UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 5
77 WEST JACKSON BOULEVARD
CHICAGO, IL 60604-3590

MEMORANDUM

SUBJECT: ENFORCEMENT ACTION MEMORANDUM – Request for Approval of Action Memorandum for Non-Time Critical Removal Action at Segments 6 & 7 of the Tittabawassee River, Saginaw River & Bay Site, Michigan (Site ID #B5KF)

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TO: Douglas Ballotti, Director
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I. PURPOSE

The purpose of this memorandum is to request approval of this Action Memorandum for a Non-Time Critical Removal Action (NTCRA) to address contaminated in-channel sediment and riverbank soil within Segments 6 & 7 of the Tittabawassee River, Saginaw River & Bay site, Michigan. For the purposes of this Action Memorandum, "Site" or "Segments 6 & 7" shall mean the stretch of the Tittabawassee River beginning approximately 17.7 miles downstream of the confluence with the Chippewa River at the upstream end of Reach NN, and extending approximately 6.7 miles through the downstream end of Reach YY, and nearby areas required to perform the Work defined in Section V below. The general location of Segments 6 & 7 is depicted in Attachment A to this Action Memorandum.

This NTCRA will mitigate actual or potential threats to public health, welfare, or the environment presented by the presence of an uncontrolled release or threat of release of hazardous substances, pollutants, or contaminants, as identified by the presence of elevated levels of polychlorinated dibenzo-p-dioxins (dioxins) and/or polychlorinated dibenzofurans (furans) from in-channel sediment deposits and riverbanks in Segments 6 & 7 that are actual or potential contaminant sources to the river system. More specifically, the Site poses a risk due to high levels of hazardous substances or pollutants or contaminants in sediment and riverbank soil

largely at or near the surface that may migrate; weather conditions that may cause hazardous substances or pollutants or contaminants to migrate or be released (e.g., periodic flooding events); and exposure to nearby human populations, animals, or the food chain from hazardous substances or pollutants or contaminants (e.g., consumers of fish). Hazardous substances or pollutants or contaminants have or may have come to be located at Segments 6 & 7 from The Dow Chemical Company (Dow) Midland Plant property, with an address of 1000 East Main Street, 1790 Building, Midland, Michigan, 48667.

Work under this Action Memorandum will generally occur at specific areas within the Site designated as Sediment Management Areas (SMAs) and Bank Management Areas (BMAs). The SMAs and BMAs contain elevated levels of dioxin (primarily furans). The term "dioxin" refers to a large family of similar chemicals, including furans. The United States Environmental Protection Agency (U.S. EPA) has concluded that dioxin may cause cancer or other human health effects such as skin problems, liver damage, and reproductive issues, depending on exposures. Dioxin is not created intentionally; in this case, dioxin formed as a byproduct of Dow's early manufacturing processes. This Action Memorandum discusses dioxin concentrations as the toxic equivalence quotient (TEQ) – a summed estimate of the relative toxicity of the congeners as compared to 2,3,7,8-tetrachlorodibenzo-p-dioxin.

The proposed response actions include a combination of the following approaches at SMAs 6-1 and 7-1 through 7-3: in-situ capping; monitored natural recovery (MNR); institutional controls in areas where U.S. EPA determines they are needed; and post-construction operation, monitoring, and maintenance. The proposed response actions include the following approaches at BMAs 6-1 through 6-4 and 7-1 through 7-3: riverbank stabilization; disposal of any material generated as a result of stabilization; institutional controls; and post-construction operation, monitoring, and maintenance.

U.S. EPA and Dow have agreed to enter into an Administrative Settlement Agreement and Order on Consent (Segments 6 & 7 AOC), pursuant to which Dow will perform the removal action described herein with U.S. EPA oversight. The Segments 6 & 7 AOC contains provisions whereby U.S. EPA and Dow agree that additional Segments 6 & 7 SMAs and/or BMAs can be designated by U.S. EPA and added to the Site cleanup plan by future amendment to this Action Memorandum and the Segments 6 & 7 AOC. U.S. EPA, in consultation with the Michigan Department of Environmental Quality (MDEQ[1]), may identify additional Segments 6 & 7 SMAs and/or BMAs based on ongoing monitoring, post-construction risk assessments, or other information. If U.S. EPA identifies any such additional SMAs and/or BMAs, U.S. EPA will amend this Action Memorandum, and U.S. EPA and Dow will amend the Segments 6 & 7 AOC. The Segments 6 & 7 SMAs and BMAs identified as of the signature of this Action Memorandum are depicted in Attachment B.

[1] The Michigan Governor signed Executive Order No. 2019-02 renaming the Department of Environmental Quality (MDEQ) as the Department of Environment, Great Lakes, and Energy (DEGLE), effective April 7, 2019. DEGLE will maintain the authority to implement the environmental regulatory programs previously implemented by MDEQ. Per the Executuve Order, for dates on and after April 7, 2019, a reference to the MDEQ will be deemed to be a reference to the DEGLE. Activities implemented by MDEQ prior to April 7, 2019 will reference MDEQ as the governing authority.

This action will be conducted in accordance with Section 104(a)(1) of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), 42 U.S.C. § 9604(a)(1), and 40 C.F.R. § 300.415 (*Removal Action*) of the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) to abate or eliminate the threats posed to public health and/or the environment. U.S. EPA has consulted, and will continue to consult, with MDEQ regarding Segments 6 & 7. This action is anticipated to require three construction seasons to implement and is expected to begin in 2019. This action will be implemented by Dow, the potentially responsible party, under a CERCLA Section 106/122 agreement. As such, pursuant to NCP Section 300.415(k)(3), the requirements to terminate response after $2 million has been obligated or 12 months have elapsed from the date of the initial response do not apply.

II. SITE CONDITIONS AND BACKGROUND

CERCLIS ID#: MID980994354
Category: Non-Time Critical Removal Action

A. Physical Location and Description

The Tittabawassee River, Saginaw River & Bay site starts at the confluence of the Tittabawassee and Chippewa Rivers. Segments 6 & 7 are the last two of seven segments in the Tittabawassee River (see Attachment A). The Site is being addressed in a general upstream to downstream approach beginning with Segment 1, which consists of a 3.1-mile stretch of the Tittabawassee River that bisects the Midland plant. Segment 2 begins immediately downstream of Segment 1 and extends approximately 4.1 miles. Segment 3 is about 4.2 miles long and is located within Tittabawassee Township and the unincorporated community of Freeland. Segment 4 is 3.4 miles long and is located within Tittabawassee, Thomas and Saginaw Townships. Segment 5 begins upstream of Imerman Park and extends approximately 2.7 miles. SMAs and BMAs in these upstream segments have been or are being addressed by earlier NTCRAs.

Segment 6 begins at State Road and extends approximately 3 miles from Reach NN[2] through Reach SS. Segment 6 is characterized by a mixed land use setting. Land use on both sides of the river consists of residential, agricultural, and undeveloped land. Segment 6 is located within the Thomas, Saginaw, and James Townships of Saginaw County. Segment 7 begins at the railroad bridge on the upstream side of West Michigan Park and extends approximately 3.7 miles to the downstream end of Green Point Island at the confluence of the Saginaw and Tittabawassee Rivers. Segment 7 includes reaches TT through YY and is characterized by a more natural river setting. Land use in Segment 7 consists of the Shiawassee National Wildlife Refuge (Refuge), agricultural, low-density residential, and undeveloped areas. In addition to the Refuge and the associated Greenpoint Nature Center, public areas in Segment 7 include West Michigan Park and the Center Road boat launch on the northeast side of the river. Segment 7 is located within the Saginaw and James Townships and City of Saginaw, all part of Saginaw County.

[2] River reaches refer to shorter sections of the Tittabawassee River than segments. Reaches were delineated as part of the geomorphological characterization of the river. Reaches begin with Reach A at the upstream end of Segment 1 and end in Reach YY at the downstream end of Segment 7.

Physical features in Segments 6 & 7 include the State Road Bridge at the Reach MM/NN boundary, Gratiot Road Bridge at the Reach PP/QQ boundary, a CSX railroad bridge at the Reach SS/TT boundary, and the South Center Road/Saginaw Valley Rail Trail Bridge at the Reach UU/VV boundary. Tributaries enter Segments 6 & 7 on the northeast sides of Reaches NN, OO, PP, SS, UU, VV, and XX, and on the southwest sides of Reaches OO, PP, QQ, SS, UU, and VV. The channel sinuosity in Segments 6 and 7 is characterized as low to moderate. The hydraulic gradient in Segments 6 and 7 is generally less than 0.5 ft per mile.

Human access to the Site is available to people using the Tittabawassee River, from West Michigan Park, Center Road boat launch, the Shiawassee National Wildlife Refuge, or across privately owned riverside properties. Wildlife in the area also has access to the Site. Segments 6 & 7 are subject to periodic flooding during high flow events. This may result in erosion at the SMAs and/or BMAs and the spread of contamination to downstream locations, including floodplains, where the contamination may become available for exposure elsewhere.

The Tittabawassee River, Saginaw River & Bay site, is defined in the Administrative Settlement Agreement and Order on Consent for Remedial Investigation, Feasibility Study and/or Engineering Evaluation and Cost Analysis, and Response Design, entered In The Matter of: The Dow Chemical Company, CERCLA Docket No. V-W-10-C-942, with an effective date of January 21, 2010 (2010 AOC). The site is the area located in and along the Tittabawassee River and its floodplains, starting upstream of the Midland Plant, and extending downstream to, and including, the Saginaw River and its floodplains, and Saginaw Bay; and any other areas in or proximate to the Tittabawassee River and its floodplains, the Saginaw River and its floodplains, and Saginaw Bay, where hazardous substances, pollutants, or contaminants from the Midland Plant have or may have come to be located.

B. Background

The Midland Plant began operations in 1897 and eventually grew to be a 1,900 acre facility. Over the time of its operation, the Midland Plant has produced over 1,000 different organic and inorganic chemicals. Early in the history of the Midland Plant, wastes were discharged directly into the Tittabawassee River and, later, wastes were stored and partially treated in settling ponds prior to discharge to the River. One major historical process used at the Midland Plant was the chloralkali process, which used electric current to extract chemicals from brine. Much of the TEQ in Segments 6 & 7 is believed to have been released in the early 1900s in the form of furan-contaminated graphitic particles that came from breakdown of the carbon anodes used in the chloralkali process. The furan contamination was unknown at that time and was formed as a byproduct of the process. Once released to the River, the graphitic particles mixed with the sediment and deposited in levees that form the riverbanks. Frequent flooding resulted in deposition of contaminated sediment in some parts of the floodplain.

Historically, flooding of the Midland Plant property may also have resulted in discharges of stored brines or untreated or partially treated process wastewaters to the Tittabawassee River. Prior to the installation of a groundwater containment system, contaminated groundwater likely discharged to the river. Over time, changes in waste management included the installation and

operation of a modern wastewater treatment plant. Current waste management practices at the Midland plant, including the wastewater treatment plant and groundwater and surface water control, have reduced or eliminated non-permitted releases from the Midland plant.

Dioxins and furans are listed as hazardous constituents in Appendix VIII to Part 261 of Title 40 of the Code of Federal Regulations, 40 C.F.R. Part 261 app. VIII, and Part 111 of Natural Resources and Environmental Protection Act (NREPA), Mich. Comp. Laws §§ 324.11101-324.11153, and as hazardous substances in Part 201 of NREPA, Mich. Comp. Laws §§ 324.20101-324.20142.

MDEQ reissued to Dow its current Resource Conservation and Recovery Act (RCRA) Hazardous Waste Management Facility Operating License for the Midland Plant, with an effective date of September 25, 2015 (License). Under its License, and the previous licenses, Dow has been conducting corrective action work including characterization of the Tittabawassee River. Dow continues to conduct corrective action work under the License on the plant site and off-site in the City of Midland. Corrective action work also is identified in the January 19, 2005, Framework for an Agreement between the State of Michigan and the Dow Chemical Company.

U.S. EPA's and MDEQ's understanding of potential hazardous substances in sediment and riverbank soil at Segments 6 & 7 is based on various sampling, analysis, and studies regarding dioxin/furans and other contaminants in the Tittabawassee River, the Saginaw River, and the Saginaw Bay. The sampling, analysis, studies, and orders relied on by U.S. EPA and MDEQ include, but are not limited to, those listed in the Administrative Record index found herein as Attachment C.

In December 2008, negotiations with Dow began for a more comprehensive approach to addressing contamination related to Dow in the rivers and Bay. On January 14, 2010, using CERCLA authority, U.S. EPA signed the 2010 AOC with the MDEQ and Dow, requiring Dow to perform investigations, and develop and design cleanup options selected by U.S. EPA for areas such as Segments 6 & 7, and other areas. The 2010 AOC became effective on January 21, 2010, and work under the 2010 AOC is ongoing.

The 2010 AOC established a comprehensive site-wide management approach for the Tittabawassee River, Saginaw River & Bay site. This Segments 6 & 7 Action Memorandum is part of the larger site-wide management plan. U.S. EPA's focus in these segments is cleanup of in-channel sediment and riverbank soil. Cleanup of the Tittabawassee River floodplain is being addressed separately and in parallel with the River segments, pursuant to a 2015 floodplain NTCRA. The site-wide management approach includes developing a set of prioritized actions (including this Segments 6 & 7 NTCRA) intended to reduce exposure to and transport of contaminated sediment, riverbanks and floodplain soil to reduce risks to human health and ecological receptors. After implementation of ongoing and potential future response actions, U.S. EPA will evaluate residual human health and ecological risk, to assess the need for further cleanup actions at Operable Unit 1 (OU 1) of the site. The residual risk assessments will be informed by the long-term monitoring conducted in OU 1, which includes the segments in the Tittabawassee River and upper Saginaw River. Subsequently, a final Record of Decision(s) will be issued for OU 1, or areas within OU 1.

C. Environmental Justice Analysis

An Environmental Justice (EJ) analysis for the Site is contained in Attachment D. Screening of the surrounding area used U.S. EPA's EJSCREEN Tool (see https://www.epa.gov/ejscreen). Region 5 reviewed environmental and demographic data for the area surrounding Segments 6 & 7 and determined there is a low potential for EJ concerns at this location.

D. Risk Assessments, Health Consultations, and Advisories

1. Risk Assessments

The 2010 AOC and associated Statement of Work (2010 SOW) set forth requirements that Dow conduct human health and ecological risk assessments. Dow has not yet completed those risk assessments but will conduct them in accordance with the requirements of the 2010 SOW. Specifically, the 2010 SOW directs Dow to conduct residual risk assessments after substantial implementation of response actions. U.S. EPA, MDEQ, and Dow initiated a Human Health Risk Assessment (HHRA) in 2018 that will assess residual dioxin/furan risk in all seven of the Tittabawassee River segments and the adjacent floodplains. U.S. EPA anticipates completion of this HHRA before all cleanups in and along Segments 6 & 7 are complete. Based on the results of the HHRA, U.S. EPA, in consultation with MDEQ, will assess whether additional response actions may be needed under CERCLA.

Dow, under U.S. EPA and MDEQ oversight, collected extensive data at the Tittabawassee River, Saginaw River & Bay site. The *Tittabawassee River Segments 6 and 7 (OU 1) Response Proposal* (Segments 6 & 7 EE/CA), dated April 13, 2018, and approved by U.S. EPA on September 28, 2018, presented detailed information obtained during a series of site investigations conducted by Dow. A brief summary of the findings is included in Section II.E, below. These investigations largely focused on TEQ, but also characterized a sub-set of samples for a wide range of other contaminants in Segments 6 & 7 sediment and riverbank soil.

The Segments 6 & 7 EE/CA presented the conceptual site model and evaluated the bases for these current response actions. Neither a human health nor an ecological risk assessment was conducted as part of the Segments 6 & 7 EE/CA, but conditions were evaluated compared to NCP removal criteria (§ 300.415(b)(2)). The SMAs and BMAs are actual or potential contaminant sources to the system. Mitigating these sources will contribute to lower TEQ surface sediment levels that, over time, will contribute to lower fish tissue levels and lower TEQ levels in sediment deposited in the floodplain. Because clean materials continually move into the site from upstream, U.S. EPA expects that natural processes to reduce TEQ levels throughout the Tittabawassee River, Saginaw River & Bay site will occur after upstream source control actions are implemented. Dow, under Agency oversight, is conducting trend monitoring of fish tissue and surface sediment TEQ levels to help assess site-wide changes over time. As discussed above, risk assessments that evaluate post-construction conditions will be conducted.

2. Health Consultations

EPA and MDEQ work with health agencies such as the Agency for Toxic Substances and Disease Registry (ATSDR) and the Michigan Department of Health and Human Services (MDHHS, formerly Michigan Department of Community Health) to understand potential health effects to people from environmental contamination. ATSDR and MDHHS completed a number of health consultations for the Tittabawassee River, Saginaw River & Bay site (found at http://www.atsdr.cdc.gov/HAC/PHA/HCPHA.asp?State=MI), including:

- 8/12/04 Health Consultation, Tittabawassee River Floodplain Dioxin Contamination, Tittabawassee River, Midland, Midland County, Michigan
- 4/29/05 Petitioned Health Consultation, Dioxins in Wild Game Taken from the Tittabawassee River Floodplain South of Midland, Midland and Saginaw Counties, Michigan
- 7/27/05 Tittabawassee River Fish Consumption Health Consultation, Tittabawassee River, Midland, Midland County, Michigan
- 11/1/07 A Pilot Exposure Investigation Report: Dioxin Exposure in Adults Living in the Tittabawassee River Floodplain
- 2/4/08 Health Consultation, Evaluation of Saginaw River Dioxin Exposures and Health Risks, Saginaw River, City of Saginaw, Saginaw County, Michigan
- 8/19/09 Health Consultation, Dioxin Contamination on Residential Property in the Tittabawassee River Floodplain, Saginaw County, Michigan

3. Advisories

The State of Michigan has issued fish consumption advisories for dioxins, PCBs, and mercury for the Tittabawassee and Saginaw Rivers and Saginaw Bay. These advisories are posted at multiple locations throughout the watershed. The advisories can be found online at http://www.michigan.gov/documents/mdch/EAT_SAFE_FISH_IN_THE_SAGINAW_BAY_AREA_WEB_356929_7.pdf

The State of Michigan has issued a public Health Advisory for Consuming Wild Game from the Tittabawassee River Flood Plain due to dioxin contamination. The wild game advisory can be found online at http://www.michigan.gov/documents/mdch/Eat_Safe_Wild_Game_277942_7.pdf

The State of Michigan's latest advisories are summarized in *Dioxins and Furans and Your Health along the Tittabawassee and Saginaw Rivers*. This brochure is found at http://www.michigan.gov/documents/mdch/Dioxin_Exposure_and_Health_Final_420292_7.pdf

E. Site Assessments

The Administrative Record for the Site contains numerous reports which summarize the investigations conducted at the Tittabawassee River, Saginaw River & Bay site to date. Assessments include chemical and geophysical sampling and analysis, stability evaluations, and biological evaluations. Segments 6 & 7 chemical assessment activities include extensive work: in 2008 and 2009 as part of the Tittabawassee River Site Investigation; in 2010 to 2012 as part of the bank face composite TEQ sampling program; in 2014 for additional bank core TEQ

sampling; multiple events in 2014 through 2018 as part of the in-channel composite TEQ testing; and in 2016 and 2017 as part of additional step-out sediment sampling. For in-channel sediment in Segments 6 & 7, Dow completed dioxin analysis on more than 1,700 samples from about 250 core locations. Additionally, in spring and fall, Dow collects 27 quarter-mile incremental composite surface sediment grab samples to assess trends in the average concentrations. For Segments 6 & 7 bank soil, Dow completed dioxin analysis on more than 180 samples from about 150 core locations. Dow also sampled for more than 220 other chemicals or chemical families at a subset of the riverbank soil and sediment core locations.

The Segments 6 & 7 EE/CA built upon the documents in the Administrative Record. The Segments 6 & 7 EE/CA identified certain areas within the Site, designated as SMAs and BMAs, for which response alternatives were developed. Existing analytical data indicates the following conditions. Dioxin (primarily furans) is the contaminant of concern in Segments 6 & 7 addressed by this Action Memorandum. The SMAs were identified primarily by depositional geomorphic features (e.g., point bars) with contiguous deposits of elevated TEQ. Both lateral and vertical extent of the contamination was considered, including distance to neighboring cores. The BMAs were identified by two primary criteria – low stability, based on multiple lines of evidence, and higher relative levels of TEQ. There are multiple sample cores in and adjacent to each SMA and BMA. In BMA 6-1 the core with the highest levels of dioxin had a length weighted average (LWA) exceeding 10,000 ppt TEQ. The cores with the highest levels of dioxin in the other BMAs generally had LWAs between 5,000 to 10,000 ppt TEQ. In both SMA 6-1 and 7-2 there are cores with LWA dioxin levels between 5,000 to 10,000 ppt TEQ. The maximum individual samples were about 15,000 ppt at SMA 6-1, 33,000 ppt at SMA 7-1, 33,200 ppt at SMA 7-2, and 22,000 ppt at SMA 7-3. Based on ongoing trend monitoring and/or residual risk assessments, additional SMAs and BMAs may be identified for response actions.

F. NPL Listing Status

Neither the Tittabawassee River, Saginaw River & Bay site nor Segments 6 & 7 are listed on the National Priorities List (NPL). U.S. EPA is addressing the Tittabawassee River, Saginaw River & Bay site under the Superfund Alternative (SA) approach, which uses the same investigation and cleanup process and standards for sites listed on the NPL. The SA approach is an alternative to listing a site on the NPL; it is not an alternative to Superfund or the Superfund process. Threshold eligibility criteria for using the SA approach are: site contaminants are significant enough that the site would be eligible for listing on the NPL (*i.e.*, the site would have a Hazard Ranking Score $\geq$ 28.5); a long-term response (*i.e.*, a remedial action) is anticipated at the site; and there is a willing, capable PRP who will negotiate and sign an agreement with EPA to perform the investigation and cleanup.

G. Maps, Pictures and Other Graphic Representations

A figure showing the general location of Segments 6 & 7 is included as Attachment A to this Action Memorandum. The BMAs and SMAs within Segments 6 & 7 where removal response actions are required as of the effective date of this Action Memorandum are depicted in the table and on the figures in Attachment B.

H. Other Actions to Date

1. Previous CERCLA Actions at Tittabawassee River, Saginaw River & Bay Site

In order to implement response actions at the Tittabawassee River, Saginaw River & Bay site, U.S. EPA and Dow have entered into numerous separate AOCs under the authority of Sections 104, 106(a), 107, and 122 of CERCLA.

a. On July 12, 2007, U.S. EPA and Dow entered into an AOC for a CERCLA time critical removal to dredge and dispose of a sediment deposit at Reach D adjacent to Dow's Midland plant. U.S. EPA provided Dow with notification of the completion of this AOC on October 15, 2008.

b. On July 12, 2007, U.S. EPA and Dow entered into an AOC for a CERCLA time critical removal at Reaches J/K to remove and dispose of contaminated riverbank soil, cap a contaminated upland area, and fence off a contaminated wetland area. U.S. EPA provided Dow with notification of the completion of this AOC on May 2, 2008.

c. On July 12, 2007, U.S. EPA and Dow entered into an AOC for a CERCLA time critical removal to dredge and dispose of a sediment deposit at Reach O. U.S. EPA provided Dow with notification of the completion of this AOC on April 10, 2008.

d. On November 15, 2007, U.S. EPA and Dow entered into an AOC for a CERCLA time critical removal to dredge and dispose of a sediment deposit near Wickes Park in the Saginaw River. U.S. EPA provided Dow with notification of the completion of this AOC on August 4, 2008.

e. On July 15, 2008, U.S. EPA and Dow entered into an AOC for a CERCLA time critical removal to remove and dispose of floodplain soil around residential properties at Riverside Boulevard and clean the inside of occupied homes. U.S. EPA provided Dow with notification of the completion of this AOC on February 1, 2010.

f. On February 27, 2009, U.S. EPA and Dow entered into an AOC for a CERCLA time critical removal to remove and dispose of floodplain soil at West Michigan Park and conduct soil removal and/or barrier controls at adjacent residential properties. U.S. EPA provided Dow with notification of the completion of this AOC on September 11, 2012.

g. On May 26, 2011, U.S. EPA and Dow entered into an AOC for a CERCLA non-time critical removal action to provide interim exposure controls at eligible floodplain properties. The work under this AOC is ongoing.

h. On July 8, 2011, U.S. EPA and Dow entered into an AOC for a CERCLA non-time critical removal action to remove a small eroding island and cap adjacent sediment in Reach MM. U.S. EPA provided Dow with notification of the completion of this AOC on July 12, 2012.

i. On November 1, 2011, U.S. EPA and Dow entered into an AOC for a CERCLA non-time critical removal action to remove and destroy dense non-aqueous phase liquids from the Tittabawassee River and install hydraulic control barriers and caps at SMAs in Segment 1. U.S. EPA provided Dow with notification of the completion of this AOC on September 27, 2017.

j. On November 21, 2013, U.S. EPA and Dow entered into an AOC for a CERCLA non-time critical removal action to address SMAs and BMAs within Segment 2. The work under this AOC is ongoing.

k. On January 8, 2015, U.S. EPA and Dow entered into an AOC for a CERCLA non-time critical removal action to address soil contaminated with dioxins and furans within the Tittabawassee River 8-year floodplain of the Tittabawassee River, Saginaw River & Bay site. The work under this AOC is ongoing.

l. On February 25, 2016, U.S. EPA and Dow entered into an AOC for a CERCLA non-time critical removal action to address SMAs and BMAs within Segment 3. The work under this AOC is ongoing.

m. On February 8, 2017, U.S. EPA and Dow entered into an AOC for a CERCLA non-time critical removal action to address SMAs and BMAs within Segments 4 & 5. The work under this AOC is ongoing.

The AOCs listed above in g, j, k, l, and m are current actions and are further described in Section II.H.3 in this Action Memorandum.

2. Previous Actions Within Segments 6 & 7

There have been no previous in-channel or riverbank actions within Segments 6 or 7. The CERCLA time critical removals discussed above in Section II.H.1.e and f occurred at floodplain properties within Segment 7. Under EPA and MDEQ oversight, Dow removed and replaced contaminated soil, and otherwise mitigated near-term exposures through these early actions.

3. Current Actions

Dow, under U.S. EPA and MDEQ oversight, is addressing potential acute or near-term exposure risks at eligible properties in the floodplain through interim exposure controls pursuant to the May 26, 2011, AOC. Dow placed interim exposure controls at many floodplain properties, primarily in 2011 and 2012. As the floodplain work discussed below (January 8, 2015, AOC) is being implemented, the need for interim exposure controls at eligible properties is being superseded. However, this AOC remains open until floodplain obligations are met.

Response options are generally developed and implemented in an upstream-to-downstream, segment-by-segment fashion for in-channel sediment and riverbanks. Pursuant to the November 21, 2013, AOC, cleanup of SMAs and BMAs in Segment 2 started in 2014 and construction of the remaining BMA work was largely complete in 2015. Pursuant to the February 25, 2016, AOC, construction of SMAs and BMAs in Segment 3 started and was largely complete in 2016. Pursuant to the February 8, 2017, AOC, Dow started cleanup of SMAs and BMAs in Segments 4 & 5 in 2017, with construction expected to be largely complete in 2019. The work required by these NTCRAs is ongoing, ensuring the native vegetation planted on the BMAs is well established, and post-removal site controls are developed and implemented.

Dow, with oversight by U.S. EPA and MDEQ, is cleaning up dioxin-contaminated soil in frequently flooded areas along the Tittabawassee River pursuant to the January 8, 2015, AOC. The eight-year floodplain includes about 4,500 acres and extends along 21 miles of the river below Dow's Midland plant. Not all areas in the floodplain will need a cleanup. U.S. EPA is assessing more than 700 properties to determine if a cleanup is needed and the most appropriate approach at eligible properties. Dow began cleanup of the first floodplain properties in the summer of 2015, and floodplain cleanup is an ongoing, multi-year project. To date, excavation/ disposal of contaminated soil and backfill with clean soil has occurred on approximately 80 floodplain properties; most cleanups have been in maintained residential areas.

I. State and Local Authorities' Role

1. State and Local Actions to Date

Dow's current License for the Midland Plant was reissued by MDEQ with an effective date of September 25, 2015. Under its License and the January 19, 2005, Framework for an Agreement between the State of Michigan and The Dow Chemical Company, Dow conducted corrective action work including characterization of the Tittabawassee River and implementation of interim response actions. U.S. EPA has partnered with MDEQ, as described under the 2010 AOC, to continue to undertake CERCLA activities at the Tittabawassee River, Saginaw River & Bay site. The CERCLA actions are intended to also meet Dow's RCRA corrective action requirements for the Tittabawassee River, Saginaw River & Bay site.

Two BMAs are on property owned by Thomas Township, one BMA is on property owned by Saginaw Charter Township, one BMA is in the Michigan Land Bank. Additionally, three SMAs are adjacent to land owned or managed by the Shiawassee National Wildlife Refuge. Before the public comment period started, U.S. EPA and/or Dow communicated to these entities about the proposed response actions, the potential impacts to these properties, and their right to provide public comment.

2. Potential for Continued State/Local Response

U.S. EPA anticipates a continuing partnership with MDEQ as outlined in the 2010 AOC. U.S. EPA and Dow will continue to work closely with the local entities and the Refuge as the response actions are designed and implemented.

III. THREATS TO PUBLIC HEALTH OR WELFARE OR THE ENVIRONMENT, AND STATUTORY AND REGULATORY AUTHORITIES

The conditions present at Segments 6 & 7 constitute a threat to public health, welfare, or the environment based upon the factors set forth in the NCP, 40 C.F.R. § 300.415(b)(2). These factors include, but are not limited to, the following:

A. High levels of hazardous substances or pollutants or contaminants in sediment and soil largely at or near the surface that may migrate.

This factor is present at the Site due to the existence of elevated TEQ at or near the surface of in-channel sediment deposits and in riverbank stretches with low stability. The Site is subject to periodic high energy events. This may result in the spread of contaminated sediment and soil to other downstream locations within the floodplain and river channel.

B. Weather conditions that may cause hazardous substances or pollutants or contaminants to migrate or be released.

This factor is present at the Site due to seasonal and often extreme weather conditions in the winter and spring (although high flow events can occur at any time of year), which enhance the threat of movement of contaminated sediment and riverbank soil. Heavy rain and storms increase stream volume and current velocity, which can contribute to movement of contaminated sediment and riverbank soil.

C. Actual or potential exposure to nearby human populations, animals, or the food chain from hazardous substances, pollutants or contaminants.

This factor is present at the Site due to the existence of surface sediment contaminated at levels that may contribute to bioaccumulation of TEQ in the food chain (fish tissue) and may result in the spread of contaminated sediment and soil to other downstream locations within the floodplain and river channel where exposure may occur.

IV. ENDANGERMENT DETERMINATION

Given the conditions at Segments 6 & 7, the nature of the hazardous substance there, and the potential exposure pathways described above, the actual or threatened release of contaminants from Segments 6 & 7, if not addressed by implementing the response actions selected in this Action Memorandum, may present an imminent and substantial endangerment to public health, or welfare, or the environment.

V. PROPOSED REMOVAL ACTION ACTIVITIES AND ESTIMATED COSTS

A. Proposed Removal Action Activities

1. Proposed Removal Action Description

The required response actions at Segments 6 & 7 will, at a minimum, include the following tasks (collectively, the Work):

- Develop and implement a Work Plan. The actions described in the approved Work Plan and all approved designs shall include, but are not limited to, the following:
  - Conduct pre-removal field investigations to delineate the final footprints and inform the design of the SMAs and BMAs.

  - Develop temporary staging areas and access to the Site to meet project requirements. Such areas may include, but are not limited to, equipment decontamination, dewatering, mobilization and demobilization, worker access, and exclusion zones.

  - Design the following response actions. Upon approval of the design(s), implement the response actions in accordance with the approved schedule.
    - SMA 6-1 – Use a combination of technologies that include in-situ capping and MNR.
    - SMAs 7-1, 7-2, and 7-3 – Construct an in-situ containment cap.
    - BMAs 6-1 through 6-4 and 7-1 through 7-3 – Stabilize the riverbanks.

  - Appropriately manage materials generated at the Site through implementation of the Work and dispose of these materials at approved locations.

  - Conduct monitoring during the construction phase of the Work.

  - Remove and restore the mobilization and staging areas.

- Develop and implement a Site Health and Safety Plan.

- Develop and implement a Post-Removal Site Control Plan which shall include provisions for periodic monitoring of the Site and maintenance (operation and maintenance), as necessary. For areas where U.S. EPA determines that institutional controls are needed, the plan shall also include an Institutional Control Implementation and Assurance Plan.

2. Contribution to Remedial Performance

The removal action implemented at Segments 6 & 7 will address actual or potential short-term and/or long-term risks by reducing exposure to and/or transport of contaminated sediment and/or riverbank soil. In accordance with Section 300.415(d) of the NCP, U.S. EPA expects that this removal action shall, to the extent practicable, contribute to the efficient performance of any anticipated long-term remedial action with respect to the release concerned.

3. Analysis of Selected Response Actions

U.S. EPA selected the proposed response actions in this NTCRA based on careful consideration of information in the Administrative Record, including the EE/CA Approval Memorandum, the

Segments 6 & 7 EE/CA, public comments as evaluated in the Responsiveness Summary found at Attachment E, and other information in the Administrative Record.

U.S. EPA guidance establishes criteria for the evaluation of removal responses. Therefore, U.S. EPA evaluated the response actions in this NTCRA relative to effectiveness, implementability, and cost. Additionally, as required by the 2010 AOC, the Segments 6 & 7 EE/CA further evaluated the potential response alternatives against the nine evaluation criteria established for remedial responses in Section 300.430(e)(9)(iii) of the NCP. The discussion below highlights the most relevant criteria in distinguishing between alternatives. U.S. EPA, in consultation with MDEQ, selected the removal responses discussed above because these options provide the best balance of the evaluation criteria.

a. SMA Alternatives

U.S. EPA evaluated three technologies to clean up sediment that may be applied separately or in combination: MNR, capping, and removal and disposal.

Effectiveness: The selected SMA alternatives are expected to help protect human health and the environment, meet the cleanup objectives and comply with laws and regulations. The response actions contribute to effectiveness because of:

- *Long-term effectiveness and permanence* – The response actions for each SMA are expected to be effective in the long term.

    - For SMA 6-1, EPA is selecting a combination of capping and MNR. SMA 6-1 is a stable point bar, and in some parts several feet of cleaner sediment cover the contamination. MNR will be used in these areas to monitor buried contamination and trigger evaluation of additional cleanup, if necessary. In other parts of SMA 6-1 the dioxin deposit is closer to the surface, so capping will stabilize those areas. The time frame to attain protection is less certain for MNR at SMAs 7-1, 7-2, and 7-3, where elevated dioxin levels are closer to the sediment surface and may be more likely to erode, so MNR is not included in those remedies. SMA 6-1 will be closely monitored to ensure that contamination stays buried.

    - Capping provides an immediate benefit by isolating and safely containing the contaminated sediment. The Segment 6 & 7 SMAs may be very suitable for Cellular Containment System (CCS) caps[3] which would enhance the sediment stability and habitat, while short-term effects are minimized. Caps must be monitored and may need maintenance to make sure they are reliable in the long term.

[3] A CCS is a capping approach that isolates and contains the underlying contaminated sediment and prevents erosion by promoting natural sedimentation. A six-inch deep geocellular material is placed over the SMA and the geocells quickly fill with sediment bedload moving through the river system. To date, CCS caps have been stable in the Tittabawassee River. Some upstream CCS caps have allowed for growth of submerged aquatic vegetation, which is rare in the Tittabawassee River.

- While removal would be effective in the long term because it permanently removes contaminated sediment from the river system, it was not selected for the Segment 6 & 7 SMAs because of trade-offs related to short-term effectiveness and implementability.

- *Short-term effectiveness* – All options except MNR would have some short-term effects that would temporarily disrupt areas in and along the river. If possible, short-term effects would be managed by construction practices and post-construction restoration of upland work areas.

  - Using heavy construction equipment could have a significant impact on the Shiawassee National Wildlife Refuge, especially for the removal alternative. Access to SMAs 7-1, 7-2, and 7-3 may require clearing roads and staging areas, which could affect the existing ecosystem, including adjacent wooded areas. Although areas will be replanted, floodplain forests may require 8 – 12 decades to return to their pre-construction condition and there is significant concern that more invasive species could colonize the construction areas. Sediment removal requires a larger nearby work area than capping using sand or gravel, and significantly more area than a CCS cap. The Refuge Manger's comment letter expressed significant concerns with remedy impacts to the Refuge (see Attachment E and the Administrative Record).

  - One alternative for SMA 6-1 was a combination of removal and MNR. While U.S. EPA believes that alternative could have been protective in the long term, there are concerns with short-term effectiveness. SMA 6-1 is a stable point bar. Removal of a part of the deposit could exacerbate short-term erosion of the remaining deposit until bedload refills the removed area.

  - Safety during construction is always a concern, but the Segment 6 & 7 SMAs will require special levels of care for both workers and recreational river users because of the size, location of the SMAs, and, in some areas, water depth. Capping results in fewer safety concerns than removal. Public trail use at the Refuge might also be affected during construction and would require safety measures.

  - Capping takes less time to complete than removal. Either alternative could result in short-term turbidity in the water. Removal could also result in release of contaminants to surface water and movement of contaminants downstream during construction, especially when the work is performed in wet conditions. If removal is performed in dry conditions, care is needed to prevent erosion in nearby areas. Removal requires truck traffic to take the contaminated sediment to an approved landfill. If capping is done using sand or gravel, there will be truck traffic to deliver the clean cover materials.

Implementability: Dow has successfully implemented the selected SMA alternatives at other areas in the Tittabawassee River, but there are implementation challenges for the Segment 6 & 7 SMAs. All equipment, personnel and material necessary to implement the alternatives should be locally available.

- There are no implementation challenges with MNR.

- Implementation of other SMA alternatives may be a challenge because access to the river will be needed on privately held land or the Shiawassee National Wildlife Refuge, so landowner cooperation is important. Removal would require the greatest degree of site access, including temporary roads and staging areas for heavy equipment, contaminated sediment staging and transport, and water management equipment. Sand/gravel caps require access roads and staging areas. CCS caps provide more flexibility because heavy equipment is not used and the SMAs could be approached by water. The Refuge Manager's letter stated, "The Refuge is opposed to the construction of access roads and staging areas in the floodplain forests to provide closer construction access to the SMAs."

- Capping using both sand/gravel and CCS has been done successfully upstream. Sand/gravel caps require heavy equipment, while CCS caps rely on intensive man-power. The water depths at portions of the SMAs may require divers to install a CCS.

- Capping is easier during lower-flow conditions. Typically, this work is planned later in the summer, but water blowing in from Saginaw Bay or unexpected high flows can bring challenges.

- There may be seasonal restrictions that limit when and how work can be done. For example, work may be limited by the breeding season of eagles.

- If sediment removal were selected, there are significant implementation challenges. Buried logs and other debris in the Tittabawassee River make wet removal difficult. For safety reasons, deeper water in portions of the SMAs might require removal to be done in wet conditions (e.g., because sheet pile coffer dams may not be stable). However, even in deeper areas, the Tittabawassee River is not deep enough for many wet removal approaches. The size and location of SMAs 6-1, 7-2, and 7-3 would require dry excavation to occur in two phases and residuals would be left behind. Temporary bridges to the work areas would be needed; these would be technically challenging to build and it might be difficult to meet the substantive requirements of the State regulations.

Cost: The total estimated present worth cost for U.S. EPA's selected SMA alternatives is about $3.45 million based on the average of the low-end and high-end costs of the capping technologies.

b. BMA Alternatives

U.S. EPA evaluated two technologies to clean up riverbanks: stabilization and removal/disposal.

Effectiveness: The selected BMA alternative, stabilization, is expected to help protect human health and the environment, meet the cleanup objectives, and comply with laws and regulations. The design of each BMA will consider current conditions to select appropriate stabilization technologies to enhance effectiveness. The response actions contribute to effectiveness because:

- *Long-term effectiveness and permanence* – Stabilization of the BMAs is expected to be effective in the long term because it ensures that highly contaminated banks do not erode into the river. The alternative requires a long-term plan to monitor and maintain the banks.

- *Short-term effectiveness* – Stabilization takes less time to construct than removal, so there are fewer short-term disruptions in and along the river. However, establishment of the deep rooted native vegetation takes several years, so more short-term maintenance is needed. Stabilization is expected to have less short-term effects on workers and the community; using less heavy construction equipment and requiring less truck traffic. Stabilization causes less change to existing riverbank conditions than removal. With stabilization the riverbank habitat would remain or be improved. Stabilization minimizes removal of mature trees and habitats that may require decades to return to their pre-construction condition.

Implementability: Dow has successfully implemented both BMA alternatives along the Tittabawassee River. Necessary personnel and equipment are available for either option. The appropriate stabilization technologies will be applied to each BMA after taking into consideration characteristics such as bank height and angle, existing vegetation quality, the potential for river flows to undercut the banks and other considerations. Stabilization is implementable for Segments 6 & 7 BMAs because:

- Community members and landowners generally find bank stabilization preferable to bank removal. All BMA alternatives will require access roads and staging areas through privately held and public land, so landowner acceptance is important. Additional access is required for stabilization because establishing the native vegetation can take a couple of years, and the banks will need irrigation, periodic on-going inspections, and long-term maintenance.

- Stabilization is easier to construct than removal. Still, it is noted that extremely high or steep banks may pose unique challenges for the placement of certain slope stabilization materials and reshaping the banks may be necessary.

- Removal is more difficult to implement, although it has been done successfully upstream. In areas of dense vegetation or areas where access is limited, the BMA and surrounding areas would require extensive clearing and preparation to allow equipment to access the bank. This would include roads and staging areas for heavy equipment, as well as areas for contaminated soil staging and transport and equipment decontamination.

Cost: The total present worth cost for all BMAs is estimated at about $2 million. Stabilization costs about $52,000 per 100 linear feet of bank, with additional costs associated with access, mobilization, and demobilization at each BMA.

4. Engineering Evaluation/Cost Analysis (EE/CA) and Public Comment

Task 8 of the 2010 SOW sets forth requirements to develop and submit segment-specific response proposals. As it deems appropriate, U.S. EPA, in consultation with MDEQ, may direct the use of U.S. EPA's removal and/or remedial program authorities under CERCLA, and Dow shall submit either a Feasibility Study or an EE/CA consistent with the 2010 SOW requirements.

Based on a review of U.S. EPA's guidance, the NCP, and conditions in Segments 6 & 7, U.S. EPA, in consultation with MDEQ, determined that Dow should submit an EE/CA for Segments 6 & 7. U.S. EPA documented this in an EE/CA Approval Memorandum dated March 20, 2017. Dow submitted the Segments 6 & 7 EE/CA dated April 13, 2018. U.S. EPA, in consultation with MDEQ, approved the Segments 6 & 7 EE/CA on September 28, 2018 for purposes of public comment.

The Segments 6 & 7 EE/CA included proposed alternatives to address sediment contamination within specific SMAs and soil contamination within specific BMAs within Segments 6 & 7 that are actual or potential contaminant sources to the system. On or before September 28, 2018, U.S. EPA released a fact sheet titled "EPA Proposes Cleanup Plan for Tittabawassee River: Segments 6 & 7." This Fact Sheet described the Segments 6 & 7 EE/CA and U.S. EPA's recommended response actions and sought public comment on the Segments 6 & 7 EE/CA, pursuant to the NCP requirements.

U.S. EPA expected that the public would want more than the normal 30-day public comment period and therefore provided in advance an extension to the public comment period. The public comment period ran from October 4 through November 20, 2018. U.S. EPA, with participation of MDEQ, held a public meeting regarding the proposed response actions on October 22, 2018, at the Thomas Township Library, Saginaw, Michigan. U.S. EPA also presented the proposed options to the Saginaw Tittabawassee Rivers Contamination Community Advisory Group (CAG) and a few public attendees on September 17, 2018.

U.S. EPA received written comments during the public comment period from 8 different individuals and organizations, including: floodplain property owners; other concerned citizens; the CAG; and the Manager of the Refuge. There was also an opportunity to make verbal comments at the public meeting, and one person made verbal comments at that meeting. U.S. EPA carefully evaluated the comments and developed a Responsiveness Summary, found herein as Attachment E. Copies of all the comments received (including the transcript of the public meeting) are included in the administrative record for Segments 6 & 7. The public comments did not result in changes to EPA's comparative evaluation of the options. Therefore, the selected response actions are those that were identified by EPA as the recommended alternatives.

5. Applicable or Relevant and Appropriate Requirements (ARARs)

In accordance with 40 C.F.R. § 300.415(j), all on-site actions required pursuant to this Action Memorandum shall, to the extent practicable, as determined by U.S. EPA, considering the exigencies of the situation, attain ARARs under federal environmental or state environmental or facility siting laws. In accordance with Section 121(e) of CERCLA , 42 U.S.C. § 6921(e), and 40 C.F.R. § 300.400(e), no federal, state or local permits will be required for on-site response actions conducted as part of this removal action. U.S. EPA, in consultation with MDEQ, reviewed the list of potential ARARs in the Segments 6 & 7 EE/CA, and approved it on September 28, 2018. Following is a summary of potential ARARs and to be considered guidance (TBCs) that were identified in the Segments 6 & 7 EE/CA:

a. Federal

Potential Federal Chemical-Specific Requirements or TBCs
Clean Water Act – Federal Surface Water Quality Standards
Clean Water Act – Federal Ambient Water Quality Criteria

Potential Federal Action-Specific Requirements or TBCs
Clean Water Act – Section 402
Resource Conservation and Recovery Act – Subtitles C and D and Land Disposal Restrictions
Endangered Species Act
Bald and Golden Eagle Protection Act

Potential Federal Location-Specific Requirements or TBCs
Floodplain and Wetland Regulations and Executive Orders 11988 and 11990
Clean Water Act – Section 404
Great Lakes Water Quality Initiative
Rivers & Harbors Act
National Historic Preservation Act
Migratory Bird Treaty Act
Archeological and Historic Preservation Act
American Indian Religious Freedom Act
Archeological Resources Protection Act
Native American Graves Protection and Repatriation Act
Fish and Wildlife Coordination Act

b. State

Potential State Chemical-Specific Requirements or TBCs
Michigan Water Quality Standards

Potential State Action-Specific Requirements or TBCs
Michigan Natural Resources and Environmental Protection Act (NREPA) – Part 31
Michigan NREPA – Part 91
Michigan NREPA – Part 111
Michigan NREPA – Part 115
Michigan NREPA – Part 121
Michigan NREPA – Part 201[4]
Michigan NREPA – Part 365
Michigan NREPA – Part 413
Michigan Administrative Code Rule R 336.1901(a)

Potential State Location-Specific Requirements or TBCs

[4] Part 201 of the Michigan Natural Resources and Environmental Protection Act, specifically at Mich. Comp. Laws §§ 324.20107a(1), and 324.20120c(1)(a), is applicable to the extent that contaminated soil (as defined by Mich. Comp. Laws § 324.20120c(5)(a)) is relocated on-site as part of this response action.

Michigan NREPA – Part 301
Michigan NREPA – Part 303

B. Project Schedule

Upon the effective date of the Segments 6 & 7 AOC, Dow will start to develop a Work Plan. The Work Plan will contain a specific schedule for implementation of the Work. U.S. EPA anticipates that Work will begin in 2019. This action is anticipated to require three construction seasons to implement (2019 through 2021).

C. Estimated Costs

The estimated cost for the required work at Segments 6 & 7 is $5.5 million. The estimated cost reflects average costs for different process options for the SMAs and BMAs, including cost differences for different cap and stabilization designs. These estimated costs include labor, equipment, materials used during installation, and operation and maintenance. Monitoring and maintenance costs were estimated for a 30-year time period. The cost estimates were developed based on a review of previous Dow project data, similar projects completed at other sites, initial input from prospective Dow contractors, and an extrapolation by U.S. EPA of unit costs to the expected work scope. Consistent with U.S. EPA guidance, the cost estimates for each alternative are anticipated to be accurate within the range of -30 to +50 percent. A future discount rate of 7 percent was used for the present worth calculations of post-construction monitoring costs, as specified by U.S. EPA guidance.

U.S. EPA guidance issued in January 2017, requested that Action Memoranda discuss potential uncertainties related to the cost estimate. The response actions selected herein will not be funded by U.S. EPA, they will be undertaken and funded by Dow pursuant to the Segments 6 & 7 AOC. The level of uncertainty or data gaps related to the extent of contamination/scope of work at an individual SMA or BMA has the potential to affect costs. In this case, there are more than 1,700 sediment TEQ samples and more than 180 bank TEQ samples in Segments 6 & 7, so the SMAs and BMAs are well characterized, and the scope of work is unlikely to change in a way that substantially increases costs. However, U.S. EPA expects that pre-design investigations will be conducted to support the final design. Finally, for some response actions there could be potential complexities or complications that may trigger increases in costs. For this Segments 6 & 7 NTCRA, U.S. EPA does not anticipate that this will occur. Dow, under U.S. EPA oversight, has conducted similar response actions at upstream SMAs and BMAs. Actual costs for those prior response actions have been similar to or slightly less than U.S. EPA's initial cost estimate.

VI. EXPECTED CHANGE IN THE SITUATION SHOULD ACTION BE DELAYED OR NOT TAKEN

Continued risk to public health or the environment will result if this response action is delayed or not taken. Delayed action increases the chance that highly contaminated sediment and/or riverbank soil could be further exposed or migrate to areas where human or ecological exposures could increase.

VII. OUTSTANDING POLICY ISSUES

According to Directive 9360.0-19, from the Office of Solid Waste and Emergency Response (OSWER), March 3, 1989, U.S. EPA Headquarters consultation must occur prior to conducting removal actions at sites that are not listed on the NPL where taking that removal action may be nationally significant or precedent-setting. That Directive at Section I.3 identifies as nationally significant or precedent-setting *"[r]emoval actions at sites involving any form of dioxin when it is one of the principal contaminants of concern.*" Further, the OSWER memorandum dated December 13, 1996, titled "Headquarters Consultation for Dioxin Sites," requests that Regions consult with Headquarters where remediation goals are to be developed for dioxin in soil.

The Segments 6 & 7 EE/CA and this NTCRA do not develop or select remediation goals for dioxin in soil or sediment; rather the actions are performance based. However, this is a removal action at a non-NPL site where dioxins are the principal contaminants of concern. Therefore, pursuant to Directive 9360.0-19, Region 5 did consult with Headquarters for this NTCRA at Segments 6 & 7. Region 5, among other activities: included Headquarters in the Alternative Array briefing on August 6, 2018; conducted a briefing for the Contaminated Sediments Technical Advisory Group, including Headquarters sediment experts, on August 8, 2018; provided to Headquarters an opportunity to review and comment on the Segments 6 & 7 EE/CA before it was finalized, and made available to the public; and provided to Headquarters an opportunity to review and comment on the draft Segments 6 & 7 Action Memorandum.

VIII. ENFORCEMENT

This action is being undertaken pursuant to the Segments 6 & 7 AOC between U.S. EPA and Dow. An enforcement addendum to this Action Memorandum details the enforcement strategy at the Tittabawassee River, Saginaw River & Bay site, Michigan.

IX. RECOMMENDATION

This decision document represents the selected removal action for Segments 6 & 7 located within the Tittabawassee River, Saginaw River & Bay site, Michigan. It was developed in accordance with CERCLA as amended and is not inconsistent with the NCP. This decision is based upon the Administrative Record for Segments 6 & 7, an index of which is Attachment C.

Conditions at Segments 6 & 7 meet the criteria of Section 300.415(b) of the NCP for a removal action, and I recommend your approval of the proposed removal action. Region 5 expects that Dow, the potentially responsible party, will perform the removal action under the oversight of the RPM/OSC. You may indicate your decision by signing below.

5/21/2019

APPROVE: X

Douglas Ballotti
Director
Signed by: DOUGLAS BALLOTTI
Superfund & Emergency Management Division

DISAPPROVE:

Superfund & Emergency Management Division

Enforcement Addendum

Attachments:

A. General Segments 6 & 7 Location Map
B. Segments 6 & 7 SMAs and BMAs
C. Administrative Record Index
D. EJ Screening
E. Responsiveness Summary

cc: T. Fischer, J. El-Zein, N. DiCosmo, M. Logan, D. Russell, J. Cahn, C. Garypie – U.S. EPA Region 5
S. Yi, U.S. EPA Headquarters, w/o Enf. Addendum
J. Victory, MDEQ, w/o Enf. Addendum
P. Synk, Michigan Department of Attorney General, w/o Enf. Addendum
L. Williams, FWS, w/o Enf. Addendum

ENFORCEMENT ADDENDUM

HAS BEEN REDACTED – FOUR PAGES

ENFORCEMENT CONFIDENTIAL

NOT SUBJECT TO DISCOVERY

FOIA EXEMPT

NOT RELEVANT TO SELECTION

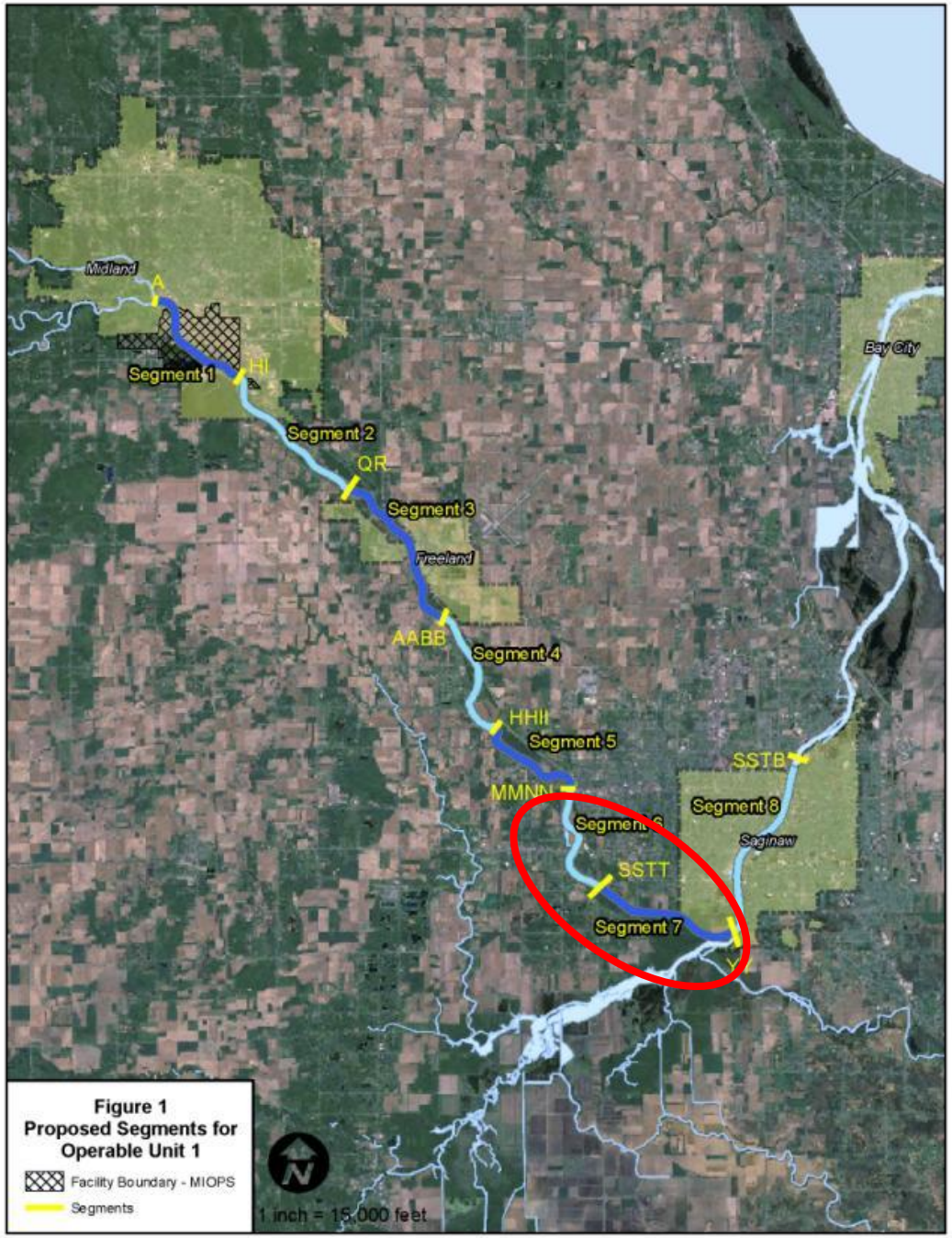
OF REMOVAL ACTION

ATTACHMENT A

General Segments 6 & 7 Location Map

Tittabawassee River, Saginaw River & Bay Site
Midland, Saginaw, and Bay Counties in Michigan

General Segments 6 & 7 Location Map



ATTACHMENT B

Segments 6 & 7 SMAs and BMAs

Tittabawassee River, Saginaw River & Bay Site
Midland, Saginaw, and Bay Counties in Michigan

Feet
0 2,900 5,800

Segment 6 and 7
BMA and SMA Locations
Tittabawassee River

Figure 1

2/21/2019 |Segment_3_Logan_20150429_L

The SMAs and BMAs in Segments 6 & 7 of the Tittabawassee River where Work is required are depicted below and shown on the attached figures. Additional SMAs and/or BMAs in Segments 6 or 7 may be identified and may be added to the Site through an addendum to or amendment of the Segments 6 & 7 Action Memorandum by U.S. EPA and amendment of the Segments 6 & 7 Settlement Agreement by the Parties.

SMA	Location	Approximate Size (acres)
SMA 6-1	Reach OO, northeast	0.7
SMA 7-1	Reach XX, north	0.5
SMA 7-2	Reach YY, center of channel	1.1
SMA 7-3	Reach YY, center of channel	0.4

BMA	Location	Approximate Length (feet)
BMA 6-1	Reach NN, southwest	830
BMA 6-2	Reach PP, southwest	450
BMA 6-3	Reach PP, southwest	270
BMA 6-4	Reach RR, northeast	160
BMA 7-1	Reach UU, northeast	130
BMA 7-2	Reach VV, northeast	360
BMA 7-3	Reach WW Island	815

ATTACHMENT C

Administrative Record Index

Segments 6 & 7 of the
Tittabawassee River, Saginaw River & Bay Site
Midland, Saginaw, and Bay Counties in Michigan

U.S. ENVIRONMENTAL PROTECTION AGENCY
REMOVAL ACTION

ADMINISTRATIVE RECORD
FOR THE
TITTABAWASSEE RIVER, SAGINAW RIVER AND BAY SITE
OPERABLE UNIT 14: SEGMENT 6 & 7
MIDLAND, SAGINAW, AND BAY COUNTIES, MICHIGAN

ORIGINAL
OCTOBER 2, 2018
SEMS ID: 943666

NO.	SEMS ID	DATE	AUTHOR	RECIPIENT	TITLE/DESCRIPTION	PAGES
1	409602	8/4/11	U.S. EPA	Public	Administrative Record Site Index - Tittabawassee River, Saginaw River and Bay, Operable Unit 9: Segment 1 - Original *(Documents listed on this index are incorporated by reference in this Administrative Record)*	5
2	904852	7/10/13	U.S. EPA	Public	Administrative Record Site Index - Tittabawassee River, Saginaw River and Bay, Operable Unit 10: Segment 2 - Original *(Documents listed on this index are incorporated by reference in this Administrative Record)*	8
3	920814	8/24/15	U.S. EPA	Public	Administrative Record Site Index - Tittabawassee River, Saginaw River and Bay, Operable Unit 12: Segment 3 - Original *(Documents listed on this index are incorporated by reference in this Administrative Record)*	4
4	929426	9/12/16	U.S. EPA	Public	Administrative Record Site Index - Tittabawassee River, Saginaw River and Bay, Operable Unit 13: Segment 4 & 5 - Original *(Documents listed on this index are incorporated by reference in this Administrative Record)*	4

NO.	SEMS ID	DATE	AUTHOR	RECIPIENT	TITLE/DESCRIPTION	PAGES
5	943656	9/28/16	Logan, M., U.S. EPA	Konechne, T., Dow Chemical Co.	Letter re: Segments 6 & 7 Response Proposal	1
6	522976	3/20/17	Logan, M., U.S. EPA	Guerriero, M., U.S. EPA	Engineering Evaluation/Cost Analysis (EE/CA) Approval Memo for a Proposed Non-Time Critical Removal Action at Segments 6 & 7 (Signed)	9
7	943652	10/20/17	Konechne, T., Dow Chemical Co.	Logan, M., U.S. EPA	Letter re: Draft Segments 6 and 7 Response Proposal for the Tittabawassee River Settlement Agreement No. V-W-10-C-942 (Cover Letter Only)	1
8	943662	12/1/17	Williams, L., U.S. Dept. of Interior	Logan, M., U.S. EPA	Natural Resource Trustee Comments on Segment 6 and 7 Response Proposal - Attached with Cover Letter	7
9	943655	12/22/17	MDEQ	File	Michigan Department of Environmental Quality (DEQ) Review Comments on Tittabawassee River - Segment 6 and 7 (OU1) Response Proposal - Revision 0	9
10	943654	1/10/18	U.S. EPA	File	Review Comments on the Draft Tittabawassee River Segment 6 and 7 Response Proposal - Attached with Cover Letter	10
11	943659	4/13/18	File	File	Responses to Agencies' Review Comments on the Draft Tittabawassee River Segments 6 and 7 Response Proposal	13
12	943653	4/13/18	Konechne, T., Dow Chemical Co.	Logan, M., U.S. EPA	Letter Re: Draft Segments 6 and 7 Response Proposal for the Tittabawassee River Settlement Agreement No. V-W-10-C-942 (Cover Letter Only)	1
13	943658	4/13/18	Tittabawassee River & Saginaw River Team	Dow Chemical Co.	Tittabawassee Segments 6 and 7 (OU1) Response Proposal	351
14	943657	7/31/18	Tittabawassee River & Saginaw River Team	Dow Chemical Co.	Segments 6 and 7 Bank Management Area (BMA) Memorandum	14

NO.	SEMS ID	DATE	AUTHOR	RECIPIENT	TITLE/DESCRIPTION	PAGES
15	943663	9/28/18	Logan, M., U.S. EPA	Konechne, T., Dow Chemical Co.	Letter re: EPA's Approval Conditions/Comments for the Tittabawassee River Segment 6 & 7 Response Proposal, Dated April 13, 2018	2
16	943661	10/1/18	U.S. EPA	Public	EPA Proposes Cleanup Plan for Tittabawassee River: Segments 6 & 7	10
17	943660	Undated	File	File	Tittabawassee River - Segments 6 and 7 (OU1) Response Proposal - Appendix A1 - In-Channel Sediments Analytical Chemistry Data	973

U.S. ENVIRONMENTAL PROTECTION AGENCY
REMOVAL ACTION

ADMINISTRATIVE RECORD
FOR THE
TITTABAWASSEE RIVER, SAGINAW RIVER AND BAY SITE
OPERABLE UNIT 14: SEGMENT 6 & 7
MIDLAND, SAGINAW, AND BAY COUNTIES, MICHIGAN

UPDATE 1
MARCH 7, 2019
SEMS ID: 944599

NO.	SEMS ID	DATE	AUTHOR	RECIPIENT	TITLE/DESCRIPTION	PAGES
1	944590	10/15/18	U.S. EPA	Resident	Cleanup Plan for Tittabawassee River's Segment 6 & 7 Public Comment Sheet	2
2	944591	10/22/18	U.S. EPA	Resident	Cleanup Plan for Tittabawassee River's Segment 6 & 7 Public Comment Sheet	2
3	944592	10/22/18	U.S. EPA	Resident	Cleanup Plan for Tittabawassee River's Segment 6 & 7 Public Comment Sheet	2
4	944593	11/13/18	Russell, D., U.S. EPA	Logan, M., U.S. EPA	Email Re: Tittabawassee River Segment 6 & 7 Comment	1
5	944595	11/19/18	Repp, P., U.S. EPA	Russell, D., U.S. EPA	Proposed Cleanup Plan for the Tittabawassee River: Segments 6 and 7. Proposed Cleanup Would Occur Within the Shiawassee National Wildlife Refuge	6
6	944594	11/20/18	Russell, D., U.S. EPA	Donnelly, D., U.S. EPA	Email Re: Saginaw River Cleanup	1
7	944598	11/22/18	Russell, D., Logan, M., Donnelly, D., U.S. EPA	Public	Public Meeting	68
8	944597	11/28/18	Russell, D., U.S. EPA	Donnelly, D., U.S. EPA	Email Re: CAG Recommendations on Segments 6/7	8

NO.	SEMS ID	DATE	AUTHOR	RECIPIENT	TITLE/DESCRIPTION	PAGES
9	944596	Undated	Student	File	Letter Re: Proposal for the Remediation of the Tittabawassee River and the Saginaw River in Midland, Michigan	1

ATTACHMENT D

EJ Screening

Segments 6 & 7 of the
Tittabawassee River, Saginaw River & Bay Site
Midland, Saginaw, and Bay Counties in Michigan

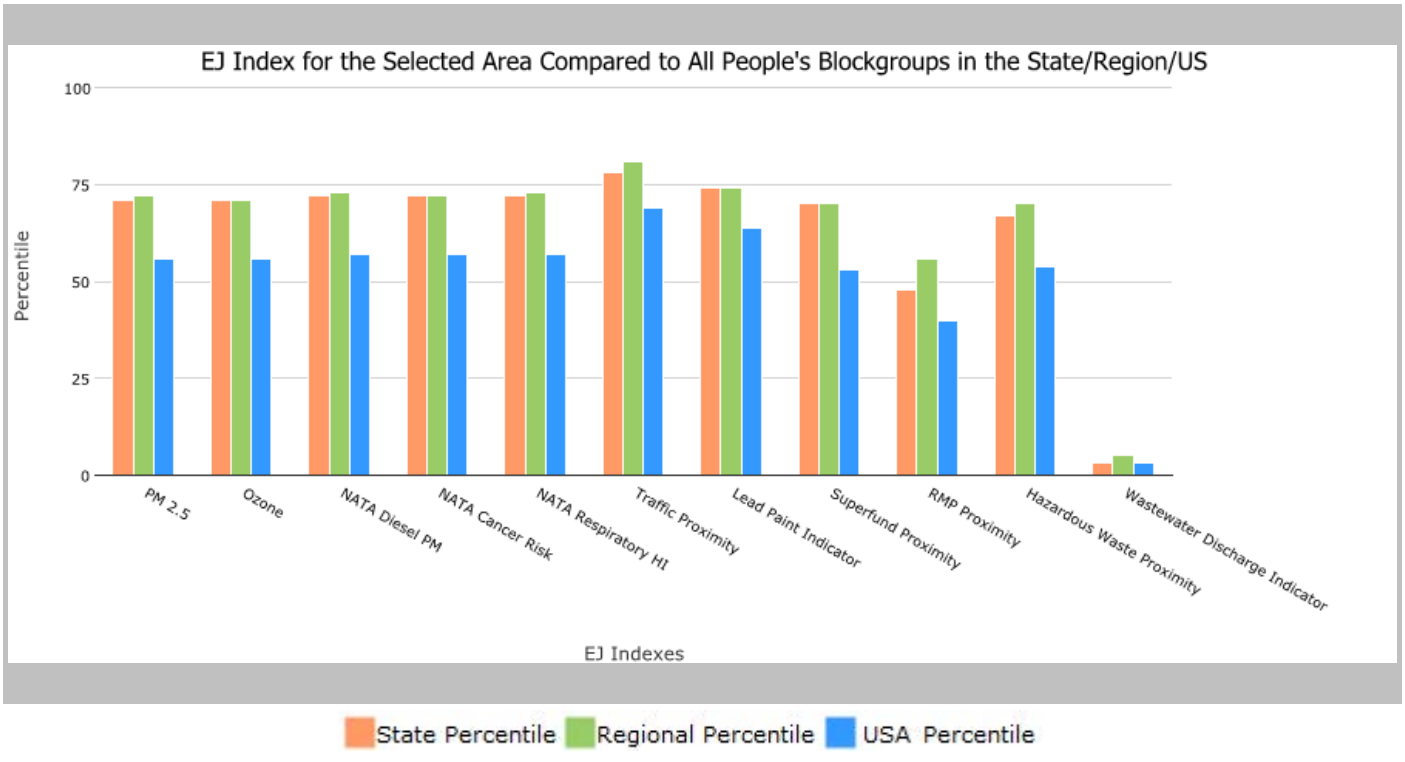
EJSCREEN Report (Version 2018)

0.5 mile Ring around the Corridor, MICHIGAN, EPA Region 5

Approximate Population: 3,615

Input Area (sq. miles): 7.47

Selected Variables	State Percentile	EPA Region Percentile	USA Percentile
EJ Indexes			
EJ Index for PM2.5	71	72	56
EJ Index for Ozone	71	71	56
EJ Index for NATA* Diesel PM	72	73	57
EJ Index for NATA* Air Toxics Cancer Risk	72	72	57
EJ Index for NATA* Respiratory Hazard Index	72	73	57
EJ Index for Traffic Proximity and Volume	78	81	69
EJ Index for Lead Paint Indicator	74	74	64
EJ Index for Superfund Proximity	70	70	53
EJ Index for RMP Proximity	48	56	40
EJ Index for Hazardous Waste Proximity	67	70	54
EJ Index for Wastewater Discharge Indicator	3	5	3



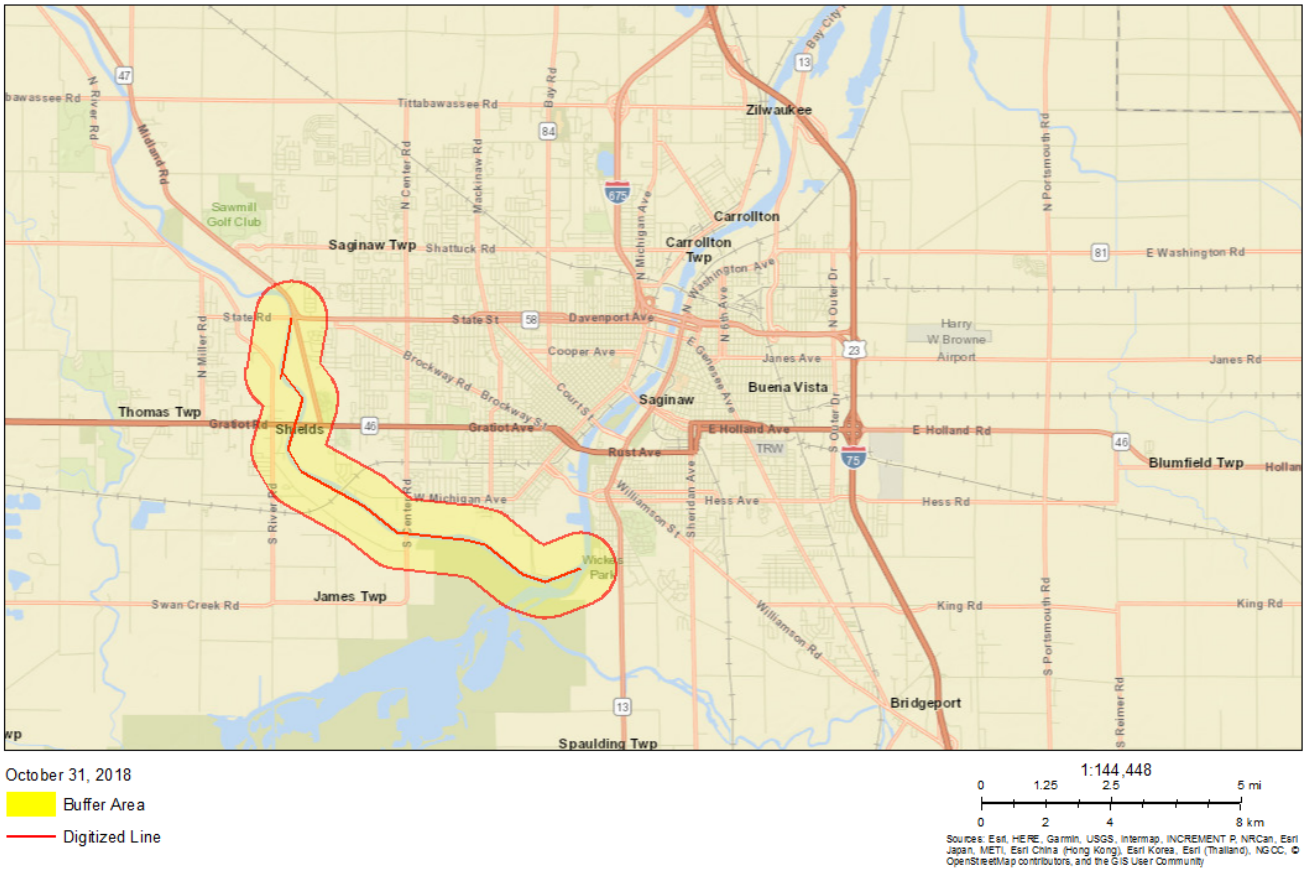
This report shows the values for environmental and demographic indicators and EJSCREEN indexes. It shows environmental and demographic raw data (e.g., the estimated concentration of ozone in the air), and also shows what percentile each raw data value represents. These percentiles provide perspective on how the selected block group or buffer area compares to the entire state, EPA region, or nation. For example, if a given location is at the 95th percentile nationwide, this means that only 5 percent of the US population has a higher block group value than the average person in the location being analyzed. The years for which the data are available, and the methods used, vary across these indicators. Important caveats and uncertainties apply to this screening-level information, so it is essential to understand the limitations on appropriate interpretations and applications of these indicators. Please see EJSCREEN documentation for discussion of these issues before using reports.

EJSCREEN Report (Version 2018)

0.5 mile Ring around the Corridor, MICHIGAN, EPA Region 5

Approximate Population: 3,615

Input Area (sq. miles): 7.47



Sites reporting to EPA	
Superfund NPL	0
Hazardous Waste Treatment, Storage, and Disposal Facilities (TSDF)	0

EJSCREEN Report (Version 2018)

0.5 mile Ring around the Corridor, MICHIGAN, EPA Region 5

Approximate Population: 3,615

Input Area (sq. miles): 7.47

Selected Variables	Value	State Avg.	%ile in State	EPA Region Avg.	%ile in EPA Region	USA Avg.	%ile in USA
Environmental Indicators							
Particulate Matter (PM 2.5 in µg/m^3)	9.53	10.2	16	10.8	19	9.53	47
Ozone (ppb)	41.1	42.9	14	42.6	20	42.5	36
NATA* Diesel PM (µg/m^3)	0.6	0.726	46	0.932	<50th	0.938	<50th
NATA* Cancer Risk (lifetime risk per million)	33	31	55	34	<50th	40	<50th
NATA* Respiratory Hazard Index	1.4	1.3	53	1.7	<50th	1.8	<50th
Traffic Proximity and Volume (daily traffic count/distance to road)	280	570	60	370	72	600	68
Lead Paint Indicator (% Pre-1960 Housing)	0.18	0.38	33	0.38	33	0.29	49
Superfund Proximity (site count/km distance)	0.034	0.13	28	0.12	35	0.12	38
RMP Proximity (facility count/km distance)	0.98	0.52	83	0.81	72	0.72	76
Hazardous Waste Proximity (facility count/km distance)	0.066	0.8	21	1.5	15	4.3	17
Wastewater Discharge Indicator (toxicity-weighted concentration/m distance)	1.1	0.16	98	4.2	97	30	95
Demographic Indicators							
Demographic Index	34%	29%	71	28%	71	36%	55
Minority Population	27%	24%	71	25%	69	38%	47
Low Income Population	41%	34%	66	32%	70	34%	66
Linguistically Isolated Population	2%	2%	73	2%	68	4%	54
Population With Less Than High School Education	10%	10%	61	10%	62	13%	52
Population Under 5 years of age	8%	6%	77	6%	74	6%	71
Population over 64 years of age	19%	15%	73	15%	75	14%	77

* The National-Scale Air Toxics Assessment (NATA) is EPA's ongoing, comprehensive evaluation of air toxics in the United States. EPA developed the NATA to prioritize air toxics, emission sources, and locations of interest for further study. It is important to remember that NATA provides broad estimates of health risks over geographic areas of the country, not definitive risks to specific individuals or locations. More information on the NATA analysis can be found at: https://www.epa.gov/national-air-toxics-assessment.

For additional information, see: www.epa.gov/environmentaljustice

ATTACHMENT E

Responsiveness Summary

Segments 6 & 7 of the
Tittabawassee River, Saginaw River & Bay Site
Midland, Saginaw, and Bay Counties in Michigan

RESPONSIVENESS SUMMARY

Non-Time Critical Removal Action for Segments 6 & 7 of the Tittabawassee River/Saginaw River & Bay Site

This Responsiveness Summary provides a summary of the public comments that the United States Environmental Protection Agency (EPA) received regarding a proposed non-time critical removal action (NTCRA) at Segments 6 & 7, and comments on the *Tittabawassee River Segments 6 and 7 (OU 1) Response Proposal*, dated April 13, 2018 (Segments 6 & 7 EE/CA) at the Tittabawassee River/Saginaw River & Bay Site (Site). This Responsiveness Summary also provides EPA's responses to those comments, developed in consultation with the Michigan Department of Environmental Quality (MDEQ[1]).

I. Outcome of Review of Public Comments and State Consultation

After carefully reviewing and considering all public comments submitted during the public comment period, EPA, in consultation with MDEQ, is issuing an Action Memorandum selecting response actions for Sediment Management Areas (SMAs) and Bank Management Areas (BMAs) within Segments 6 & 7. This Responsiveness Summary is an attachment to the Action Memorandum. The public comments did not result in changes to EPA's comparative evaluation of the options. Therefore, the selected response actions are those that were identified by EPA as the recommended alternatives.

EPA, after consultation with MDEQ, negotiated an Administrative Settlement Agreement and Order on Consent (Segments 6 & 7 AOC) with The Dow Chemical Company (Dow), requiring Dow to implement the selected work. A copy of the Segments 6 & 7 AOC, Action Memorandum, and this Responsiveness Summary (which is Attachment D to the Action Memorandum) will be available through http://www.epa.gov/superfund/tittabawassee-river.

II. Background and Community Involvement

Dioxins (primarily furans) are found in the Tittabawassee and Saginaw Rivers and their floodplains, and in Saginaw Bay. The dioxins came from past waste disposal practices at Dow's plant in Midland, Michigan. EPA began negotiations with Dow in December 2008 for a comprehensive approach to address contamination related to Dow in the rivers and Bay. Effective January 21, 2010, EPA signed an Administrative Settlement Agreement and Order on Consent No. V-W-10-C-942 (2010 AOC) with MDEQ and Dow, requiring Dow to perform Site investigations, and develop and design cleanup options selected by EPA, in consultation with MDEQ, using Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) authority. Work under the 2010 AOC is ongoing.

The 2010 AOC requires Dow, with EPA and MDEQ oversight, to conduct evaluations of current

[1] In April 2019, MDEQ changed its name. Where this Responsiveness Summary refers to MDEQ in the present or future tense, it encompasses the newly named Michigan Department of Environment, Great Lakes, and Energy.

conditions and assessments of response options to protect human health and the environment at the Site. The 2010 AOC also required Dow to define segments within Operable Unit 1 that would be assessed and addressed in a sequential upstream-to-downstream approach. Segments 6 & 7 are the sixth and seventh of seven segments delineated within the Tittabawassee River. EPA, in consultation with MDEQ, directs the use of EPA's removal and/or remedial program authorities under CERCLA, and Dow is required to submit either a Feasibility Study or an EE/CA for each segment. EPA determined that Dow should submit an EE/CA for Segments 6 & 7 based on a review of EPA's guidance, the National Contingency Plan (NCP), and conditions in Segments 6 & 7, and documented this in an EE/CA Approval Memorandum dated March 20, 2017. Dow submitted the final Segments 6 & 7 EE/CA dated April 13, 2018. EPA, in consultation with MDEQ, approved the Segments 6 & 7 EE/CA on September 28, 2018. The Segments 6 & 7 EE/CA includes proposed alternatives to address sediment contamination within specific SMAs and soil contamination within specific BMAs.

On or before October 3, 2018, EPA established the administrative record for Segments 6 & 7. The administrative record for a response action serves an important purpose: it contains the information that explains why EPA will conduct a particular response at a site. EPA published the administrative record on the Site website at www.epa.gov/superfund/tittabawassee-river and sent copies to three local repositories (public libraries in Midland, Saginaw and Bay City). On or before September 28, 2018, EPA posted and mailed a fact sheet titled "EPA Proposes Cleanup Plan for Tittabawassee River: Segments 6 & 7." This fact sheet described the Segments 6 & 7 EE/CA and EPA's recommended response actions and sought public comment on the Segments 6 & 7 EE/CA and the administrative record, pursuant to the requirements of NCP § 300.415(n). The fact sheet was mailed to a list of about 1,500 recipients. EPA took ads in three local papers to announce the proposed cleanup plan and the opportunities for public comment.

EPA expected that the public would want more than the normal 30-day public comment period and therefore provided in advance a 15-day extension to the public comment period. The public comment period ran from October 4 through November 20, 2018. EPA presented its proposed options to the Saginaw Tittabawassee Rivers Contamination Community Advisory Group (CAG) and a few public attendees at the CAG meeting on September 17, 2018. EPA, with participation of MDEQ, held a public meeting regarding the proposed response actions on October 22, 2018, at the Thomas Township Library, Saginaw, Michigan.

III. Comments and Responses

EPA received written comments during the public comment period from 8 different individuals and organizations, including: floodplain property owners; other concerned citizens; the CAG; and the Manager of the Shiawassee National Wildlife Refuge (Refuge). There was also an opportunity to make verbal comments at the public meeting, and one person made verbal comments at that meeting. Copies of all the comments received (including the verbal comments reflected in the transcript of the public meeting) are included in the administrative record for Segments 6 & 7. EPA carefully considered each comment while developing this Responsiveness Summary.

This Responsiveness Summary does not repeat verbatim each individual comment. Rather, the comments are summarized and grouped by category with respect to the type of issue raised. The

comments fell within several different categories: remedy options; remedy implementation; additional information requested and recommendations; and miscellaneous comments. The remainder of this Responsiveness Summary contains a summary of the comments received (grouped by category) and EPA's responses to those comments, in consultation with MDEQ.

A. REMEDY OPTIONS

1. *Two commenters supported EPA's proposed cleanup plan. One felt EPA's proposal achieved long-term effectiveness while minimizing impacts to the environment. The second felt that the plan would help stop the spread of dioxin to fish.*

EPA acknowledges these comments.

2. *The Refuge Manager's 11/19/2018 letter stated: "Proposed cleanup would occur within the Shiawassee National Wildlife Refuge (Refuge), specifically Bank Management Areas (BMAs) 7-2 and 7-3, and Sediment Management Areas (SMAs) 7-1, 7-2 and 7-3. The proposed action is for shoreline stabilization of BMAs 7-2 and 7-3 (Alternative 1) and capping of SMAs 7-1, 7-2 and 7-3 (Alternative 2). We support these alternatives over the other alternatives to contain or remove contaminated sediments in the BMAs and SMAs within the Refuge as the proposed action would minimize the construction-related impacts on resources of concern within the Refuge."*

EPA acknowledges this comment.

3. *From the CAG's 11/20/2018 letter, Recommendation 2: "The CAG would like to reiterate its strong preference for permanent remedies wherever possible to remove contamination from the river environment. Whenever removal of contaminants of concern can be achieved without significant disruption or long-term damage the ecosystem, that should be the preferred permanent solution."*

Regarding the CAG's preference for removal, EPA's "Contaminated Sediment Remediation Guidance for Hazardous Waste Sites" (December 2005, OSWER 9355.0-85) clearly outlines EPA policies on remedy selection for contaminated sediment sites. These include:

- There is no presumptive remedy for any contaminated sediment site, regardless of the contaminant or level of risk.
- Generally, EPA should evaluate dredging, capping and monitored natural recovery (MNR) at every site.
- Both in-situ and ex-situ approaches may reach acceptable levels of effectiveness and permanence.
- EPA must consider both risk reduction associated with reduced exposure to contaminants, and also risks introduced by implementing alternatives.

Protectiveness is a threshold criterion that must be met for an option to be considered. EPA, in consultation with MDEQ, developed and evaluated an array of protective response options, including removal and containment options, for the Segments 6 & 7 SMAs and BMAs. EPA does not believe that removal is the only permanent solution. When comparing NTCRA response

options, EPA is required to evaluate them against three NCP criteria: effectiveness; implementability; and cost. Additionally, EPA also evaluated cleanup alternatives against the NCP's nine remedial evaluation criteria. These criteria include long-term effectiveness and permanence. The Action Memorandum to which this Responsiveness Summary is attached provides EPA's assessment of the selected response actions and how they meet the evaluation criteria. In short, EPA believes that the final selected response actions achieve the best balance of EPA's evaluation criteria.

4. *For SMA 6-1, the CAG's Recommendation 2 is that EPA select a combination of removal and MNR (Alternative 5), rather that EPA's proposed Alternative 4, a combination of capping and MNR. From the CAG's 11/20/2018 letter: "The CAG agrees that MNR is appropriate at the downstream and in-channel portion of the SMA because the elevated TEQ levels are buried beneath approximately 6 to 7 feet of cleaner sediment. The sediment bed has been proven to be stable in the MNR area based on differential bathymetry data. However, the CAG expressed concerns about leaving contaminants at shallower depths in place both because of the CAG's preference for permanent remedies and additional concerns about the potential for burrowing animals."*

As discussed in response to comment 3 above, EPA does not have a preferred or presumptive remedy for contaminated sediment. EPA balances trade-offs between alternatives. In selecting response actions, EPA must consider both risk reduction associated with reduced exposure to contaminants, and risks introduced by implementing alternatives. Alternative 5 for SMA 6-1 was a combination of removal and MNR. While EPA believes that this alternative could be protective in the long term, there are concerns with short-term effectiveness. SMA 6-1 is a stable point bar. Removal of a part of the deposit could exacerbate short-term erosion of the remaining deposit until bedload refills the removed area. This could undermine the MNR component of the remedy. The specific trade-offs for the Segments 6 & 7 SMAs are discussed in detail in the Segments 6 & 7 EE/CA and summarized in the Action Memorandum

Regarding the CAG's concern with burrowing animals, EPA believes that a Cellular Containment System or a sand/gravel cap sufficiently isolate the underlying deposit. EPA's guidance document "Determination of the Biologically Relevant Sampling Depth for Terrestrial and Aquatic Ecological Risk Assessments," EPA/600/R-15/176, ERASC-015F, October 2015, identifies the biologically active zone for soil and sediment habitats. In rivers like the Tittabawassee with coarse grain sands the guidance recommends considering the biologically active zone to be 15 centimeters (about 6 inches). Either cap design will be 6 inches or more.

5. *The CAG did not have a specific recommendation for an alternative remedy for SMAs 7-1, 7-2, and 7-3. However, made several comments about these SMAs:*
   a. *They stated that they found the analysis in the Segment 6 & 7 EE/CA biased toward capping.*

   EPA did not intend to bias the report towards capping. As discussed in response to comment 3 above, EPA balances the tradeoffs between response options by evaluating each against the NCP criteria. Because of the proximity of these SMAs to the Refuge, capping options are believed to have significantly less short-term adverse effects than removal options. Please see comment 2 above that provides the Refuge's opinion about potential remedy impacts.

b. *They stated that they would have liked to have seen a more thorough analysis of the long-term damage to forests and that the Segment 6 & 7 EE/CA should have noted that that the ecosystem is not original growth and may include many non-native species.*

In the Segment 6 & 7 EE/CA and EPA's fact sheet, EPA provided a discussion of the potential impacts to nearby forests from remedy implementation. The Refuge Manager's letter was more detailed. The letter stated that about half of the Refuge is floodplain forest and discussed how "successful conservation and management of floodplain forests can contribute significantly to regional biodiversity because these systems possess an unusually high diversity of plant and animal species, vegetation types, and ecological processes." "Therefore, the floodplain riparian forests within the Refuge are extremely important to the biodiversity of the Refuge, watershed and Michigan." In our documents, EPA discussed that the creation of access roads and staging areas for heavy equipment could have a significant impact and may take many decades to restore the affected forests. The Refuge recognizes that the forests had been logged but suggested that regrowth to current conditions might require be 8 to 12 decades.

Regarding the SMAs, the Refuge Manager's letter stated "The Refuge is opposed to the construction of access roads and staging areas in the floodplain forests to provide closer construction access to the SMAs. We believe the significance of the impacts warrants finding an alternative access point for the SMAs. Construction of an access road through the floodplain forests for 'heavy equipment' would be very difficult given the terrain and wet soil conditions nearly year-round. Use of extensive mat roads would likely be required. Access roads and staging areas through the floodplain would likely have to be large (we anticipate 15 to 20 feet wide) to provide heavy equipment access (one-way) and staging areas would likely need to be between 1 and 5 acres in size. This would require the felling of a large number of mature trees in the riparian area of a floodplain forest. In addition, for construction worker safety, snags (dead trees) adjacent to the access road and staging area would likely need to be felled. OSHA generally requires all hazard trees (snags) to be removed within two tree lengths of a construction area. This could mean all snags within several hundred feet of the access road and staging area may need to be felled. Snags provide valuable wildlife habitat for a large number of wildlife species. The loss of mature trees and snags would reduce biodiversity by removing important wildlife habitat components and fragmenting the existing forest cover thus increasing the amount of edge effect and its concurrent impacts such as increased predations, etc. Opening the forest would also likely cause the spread of invasive plants or the introduction of new invasive plant species given the open canopy conditions. Wildlife in this area are unaccustomed to disturbances in the woods besides hikers. Therefore, active construction activity would cause disturbance to wildlife using the area throughout the duration of the project. Construction activity may also impact the recreating public and trail infrastructure."

c. *The CAG would have liked to see an alternative that explored the opportunity for an in-river hydraulic removal of relatively shallow areas of contamination by way of barge, and replacing with clean sediment, while capping the deeper contaminants*

The draft of a ship's hull is the vertical distance between the waterline and the bottom of the hull. Draft determines the minimum depth of water a ship or boat can safely navigate. The

standard barge is 195 feet long, 35 feet wide, and can be used to a 9-foot draft. Smaller barges are available with a 7-foot draft. We do not have that depth of water in the Tittabawassee River near these SMAs. Therefore, sediment removal by barge is not implementable.

6. *The CAG expressed concern about the use of MNR for any contamination that is close to the surface which could result in erosion and transport. They are concerned about river conditions that could cause releases and feel that confidence in MNR is dependent on robust monitoring.*

EPA has selected MNR for the portion of SMA 6-1 where the dioxin deposit is deeply buried. EPA agrees that monitoring is an important component of MNR. Monitoring will include routine monitoring as well as event-driven monitoring (e.g., high flow events).

7. *The CAG concurs with EPA's BMA proposal. However, the CAG would like to see a more detailed discussion of BMAs in future EE/CAs in keeping with the more detailed analysis and comparisons created for the SMAs.*

The simpler discussion of BMAs reflects that there are only two response options for banks. Segments 6 & 7 are the final segments in the Tittabawassee River. Once the project moves into the Saginaw River, it is not clear if we will have any more BMAs because of the very different conditions. If additional BMAs are identified for response actions, as appropriate, EPA will include a more detailed discussion of bank options in the EE/CA or FS.

8. *One commenter requested EPA to consider using mushroom fungus to clean up the dioxin in the SMAs. The commenter stated that mushrooms can produce enzymes that can deteriorate toxins. The commenter provided references on mycoremediation, including Fungi.com.*

Under the NCP, EPA is required to select response actions that are effective and that can be implemented. EPA reviewed the references provided, as well as other sources. For the Segment 6 & 7 conditions and contaminants, mycoremediation cannot be considered either effective or implementable; it has not been implemented at field scale for sediments and has not been shown to be effective on dioxin contamination. However, EPA will evaluate whether a mycoremediation pilot study would be useful for the Site.

B. REMEDY IMPLEMENTATION

9. *The Refuge Manger's letter stated: "For all sites within the Refuge, floodplain forests may be impacted through stabilization and capping activities. As a result, we offer the following construction-related recommendations as you plan these activities to minimize the impacts on the Refuge's fish and wildlife habitats, recreational amenities and the public." Twelve specific recommendations were made for BMA implementation and 14 recommendations for SMA implementation.*

Dow will implement the cleanups under a legal agreement with EPA. Dow's project team works closely with all affected property owners/managers to ensure that there is an acceptable plan and schedule. EPA anticipates that work in or near the Refuge will not occur until 2020, so there will be sufficient time to develop the plans.

10. *The Refuge Manger's letter stated: "In summary: Every effort should be made to avoid the significant impact of removing floodplain forests in the Refuge as this will have long-term impacts on resources and public use of this area established by Congress for its significant contributions to wildlife, watersheds and public use."*

The potential impacts on the Refuge resources from remedy construction was a major consideration for EPA in comparing and selecting remedies. EPA and Dow will work closely with the Refuge to minimize impacts to floodplain forests, other resources, and public use.

11. *The Refuge Manager emphasized the work will need to comply with all applicable environmental laws including, but not limited to the Endangered Species Act, National Historic Preservation Act, and Bald and Golden Eagle Protection Act.*

For on-site CERCLA response actions EPA is required to comply with the substantive technical requirements of applicable or relevant and appropriate requirements (ARARs). The Segment 6 & 7 EE/CA includes an extensive discussion of ARARs, including, but not limited to those mentioned by the Refuge. EPA will ensure compliance with ARARs, to the extent practicable.

12. *One commenter indicated that he thought work on his bank would be challenging because of hardened materials placed there. Another commenter said his bank is eroding and requested that it be stabilized.*

EPA has not identified these banks as BMAs, so no response action is currently planned. Not every eroding bank will require response actions. BMAs are identified based upon both the relative TEQ levels and how much they are eroding. It is common to find eroding banks in river systems. Just because a bank is eroding does not mean it will require cleanup. If a future response action is needed, EPA and Dow would work with the owners about the best approach.

C. ADDITIONAL INFORMATION REQUESTED AND RECOMMENDATIONS

13. *The CAG had seven specific recommendations, as outlined below:*
    a. *"1. The CAG would like to emphasize how important it is to create models capable of providing support for identifying targets for modelling [sic – monitoring?]to help understand the success (or failures) of the various approaches to containing both contaminated sediment and banks."*

    EPA and MDEQ agree that long-term monitoring of the Site is necessary ensure the long-term effectiveness of remedies. EPA and MDEQ require monitoring as part of the work to be performed under the 2010 AOC; the legal agreement requires Dow to develop and implement a Site-Wide Monitoring Plan that includes uptake to biota, sediment and contaminant loading, and post-response monitoring. Additionally, each of the Settlement Agreements requiring implementation of NTCRAs has included monitoring as required post-removal site control work. Monitoring of the Site over time will be important to assess and document baseline and ongoing conditions, and to provide a basis for comparing and assessing the effectiveness of response options. Because information needs may change over time, the Site-Wide Monitoring

Plan is expected to evolve and change to reflect changing data quality objectives and information needs.

b. "*2. The CAG would like to reiterate its strong preference for permanent remedies wherever possible to remove contamination from the river environment. Whenever removal of contaminants of concern can be achieved without significant disruption or long-term damage the ecosystem, that should be the preferred permanent solution."*

See response to comment 3 above.

c. "*3. For SMA 6-1, the CAG recommends removal be used for the upstream contaminants which are located at shallower depths."*

See response to comment 4 above.

d. *"4. The CAG would like to see the development of simple annual reports to help the community understand the effectiveness of remediation that has already taken place. These reports could identify the remediation completed, the monitoring being conducted and, as results become available, sampling measures indicating successful remediation."*

Dow is required to submit annual reports documenting work completed and monitoring results. EPA and MDEQ use these reports, along with field oversight, to ensure the ongoing protectiveness of remedies. These reports are several hundred pages long and highly technical, so they are probably not easily reviewed by the public. For the past two years EPA has produced a four-page brochure documenting cleanup progress. The brochure discusses remediation completed but does not discuss monitoring of remedies. EPA will discuss with the CAG whether this brochure could be modified to meet their goal, or whether they envision something different.

e. *"5. Future Response Documents should include a section on anticipated future conditions. As noted by the Trustees: "Over time, land uses may change and improved agricultural practices may reduce the input of relatively clean sediment into the system. Changes in dam operation and water withdrawals may affect hydrology and erosion. Climate-related changes are also expected to affect hydrology, erosion, and ice scour, especially as extreme weather events become more frequent."*

Areas identified for action under the Segments 6 & 7 cleanup plan were identified because they have elevated dioxin and could act as secondary sources if they erode. The basis for action assumed that there could be future conditions that would cause erosion. In future response documents EPA will ensure that there is a transparent discussion of anticipated future conditions.

f. *"6. The response proposal should include a bibliography of all other documents referenced in the report."*

Section 8 of the Segments 6 & 7 EE/CA contains a reference list of all the documents cited in the report.

g. *"7. Document IDs or other relevant information should be provided for all other documents referenced in the report, such that online retrieval is possible."*

Document IDs are published in the index to the administrative record, and all those documents are available online throughout the public comment period. In the future, EPA will provide specific detailed instruction to the CAG on use of the administrative record and retrieval of online documents.

14. *The CAG also reiterated a few of the recommendations previously provided in response to Segments 4 and 5, including:*
    a. *"The CAG requests EPA provide further information to better understand how MNR relates to previous decisions for all segments with information about size, location, extent of soil removal, capping, and MNR, and the contamination levels and depths in each and the particular issues related to accessibility, etc. that were used to decide what method was selected for the remediation."*

    In response to this previous comment EPA replied: "EPA will work with the CAG to prepare and present to them the requested information on past and future SMAs and their conditions and response decisions, including specific information on MNR." EPA presented information to the CAG on September 18, 2017, and July 16, 2018, discussing remedies selected for SMAs and general considerations. It appears that the CAG wants additional details, so EPA will do another presentation for the group on the SMAs. Prior to SMA 6-1, EPA has only been selected MNR once at the Site; as part of a combined remedy at SMA 5-1 where a portion of the dioxin deposit was deeply buried.

    b. *"The CAG requests EPA develop a Fact Sheet explaining the variety of long-term obligations expected to be identified during course of this cleanup project, such as monitoring, maintenance, corrective action, etc., what financial assurance methods will be used and how they are to be maintained in order to meet these obligations in perpetuity."*

    In response to this previous comment EPA replied: "EPA will work with the CAG to prepare information about the long-term obligations and how they will be implemented, overseen by the Agencies, and funded. EPA anticipates that there will be a slide presentation at a CAG meeting that can be posted to the CAG and EPA websites. Following CAG feedback, EPA anticipates preparing a fact sheet or other written "plain language" information for the public. EPA presented information to the CAG on March 27, 2017, and September 18, 2017, discussing long-term obligations including monitoring, maintenance, Dow's financial obligations, trend analysis, etc. EPA has not prepared a fact sheet because we would like feedback from the CAG about what would be useful to the public. We will continue to work with the CAG to develop information for the public on the long-term Site management.

15. *The CAG requested additional discussions of monitoring to look at how monitoring results will ultimately be tied to the need for additional response, and to understand questions such as:*

What is the response criteria for determining a failed MNR? What is a measure of success? What criteria triggers a response?

EPA will make a presentation at one of the CAG meetings to address these questions.

16. The CAG had questions about the cost estimates in the Segment 6 & 7 EE/CA. They pointed out that the document refers to a 30-year period of monitoring, but the contaminants are stable and toxic far longer. They asked what is the basis for choosing a 30-year period?

EPA recognizes that the contaminants left in stabilized BMAs and in SMAs using capping and MNR will require monitoring beyond 30 years. EPAs legal agreements with Dow require that long-term monitoring. The 30-year period in the EE/CA is a function of how EPA assesses costs. A present worth analysis is used to evaluate expenditures that occur over different time periods by discounting all future costs to a common base year, usually the current year. This allows the cost of response alternatives to be compared based on a single figure representing the amount of money that, if invested in the base year and disbursed as needed, would be sufficient to cover all costs associated with the remedial action over its planned life. EPA's RI/FS guidance says that in general, the period of performance for costing purposes should not exceed 30 years.

The Segment 6 and 7 SMAs and BMAs are being addressed through EPA's removal authorities because they have elevated dioxin and could act as secondary sources if they erode. A final cleanup decision for all Segments of the Tittabawassee River will be made after monitoring data on the implemented NTCRAs are generated and analyzed, and after an assessment of any remaining site risk is conducted. The final cleanup decision will describe ongoing monitoring needs and reassess costs in accordance with EPA guidance such as "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study," OSWER 9355.0-75.

17. The CAG would like to see a more thorough discussion of specific long-term operation and maintenance for BMAs.

EPA will make a presentation at one of the CAG meetings to discuss this.

D. MISCELLANEOUS COMMENTS

The comments in this section are not relevant to decision-making for Segments 6 & 7. However, they are relevant to the Site, so EPA is summarizing and responding to these comments.

18. One commenter expressed concerns that the sampling protocol for floodplain property is non-representative and would dilute out areas that need a cleanup.

EPA believes our approach for floodplain decision-making is appropriate. EPA selected a cleanup plan for properties along the Tittabawassee River in 2015, after a public comment period and in consultation with MDEQ. Based on a robust data set, the focus is on properties in frequently flooded areas, known as the 8-year floodplain. Not every floodplain property will need a cleanup because contamination is not distributed evenly throughout the 8-year floodplain. EPA and MDEQ developed cleanup numbers to determine where cleanup is needed. To make cleanup decisions,

EPA first evaluates how the 8-year floodplain portion of each property is currently used to see which cleanup numbers apply. EPA next reviews existing information to evaluate dioxin levels for each property and directs Dow to take confirmation samples, where needed. When properties are large or used in different ways they are sub-divided for this evaluation into what we call "decision units." EPA's cleanup decisions are based on the overall (incremental composite) dioxin concentrations in each decision unit. If dioxin levels are lower than the appropriate cleanup number, no further action is needed. If dioxin levels are higher than the cleanup number, that property will be eligible for a cleanup, and Dow will contact the property owner to offer a cleanup.

19. One commenter expressed concerns that sand deposited on his property after flooding might be contaminated and asked whether it should be tested.

This property has not yet been assessed for a floodplain cleanup. The assessment will follow the steps discussed immediately above. If needed, his property will have additional sampling and be offered a cleanup. Deposition of contaminated material after flooding is a potential but is not expected to occur at levels that would require additional cleanup. The site strategy is generally following an upstream-to-downstream approach. Distinct sediment deposits and riverbank areas that may be sources of dioxins when they erode are being targeted for cleanup. The upstream cleanup, combined with current management practices that control releases from Dow's facility, will help prevent recontamination. Dow is currently monitoring places with previous cleanups (i.e., West Michigan Park and Riverside Boulevard) to assess the potential for recontamination. So far, it has not been a concern. However, if recontamination were to occur at levels exceeding the cleanup numbers, additional cleanup would be required. There will be an ongoing monitoring program in place at select floodplain properties to assess this.

20. One commenter asked EPA to ensure that the man-made island in Saginaw Bay is included in the studies and cleanup. The commenter is concerned that the contaminated dredge material placed there might be eroding. Another commenter requested monitoring out to Saginaw Bay.

The Site includes the lower 24 miles of the Tittabawassee River, the 22-mile Saginaw River, and the parts of Saginaw Bay where site-related contaminants have migrated. Because of this large geographic area, the general approach for the Site is to conduct cleanup in an upstream to downstream fashion (although EPA has the authority to take necessary response actions "out of order"). EPA expects the Tittabawassee cleanup to occur through 2021. After that, EPA will focus on investigating and developing cleanup plans for the Saginaw River and Bay. At this time, the scope of the work for Saginaw River and Bay has not been established, but EPA expects to direct Dow to sample in parts of the Bay. Channel Island in the Bay was built and is regulated by the U.S. Army Corps of Engineers as a Confined Disposal Facility for dredged material. As such, EPA does not expect to include the island in the CERCLA investigations.

21. One commenter requested sampling data from his property.

EPA has provided the data.