (RRFs) must be greater than or equal to 0.05; and

ii) percent relative standard deviation (%RSD) values must not exceed 30 percent.

The initial calibration data for VOCs and SVOCs were reviewed. All %RSDs met the above criteria for VOCs and SVOCs.

4.1.2 CONTINUING CALIBRATION

To ensure that instrument calibration is acceptable throughout the sample analysis period, continuing calibration standards must be analyzed and compared to the initial calibration curve every 12 hours.

The following criteria were employed to evaluate continuing calibration data:

i) all RRF values must be greater than or equal to 0.05; and

ii) percent difference (%D) values must not exceed 25 percent.

All RRFs and %Ds were acceptable.

5.0 SURROGATE SPIKE RECOVERIES

In accordance with the methods employed, all samples, blanks, and standards analyzed for VOCs and SVOCs were spiked with surrogate compounds prior to sample extraction and/or analysis. Surrogate recoveries provide a means to evaluate the effects of individual sample matrices on analytical efficiency. Surrogate recovery evaluations were performed as specified in the validation SOPs.

5.1 VOLATILES

All surrogate recoveries reported for the VOC analyses were within the method control limits, indicating good analytical efficiency.

5.2 SEMI-VOLATILES

All sample surrogate recoveries met the criteria, indicating good analytical efficiency.

6.0 INTERNAL STANDARD RECOVERIES - VOLATILES AND SEMI-VOLATILES

To ensure that changes in GC/MS response and sensitivity do not affect sample analysis results, internal standard compounds are added to all samples, blanks, and spike samples prior to VOC and SVOC analyses. All results are calculated as a ratio of the internal standard response. The criteria by which the internal standard results are assessed are as follows:

i) internal standard area counts must not vary by more than a factor of two (-50 percent to +100 percent) from the associated calibration standard; and

ii) the retention time of the internal standard must not vary more than ±30 seconds from the associated calibration standard.

All internal standard recoveries and retention times were acceptable, demonstrating good analytical performance.

7.0 LABORATORY BLANK ANALYSES

The purpose of assessing the results of laboratory blank analyses is to determine the existence and magnitude of sample contamination introduced during analysis. Laboratory blanks are prepared from deionized water and analyzed as samples.

For this study, laboratory blanks were analyzed at a minimum frequency of one per analytical batch.

7.1 VOLATILES

All blank results were non-detect for the VOCs of interest, indicating that contamination was not a factor for this analysis.

7.2 SEMI-VOLATILES

All blank results were non-detect for the SVOCs of interest, indicating that contamination was not a factor in this analysis.

8.0 BLANK SPIKE ANALYSES

Blank spikes are prepared and analyzed as samples to assess the analytical efficiencies of the method employed, independent of sample matrix effects. Blank spikes were performed for all analyses.

8.1 VOLATILES

All blank spike sample analyses yielded recoveries within the method control limits, indicating acceptable analytical accuracy.

8.2 SEMI-VOLATILES

Most blank spike sample analyses yielded recoveries within the control limits, indicating acceptable analytical accuracy. A high 2-picoline recovery was reported. All associated detected data were qualified as estimated (see Table 4).

9.0 MATRIX SPIKE/MATRIX SPIKE DUPLICATE (MS/MSD) ANALYSES - ORGANICS

The recoveries of MS/MSD analyses are used to assess the analytical accuracy achieved on individual sample matrices. The relative percent difference (RPD) between the MS and MSD is used to assess analytical precision.

The sample chosen for MS/MSD analyses is specified in Table 1.

9.1 VOLATILES

All recoveries and RPDs were acceptable, indicating good laboratory accuracy and precision.

9.2 SEMI-VOLATILES

All recoveries and most RPDs were acceptable, indicating good laboratory accuracy and precision. A high 2-aminopyridine RPD was reported. The associated sample result was non-detect and was not impacted by the indicated variability.

10.0 FIELD QA/QC

10.1 FIELD DUPLICATES

To assess the analytical and sampling protocol precision, one field duplicate (as identified in Table 1) was collected and submitted "blind" to the laboratory. All results demonstrated acceptable agreement.

10.2 RINSE BLANKS

To assess contamination from field equipment cleaning activities, a rinse blank was collected as identified in Table 1. All sample results were non-detect for the analytes of interest.

12.0 CONCLUSION

Based on the assessment detailed in the foregoing, the data produced by H2M are acceptable with the qualifications noted.

TABLES

TABLE 1

SAMPLE COLLECTION AND ANALYSIS SUMMARY
SEMI-ANNUAL GROUNDWATER SAMPLING
FORMER LAGOON SITE
HAMPTONBURGH, NEW YORK
FEBRUARY 2004

Sample Number	*Well ID*	*Date Collected*	*Time Collected*	*Sample Type*	*Analyses*	*Comments*
GW-021804-016	MW-1	02/18/04	11:00	Groundwater	SSPL VOCs and SVOCs	
GW-021704-008	MW-5U-95	02/17/04	14:55	Groundwater	SSPL VOCs and SVOCs	
GW-021804-020	MW-8U-95	02/18/04	14:15	Groundwater	SSPL VOCs and SVOCs	
GW-021704-RR-001	MW-9U-01	02/17/04	14:10	Groundwater	SSPL VOCs and SVOCs	MS/MSD
GW-021704-002	MW-10U-01	02/17/04	12:00	Groundwater	SSPL VOCs and SVOCs	
GW-021704-004	MW-10U-01	02/17/04	12:10	Groundwater	SSPL VOCs and SVOCs	Field Duplicate
GW-021804-RR-005	MW-11U-01	02/18/04	09:15	Groundwater	SSPL VOCs and SVOCs	
GW-021804-RR-009	SW-9	02/18/04	13:25	Groundwater	SSPL VOCs and SVOCs	
GW-021704-010	MW-5D-95	02/17/04	16:35	Groundwater	SSPL VOCs and SVOCs	
GW-021704-RR-003	MW-9D-01	02/17/04	16:00	Groundwater	SSPL VOCs and SVOCs	
GW-021704-006	MW-10D-01	02/17/04	13:35	Groundwater	SSPL VOCs and SVOCs	
GW-021804-RR-007	MW-11D-01	02/18/04	10:40	Groundwater	SSPL VOCs and SVOCs	
GW-021804-011	MW-12D-01	02/18/04	15:35	Groundwater	SSPL VOCs and SVOCs	
GW-021804-018	MW-13D-01	02/18/04	12:40	Groundwater	SSPL VOCs and SVOCs	
GW-021804-014	T-2	02/18/04	08:20	Groundwater	SSPL VOCs and SVOCs	
GW-021804-012	Rinse Blank	02/18/04	07:30	Water	SSPL VOCs and SVOCs	Rinse Blank

Notes:

MS	Matrix Spike.
MSD	Matrix Spike Duplicate.
SSPL	Site-Specific Parameter List.
SVOCs	Semi-Volatile Organic Compounds.
VOCs	Volatile Organic Compounds.

TABLE 2

SAMPLE HOLDING TIMES CRITERIA AND ANALYTICAL METHODS SUMMARY
SEMI-ANNUAL GROUNDWATER SAMPLING
FORMER LAGOON SITE
HAMPTONBURGH, NEW YORK
FEBRUARY 2004

Parameter	*Matrix*	*Analytical Method*	*VTSR to Extraction (Days)*	*VTSR to Analysis (Days)*
Volatiles [2]	Groundwater	95-4 [1]	-	10
Semi-Volatiles [3]	Groundwater	95-2 [1]	5	40

Notes:

(1) Referenced from New York State Department of Environmental Conservation (NYSDEC) Analytical Services Protocol (ASP), 10/95 Edition.

(2) Benzene, toluene, ethylbenzene, and xylenes.

(3) Pyridine, 2-aminopyridine, and alpha-picoline by Selective Ion Monitoring (SIM).

VTSR Verified Time of Sample Receipt.

TABLE 3

ANALYTICAL RESULTS SUMMARY
SEMI-ANNUAL GROUNDWATER SAMPLING
FORMER LAGOON SITE
HAMPTONBURGH, NEW YORK
FEBRUARY 2004

Location:	*MW-1*	*MW-5D-95*	*MW-5U-95*	*MW-8U-95*	*MW-9D-01*	*MW-9U-01*	*MW-10D-01*	*MW-10U-01*
Sample Name:	*GW-021804-016*	*GW-021704-010*	*GW-021704-008*	*GW-021804-020*	*GW-021704-RR-003*	*GW-021704-RR-001*	*GW-021704-006*	*GW-021704-002*
Sample Date:	*02/18/2004*	*02/17/2004*	*02/17/2004*	*02/18/2004*	*02/17/2004*	*02/17/2004*	*02/17/2004*	*02/17/2004*
Parameter	*Units*							
Volatiles								
Benzene	µg/L	1U	1U	1U	2	2	1U	1U	1U
Ethylbenzene	µg/L	1U	1U	1U	1U	1U	1U	1U	1U
m&p-Xylene	µg/L	2U	2U	2U	2U	2U	2U	2U	2U
o-Xylene	µg/L	1U	1U	1U	1U	1U	1U	1U	1U
Toluene	µg/L	1U	1U	1U	1U	1U	1U	1U	1U
Semi-Volatiles								
2-Aminopyridine	µg/L	1U	1U	1U	1U	23	1U	1U	1U
2-Picoline	µg/L	1U	1U	1U	0.6J	0.6J	1U	1U	1U
Pyridine	µg/L	1U	1U	1U	1U	1U	1U	1U	1U

Location:	*MW-10U-01*	*MW-11D-01*	*MW-11U-01*	*MW-12D-01*	*MW-13D-01*	*SW-9*	*T-2*
Sample Name:	*GW-021704-004*	*GW-021804-RR-007*	*GW-021804-RR-005*	*GW-021804-011*	*GW-021804-018*	*GW-021804-RR-009*	*GW-021804-014*
Sample Date:	*02/17/2004*	*02/18/2004*	*02/18/2004*	*02/18/2004*	*02/18/2004*	*02/18/2004*	*02/18/2004*
	Duplicate						
Volatiles							
Benzene	µg/L	1U	1U	1U	1U	1U	1U	1U
Ethylbenzene	µg/L	1U	1U	1U	1U	1U	1U	1U
m&p-Xylene	µg/L	2U	2U	2U	2U	2U	2U	2U
o-Xylene	µg/L	1U	1U	1U	1U	1U	1U	1U
Toluene	µg/L	1U	1U	1U	1U	1U	1U	1U
Semi-Volatiles								
2-Aminopyridine	µg/L	1U	1U	1U	1U	1U	3	1U
2-Picoline	µg/L	1U	1U	1U	1U	1U	1U	1U
Pyridine	µg/L	1U	1U	1U	1U	1U	1U	1U

Notes:
J Estimated.
U Non-detect at associated value.

TABLE 4

QUALIFIED SAMPLE RESULTS DUE TO OUTLYING BLANK SPIKE RECOVERIES
SEMI-ANNUAL GROUNDWATER SAMPLING
FORMER LAGOON SITE
HAMPTONBURGH, NEW YORK
FEBRUARY 2004

Parameter	*Analyte*	*BS Recovery (percent)*	*Control Limits (percent)*	*Associated Sample ID*	*Sample Result (ug/L)*	*Qualifier*
SVOCs	2-Picoline	119	24-100	GW-021704-RR-003	0.6	J
				GW-021804-020	0.6	J

Notes:
BS Blank Spike.
J Estimated.
SVOCs Semi-Volatile Organic Compounds.