UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 5

COMMENTS ON

Responses to the Michigan Department of Environmental Quality's (MDEQ) March 2 and April 13, 2006 Notices of Deficiency (May 1, 2006) Submitted to MDEQ by the Dow Chemical Company, Midland, Michigan (MID 000 724 724)

June 7, 2007

INTRODUCTION

The United States Environmental Protection Agency, Region 5 (U.S. EPA or the Agency) has completed a general review of the documents titled: "Remedial Investigation Work Plan -- Tittabawassee River and Upper Saginaw River and Floodplain Soils, Midland, Michigan" and "Midland Area Soils Remedial Investigation Work Plan" (the revised RIWPs). The revised RIWPs were submitted on December 1, 2006 to the Michigan Department of Environmental Quality's (MDEQ) by the Dow Chemical Company (Dow), Midland, Michigan in response to MDEQ's March 2, 2006 and April 13, 2006 Notices of Deficiency (NOD).

U.S. EPA acknowledges the efforts of Ann Arbor Technical Services, Inc. (ATS) to develop Dow's pilot GeoMorph sampling approach for the Tittabawassee River (TR) and floodplain and to revise Dow's Remedial Investigation Work Plan (RIWP) for the TR. Nevertheless, as detailed below, U.S. EPA has identified significant deficiencies in the revised RIWPs which the Agency recommends MDEQ require Dow to correct prior to approval of the documents. Accordingly, U.S. EPA recommends that MDEQ issue a NOD to Dow no later than thirty (30) days from the date of this letter requiring Dow to promptly address the deficiencies detailed in this document.

GENERAL COMMENTS (Listed in order of priority)

1. Corrective Action Compliance Schedule

The lack of detailed implementation schedules in the revised RIWPs is of primary concern to U.S. EPA. Dow's state-issued June 12, 2003 hazardous waste operating license (RCRA License or RCRA Permit) requires Dow to complete the characterization of any off-site contamination pursuant to specific timelines and the requirements of Part 201 of Michigan Act 451. Dow, however, is conducting its remedial investigation of the Saginaw Bay watershed without approved or enforceable compliance schedules in conflict with the terms and conditions of Dow's RCRA Permit. U. S. EPA recommends that MDEQ require Dow to submit detailed implementation schedules for approval and incorporation into Dow's RCRA License.

U.S. EPA believes that enforceable and detailed compliance schedules should be submitted by Dow to the State of Michigan and approved by MDEQ as required by Dow's RCRA Permit. These schedules should require Dow to complete the characterization of all off-site contamination from Dow's Midland facility pursuant to the requirements of Part 201 of Act 451 and under specific timelines approved by MDEQ. The requirement for such schedules is set forth in Part XI of Dow's RCRA Permit—Corrective Action Conditions.

Condition XI.B.3.b of Dow's RCRA License requires Dow to submit within 60 days of the issuance of the RCRA permit (June 12, 2003) to MDEQ Scopes of Work (SOWs) which:

> …must describe the proposed phasing and prioritization of work in a schedule based on consideration of potential risks to human health and the environment. In planning, submitting, and conducting each area/project/phase of the RI, the requirements listed in R 299.5528(3) of the administrative rules for Part 201 of Act 451 must be addressed. The areas identified in Condition XI.B.2. of this license covered under this SOW must be incorporated into the detailed Compliance Schedule for the facility under Condition XII.A. of Dow's RCRA License. The RI must include the development and submittal of detailed and legible figures and diagrams identifying the specific locations of known off-site soil and sediment impact areas.

The SOWs submitted by Dow to MDEQ for the City of Midland and the TR and Upper Saginaw River (USR) did not contain detailed compliance schedules as required by Condition XI.B.3.b of Dow's RCRA License. U.S. EPA considers Dow's failure to submit approvable SOWs to MDEQ with the compliance schedules identified above to be in conflict with the requirements Dow's RCRA License. U.S. EPA does not consider the schedule in Section 10 of the TR RIWP (10-1 and 2) to be sufficient to meet the requirements of Condition XI.B.3.b of Dow's RCRA License as it only provides a limited schedule for certain characterization activities.

Lastly, it should be noted that the SOWs have yet to be approved by MDEQ. U.S. EPA believes MDEQ approval of SOWs with enforceable compliance schedules is a priority in this matter and that no term or condition of the January 20, 2005 Framework Agreement (FA) between Dow and the State of Michigan should prevent MDEQ approval of SOWs with detailed compliance schedules, as EPA believes that the terms and conditions of Dow's RCRA Permit are the controlling authority in this regard (also, see comment # 42).

Recommendation:

- **U.S. EPA recommends that MDEQ require Dow to resubmit to MDEQ, within thirty (30) days, SOWs with approvable compliance schedules, as required by Dow's state-authorized RCRA license, meeting the conditions of XI.B.3.b of Dow's RCRA Permit, for approval by MDEQ and incorporation into Dow's RCRA License.**

2. Human Health Risk Assessment Work Plans

U.S. EPA is concerned that Dow's human health risk assessments (HHRAs) are inconsistent with current Agency guidance and set forth no compelling reason for departing from the Agency's policy or guidance, and the typically accepted methods for conducting such risk assessments. U.S. EPA has stated on several prior occasions that Dow's HHRAs are unacceptable due to these deficiencies [See U.S. EPA's February 10, 2006, "Critical Deficiency Comments On The Tittabawassee River and Floodplain Remedial Investigation Work Plan and Midland Area Soils Remedial Investigation Work Plan Midland, Michigan (December 2005)"].

U.S. EPA believes that Dow's proposed HHRAs will be of limited value in the selection of a final remedy for the contamination of the Saginaw Bay watershed. The Agency does not recommend MDEQ approval of the HHRAs in their current form. U.S. EPA believes that risks to human health and the environment posed by the contamination of the Saginaw Bay watershed

are so significant and widely distributed, that a risk assessment will unlikely provide site specific clean-up criteria that can be directly implemented at this site.

At sites as large and complex as the subject site, corrective measure technologies and their scope of application are often selected based on the amount of risk reduction that can be reasonably achieved by such measures, i.e. the amount of risk reduction is maximized until a point of diminishing returns is reached. Therefore, a presumptive approach utilizing a conventional HHRA is usually more appropriate. U.S. EPA recommends that MDEQ not approve Dow's proposed HHRA or Dow's unprecedented proposal to develop site-specific dose-response values for this site. U.S. EPA also believes Dow's HHRAs are fundamentally flawed because they only address dioxins and furans and do not consider other potential human health risks in the watershed. For example, U.S. EPA believes that a number of additional persistent bio-accumulative toxins (PBTs) were likely released by Dow to the Saginaw Bay watershed and may be contributing to human health risk. U.S. EPA is concerned that corrective action will be delayed if Dow repeats the currently proposed HHRA process to address other constituents in the watershed.

Lastly, U.S. EPA has significant concerns with human health risks associated with dioxin exposure through the food chain pathway, especially for at-risk populations such as pregnant women, children, Native Americans, subsistence and sport hunters and fishermen. A recent Michigan Department of Community Health study identified segments of the Saginaw Bay watershed population which consume significant amounts of highly contaminated bottom feeding fish. It should be noted that issues of environmental justice and fair treatment may be relevant with regard to some of these populations. U.S. EPA is concerned that Dow has not addressed such risks in its HHRAs or proactively initiated any IRAs specifically designed to address these significant health risks.

Recommendations:

- **U.S. EPA recommends that MDEQ require Dow to submit revised HHRA work plans which are consistent with U.S. EPA guidance to MDEQ and incorporate these work plans into the revised RIWPs. U.S. EPA has a significant interest in the resolution of this HHRA process due to the precedent setting effect this approach may have. U.S. EPA reserves its right to comment on any HHRA proposals submitted by Dow to MDEQ.**
- **U.S. EPA recommends that any detailed review and comment on Dow's HHRAs by MDEQ be postponed until Dow has resubmitted substantially revised HHRAs to MDEQ.**
- **U.S. EPA recommends that MDEQ limit its participation in working sessions with Dow to discuss the HHRAs until an approvable HHRA submittal has been provided by Dow to MDEQ.**

3. Ecological Risk Assessment Studies

U.S. EPA is concerned that Dow's ecological risk assessment (ERA) is inconsistent with current Agency guidance and the typically accepted methods for conducting such risk assessments. U.S. EPA recommends that MDEQ require Dow to submit a revised ERA work plan to MDEQ and incorporate an approvable ERA work plan into the revised RIWPs which is consistent with U.S. EPA guidance.

U.S. EPA does not believe that ecological risk has been adequately addressed by Dow in the revised RIWPs. First, Dow has not produced an ecological risk assessment work plan as part of its RIWP submittals, i.e. Dow's ERAs were submitted to MDEQ separately. Dow's Screening Level Ecological Risk Assessment and Baseline Ecological Risk Assessment work plans and studies are currently being conducted by Michigan State University. These studies appear to focus on a determination of ecological risk largely by the study of population-level effects. This methodology is typically not acceptable. This concerns U.S. EPA because it is known that individuals within a population can be adversely impacted by contaminants without observed population-level effects. Healthy individuals may be recruited into the local population from outside of the affected area. In addition, it is often difficult to identify causes of population-level effects due to natural variations or to isolate contaminant effects from other stressors, such as predator/prey population changes, habitat changes, etc., using such an approach.

While U.S. EPA guidance [Guidelines for Ecological Risk Assessment, U.S. EPA 630/R-95/002F April 1998 (e.g., Sections 3.3.1.1 through 3.3.1.3) and Ecological Risk Assessment Guidance for Superfund, U.S. EPA 540/R-97/006 June 5, 1997 (e.g., Section 4.2.2)] allow for the consideration of population studies when determining ecological risk, the primary determining factor(s) should be focused on individuals that represent likely exposure pathways.

Recommendation:

- **U.S. EPA recommends that MDEQ require Dow to determine ecological risk through the use of traditional ecological risk assessment methodologies pursuant to the requirements of Agency guidance.**

4. Interim Response Activities

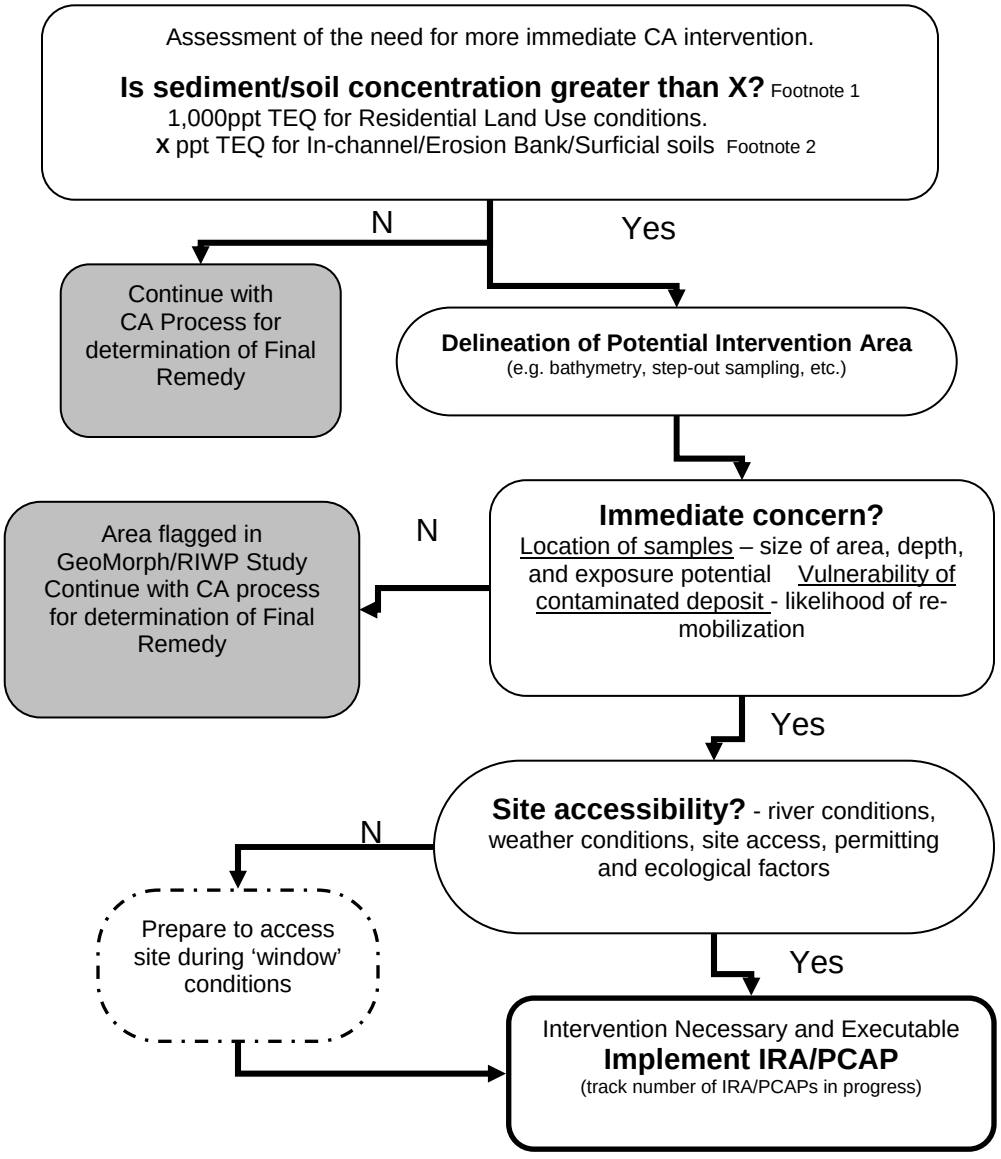
U.S. EPA is concerned with Dow's lack of progress in addressing the significantly elevated levels of dioxin and furan contamination in the Saginaw Bay watershed through the timely implementation of Interim Response Actions (IRAs) as required by Dow's RCRA Permit. In particular, U.S. EPA is not satisfied with the pace of implementation of the IRAs proposed by Dow in the upper six miles of the Tittabawassee River. In addition, U.S. EPA is concerned with Dow's lack of progress in implementing additional IRAs in the Saginaw Bay watershed, e.g. sediment traps to reduce the migration of contaminated sediments into Saginaw Bay of Lake Huron and to reduce the potential health risks associated with the consumption of contaminated fish and game in the watershed.

U.S. EPA has significant concerns with the scope and timing of the IRAs proposed by Dow in the TR flood plain and with Dow's failure to initiate additional IRAs in the Saginaw Bay watershed to reduce the migration of contaminated sediments into Saginaw Bay. U.S. EPA believes that hazardous constituents are actively migrating downstream from Dow's facility into Lake Huron. U.S. EPA concurs with MDEQ's decision to establish and approve the methodology below (see IRA/PCAP Implementation Decision Tree) setting forth specific criteria for triggering future IRAs when new hot spots are identified in the Saginaw Bay watershed.

IRA/PCAP Implementation Decision Tree

Dow/DEQ Working Draft 3/9/07

Objective: To define a process that consistently addresses future sampling results for determining when the IRA/PCAP response needs to be judiciously initiated. Any identified IRA/PCAP work is performed to reduce human exposure for the short term and is separate from the ongoing requirement to complete the Corrective Action (CA) process for selecting, designing and implementing the final corrective measures/remedial action plan which will address long term human health and ecological issues (which may incorporate IRA/PCAP work into the final CA measure).



Footnote 1: This decision tree currently applies only to Dioxins & Furans. This IRA/PCAP decision process will need to be reviewed and revised based on continued RIWP findings (e.g. other PCOIs, other factors affecting IRA/PCAP process).

Footnote 2: evaluation of 'surficial soils' is to include intervals up to and including one foot in depth.

Recommendations:

- **U.S. EPA recommends that MDEQ order Dow to complete the proposed IRAs for Reach D & Reach O in the TR by the end of the 2007 calendar year.**
- **U.S. EPA recommends that MDEQ require Dow to promptly initiate IRAs to address the downstream migration of contaminants, e.g. the design and construction of one or more sediment traps to capture these materials by no later than October of 2008.**
- **U.S. EPA recommends that MDEQ establish, approve and incorporate into Dow's RCRA Permit the methodology above (see IRA/PCAP Implementation Decision Tree) setting forth specific criteria for triggering future IRAs when new hot spots are identified in the Saginaw Bay watershed. U.S. EPA believes this methodology will significantly expedite the implementation of future IRAs in the Saginaw Bay watershed. This methodology will also provide Dow with certainty with regard to its IRA permit obligations and will provide MDEQ with a reasonable method to prioritize future IRA response actions.**
- **U.S. EPA recommends that MDEQ require Dow to submit for approval an IRA implementation schedule to be incorporated into Dow's RCRA Permit.**

5. Description of Dow's Historical Plant Operations and Waste Management Practices

Dow's description of historical plant operations and waste management practices at its Midland, Michigan facility has significant deficiencies. Dow provides no specific information in the revised RIWPs concerning the many hazardous constituents potentially released by Dow to the Saginaw Bay watershed, aside from a relatively detailed history of Dow's historic chlorine production and a general list of products produced by Dow. This is despite the fact that Dow produced several hundred chemical products, and many by-products, at its Midland, Michigan facility over the last century. In addition, because several significant chemical constituents likely to have been released from Dow's Midland facility have been found in the surrounding environment, e.g. Octachlorostyrene, DDT, Hexachlorobenzene, etc., it is important that Dow provide additional information in the revised RIWPs on these chemicals.

U.S. EPA does not consider Dow's description to be complete given the scope of Dow's chemical operations in Midland, Michigan. The limited information provided by Dow to MDEQ in the revised RIWPs is problematic.

Recommendations:

- **U.S. EPA recommends that MDEQ require Dow to substantially revise its description of Dow's historical plant operations and waste management practices at Dow's Midland facility in the revised RIWPs.**

6. Corrective Action Activities--Incomplete Submittals with "Placeholders" and a Pattern of Missed Deadlines

U.S. EPA believes that the record in this matter demonstrates a pattern by Dow of missed deadlines and the submittal of incomplete corrective action documents to MDEQ (see Dow Off-Site Corrective Action Activity Table below). U.S. EPA considers these actions by Dow to be inconsistent with the requirements of Dow's RCRA License. U.S. EPA is particularly

concerned with the numerous "placeholders" Dow has identified in the revised RIWPs, i.e. incomplete sections of the revised RIWPs. Dow has proposed to submit the missing sections at a later date or further revise the sections, over time, through "working sessions" with MDEQ. This approach to corrective action is not efficient and is inconsistent with the requirements of Dow's RCRA permit. The Agency has significant concerns with Dow's use of this placeholder and working session approach for the following reasons:

- The placeholder and working session approach to the submittal of the revised RIWPs is in violation of the Notices of Deficiency (NODs) issued to Dow by MDEQ on March 2, 2006 and April 13, 2006. The NODs require Dow to modify and resubmit the revised RIWPs correcting the identified deficiencies. MDEQ has provided more than sufficient time to Dow (over two years) to submit final and approvable RIWPs.
- The placeholder and working session approach to the submittal of the revised RIWPs limits the exchange of documents and the record in this matter, obscuring what would otherwise be a transparent decision making process. In addition, the working session approach has resulted in one or more disputes concerning agreements reached during this largely undocumented process. For example, see Dow's May 22, 2007 letter to MDEQ concerning MDEQ's May 3, 2007 approval of the GeoMorph pilot characterization methodology in which Dow questions several oral agreements which MDEQ presumed were reached between MDEQ and Dow during the recent GeoMorph working sessions.
- U.S. EPA believes that the placeholder and working session approach has not been successful in achieving progress toward the submittal of approvable RIWPs.

U.S. EPA Summary of Corrective Action Activities to date:

DOW OFF-SITE CORRECTIVE ACTION ACTIVITY				
Document	**Date Due**	**Date Submitted**	**Late**	**Completeness**
SOW for conducting an RI for Midland Area Soils and Tittabawassee River Sediments and Flood Plain	8/12/03	8/11/03		Deficient
Revised SOW in response to MDEQ comments	2/17/04 (MDEQ Granted Extension) Delay caused by undocumented negotiations on SOW, and Framework negotiations	1/23/04 Revised 9/19/05 Revised 10/14/05		Deficient
Submit revised RIWPs	12/31/05 (Framework Agreement)	12/29/05		Critically Deficient
Revised RIWPs (first revision)	5/2/06 (60 days after NOD)	5/1/06		Deficient
Revised RIWPs (second revision)	12/1/06 (6 month extension by MDEQ from original due date)	12/1/06		Incomplete due to many "placeholders"
Pilot GeoMorph Workplan	5/16/06 (4/26/06 meeting notes and 5/1/06 NOD response) 5/24/06 (5/18/06 meeting) 6/1/06 (5/25/06 meeting)	- - 6/1/06	Late	Incomplete: • No PCOI study • No Geochemistry study • Incomplete statistical

DOW OFF-SITE CORRECTIVE ACTION ACTIVITY				
Document	**Date Due**	**Date Submitted**	**Late**	**Completeness**
				evaluation method
Revised Pilot GeoMorph Workplan	6/30/06 (Working sessions)	6/30/06		Approved on Pilot Basis
PCOI Investigation	5/16/06 (4/26/06 meeting notes and 5/1/06 NOD response) After 6/1/06 (5/18/06 meeting)	6/1/06 12/1/06	Late Late	Incomplete Under review
Geochemistry Study Workplan	5/16/06 (4/26/06 meeting notes and 5/1/06 NOD response) 6/1/06 (5/25/06 meeting)	- 6/8/06 Revised 6/14/06	Late	 Approved on pilot basis
Dioxin SOP	5/26/06	6/1/06 Revised 6/15/06 Revised 6/16/06	Late	Incomplete
GeoMorph Pilot Final Report	2/1/07	2/1/07		Incomplete: • No Geochemistry Study • No concentration contour maps • No SWAC maps • Incomplete analysis
Geochemistry Study	2/1/07 4/1/07 (GeoMorph final report)	- 3/30/07	Late	 Incomplete Requires a Phase 2
Sediment Trap Pilot Study (Environmental Monitoring Data Results)	3/1/07	-	Late	
Detailed PCAP Workplan	1/17/07 2/20/07 (MDEQ 12/21/06 letter) 3/07 (2/20/07 PCAP Workplan) 4/07 (verbal)	- 2/20/07 - -	Late	 Incomplete

Recommendations:

- **U.S. EPA recommends that MDEQ focus on reviewing and approving the portions of the revised RIWPs that are critical to additional characterization sampling, and defer review and approval of the remaining portions of the revised RIWPs. U.S. EPA fully supports MDEQ's goal of ensuring that Dow conducts the next phase of characterization including the Middle TR, during the 2007 construction season.**
- **U.S. EPA recommends that Dow be required to comply with its RCRA permit, by meeting required submittal due dates and submitting complete and approvable documents, as required by EPA's authorization of Michigan's**

RCRA program. U.S. EPA recognizes the potential value and possible efficiencies that may be gained from a collaborative process, however, use of this process should be limited to major objectives and the resolution of significant issues.

- **U.S. EPA recommends that MDEQ initiate an enforcement action to address Dow's continuing RCRA Permit violations.**

7. Failure to Report all Environmental Monitoring Data and Improper Application of Confidential Status to Data

U.S. EPA believes the record in this matter demonstrates a pattern of repeated failures by Dow to report environmental monitoring data to MDEQ and a pattern of improper application by Dow of confidential status to otherwise public data. U.S. EPA considers these actions by Dow in conflict with the terms and conditions of Dow's RCRA License. While these issues are not directly related to deficiencies in the revised RIWPs, U.S. EPA believes it is necessary to identify for the record the Agency's concerns with Dow's continuing failure to properly submit all environmental monitoring information and data to MDEQ and to do so in a transparent manner, as required by Dow's RCRA License.

Condition II.L.6. of Dow's RCRA License requires Dow to report to MDEQ, in accordance with Condition II.L.4., the results of any environmental sampling or analysis it conducts beyond that required by Dow's License. Condition II.L.4 requires Dow to submit the results of all environmental monitoring required by its RCRA license in the form of an Environmental Monitoring Report (EMR) to the Chief of the Waste and Hazardous Materials Division within 60 days after the end of the quarter in which the sample(s) were collected. {R 299.9521(1)(a) and 40 CFR §270.30(l)(4), which is ABR in R 299.11003}. Dow has repeatedly failed to meet these conditions its RCRA permit by failing to properly submit required environmental information and data to MDEQ.

Condition II.L.4 and 6 of Dow's RCRA license required Dow to submit the results of any sampling and analysis conducted by Dow during the fourth quarter of 2006 (October through December) in the form of an EMR to MDEQ by no later than March 1, 2007. It is a matter of public record that Dow was to have conducted field sampling and analysis in the Saginaw River as part of its October 16, 2006 "Characterization of Sediments in the Ojibwa Turning Basin Field Sampling and Analysis Plan, Saginaw River, Michigan" and "Sediment Trap Filed Performance and Feasibility Study in the Saginaw River Sixth Street Turning Basin--Sampling and Analysis Plan (SAP)" sediment trap studies. Dow did not provide this data to MDEQ until April 24, 2007. This ongoing failure to provide data within time frames specified in Dow's RCRA permit continues despite the fact that Dow was issued a Notice of Violation (NOV) by MDEQ for a similar series of violations on September 19, 2005.

U.S. EPA also has significant concerns with the agreement between the City of Midland and MDEQ to allow Dow to partially shield corrective action data gathered within the City of Midland from public disclosure. U.S. EPA considers the holding of what would normally be publicly available corrective action data in a confidential manner by a third party not subject to the terms and conditions of Dow's RCRA License to be inconsistent with the recordkeeping and reporting requirements of Dow's RCRA License. Condition II.L.4 and 6 of Dow's RCRA License requires Dow to report to MDEQ the results of all environmental monitoring performed

under Dow's RCRA Permit. Nowhere within Section II.L (Recordkeeping and Reporting) does Dow's RCRA License provide for the selective or partial reporting of data by Dow.

Recommendation:

- **U.S. EPA recommends that MDEQ consider issuing an NOV to Dow to address any future failure by Dow to report to MDEQ the results of any environmental monitoring.**

8. 2010 Timeline for Characterization and Remediation

U.S. EPA was encouraged to hear Dow propose, at the February 8, 2007 MDEQ/Dow public meeting, a more proactive implementation schedule, i.e. by 2010, for its corrective action activities. As stated above, however, Dow has not provided a detailed implementation schedule to MDEQ to achieve Dow's 2010 goal.

Recommendations:

- **U.S. EPA recommends that MDEQ require Dow to submit to MDEQ a detailed implementation schedule incorporating Dow's 2010 corrective action timeline into Dow's RCRA Permit.**
- **U.S. EPA recommends that MDEQ require Dow to submit to MDEQ a similar but separate implementation schedule for addressing the currently identified dioxin and furan hot spots in the upper TR.**
- **Should Dow fail to timely provide an acceptable implementation schedule to MDEQ, MDEQ should incorporate implementation schedules based on those provided in Comments 37 and 47 of this document into the revised RIWPs as part of any approval of these documents.**
- **U.S. EPA recommends that MDEQ require Dow to adhere to the following timelines for corrective action activities in the TR and the City of Midland when approving Dow's revised RIWPs.**

2007

- Remediate dioxin hot spots identified in 2006 (PCAP)
- Complete characterization of the middle Tittabawassee River and floodplain for all Target Analyte List (TAL) constituents
- Develop an understanding of the fate and transport characteristics (geochemistry study) of TAL constituents
- Complete characterization of the City of Midland
- Remediate any newly identified dioxin hot spots
- Approval of City of Midland and Tittabawassee River Remedial Investigation Work Plans
- Complete human health risk assessment
- Approval of lower Saginaw River and Bay Scope of Work

2008

- Complete characterization of the lower Tittabawassee and upper Saginaw River floodplains for all TAL constituents

- Implement IRAs for additional hot spots
- Complete ecological risk assessment in coordination with Natural Resource Damage trustees
- Approval of lower Saginaw River and Bay and Remedial Investigation Work Plans

2009

- Complete characterization of Tittabawassee and upper Saginaw River sediments
- Complete characterization of the lower Saginaw River and Bay for all TAL constituents
- Implement IRAs for additional hot spots
- Identify areas associated with unacceptable risk from TAL constituents
- Select final remedies

2010

- Implement final remedies

9. Pilot GeoMorph Study

U.S. EPA concurs with MDEQ that the Pilot GeoMorph study performed by ATS to develop a sampling approach for the TR and floodplain has merit. U.S. EPA, however, continues to have the following fundamental concerns with the GeoMorph approach as it is being applied at this particular site:

- Many of the concepts implicit in the GeoMorph characterization process presume an understanding of the geochemistry of the contaminants. A limited geochemistry study was provided to MDEQ on March 30, 2007. The study was not complete nor does it provide the required information needed to validate the GeoMorph approach. Typically, a geochemistry study should be completed before the initiation of field sampling work. Rather, ATS and Dow propose to continue to collect data using the GeoMorph approach despite the fact that that they have admitted they do not yet understand the geochemistry in the watershed. Therefore, it is critical that Dow completes the second phase of the geochemistry study as soon as possible.
- ATS has yet to demonstrate that the distribution of contaminants within the geomorphic units identified at this site is relatively homogeneous. Additional sampling results making this demonstration have not been provided to MDEQ, to the Agency's knowledge. This lack of demonstration calls into question the ability of ATS to conduct a GeoMorph approach at this site in a scientifically justifiable manner.
- A fundamental component of the GeoMorph process, as explained by ATS, is real-time remediation. This component of GeoMorph is not being implemented and calls into question the value of the GeoMorph approach when applied at this site.
- Dow/ATS have not, to date, produced maps, analyses or other relevant work product which MDEQ may use to verify the validity and value of the GeoMorph approach.

Recommendation:

- **U.S. EPA recommends that MDEQ require ATS/Dow to correct the above-listed deficiencies as soon as possible.**

SPECIFIC COMMENTS

COMMENTS ON REMEDIAL INVESTIGATION WORKPLAN FOR THE TITTABAWASSEE RIVER AND UPPER SAGINAW RIVER AND FLOODPLAIN SOILS

INTRODUCTION [Section 1]

10. U.S. EPA does not agree with the assertion that the GeoMorph process has been fully proven at this site. As stated above, a sufficient geochemistry study to explain the location and movement of dioxins and furans within the floodplain soils and river sediments has not been produced. In addition, Dow/ATS have yet to produce maps, analyses or other relevant work product which MDEQ may use to verify the validity and value of the GeoMorph approach.

    Recommendation:
    - **U.S. EPA recommends that MDEQ require Dow to complete the second phase of the geochemistry and submit the maps, analyses or other relevant work product discussed above as soon as possible.**

OBJECTIVES AND DELIVERABLES [Section 1.1]

11. U.S. EPA recommends that MDEQ require Dow to include in the TR RIWP the following objectives:

    - Identify constituents of concern beyond dioxins and furans.
    - Develop an understanding of the geological/geochemical parameters affecting contaminant distribution and bioavailability, including fate and transport mechanisms affecting the distribution of Potential Constituents of Interest (PCOIs).
    - Characterize the nature and extent of contamination in the Tittabawassee and Upper Saginaw Rivers (USR) and floodplains:
        - Identify and implement interim response actions to abate the further spread of contaminants, and control areas acting as continuing sources of contamination.
        - Develop depth based contour maps of contaminant concentrations.
    - Determine human health and ecological risks from PCOIs:
        - PCOI Human Health Risk, including:
            - Identify relevant exposure pathways.
            - Quantify PCOI exposure pathway risks.
            - Identify areas within the TR/USR associated with unacceptable risk.
        - PCOI Ecological Risk, including:
            - Identify relevant exposure pathways.
            - Quantify ecological PCOI exposure pathway risks.
            - Identification of areas within the TR/USR associated with unacceptable ecological risk.

RIVER-FLOODPLAIN EXCHANGE [Section 3.1.7.3]

12. The RIWP does not include a discussion of lateral erosion along river banks.

Recommendation:

- **U.S. EPA recommends that MDEQ require Dow to include a discussion of lateral erosion along river banks in this section, since this is likely a major continuing source of contaminated sediments into the river.**

HISTORICAL PLANT OPERATIONS AND WASTE MANAGEMENT PRACTICES [Section 3.3]

A majority of U.S. EPA comments on the revised RIWPs have been restricted to relatively general big-picture issues and concerns. The Agency is submitting more detailed comments to MDEQ on Sections 3 and 4 of the TR RIWP due to the impact the development of a complete and accurate PCOI list will have on Dow's remedial investigation. U.S. EPA believes a complete and accurate PCOI list is vital to a proper characterization of the Saginaw Bay watershed. U.S. EPA also believes that a detailed description of Dow's historic plant operations and waste management practices is necessary to develop a complete and accurate PCOI list.

While Dow has provided a relatively detailed history of Dow's historic chlorine production at Section 3.3.1.1 of the TR RIWP, Dow provides virtually no additional specific information, other than a list of products organized by decade(s), in the revised RIWPs concerning the many hazardous constituents potentially released by Dow to the Saginaw Bay watershed. U.S. EPA does not consider Dow's description to be complete.

Recommendations:

- **U.S. EPA recommends that additional work be completed by Dow and MDEQ to produce a complete and accurate PCOI list and that a revised PCOI list be approved by MDEQ as soon as possible. Agreement on a PCOI list is critical to the remedial investigation and to minimize repetitive or unnecessary sampling and analysis.**
- **U.S. EPA recommends that MDEQ require Dow to revise the "Historical Plant Operations and Waste Management Practices" section of Dow's TR RIWP to include the additional information concerning Dow's production of the chemicals identified below and their potential by-products. U.S. EPA recognizes that some of the chemicals discussed below are already on Dow's PCOI list. However, U.S. EPA believes that MDEQ should require Dow to provide additional information concerning the potential off-site release of such chemicals and their by-products as such information is essential to a complete and accurate PCOI list.**
- **U.S. EPA recommends that MDEQ, at a minimum, require Dow to address the production and the fate and transport of the following chemicals/products and their byproducts.**

<u>Historic Operations and Waste Management Practices at the Dow Corning Facility</u>

13. Dow does not provide a detailed discussion of the historic operations and waste management practices of the Dow Corning Corporation (Dow Corning) facility adjacent to Dow's Midland Plant in the revised RIWP. The Agency believes this discussion is necessary for the following reasons. First, it is U.S. EPA's understanding that one or more waste streams from the Dow Corning facility were, and are, discharged to the Dow waste water treatment facility. Such constituents were then likely discharged in combination with hazardous constituents from Dow's Midland Plant to the TR. U.S. EPA believes there is merit in

determining whether these constituents from the Dow Corning facility may have potentially affected the distribution of contaminants from Dow's Midland facility within the Saginaw Bay watershed. Second, it is U.S. EPA's understanding that Dow Corning may have discharged constituents from its facility directly to the TR through the Lingle drain. Dow's characterization of the hazardous contamination in the Saginaw Bay watershed, therefore, will not be complete without an understanding of the historic operations and waste management practices of the Dow Corning facility whose operations were, and are, intertwined with those of Dow's Midland facility.

U.S. EPA believes, based upon Dow's recent geochemistry study and other off-site sampling, that one potential explanation for the aberrant distribution of dioxins and furans in the Saginaw Bay watershed may be the presence of silicones in soils and sediments of the watershed released from the Dow Corning facility. In 2004, the Superfund Innovative Technology Evaluation project conducted by the Battelle Memorial Institute identified silicone compounds in all of the soil samples taken from the TR. U.S. EPA believes the presence of silicones in the soils and sediments of the Saginaw Bay watershed to be unique and, therefore, could be an explanation for the unusual distribution of dioxins and furans in the subject environment. U.S. EPA believes further investigation by Dow of this situation is warranted and recommends that MDEQ require Dow to provide a detailed discussion of the historic operations and waste management practices of the Dow Corning facility and their potential impact on hazardous contaminant distribution within the watershed.

Recommendation:

- **U.S. EPA recommends that MDEQ require Dow to supplement Section 3.3 of the TR RIWP with a detailed discussion of the historic operations and waste management practices of the Dow Corning facility adjacent to Dow's Midland Plant.**

History of 1986 Flood Event

14. Dow does not provide a detailed discussion of the 1986 flood event on the Tittabawassee River and the potential release of contaminants to the river during that event. U.S. EPA is concerned with this event because U.S. EPA believes there may have been a release of hazardous constituents from Dow's wastewater treatment facilities during this time period. If so, a detailed description of such events is warranted.

Recommendation:

- **U.S. EPA recommends MDEQ require Dow to supplement Section 3.3 of the TR RIWP with a detailed discussion of the 1986 flood event on the Tittabawassee River and the potential release of contaminants to the river during that event.**

Persistent, Bio-Accumulative and Toxic Pollutants (PBTs) Potentially Released by Dow

15. Dow does not provide a detailed discussion of the potential release of persistent, bio-accumulative and toxic pollutants (PBTs) which U.S. EPA has targeted for virtual elimination from the Great Lakes Basin to the Saginaw Bay watershed. U.S. EPA believes this information is critical to Dow's remedial investigation because the following substances have been associated with widespread, long-term adverse effects on wildlife in the Great

Lakes. In addition, due to their bio-accumulative tendencies and associated human health and ecological impacts, U.S. EPA believes the potential presence of these PBTs should be investigated by Dow, and, if they were released by Dow from its Midland, Michigan facility, their presence in the ecosystem should be properly addressed.

Recommendation:

- **U.S. EPA recommends that MDEQ require Dow to supplement Section 3.3 of the TR RIWP with a detailed discussion of the potential release of the following list of PBTs:**

Aldrin/dieldrin
Benzo(a)pyrene {B(a)P}
Chlordane (Dow-Klor and Dowchlor)
DDT (+DDD+DDE)
Hexachlorobenzene (HCB)
Alkyl-lead
Mercury and mercury compounds
Mirex(Hexachloropentadiene)
Octachlorostyrene
Toxaphene
Cadmium and cadmium compounds
1,4-dichlorobenzene
3,3'-dichlorobenzidine
Dinitropyrene
Endrin
Heptachlor (+Heptachlor epoxide)
Hexachlorobutadiene (+Hexachloro-1,3-butadiene)
Hexachlorocyclohexane
4,4'-methylenebis(2-chloroaniline)
Pentachlorobenzene
Pentachlorophenol
Tetrachlorobenzene (1,2,3,4- and 1,2,4,5-)
Tributyl tin
[Plus PAHs as a group, including but not limited to]:
Anthracene
Benzo(a)anthracene
Benzo(g,h,i)perylene
Perylene
Phenanthrene

U.S. EPA is particularly concerned with the following PBTs, due to the fact that these chemicals have either: 1) been identified in fish tissue in the Saginaw Bay watershed; 2) are known by-products of one or more chemical production processes identified by Dow in the revised RIWPs as having occurred at its Midland, Michigan facility; and/or 3) U.S. EPA has reason to believe these PBTs may have been produced and released by Dow from its Midland, Michigan facility.

Octachlorostyrene

Octachlorostyrene (OCS) is a PBT which is formed when graphite anodes are used during electrolytic production of magnesium from magnesium chloride. In addition, it is a byproduct from the electrolytic production of chlorine. OCS is a halogenated aromatic compound which is not commercially manufactured, but has been reported to be an inadvertent by-product of processes which combine carbon and chlorine, under elevated temperatures. OCS may also result from various incineration processes. U.S. EPA believes that several of the production processes identified by Dow in the TR RIWP, such as magnesium production, chlorinated solvent production, chlor-alkali and chlorine production and hazardous waste incineration, are likely sources of OCS to the environment [see table below].

Table 1. Sources of OCS Reported in the Literature[1]

Industry	Industrial Process	Literature Reference
Magnesium Production	Purification of magnesium with chlorine and carbon under high temperature, plus electrolytic separation of magnesium from chlorine with graphite electrodes	Lunde & Bjorseth 1977; Oehme et al. 1989
Chlorinated Solvents	Commercial production of carbon tetrachloride and tetrachloroethylene	Otero & Grimalt 1994; King & Sherbin 1986; Markovec & Magee 1984; Durham & Oliver 1983
Semiconductor/ Microelectronics	Aluminum plasma etching with chlorinated solvents	Schmidt et al. 1995; Raabe et al. 1993
Secondary Aluminum/Metal Alloy Casting	Aluminum degassing with hexachloroethane	Westberg et al. 1997; Selden et al. 1997; Vogelgesang 1986
Niobium and Tantalum	Ore extraction with chlorine	Vogelgesang 1986
Titanium	Chlorination of titanium ore or chlorine regeneration from MgCl2	Vogelgesang 1986
Incineration	Incomplete combustion of chlorinated compounds	Ahling et al. 1978; Lahaniatis et al. 1989
Chlor-alkali/Chlorine	Production with Graphite Anodes Electrolytic separation of chlorine from brine using graphite electrodes, no longer in use today	Kaminsky & Hites 1984; Svensson et al. 1993
Primary and Secondary Copper Smelting	Chlorinating roasting process not used in the U.S.; Recycling of scrap copper	Döring et al. 1992

Concern over the occurrence of OCS in the environment is driven by two main factors: its persistence (i.e., its resistance to chemical and/or metabolic degradation) and its high bioaccumulation potential (i.e., increase in concentration in higher order wildlife of an aquatic food web). Studies of potential human toxicological effects are few, because OCS

was never an intentionally produced product, for which such studies would be commissioned. However, U.S. EPA believes that since OCS is structurally similar to hexachlorobenzene (HCB) in its aromaticity and degree of chlorination, it can reasonably be anticipated to have a similar toxicological profile.

U.S. EPA believes an investigation into OCS contamination in the watershed is warranted because, based upon Dow's description of its historical plant operations and waste management practices at Dow's Midland facility, Dow's Midland facility may have been a significant source of OCS to the Saginaw Bay watershed and Lake Huron.

Hexachlorobenzene

Hexachlorobenzene (HCB) is a PBT which was synthesized as a fungicide and which is no longer commercially produced in the United States. HCB is formed as an inadvertent by-product in the production of silicone products, pesticides, chlorine, and in other chlorination processes. HCB is also generated as an impurity during the production of chlorinated solvents, such as carbon tetrachloride, perchloroethylene, trichloroethylene, ethylene dichloride, and 1,1,1-trichloroethane. HCB was used in the past as a solvent and as an intermediate and/or additive in various manufacturing processes, including the production of PVC, pyrotechnics and ammunition, dyes, and pentachlorophenol. Although HCB is no longer used directly as a pesticide, it is currently formed as an inadvertent by-product at trace levels in the production of chemical solvents, chlorine and chlorine-containing compounds, and several currently used pesticides. Combustion of chlorinated waste material may also emit HCB. HCB was also formed during the electrolytic production of chlorine using graphite anodes and may be generated as an impurity in the synthesis of chlorinated pesticides such as: atrazine, chlorothalonil, dimethyltetrachloro-terephthalate (DCPA), lindane, pentachloronitrobenzene (PCNB), pentachlorophenol, picloram, and simazine. In addition, HCB has been identified as a residue level contaminant in the wood preservative pentachlorophenol. HCB air emissions have also been reported for hydrochloric acid (HCl) production and as a result of incomplete combustion of chlorinated substances from hazardous waste and sludge incinerators.

In water, HCB binds to sediments and suspended matter. In soil, HCB binds strongly and generally does not leach to water. Transport to ground water is slow, but varies with the organic makeup of the soil, as HCB tends to bind more strongly to soils with high organic content. Co-solvents in active/inactive sites can mobilize HCB. HCB bio-accumulates in both terrestrial and aquatic food chains. HCB accumulates in fatty tissues and its presence in fish, plants, and wild game species can be a source of ingestion exposure for humans.

HCB is considered a probable human carcinogen and is toxic by all routes of exposure. The general population appears to be exposed to HCB primarily through the food chain. Ingestion of HCB-contaminated fish is potentially the most significant source of exposure. HCB bio-accumulates in fish, marine animals, birds, lichens, and their predators. HCB has been found in fish and wildlife in the TR and the Great Lakes. Native populations who consume locally caught fish and game species may be particularly susceptible to high levels of HCB exposure. Based on studies conducted on animals, long-term low exposures may damage a developing fetus, cause cancer, lead to kidney and liver damage, and cause fatigue and skin irritation.

U.S. EPA believes an investigation into HCB contamination in the watershed is warranted because, based upon Dow's description of its historical plant operations and waste management practices at Dow's Midland facility, it may have been a significant source of HCB to the Saginaw Bay watershed and Lake Huron.

Aldrin, Dieldrin, Chlordane, DDT, Mirex and Toxaphene

Aldrin, dieldrin, chlordane (Dow-Klor and Dowchlor), DDT, mirex (Hexachloropentadiene), and toxaphene are all highly chlorinated PBTs that were once widely used in large quantities in the United States. Because of evidence supporting the adverse environmental and human health effects of these substances, including their probable carcinogenicity, their use has been banned in the United States. These highly chlorinated organic compounds degrade very slowly, and as a result, generally persist in the environment. In soils, these pesticides generally bind strongly to particles, and may remain in surface soils for long periods of time. In aquatic systems, most of these pesticides are not very soluble in water, and typically tend to accumulate in the solid phase (suspended particulate matter and bottom sediments) due to their tendency to bind to particles, and, therefore, they may also persist for years in aquatic sediments.

In biota, these pesticides tend to accumulate in biological tissues, especially the fatty tissues of fish and piscivorus (fish-eating) wildlife, such as marine mammals and predatory birds, as well as humans. As these substances are taken up by shellfish and fish from contaminated water and sediments, they tend to bio-magnify (accumulate in increasing larger amounts) through the food chain. This bioaccumulation and bio-magnification can result in high levels of these pesticides in fish, aquatic mammals, and other fish-consuming species. Human exposure to these pesticides occurs mainly through the food chain. Potential risk and health consequences due to these pesticides are of particular concern for certain human populations who have increased exposure (e.g., subsistence fishers) and/or increased susceptibility (e.g., the developing embryo/fetus, nursing infants, and children). Long-term health effects of these pesticides can include: central nervous system damage and neurological system disruption; damage to the reproductive system; liver, kidney and thyroid damage; and damage to the digestive system. Some of these pesticides (e.g., chlordane) may also cause neurological and behavioral disorders in children who are exposed before birth or while being nursed, and may increase the chance of miscarriage. Many of these pesticides are suspected endocrine disruptors, and all are classified by U.S. EPA as probable human carcinogens based on sufficient evidence from animal studies.

U.S. EPA believes an investigation into aldrin, dieldrin, chlordane, DDT, mirex, and toxaphene contamination in the watershed is warranted because, based upon Dow's description of its historical plant operations and waste management practices at Dow's Midland facility, it may have been a significant source of aldrin, dieldrin, chlordane, DDT, mirex, and toxaphene to the Saginaw Bay watershed and Lake Huron.

Additional Significant Products or Pollutants Likely Released by Dow

16. Dow does not provide a detailed discussion of the following historic operations and waste management practices conducted at its Midland, Michigan facility. This information is

necessary because the production of these products or their associated processes occurred over significant periods of time and may have resulted in the release of large quantities of hazardous constituents to the environment.

Magnesium Production

At Section 3.3.1.2 of the TR RIWP, Dow states that it was "one of the United States largest producers of magnesium…", nevertheless, Dow fails to specifically describe the process or processes by which such magnesium was produced or identify any hazardous byproducts that may have been produced and released to the environment from such process or processes. U.S. EPA considers this to be a substantial omission from Dow's production history. A detailed description of Dow's historic magnesium production and the associated process and waste streams is necessary to Dow's remedial investigation and should be included in this section. This is especially important since Dow states that it was the major producer of this metal for a number of decades and that this metal was one of Dow's largest products by tonnage measure during 1939-1945 (3.3.1.2).

Recommendation:

- **U.S. EPA recommends that MDEQ require Dow to provide additional information in its TR RIWP concerning its magnesium production including, but not necessarily limited to, the chemical reaction(s) that Dow used to produce magnesium; the specific location(s) and date(s) where and when magnesium was produced; the amount of magnesium produced on a yearly basis; and the identity of the byproducts that may have resulted from the production of magnesium.**

Polyvinyl Chloride

At Section 3.3.1.2 of the TR RIWP, Dow states that it produced polyvinyl chloride (PVC) plastic, commonly known as vinyl, which was used in a myriad of applications. The PVC life cycle begins with the generation of chlorine gas and ethylene. These are combined to create ethylene dichloride, which is used to make vinyl chloride monomer. The monomer is polymerized into polyvinyl chloride, and the PVC is then mixed with various additives and formed into various other plastic products. Chlorine gas used in PVC production is normally made by splitting salt (sodium chloride) at facilities called chloralkali plants.

It is known that many toxic chemicals, including numerous PBTs, are used, created and/or released to the environment throughout the PVC life cycle, i.e. via manufacture, use and disposal. PBTs are also added as catalysts and stabilizers during the PVC production process. Persistent chlorinated organics such as dioxin and hexachlorobenzene are generated as by-products in the manufacture of chemicals used as PVC feedstocks. Also, additives such as phthalates, which can persist and bioaccumulate in certain organisms, are added to PVC before it is molded into final products. Chlorine gas produced at chloralkali plants can contain mercury and other persistent toxic chemicals contaminants, including trace amounts of hexachlorobenzene, hexachloroethane, PCBs and OCS. It is known that the use of graphite electrodes used in the manufacture of chlorine gas at chloralkali plants generates octachlorostyrene as well as polychlorinated dioxins and furans. For example, OCS contamination of Lake Ontario sediment has been traced to the disposal of used graphite electrodes from the chloralkali industry. In addition, high levels of polychlorinated dioxins

and furans have been found in the blood of workers who handled sludge from chloralkali plants where graphite electrodes were used.

The combination of chlorine and ethylene to make ethylene dichloride likewise generates persistent toxic chemicals and PBTs, including polychlorinated dioxins and furans, PCBs, hexachloroethane, and hexachlorobutadiene. The production of both ethylene dichloride and vinyl chloride monomer -- the next product of PVC manufacture -- can result in wastes containing chloroform, hexachlorobenzene, di-(2-ethylhexyl) phthalate (DEHP), zinc, copper, and dioxin. Small amounts of dioxin can also be emitted when vinyl chloride monomer is polymerized into PVC. In addition, some (but not all) studies show that trace amounts of polychlorinated dioxins and furans can be found in PVC resin and in finished PVC products. In addition, because very high temperatures are needed to make certain PVC products, stabilizers must be used to prevent PVC from degrading during production. Dow, however, fails to describe the process or processes by which PVC was produced or identify any hazardous byproducts that may have been produced and released to the environment from such process or processes. Again, U.S. EPA considers this to be a substantial omission from Dow's production history.

Recommendation:

- **U.S. EPA recommends that MDEQ require Dow to provide additional information in its RIWP concerning its production of PVC including, but not necessarily limited to the chemical reaction(s) that Dow used to produce PVC; the specific location and dates where and when PVC was produced; the amount of PVC produced on a yearly basis; and the identity of the byproducts that may have resulted from the production of PVC.**

Chlorophenol Production

Chlorophenols are a group of chemicals in which chlorines (between one and five) have been added to phenol. Phenol is an aromatic compound derived from benzene, the simplest aromatic hydrocarbon, by adding a hydroxy group to a carbon to replace a hydrogen. There are five basic types of chlorophenols: monochlorophenols, dichlorophenols, trichlorophenols, tetrachlorophenols and pentachlorophenols. In all, there are 19 different chlorophenols, including, but not limited to, 2,4-dichlorophenol, 2,4,5-Trichlorophenol (TCP) [Dowicide 2, Dowicide B], 2,4,6-TCP [Dowicide 25], 2,4,5, 6-Tetrachlorophenol (TTCP) [Dowicide 6] and Pentachlorophenol (PCP) [Dow PCP DP-2 Antimicrobial, Dowicide 6, Dowicide 7, Dowicide-7 antimicrobial and Dowicide EC-7].

Of particular note, PCP was one of the most widely used biocides in the United States prior to EPA regulatory actions to cancel and restrict certain non-wood preservative uses of pentachlorophenol in 1987. PCP is a standardized oil-borne preservative listed in the AWPA Book of Standards under P8, Section 1. The production of PCP for wood preserving began on an experimental basis in the 1930s. In 1947 nearly 3,200 metric tons of pentachlorophenol was reported to have been used in the United States. Before the 1987 Federal Register Notice that canceled and restricted certain non-wood uses, pentachlorophenol was registered for use as a herbicide, defoliant, mossicide, and as a disinfectant, but now all these uses have been cancelled. As of 2002, approximately 11 million pounds of PCP were produced. Hexachlorobenzene (HCB) and dioxins/furans (CDDs/CDFs) are known contaminants of pentachlorophenol.

Exposure to high levels of PCP can cause increases in body temperature, liver effects, damage to the immune system, reproductive effects, and developmental effects. Damage to the thyroid and reproductive system has been observed in laboratory animals exposed to high doses of pentachlorophenol. Some of the harmful effects of pentachlorophenol are caused by the other chemicals present in pentachlorophenol. Increases in liver, adrenal gland, and nasal tumors have been found in laboratory animals exposed to high doses of pentachlorophenol. Death, low body weights, decreased growth, and skeletal effects have been observed in laboratory animals exposed to high levels of pentachlorophenol during development. Environmental exposures and risks to aquatic and terrestrial wildlife may occur via food items from soil contaminated with HCB and dioxins/furans. EPA has determined that PCP is a probable human carcinogen and the International Agency for Cancer Research (IARC) considers it possibly carcinogenic to humans.

Also of note, TCP is a germicidal agent that has been used to preserve wood and glue, to protect textiles against mildew, and also as a bactericide, fungicide, and component in the synthesis of defoliants in herbicide. Production of TCP (for sale as an end product) was discontinued in 1975 by Dow Chemical Company, the only manufacturer of trichlorophenol in the United States, because of the high cost of removing toxic dioxin impurities. Of the six isomers of TCP, 2,4,5-TCP and 2,4,6-TCP are considered priority pollutants. Dioxin is a known by-product and trace contaminant of TCP.

Despite the fact that dioxin is a known byproduct or trace contaminant of many of the above-listed chemicals, Dow fails to describe the process or processes by which chlorophenols were produced at its Midland, Michigan facility or identify any hazardous byproducts that may have been produced and released to the environment from such process or processes. Again, U.S. EPA considers this to be a substantial omission from Dow's production history.

Recommendation

EPA recommends that MDEQ require Dow to provide detailed information in the revised RIWPs concerning its production and disposal of chlorophenols. This information is necessary to more fully understand the fate and transport of HCB and dioxins/furans within the Saginaw Bay watershed.

Additional Dow Products, Chemicals and By-Products Requiring More Information

Dow references the following products in the RIWP, however, provides no additional information concerning the production and environmental fate and transport of each of these products or their by-products.

Dow products mentioned in Section 3.3 but not listed in Table 3-3 and 3-4

trinitrophenol
dichloroethylsulfide
mustard agent
ethylene glycol
ethylene chlorohydrin and its acetate
sodium acetate
trichloroethylene,
synthetic amino acids
phenylethyl alcohol
carbonic acid
ethylene dichloride
propylene dichloride
synthetic ammonia
Dowtherm™ (diphenyl and diphenyloxide)
Dowell™ (hydrochloric acid)
Dowex™ ion exchange resins

CC-2 (impregnite)
2-chloro-Nisopropylacetanilide (Propachlor™)
Seldane™ (antihistamine)
Drytech™
1,1,1-Trichloroethane- TCA
Ethyl Cellulose
Vinyl Chloride (Saran™)
Vinylidene Chloride
Polyvinyl Chloride (PVC)
Ethanolamines
Styron™ polystyrene
Plastic and Plastic Lattices
Soil Fumigant
Weed Killers
Ethylene Dibromide
ethyl benzene
Bisphenol A
Chloro-alkali plant products
Trichlorobenzene

Table 3-3 Products Circa 1926-1928

acetic acid
Dowmetal™ (magnesium)
orthodichlorobenzene
acetic anhydride
Epsom salt (magnesium sulfate)
orthophenylphenol
acetylene tetrabromide
ethyl chloride
paradibromobenzene
acetylsalicylic acid
ethyl monochloracetate
paradichlorobenzene (Paradow)
ammonium bromide
ethylene bromide
paraphenetidin
ammonium salicylate
ethylene chlorbromide
paraphenylphenol
aniline hydrochloride
ethylene chlorhydrin
pentachloroethane
aniline oil
ferric chloride
phenol
anthralic acid
ferrous chloride
phenol salicylate
barium bromate
hexachloroethane
phenyl acetate
Bordo mixtures
hydrobromic acid
phenyl ethyl alcohol
bromoform
lead arsenate
potassium bromate
cadmium bromate
lime sulfur
potassium bromide
calcium arsenate
lithium bromide
propylene chloride
calcium bromide
lithium salicylate
purified bromine
calcium chloride
magnesium arsenate
salicylaldehyde
camphor
monobrominated
magnesium bromate
sodium bromate
carbolic acid
magnesium bromide
sodium bromide
carbon bisulfide
magnesium chloride
sodium chloride
carbon tetrachloride
magnesium oxychloride
sodium salicylate
caustic soda
magnesium salicylate
sodium sulfide
chloracetyl chloride
methyl anthranilate
strontium bromide
chlorine
methyl bromide
strontium salicylate
chloroform
methyl salicylate
sulfur chloride
Ciba dyes (7 colors)
methylene chloride
sulfur monochloride
cinchophen
Midland Vat Blue dyes (3 types)
synthetic indigo
coumarin
mining salts
tetrachloroethane
dichloromethane
monobromobenzene
tetrachloroethylene
dichloroacetic acid
monochloroacetic acid
tribromophenol
diethylaniline
monochlorobenzene
trichloroacetic acid
dimethylaniline
nicotine
sulfate
diphenyloxide
orthocresotinic acid

Table 3-4 Continued New Product Introductions during the 1940s, 1950s, and 1960s

1,1-dichloroethane
1,2,4,5-tetrachlorobenzene
2,4,6-trichlorophenol
2-(2,4-dichlorophenoxy)acetic acid (2-4-D; Dowspray™ 66
Esteron™ 44; Esteron™ 99; Esteron™ Brush Killer)
2-chloropropionic acid
4-chloro-2-phenyl-phenol (Dowicide™ 32)
acrylonitrile

alpha-methylstyrene
antipyrene
bromoform
demethylaminobenzene
dicyclopentadiene
diethylbenzene
diisopropanolamine
dinitro-o-sec-butylphenol (Dinoseb™, Premerge™, DN289™)
methylchloroacetate
propylene glycol
sodium trichloroacetate
toluene
xylidene
2,4,5-T (Esteron™ 245)
4-chloro-2-cyclopentyl-phenol (Dowicide™ 9)
1,2-dibromo-3-chloropropane (Fumazone™)
1-methoxy-2-propanol (Dowanol™ PM)
2-(2,4,5-trichlorphenoxy) ethyl 2,2-dichlorpropanoate (Erbon™)
2,2-dichloroproprionic acid (Dalapon™)
2-chloro-1-morpholin-4-yl-ethanone (Morpholine™)
2-ethoxyethanol (Dowanol™ EE)
2-methoxyethanol (Dowanol™ EM)
acrylamide
acrylic acid
bromobenzene
bromomethylbenzene
dimethoxy-sulfanylidene-(2,4,5- trichlor-phenoxyphosphorane (Ectoral™, Trolene™, Ronnel™, Korlan™, Nankor™, Viozene™)
Kuron™ herbicide containing 2,4,5-trichlorophenoxypropionic acid (also known as Silvex™)
monoisopropanolamine
o,o-dimethyl-o-(2,4,5-trichlorophenyl) phosphorothioate (Dowpon™, Ronnel™, Ruelene™)
o-chlorophenol
parachlorophenol
p-dibromobenzene
polyacrylamide (Separan™)
SE-651
styrene/butadiene latex
Styrofoam™ brand plastic foam
tetrachlorobenzene
tetraethylene pentamine
tetrasodium 2-[2-bis-(carboxylatomethyl)amon]ethyl-(carboxylatomethyl)amino]acetate (Versene™)
trichlorophenol
Vidden™ (a mixture of dichloroprpenes and dichloropropanes)
(17-acetyl-6-chloro-3-hydroxy-10,10-dimethyl-1,2,3,8,9,11,12,14,15,16-decahydrocydopenta[a]phenanthren-17-yl)acetate (Verton™)
(4-dimethylamino-3,5-dimethyl-phenyl methylaminoformate (Zectran™)
2,3,5-trichloro-1H-pyridin-4-one (Daxtron™)
2,4,5-T and 2,4-D mixture
2-butoxyethanol (Dowanol™ EB)
2-phenoxyethanol (Dowanol™ EP and Dowanol™ EPH)
chlorpyrifos o,o-diethyl o-(2,4,6-trichlor-2-pyridyl)l (Dursban™)
decabromodiphenyl oxide
dimethylamine salt of 2-methyl-chlorophenoxyacetic acid
Dowicil™ TBS
l-isobutoxy-2-propanol (Dowanol™ PIB)
methylene bromide
o-2,4-dichlorophenyl-o-methyl isopropylphosphoramidothioate (Zytron™)
o-sec-butylphenol
pentachloropyridine
pentachlorphenol (glazed, prilled form)
t-butylsalol
tert-butyl-salol (TBS, Tausol™)
tricyclohexylstannane hydrate
triisopropanolamine
Zetabon™ (coils of metal coated with ethylene copolymer plastic)

Recommendation:

- **U.S. EPA recommends that MDEQ require Dow to 1) supplement Section 3.3 of the TR RIWP by providing additional information concerning the production and environmental fate and transport of each of the chemicals identified above, and 2) identify the potential by-products which resulted from the production of each of these products and to provide additional information concerning the environmental fate and transport of such by-products.**

POTENTIAL SOURCES [Section 4.1]

17. In Section 4.1 (Potential Sources), Dow describes potential historical contaminant sources from its Midland, Michigan facility. U.S. EPA does not consider the limited discussion in the revised RIWPs of the specific potential sources of chemical contamination from its Midland, Michigan facility to the Saginaw Bay watershed to be complete. Based upon the production information provided in the RIWP, U.S. EPA believes that it is very likely that a substantial number of additional potential sources of hazardous constituent contamination existed at Dow's Midland, Michigan facility.

    Recommendation:

    - **U.S. EPA recommends that MDEQ require Dow to identify these additional sources, locations, processes, products, chemicals and by-products in the revised RIWPs.**

    U.S. EPA is concerned that Dow spends a majority of its discussion in Sections 3 and 4 on its historic chlorine production and then appears to dismiss the possibility that other hazardous constituents of concern may have been released to the environment in significant quantities during the more than one century of chemical production at its Midland, Michigan facility. Dow states in this section that it was one of the nation's most significant producers of magnesium, phenol, polystyrene and certain pesticides, yet fails to provide any information concerning these products, their production processes and by-products or the fate and transport of any associated hazardous constituents. Dow's failure to produce additional information concerning the production of these various products and/or chemicals and whether such production may have resulted in the release of hazardous constituents to the environment is not acceptable.

    For example, it is known that OCS is a by-product of the production of a number of the products listed by Dow in the revised RIWPs as having been produced by Dow over the last century at its Midland, Michigan facility, e.g. magnesium, chlorinated solvents, chlorine and PVC, nevertheless, Dow does not discuss OCS as a potential byproduct from its historic production processes or if OCS may have been released to the environment from its Midland, Michigan facility.

    As another example, U.S. EPA believes, as stated above, that the adjacent Dow Corning facility, which shares Dow's waste water treatment plant, may have been a significant source of constituents to the Saginaw Bay watershed. Nevertheless, Dow does not discuss the historic operations and waste management practices of the adjacent Dow Corning facility. This is of concern to U.S. EPA because the Agency believes that a detailed discussion of the historic operations and waste management practices of the adjacent Dow Corning facility is warranted because constituents released from the Dow Corning facility may have affected, or may be affecting, the contaminant distribution within the Saginaw Bay watershed.

    Recommendation:

    - **U.S. EPA recommends that MDEQ require Dow to provide additional detailed information in its revised RIWPs concerning the additional likely potential sources**

of chemical contamination from its Midland, MI facility to the Saginaw Bay watershed.

GEOCHEMISTRY CHARACTERIZATION OF SELECT UTR SEDIMENTS AND SOILS [Section 5.1.3.2]

18. Dow's *GeoMorph Sampling and Analysis Plan - Upper Tittabawassee River, Midland, Michigan*, dated June 1, 2006, states that: "[u]nderstanding the occurrence of furans and dioxins is fundamental to this GeoMorph™ investigation. Therefore, to resolve this seemingly surprising finding of furans and dioxins where they would not be expected, a geochemistry study will be conducted concurrently with the field survey to evaluate where, precisely, the chlorinated furans and dioxins occur in Tittabawassee River sediment fractions." Despite the fact that Dow has acknowledged that an understanding of the geochemistry of the Saginaw Bay watershed is fundamental to this GeoMorph investigation, Dow has yet to produce a geochemistry study that fully explains the anomalous concentrations of dioxins and furans within the soils and sediments of the watershed.

    While Dow submitted a preliminary geochemistry study to MDEQ on March 30, 2007 (which was to have been submitted on February 1, 2007 as part of the GeoMorph UTR Characterization Report), this study is severely limited by sample numbers and geographic coverage. U.S. EPA views the study as only the first step towards a complete understanding the furan and dioxin geochemistry in the soils and sediments downstream of Midland.

    The study consists of only thirteen (13) samples collected from four (4) locations in the Tittabawassee River floodplain. It should be noted that the dioxin and furan contamination downstream from Midland covers approximately forty (40) square miles of river and floodplain. The industrial history of the site indicates that the contamination originated from multiple sources which emitted dioxins and furans in different forms at different times. U.S. EPA believes that the second phase of the geochemistry study should require significantly more samples collected from a variety of sites both proximate to and downstream from Midland. These samples will need to be of both floodplain soil and river sediments.

    Dow's limited study concludes that the course-grained soil fraction contains anomalously elevated furan and dioxin concentrations. As this result is inconsistent with the known behavior of furans and dioxins in the environment, its chemical basis must be determined for it to have validity or use for Dow's remedial investigation. Therefore, Dow's additional geochemistry investigation should include an analysis of the nature of the course material(s) associated with the elevated furan and dioxin concentrations (natural or anthropogenic in origin, their mineralogy, surface characteristics, the presence of other contaminants affecting furan and dioxin surface chemistry, etc.) and a review of the emission history of the Dow Midland facility. In addition, ATS's assumption of the homogeneity of geomorphic units identified in the pilot GeoMorph approach should be verified empirically in the field via sub-sampling and dioxin and furan analysis of the sediment and soil core sections which have been defined as homogeneous. In addition, an analysis should be conducted to determine whether silicones from Dow or Dow Corning which have been found in dioxin and furan

samples from the TR are in any way responsible for the anomalous concentrations of dioxins and furans in the soils and sediments of the watershed.

In addition, the dioxin and furan mass imbalance (up to 3,551%) reported in Dow's geochemistry study appears to be due to a problem with the laboratory sample preparation method. For example, if a portion (or 'nugget') of course grained fractionated material is associated with very elevated dioxin and furan concentrations, a bulk laboratory sample that didn't include a piece of the high-concentration course-grained material would register a relatively low dioxin and furan concentration. Assuming these high-concentration nuggets are relatively rare, the probability of a bulk sample containing one or more of these nuggets would not be as great as the probability that one or more would be included in the course-grained laboratory sample. As a result, meticulous characterization of bulk sample (i.e. replicates) would better represent its contents. The mass balance calculations found in summary Tables 1 and 2 of the geochemistry study are relatively meaningless. The bulk and percent bulk analytical data should be excised from the Tables for ease of comprehension because as an interpretive 'sensitivity check' it is unreliable. In any case, the cause of the mass imbalance needs to be determined and a proper laboratory sample preparation procedure needs to be generated prior to proceeding with further dioxin and furan geochemical studies. Determination of the cause of the mass imbalance could prove to be a significant factor in understanding the sediment and soil dioxin and furan geochemistry downstream from the Midland facility.

MDEQ and U.S. EPA have recently discussed with Dow issues related to the presence of a woody or cellulosic layer in the sediments of the Tittabawassee River which is associated with elevated levels of dioxins and furans. It should be noted that Dow and U.S. EPA do not agree at this time on the sources of those materials and associated contamination or the significance of this discovery. A significant and detailed analysis of these deposits should be included in the second phase of the geochemistry study. In particular, U.S. EPA would like to determine whether the woody or cellulosic deposits are remnant materials from Dow's historic chlorine production. The answer to this question could impact the fate and transport analysis of this investigation.

U.S. EPA also notes that Dow's furan and dioxin geochemical study is long overdue. The Agency stressed the importance of a geochemistry study on numerous previous occasions (February 10, 2006, May 18, 2006, and May 25, 2006). Because many of the concepts implicit in the ongoing GeoMorph characterization process presume an understanding of dioxin and furan geochemistry, i.e. an ability to determine dioxin and furan homogeneity both horizontally and vertically through the observation of aerial photographs and soil/sediment cores respectively, as is stated in Dow's *GeoMorph Sampling and Analysis Plan - Upper Tittabawassee River, Midland, Michigan*, dated June 1, 2006, Dow's failure to complete the study in a timely manner jeopardizes the validity of the remedial investigation.

U.S. EPA believes that Dow's furan and dioxin geochemistry study results may be applicable to an assessment of the effectiveness of a sediment trap on the Tittabawassee and/or Saginaw Rivers. As a result, the sediment trap geochemical analysis and second phase of the geochemistry study should be coordinated.

Recommendations:

- **U.S. EPA recommends that MDEQ require Dow to include significantly more samples collected from a variety of sites both proximate to and downstream from Midland in the second phase of the geochemistry study. These samples will need to be of both floodplain soils and river sediments.**
- **U.S. EPA recommends that MDEQ require that Dow's additional geochemistry investigation include an analysis of the nature of the course material(s) associated with the elevated furan and dioxin concentrations (natural or anthropogenic in origin, their mineralogy, surface characteristics, the presence of other contaminants affecting furan and dioxin surface chemistry, etc.), a detailed analysis of the woody or cellulosic deposits in river sediments and a review of the emission history of the Dow Midland facility.**
- **U.S. EPA recommends that MDEQ require Dow to complete the next phase of its geochemistry study as soon as possible so as not to unnecessarily delay the 2008 implementation date for the IRA sediment traps as recommended by U.S. EPA. Because the purpose of the sediment traps is to reduce the ongoing transport of sediment-bound dioxin and furan contamination to downstream river reaches/floodplains and Lake Huron, knowing how the dioxin and furan contamination is distributed by grain size, mineralogy and/or surface chemistry is critical for this assessment.**

CURRENT CONDITION SWAC PROCESS [Section 5.2.3.2]

19. Dow has not proposed a detailed methodology for the calculation of Surface Weighted Average Concentration (SWACs) in the RIWP.

    Recommendation:

    - **U.S. EPA recommends that MDEQ not use a negotiated approach to approval of the SWAC process until Dow's proposed SWAC process is submitted.**

20. Dow proposes to modify the concentration values of polygons by erosion factors or attenuation factors in the RIWP.

    Recommendation:

    - **U.S. EPA recommends that MDEQ require Dow not to modify the concentrations for polygons by erosion factors or attenuation factors. U.S. EPA recommends that information concerning erosion and attenuation be considered during the risk management phase of the project, but should not be used to modify concentration data.**

21. The description of the calculation method for generating a SWAC, i.e. "[t]he adjusted concentration will be multiplied by the square footage of the polygon to obtain a 'COI concentration times Area' number. The SWAC value is the sum of the adjusted 'COI concentration times Area' numbers, divided by the sum of the Areas for a reach of the river, or for the entire river section. Dow proposes to calculate the total SWAC for each reach by

summing the products of area and the adjusted concentration, divided by sum of all areas" is unclear.

Recommendation:

- **U.S. EPA recommends that MDEQ determine whether the SWAC calculation is intended to provide an average concentration value for each geomorphic polygon, each geomorphic unit or each river reach.**

DATA QUALITY OBJECTIVES AND REQUIREMENTS FOR SITE CHARACTERIZATION [Section 5.5]

22. ATS/Dow have not provided data of sufficient resolution to support identification of areas of elevated contaminant concentrations for removal to date.

Recommendation:

- **U.S. EPA recommends that MDEQ require Dow to ensure that the GeoMorph methodology produces data of sufficient resolution to support identification of areas of elevated contaminant concentrations for removal. In addition, Dow should identify the minimum size of an area of elevated contamination (hot spot) the GeoMorph methodology will be able to identify.**

HUMAN HEALTH RISK ASSESSMENT [Section 6]

23. While U.S. EPA believes that Dow raises several legitimate scientific points in this section, Dow, in many instances, cites to the current scientific literature in a very selective manner. For example, Dow repeatedly emphasizes that humans are less sensitive than rats to the effects of dioxin. Dow's assertion ignores the recent paper by K. Nohara et al. (Toxicology 225: 204-213; 2006) which clearly shows that humans are the most sensitive species, as well as earlier work demonstrating that for multiple endpoints, there was similar sensitivity between animals and people. Also, recent work from the laboratory of Allen Okey (Univ. of Toronto) stresses that there is a distribution in AhR binding in the human population, such that while the average human has binding affinity similar to the "less-sensitive" mouse, there are humans who have binding affinity even more sensitive than the "most sensitive" mouse.

U.S. EPA agrees that the recent poisonings of several human individuals with high levels of TCDD indicate that humans do not have the same LD50 as guinea pigs - but guinea pigs die at doses that are 50-200X lower than mice, rats or monkeys; and fortunately no humans have been exposed to that kind of dose.

U.S. EPA agrees that there is a difference in the hepatic induction of CYP1A1 between rodents and humans; however, this enzyme is not inducible in human liver *in vivo*. Therefore, the fact that many published studies concluded that humans are less sensitive than rodents to this response is a given, and not a surprise. Dow states that there are no studies of the reproductive effects of the PCDFs, which ignores the work of Hamm et al. (Toxicol. Sci. 74:182-191; 2003) showing that the 1998 WHO TEFs did an excellent job (within 2X) of predicting the reproductive effects. While Dow also repeatedly cites the National Academy

of Sciences (NAS) Report which reviewed two chapters of U.S. EPA's Dioxin Risk Assessment, Dow cites the NAS recommendations selectively. The NAS Report actually states that the Agency should consider a non-linear approach to the carcinogenic effects, and compare it to the linear approach.

Dow ignores some of the recent cancer studies showing that early life exposure may enhance the risk of cancer both in animals and humans (C. LaMartinierre et al. in rats; M. Warner et al. in the Seveso cohort). U.S. EPA notes that the recent NTP studies are only in female SD rats - there is a wealth of other studies in male rats, mice, and hamsters which also need to be considered. In addition, there were tumors found at multiple sites in many of the other studies. Portier et al. (2000) analyzed, as part of the WHO TDI process, all of the available tumor data and concluded that nearly 50% of the cancer data best fit a linear model. The Rier et al. (2001) work demonstrates that the TEQ describes the effects observed in monkeys in her laboratory. In no way does that finding cancel out the earlier reports from the Wisconsin research group about the TCDD effects.

U.S. EPA is concerned that Dow may not be using the most appropriate dose metrics, which are very dependent upon response. For example, while concentration during a critical window is clearly appropriate for a developmental effect, it is not clear whether the average body burden by itself is the best dosemetric for cancer or whether some integrated measure of concentration above a peak is needed. This is a data need, and never addressed. The relationship between tissue concentration and body burden can be well modeled. Despite this draft, there is no evidence that the pharmacokinetic considerations are different between humans and animals. In fact, the key determinants of the PK are well known - lipophilicity, induction and binding to CYP1A2 resulting in hepatic sequestration, metabolism. It is known that the PK of dioxins are dose dependent, with more rapid elimination at higher doses (Body burdens), and that body composition (% fat) plays a major role, especially at lower doses (body burdens).

The epidemiological studies of Dow "TCDD" workers used "controls" who were highly exposed to PCDFs (Collins et al, 2005), so it is inappropriate to say that Dow TCP and PCP workers had no increased cancer risk - their exposure was similar to the "controls."

U.S. EPA notes that there are additional examples of selective citations and/or interpretations in this Section which are not addressed in these comments. U.S. EPA considers Dow's selective citation to the scientific literature to be unacceptable.

24. Dow has proposed to conduct numerous studies to support a HHRA which could result in a higher clean-up criteria for dioxin than required by Part 201 of Michigan Act 451. U.S. EPA believes most if not all of these studies are unnecessary and will only result in lengthening the time frames for the completion of many of the components of the remedial investigation. For example, Dow continues to propose the completion of a lengthy dioxin bioavailability study in the Response. It appears, however, that the bioavailability study proposed by Dow, based upon the results of Dow's pilot bioavailability study and subsequent follow-up study, will not result in a significant change to the default clean-up criteria for dioxin. Rather, Dow's bioavailability study will likely confirm the long-standing position of MDEQ and

U.S. EPA that the bioavailability factor for dioxin at this site should be set at or above the default factor of fifty percent (50%). As a result, there appears to be no reasonable basis for Dow to continue to propose the completion of a bioavailability study which will unnecessarily delay corrective action activities. Similarly, U.S. EPA believes that many of the numerous human health risk assessment studies proposed by Dow will be of similarly limited value to the selection of a final remedy for the contamination of the Saginaw Bay watershed and will unnecessarily delay corrective action activities.

25. U.S. EPA also has significant concerns with human health risks associated with dioxin exposure through the food chain pathway, especially for at-risk populations such as pregnant women, children, subsistence hunters and fishers, and Native Americans. For example, a recent Michigan Department of Community Health study has identified potentially at-risk segments of the Saginaw Bay watershed population which consume a significant amount of highly contaminated fish. Of particular note, issues of environmental justice and fair treatment may be relevant with regard to some of these populations. Given the significant risks associated with exposure to dioxins, furans and other possible hazardous constituents throughout the Saginaw Bay watershed, Dow's failure to address such risks in the revised RIWPs is problematic.

Recommendation: MDEQ require Dow to proceed as follows to expedite the determination of SSCC values:

- **As Dow proposed in the draft HHRA WP documents for City of Midland and the Tittabawassee River & Floodplain, exposure algorithms may be designed and utilized to back calculate chemical-specific SSCC values. While Dow's general methodology and algorithms are essentially the same as the MDEQ Part 201 methodology for calculating Generic Cleanup Criteria, U.S. EPA does not agree with Dow's proposal to conduct site-specific studies for a large number of the exposure factors used in the algorithms. Rather there are numerous widely-accepted exposure factor values currently in existence which can be and should be used by Dow. For derivation of the SSCC, U.S. EPA recommends that MDEQ require Dow to incorporate the exposure factors and exposure parameters, including the Probability Mass Functions (PMFs) for several factors/parameters, for which there already are scientifically valid data available for deriving a PMF.**

- **U.S. EPA has stated that Dow could incorporate Probabilistic Risk Assessment (PRA) into a calculation of the SSCC values by following appropriate U.S. EPA guidance to propose a PRA method for describing the variability of exposure factors/exposure parameters. However, U.S. EPA has never stated or agreed that the use of PRA methodology for selecting chemical-specific dose-response factors is justified because: a) no peer reviewed or widely accepted scientific consensus methodology is available for applying PRA to chemical-specific dose-response factors or deriving PDFs for such factors; and b) the use of PRA for deriving chemical-specific dose-response factors is not compliant with Part 201 regulatory requirements. U.S. EPA recommends that Dow be required to apply the MDEQ**

approved dose-response toxicity factors (RfDs, Slope Factors, TEF values) as used in MDEQ's Part 201 program.

- **In order to obtain site-specific information for exposure factors/parameters, Dow proposes to submit a Behavioral Study Plan for review and approval and then conduct an Activity Survey. While the Activity Survey may provide useful information on the behavior and activity parameters of Midland and Tittabawassee River residents, U.S. EPA recommends that MDEQ require Dow to significantly revise the Activity Survey to avoid unnecessarily delaying the determination of a clean-up criteria. For example, while the information from an activity survey may be used to propose site-specific quantitative values for parameters such as: food ingestion rates, time fraction spent in potentially contaminated soil and sediment areas, types of activities conducted in potentially contaminated areas and unique or enhanced exposure activities that may apply to tribal populations, much of this information and quantitative data could presumably be provided by the University of Michigan (the University) Dioxin Exposure Study (UMDES). As a result, U.S. EPA recommends that MDEQ require Dow to amend its proposed Activity Survey to take advantage of the numerous data from the UMDES and require Dow to complete the Activity Survey on or before August of 2007.**

- **U.S. EPA recommends that once reasonably conservative food ingestion rates are proposed and selected for potential local dietary exposure items such as home grown vegetables, chicken, eggs, fish fillets, deer meat, wild turkey and other game animal tissues, MDEQ should require Dow to directly calculate the risk-based protective target concentration levels of dioxin and other TAL constituents in these local dietary items. It should not be necessary to conduct additional extensive and time intensive site-specific studies to determine the current level of dioxin and other TAL constituents in these food items [Please see bullet below].**

- **After the information from the previous bullets above become available, U.S. EPA recommends that MDEQ require Dow to calculate risk-based protective SSCC values for soils and sediments that can be designed to: (1) take into account all relevant and complete exposure pathways and (2) apply to variations in land uses (e.g., Midland resident, floodplain resident, local farmer, local fisher, local game hunter, etc.).**

Based on the procedure outlined above for the determination of SSCC values, U.S. EPA does not believe that there is any need for Dow to conduct the extensive and time intensive additional site-specific studies currently grouped under the heading "Exposure Study Plans." These include the following studies: "Fish Sampling Study Plan," "Game Tissue Study Plan," "Garden Vegetable Study Plan," "Domestic Livestock Study Plan" and "Airborne Dust Study Plans." For two of the potential exposure pathways, fish and deer, extensive information currently exists showing elevated dioxin contaminant levels in fish and deer caught or harvested in various areas of the Tittabawassee River and floodplain which are known to contain significant levels of dioxins in soils or sediments. As a result, additional

data to verify the presence of dioxin contamination in these organisms is not needed, necessary or justified. For three of the other categories, non-deer wild game, farm animals and garden vegetables, it is not clear that the planned Exposure Studies would be adequate or sufficient to calculate contaminant intake levels which would be representative of potential high-end intake rates of dioxin or other TALs from dietary food consumption. For example, unless the sample population of domestic chickens is actually raised or grazed in an area with a high-end level of dioxin or other TAL contaminant levels in soil, it is not clear that the measured level of dioxin in the chicken meat or eggs would represent a high-end exposure level for future human consumption. Accordingly, U.S. EPA recommends that MDEQ require Dow to eliminate the "Fish Sampling Study Plan," "Game Tissue Study Plan," "Garden Vegetable Study Plan," Domestic Livestock Study Plan" and "Airborne Dust Study Plans" from Dow's revised RIWPs and they be amended accordingly.

Because of the significant concerns with human health risks associated with dioxin exposure through the fish and wild game food chain pathways, especially for at-risk populations such as pregnant women, children, subsistence hunters and fishers and Native Americans, U.S. EPA does not believe that further study of these food chain pathways is warranted as it could potentially delay remediation activities. For example, a recent Michigan Department of Community Health study has identified potentially at-risk segments of the population in Saginaw and Bay City, Michigan which consume a significant amount of highly contaminated river bottom feeding fish (catfish and carp). Given the significant risks associated with exposure to dioxins, furans and other possible hazardous constituents from eating such fish, Dow's proposal to continue to study such pathways before initiating any remedial actions is not acceptable.

STUDIES PROPOSED TO SUPPORT THE HHRA [Section 6.1.5]

26. Based on the procedure outlined in U.S. EPA Comment on Section 6.0 for the determination of SSCC values, U.S. EPA does not believe that there is a need or requirement for Dow to conduct the extensive (and time intensive) additional site-specific studies currently listed in Appendix HHRA-C. These include: "Fish and Game"; "Local Grown Foods"; and "Dust Study Plans." For two of these categories (fish and deer), extensive (at least for fish), as noted above, current information on elevated dioxin contaminant levels is already available, therefore, additional data to verify the presence of dioxin contamination in these organisms is not needed. For three of the other categories (e.g., non-deer wild game, farm animals, and garden vegetables), it is not clear that the planned Exposure Studies would be adequate or sufficient to calculate contaminant intake levels which would be representative of potential high-end intake rates of dioxin or other TALs from dietary food consumption. For example, unless the sample population of domestic chickens is actually raised or grazed in an area with a high-end level of dioxin or other TAL contaminant levels in soil, it is not clear that the measured level of dioxin in the chicken meat (or in eggs) would represent a high-end exposure level for future human consumption.

27. U.S. EPA notes that Dow's bioavailability study has been under design and discussion since 2002 and yet it is no closer to identifying a bio-availability factor any lower than the default value and the recommendations of Dow/MDEQ's expert external peer review panel have

been frequently ignored. Because this study does not look at multiple soil samples or a wide range of soil concentrations and the pilot study results are consistent with the 50% bioavailability factor, U.S. EPA recommends that MDEQ require Dow to use the default value of 50%.

For example, Dow continues to propose the completion of a dioxin bioavailability study (initiated in 2002) in the RIWP. As stated previously, U.S. EPA believes that Dow's bioavailability study will not result in a significant change in the default clean-up criteria for dioxin in soils. Rather, the study will likely confirm the long-standing position of MDEQ and U.S. EPA that the bioavailability factor for dioxin in soils at this site should be set at or above the default factor of fifty percent (50%). There appears to be no basis for Dow to continue to propose the completion of a bioavailability study.

ANGLERS — FISH CONSUMPTION [Section 6.2.2.5]

28. Data collected in by the Michigan Department of Community health should also be included in the HHRA.

PROPOSED USE OF UMDES DATA [Section 6.4.2]

29. The UMDES study is still being analyzed. The preliminary results which have been released show that people living in the Midland-Saginaw area have a slightly higher TEQ than people living outside of that area. U.S. EPA's understanding is that the authors of the UMDES study are currently analyzing the factors contributing to the TEQ at the high-end of each study population and attempting to determine if the high TEQ individuals are also the high TCDD individuals, or if some of them are high PCB or high PCDF individuals. It is important to remember that the UMDES study did not assess levels in anyone younger than 18 years of age, or who had lived in their current residence for less than 5 years. Also, the UMDES study population is only a fraction of the actual population size living in the "dioxin plume" in Midland.

TOXICITY VALUES FOR PCDD/Fs [Section 6.5.1]

30. U.S. EPA continues to assert that the HHRA, as proposed by Dow in the December 1, 2006 revised RIWPs, do not comply with U.S. EPA risk assessment policy and guidance and, therefore, cannot be approved by U.S. EPA (See U.S. EPA's February 10, 2006, and June 22, 2006 Comments). U.S. EPA continues to reserve its right to review and to provide written comments to MDEQ on Dow's HHRAs once they are resubmitted.

Recommendations:

- **U.S. EPA recommends that MDEQ require Dow to substantially amend and revise the HHRAs and resubmit new HHRA workplans to MDEQ prior to MDEQ participation in further HHRA working sessions.**
- **U.S. EPA recommends that detailed review and comment of Dow's HHRAs not be initiated by MDEQ until Dow has submitted substantially revised HHRAs to MDEQ in order to conserve limited government resources.**

TOXICITY EQUIVALENCY FACTORS FOR PCDD/Fs [Section 6.5.3]

31. The 2005 re-evaluation of the WHO TEFs (Van den Berg et al, 2006) were critically arrived at using all of the available data. Haws and co-workers presented some probabilistic analyses of the data at the DIOXIN2006 Conference which demonstrated that weighting based on quality of study, etc. did not have a major impact on the TEF values. Dow's proposal to undertake an extensive effort to re-evaluate the TEFs is unlikely to have any significant effect on the HHRA.

APPENDIX HHRA A – SUMMARY OF UNIVERSITY OF MICHIGAN DIOXIN EXPOSURE STUDY

32. The University has yet to provide a more detailed analysis of the data from the UMDES, conducted by the University's School of Public Health as requested by MDEQ. This more detailed analysis was expected to be submitted to MDEQ in September 2006; however, it has not been submitted to date. The production of this information from the University is necessary.

    U.S. EPA is aware that a certificate of confidentiality has been issued to the University by the National Institute of Health (NIH) pursuant to section 301(d) of the Public Health Service Act, 42 U.S.C. 241(d),) which protects "…the privacy of the individuals who are the subjects…" of the University's research by "withholding their names and other identifying characteristics from all persons not connected with the conduct of that research," and, as a result, U.S. EPA does not recommend seeking the production of any information from the University which could reasonably be expected to lead to the identification of any of the research subjects who participated in the UMDES, i.e. names, addresses, social security numbers, fingerprints, photographs, genetic information, tissue samples, etc.

    Nevertheless, the production of any and all relevant information concerning the nature and extent of dioxin and furan contamination in the Saginaw Bay watershed that could not reasonably be expected to lead to the identification of any of the research subjects who participated in the UMDES is necessary. There are methods to produce such information without identifying specific individuals who participated in the UMDES.

    The production of information concerning the nature and extent of dioxin and furan contamination in the Saginaw Bay watershed is necessary, and U.S. EPA believes that a reasonable basis exists to request this information for the following reasons. First, U.S. EPA believes the production of this information by the University is necessary in order for MDEQ to protect human health and the environment in the Saginaw Bay watershed and in order for MDEQ to ascertain whether Dow is currently complying with the terms and conditions of its RCRA permit. Second, while certificates of confidentiality are issued by NIH to protect the privacy of research subjects by protecting investigators and institutions from being compelled to release information that could be used to identify subjects with a research project, their protections are not absolute and, as a result, they may not be used arbitrarily or broadly to frustrate important public policy goals such as the protection of human health and

the environment, i.e. there is no absolute privilege to protect the confidentiality of research data from discovery. Rather, certificates of confidentiality are intended to be used for the important but limited purpose of encouraging people to participate in human health research by protecting identifiable human health information. As a result, when determining the extent to which confidential data shall be protected in this matter, U.S. EPA believes the University's important goal of protecting the privacy of its UMDES research subjects must be weighed against MDEQ's equally important public policy goal of protecting human health and the environment in the Saginaw Bay watershed.

The production of information concerning Dow's funding of and contractual control over, or lack thereof, the UMDES is necessary, and U.S. EPA believes that a reasonable basis exists to do so, due to the apparent lack of cooperation exhibited by the University in response to numerous and longstanding informal requests by MDEQ and U.S. EPA for the production of non-confidential data and analyses related to the UMDES. As a result, U.S. EPA believes it is important for MDEQ to determine whether there is, or was, any reason, contractual or otherwise, other than to protect the confidentiality of the UMDES research participants, for the University, or any of its employees or agents, to prevent, limit or any other way hinder the release, publication or production of any information concerning the nature and extent of the dioxin and furan contamination in the Saginaw Bay watershed. Should any such reason exist, the circumstances of any such limitation should be identified to determine whether the limitation has, or may have, had a prejudicial effect on any of the analyses and/or conclusions of the UMDES concerning human exposure to the dioxin and furan contamination in the Saginaw Bay watershed.

Because Dow has requested that MDEQ and U.S. EPA consider certain of the data and analyses produced by the University under the UMDES in reviewing and approving one or more site-specific risk assessments to be conducted by Dow to establish one or more clean-up criteria for the Saginaw Bay watershed, the answers to any questions concerning the validity of these data and analyses are necessary in order for MDEQ to properly protect human health and the environment in the Saginaw Bay watershed and to ascertain whether Dow is currently complying with the terms and conditions of its federally enforceable state-issued RCRA permit.

Recommendations:

- **U.S. EPA recommends that MDEQ seek the production of any and all relevant information concerning the nature and extent of dioxin and furan contamination in the Saginaw Bay watershed obtained during or related to the UMDES from the University.**
- **U.S. EPA recommends that MDEQ seek the production of information concerning Dow's funding and contractual control over the UMDES from the University.**

CURRENT AND FUTURE INVESTIGATION WORK [Section 9]

33. Dow does not provide a work plan for detailed characterization sampling of Tittabawassee and Upper Saginaw River sediments in the RIWP.

Recommendation:

- **U.S. EPA recommends that MDEQ require Dow to amend the revised RIWPS to include a work plan for detailed characterization sampling of Tittabawassee and Upper Saginaw River sediments.**

FLOW AND SUSPENDED SOLIDS MONITORING [Section 9.1.5]

34. Dow does not include a work plan for bed load solids monitoring in the RIWP to measure the amount of contaminants migrating down stream with coarser grained materials.

Recommendation:

- **U.S. EPA recommends that MDEQ require Dow to amend the revised RIWPs to include a work plan for bed load solids monitoring.**

DEVELOPMENT AND PRELIMINARY SCREENING OF SHORT AND LONG TERM CORRECTIVE ACTION TECHNOLOGIES FOR AREAS WITH HIGH RISK OF EROSION IN UTR [Section 9.1.15]

35. Dow does not state that river channel modification options may have significant operation and maintenance costs, and financial assurance requirements associated with it, as well as unintended consequences in this section of the RIWP.

Recommendation:

- **U.S. EPA recommends that MDEQ require Dow to amend the revised RIWPs to include a discussion in the section entitled River Channel Modification stating that these options may have significant operation and maintenance costs, and financial assurance requirements associated with it, as well as unintended consequences.**

36. Dow states that the removal option will be "only considered when no other option is available."

Recommendation:

- **U.S. EPA recommends that MDEQ require Dow to amend the revised RIWPs to state that the removal option will be generally considered, and not "only considered when no other option is available."**

SCHEDULE [Section 10]

37. While U.S. EPA was encouraged to hear Dow propose a more proactive schedule for its corrective action activities at the February 8, 2007 public meeting, i.e. by 2010, a detailed schedule for corrective action activities to achieve this goal has not been provided to MDEQ.

Recommendations:

- **U.S. EPA recommends that MDEQ require Dow to submit an approvable compliance schedule, as required by Dow's state-authorized RCRA license, to meet such goals and that this enforceable compliance schedule be incorporated by**

MDEQ into Dow's license in order to hold Dow accountable for its 2010 commitments.

- **U.S. EPA recommends that MDEQ incorporate the following compliance schedule into any approval of the revised RIWPs, if Dow fails to timely provide a compliance schedule as required by their RCRA License.**
- **U.S. EPA recommends that MDEQ require Dow to provide a separate enforceable IRA compliance schedule to be approved by MDEQ and incorporated into Dow's RCRA License for addressing the currently identified TR dioxin hot spots.**

Tittabawassee River Timeline

2007

- MDEQ approval of constituents of concern beyond dioxins and furans (finalize PCOI list) for upper TR.
- Dow completes and submits HHRA Sensitivity Analysis that covers the TR.
- Dow/Agencies collaboratively confirm exposure pathways for dioxins/furans and identify necessary site-specific exposure studies for HHRA to include in RIWP.
- Dow completes and submits ERA Sensitivity Analysis that covers the TR (necessary for identifying preliminary cleanup actions).
- Dow drops *all or portions of* PRA approach to HHRA (incompatible with 2010 goal) and replace with deterministic HHRA (compatible with 2010 goal) using literature values.
- Identification of preliminary IRA (possibly final) TR sediment and floodplain soil cleanup action levels.
- Preliminary identification of interim (possibly final) riverbank and floodplain soil response activities.
- Implementation and monitoring of pilot TR IRAs (e.g., bank stabilization or bank removal).
- Evaluate environmental media data available (including biota) and identify data gaps for baseline prior to post remediation trend monitoring (e.g., for later evaluation against performance criteria).
- (Mid 2007) - Identification of objective remedial criteria (e.g., removal of fish and wild game consumption advisories) and target timeline to achieve each.
- Collect additional environmental media data (including biota) necessary to fill identified data gaps for baseline prior to post remediation trend monitoring.
- Dow completes and submits results of geochemistry study(s) which will identify and describe the geological/geochemical parameters affecting PCOI distribution and bioavailability.
- MDEQ/U.S. EPA evaluation GeoMorph pilot study for suitability for TR.
    - Confirm/disprove implicit assumptions associated with GeoMorph approach.
    - Evaluate GeoMorph approach for suitability in identifying hot spots within geomorphic units (horizontally and vertically).
    - Evaluate the appropriateness of pilot GeoMorph work product for suitability to conduct remedy selection.

- Validate use of GeoMorph results to predict exposure unit concentrations.
- Continue to conduct and monitor pilot IRAs/final remedies.
- Continue riverfront access agreements for response activity implementation.
- MDEQ approval, approval with modifications, or disapproval of pilot GeoMorph approach for TR and USR.
- Refine PCOI list based on TR RIWP submittals and document review.
- Dow completes analyzing archived samples from 2006 GeoMorph sampling for remaining PCOIs.
- Review and collaboratively modify (if needed) and MDEQ approval of TR/Upper SR RIWP.
- Dow completes PCOI chemical characterization of half of remaining TR/upper SR, including all Priority 1 and 2 properties (i.e., likely to be discontinuous river miles).
- Dow determines/refines human health and ecological risks from PCOIs and other drivers for corrective action decisions:
    - PCOI Human Health Risk, including:
        - Identify additional/different relevant exposure pathways.
        - Quantify PCOI exposure pathway risks.
        - Identify areas within the TR/USR associated with unacceptable risk.
    - PCOI Ecological Risk, including:
        - Identify relevant exposure pathways.
        - Animal and vegetation tissue analysis.
        - Quantify ecological PCOI exposure pathway risks.
        - Identification of areas within the TR/USR associated with unacceptable ecological risk.
    - Cultural and spiritual impacts, including:
        - Analysis of impacts of PCOIs on fish, wild game, plants, and other tribal food sources.
        - Analysis of loss of use or value of cultural and spiritual location or entities.
- Identification of disposal options for contaminated media that may require removal and initiate all necessary steps to procure/acquire all local, state, and federal licenses for such options.
- Dow continues/expands/adapts implementation of IRAs and pilot studies (to evaluate remedial alternatives), including:
    - Sediment trap(s).
    - Bank stabilization and erosion control of PCOI contaminated media (monitoring and maintenance plan).
    - Dredging/excavation of select areas with elevated concentrations of PCOIs.
        - Levees.
        - Other areas with significantly elevated concentrations of PCOIs in the TR/USR.
        - Possible separation/treatment of dredged/excavated material.
    - Application of a binding agent to soils/sediments to render PCOIs less bioavailable.

- Other.

- MDEQ continues review of HHRA and ecological risk assessment processes.

2008

- MDEQ makes final decision regarding use of sediments trap(s) to protect Lake Huron.
- Dow completes characterization of TR/USR.
- Dow submits Feasibility Study (FS)/Remedial Action Proposal (RAP) to MDEQ.
    - Identify feasible remedial alternatives for the TR/USR associated with unacceptable risk(s), including:
        - Dredging/excavation of areas with elevated PCOI concentrations, including:
            - Levees.
            - Other areas with significantly elevated PCOI concentrations in the TR/USR.
            - Possible separation/treatment of dredged/excavated material.
            - Disposal options.
        - Bank stabilization and erosion control of contaminated media (monitoring and maintenance plan).
        - Application of a binding agent to soils/sediments to render PCOIs less bioavailable.
        - Sediment trap(s).
        - Institutional controls.
        - Monitored natural attenuation.
        - Other.
    - Collect additional data needed to evaluate remedial technologies (may include pilot studies).
    - Evaluate and compare degree of risk reduction associated with remedial alternatives.
    - Develop a logic for apportioning contaminated sediments and soils among alternatives.
    - Develop performance criteria for selected remedial alternatives.
- Identify disposal options for contaminated media that may require removal.
- Redacted – Confidential information pursuant to the Administrative Dispute Resolution Act of 1996.
- MDEQ approval of HHRA and ecological risk assessment.
- (End of 2008) – MDEQ identification of media cleanup criteria.
- MDEQ approval of Dow FS/RAP.
- Dow begins implementation of RAP (implementation will need to be sequenced to avoid recontamination).
- MDEQ verifies that performance criteria of selected remedial alternatives are being met.

2009 & 2010

- Dow continues RAP implementation.

- MDEQ verifies that performance criteria of selected remedial alternatives are being met.
- Dow implements previously identified management actions if performance criteria are not being met.

ATTACHMENT G - EVALUATION OF POTENTIAL CONSTITUENTS OF CONCERN

38. U.S. EPA believes that the TAL list and associated analytical protocol remain in need of substantial refinement through the method development QAPP process. Also, Dow should identify the basis by which the 'definitive' analytical procedure will be selected when a specific chemical constituent can be reported by multiple methods. The revised QAPP should include additional SOPs reflecting the ongoing 'PCOI/TAL work and should indicate how the results and ensuing data interpretation might be impacted by the possibility of extended holding times now necessitated for various analytes.

39. U.S. EPA recommends, to the extent possible, a Table should be prepared comparing analytical RLs to MDEQ's target Part 201 risk concentration values which are relevant to this study. Such a table will aid in the task of method selection. For instance, choosing method 8310 or method 8270C for analysis of PAHs.

40. It is the understanding of the U.S. EPA that Dow has requested the removal of compounds greater than 5,000 Daltons from the TAL list, due to their presumed lack of bioavailability. U.S. EPA believes that Dow has not provided a sufficient justification for the removal of these compounds. U.S. EPA does not approve of the removal of these compounds because it is known that these constituents may degrade or break down into lower weight molecular compounds that may be toxic and bioavailable in the environment.
    Recommendation:
    - **U.S. EPA recommends that breakdown products resulting from the breakdown of compounds greater than 5,000 Daltons should be readded to the list.**

41. U.S. EPA recommends that MDEQ have the TAL reviewed by one or more experts with the appropriate background in industrial chemical production, chemical byproducts, and environmental fate and transport prior to final approval.

MIDLAND AREA SOILS REMEDIAL INVESTIGATION WORK PLAN (M-RIWP)

General Comments

42. As stated above, U.S. EPA has significant concerns with the agreement between the City of Midland and MDEQ to allow Dow to partially shield corrective action data gathered within the City of Midland from public disclosure. U.S. EPA considers the holding of what would normally be publicly available corrective action data in a confidential manner by a third party not subject to the terms and conditions of Dow's RCRA License to be a violation of the recordkeeping and reporting requirements of Dow's RCRA License. Pursuant to Condition II.L.4 and 6 of Dow's RCRA License, Dow is required to report the results of all

environmental monitoring performed under Dow's RCRA Permit. Nowhere within Section II.L (Recordkeeping and Reporting) does Dow's RCRA License provide for the selective or partial reporting of data by Dow as agreed to by the City of Midland and MDEQ. As a result, U.S. EPA believes that all corrective action data gathered within the City of Midland should be promptly provided by Dow to MDEQ in its entirety in a non-confidential manner.

Dow cites to the FA between Dow and the State of Michigan in the revised RIWPs to justify the delay of additional sampling within the City of Midland until a site specific clean-up criteria for dioxins and furans in soil is approved by MDEQ. U.S. EPA questions the FA's merit and relevance to the Agency's oversight of the State of Michigan's implementation of corrective action at this site. In addition, because the document did not undergo public review and comment, U.S. EPA considers it to be of limited value to what should be an open and transparent corrective action process in this matter. Lastly, as the record reflects, U.S. EPA supported the document only to the limited extent that it furthered the goal of a reasonable plan to ensure the comprehensive characterization and remediation of the dioxin contamination in the Saginaw Bay watershed, consistent with Dow's June 12, 2003 hazardous waste operating license. As evidenced by the numerous comments set forth and issues raised in this document, U.S. EPA does not consider this important goal as being furthered consistent with Dow's RCRA Permit at this time.

43. As stated above, U.S. EPA believes Dow's proposed process of developing, reviewing and approving these risk-based and/or area-wide criteria will unnecessarily delay a thorough evaluation of the nature and of the dioxin and furan contamination within the City of Midland. U.S. EPA believes that this delay is problematic in light of the potential risks posed by the known hazardous constituent contamination in the City of Midland.

Recommendation:

- **U.S. EPA recommends that MDEQ require Dow to provide to MDEQ the complete results of all environmental monitoring within the City of Midland as required by Dow's RCRA License.**
- **U.S. EPA recommends that MDEQ require Dow to conduct a comprehensive characterization of the contamination within the City of Midland starting in 2007 and, if necessary, the prompt implementation IRAs to address such contamination.**

OBJECTIVES AND APPROACH [Section 1.1]

44. Dow presents a set of objectives that is too limited in this section of the RIWP.

Recommendation:

- **U.S. EPA recommends that MDEQ require Dow to include the following objectives:**

- Identify constituents of concern beyond dioxins and furans.
- Develop an understanding of the geological/geochemical parameters affecting contaminant distribution and bioavailability.
- Characterize the nature and extent of contamination in the City of Midland.

- Develop depth based contour maps of contaminant concentrations.

- Determine human health and ecological risks from PCOIs:
  - PCOI Human Health Risk, including:
    - Identify relevant exposure pathways.
    - Quantify PCOI exposure pathway risks.
    - Identify areas within the City of Midland associated with unacceptable risk.
  - PCOI Ecological Risk, including:
    - Identify relevant exposure pathways.
    - Quantify ecological PCOI exposure pathway risks.
    - Identification of areas within the City of Midland associated with unacceptable ecological risk.

DEVELOPMENT OF TARGET ANALYTE LIST [Section 5.1.2]

45. See Comments # 15 and 16 above in the context of potential releases of hazardous constituents to the City of Midland.

HUMAN HEALTH RISK ASSESSMENT [Section 6]

46. See Comments # 22-31 above.

IMPLEMENTATION SCHEDULE [Section 9]

47. While U.S. EPA was encouraged to hear Dow propose a more proactive schedule for its corrective action activities at the February 8, 2007 public meeting, i.e. by 2010, a detailed schedule for corrective action activities to achieve this goal has not been provided to MDEQ.

Recommendations:

- **U.S. EPA recommends that MDEQ require Dow to submit an approvable compliance schedule, as required by Dow's state-authorized RCRA license, to meet such goals and that this enforceable compliance schedule be incorporated by MDEQ into Dow's license in order to hold Dow accountable for its 2010 commitments.**
- **U.S. EPA recommends that MDEQ incorporate the following compliance schedule into any approval of the revised RIWPs, if Dow fails to timely provide a compliance schedule as required by their RCRA License.**

City of Midland Timeline

2007

- MDEQ approval of constituents of concern beyond D/F (finalize PCOI list) for Midland.
- Dow completes and submits HHRA Sensitivity Analysis that covers the City of Midland.
- Dow/Agencies collaboratively confirm exposure pathways for dioxins/furans and identify necessary site-specific exposure studies for HHRA to include in RIWP.

- Dow completes and submits ERA Sensitivity Analysis that covers the City of Midland.
- Dow drops *all or portions of* PRA approach to HHRA (incompatible with 2010 goal) and replace with deterministic HHRA (compatible with 2010 goal) using literature values.
- MDEQ identification of preliminary IRA (possibly final) Midland soil cleanup action levels.
- Dow preliminary identification of interim (possibly final) Midland soil response activities.
- Dow implementation and monitoring of pilot Midland IRAs (e.g., removal of surficial soils).
- MDEQ evaluates environmental media data available (including biota) and identify data gaps for baseline prior to post remediation trend monitoring (e.g., for later evaluation against performance criteria).
- (Mid 2007) - Identification of objective remedial criteria and target timeline to achieve each.
- Dow collects additional environmental media data (including biota) necessary to fill identified data gaps for baseline prior to post remediation trend monitoring.
- Dow completes and submits results of geochemistry study(s) which will identify and describe the geological/geochemical parameters affecting PCOI distribution and bioavailability.
- Dow continues to conduct and monitor pilot IRAs/final remedies.
- MDEQ refines PCOI list based on Midland RIWP submittals and document review.
- Dow completes analyzing archived samples from 2006 Midland preliminary characterization sampling for remaining PCOIs.
- Review and collaboratively modify (if needed) and MDEQ approval of Midland RIWP.
- Dow implements PCOI characterization of City of Midland, including all Priority 1 and 2 properties.
- Dow determines/refines human health and ecological risks from PCOIs and other drivers for corrective action decisions:
    - PCOI Human Health Risk, including:
        - Identify additional/different relevant exposure pathways.
        - Quantify PCOI exposure pathway risks.
        - Identify areas within the City of Midland associated with unacceptable risk.
    - PCOI Ecological Risk, including:
        - Identify relevant exposure pathways.
        - Animal and vegetation tissue analysis.
        - Quantify ecological PCOI exposure pathway risks.
        - Identification of areas within the City of Midland associated with unacceptable ecological risk.
- Dow identifies disposal options for contaminated media that may require removal and initiate all necessary steps to procure/acquire all local, state, and federal licenses for such options.
- Dow continues/expands/adapts implementation of IRAs and pilot studies (to evaluate remedial alternatives), including:

- Surficial soil removal.
- Application of a binding agent to media to render PCOIs less bioavailable.
- Other.

- MDEQ continues review of HHRA and ecological risk assessment processes.

2008

- Dow submits Feasibility Study (FS)/Remedial Action Proposal (RAP) to MDEQ.
  - Identify feasible remedial alternatives for the City of Midland associated with unacceptable risk(s), including:
    - Surficial soil removal.
    - Application of a binding agent to soils/sediments to render PCOIs less bioavailable.
    - Institutional controls.
    - Monitored natural attenuation.
    - Other.
  - Collect additional data needed to evaluate remedial technologies (may include pilot studies).
  - Evaluate and compare degree of risk reduction associated with remedial alternatives.
  - Develop a logic for apportioning contaminated soils among alternatives.
  - Develop performance criteria for selected remedial alternatives.
- Identify disposal options for contaminated soils that may require removal.
- MDEQ approval of HHRA and ecological risk assessment.
- (End of 2008) – MDEQ identification of media cleanup criteria.
- MDEQ approval of Dow FS/RAP.
- Dow begins implementation of RAP.
- MDEQ verifies that performance criteria of selected remedial alternatives are being met.

2009 & 2010

- Dow continues RAP implementation.
- MDEQ verifies that performance criteria of selected remedial alternatives are being met.
- Dow implements previously identified management actions if performance criteria are not being met.

ATTACHMENT G - EVALUATION OF POTENTIAL CONSTITUENTS OF CONCERN

48. It is the understanding of the U.S. EPA that Dow has requested the removal of compounds greater than 5,000 Daltons from the TAL list, due to their presumed lack of bioavailability. U.S. EPA believes that Dow has not provided a sufficient justification for the removal of these compounds. U.S. EPA does not approve of the removal of these compounds because it is known that these constituents may degrade or break down into lower weight molecular compounds that may be toxic and bioavailable in the environment.

Recommendation:

- **U.S. EPA recommends that breakdown products resulting from the breakdown of compounds greater than 5,000 Daltons should be readded to the list.**