Memorandum

TO: Kurt Erichsen, TMACOG

DATE: October 30, 2001

COPIES: Phil Williams, OEPA

FROM: Victor Bierman and Wendy Larson

SUBJECT: Ecological and Human Health Risk Assessment Reports; Ottawa River

LTI is pleased to submit the two enclosed reports for the Ecological Risk Assessment (ERA) and the Human Health Risk Assessment (HHRA) for the Ottawa River. These reports are the product of more than 20 months of effort on the part of the Limno-Tech, Inc. (LTI) Team, with significant input and support from TMACOG and OEPA. We have incorporated the comments we received on the draft reports, which were submitted in July, 2001. A separate document provides responses to each of the comments received.

This cover memo puts these reports in the context of the overall Ottawa River Environmental "Hot Spot" Delineation and Risk Assessment project by: stating the project goals; summarizing the principal project tasks; summarizing the approaches and major findings of both risk assessment reports; and providing initial recommendations for next steps. This document was prepared to provide a general overview and synthesis of both risk assessments. Please note that a careful read of both of the attached reports is essential for a complete understanding of the approach and results.

I. PROJECT GOALS

The Scope of Work states that the project goals are to "assess the risks posed by existing conditions in the river, and to use this information to prioritize areas for remediation" (LTI, et al., 2000).

II. SUMMARY OF PRINCIPAL PROJECT TASKS

The Ottawa River Environmental "Hot Spot" Delineation and Risk Assessment project involved the following principal project tasks:

A. Database Development

The initial project task was to develop a database that includes all data that are relevant to the risk assessment work. The Ottawa River database that was developed under this project is a "living database;" that is, it can be used for other purposes as efforts on the Ottawa progress, and it can be continuously updated with new data.

LTI first obtained all Ottawa River data sets from recent years and evaluated the data with respect to the needs of the ecological and human health risk assessments. These data included chemical concentrations in sediment, fish and water, as well as several bioassay and other studies. Before database development was implemented, a Quality Assurance Project Plan (QAPP) for data entry, processing, and follow-up procedures was prepared

(LTI, 2000b). A data inventory was then prepared and distributed to team members (LTI, 2000c). An initial relational database (LTI, 2000d) was then developed, incorporating all data sets determined by the project team to be relevant to the risk assessments, and following the procedures outlined in the QAPP. A memorandum describing existing conditions was then prepared by LTI (LTI, 2000e), utilizing the database and by creating Geographical Information System (GIS) maps to illustrate the spatial distribution of contaminants in the river.

This information on existing data was then assessed by the project team, and data gaps were identified. These gaps were described in three memoranda outlining detailed recommendations for additional sampling (LTI 2000f, Parametrix 2000a, and Intertox 2000a). The recommendations were discussed with TMACOG team members, and concerns related to resource limitations were discussed. Due to these limitations, the project team was asked to use existing data as much as possible. The outcome of this dialog was a reduced and prioritized list of additional data needs. There was recognition by team members that the sampling plan would not completely address the identified data gaps and would be driven in part by resource limitations.

Sampling plans for summer and fall 2000 surveys were then developed by OEPA. LTI worked closely with OEPA to identify sampling locations with the highest anticipated exposure to humans and/or aquatic life. After these data were collected, they were incorporated in the database (Version 1.2), and a final database report was prepared (LTI, 2001a and b). The final Ottawa River database has been provided to TMACOG and OEPA, and these and other parties can update the database with new data in the future, and is available to use for other purposes if desired.

B. Screening Level Risk Assessments

Screening level risk assessments were conducted for ecological and human health by Parametrix and Intertox, respectively. After the database was completed, Parametrix and Intertox each prepared memoranda describing their proposed approaches for conducting the risk assessments, based on available data and information at the time (Parametrix, 2000b and Intertox, 2000b). The interim reports provided the TMACOG team with the opportunity for input to the risk assessment approach before work was begun. Draft reports were reviewed by the TMACOG team, and comments from reviewers were received and addressed.

C. Presentation of Findings

In addition to the written reports described in the previous section, the findings of the risk assessment work have been and will continue to be communicated to the TMACOG team and other interested parties through several channels. With the exception of the final bullet, these tasks are outside of the original scope of work.

- Dr. Victor Bierman of LTI participated in a meeting with the Ottawa River Remediation Team in November 2000, where he discussed the ongoing project work with team members.

- This memo provides an overview of the entire project, as well as a synthesis and interpretation of both risk assessment study results.

- LTI will participate in a meeting with the Maumee RAP Team in September 2001. The purpose of the meeting will be to discuss and plan for the upcoming public information meeting in November.

- LTI staff will give a presentation on the project at a public information meeting in November 2001.

III. RISK ASSESSMENT FINDINGS

The attached reports describe screening level risk assessments for human and ecological health. It is important to understand the results of these assessments in the context of the methods and assumptions that were used, as well as the data that were available. A brief definition of a screening level risk assessment is provided below, followed by a general overview of the approaches that were used. This information is provided in this memo to provide a framework for the reported findings, and the reader is referred to the reports for essential details.

A. Definition of Screening Level Risk Assessment

Screening level risk assessments are often used as the first tier of the risk assessment process. Conservative assumptions regarding stressor exposure levels (chemical concentrations in sediment, for example) and effects on receptors (such as humans or bald eagles) are used to eliminate stressors or locations from further evaluation. Stressors and locations showing potential risk should be evaluated further using additional site-specific information and more realistic assumptions, where possible. In other words, a screening level risk assessment can support that a particular contaminant in a specific location poses little or no risk to the selected receptors, or it can support potential risk and point to the need for additional data and information.

Screening level assessments are based on multiple conservative assumptions related to chemical exposure and toxicity.

Some examples from the ecological risk assessment:

- o Chronic exposure concentrations were estimated using the 95 percent upper confidence limit (UCL) on the mean, and acute exposure concentrations were estimated using the 95th percentile of the data.

- Wildlife receptors receive 100% of their chemical dose from an individual river segment. In reality, wildlife have a larger home range and are not exposed only to chemicals in a particular reach.

- All chemicals in each medium were assumed to be completely absorbed following ingestion.

- Fish-eating receptors were assumed to feed exclusively on fish.

- Some examples from the human health risk assessment:

  - Upperbound exposures for anglers were estimated assuming that a person eats about 60 meals per year of fish caught from the Lower Ottawa River. These estimates are based on data for people who fish in Lake Michigan; consumption rates of fish from the Lower Ottawa River for most people are likely to be lower.

  - Upperbound exposures for recreators were estimated assuming that adults submerge themselves in river water during 24 events per year for 3 hours per event, and that children and adolescents submerge themselves in river water during 48 events per year for 3 hours per event.

  - All chemicals in each medium were assumed to be completely absorbed following ingestion.

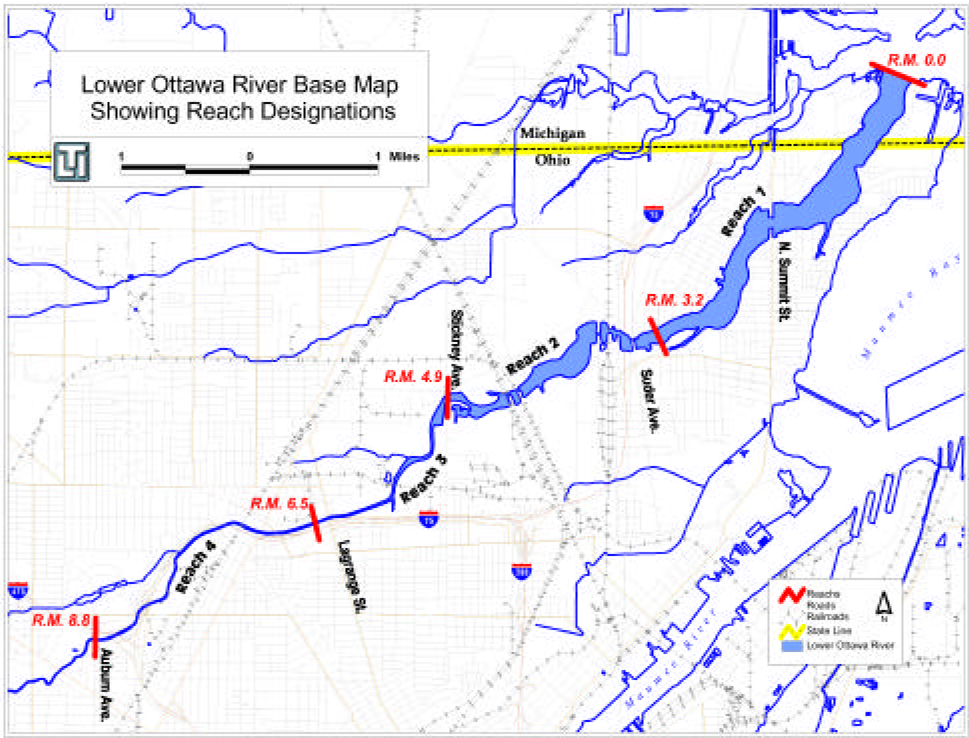
These conservative assumptions result in a screening level risk assessment that is likely to over- rather than under predict risk potential. If the screening level assessment does not support potential risk in a particular reach, efforts can be directed at other reaches where potential risk was identified. Caution should be used in interpreting the findings of a screening level risk assessment because of these conservative assumptions, and further study is generally recommended in reaches where potential risks are identified.

B. General Risk Assessment Approach

The description of methods provided in this memo is limited to basic information and key definitions of terminology so that the findings can be understood. The attached reports provide summaries as well as detailed descriptions of the approaches used in the risk assessments. Figure 1 illustrates U.S. EPA's framework for risk assessments as applied to ecological risk assessments. This is similar to the framework for human health risk assessments. For a detailed diagram of the risk assessment process, the reader is referred to Figures E-2 and 3-1 and related text in the Ecological and Human Health Risk Assessment reports, respectively.

Separate evaluations were conducted for each of four river segments, identified based on flow characteristics and river use patterns. These segments were Segment 1, extending from the river mouth to River Mile (RM) 3.2; Segment 2, extending from RM 3.2 to RM

4.9; Segment 3, extending from RM 4.9 to 6.5; and Segment 4, extending from RM 6.5 to RM 8.8. These are shown in the base map of the Lower Ottawa River below.



An early step in both risk assessments was to identify chemicals detected in site media that are likely to be of greatest toxicological significance. These chemicals were identified and selected for analysis in the risk assessments. They are referred to as Chemicals of Interest (COI) in the human health risk assessment, and Chemicals of Potential Concern (COPC) in the Ecological Risk Assessment. Representative receptors were also identified. The human health risk assessment assessed risks to one receptor (humans), but considered two types of individuals; those who catch and consume fish, and those who recreate in the river. The ecological risk assessment assessed risks to multiple wildlife and aquatic receptors.

For both the ecological and human health risk assessments, potential risk was then estimated for each chemical/receptor pair for each segment. In the real world, receptors are exposed to chemicals through multiple routes of exposure. For example, a human may be exposed to a multiple chemicals through consumption of fish, direct contact with sediments and water, and/or drinking the water. While these individual risks are not additive, a conservative assumption of additivity can in some cases be assumed to understand relative risks. This is discussed further in the following section.

Human Health Risk Assessment

Two populations were evaluated: people who fish in the river and consume the fish (angler scenario), and people who recreate in the river (recreator scenario). These scenarios are evaluated for individuals who are "reasonably maximally exposed" (RME) and individuals who have an average, or "central tendency" (CT) exposure. Cancer and non-cancer risks were estimated for each of these scenarios.

For the human health risk assessment, cancer risk is estimated in terms of the probability of cancer occurring as the result of exposure at some point during an individual's lifetime. This risk is in excess of the probability of cancer without exposure. Estimated cancer risk is described as a probability, such as $1x10^{-4,}$ which is equal to a 1 in 10,000 chance of getting cancer. This risk can be compared to U.S. EPA's acceptable levels of risk under the Superfund program and other guidelines. For known or suspected risks, U.S. EPA generally considers upper-bound excess cancer risks to an RME individual of $1x10^{-6}$ to $1x10^{-4}$ (1 in 1,000,000 to 10,000) to be acceptable. The $1x10^{-6}$ (1 in a million) risk level is typically considered the "point of departure" for establishing remediation goals at contaminated sediment sites. Risks less than 1 in a million are nearly always considered acceptable, whereas risks greater than 1 in 10,000 are nearly always considered unacceptable.

Noncancer health effects are estimated by computing a Hazard Index (HI). An HI of one is the reference level established by USEPA above which concerns about non-cancer health effects should be evaluated further. Cancer risks and Hazard Indices are first estimated separately for each receptor exposed to each chemical of interest. For the Ottawa River human health risk assessment, these values were then added to estimate a total risk for each receptor.

Ecological Risk Assessment

Potential risks to wildlife and aquatic life were estimated, based on chemistry data for surface water, tissue and sediment, and other data such as bioassay results. Risks were estimated by computing a Hazard Quotient (HQ). An HQ less than 1.0 suggests that a receptor is not at risk, while an HQ greater than 1.0 suggests that a receptor may be at risk. It is not possible to reasonable differentiate chemicals as posing low, moderate, or high potential risk for those with HQs greater than 1.0, because the conservatism in the data and assumptions used are chemical specific. As a general guideline, however, HQs greater than 10 likely suggest a high potential risk.

For the Ottawa River ecological risk assessment, the estimated HQs were presented separately, and not added together, because assuming additivity presents an additional very conservative assumption when multiple receptors and chemicals are involved. However, the HQs were added together for this overview memo and presented in the discussion below. Assuming additivity for both the human health and ecological risk assessments is consistent with the conservative assumptions in a screening level assessment, and it contributes to a consistent, "big picture" understanding of both sets of results. This also provides consistency between the HI and HQ values in this cover document.

C. Overview of Findings

Both risk assessment studies identify potential risks to some receptors in all reaches of the Ottawa River. The findings are summarized separately below. The reader is referred to the attached reports for more detail and discussion.

<u>Human Health Risk Assessment</u>

- Lifetime excess cancer risks to individuals who catch and consume fish in the Ottawa River from all reaches may be significant.

- Most fish in the river of the size and species likely to be caught for human consumption have concentrations exceeding Great Lakes Fish Advisory Task Force advisories for limited consumption (e.g., one meal every two months). Consequently, consumption of any fish from the Lower Ottawa River is not recommended.

- In general, cancer risks and hazards of noncarcinogenic effects associated with recreational contact with Lower Ottawa River surface waters and sediments are not likely to be significant. However, for some chemicals, estimated risks due to exposure to sediments and surface water are highly uncertain because their limits of detection exceed risk-based concentrations.

- Estimated cancer risks and noncancer hazards did not vary significantly between the four segments.

- Other studies have shown that high levels of bacteria occur often in segments 2, 3, and 4 that are above river mile 3.2. Recreational use there is seldom safe due to the potential for exposure to infectious agents. Unacceptable bacteria levels are much less frequent in segment 1 (RM 0.0 to RM 3.2) but are most likely to occur during and within 24 hours of rain events that result in storm and sanitary sewer discharges to the river.

Figures 2 (a,b) and 3 illustrate the human health risk assessment results for the RME angler scenario. These figures are included in this memo because risks due to fish consumption under the angler scenario were high in comparison to the recreator scenario. The estimated risks for the recreator scenario were found to be considerably lower, and the report provides a detailed discussion of the results of this scenario, with figures. Figures 2 (a,b) and 3 are discussed below:

- Figure 2a shows estimated cancer risks for the RME angler scenario. In every reach, estimated risks exceed U.S. EPA's acceptable risk range, and risks are driven largely by exposure to fish tissue concentrations.

- Figure 2b shows contributions of COIs to these total estimated cancer risks, indicating that PCBs in fish are clearly the major driver of human health risk.

- Figure 3 shows estimated non-cancer risks for the RME angler scenario. This figure shows that potentially unacceptable non-cancer hazards were estimated for all segments. These non-cancer risks are due almost entirely to PCBs in fish tissue.

<u>Ecological Risk Assessment</u>

- Lead and PCBs were consistently identified as Chemicals of Potential Concern (COPC) for both wildlife receptors and aquatic life. Lead and PCB hot spots were not co-located, suggesting different sources, and possible transport, within the river.

  - Lead was primarily identified due to its concentrations in sediment, but concentrations in fish tissue also reached levels that have been shown in the laboratory to be toxic to fish.

  - Potential risks to wildlife due to PCBs were primarily due to PCB concentrations in fish tissue and risks to aquatic life were primarily due to sediment PCB concentrations. Potential risks were fairly similar across multiple river segments.

- Segment 3 (RM 4.9 to 6.5) poses the greatest potential to all wildlife receptors. Potential risks were also identified in the other river segments, but at lower levels. In general, the lowest potential risk for wildlife receptors was identified in Segment 1 at the mouth of the Ottawa River (RM 0 to 3.2).

- RM 4.9-6.5 represents a potential hot spot for metal contamination. Data collected at RM 5.5 showed metals concentrations (including lead) that were significantly elevated.

- The potential risks posed by polycyclic aromatic hydrocarbons (PAHs) to bottom-dwelling aquatic organisms are uncertain. Observed fish deformities could be due to the presence of PAHs in sediment, and further investigation may be warranted.

- Biological monitoring results support that fish and macroinvertebrate communities are being impacted.

The reader is referred to the figures in the report for results for individual receptors and chemicals. Figure 4 in this memo is an example of one such figure showing chronic HQs for terns feeding in the Ottawa River. The figure shows that potential risk (HQ>1) was estimated in all reaches, primarily due to PCB and lead and DDT concentrations. Results support a high potential risk due to PCBs (HQ>10) in Segments 2, 3, and 4. Similar figures can be found in the report for other receptors.

Figures 5a and 5b provide a visual summary of the ecological risk assessment results. In order to create these figures, the individual HQs greater than 1.0 were added together. This is consistent with the approach used in the human health risk assessment, and allows a means of communicating the results in the simplest possible way to gain a "big picture" understanding. While the results should be interpreted with caution because assuming additivity is a conservative assumption, they do allow a relative comparison of the estimated risks by segment, and they show contributions from the identified COPCs.

- To identify river segments posing the greatest potential risk, all chemical HQs greater than 1.0 (i.e., the risk drivers) were summed by river segment and wildlife receptor (Figure 5a). As shown, Segment 3 (RM 4.9 to 6.5) poses the greatest potential to all wildlife receptors. Potential risks were also identified in the other river segments, but at lower levels. In general, the lowest potential risk for wildlife receptors was identified in Segment 1 at the mouth of the Ottawa River (RM 0 to 3.2).

- Figure 5b shows the contributions by COPCs to total potential risk in all segments. Lead and PCBs are identified as the primary drivers of potential risk in all segments. For example, benthic organisms are sensitive to the high lead concentrations observed in sediments in Segment 3.

IV. RECOMMENDATIONS

The attached reports provide recommendations including additional data needs to reduce uncertainty in the risk assessments. These are summarized below. Additional recommendations related to the overall assessment and remediation process are included in Section C below.

A. Human Health Risk Assessment

- Continue efforts to prohibit consumption of fish from the Lower Ottawa River due to significant estimated lifetime excess cancer risks and noncancer hazards associated with exposure to PCBs in fish in all four river segments.

- Further investigate chemicals identified infrequently or not detected in water and sediment with detection limits that exceeded risk-based concentrations to reduce uncertainties about the actual concentrations of these chemicals.

B. Ecological Risk Assessment

- Conduct temporally and spatially co-located chemistry sampling for the COPCs, with bioassays using more sensitive (chronic) effect endpoints.

- Conduct additional core sampling in the reach from RM 4.9 to 6.5 to further characterize the extent and distribution of PCBs and metals (particularly lead concentrations). The additional sampling for PCBs should provide good coverage in the vicinity of the former mouth of the unnamed tributary.

C. Overall Ottawa River Assessment and Remediation

- Identify and quantify any remaining external sources of key contaminants identified in these risk assessments.

- Use the 1998 sediment core data to identify and map hotspots and localized areas in terms of total PCB mass.

- Conduct additional sampling to better characterize the spatial distributions of surface bioavailable concentrations of PCBs and metals in all river segments.

- Combine information on spatial distributions of total PCB mass with the recommended additional data on spatial distributions of surface bioavailable PCB concentrations to identify high priority areas for remediation within the larger river segments.

- Assess the transport, movement and fate of the identified contaminants within the Ottawa River system.

- Assess the movement of contaminants between the Lower Ottawa River and Lake Erie, including the impact of seiching.

PROJECT DELIVERABLES

Intertox. 2000a. Analysis of Data Gaps and Data Needs for Ottawa River "Hot Spot" Delineation and Risk Assessment. Memo from Gretchen Bruce to Wendy Larson, LTI. May 8.

Intertox. 2000b. Methods for Conducting the Screening-Level Human Health Risk Assessment for the Lower Ottawa River, Ohio. November 13.

LTI, Parametrix and Intertox. 2000. Proposal for the Ottawa River Environmental "Hot Spot" Delineation and Risk Assessment. Submitted to TMACOG. January 25.

LTI 2000a. Addendum to Proposal for the Ottawa River Environmental "Hot Spot" Delineation and Risk Assessment. Submitted to TMACOG. February.

LTI. 2000b. Quality Assurance Project Plan; Database Development for the Ottawa River, Ohio. March 3.

LTI. 2000c. Draft Data Inventory for the Ottawa River. Memo from Wendy Larson to TMACOG Team. March 13.

LTI. 2000d. Ottawa River, Ohio; Database and Database Report Version 1.0. April 12.

LTI. 2000e Memorandum on Evaluation of Existing Conditions. April 25.

LTI. 2000f. Identification of Data Gaps for the Ottawa River Risk Assessments. May 8.

LTI. 2001a. Ottawa River, Ohio; Database Version 1.2. February 5.

LTI. 2001b. Ottawa River, Ohio; Database Report Version 1.2. February 5.

Parametrix. 2000a. Data Needs Summary. Memo from Sue Robinson and David DeForest to Wendy Larson, LTI. May 8.

Parametrix. 2000b. Methods for Screening Ecological Risk Potential in the Lower Ottawa River, Ohio. November 13.

Figure 1. Framework for Ecological Risk Assessment

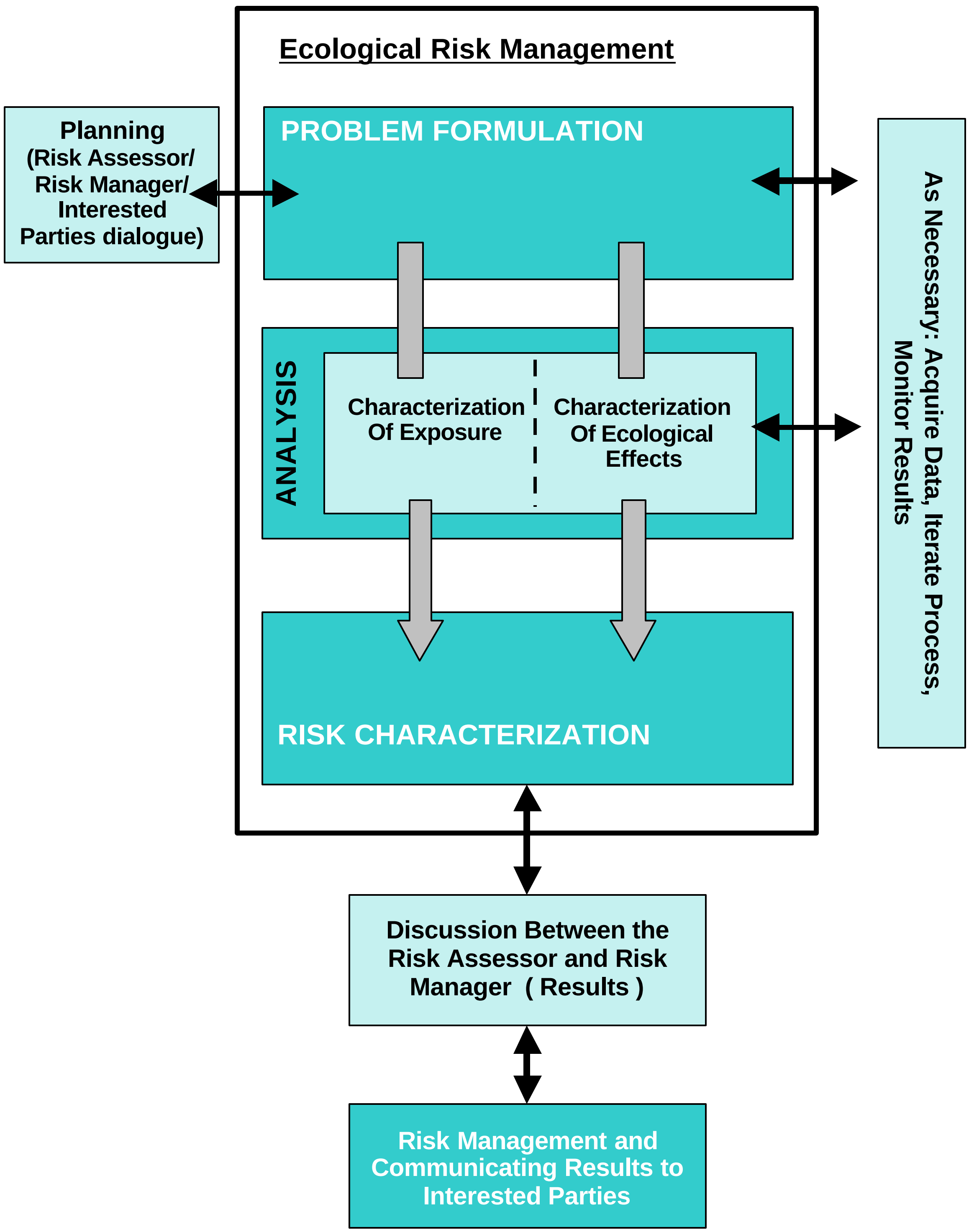


Figure 2a. Estimated Cancer Risks for the RME Angler Scenario, Lower Ottawa River Human Health Risk Assessment

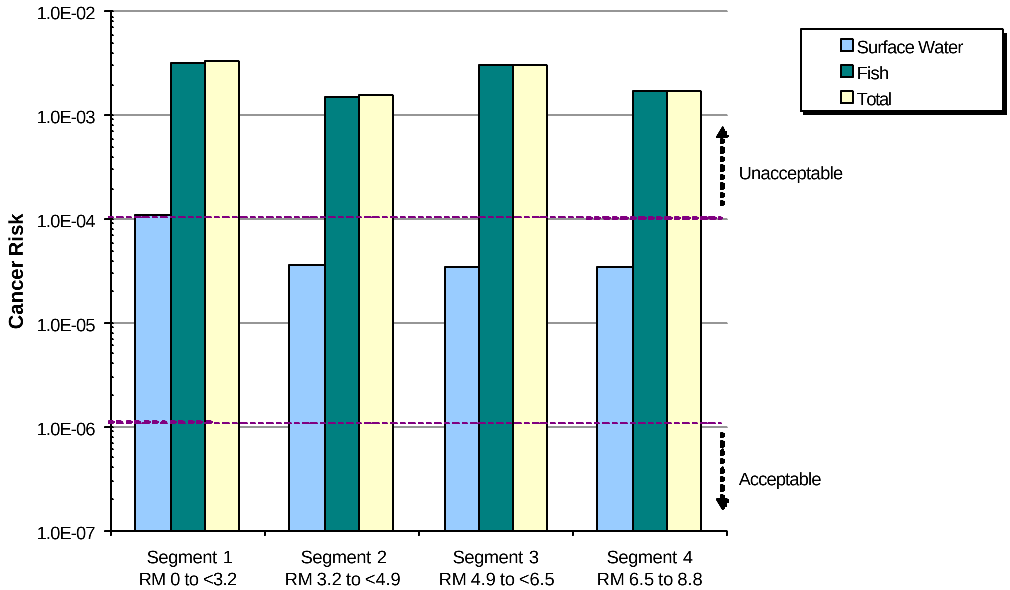


Figure 2b. Contribution of COIs to Total Estimated Cancer Risks for Fish Consumption, RME Angler Scenario, Lower Ottawa River HHRA

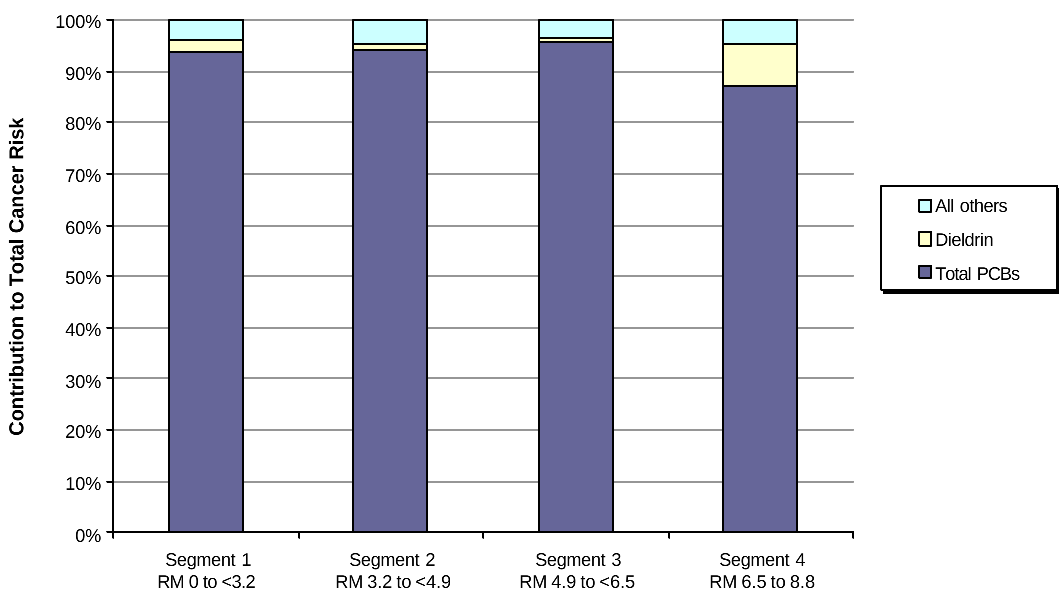


Figure 3. Estimated Noncancer Hazards for the RME Angler Scenario, Lower Ottawa River Human Health Risk Assessment

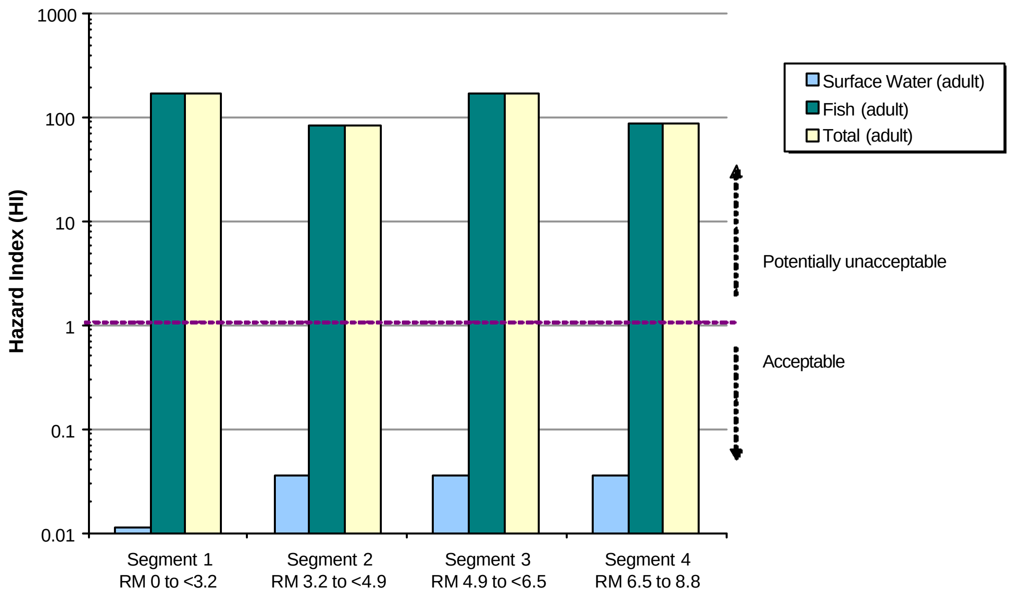


Figure 4. Chronic hazard quotients for terns feeding in the Ottawa River.

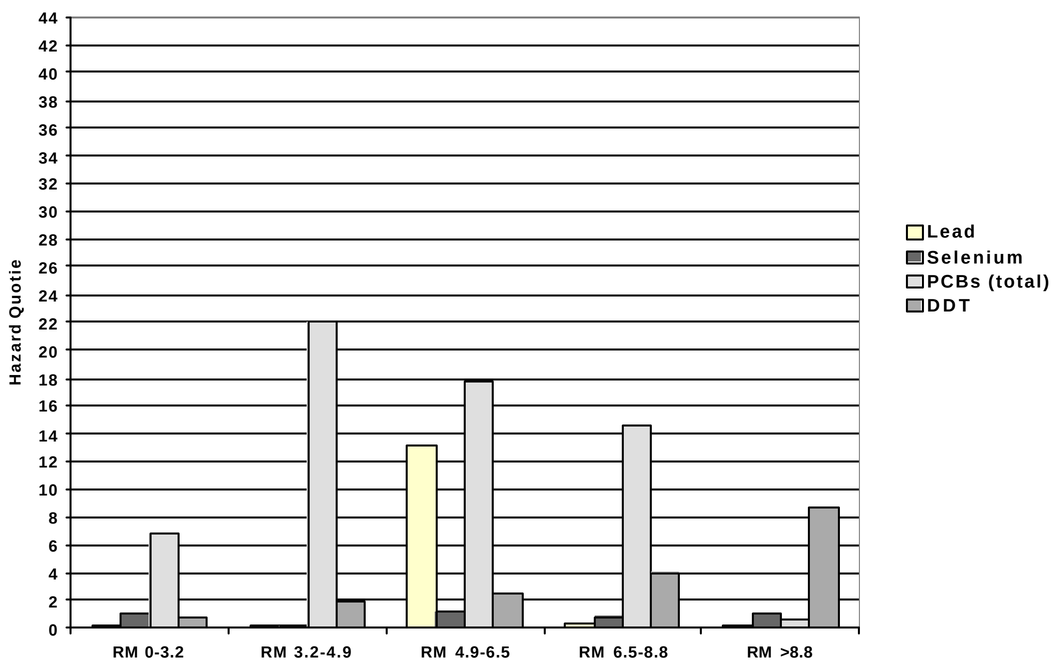
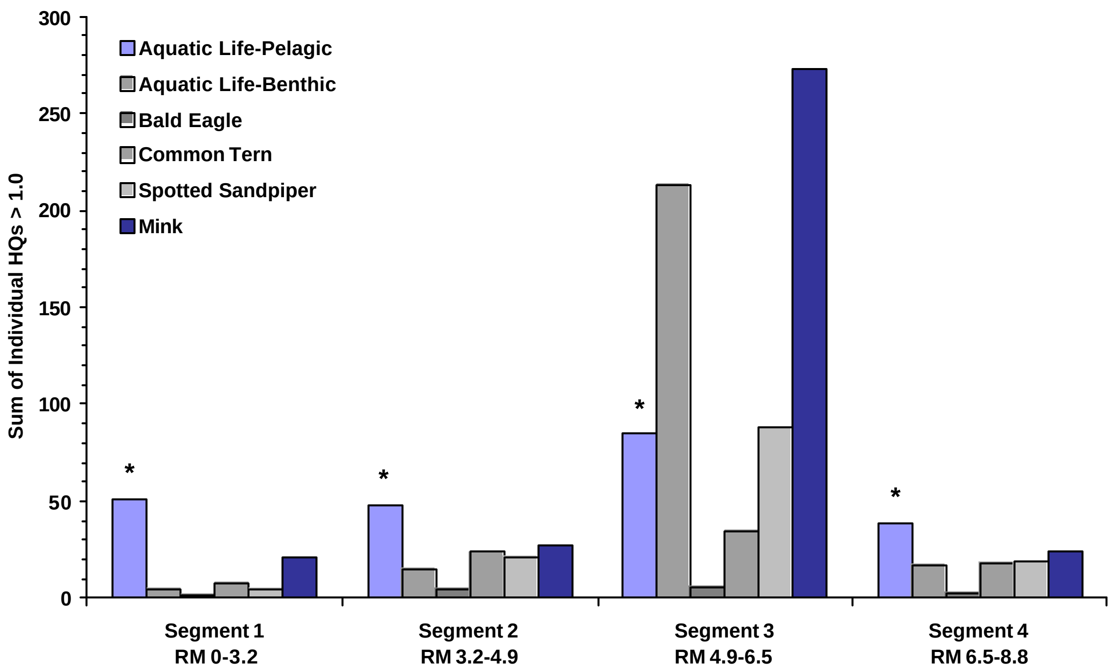


Figure 5a. Ecological Hazard Quotient Comparison by River Segment



* Pelagic aquatic life HQs driven by ubiquitous metals and are likely extremely conservative.

Figure 5b. Percent Contribution of Lead and PCB HQs to Total Sum of HQs