Memorandum

March 14, 2019

To:	Zachary Sasnow (EPA)	Ref. No.:	058502
From:	Daniel Smith/John-Eric Pardys/36		
cc:	Dave Favero (RACER)		

Subject: North Ditch – Ecological Screening Assessment

1. Introduction

The following is a review of potential ecological risks in the former stormwater discharge ditch (referred to as the North Ditch), at the RACER Trust Saginaw Nodular Industrial Land (Site) in Saginaw, Michigan (Figure 1). The North Ditch is a small (< 1-acre), L shaped pond aquatic feature southwest of the Secondary Pond (Figure 2). The North Ditch had been part of General Motors Corporation (GMC) entire property (pre-bankruptcy) process water system until the mid-1980's and, thus, has elevated levels of Site-related chemicals. Between the mid-1980s and demolition of the Nodular Plant in 1999, the North Ditch received storm water from the Nodular Plant, but since demolition, no longer receives storm water from the Nodular Plant. In short, the North Ditch is an artificial aquatic system that is now naturalizing.

Over the past several decades, the surface water, underlying sediments, and bank soils have been sampled for Nodular-specific chemicals: target analyte list (TAL) metals, PCB Aroclors, and others (e.g., nitrate, ammonia, and cyanide). These samples document that the North Ditch has elevated concentrations of the same constituents, e.g., PCBs, organic carbon, and metals, especially zinc and manganese which were found in high concentrations in the heretofore upstream Secondary Ponds (GHD 2017).

An Ecological Risk Assessment (ERA) for the entire GMC property (pre-bankruptcy) (Exponent 2007) was conducted and included an abbreviated analysis of the available chemical data. Because the North Ditch was an artificial water body and, at the time of the ERA, was part of the plant's storm water system, the ERA did not consider risks to the fish and sediment macrobenthos in the North Ditch. Instead, the ERA considered only risk to semi-aquatic birds and mammals consuming fish and macroinvertebrates from the North Ditch. Based on this limited risk analysis, the ERA concluded that chemicals in ditch water and sediments did not pose ecological risks, via bioaccumulation pathways, to semi-aquatic predators of aquatic life living in the North Ditch. This ERA was reviewed by USEPA and received minimal comment. However, the 2007 ERA for the entire site was not formally accepted by USEPA. The site was split following the bankruptcy, and revised RCRA Facility Investigation (RFI) Reports were submitted for each of the subsequent owners (RACER and General Motors LLC [GM]). Note that sections of the ERA relevant to the current GM property were accepted by USEPA for use in assessing risks to that part of the entire property.

GHD
410 Eagleview Boulevard Suite 110 Exton Pennsylvania 19341 USA
T 610 321 1800 F 610 321 2763 W www.ghd.com

Since the ERA was conducted, additional samples of North Ditch surface water, sediment, and bank soil samples were taken in 2013. The sampling data for sediments and surface water were presented in a 2013 report (CRA 2013). Although not the primary intent of the report, some of these samples were compared to ecological screening values (ESV) in that document. In general, the screening showed that surface water and sediments did not pose acute risks to aquatic life. However, this screening was limited in intent and scope, and the North Ditch is now naturalizing as a small pond.

Given this background, the following analyses provide an updated screening of ecological risks for North Ditch biota. Given the previous ERA assessment, and the very small area and artificial nature of the North Ditch environment, this following screening follows the same streamlined ERA methods used for assessing risks to the Secondary Ponds (GHD 2017). Specifically, the water, sediment, and soil data are screened against ESVs to more fully assess potential risks from all chemicals in all media. However, the following assessment employs less conservative screening values (e.g., probable effects concentrations (PEC) values for sediments) and forgoes more conservative assumptions of a typical SLERA.

Background

The North Ditch is a narrow, L- shaped body of water just south of the municipal waste water treatment plant (WWTP). Prior to the mid-1980s and construction of the system for recycling process water, the North Ditch was part of the process water system. At that time, surface water was taken from the Saginaw River, used in various industrial processes, routed through the Secondary Settling Ponds, then through the North Ditch, and finally discharged back into the Saginaw River. However, in the mid-1980s, a closed-loop, process-water recycling system was constructed. After this, process water was no longer routed through the North Ditch. Between this time and demolition of the Nodular Plant, the North Ditch received storm water from the Nodular Plant and from the municipal WWTP. Direct storm water discharges from the Nodular Plant ceased in 1999 when the Nodular Plant was demolished. In 2004, a small portion of the ditch was backfilled with clay to prevent the discharge pipes from leaking water from the ditch into the Saginaw River. Since then, the North Ditch's connection to the Saginaw River has been curtailed by a catchbasin immediately south of the North Ditch adjacent to the entranceway off of M-13. Consequently, the North Ditch only discharges to the Saginaw River when water levels in the North Ditch rise to the level of the catchbasin during very wet periods. The discharges to the Saginaw River are monitored in accordance with NPDES permit No. MI0059042. There have been no exceedances of discharge parameters.

The North Ditch is approximately 1200 feet (ft) long, with widths ranging from about 40 ft to about 20 ft. The North Ditch has a total surface area of approximately 0.8 acre and a maximum depth of 6 to 8 ft. However, all dimensions, especially the width and depth, vary depending on season and meteorological conditions. Although stream-like in appearance, the North Ditch has little to no flow except during major flood events. Consequently, the North Ditch functions ecologically as a small pond, albeit a long, narrow and shallow pond.

The habitat of the North Ditch was described in the ERA for the GMC property (pre-bankruptcy) (Exponent 2007). According to this ERA, the ditch contains considerable habitat structure:

> "including submerged aquatic vascular plants, terrestrial shrubs (e.g., willows) rooted in the shallows, and considerable underwater debris (e.g., sunken tree limbs and branches). The banks of

the ditch are densely vegetated with terrestrial grasses, forbs, woody shrubs, and trees to a lateral distance of 4–8 ft on either side of the ditch."

The North Ditch was sampled for fish in 1997. The North Ditch contained a typical warm/cool water fish assemblage: common carp, suckers, various sunfish species, (e.g., pumpkinseed, green sunfish, and Warmouth), black bullhead, and brook silverside. Young of the year fish were captured indicating that fish were reproducing. Great blue herons (Ardea herodias) were observed in the North Ditch during the Facility investigations, presumably feeding on fish.

2. Ecological Evaluation

As previously discussed, the North Ditch stopped receiving directed storm water runoff from the Nodular Plant when it was demolished. Thus, the North Ditch is no longer part of the process or even storm water management system for the Nodular Plant. It is now naturalizing as a small pond. To be conservative, the following considers potential ecological risks for the North Ditch as a natural aquatic system

The following analyses screen risks with the widely used quotient method, in which an ecological screening quotient (SQ) for each chemical is estimated as:

$$SQ = \frac{EEC}{ESV}$$

where EEC is the estimated exposure concentration and ESV is the ecological screening value, which is also a concentration. In the following analyses, the EEC and SQ values are based on both the maximum and mean concentrations of each chemical. In addition to SQ values, screening tables will also provide the frequency of exceedance (FOE), the proportion of samples that exceeded the ESVs. Assuming that samples are reasonably well dispersed in space, the FOE is an index of the percent of the total area that could be potentially problematic. For sedentary and non-motile biota, such as plants and benthic invertebrates, the FOE may be a useful indicator of potential risks to population and communities. Screening tables also provide summary information, such as number of samples, frequency of detection, maximum and mean concentrations.

2.1 Ecological Risks for the Pond-like Ecosystem of the North Ditch

Recent experience and climate data suggest that annual precipitation slightly exceeds total losses due to evapotranspiration in the North Ditch. Therefore, the North Ditch is expected to persist as a small pond ecosystem into the future, even without receiving any runoff from nearby areas. In this ecosystem, the primary ecological receptors are those of a natural pond: fish and water column invertebrates and benthic invertebrates. Exposure media to these aquatic receptors are water and sediments. There may also be semi-aquatic predators consuming fish, amphibians, and invertebrates from the pond. The semi-aquatic predators will be exposed, indirectly via the food chain, to the sediment and surface water chemicals, which readily bioaccumulate in the tissues of aquatic prey.

2.2 Risks to Water Column Species

Seven water samples were collected from three locations at two depths (surface and mid-depth) from the North Ditch (Figure 3). The samples were analyzed for TAL metals, PCBs, ammonia, cyanide (total and amenable), and hardness. The results were screened against Michigan Department of Environmental Quality (MDEQ) Surface DEQ Rule 57 Water Quality Values for protection of aquatic life. More conservative chronic aquatic life criteria were used to screen concentrations observed in surface water samples. Hardness related criteria were estimated at a hardness of 20 milligrams per liter (mg/L), which was about average hardness of all samples.

MDEQ does not have an aquatic life criterion for PCBs, so the USEPA chronic water quality criterion of 0.000014 milligram per liter (mg/L) was used. The choice of ESV for PCBs was not critical since no PCB Aroclor was detected in any water sample. Similarly, no valid criteria are available for total amenable cyanide, so the water column concentrations were compared to the WQC for free cyanide.

The screening results are presented in Table 1 and the analytical results are presented in Attachment A. As can be seen from Table 1, no chemical came close to exceeding its WQC or surrogate WQC. This was true for the metals even though the water concentrations are based on total metals analyses and the ESVs generally pertain to dissolved metals. Thus, potential risks to water column species can be dismissed with available information.

2.3 Risks to Aquatic Benthos

In 2013, seven sediment samples were collected from six locations in the North Ditch (Figure 3). The samples were analyzed for TAL metals, PCBs, ammonia, cyanide (total), total organic carbon (TOC), and AVS/SEM. Several sediment samples had also been collected in 1998 and 2005 and analyzed for a subset of those parameters. To screen for risks to aquatic benthos, the sediment data were screened against the following ESVs. Metals were screened against Probable Effects Concentrations (PEC), which are recommended by Michigan for screening sediments (MDEQ 2006). As a second choice if no PEC was available, Region 4 ESVs were used (USEPA Region 4, 2018). Because the intent of this screening is to assess real potential for toxicity, Region 4's less conservative rescreening values (RSV) were used if they were available. If none of these sources had an ESV, then Dutch Maximum Permissible Concentrations (MPC) [1] for sediments were used (Crommentuijn et al. 1997).

AVS/SEM (Acid volatile Sulfide/Simultaneously Extractable Metals) analyses were also conducted on most of the sediment samples. AVS/SEM analyses provide a more refined estimate of metals bioavailability and potential toxicity (USEPA 2005, Burgess et al. 2013). For the AVS/SEM data, guidance (USEPA 2005) indicates that values of carbon normalized excess SEM (CNE-SEM) less than 130 micromole (umol/gram) organic carbon (OC) are not toxic to benthic invertebrates. The CNE-SEM is simply the difference between SEM and AVS (i.e., SEM – AVS) divided by the concentration of organic carbon. Values of CNE-SEM below

[1] The MPCs are estimated as the maximum amount of a metal that could be added to background concentrations without causing toxicity to most species. The derivation of the Netherlands MPCs is transparent, and it is well described in the source document (Crommentuijn et al., 1997). The Netherlands values also specifically incorporate background concentrations. On the other hand, these values are primarily based on direct toxicity, although potential toxicity via bioaccumulation pathways is a minor part of the derivation.

130 umol/gram OC are likely not toxic, those above 3,000 umol/gram OC may be toxic[2]. Between these two thresholds, it is uncertain whether the samples will be toxic or non-toxic, although the probability of toxicity rises as the value of CNE-SEM increases (See Figure 4, taken from Figure 3.8 of USEPA 2005). Results for CNE-SEM are compared to both thresholds to allow inferences (Table 2). AVS/SEM analyses also provide information on potential toxicity of silver and chromium. Both metals are unlikely to be toxic in the presence of measurable amounts of sulfide (USEPA 2005).

The screening results of sediment from North Ditch are presented in Table 2 and the analytical results are presented in Attachment A. As shown there, concentrations of some metals exceed the screening values, but mean values generally do not. The exceptions to this are zinc and manganese, although average manganese concentrations are only slightly above the ESV. The high concentrations of zinc and manganese in sediments also occurred in the Secondary Pond sediments (GHD 2017), which historically had been the primary source of water to the North Ditch. Moreover, while lead, nickel, and zinc were sometimes problematic when compared to PECs, these divalent metals were usually not a problem using the more reliable AVS/SEM method. Nine (9) AVS/SEM samples were taken in North Ditch sediments, and 2/3 had CNE-SEM values below 130 umol/gram OC (Table 2), the threshold below which toxicity is unlikely. However, the three samples that did exceed this safe threshold for CNE-SEM were far below the likely-to-be-toxic threshold of 3000 umol/gram OC. In addition, the three uncertain samples are much closer to the lower threshold.

To make better use of the data, the potential for toxicity was estimated as follows. Sediment samples with a CNE-SEM value below 130 umol/gram OC are assumed to have 0% of being toxic. Sediment samples with CNE-SEM values above 3000 umol/gram are assumed to have a 50% chance of being toxic. Between these two thresholds, the relationship between toxicity and CNE-SEM is logarithmic. Therefore, the probability of toxicity for intermediate samples, with CNE-SEM values of X, is assumed to be equal to

$$(Ln(X) – Ln(130)) / (Ln(3000) – Ln(130)\} * 50\%$$

Thus, for example, a sample with CNE-SEM value of 624.5 umol/gram OC would be predicted to have a 25% chance of being toxic.

Using this method of prediction, the three samples with uncertain toxicity are estimated to each have an 11% chance of being toxic. Assuming that samples are representative of bottom sediments, this estimation method means that 2/3rds of the bottom has no chance of being toxic due to metals, whereas the remaining third has about a 11% of being toxic to benthic invertebrates. Following, the prediction for the entire sediment bottom is then that there is about a 3.6% chance that any bottom area would be toxic: 66.6% * 0% + 33.3% * 11%. This potential for toxicity is not considered ecologically meaningful. It is well below a widely used threshold, 20% of the area, for *de minimis* ecological effects (Suter et al. 1995, 2000; Henning and Shear 1998).

[2] USEPA (2005) is not explicit about how this upper threshold was determined. However, inspection of Figure 3.8 of that document, reprinted as Figure 4, suggests that this upper threshold is the threshold at which about 50% of samples are toxic or, potentially, where concentrations produce, on average 50% mortality. Non-toxic samples occur above this threshold and sometimes well above; some samples with CNE-SEM up to about 15,000 umol/g OC are not toxic.

Manganese was above its ESV in three of seven samples. However, manganese is not amenable to more refined risk assessment using AVS/SEM method. Thus, the manganese exceedances are based on PEC values. PEC values are based on the co-occurrence methodology, which has a weak to null scientific basis (Smith and Jones 2006, 2012). As described in GHD (2018a), a much more scientifically defensible method of assessing risk to benthic invertebrates considers pore water concentrations.

Sampling of sediment pore water was applied to sediments in the Secondary Pond. Historically, the Secondary Pond had been the upstream source of chemicals and sediments to the North Ditch, and has considerably higher concentrations of manganese (and zinc and PCBs) in its sediments. In fact, manganese concentrations in the Secondary Pond average about 4000 milligram per kilogram (mg/kg) (GHD 2017), which is higher than the maximum manganese concentration found in the North Ditch (Table 2). Despite these very high concentrations of manganese in Secondary Pond sediments, sediment pore waters in the Secondary Pond were never elevated above Michigan's WQC for manganese (GHD 2018b). The sediments in the North Ditch are similar to those in the Secondary Pond (and likely derived from same sources). The null results for manganese toxicity found in the Secondary Pond, therefore, are assumed to be applicable to North Ditch sediments as well. Consequently, risks from manganese in North Ditch sediments are assumed to be unlikely.

Two other Site-related pollutants (total cyanide and ammonia) were found at elevated concentrations in North Ditch sediments. Ammonia concentrations are below its ESV (Table 2), but cyanide has no reliable ESV. Nonetheless, the potential risks of cyanide can be dismissed because free cyanide, the toxic form of cyanide, is quite vulnerable to biodegradation. Thus, free cyanide is not expected to persist in the biologically active zone of sediments, where benthos live.

Lastly, PCB concentrations also exceeded the PEC values, although the moderately elevated PCB concentrations were alleviated by high levels of organic carbon, which averaged about 6% across all sediment samples. Moreover, it is well established that PCBs are not very toxic to benthic invertebrates. Invertebrates lack the Ah receptor, which mediates the extreme dioxin-like toxicity of PCBs (National Academy of Sciences 2002, Fuchsman et al. 2006). PCB toxicity to benthic invertebrates is mediate by non-specific narcosis, which is a much lower form of toxicity. Observed PCB concentrations are well below levels potentially toxic to benthic invertebrates, which have to be greater than 20 mg/kg in carbon rich sediments (Fuchsman et al. 2006). Thus, risks of PCBs to benthic invertebrates can also be dismissed with available information[3].

2.4 Risks to Consumers of Aquatic Life in Secondary Pond

As noted above, the original ERA (Exponent 2007) already considered and dismissed risks to semi-aquatic predators feeding on fish and macroinvertebrates from the North Ditch. However, the 2007 ERA for the North Ditch was never formally accepted by USEPA. In addition, some additional sediment samples have been taken after the 2007 ERA was conducted. Thus, the following section updates the assessment of risks via bioaccumulation pathways to consumers of aquatic prey from the North Ditch. Of the sediment bound

[3] PCBs are very toxic to vertebrates, which have Ah receptors and are subject to dioxin-like toxicity. However, as discussed previously, risks to vertebrate predators were addressed, and dismissed, in the original ERA (Exponent 2007.

chemicals detected at elevated concentrations, only PCBs readily bioaccumulate, or biomagnify, in fish[4]. Total PCB concentrations in the North Ditch sediments average approximately 0.96 mg/kg. The total PCBs are a mixture of Aroclors, about 40% Aroclor 1260 with the remainder divided about equally among Aroclors 1242, 1248, and 1254.

As the North Ditch is colonized by fish, there will be exposure to fish-eating wildlife, typically represented in ERAs by mink and herons. Mink are more sensitive than birds to PCB toxicity; thus, the following will focus on risks to this most-sensitive species. Tracey and Hansen (1996) considered bioaccumulation of PCBs by benthos and benthically coupled fish and found a median BSAF of 1.64 for fish, normalized to fish lipid and organic carbon in the sediments. The North Ditch sediments average about 6% organic carbon, while small forage fish generally have approximately 3 to 5 percent lipid (e.g., see Suns and Hitchens 1992). Assuming forage fish average 4% lipid, the BSAF is 1.09 (= 4/6 * 1.64).

This BSAF produces an estimated average PCB concentration for bottom-feeding forage fish of approximately 1.0 mg/kg, based on the average PCB concentration of 0.96 mg/kg. By comparison, the Region V No Observed Effect Concentration (NOEC) observed for PCBs in food and effects on mink is 0.5 mg/kg (Chapman 2003). Therefore, potential PCB exposures to most sensitive fish-eating wildlife, the mink, are about double the NOEC and 170% of the lowest observed effects concentration (LOEC) of 0.6 mg/kg PCBs in prey. However, there are four conservative elements of this assessment that render risks to mink, and other less sensitive predators, unlikely.

- First, the exposure assessment assumes that mink eat only fish from the North Ditch. In fact, mink typically eat about as much terrestrial prey as aquatic prey (USEPA 1993). Using the more realistic assumption about diet would reduce the exposure to PCBs by about half.
- Second, the North Ditch is less than 1 acre, but mink forage over tens to hundreds of acres (USEPA 1993, Halbrook and Petach 2018). Using realistic assumptions about site usage would reduce exposure by one to two orders of magnitude.
- Third, the assessment is based on benthivorous fish, which are most exposed to sediment-bound PCBs. Many forage fish in the Ditch will instead be feeding on the less contaminated water-column food chain, which includes those feeding on the abundant physical structure (vegetation, branches) that occurs in the North Ditch. Even moderate reductions in fish concentrations would reduce exposures to *de minimis* levels.
- Lastly, the North Ditch previously received flow from the Secondary Ponds, and like this heretofore upstream source, has very elevated levels of manganese and especially zinc and moderately elevated concentrations of PCBs and organic carbon. Importantly, subsequent testing of the Secondary Pond sediments found very high contributions of black carbon (2.9%, GHD 2018c), which presumably also occur in the Ditch. Compared to typical organic carbon, black carbon binds much more aggressively to hydrophobic substances, like PCBs, greatly reducing their bioavailability and potential for bioaccumulation (e.g., see Cornelissen et al. 2005; Driscoll et al. 2009; USEPA 2012). The likely

[4] With the exception of mercury, the metals do not accumulate readily (i.e., biomagnify) in food chains, and mercury was not found at elevated concentrations in North Ditch sediments.

presence of significant amounts of black carbon in North Ditch would significantly reduce PCB concentrations in forage fish compared to those estimated with Tracey and Hansen's results.

These factors, sometimes individually but certainly in combination, would reduce exposures to well below *de minimis* levels. Because fish-eating birds are less sensitive than mink to PCBs and forage over wider areas, risks to piscivorous birds can also be dismissed as unlikely.

2.5 Ecological Risk of Pond Bank as Terrestrial Ecosystem

Ten soil samples were collected from nine locations along the banks of the North Ditch (Figure 3). The samples were analyzed for TAL metals, PCBs, ammonia, cyanide (total), and TOC. The soil in the pond bank was sampled to determine whether it had been contaminated under high water conditions. As the pond has a perimeter of about 2500 ft, the total area of the pond bank is very small, maybe 0.35-acres, if the bank is assumed to be 6 ft wide. This is probably a *de minimis* terrestrial area for an ecological risk assessment. Although USEPA has not provided a quantitative value for the *de minimis* area, its guidance is clear that ERAs should focus on ecologically important issues. Guidance from both Pennsylvania and Texas have suggested that less than 2-acres and less than 1-acre of terrestrial habitats are too small, respectively, to warrant consideration of ecological risks[5]. In addition, the land is privately owned and will be maintained into the future as a commercial-industrial land use, with the potential for future development. This small terrestrial area would not be considered an ecologically or societally important habitat upon which ERA's should focus (USEPA 1997, 1998).

Notwithstanding the bank's very small area and uncertain societal and ecological value, the bank soil data were screened against soil ESVs for conservatisms and completeness. By usual ERA practice for fully functional and sufficiently large terrestrial habitat, the relevant ecological receptors would be terrestrial plants, soil invertebrates, and vertebrates (e.g., mammals and birds) that feed on the resident biota (e.g., worms and plants) and are incidentally exposed to soils. To be conservative, the soil data were screened for risks to all three receptor groups. ESVs were based on those provided by EPA Region 4 soil screening levels, almost all of which are based on USEPA's conservative EcoSSL methods (USEPA 2007). The ESV from Oak Ridge National Labs (ORNL), from Efroymonson et al. 1997, was used for PCBs.

The screening results are presented in Table 3 and the analytical results are presented in Attachment A. As can be seen in Table 3, screening bank soils against the conservative ESVs, which account for potential risks to all ecological receptor groups, produces max and average screening quotients greater than 1.0 for several compounds. Because ecological risks pertain to populations and communities, the more relevant quotients are the mean SQ values. Mean SQ values exceeded 1.0 for five metals: chromium, lead, manganese selenium, zinc, although just barely for selenium.

Most of these exceedances are attributable to the conservativeness of the ESVs. All of the ESVs that were exceeded are based on USEPA's very conservative EcoSSL methodology. As described in the source documents (e.g., see USEPA 2007), this conservative methodology frequently produces ESVs in the range of naturally occurring background concentrations for metals. Such EcoSSLs are too conservative to be valid

[5] From Pennsylvania Code 250.311, "Evaluation of ecological receptors". TCEQ. 2006. Update to Guidance for Conducting Ecological Risk Assessments at Remediation Sites in Texas RG-263 (Revised) January 2006 Version

toxicological values; it is very unlikely that widely distributed wildlife and plant species would face toxicity from commonly occurring soil concentrations. Notably, of the five potentially problematic metals listed above, only average zinc concentration is significantly above a commonplace, e.g., 75th percentile, metal concentration for the US (USEPA 2007). Thus, the exceedances of metals other than zinc can be dismissed as due more to conservative ESVs rather than true likelihood of effects.

In turn, potential risks of zinc can be dismissed based on other conservative aspects of EcoSSL calculation. The zinc EcoSSL is based on risks to worm-eating bird, the woodcock, which is assumed to eat only worms from the site over the long-term. While woodcocks do mostly eat worms, they also eat a variety of other food that tend to be less contaminated than worm. More importantly, woodcocks forage over dozens of acres (> 50-acres, USEPA 1993) and migrate south during the typically harsh Michigan winters when worms and other invertebrate prey are unavailable. Thus, their potential exposure to worm prey in this tiny area of the North Ditch Bank is actually much lower than the chronic, lifetime exposure assumed by the ESV. Risks from zinc to foraging woodcocks are, therefore, dismissible despite the exceedance of the conservative ESV.

Note that additional soil samples were collected beneath the sediments in the North Ditch of the native clay (SO-327-13, SO-325-13, SO-322-13, SO-320-13, and SO-318-13). However, these samples were not evaluated because they are below the sediments and pose no exposure.

3. Summary of Risks to the North Ditch

The North Ditch is a very small (<1-acre), unnatural aquatic system that was once part of GMC Property's (pre-bankruptcy) process water system and then the Nodular Plants storm water management system. During this period, the North Ditch was contaminated with Site related chemicals: primarily metals and PCBs. Since the Nodular Plant was demolished, the North Ditch is naturalizing as a long, narrow pond.

Water, sediment, and pond bank samples have been taken in the past two decades. The available evidence suggests that current concentrations of chemicals in water and sediments of the North Ditch are not likely to cause toxicity to surface water biota or benthos living in the sediments. No chemicals exceeded ESVs in North Ditch surface water. Metals, especially manganese and zinc, were elevated above ESVs in sediments, but more refined analyses suggested that these chemicals were not likely problematic. PCB concentrations in sediments were also elevated, but these were neutralized, in part, by high concentrations of organic carbon, which averaged about 6% in North Ditch sediments. Thus, PCBs were not likely to cause toxicity to benthic invertebrates.

A previous risk assessment, which was reviewed by USEPA, concluded that there was also no risk from PCBs bioaccumulated by fish or macroinvertebrates to semi-aquatic predators feeding in the North Ditch. However, this earlier analysis was not formally accepted by USEPA and because additional sediment samples have been collected, the risk of PCBs to semi-aquatic predators was reconsidered. This reconsideration showed that risks from PCBs were likely not ecologically significant, in large part due to the very small size of, and consequent very small exposure posed by, the North Ditch.

However, to reduce the uncertainty associated with risks to biota from PCBs in sediments, GHD recommends collecting six sediment samples from the North Ditch sediments to confirm the presence of

black carbon in the North Ditch. As discussed in Section 2.4, the presence of black carbon significantly reduces PCB bioavailability and, thus, likely PCB concentrations in forage fish.

The weight of evidence suggests that the North Ditch has positive ecological value, despite its very small size, artificial nature, and moderate concentrations of chemicals. Potential ecological risks to aquatic and semi-aquatic biota associated with the North Ditch are acceptable. Thus, with the exception of the proposed analysis of sediments for black carbon, no further risk assessment activities or remediation is warranted.

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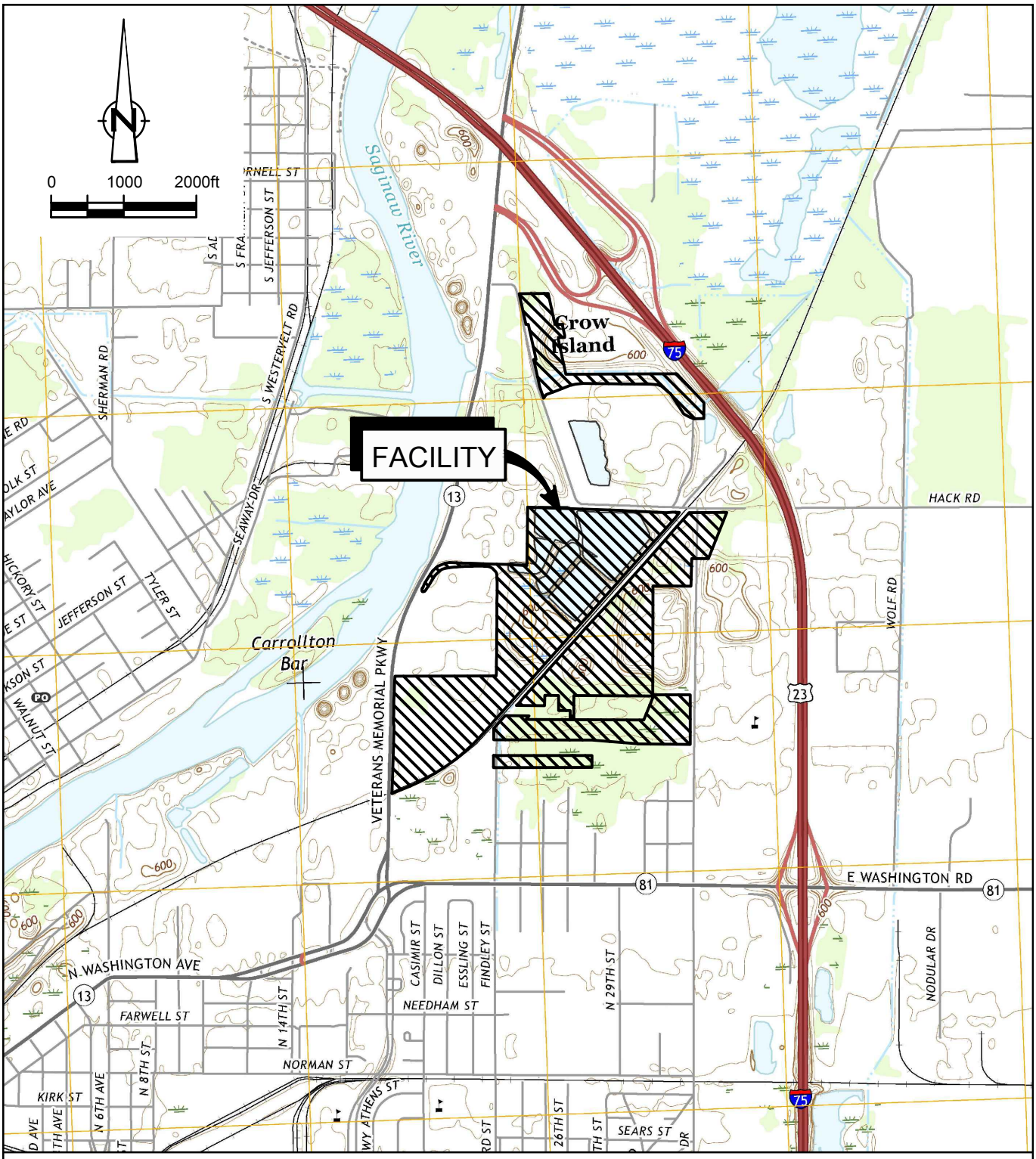
List of Figures

List of Tables

Attachments



SOURCE: USGS 7.5 MINUTE TOPOGRAPHIC QUADRANGLE SAGINAW, MICHIGAN 2012

figure 1

SITE LOCATION
REVITALIZING AUTOMOTIVE COMMUNITY ENVIRONMENTAL RESPONSE

Saginaw, Michigan

NORTH DITCH

SECONDARY POND

LAGOON 5

INVESTIGATIVE UNIT H

INVESTIGATIVE UNIT I

FORMER NODULAR IRON PLANT AREA

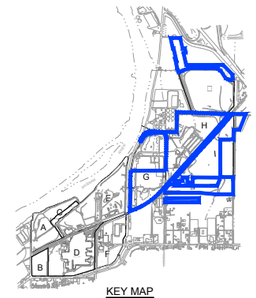
INVESTIGATIVE UNIT G

0 100 200 ft

LEGEND

INVESTIGATIVE UNIT BOUNDARY

RACER PROPERTY



KEY MAP

SCALE VERIFICATION

THIS BAR MEASURES 1" ON ORIGINAL. ADJUST SCALE ACCORDINGLY.

REVITALIZING AUTO COMMUNITES ENVIRONMENTAL RESPONSE

SAGINAW, MICHIGAN

SITE PLAN

GHD

Source Reference:
MICHIGAN STATE PLANE SOUTH, NAD 83 USING INTERNATIONAL FEET, NGVD 88
SPICER SURVEY, OCTOBER 2009.

Project Manager:	Reviewed By:	Date:	
EP	GR	FEBRUARY 2019	
Scale: 1:200	Project No: 58502-T02	Report No: MEMO036	Drawing No: figure 2

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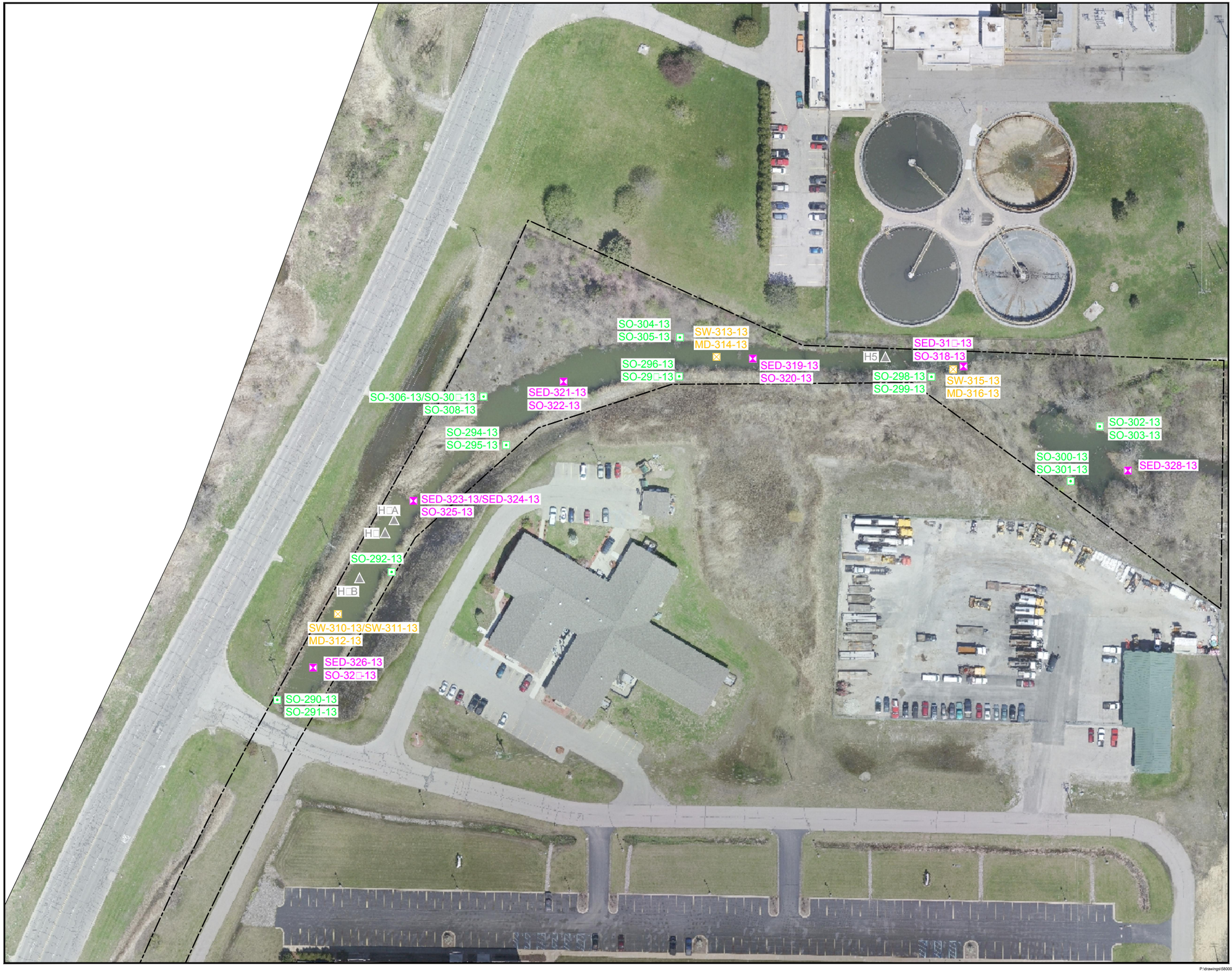

SCALE VERIFICATION

THIS BAR MEASURES 1" ON ORIGINAL. AD□UST SCALE ACCORDINGLY.

REVITALIZING AUTO COMMUNITES ENVIRONMENTAL RESPONSE

SAGINAW, MICHIGAN

NORTH DITCH SEDIMENT, SOIL, AND SURFACE WATER SAMPLE LOCATIONS

GHD

Source Reference:
MICHIGAN STATE PLANE SOUTH, NAD 83 USING INTERNATIONAL FEET, NGVD 88
AERIAL: GHD UAV ORTHOIMAGERY - MAY 3, 2016.

Pro□ect Manager:	Reviewed B□:	Date:	
□EP	GR	FEBRUARY 2019	
Scale: 1" □ 50□	Pro□ect N□: 58502-T02	Report N□: MEMO036	Drawing N□: figure 3

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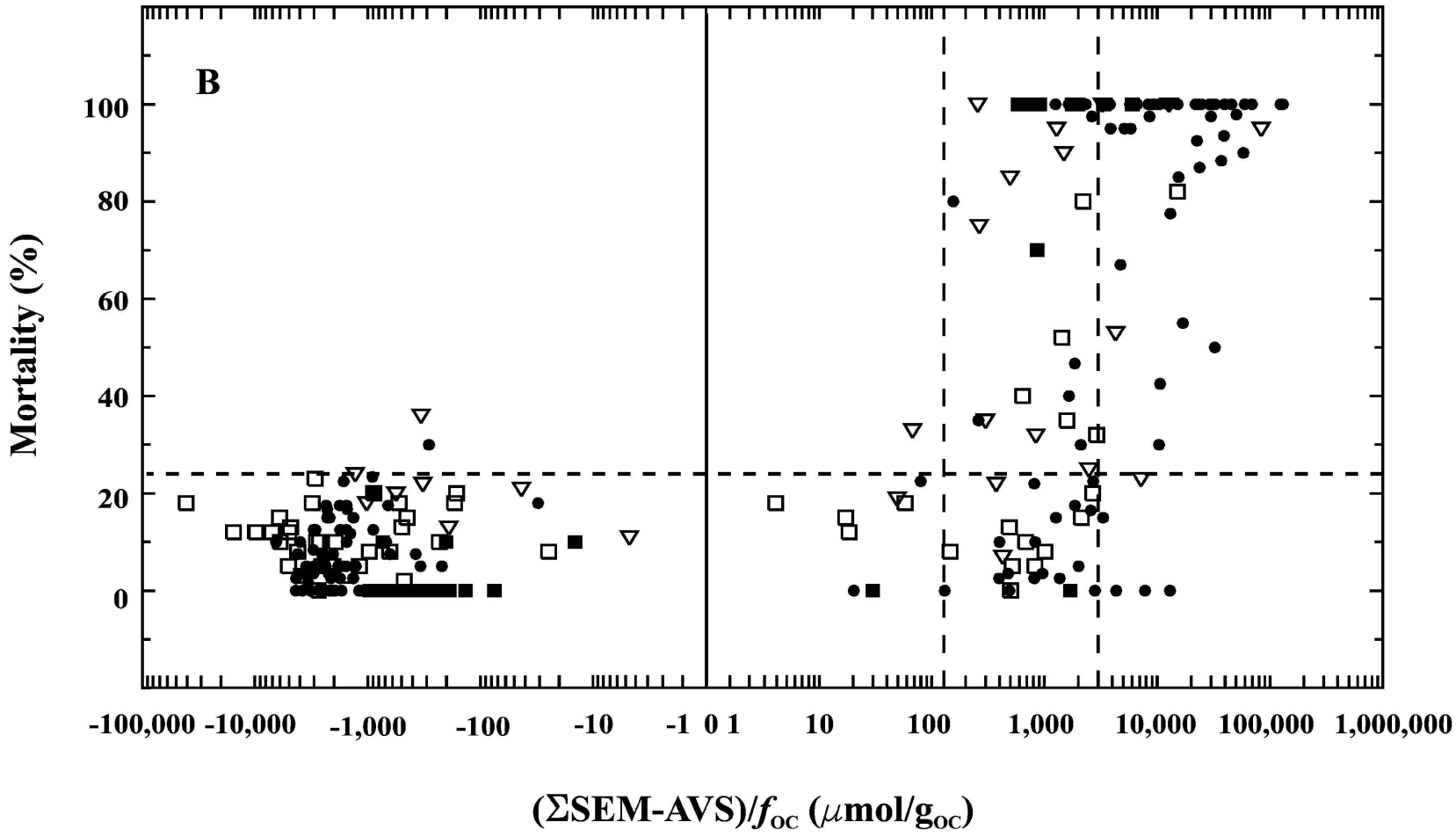

REFERENCE:

USEPA. 2005. Procedures for the Derivation of Equilibrium Partitioning Sediment Benchmarks (ESBs) for the Protection of Benthic Organisms: Metal Mixtures (Cadmium, Copper, Lead, Nickel, Silver and Zinc). EPA/600/R 02/011.

REVITALIZING AUTOMOTIVE COMMUNITY
ENVIRONMENTAL RESPONSE
SAGINAW, MICHIGAN

PERCENT MORTALITY VERSUS (SEM-AVS)/fOC
TAKEN FROM FIGURE 3-8 B OF USEPA (2005)

58502A-T02

Feb 28, 2019

FIGURE 4

CAD File: P:\drawings\58000s\58502\58502-MEMO\58502-T02(MEMO036)\58502-T02(MEMO036)GN\58502-T02(MEMO036)GN-WA004.DWG

Table 1

Surface Water - Ecological Screening Results
North Ditch
RACER Nodular Industrial Land (10040)
Saginaw, MI

Parameters:	Units	MDEQ Chronic WQC	# Samples	Freq. of Detection	Max Detection	Mean Detection (ND = 1/2 DL)	Mean Detection (ND = 0)	Max SQ	Mean SQ (ND=1/2 DL)	Mean SQ (ND = 0)	Freq. of Exceedance ND = 0
Metals											
Antimony	mg/L	0.24	7	100%	0.0005	0.0004	0.0004	0.0021	0.0016	0.0016	0%
Arsenic	mg/L	0.15	7	0%	0.0	0.0025	0.0	0.0	0.017	0.0	0%
Barium	mg/L	0.91	7	100%	0.037	0.034	0.034	0.040	0.038	0.038	0%
Beryllium	mg/L	0.014	7	86%	0.00025	0.00017	0.00010	0.018	0.013	0.007	0%
Cadmium	mg/L	0.004	7	57%	0.00014	0.00026	0.000046	0.033	0.061	0.011	0%
Chromium	mg/L	0.15	7	0%	0.0	0.0025	0.0	0.0	0.016	0.0	0%
Cobalt	mg/L	0.10	7	100%	0.00029	0.00017	0.00017	0.0029	0.0017	0.0017	0%
Copper	mg/L	0.017	7	0%	0.0	0.0010	0.0	0.0	0.059	0.0	0%
Lead	mg/L	0.031	7	100%	0.0020	0.0012	0.0012	0.064	0.037	0.037	0%
Manganese	mg/L	3.5	7	100%	0.18	0.15	0.15	0.051	0.042	0.042	0%
Mercury	mg/L	0.0008	7	0%	0.0	0.00010	0.0	0.0	0.12987	0.0	0%
Nickel	mg/L	0.094	7	0%	0.0	0.010	0.0	0.0	0.11	0.0	0%
Selenium	mg/L	0.005	7	100%	0.00083	0.00057	0.00057	0.17	0.11	0.11	0%
Silver	mg/L	0.0	7	100%	0.000039	0.000020	0.000020	0.65	0.33	0.33	0%
Thallium	mg/L	0.007	7	0%	0.0	0.0	0.0	0.0	0.069	0.0	0%
Vanadium	mg/L	0.012	7	0%	0.0	0.0020	0.0	0.0	0.17	0.0	0%
Zinc	mg/L	0.22	7	0%	0.0	0.010	0.0	0.0	0.046	0.0	0%
Polychlorinated Biphenyls											
None Detected	mg/L	0.000014	7	0%	0.00	0.00	0.00	0.00	**3.53**	0.00	0%
General Chemistry											
Ammonia	mg/L	-	7	43%	1.40	1.09	0.51				
Ammonia (unionized)	mg/L	0.053	3	100%	0.01	0.01	0.01	0.28	0.24	0.24	0%
Biochemical oxygen demand (BOD)	mg/L	-	7	0%	0.00	1.00	0.00				
Chemical oxygen demand (COD)	mg/L	-	7	100%	30.0	22.3	22.3				
Cyanide (amenable)	mg/L	0.0052	7	0%	0.00	0.01	0.00	0.00	0.96	0.00	0%
Hardness, carbonate	mg/L	-	7	100%	180.0	154.3	154.3				
Hardness, magnesium	mg/L	-	7	100%	46.0	44.7	44.7				
pH, lab	s.u.	-	7	100%	7.52	7.44	7.44				
Total organic carbon (TOC)	mg/L	-	7	100%	6.40	6.10	6.10				
Total Hardness			7	100%	225	199	199				

Notes:

SQ - Screening Quotient
WQC - Water Quality Criteria
3.53 above de minimus threshold

Table 2

Sediment - Ecological Screening Results
North Ditch
RACER Nodular Industrial Land (10040)
Saginaw, MI

Parameters:	Units	ESV	Source	# Samples	Freq. of Detection	Max Detection	Mean Detection (ND = 1/2 DL)	Mean Detection (ND = 0)	Max SQ	Mean SQ (ND=1/2 DL)	Mean SQ (ND = 0)	Freq. of Exceedance ND = 0
Metals												
Aluminum	mg/kg	Not Toxic	-	7	100%	14000	8300	8300				
Antimony	mg/kg	25	Region 4	7	100%	1.30	0.51	0.51	0.052	0.020	0.020	0%
Arsenic	mg/kg	33	PEC	7	100%	17	6.36	6.36	0.52	0.19	0.19	0%
Barium	mg/kg	60	Region 4	7	100%	110	56.3	56.3	**1.83**	0.94	0.94	57%
Beryllium	mg/kg	1.20	Dutch	7	100%	0.90	0.51	0.51	0.75	0.43	0.43	0%
Cadmium	mg/kg	4.98	PEC	7	86%	1.40	0.64	0.58	0.28	0.13	0.12	0%
Calcium	mg/kg	Nutrient	-	7	100%	74000	46000	46000				
Chromium	mg/kg	110	PEC	7	100%	190	50.0	50.0	**1.73**	0.45	0.45	14%
Cobalt	mg/kg	50	Region 4	7	100%	9.40	5.39	5.39	0.19	0.11	0.11	0%
Copper	mg/kg	149	PEC	7	100%	120	41.4	41.4	0.81	0.28	0.28	0%
Iron	mg/kg	Not Toxic	-	7	100%	180000	42471	42471				
Lead	mg/kg	128	PEC	7	100%	150	67.3	67.3	**1.17**	0.53	0.53	29%
Magnesium	mg/kg	Nutrient	-	7	100%	22000	12586	12586				N/A
Manganese	mg/kg	1100	Region 4	7	100%	3500	1131	1131	**3.18**	**1.03**	**1.03**	43%
Mercury	mg/kg	1.10	PEC	7	57%	0.12	0.06	0.05	0.11	0.06	0.04	0%
Nickel	mg/kg	48.3	PEC	7	100%	100	29.0	29.0	**2.07**	0.60	0.60	14%
Potassium	mg/kg	Nutrient	-	7	100%	2400	1160	1160				
Selenium	mg/kg	20	Region 4	7	100%	2.10	1.31	1.31	0.11	0.07	0.07	0%
Silver	mg/kg	2.20	Region 4	7	100%	0.40	0.19	0.19	0.18	0.09	0.09	0%
Sodium	mg/kg	Nutrient	-	7	100%	430	263	263				
Thallium	mg/kg	2.60	Dutch	7	100%	0.23	0.13	0.13	0.09	0.05	0.05	0%
Vanadium	mg/kg	56	Dutch	7	100%	26.0	15.0	15.0	0.46	0.27	0.27	0%
Zinc	mg/kg	459	PEC	7	100%	2900	1121	1121	**6.32**	**2.44**	**2.44**	57%
Metals - SEM												
Total SEM	umol/g			9	1	96.94246138	30.9819981	30.9819981				
Sulfide	umol/g			9	1	235.9617682	37.5348467	37.5348467				
CNE-SEM, not toxic thresh.	umol/g OC	130	EPA 2005	9	1	295.8333037	-1438.19316	-1438.19316				33%
CNE-SEM, likely toxic thresh.	umol/g OC	3000	EPA 2005	9	1	295.8333037	-1438.19316	-1438.19316				0%
Polychlorinated Biphenyls												
Aroclor-1242 (PCB-1242)	ug/kg	0.67	PEC	13	38%	0.70	0.37	0.18	**1.04**	0.54	0.27	8%
Aroclor-1248 (PCB-1248)	ug/kg	0.67	PEC	13	15%	1.10	0.33	0.14	**1.64**	0.49	0.20	8%
Aroclor-1254 (PCB-1254)	ug/kg	0.67	PEC	13	31%	0.99	0.44	0.26	**1.48**	0.65	0.38	31%
Aroclor-1260 (PCB-1260)	ug/kg	0.67	PEC	13	31%	1.40	0.57	0.39	**2.09**	0.86	0.59	31%
Total PCBs (ND = 0)	ug/kg	0.67	PEC	13	100%	3.39	0.96	0.96	**5.06**	**1.44**	**1.44**	31%
Total PCBs at 1% OC	ug/kg	0.67	PEC	13	100%	0.62	0.18	0.18	0.92	0.26	0.26	0%
General Chemistry												
Ammonia	mg/kg	300.00	Region 4	7	100%	270	95.7	95.7				
Cyanide (total)	mg/kg	NVA		7	71%	4.50	1.22	1.12				
pH, lab	s.u.			7	100%	7.53	7.20	7.20				
Total organic carbon (TOC)	mg/kg			9	100%	120000	60778	60778				

Notes:
OC - Organic Carbon
ESV - Ecological Screening Values
SQ - Screening Quotient
PEC - Probably Effect Concentrations
1.04 above de minimus threshold

Table 3

Bank Soil - Ecological Screening Results
North Ditch
RACER Nodular Industrial Land (10040)
Saginaw, MI

Parameters:	Units	ESV	Units	# Samples	Frequency of Detection	Max Detection	Mean Detection (ND = 1/2 DL)	Mean Detection (ND = 0)	Max SQ	Mean SQ (ND=1/2 DL)	Mean SQ (ND = 0)	Frequency of Exceedance
Metals												
Aluminum	mg/kg	Not Toxic	EPA 4	10	100%	9300	4259	4259				
Antimony	mg/kg	0.27	EPA 4	10	100%	0.5	0.2	0.2	**1.8**	0.8	0.8	20%
Arsenic	mg/kg	18	EPA 4	10	100%	6.1	3.6	3.6	0.3	0.2	0.2	0%
Barium	mg/kg	330	EPA 4	10	100%	79	36	36	0.2	0.1	0.1	0%
Beryllium	mg/kg	10	EPA 4	10	100%	0.64	0.28	0.28	0.1	0.0	0.0	0%
Cadmium	mg/kg	0.36	EPA 4	10	100%	0.24	0.12	0.12	0.67	0.3	0.3	0%
Calcium	mg/kg	Nutrient		10	100%	36000	13060	13060				
Chromium	mg/kg	18	EPA 4	10	100%	110	33	33	**6.1**	**1.8**	**1.8**	50%
Cobalt	mg/kg	13	EPA 4	10	100%	5.8	2.1	2.1	0.4	0.2	0.2	0%
Copper	mg/kg	28	EPA 4	10	100%	54	16	16	**1.9**	0.6	0.6	10%
Iron	mg/kg	Not Toxic	EPA 4	10	100%	61000	17280	17280				
Lead	mg/kg	11	EPA 4	10	100%	33	18	18	**3.0**	**1.6**	**1.6**	70%
Magnesium	mg/kg	Nutrient		10	100%	13000	3132	3132				
Manganese	mg/kg	220	EPA 4	10	100%	1400	456	456	**6.4**	**2.1**	**2.1**	60%
Mercury	mg/kg	0.10	EPA 4	10	10%	0.04	0.03	0.00	0.4	0.3	0.0	0%
Nickel	mg/kg	38	EPA 4	10	100%	57	14	14	**1.5**	0.4	0.4	10%
Potassium	mg/kg	Nutrient		10	90%	1700	454	431				
Selenium	mg/kg	0.52	EPA 4	10	100%	1.1	0.6	0.6	**2.1**	**1.2**	**1.2**	80%
Silver	mg/kg	4.20	EPA 4	10	100%	0.09	0.04	0.04	0.0	0.0	0.0	0%
Sodium	mg/kg	Nutrient		10	10%	87	48.4	8.7				
Thallium	mg/kg	0.22	EPA 4	10	30%	0.2	0.1	0.1	1.0	0.5	0.2	10%
Vanadium	mg/kg	7.80	EPA 4	10	100%	20.0	7.6	7.6	**2.6**	1.0	1.0	20%
Zinc	mg/kg	46	EPA 4	10	100%	370	120	120	**8.0**	**2.6**	**2.6**	70%
Polychlorinated Biphenyls												
Total PCBs	mg/kg	0.37	ORNL	10	40%	0.36	0.15	0.06	1.0	0.4	0.2	0%
General Chemistry												
Ammonia	mg/kg	NVA		10	40%	81	45	29.7				
Cyanide (total)	mg/kg			10	20%	5	1	0.69				
pH, lab	s.u.	Not Toxic		10	100%	8	8	7.85				
Total organic carbon (	mg/kg	Not Toxic		10	100%	44000	20720	20720				

Notes:

NVA - no value available
ESV - Ecological Screening Values
SQ - Screening Quotient
8.0 above de minimus threshold

Attachment **A**
North Ditch Analytical Data

Table A.1

Analytical Results Summary - Surface Water Data
North Ditch
Racer Nodular Industrial Land (10040)
Saginaw, MI

Sample Location:				**MD-312-13**	**MD-314-13**	**MD-316-13**	**SW-310-13**
Sample ID:				**W-58502-071713-SSH-312**	**W-58502-071713-SSH-314**	**W-58502-071713-SSH-316**	**W-58502-071713-SSH-310**
Sample Date:				**7/17/2013**	**7/17/2013**	**7/17/2013**	**7/17/2013**
Sample Depth:				**(2.5-2.5) ft BWS**	**(2.5-2.5) ft BWS**	**(2-2) ft BWS**	**(0-0) ft BWS**
matrix_code				**WS**	**WS**	**WS**	**WS**
Parameters:	**Units**	Res/Non_Res/GW SW Interface	DEQ Rule 57 - Surface Water Quality Values				
Metals							
Antimony	mg/L	0.13	0.0017	0.00038 J	0.00045 J	0.00029 J	0.0005 J
Arsenic	mg/L	0.01	0.01	0.005 U	0.005 U	0.005 U	0.005 U
Barium	mg/L	-	1.9	0.036 J	0.033 J	0.033 J	0.037 J
Beryllium	mg/L	-	0.16	0.001 U	0.00013 J	0.000056 J	0.00025 J
Cadmium	mg/L	-	0.0025	0.00003 J	0.00012 J	0.001 U	0.00014 J
Chromium	mg/L	0.011	0.12	0.005 U	0.005 U	0.005 U	0.005 U
Cobalt	mg/L	0.1	0.1	0.00018 J	0.0002 J	0.000093 J	0.00029 J
Copper	mg/L	-	0.47	0.002 U	0.002 U	0.002 U	0.002 U
Lead	mg/L	-	0.014	0.0014 J	0.001 J	0.00053 J	0.002 J
Manganese	mg/L	-	1.3	0.16	0.14	0.14	0.17
Mercury	mg/L	0.0000013	0.0000013	0.0002 U	0.0002 U	0.0002 U	0.0002 U
Nickel	mg/L	-	2.6	0.02 U	0.02 U	0.02 U	0.02 U
Selenium	mg/L	0.005	0.005	0.00067 J	0.00056 J	0.00035 J	0.00083 J
Silver	mg/L	0.0002	0.00006	0.000019 J	0.000018 J	0.00001 J	0.000039 J
Thallium	mg/L	0.0037	0.0012	0.001 U	0.001 U	0.001 U	0.001 U
Vanadium	mg/L	0.012	0.027	0.004 U	0.004 U	0.004 U	0.004 U
Zinc	mg/L	-	3.3	0.02 U	0.02 U	0.02 U	0.02 U
Polychlorinated Biphenyls							
Aroclor-1016 (PCB-1016)	mg/L	0.0002	0.000000026	0.000095 U	0.000095 U	0.000095 U	0.00011 U
Aroclor-1221 (PCB-1221)	mg/L	0.0002	0.000000026	0.000095 U	0.000095 U	0.000095 U	0.00011 U
Aroclor-1232 (PCB-1232)	mg/L	0.0002	0.000000026	0.000095 U	0.000095 U	0.000095 U	0.00011 U
Aroclor-1242 (PCB-1242)	mg/L	0.0002	0.000000026	0.000095 U	0.000095 U	0.000095 U	0.00011 U
Aroclor-1248 (PCB-1248)	mg/L	0.0002	0.000000026	0.000095 U	0.000095 U	0.000095 U	0.00011 U
Aroclor-1254 (PCB-1254)	mg/L	0.0002	0.000000026	0.000095 U	0.000095 U	0.000095 U	0.00011 U
Aroclor-1260 (PCB-1260)	mg/L	0.0002	0.000000026	0.000095 U	0.000095 U	0.000095 U	0.00011 U
Aroclor-1262 (PCB-1262)	mg/L	0.0002	0.000000026	0.000095 U	0.000095 U	0.000095 U	0.00011 U
Aroclor-1268 (PCB-1268)	mg/L	0.0002	0.000000026	0.000095 U	0.000095 U	0.000095 U	0.00011 U
General Chemistry							
Ammonia	mg/L	-	-	1.4 J	2.0 U	2.0 U	2.0 U
Ammonia (unionized)	mg/L	0.053	0.053	0.01	-	-	-
Biochemical oxygen demand (BOD)	mg/L	-	-	2.0 U	2.0 U	2.0 U	2.0 U
Chemical oxygen demand (COD)	mg/L	-	-	20	20	22	22
Cyanide (amenable)	mg/L	-	-	0.010 U	0.010 U	0.010 U	0.010 U
Cyanide (total)	mg/L	0.0052	0.0052	0.010 U	0.010 U	0.010 U	0.010 U
Hardness, carbonate	mg/L	-	-	130	130	120	180
Hardness, magnesium	mg/L	-	-	44	45	46	45
Nitrate (as N)	mg/L	-	10	0.10 U	0.10 U	0.10 U	0.10 U
Oil and grease (HEM), polar	mg/L	-	-	4.7 U	4.8 UJ	4.8 U	4.9 U
pH, lab	s.u.	-	-	7.45 J	7.52 J	7.42 J	7.43 J
Phenolics (total)	mg/L	-	-	0.040 U	0.040 U	0.040 U	0.040 U
Total organic carbon (TOC)	mg/L	-	-	5.9	6.2	6.1	6.0

Notes:

J - Estimated concentration.
U - Not present at or above the associated value.
UJ - Estimated reporting limit.
BWS - Below Water surface

(1) The generic GSI criteria are based on the toxicity of unionized ammonia (NH3); the criteria is 53 µg/L warm water surface water

(2) Temperature of the water was assumed to be approximately 65 degrees F at the criteria is 53 µg/L warm water surface water

Table A.1

Analytical Results Summary - Surface Water Data
North Ditch
Racer Nodular Industrial Land (10040)
Saginaw, MI

Sample Location:				**SW-311-13**	**SW-313-13**	**SW-315-13**
Sample ID:				**W-58502-071713-SSH-311**	**W-58502-071713-SSH-313**	**W-58502-071713-SSH-315**
Sample Date:				**7/17/2013**	**7/17/2013**	**7/17/2013**
Sample Depth:				**(0-0) ft BWS**	**(0-0) ft BWS**	**(0-0) ft BWS**
matrix_code				**WS**	**WS**	**WS**
Parameters:	**Units**	Res/Non_Res/GW SW Interface	DEQ Rule 57 - Surface Water Quality Values			
Metals						
Antimony	mg/L	0.13	0.0017	0.00036 J	0.00032 J	0.00036 J
Arsenic	mg/L	0.01	0.01	0.005 U	0.005 U	0.005 U
Barium	mg/L	-	1.9	0.036 J	0.033 J	0.033 J
Beryllium	mg/L	-	0.16	0.00015 J	0.00004 J	0.000096 J
Cadmium	mg/L	-	0.0025	0.000029 J	0.001 U	0.001 U
Chromium	mg/L	0.011	0.12	0.005 U	0.005 U	0.005 U
Cobalt	mg/L	0.1	0.1	0.00018 J	0.000083 J	0.00014 J
Copper	mg/L	-	0.47	0.002 U	0.002 U	0.002 U
Lead	mg/L	-	0.014	0.0015 J	0.00062 J	0.001 J
Manganese	mg/L	-	1.3	0.15	0.11	0.18
Mercury	mg/L	0.0000013	0.0000013	0.0002 U	0.0002 U	0.0002 U
Nickel	mg/L	-	2.6	0.02 U	0.02 U	0.02 U
Selenium	mg/L	0.005	0.005	0.00052 J	0.00055 J	0.00049 J
Silver	mg/L	0.0002	0.00006	0.000022 J	0.000017 J	0.000012 J
Thallium	mg/L	0.0037	0.0012	0.001 U	0.001 U	0.001 U
Vanadium	mg/L	0.012	0.027	0.004 U	0.004 U	0.004 U
Zinc	mg/L	-	3.3	0.02 U	0.02 U	0.02 U
Polychlorinated Biphenyls						
Aroclor-1016 (PCB-1016)	mg/L	0.0002	0.000000026	0.0001 U	0.0001 U	0.000097 U
Aroclor-1221 (PCB-1221)	mg/L	0.0002	0.000000026	0.0001 U	0.0001 U	0.000097 U
Aroclor-1232 (PCB-1232)	mg/L	0.0002	0.000000026	0.0001 U	0.0001 U	0.000097 U
Aroclor-1242 (PCB-1242)	mg/L	0.0002	0.000000026	0.0001 U	0.0001 U	0.000097 U
Aroclor-1248 (PCB-1248)	mg/L	0.0002	0.000000026	0.0001 U	0.0001 U	0.000097 U
Aroclor-1254 (PCB-1254)	mg/L	0.0002	0.000000026	0.0001 U	0.0001 U	0.000097 U
Aroclor-1260 (PCB-1260)	mg/L	0.0002	0.000000026	0.0001 U	0.0001 U	0.000097 U
Aroclor-1262 (PCB-1262)	mg/L	0.0002	0.000000026	0.0001 U	0.0001 U	0.000097 U
Aroclor-1268 (PCB-1268)	mg/L	0.0002	0.000000026	0.0001 U	0.0001 U	0.000097 U
General Chemistry						
Ammonia	mg/L	-	-	1.1 J	1.1 J	2.0 U
Ammonia (unionized)	mg/L	0.053	0.053	0.01	0.01	-
Biochemical oxygen demand (BOD)	mg/L	-	-	2.0 U	2.0 U	2.0 U
Chemical oxygen demand (COD)	mg/L	-	-	25	17 J	30
Cyanide (amenable)	mg/L	-	-	0.010 U	0.010 U	0.010 U
Cyanide (total)	mg/L	0.0052	0.0052	0.010 U	0.010 U	0.010 U
Hardness, carbonate	mg/L	-	-	180	170	170
Hardness, magnesium	mg/L	-	-	44	45	44
Nitrate (as N)	mg/L	-	10	0.10 U	0.10 U	0.10 U
Oil and grease (HEM), polar	mg/L	-	-	4.9 U	4.8 U	4.9 U
pH, lab	s.u.	-	-	7.44 J	7.44 J	7.41 J
Phenolics (total)	mg/L	-	-	0.040 U	0.040 U	0.040 U
Total organic carbon (TOC)	mg/L	-	-	6.1	6.0	6.4

Notes:

J - Estimated concentration.
U - Not present at or above the associated value.
UJ - Estimated reporting limit.
BWS - Below Water surface

(1) The generic GSI criteria are based on the toxicity of unionized ammonia (NH3); the criteria is 53 µg/L warm water surface water

(2) Temperature of the water was assumed to be approximately 65 degrees F at the criteria is 53 µg/L warm water surface water

Table A.2

Analytical Results Summary - Sediment
North Ditch
Racer Nodular Industrial Land (10040)
Saginaw, MI

Sample Location:				H5	**H5**	**H7**	**H7A**	**H7A**
Sample ID:				S00016	**S00017**	**S00020**	**B-7-0531**	**B-7-0532Q**
Sample Date:				11/19/1998	**11/19/1998**	**11/19/1998**	**1/19/2005**	**1/19/2005**
Sample Depth:					**DUP**		**(0-0.5) ft BGS**	**DUP (0-0.5) ft BGS**
matrix_code				**SE**	**SE**	**SE**	**SE**	**SE**
Parameters:	**Units**	**Statewide Default Background Levels**	Res/Non_Res/GW Prot_GW SW Interface Prot					
Metals								
Aluminum	mg/kg		-					
Antimony	mg/kg		94					
Arsenic	mg/kg	5.8	4.6					
Barium	mg/kg		-					
Beryllium	mg/kg		-					
Cadmium	mg/kg		-					
Calcium	mg/kg		-					
Chromium	mg/kg	18	3.3					
Cobalt	mg/kg	6.8	2					
Copper	mg/kg		-					
Iron	mg/kg		-					
Lead	mg/kg		-					
Magnesium	mg/kg		-					
Manganese	mg/kg		-					
Mercury	mg/kg	0.13	0.05					
Nickel	mg/kg		-					
Potassium	mg/kg		-					
Selenium	mg/kg	0.41	0.4					
Silver	mg/kg	1.0	0.1					
Sodium	mg/kg		-					
Thallium	mg/kg		4.2					
Vanadium	mg/kg		190					
Zinc	mg/kg		-					
Metals - SEM								
Cadmium	mg/kg		-					
Copper	mg/kg		-					
Lead	mg/kg		-					
Mercury	mg/kg		0.05					
Nickel	mg/kg		-					
Zinc	mg/kg		-					
SEM/AVS	none		-					
Polychlorinated Biphenyls								
Aroclor-1016 (PCB-1016)	ug/kg		-	0.3 UJ	0.2 U	0.2 UJ	0.50 U	0.50 U
Aroclor-1221 (PCB-1221)	ug/kg		-	0.3 UJ	0.2 U	0.2 UJ	1.0 U	1.0 U
Aroclor-1232 (PCB-1232)	ug/kg		-	0.3 UJ	0.2 U	0.2 UJ	0.50 U	0.50 U
Aroclor-1242 (PCB-1242)	ug/kg		-	0.6 J	0.3	0.7 J	0.50 U	0.50 U
Aroclor-1248 (PCB-1248)	ug/kg		-	0.3 UJ	0.2 U	0.2 UJ	1.1	0.67
Aroclor-1254 (PCB-1254)	ug/kg		-	0.3 UJ	0.2 U	0.9 J	0.99	0.73
Aroclor-1260 (PCB-1260)	ug/kg		-	0.3 UJ	0.2 U	1.2 J	1.3	1.4
Aroclor-1262 (PCB-1262)	ug/kg		-					
Aroclor-1268 (PCB-1268)	ug/kg		-					
General Chemistry								
Ammonia	mg/kg		-					
Cyanide (total)	mg/kg		0.1					
Nitrate (as N)	mg/kg		-					
pH, lab	s.u.		-					
Sulfide	mg/kg		-					
Total organic carbon (TOC)	mg/kg		-					
Total organic carbon (TOC)	%							

Notes:

J - Estimated concentration.

U - Not present at or above the associated value.

Table A.2

Analytical Results Summary - Sediment
North Ditch
Racer Nodular Industrial Land (10040)
Saginaw, MI

Sample Location:				H7B	SED-317-13	SED-319-13	SED-321-13
Sample ID:				B-7-0530	S-58502-071713-SSH-317	S-58502-071713-SSH-319	S-58502-071713-SSH-321
Sample Date:				1/19/2005	7/17/2013	7/17/2013	7/17/2013
Sample Depth:				(0-0.5) ft BGS	(0-1.5) ft BGS	(0-5) ft BGS	(0-4) ft BGS
matrix_code				SE	SE	SE	SE
Parameters:	**Units**	**Statewide Default Background Levels**	Res/Non_Res/GW Prot_GW SW Interface Prot				
Metals							
Aluminum	mg/kg		-		2400	13000	14000
Antimony	mg/kg		94		0.12 J	0.71 J	0.78 J
Arsenic	mg/kg	5.8	4.6		1.8	**7.5**	**8.0**
Barium	mg/kg		-		14	75	79
Beryllium	mg/kg		-		0.13 J	0.76	0.74
Cadmium	mg/kg		-		0.046 J	1.2	1.4
Calcium	mg/kg		-		14000 J	51000 J	61000 J
Chromium	mg/kg	18	3.3		8.9	**44**	**43**
Cobalt	mg/kg	6.8	2		1.4	**7.2**	**7.7**
Copper	mg/kg		-		7.8	51	52
Iron	mg/kg		-		6500	35000	35000
Lead	mg/kg		-		6.4 J	130 J	150 J
Magnesium	mg/kg		-		3800	14000	16000
Manganese	mg/kg		-		110	1200	1400
Mercury	mg/kg	0.13	0.05		0.056 U	0.10 J	0.092 J
Nickel	mg/kg		-		6.5	29	28
Potassium	mg/kg		-		310 J	1700	2100
Selenium	mg/kg	0.41	0.4		**0.47**	**2.1**	**2.0**
Silver	mg/kg	1.0	0.1		0.021 J	0.32 J	0.40 J
Sodium	mg/kg		-		88 J	430	400
Thallium	mg/kg		4.2		0.057 J	0.20 J	0.23 J
Vanadium	mg/kg		190		6.4	22	24
Zinc	mg/kg		-		60	1800	2900
Metals - SEM							
Cadmium	mg/kg		-		0.075 J	1.3	1.3
Copper	mg/kg		-		7.3	49	47
Lead	mg/kg		-		6.8	160	130
Mercury	mg/kg		0.05		0.017 U	0.040 U	0.0047 J
Nickel	mg/kg		-		5.0	21	20
Zinc	mg/kg		-		75	2600	2400
SEM/AVS	none		-		0.87	1.4	2.5
Polychlorinated Biphenyls							
Aroclor-1016 (PCB-1016)	ug/kg		-	0.10 U	0.35 U	0.89 U	0.85 U
Aroclor-1221 (PCB-1221)	ug/kg		-	0.20 U	0.35 U	0.89 U	0.85 U
Aroclor-1232 (PCB-1232)	ug/kg		-	0.10 U	0.35 U	0.89 U	0.85 U
Aroclor-1242 (PCB-1242)	ug/kg		-	0.60	0.11 J	0.89 U	0.85 U
Aroclor-1248 (PCB-1248)	ug/kg		-	0.10 U	0.35 U	0.89 U	0.85 U
Aroclor-1254 (PCB-1254)	ug/kg		-	0.71	0.35 U	0.89 U	0.85 U
Aroclor-1260 (PCB-1260)	ug/kg		-	1.2	0.35 U	0.89 U	0.85 U
Aroclor-1262 (PCB-1262)	ug/kg		-		0.35 U	0.89 U	0.85 U
Aroclor-1268 (PCB-1268)	ug/kg		-		0.35 U	0.89 U	0.85 U
General Chemistry							
Ammonia	mg/kg		-		26 J	270	94
Cyanide (total)	mg/kg		0.1		**0.14 J**	**0.89 J**	**2.0**
Nitrate (as N)	mg/kg		-		340 U	860 U	790 U
pH, lab	s.u.		-		7.29 J	7.01 J	7.03 J
Sulfide	mg/kg		-		51	920	490
Total organic carbon (TOC)	mg/kg		-		28000	120000	96000
Total organic carbon (TOC)	%				0.03	0.12	0.10

Notes:

J - Estimated concentration.

U - Not present at or above the associated value.

Table A.2

Analytical Results Summary - Sediment
North Ditch
Racer Nodular Industrial Land (10040)
Saginaw, MI

Sample Location:				SED-323-13	SED-324-13	SED-326-13	SED328-13
Sample ID:				S-58502-071713-SSH-323	S-58502-071713-SSH-324	S-58502-071713-SSH-326	S-58502-071713-SSH-328
Sample Date:				7/17/2013	7/17/2013	7/17/2013	7/17/2013
Sample Depth:				(0-1.5) ft BGS	DUP (0-1.5) ft BGS	(0-2.5) ft BGS	-
matrix_code				SE	SE	SE	SE
Parameters:	**Units**	**Statewide Default Background Levels**	Res/Non_Res/GW Prot_GW SW Interface Prot				
Metals							
Aluminum	mg/kg		-	3200	2900	14000	8600
Antimony	mg/kg		94	0.12 J	0.065 J	0.48 J	1.3 J
Arsenic	mg/kg	5.8	4.6	2.2	1.8	**6.2**	**17**
Barium	mg/kg		-	17	16	83	110
Beryllium	mg/kg		-	0.16 J	0.15 J	0.74	0.90
Cadmium	mg/kg		-	0.18	0.14	1.1	0.83 U
Calcium	mg/kg		-	43000 J	41000 J	74000 J	38000 J
Chromium	mg/kg	18	3.3	11	14	**39**	**190**
Cobalt	mg/kg	6.8	2	2.1	1.8	**8.1**	**9.4**
Copper	mg/kg		-	9.2	6.5	43	120
Iron	mg/kg		-	7500	6300	27000	180000
Lead	mg/kg		-	16 J	9.5 J	94 J	65 J
Magnesium	mg/kg		-	14000	13000	22000	5300
Manganese	mg/kg		-	300	310	1100	3500
Mercury	mg/kg	0.13	0.05	0.018 J	0.052 U	0.12	0.10 U
Nickel	mg/kg		-	6.6	5.7	27	100
Potassium	mg/kg		-	610	520	2400	480 J
Selenium	mg/kg	0.41	0.4	**0.51**	**0.51**	**1.9**	**1.7**
Silver	mg/kg	1.0	0.1	0.042 J	0.031 J	0.39 J	0.14 J
Sodium	mg/kg		-	130	130	360	300
Thallium	mg/kg		4.2	0.090 J	0.050 J	0.23 J	0.067 J
Vanadium	mg/kg		190	8.0	7.8	26	11
Zinc	mg/kg		-	150	140	1700	1100
Metals - SEM							
Cadmium	mg/kg		-	0.078 J	0.10 J	1.0	2.6 U
Copper	mg/kg		-	4.8	6.1	37	140
Lead	mg/kg		-	7.3	8.9	82	33
Mercury	mg/kg		0.05	0.016 U	0.017 U	0.0096 J	0.026 U
Nickel	mg/kg		-	3.4	4.0	19	76
Zinc	mg/kg		-	110	130	1700	740
SEM/AVS	none		-	1.2	1.6	2.4	0.86
Polychlorinated Biphenyls							
Aroclor-1016 (PCB-1016)	ug/kg		-	0.34 U	0.36 U	0.73 U	0.7 U
Aroclor-1221 (PCB-1221)	ug/kg		-	0.34 U	0.36 U	0.73 U	0.7 U
Aroclor-1232 (PCB-1232)	ug/kg		-	0.34 U	0.36 U	0.73 U	0.7 U
Aroclor-1242 (PCB-1242)	ug/kg		-	0.34 U	0.36 U	0.73 U	0.7 U
Aroclor-1248 (PCB-1248)	ug/kg		-	0.34 U	0.36 U	0.73 U	0.7 U
Aroclor-1254 (PCB-1254)	ug/kg		-	0.34 U	0.36 U	0.73 U	0.7 U
Aroclor-1260 (PCB-1260)	ug/kg		-	0.34 U	0.36 U	0.73 U	0.7 U
Aroclor-1262 (PCB-1262)	ug/kg		-	0.34 U	0.36 U	0.73 U	0.7 U
Aroclor-1268 (PCB-1268)	ug/kg		-	0.34 U	0.36 U	0.73 U	0.7 U
General Chemistry							
Ammonia	mg/kg		-	40 J	66	54	120
Cyanide (total)	mg/kg		0.1	0.66 U	0.70 U	**0.32 J**	**4.5**
Nitrate (as N)	mg/kg		-	330 U	340 U	690 U	660 U
pH, lab	s.u.		-	7.17 J	7.20 J	7.14 J	7.53 J
Sulfide	mg/kg		-	50	46	350	550
Total organic carbon (TOC)	mg/kg		-	28000	17000	57000	91000
Total organic carbon (TOC)	%			0.03	0.02	0.06	0.09

Notes:

J - Estimated concentration.

U - Not present at or above the associated value.

Table A.3

Analytical Results Summary - Bank Soil
North Ditch
Racer Nodular Industrial Land (10040)
Saginaw, MI

Sample Location:					SO-290-13	SO-292-13	SO-294-13
Sample ID:					S-58502-071613-SSH-290	S-58502-071613-SSH-292	S-58502-071613-SSH-294
Sample Date:					7/16/2013	7/16/2013	7/16/2013
Sample Depth:					(0-0.5) ft BGS	(0-0.5) ft BGS	(0-0.5) ft BGS
matrix_code					SO	SO	SO
Parameters:	**Units**	**Statewide Default Background Levels**	**Direct Contact Criteria & RBSLs (a)**	**Res/Non_Res/ GW Prot_GW SW Interface Prot (b)**			
Metals							
Aluminum	mg/kg		370000	-	2200	4100	890
Antimony	mg/kg		670	94	0.13 J	0.14 J	0.094 J
Arsenic	mg/kg	5.8	37	4.6	1.1	2.8	3.8
Barium	mg/kg		130000	-	14	65	6.0
Beryllium	mg/kg		1600	-	0.10 J	0.42	0.066 J
Cadmium	mg/kg		2100	-	0.11	0.065 J	0.096
Calcium	mg/kg			-	3600	17000	1600
Chromium	mg/kg	18		3.3	12	**70 (b)**	5.8
Cobalt	mg/kg	6.8	9000	2	0.82	1.3	0.89
Copper	mg/kg		73000	-	7.5	18	3.6
Iron	mg/kg			-	5300	16000	6100
Lead	mg/kg		900	-	15	11	15
Magnesium	mg/kg		1000000	-	1300	1800	640
Manganese	mg/kg		90000	-	61	940	100
Mercury	mg/kg	0.13	580	0.05	0.055 U	0.058 U	0.050 U
Nickel	mg/kg		150000	-	4.9	13	2.5
Potassium	mg/kg			-	180 J	290 J	450 U
Selenium	mg/kg	0.41	9600	0.4	0.28 J	**0.74 (b)**	0.22 J
Silver	mg/kg	1.0	9000	0.1	0.013 J	0.081 J	0.019 J
Sodium	mg/kg		1000000	-	100 U	84 U	91 U
Thallium	mg/kg		130	4.2	0.14 J	0.17	0.18 U
Vanadium	mg/kg		5500	190	5.1	6.4	6.7
Zinc	mg/kg		630000	-	99	270	73
Polychlorinated Biphenyls							
Aroclor-1016 (PCB-1016) [1]	µg/kg		1000	-	0.35 U	0.35 U	0.33 U
Aroclor-1221 (PCB-1221) [1]	µg/kg		1000	-	0.35 U	0.35 U	0.33 U
Aroclor-1232 (PCB-1232) [1]	µg/kg		1000	-	0.35 U	0.35 U	0.33 U
Aroclor-1242 (PCB-1242) [1]	µg/kg		1000	-	0.35 U	0.35 U	0.33 U
Aroclor-1248 (PCB-1248) [1]	µg/kg		1000	-	0.35 U	0.35 U	0.33 U
Aroclor-1254 (PCB-1254) [1]	µg/kg		1000	-	0.35 U	0.35 U	0.33 U
Aroclor-1260 (PCB-1260) [1]	µg/kg		1000	-	0.35 U	0.35 U	0.33 U
Aroclor-1262 (PCB-1262) [1]	µg/kg		1000	-	0.35 U	0.35 U	0.33 U
Aroclor-1268 (PCB-1268) [1]	µg/kg		1000	-	0.35 U	0.35 U	0.33 U
General Chemistry							
Ammonia	mg/kg			-	48 U	49 U	50 U
Cyanide (total)	mg/kg		250	0.1	0.67 U	**1.8 (b)**	0.64 U
Nitrate (as N)	mg/kg			-	330 U	330 U	310 U
pH, lab	s.u.			-	7.46 J	7.07 J	8.36 J
Total organic carbon (TOC)	mg/kg			-	12000	12000	8200

Notes:

J - Estimated concentration.

U - Not present at or above the associated value.

[1] MDEQ guidance references TSCA regulations. 1000ppb PCBs is the criteria for unrestricted use

Table A.3

Analytical Results Summary - Bank Soil
North Ditch
Racer Nodular Industrial Land (10040)
Saginaw, MI

Sample Location:					SO-296-13	SO-298-13	SO-300-13
Sample ID:					S-58502-071613-SSH-296	S-58502-071613-SSH-298	S-58502-071613-SSH-300
Sample Date:					7/16/2013	7/16/2013	7/16/2013
Sample Depth:					(0-0.5) ft BGS	(0-0.5) ft BGS	(0-0.5) ft BGS
matrix_code					SO	SO	SO
Parameters:	**Units**	**Statewide Default Background Levels**	**Direct Contact Criteria & RBSLs (a)**	**Res/Non_Res/ GW Prot_GW SW Interface Prot (b)**			
Metals							
Aluminum	mg/kg		370000	-	3200	5100	7900
Antimony	mg/kg		670	94	0.27 J	0.49 J	0.43 J
Arsenic	mg/kg	5.8	37	4.6	5.4	4.2	**6.1 (b)**
Barium	mg/kg		130000	-	27	38	79
Beryllium	mg/kg		1600	-	0.22	0.28	0.64
Cadmium	mg/kg		2100	-	0.19	0.081 J	0.19 J
Calcium	mg/kg			-	15000	9200	35000
Chromium	mg/kg	18		3.3	**41 (b)**	**34 (b)**	**110 (b)**
Cobalt	mg/kg	6.8	9000	2	1.9	3.3	4.0
Copper	mg/kg		73000	-	15	28	54
Iron	mg/kg			-	16000	32000	61000
Lead	mg/kg		900	-	29	20	33
Magnesium	mg/kg		1000000	-	3000	2700	5600
Manganese	mg/kg		90000	-	380	580	1400
Mercury	mg/kg	0.13	580	0.05	0.049 U	0.050 U	0.047 U
Nickel	mg/kg		150000	-	13	20	57
Potassium	mg/kg			-	320 J	410 J	610
Selenium	mg/kg	0.41	9600	0.4	**0.79 (b)**	**0.65 (b)**	**1.1 (b)**
Silver	mg/kg	1.0	9000	0.1	0.062 J	0.049 J	0.088 J
Sodium	mg/kg		1000000	-	100 U	92 U	78 U
Thallium	mg/kg		130	4.2	0.22	0.18 U	0.16 U
Vanadium	mg/kg		5500	190	6.9	7.5	9.9
Zinc	mg/kg		630000	-	98	86	370
Polychlorinated Biphenyls							
Aroclor-1016 (PCB-1016) [1]	µg/kg		1000	-	0.34 U	0.33 U	0.29 U
Aroclor-1221 (PCB-1221) [1]	µg/kg		1000	-	0.34 U	0.33 U	0.29 U
Aroclor-1232 (PCB-1232) [1]	µg/kg		1000	-	0.34 U	0.33 U	0.29 U
Aroclor-1242 (PCB-1242) [1]	µg/kg		1000	-	0.34 U	0.16 J	0.075 J
Aroclor-1248 (PCB-1248) [1]	µg/kg		1000	-	0.34 U	0.33 U	0.29 U
Aroclor-1254 (PCB-1254) [1]	µg/kg		1000	-	0.037 J	0.17 J	0.049 J
Aroclor-1260 (PCB-1260) [1]	µg/kg		1000	-	0.34 U	0.026 J	0.29 U
Aroclor-1262 (PCB-1262) [1]	µg/kg		1000	-	0.34 U	0.33 U	0.29 U
Aroclor-1268 (PCB-1268) [1]	µg/kg		1000	-	0.34 U	0.33 U	0.29 U
General Chemistry							
Ammonia	mg/kg			-	80	50 U	68
Cyanide (total)	mg/kg		250	0.1	0.61 U	0.65 U	**5.1 (b)**
Nitrate (as N)	mg/kg			-	310 U	310 U	270 U
pH, lab	s.u.			-	8.18 J	7.97 J	8.13 J
Total organic carbon (TOC)	mg/kg			-	23000	18000	44000

Notes:

J - Estimated concentration.

U - Not present at or above the associated value.

[1] MDEQ guidance references TSCA regulations. 1000ppb PCBs is the criteria for unrestri

Table A.3

Analytical Results Summary - Bank Soil
North Ditch
Racer Nodular Industrial Land (10040)
Saginaw, MI

Sample Location:					SO-302-13	SO-304-13	SO-306-13
Sample ID:					S-58502-071613-SSH-302	S-58502-071613-SSH-304	S-58502-071613-SSH-306
Sample Date:					7/16/2013	7/16/2013	7/16/2013
Sample Depth:					(0-0.5) ft BGS	(0-0.5) ft BGS	(0-0.5) ft BGS
matrix_code					SO	SO	SO
Parameters:	**Units**	**Statewide Default Background Levels**	**Direct Contact Criteria & RBSLs (a)**	**Res/Non_Res/ GW Prot_GW SW Interface Prot (b)**			
Metals							
Aluminum	mg/kg		370000	-	9300	4100	2900
Antimony	mg/kg		670	94	0.15 J	0.11 J	0.16 J
Arsenic	mg/kg	5.8	37	4.6	**5.7 (b)**	1.6	2.7
Barium	mg/kg		130000	-	59	34	19
Beryllium	mg/kg		1600	-	0.47	0.22	0.20
Cadmium	mg/kg		2100	-	0.24	0.097	0.045 J
Calcium	mg/kg			-	36000	7300	3300
Chromium	mg/kg	18		3.3	**23 (b)**	7.4	16
Cobalt	mg/kg	6.8	9000	2	5.8	0.88	1.1
Copper	mg/kg		73000	-	19	4.5	6.7
Iron	mg/kg			-	15000	4700	9500
Lead	mg/kg		900	-	23	8.4	12
Magnesium	mg/kg		1000000	-	13000	1600	810
Manganese	mg/kg		90000	-	530	170	240
Mercury	mg/kg	0.13	580	0.05	0.035 J	0.050 U	0.043 U
Nickel	mg/kg		150000	-	18	3.1	5.2
Potassium	mg/kg			-	1700	260 J	280 J
Selenium	mg/kg	0.41	9600	0.4	**0.91 (b)**	**0.57 (b)**	**0.54 (b)**
Silver	mg/kg	1.0	9000	0.1	0.053 J	0.019 J	0.023 J
Sodium	mg/kg		1000000	-	87	80 U	86 U
Thallium	mg/kg		130	4.2	0.17 U	0.16 U	0.17 U
Vanadium	mg/kg		5500	190	20	4.3	4.5
Zinc	mg/kg		630000	-	110	29	35
Polychlorinated Biphenyls							
Aroclor-1016 (PCB-1016) [1]	µg/kg		1000	-	0.31 U	0.29 U	0.3 U
Aroclor-1221 (PCB-1221) [1]	µg/kg		1000	-	0.31 U	0.29 U	0.3 U
Aroclor-1232 (PCB-1232) [1]	µg/kg		1000	-	0.31 U	0.29 U	0.3 U
Aroclor-1242 (PCB-1242) [1]	µg/kg		1000	-	0.31 U	0.29 U	0.3 U
Aroclor-1248 (PCB-1248) [1]	µg/kg		1000	-	0.31 U	0.29 U	0.3 U
Aroclor-1254 (PCB-1254) [1]	µg/kg		1000	-	0.065 J	0.29 U	0.3 U
Aroclor-1260 (PCB-1260) [1]	µg/kg		1000	-	0.31 U	0.29 U	0.3 U
Aroclor-1262 (PCB-1262) [1]	µg/kg		1000	-	0.31 U	0.29 U	0.3 U
Aroclor-1268 (PCB-1268) [1]	µg/kg		1000	-	0.31 U	0.29 U	0.3 U
General Chemistry							
Ammonia	mg/kg			-	68	50 U	81
Cyanide (total)	mg/kg		250	0.1	0.59 U	0.53 U	0.55 U
Nitrate (as N)	mg/kg			-	290 U	280 U	280 U
pH, lab	s.u.			-	8.14 J	8.04 J	7.60 J
Total organic carbon (TOC)	mg/kg			-	27000	18000	24000

Notes:

J - Estimated concentration.

U - Not present at or above the associated value.

[1] MDEQ guidance references TSCA regulations. 1000ppb PCBs is the criteria for unrestri

Table A.3

Analytical Results Summary - Bank Soil
North Ditch
Racer Nodular Industrial Land (10040)
Saginaw, MI

Sample Location:					SO-307-13
Sample ID:					S-58502-071613-SSH-307
Sample Date:					7/16/2013
Sample Depth:					(0-0.5) ft BGS
matrix_code					SO (Duplicate)
Parameters:	**Units**	**Statewide Default Background Levels**	**Direct Contact Criteria & RBSLs (a)**	**Res/Non_Res/ GW Prot_GW SW Interface Prot (b)**	
Metals					
Aluminum	mg/kg		370000	-	2900
Antimony	mg/kg		670	94	0.072 J
Arsenic	mg/kg	5.8	37	4.6	2.1
Barium	mg/kg		130000	-	18
Beryllium	mg/kg		1600	-	0.18
Cadmium	mg/kg		2100	-	0.038 J
Calcium	mg/kg			-	2600
Chromium	mg/kg	18		3.3	10
Cobalt	mg/kg	6.8	9000	2	0.95
Copper	mg/kg		73000	-	5.0
Iron	mg/kg			-	7200
Lead	mg/kg		900	-	11
Magnesium	mg/kg		1000000	-	870
Manganese	mg/kg		90000	-	160
Mercury	mg/kg	0.13	580	0.05	0.043 U
Nickel	mg/kg		150000	-	3.3
Potassium	mg/kg			-	260 J
Selenium	mg/kg	0.41	9600	0.4	**0.53 (b)**
Silver	mg/kg	1.0	9000	0.1	0.027 J
Sodium	mg/kg		1000000	-	82 U
Thallium	mg/kg		130	4.2	0.16 U
Vanadium	mg/kg		5500	190	4.3
Zinc	mg/kg		630000	-	34
Polychlorinated Biphenyls					
Aroclor-1016 (PCB-1016) [1]	µg/kg		1000	-	0.3 U
Aroclor-1221 (PCB-1221) [1]	µg/kg		1000	-	0.3 U
Aroclor-1232 (PCB-1232) [1]	µg/kg		1000	-	0.3 U
Aroclor-1242 (PCB-1242) [1]	µg/kg		1000	-	0.3 U
Aroclor-1248 (PCB-1248) [1]	µg/kg		1000	-	0.3 U
Aroclor-1254 (PCB-1254) [1]	µg/kg		1000	-	0.3 U
Aroclor-1260 (PCB-1260) [1]	µg/kg		1000	-	0.3 U
Aroclor-1262 (PCB-1262) [1]	µg/kg		1000	-	0.3 U
Aroclor-1268 (PCB-1268) [1]	µg/kg		1000	-	0.3 U
General Chemistry					
Ammonia	mg/kg			-	49 U
Cyanide (total)	mg/kg		250	0.1	0.54 U
Nitrate (as N)	mg/kg			-	280 U
pH, lab	s.u.			-	7.53 J
Total organic carbon (TOC)	mg/kg			-	21000

Notes:

J - Estimated concentration.

U - Not present at or above the associated value.

[1] MDEQ guidance references TSCA regulations. 1000ppb PCBs is the criteria for unrestri