Peer Review of the Remedial Investigation and Data Management Reports for the Lower Fox River Natural Resources Damage Assessment

The Wisconsin Department of Natural Resources (WDNR) is currently studying the environmental conditions of the Lower Fox River Natural Resources Damage Assessment Site. As part of this study, EcoChem, Inc. and ThermoRetec Consulting Corporation submitted a Data Management Summary Report in December 1998, and ThermoRetec Consulting Corporation and Natural Resource Technology, Inc. submitted a Draft Remedial Investigation Report in February 1999. These studies were conducted under the direction of WDNR, with funding and technical assistance from the United States Environmental Protection Agency (U.S. EPA) Region V. U.S. EPA subsequently contracted Roy F. Weston, Inc. (WESTON) to establish an independent panel comprised of Dr. Nancy C. Rothman of New Environmental Horizons, Inc., Dr. Jack Adams of Applied Biosciences, and Mr. David Templeton, of Anchor Environmental, L.L.C. to review this effort. The panel was moderated by Ms. Nancy Musgrove of WESTON. This panel was given two specific charges:

1. Determine if data are of sufficient quality (i.e., do they meet QA/QC requirements) to support an RI/FS. If not, identify major deficiencies and provide specific recommendations.

2. Determine if there is sufficient quantity of useable data to complete the RI/FS. If not, identify major deficiencies and provide specific recommendations.

To provide additional focus to these charges, the experts further refined the questions to address the end use of the information:

- Are data adequate (in terms of quality and quantity) to support the need for a cleanup action?

- Are data adequate to determine the distribution of contaminants (i.e., can it be decided where cleanups should take place)?

- Are data adequate to support identification and selection of a remedy?

BACKGROUND

The Fox River Natural Resources Damage Assessment Site consists of 39 miles of the Lower Fox River from Lake Winnebago to Green Bay. In 1954, Fox River Valley paper mills began manufacturing carbonless copy paper coated with a polychlorinated biphenyl (PCB) emulsion. PCBs were released to the environment through manufacture, de-inking and recycling of carbonless paper. The use of PCBs in carbonless paper manufacture ceased in 1971; however, PCBs continued to be detected in the river water, sediment, and in many fish and bird species in the Lower Fox River.

In February 1999, a series of draft documents for the Lower Fox River Natural Resource Damage Assessment were prepared for the WDNR by ThermoRetec Consulting Corporation, Inc. Reports included the Remedial Investigation Report (RI), a Data Management Summary Report, a Human Health Risk Assessment Report, an Ecological Risk Assessment Report, and a Feasibility Study (FS). The reports were based on selected sediment and water analytical data collected between 1989 and 1998 along the entire 39-mile project area.

Generally, data evaluation showed that the Lower Fox River sediments are impacted by a wide range of toxic substances including PCBs and heavy metals. The extent of the pollution can best be described as widespread lower levels of contamination with localized hot spots in both surface and subsurface sediment deposits that have the potential to be transported downstream via various mechanisms. The WDNR reports divide the river into four reaches, each with many contaminated sediment deposits:

Reach	Sediment Deposit
Little Lake Butte des Morts	A,B,C,POG,D,E,F,G,H
Appleton to Little Rapids	I,J,K,L,M,N,O,P,Q,R,S,T,U,V,W,X,Y,Z, AA,BB,CC,DD
Little Rapids to De Pere	EE,FF,GG,HH
De Pere to Green Bay	SMUs 20-115

APPROACH

Methods used to conduct a peer review of the Draft RI: Lower Fox River, Wisconsin and the Data Management Summary Report: Lower Fox River RI/FS documents are summarized below:

- Establish project purpose and scope – provided by U.S. EPA through Roy F. Weston, Inc.
- Screen primary documents.
- Identify supporting documents and information required for peer review.
- Review primary and supporting documents and information.
- Analyze primary and supporting information.
- Independently develop results and conclusions.
- Discuss and document collective peer review recommendations.

DISCUSSION

The review panel anticipated that the RI would reflect the following general process:

- Summarize available historical data and comparability of data sets.
- Summarize available fate and transport studies, results, and uncertainties.
- Summarize sources and source control activities.
- Evaluate the sufficiency of data for each reach/deposit to assess the nature and extent considering:
  - Spatial uncertainties.
  - Temporal uncertainties.
  - Transport issues.
- Identify data gaps concerning:
  - Determining the need for cleanup (nature, extent, risk).
  - Supporting the identification of appropriate cleanup remedies.
- Design RI activities necessary to fill these data gaps.
- Develop an RI report that summarizes this information.

Overall, the RI did not reflect this process. Specific issues that affect the RI's effectiveness in discussing data quality and the nature and extent of the contaminants are discussed below.

Data Quality

The Data Management Summary Report (EcoChem, 1998) evaluated the historical and current data sets with a consistent set of criteria; data were judged to be Usable, Supporting, or Indeterminate, or were rejected based on both issues of actual quality or the certainty with which quality could be judged. No information was provided regarding how this categorization would limit the use of the data. As a result both, Usable and Supporting data have been used in the RI. In addition, no evaluation was made in the RI of the comparability of the data sets collected between 1989 and 1998 that were later combined in the RI. Because analytical methods have changed dramatically over this time (particularly for organic compounds), data categorized as Usable or Supporting may need revision based on the actual comparability of the data.

There are many data sets and data types (e.g., biological, contaminant, sediment depth) but none are adequately summarized or evaluated in the RI to make an accurate quality determination without an independent statistical analysis of the data. The supplemental reports, and the accessible databases on the WDNR worldwide web (Web) site gave conflicting information on whether the gathered data meet all the proposed QA/QC criteria (Remediation Technologies, Inc. et al., 1998). For example, the WDNR database does not indicate whether the data fall into categories of Usable, Supporting, and Indeterminate; furthermore, it does not show whether samples were analyzed within the holding-time limitations. In the reports and databases accessible over the Web, it is impossible to determine data quality directly. Also, many of the PDF databases on the Web were not downloadable and portions of the databases that did download were corrupted.

The determination of total PCB concentrations from the sum of specific Aroclors appears to be the primary basis for assessing the nature and extent of contamination in the Lower Fox River. However, it appears that in some instances, congener concentrations have been extrapolated from a total Aroclor concentration and the congener composition of Aroclor data as reported in the

literature (RI Appendix F). In other instances, Aroclor concentrations have been estimated from a limited set of congener data. Environmental processes (dechlorination, biotransformation, degradation) complicate the quantitative assessment of PCB mixtures in river sediment; therefore, this approach will not adequately determine Aroclor or congener concentrations with the accuracy required to evaluate the risks associated with PCBs.

Usability of the data presented will depend on its intended use and on the level of uncertainty in the data (e.g., data may not be acceptable for use in the Ecological and Human Health Risk Assessment because risk-based screening criteria may have been exceeded in some analyses and/or the level of uncertainty in the data may make assessment impossible). The discussion of PCB congeners will have little relevance to developing Remedial Alternatives; however, the congeners may have an impact on the Ecological or Human Health Risk Assessments. Coplanar PCB congener information should be used very judiciously, if applied to these risk assessments since much of the information has been interpolated and has not been confirmed by actual sample analysis.

Representation of Nature and Extent

Evaluation of available data and the identification of RI data gaps necessary to assess the nature and extent of contamination should consider the following issues:

- Identification of contaminants of concern.
- Extent of PCB distribution.
- Sediment transport.
- Temporal and spatial considerations.

Each of these issues is discussed below.

Identification of Contaminants of Concern

Currently, PCBs are considered the primary contaminant of concern (COC) throughout the river. Some conclusions reached in the RI (and Draft FS) about the presence/absence of certain COCs in different parts of the river reaches are not well supported by the sampling and analysis efforts. Further, an assessment of source inputs has not been presented to justify exclusion of certain COCs. Conclusions are given about the presence/absence of, for example, coplanar PCB congeners and metals in different reaches that may actually be due to the presence/absence of actual data points. Therefore, discounting certain contaminants in the river is inappropriate, without adequate justification.

Extent of PCB Distribution

As discussed in the Data Quality section, congener concentrations have been extrapolated from the total Aroclor concentration based on congener composition of Aroclor data as reported in the literature (RI Appendix F). The reverse was also done, where Aroclor concentrations were estimated from a limited set of congener data. This approach is inappropriate for determining Aroclor or congener concentrations in specific deposits or reaches of the river. However, total PCB concentration is an appropriate approach to assess PCB distribution and is suitable for use in the FS.

Several discrepancies regarding the number and type of PCB data exist between the RI and the Data Management Summary Report. Data Set Analysis in Table 2-1 of Data Management Summary Report shows a breakdown of samples by study indicating the total number of samples evaluated was 8,665 for all studies; however, Table 4-1 of Draft RI Report shows 18,556 “samples” were analyzed for PCB congeners alone. This discrepancy may have been due to the extrapolation method used to estimate Aroclor and congeners. The Quality Assurance Project Plan for the RETEC 1998 Supplemental Data Collection indicates only 42 samples were to be analyzed for PCB congeners and approximately 157 samples for Aroclors (which also correlates with the Data Management Summary report). Therefore, the total number of samples analyzed for the 1998 RI/FS for Aroclors is about 157 (or 162 to 164 samples as indicated) and NOT 1,141 (7 Aroclors x 163 = 1,141). Table 4-1 of

the Draft RI report and the associated verbiage on the number of samples analyzed are misleading to users. Specifically, this presentation implies that more than the actual number of samples were analyzed (i.e., one sample analyzed for seven Aroclors, not seven samples analyzed for seven Aroclors).

Sediment Transport

The Lower Fox River is a dynamic system; the varying susceptibility of sediments to resuspension and relocation warrants an evaluation of sediment transport as it relates to the comparability and applicability of different data sets. Consequently, the results of fate and transport should be central to evaluating the nature and extent of COCs. A comprehensive evaluation of modeling results would be appropriate to an RI but this evaluation was not provided in Section 2.1.1.

The locations and depths of the sediment deposits seem to be understood; however, the RI does not contain any conclusions on the permanence of these deposits. For example, PCB distribution within Little Lake Butte des Morts (Deposits A through G and POG) indicates that the upper 100 cm of sediment deposits contain elevated PCBs, with the upper 30 cm having the highest concentrations (Plate Number 4-1). The Deterministic PCB Transport Model (WDNR 1995) results show that sediments in this area are accumulating (Figure 5-62) and that even during a high flow event, do not erode (Figure 5-63). This is consistent with Figure 6-43, where these segments have the highest PCB concentrations in the upper segment. Further, the few interpretable Cs-137 profiles in this area support these observations (Table V-1, Core 4 A1). The deposits within the Little Lake Butte des Morts appear to be stable and the grouping of data from 1989 through 1994 is appropriate. However, the WDNR on-line databases do not provide sufficient data to make a direct comparison.

It was also reported that more than 60 percent of the PCB transport occurs when river flow is above the annual mean or during an extreme event (EWI, 1991; Gailani et al., 1991; Lick et al., 1995; WDNR 1995, 1998), but it is not evident that the data have been collected to reflect the effects of these more extreme flows.

Temporal and Spatial Considerations

The RI has grouped various data sets over time into a single view of the nature and extent of the COCs although data comparability does not appear to have been assessed (see Data Quality Section). Figures 1 through 6 (attached), prepared by Dr. Adams from information available in the RI and on the WDNR Web site clearly represent the reliance on one data set, though the appropriateness of the data set to represent current conditions has not been established.

For example, an evaluation of sediment transport for characterization of Deposit C with data from 1989 and 1994 is appropriate. It is interesting to note that remediation simulations (Velleux et al. 1995) indicate that remediation (dredging or removal) of sediments within the Little Lake Butte des Morts area was only predicted to reduce the mass exported to Green Bay by 4 percent. In predictive PCB transport fluxes (WDNR) for the 25-year period, about 40 percent of the PCBs within this reach are transported over DePere Dam and 60 percent of this transport occurs during high flow events. Only about 15 percent of the PCBs remain in the original deposits after 25 years (50 percent ends up behind De Pere Dam). However, considerations of how an extremely high flow (such as the 100-year flood in 1960) would affect this area would need to be considered since even typically low flow areas are expected to erode (Gailani et al. [1991] examined 10-year high flows).

A similar evaluation should be performed for other reaches and deposits. Briefly, for the Appleton to Little Rapids below De Pere Dam, soft sediment thickness is generally 0 to 0.5 meters (Plate Number 3-2); Plate Number 4-2 shows that PCBs are generally low in this reach and are limited to the upper 30 cm. This finding is consistent with Figures 4-62 and 5-63 (WDNR, 1995), which predict net erosion in this reach. Gailani et al. (1991) characterize this type of system as an area where sediments are deposited during low flow periods before being transported downstream. Control of PCBs upstream would be expected to affect PCB concentrations in this reach. Consequently, combining data from a 10-year period should be evaluated. Most of the data presented on Plate 3-2 is from 1989 and may not represent present concentrations (Deposits X and W use a combination of data from 1989 and 1998).

An attempt to assess the changes of PCB distributions over time in any particular reach or deposit is difficult based on Plates 3-1 to 3-4 and 4-1 to 4-4. It appears as if some of the deposits were only evaluated in the 1989/90 Mass Balance Sediment Study, which according to the 1998 Draft Data Management Summary Report can only be considered as Supporting information based on the lack of detail about the quality control activities during this work. Consequently, the panel identified obvious data gaps; however, since this system is so dynamic, it is believed that some data gaps could be filled during design activities. In other words, obtaining more data today of "better" quality (i.e., representative of current conditions) will not ensure that the distribution of COCs has not changed prior to any remediation construction activities. Therefore, these data, in conjunction with an evaluation of fate and transport information, should be used to identify appropriate remedies and real-time data must be obtained at the initiation of remedial action to verify that the actions are needed (e.g., using immunoassay field analysis).

There are many inconsistencies between Plates 3-X, showing data sampling point/date of study, and Plates 4-X, showing PCB distribution. For example, Plate 3-1 for Deposit B shows data from three samples from 1989/90 Mass Balance Study were used, while Plate 4-1 for Deposit B (particularly 30- to 50-cm depth sediment) shows PCB distributions for at least six samples all along west/south-west section of Deposit B. This does not correlate with the sampling points shown in Plate 3-1. In general, the sampling point representativeness to a deposit's particular characteristics must be addressed.

Data to generate these figures on total PCB profiles in subsurface and surface sediment samples were collected in 1989 and 1994 and presented in the WDNR database. No additional data were found in the WDNR Web database searches for total PCBs that would provide more information on sediment movement within the sediment deposits of concern. Since the data provided were collected over a 10-year period in a dynamic system, it may or may not be a valid representation of the current distribution of contaminants and raises the following questions:

- Which sediment deposits have been (are) most affected in normal flow, moderately high, and extreme river events?

- How much of these sediments, containing the bulk of the PCBs, have been affected and where have these sediments been redeposited in these events?

CONCLUSIONS

In response to the charges presented in the Purpose and Scope, the panel of experts concluded the following:

- Data are adequate (in terms of quality and quantity) to support the need for a cleanup action.
- Data are adequate to determine the distribution of contaminants (i.e., it can be decided where cleanups should take place), if all data sources are considered (i.e., the RI does not provide a complete record).
- Data from all available sources are adequate to support identification and selection of a remedy for those technologies (e.g., dredging and capping) that have been used on a large scale at other, similar sites. Data are insufficient for developing *in situ* biotechnologies that may be applicable to the site.

The panel also concluded:

- The data in the primary documents are generally of sufficient quality to recommend the need for a cleanup action and an evaluation of remedial actions for most river sections. Examples of well-studied areas include the Little Lake Butte des Morts, Deposit A, and the general reach from De Pere to Green Bay.
- Sufficient data of sufficient quality have been obtained to begin remedial actions. The primary documents, in conjunction with supplemental reports, provide the location of the more contaminated sediment deposits in each river reach and a good indication of the total volume of sediment requiring remediation. This information can be used to address a whole river cleanup strategy.
- The transport models provide necessary information on the fate of sediments mobilized in low, moderate, and extreme river events that will aid in river cleanup decisions and the steps required to minimize the continued transport of contaminated sediments into Green Bay.
- Sufficient data exist to enable the transfer of information from other, similar sites where large-scale remedial actions such as dredging and capping have been performed, but are not sufficient to initiate relatively new *in situ* biotechnologies.

- Investigations from 1989/1990 WDNR Mass Balance Sediment Study through 1998 RI/FS Supplemental Data Collection have detected the same, or similar, chemicals of concern (i.e., apparently no new "surprise" COCs were determined in later studies that were not detected throughout the sampling efforts).

- The RI does not summarize or evaluate all available data in a useful form and the existing data were not used to identify key data gaps that should have been addressed as part of the RI.

- From the reports and information provided and obtained on the Web, there appears to be no contamination or biological, chemical or physical characteristic of the Lower Fox River that would preclude transferring information from other similar sites where remedial action such as dredging, capping, etc. has been performed.

RECOMMENDATIONS

- The RI process did not follow the reviewers anticipated format. However, extended effort to improve the RI document is not recommended. Rather, inclusion of missing information and analyses should be incorporated in either the FS or the design process, to move the project forward in a timely fashion.

- Generally, metals have been given less attention than organics and a comparison with similar sites and statistical analysis are needed to provide a good estimate of whether enough samples had been collected to provide insight into reach- or deposit-specific remedial approaches.

- Development of contamination profiles and collection dates by river reach and sediment deposit along with a good statistical analysis is needed.

- When the information on the ongoing sediment demonstration projects, Deposit N and SMU 56/57, is available, this information should be included in the development of a remedy for these sites. These projects should help determine whether the existing data quality is sufficient to develop and implement previously tested large-scale dredging type remedial actions.

- Where remedial action is planned, the data need to be confirmed as the remediation plans are developed. Since the Lower Fox River is dynamic system, where sediment transport is known to have occurred, and the data have been gathered over an extended time (10 years), the location of contaminated sediments should be reconfirmed as remedial actions are initiated. The fate and transport evaluations should be performed for all reaches and deposits that have significant PCB mass. Additionally, fate and transport evaluations should be conducted so that remedial actions can proceed in a timely manner.

- Some conclusions reached in the RI about the presence/absence of certain COCs in different parts of the reaches are not well supported by the sampling and analysis efforts. Conclusions are given about the presence/absence of, for example, coplanar PCB congeners in different parts of the reaches that may actually be due to the presence/absence of actual data points. Remediation alternatives must consider all COCs that are present in each reach to be effective (i.e., it would not be advisable to remediate a section of a reach for PCB only while ignoring metals contamination).

- A comprehensive evaluation of modeling results would be appropriate for an RI; however, in the interest of moving the project forward, a separate technical memorandum or an addendum to the FS could be prepared.

- Relationships between the sediment contamination profiles need to be generated and additional information such as determination of source and deposition of transported contaminants should be determined by pattern recognition and other suitable statistical analysis.

- Usability of the data in the Ecological and Human Health Risk Assessment will depend on its intended use and on the level of uncertainty in the data. Coplanar PCB congener information should be used very judiciously, if applied to these risk assessments since much of the information has been interpolated and has not been confirmed by actual sample analysis.

- A demonstration or supported statement in the RI that point sources are controlled in a given area would strengthen the document.

- An expert from each review panel should be involved in compiling data from the various peer reviews into a final conclusions and recommendation document.

PRIMARY DOCUMENTS REVIEWED:

EcoChem, Inc. and ThermoRetec Consulting Corp. December 17, 1998. Data Management Summary Report: Lower Fox River RI/FS, ThermoRetec Project No. 3-3584-100.

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WDNR. 1995. A Deterministic PCB Transport Model for the Lower Fox River Between Lake Winnebago and De Pere, Wisconsin. PUBL WR 389-95.

Woodward-Clyde (WWC). 1996. Sediment/Site Characterization Summary – Little Lake Butte Des Morts, Deposit A. Neenah-Menasha, Wisconsin.

COLOR PLATES:

ThermoRetec. 1999. Soft Sediment Thickness and Sample Location: Little Lake Butte Small Des Morts. Plate no. 3-1.

ThermoRetec. 1999. PCB Distribution: Little Lake Butte Small Des Morts. Plate no. 4-1.

ThermoRetec. 1999. Soft Sediment Thickness and Sample Location: Appleton to Little Rapids. Plate no. 3-2.

ThermoRetec. 1999. PCB Distribution: Appleton to Little Rapids. Plate no. 4-2.

ThermoRetec. 1999. Soft Sediment Thickness and Sample Location: Little Rapids to De Pere. Plate no. 3-3.

ThermoRetec. 1999. PCB Distribution: Little Rapids to De Pere. Plate no. 4-3.

ThermoRetec. 1999. Soft Sediment Thickness and Sample Location: De Pere to Green Bay. Plate no. 3-4.

ThermoRetec. 1999. PCB Distribution: De Pere to Green Bay. Plate no. 4-4.

WEB SITES:

EPA/WDNR Sites and Databases

http://www.dnr.state.wi.us.org/water.wm/lowerfox/sediment smu5657.html

http://www.dnr.state.wi.us.org/water.wm/lowerfox/sediment/demoproject.html