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# Scope of Work for Tittabawassee River Sediments and Floodplain Remedial Investigation (RI)

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## I. Purpose and Objectives

This revised Scope of Work (SOW) is being submitted pursuant to the Part 111 Hazardous Waste Facility Operating License (License) of The Dow Chemical Company (Dow) Michigan Operations-Midland Plant in Midland, Michigan (Facility). Condition XI.B.3. of the License requires Dow to submit a SOW to the Michigan Department of Environmental Quality (MDEQ) for conducting a Remedial Investigation (RI) for certain offsite areas. This SOW addresses the Tittabawassee River Sediments and Floodplain, two of the areas identified in Condition XI.B.2. of the License.

The objective of this SOW is to provide a general description of the process, steps and schedule Dow will use to plan and implement the RI for the subject areas. Specific RI planning and implementation details are being developed and will be presented in the RI Work Plan (RIWP). The SOW consists of this document and the attached five figures:

- Figure 1 – Remedial Investigation (RI) Overview
- Figure 1A – Human Health Risk Assessment Portion of Remedial Investigation
- Figure 1A(i) – Bioavailability Study
- Figure 1B – Ecological Risk Assessment Portion of Remedial Investigation
- Figure 2 – Preliminary RI Schedule

The figures illustrate the primary elements and proposed sequence of key RI activities. This document briefly outlines the information presented in the flowcharts and provides supplemental information, as discussed with MDEQ staff in May and June 2005.

## II. RI Purpose and Overview

The Tittabawassee River Sediments and Floodplain RI will be conducted to meet applicable requirements of the License, Parts 111 and 201 of Act 451, as well as relevant Resource Conservation and Recovery Act (RCRA) regulations

The RI Work Plan will be designed to provide the information necessary to support a risk-based decision process and achieve the goal of a remedial investigation as set forth in R 299.5528: *“The purpose of a remedial investigation is to assess site conditions in order to select an appropriate remedial action, if one is required, that adequately addresses those conditions.”* The RI Work Plan will also be designed to address the factors described in R299.5528 (3), *“...as appropriate to the facility...”*.

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Figure 1 illustrates the primary tasks and general sequence of events associated with development and implementation of the RI. The following subsections provide a brief description of each of the primary tasks.

### III. Planning of Remedial Investigation Work

#### A) RI Work Plan Background Information

Dow has taken several steps to gather information for use in development of the RI Work Plan. These steps include the following:

- Review and Summarize Existing Information  
Dow has been obtaining and summarizing existing information pertaining to the Tittabawassee River Watershed. Information relevant to the RI will be summarized in the description of current conditions within the RI Work Plan.
- Pre-RI Studies  
The preliminary investigations listed below have been conducted to augment the existing information referenced above. As discussed further below, the results of these “pre-RI” studies will be summarized in the RI Work Plan and will be used to design the proposed RI sampling and analysis approach. These results will also be incorporated into the Preliminary Conceptual Site Model. These studies and their conclusions will be reviewed and commented on as part of the RI Work Plan review and approval process.
  - Tittabawassee River Floodplain Wild Game Study (submitted July 2004)
  - Preliminary Flow and Solids Monitoring 2003-2004, Tittabawassee River (Nov. 2004)
  - Probing and Coring Study for Characterization of Sediment Type and Thickness of Unconsolidated Deposits, Tittabawassee River (Nov. 2004)
  - Non-Analytical Sampling Activities for Tittabawassee River (April 2005)
  - Geochronology Pilot Study, Floodplain Soils, Tittabawassee River (May 2005)
  - Dendrogeomorphic Pilot Study, Tittabawassee River Floodplain, Michigan (May 2005)
  - Tittabawassee River Sediment Dioxin/Furan Concentration Variability (March 2005)
  - Tittabawassee River Dioxin/Furan Concentration Vertical Variability (May 2005)
  - Tittabawassee River Floodplain Scoping Study Phase I (proposed June 2005)

The focus of this preliminary work has been on improving the understanding of the river system characteristics related to solids movement (e.g., sediment deposition, erosion, solid transport, flooding, etc.). In addition, a preliminary evaluation of existing analytical data was done to see if it were possible to ascertain trends in the distribution of dioxins and furans within the river and floodplain.

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## B) RI Work Plan Development

The RI Work Plan is being developed in accordance with applicable Part 201 and RCRA regulations and standards of practice. It will include, but not be limited to, the following elements:

- A description of current conditions will summarize existing information on relevant facility history as well as the study site.
- A preliminary conceptual site model (PCSM) will integrate existing information on physical conditions, nature and extent of contaminants, environmental fate and transport, land use, and potential receptors. The RI will be coordinated with the onsite portions of the License, which already require Dow to identify the potential for continuing sources. This will include coordination with work being done under License Conditions X.J. Facility Shallow Groundwater Monitoring Program, X.K. Ambient Air Monitoring, X.L. Soil Monitoring Programs, and XI.R. Source Control. The PCSM to be included in the RI Work Plan will include information available through October 2005. To respond to MDEQ's August 12, 2005 letter, Dow committed in its letter of August 23, 2005 to provide an updated PCSM document by November 1, 2005.
- The Tittabawassee River and Floodplain Scoping Study was submitted in June 2005. Phase I was conducted to provide information that will support refinement of the PCSM for the Tittabawassee River. These scoping investigations are designed to make a preliminary assessment of the geospatial predictability of dioxin and furan distribution in floodplain soil and to make a preliminary assessment of the vertical distribution of dioxins and furans within river sediments and floodplain soils. The information generated from this preliminary study as well as other information from prior investigations will be used to support design of the RI.
- Field sampling and analysis will be performed in at least two phases. As shown in Figure 2, Phase I is scheduled to begin in April 2006 and Phase II is scheduled to begin in September 2006. This information will be used, in part, to define the nature and extent of contamination.
- Data Quality Objectives (DQOs) are being developed to clearly identify the questions that will be answered by RI data and to ensure that the proper type and quality of data will be collected. Types of questions to be addressed by the RI will include, for example:
  - Are there relationships between geospatial factors (elevation, geomorphology, surface activity and use, etc) and concentrations of potential constituents of interest (PCOIs), including dioxins and furans, in floodplain soils?
  - What are the characteristics of soils within the floodplain, and is there a relationship with concentrations of dioxins and furans?
  - What is the relationship between the dioxins and furans in sediments and the occurrence and distribution of dioxins and furans in floodplain soils?
  - What PCOIs have the most influence on risk(s) and the need for and scope of remedial actions?

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- Do conditions in sediments and floodplain soils present a risk to the public health, safety and welfare and to the environment and natural resources?
  - To address these types of questions, the initial phase of the RI is anticipated to include collection of data to:
    - Identify PCOIs
    - Test and refine the PCSM and to further understand geospatial factors that may affect PCOI distribution in floodplain soils and sediments
    - To Refine the current understanding of the study area boundaries
    - To Develop an understanding of the affects of physical systems within the confluence
    - To develop an understanding of the physical and chemical properties that control or influence the distribution of dioxins and furans and other PCOIs in contaminated sediment and soil samples (e.g., are higher concentrations associated with a particular grain size, TOC concentration, mineral surface feature, etc.?)
    - To identify and collect exposure data to support the human health risk assessment (HHRA).
  - As required by the License, one of the investigation objectives will be to determine if there are continuing sources of dioxins and furans, or other applicable PCOIs, to or within the areas identified in Condition XI.B.2. of the License. As part of this determination, the RI will explore the relationships between River sediments and floodplain soils, including investigations of erosional and depositional processes and the extent to which any areas of sediment or floodplain soil may be ongoing sources of contamination to other areas. RI evaluations of the potential for continuing releases will include, but not be limited to, the following:
    - Information from the Flow/Solids Monitoring Study and future investigations will be used to develop a better understanding of the riverbed structure and system dynamics (such as solids transport and scour and deposition patterns).
    - River hydraulics will be evaluated during flooding events to better understand solids movement during flooding events.
    - Bank studies will be performed to evaluate bank stability and erosion potential.
  - The RI Work Plan will provide details regarding the specific areas to be investigated, as well as the proposed analyte lists, within the Sampling and Analysis Plan (SAP). The RI Work Plan will also include maps and figures, as well as Standard Operating Procedures (SOPs) to describe the protocols and methodologies proposed for the collection and quality evaluation of data. In accordance with Conditions XI.B.2. and XI.B.3. of the License, this RI will evaluate the Tittabawassee River Sediments and Floodplain from the Facility's upstream boundary to the confluence of the Tittabawassee and Shiawassee Rivers downstream of Greenpoint Island, and will include areas with residential,

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agricultural, recreational and other appropriate land use designations. The RI Work Plan will also include necessary maps and figures, as well as Standard Operating Procedures (SOPs) to describe the protocols and methodologies proposed for the collection and quality evaluation of data.

### C) Human Health Risk Assessment (HHRA) Work Planning

The RI Work Plan will include a work plan element for human health risk assessment activities during the RI. The RI will provide the information required to evaluate potential risks to human health in and along the Tittabawassee floodplain. The primary RI steps associated with evaluation of potential risks to human health are illustrated in Figure 1.A.

The RI Work Plan will include further identification of potential exposure pathways and DQOs related to HHRA work as appropriate. Part 201 provides generic criteria for exposure to PCOIs. There may be additional exposure pathways that do not have Part 201 generic criteria. Dow is currently reviewing and evaluating these potential exposure pathways with MDEQ. The RIWP will identify which of these potential exposure pathways will be addressed in the RI through the development of additional information as shown in Figure 1.A. Specific elements in the process follow:

- The HHRA will include the following elements to identify and refine relevant land uses, potential exposure pathways, and DQOs related to HHRA work, as appropriate, for the Tittabawassee floodplain, for inclusion in the RI Work Plan:
  - Exposure Pathway Identification and Refinements (qualitative)
  - Exposure Algorithm Identification (quantitative)
  - Exposure Data Needs, Collection and Analysis (qualitative/quantitative)
  - Toxicity Criteria Identification/Derivation (qualitative/quantitative)
  - Screening-Level Risk Assessment (quantitative)
  - Perform Fully Probabilistic Risk Assessment and Generate Site-Specific and/or Area-Wide Clean-up Criteria (quantitative)
  - Risk Management Decision(s) (qualitative)
- Part 201 only has generic clean-up criteria and exposure pathways for ingestion, inhalation, and dermal absorption of contaminated soils and groundwater under various land use scenarios. Potential land uses and exposure pathways exist that lack Part 201 criteria and require additional evaluation. This will include an evaluation of all land uses allowed under current zoning requirements. Land uses for the Tittabawassee flood plain include residential, agricultural, commercial, industrial, and recreational. Tentative exposure pathways for the Tittabawassee floodplain include ingestion of soil and dust (interior and exterior), ingestion of local vegetables and produce (including meat, milk, and eggs), ingestion of local fish and game, ingestion of sediment and surface water (primarily recreational), inhalation of soil and dusts (including agricultural dusts), and dermal exposure via soil, dusts, sediments, and surface water. Non-residential exposure (commercial and industrial workers) will focus primarily on exposure via the same routes to soil and dusts. Recreational exposure could include ingestion of soils and dusts (interior and exterior), ingestion of sediments and surface water,

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ingestion of fish and game, inhalation of soils and dusts, and dermal exposure to soils, dusts, sediments, and surface water.

- The RIWP will propose potential Tittabawassee floodplain exposure pathways that will need to be fully addressed in the RI. All exposure pathways evaluated will be identified and the rationale for inclusion or exclusion in the final human health risk assessment will be provided.
- The proposed process for the development of human health risk assessment and site-specific cleanup criteria (SSCC) and/or area-wide cleanup criteria (AWCC) is conceptually illustrated in Figure 1.A, and will be further developed in coordination with MDEQ. This process, which is part of the RI, will be documented in separate work plans and submitted to MDEQ for preliminary review and then jointly submitted to an independent science advisory panel for review. After the science advisory panel reviews the proposed process, it will be submitted to MDEQ for final review and approval. Work currently underway on bioavailability studies (as shown in Figure 1.A.i) will support efforts to evaluate potential exposure pathways. Other data needs, which would require the development of DQOs and an approach to obtain the data, may also be identified for the area to be investigated as defined by the License and will be coordinated with overall RI work as necessary.

#### D) Ecological Risk Assessment (ERA) Work Planning

The RI will provide the information required to evaluate potential risks to ecological receptors. The RI Work Plan will include a work plan element for ecological risk assessment activities during the RI. The overall process is illustrated in Figure 1.B and includes the performance of a Screening Level Ecological Risk Assessment (SLERA) and a Baseline Ecological Risk Assessment (BERA) Work plans for these assessments were submitted to MDEQ for preliminary review on July 1, 2005. The results of these assessments will be used, along with existing ecological risk studies and other information obtained during the RI, to evaluate potential risks to ecological receptors.

#### E) Preliminary Feasibility Study Planning

Preliminary feasibility study evaluations will be done to identify potential remedial alternatives that may be necessary to manage risk to human health and/or the environment. The objective of this element of the RI Work Plan will be to ensure that DQOs are developed to include remedy considerations and information is obtained through the RI to support future risk management decisions.

#### F) Public Participation Plan

An interim public participation plan as required by Condition XI.B.3. of the License and envisioned by Section III.A.1. of the Framework is in place and being implemented. A revised and consolidated public participation plan will be submitted as part of the RIWP. The interim plan includes the approved Communication IRA, which is being implemented, as well as a series of public meetings. Dow has held meetings with residents and sent them informational mailings as required under the

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Tittabawassee River Floodplain IRA Work Plan for Priority 1 properties. MDEQ and Dow have held a series of public meetings on the development of a stakeholder process. Elements of the stakeholder process that is being developed will be incorporated as appropriate into the consolidated public participation plan.

#### IV. RI Deliverables and Schedule Milestones

A schedule for the elements discussed within this SOW is provided in Figure 2. Figure 2 is considered a “contingent” schedule at this time because it was built using assumed durations for agency, science advisory and public review and approval timeframes. The RI Work Plan will provide a detailed implementation schedule for the RI.

Key deliverables and their anticipated submittal sequence are:

- Draft Baseline Ecological Risk Assessment Work Plan for Polychlorinated Dibenzop-Dioxins (PCDDs) and Dibenzofurans (PCDFs) in the Tittabawassee River and Associated Floodplains
- Draft Screening Level Ecological Risk Assessment Work Plan for the Tittabawassee River and Associated Floodplains
- The RI Work Plan will be submitted to MDEQ by December 31, 2005.
- Implementation of the RI will commence within 45 days of MDEQ approval of the RI WP (in accordance with Section XI.F.3 of the License).
- Phase I RI Report reports will be submitted to MDEQ within 60 days of completion of the Phase I RI work and will (pursuant to License Condition XI.B.3.(b)) present information on appropriately detailed maps and figures as are currently being provided to MDEQ in the form of GIS shape files.
- Draft Work Plan for Development of Site-specific and/or Area-wide Cleanup Criteria
- Final Work Plan for Development of Site-specific and/or Area-wide Cleanup Criteria
- Phase II RI Work Plan will be submitted to MDEQ in accordance with the schedule approved as part of the Phase I RI Report.
- Site-specific and/or Area-wide Cleanup Criteria Proposal

Dow will provide MDEQ with RI data pursuant to the License, including bi-monthly progress reports.

#### V. Interim Response Activities

Condition XI.B.3. (a) of the License requires Dow to propose Interim Response Activities (IRAs) in the SOW. This SOW condition was satisfied by submittal and subsequent approval by MDEQ of the:

- Tittabawassee River Floodplain Interim Response Activities Work Plan, February 2004, which was modified and approved by the Michigan Department of Environmental Quality, January 2005
- Interim Response Activity Work Plan: Communications, February 2004 which was modified and approved by the Michigan Department of Environmental Quality, October 2004

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Section I.B.1. (b) of the Framework for an Agreement cites additional IRAs for Exposure Mitigation and Enhancements at certain parks in the Tittabawassee River Floodplain. They include the following actions initiated in late 2003:



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### Freeland Festival Park

- Installation of viewing deck along river bank
- Wall to direct park visitors to viewing deck
- Six inches of cover and establishment of groundcover over developed portion of park
- Hand wash station placed for use by park visitors during warm weather months
- Flood support cleanup as requested by Park Officials
- Advisory signage

### Imerman Park

- River bank stabilization by pavilion along river's edge
- Installation of handicapped fishing platform
- New floating dock for fishing near pavilion
- Hand wash stations placed for use by park visitors during warm weather months
- Relocation of dog park from lower park to upper park
- Installation of concrete pad for combined cross-country track staging & roller hockey playing surface
- Augment ground cover where sparse or missing
- Gravel parking lot in lower park paved
- Gravel walkway from upper parking lot to rest room at upper park paved
- Gravel pull-off near entrance paved
- Flood support cleanup as requested by Park Officials
- Advisory signage

### West Michigan Park

- Hand wash station placed for use by park visitors during warm weather months
- Replacement of sand at child play areas
- Augment ground cover where sparse or missing
- Flood support cleanup as requested by Park Officials
- Advisory signage

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- Interim Response Activity: Dust Control on Private Drive Parcel Number 19225200200 (14 Riverside Boulevard Site) submitted on July 19, 2005; resubmitted August 24, 2005. Approved with modifications by MDEQ on September 16, 2005

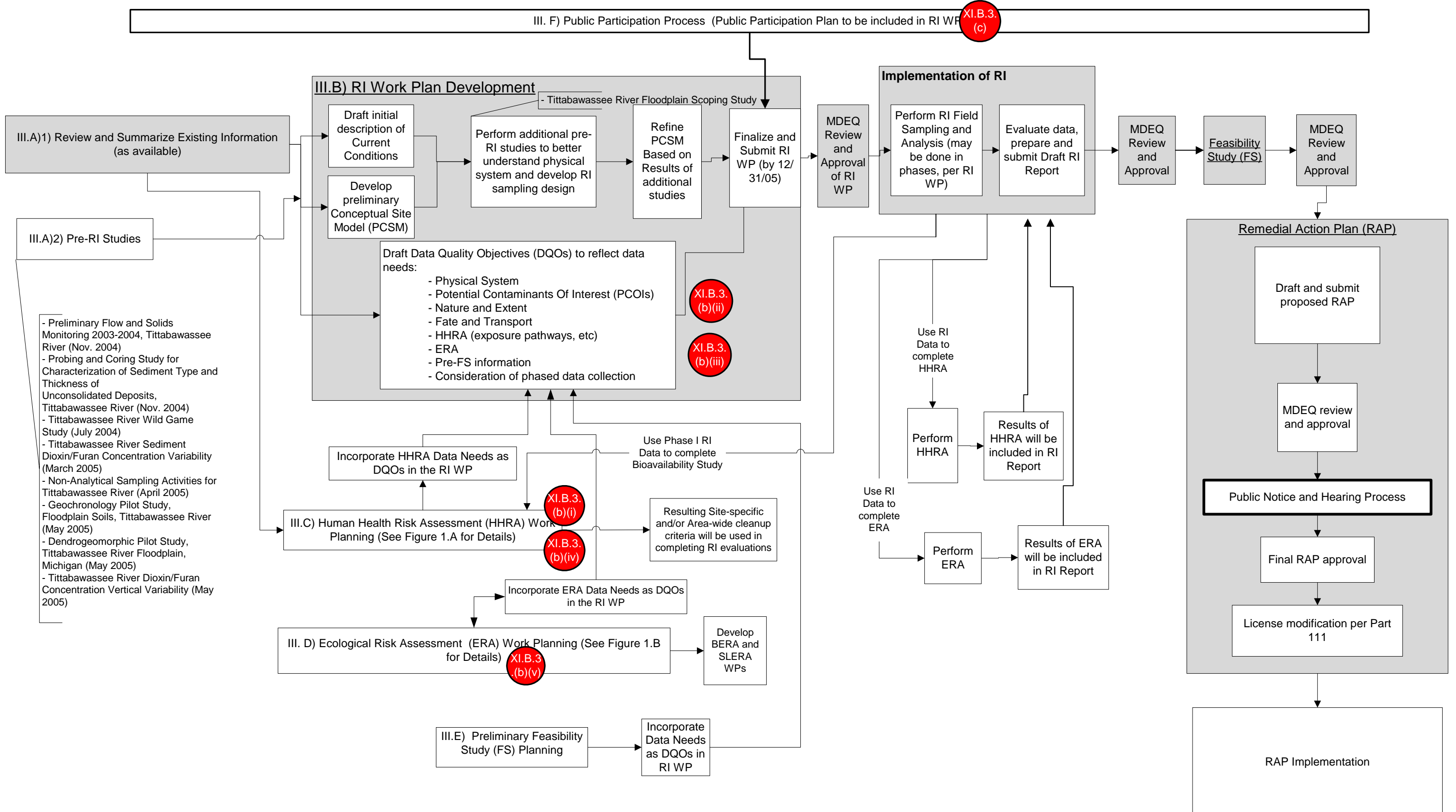
Dow will continue to perform IRAs in compliance with Conditions XI.B. and XI.G. of the License. New information will be evaluated as it becomes available to determine if additional IRAs or additional action for previously completed IRAs are necessary.

**Figure 1 - Remedial Investigation (RI) Overview**  
**Tittabawassee River Sediments and Floodplain Scope of Work**

10/12/2005 SUBMITTAL

Notes:

- 1) The shaded boxes are repeated on Figures 1A and 1B to show additional detail on the HHRA and ERA activities.
- 2) The Feasibility Study and Remedial Action Plan are shown conceptually to indicate steps beyond the RI.
- 3) The shaded circles reference License conditions being addressed.



**Figure 1.A Human Health Risk Assessment Portion of Remedial Investigation Tittabawassee River Sediments and Floodplain Scope of Work**

10/12/2005 SUBMITTAL

Notes:

- 1) The shaded boxes are repeated from Figure 1: Remedial Investigation Overview to show where HHRA work occurs within RI
- 2) The Feasibility Study and Remedial Action Plan are shown conceptually to indicate steps beyond the RI
- 3) Triangle symbols indicate near-term decision points to be discussed with MDEQ prior to submittal of next phase of work.
- 4) Additional HHRA activities may need to be added to the RI process if additional PCOIs are identified in addition to dioxins and furans

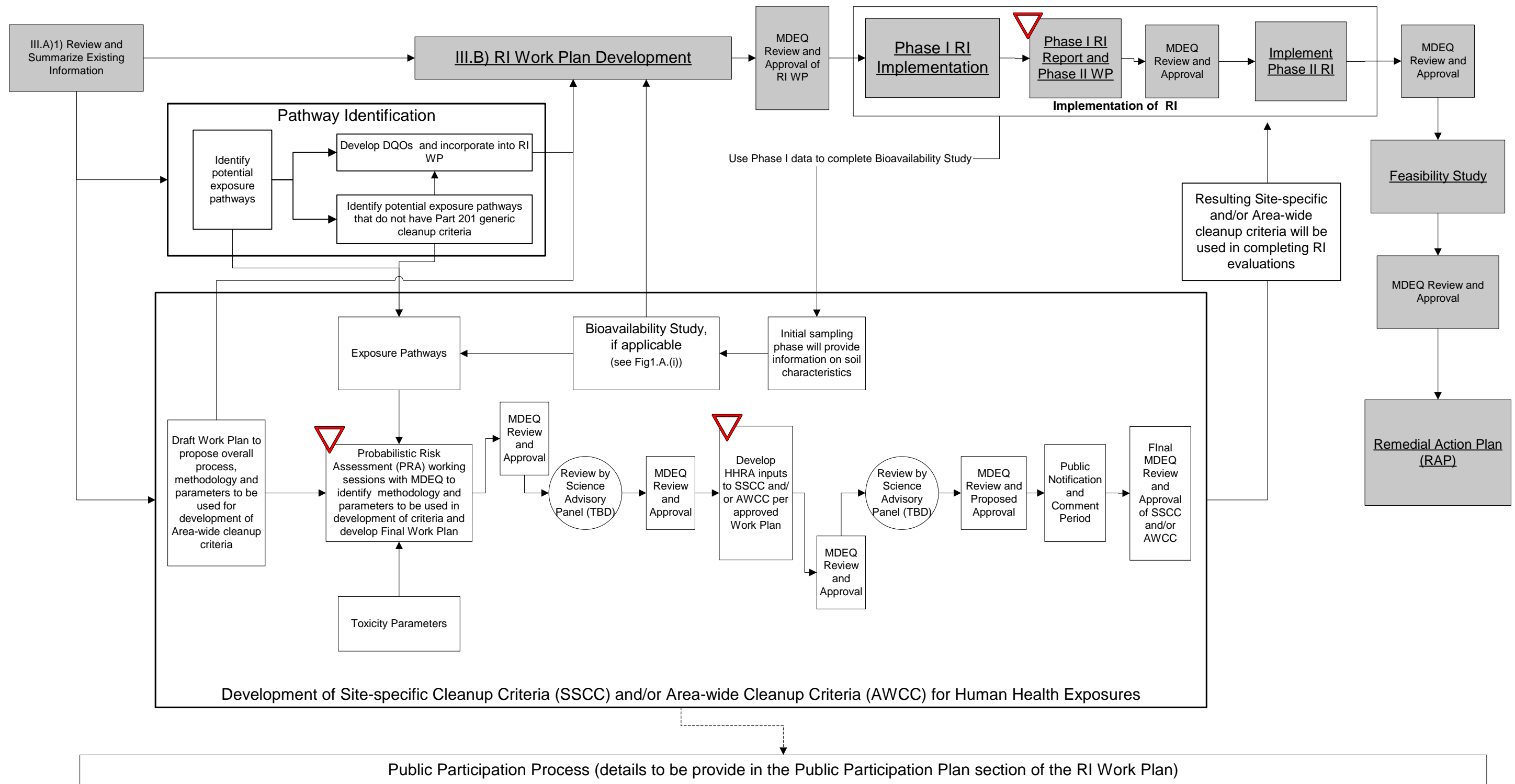
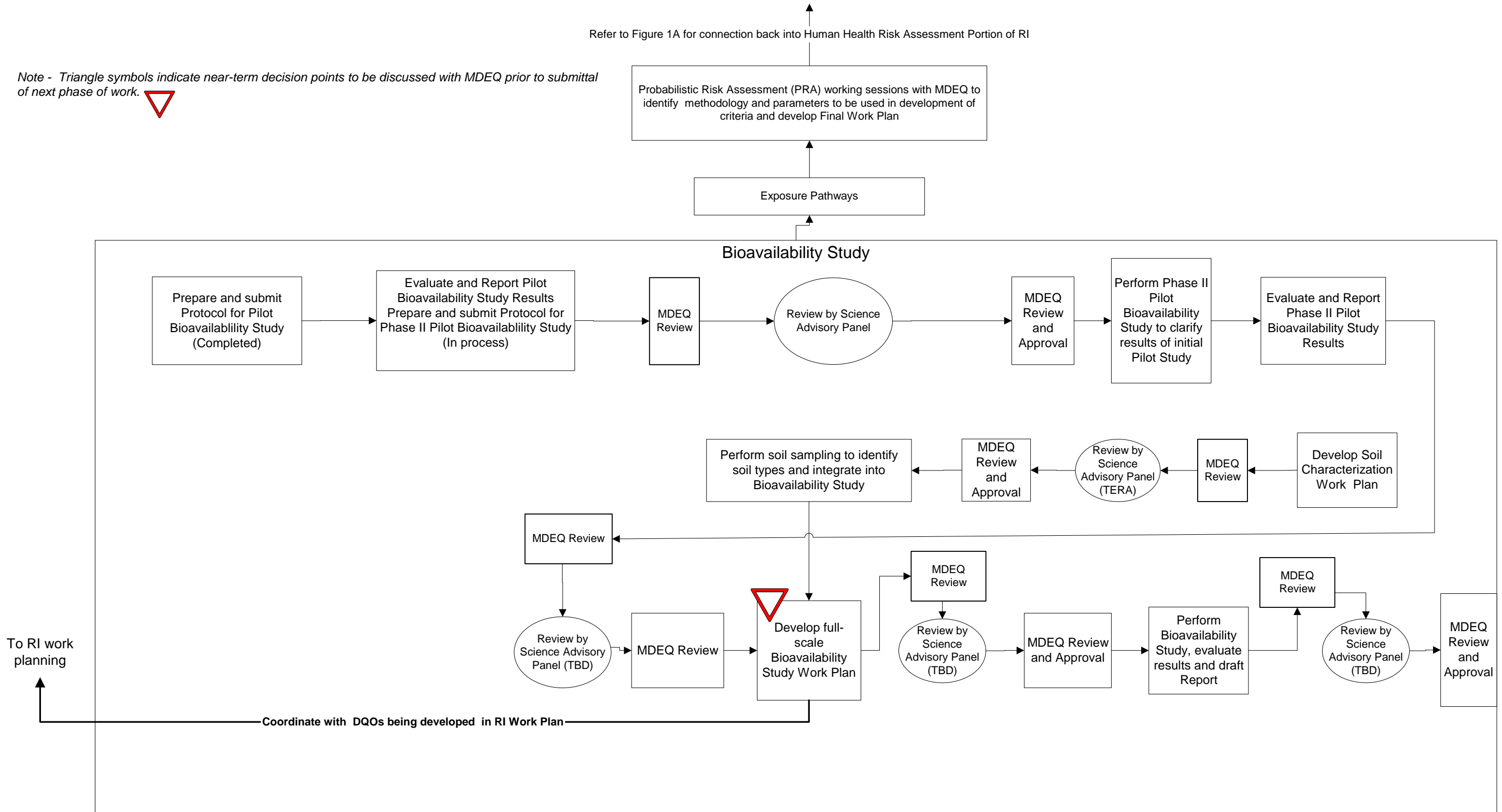


Figure 1.A.(i) Bioavailability Study for Dioxins and Furans  
Tittabawassee River Sediments and Floodplain Scope of Work

10/12/2005 SUBMITTAL

Note - Triangle symbols indicate near-term decision points to be discussed with MDEQ prior to submittal of next phase of work.



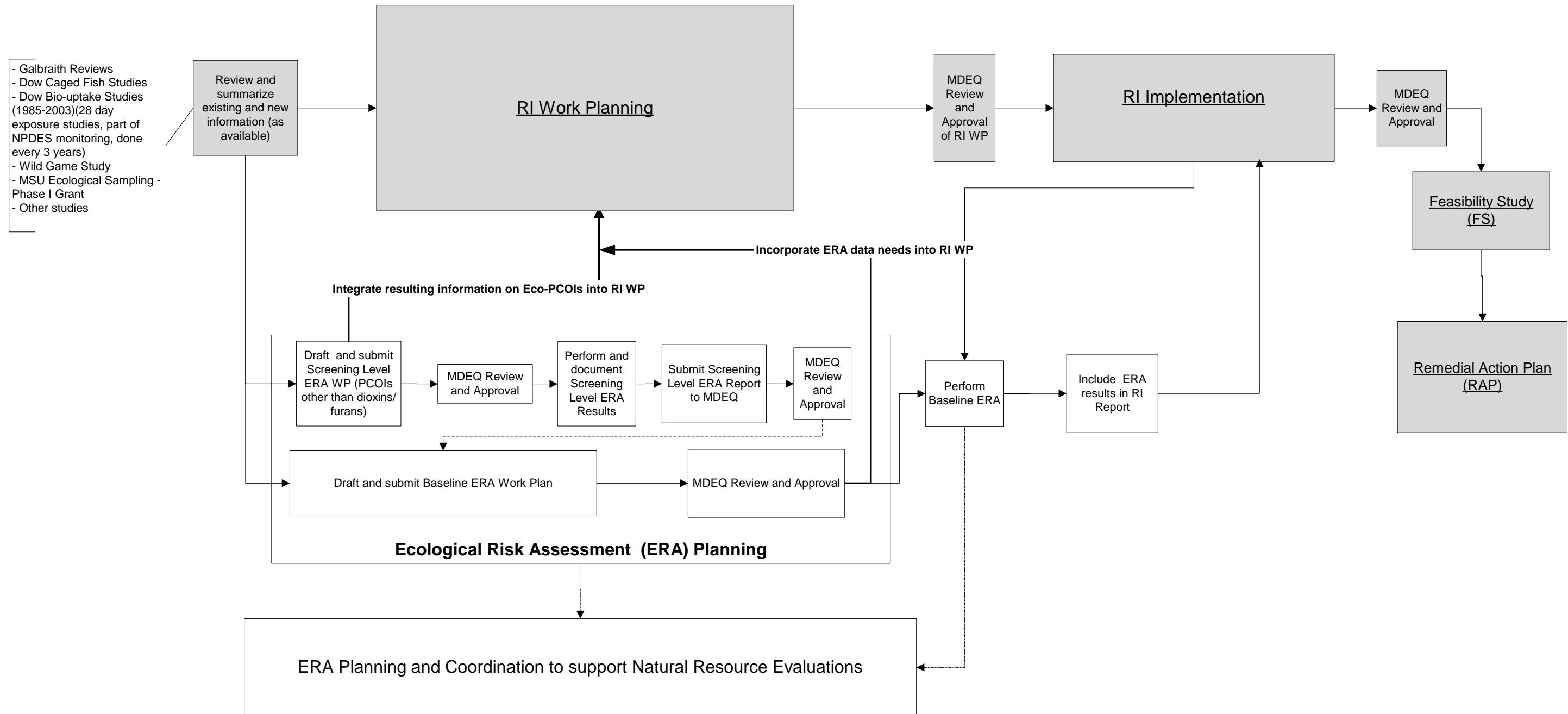
**Figure 1.B Ecological Risk Assessment Portion of Remedial Investigation**

9/15/2005 SUBMITTAL

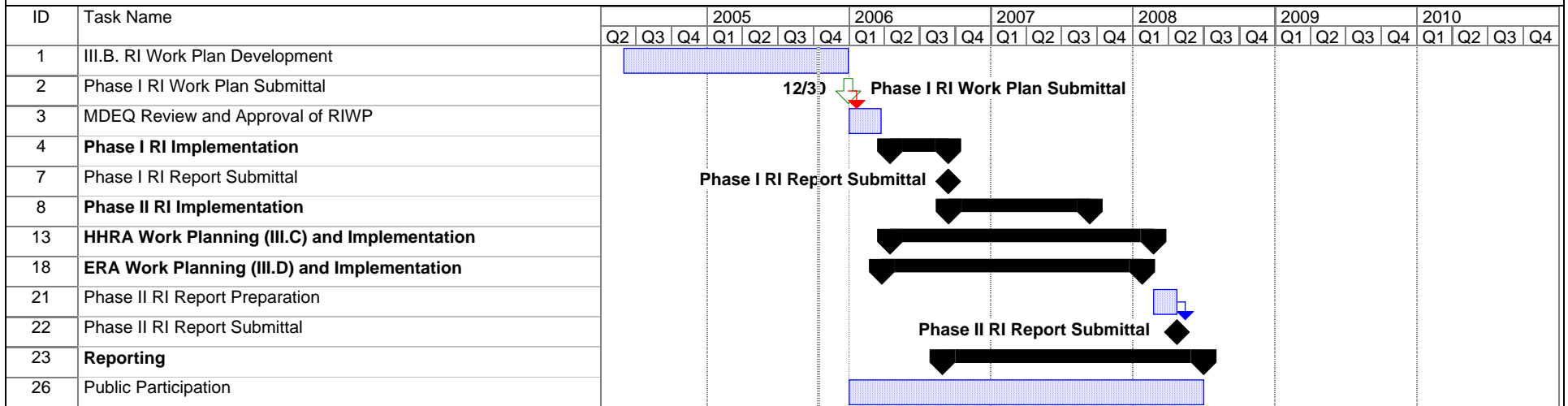
**Tittabawassee River Sediments and Floodplain Scope of Work**

Notes:

- 1) The shaded boxes are repeated from Figure 1: Remedial Investigation Overview to show where HHRA work occurs within RI
- 2) The Feasibility Study and Remedial Action Plan are shown conceptually to indicate steps beyond the RI



## Figure 2 - Preliminary RI Schedule: Tittabawassee River Sediments and Floodplain



Date: Thu 10/13/05	Task		Rolled Up Task		External Tasks	
	Critical Task		Rolled Up Critical Task		Project Summary	↓
	Progress		Rolled Up Milestone	◇	Group By Summary	↓
	Milestone	◆	Rolled Up Progress		Deadline	↓
	Summary	↓	Split			