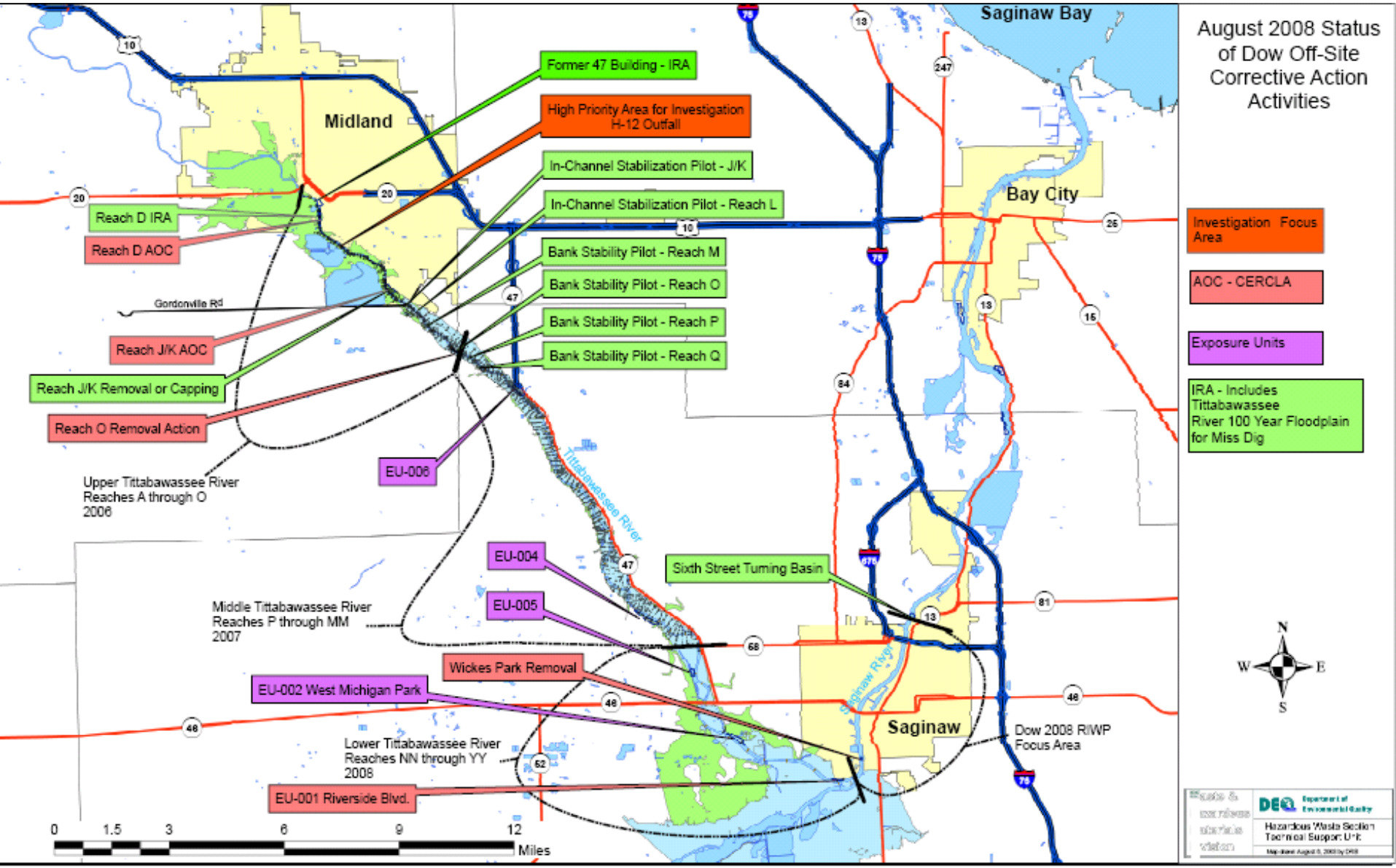
2009
Update on
Corrective Action Activities
Tittabawassee and Saginaw Rivers

May 6, 2009

The Dow Chemical Company
Off-Site Corrective Action Program

Al Taylor, Geologist
Waste and Hazardous Materials Division

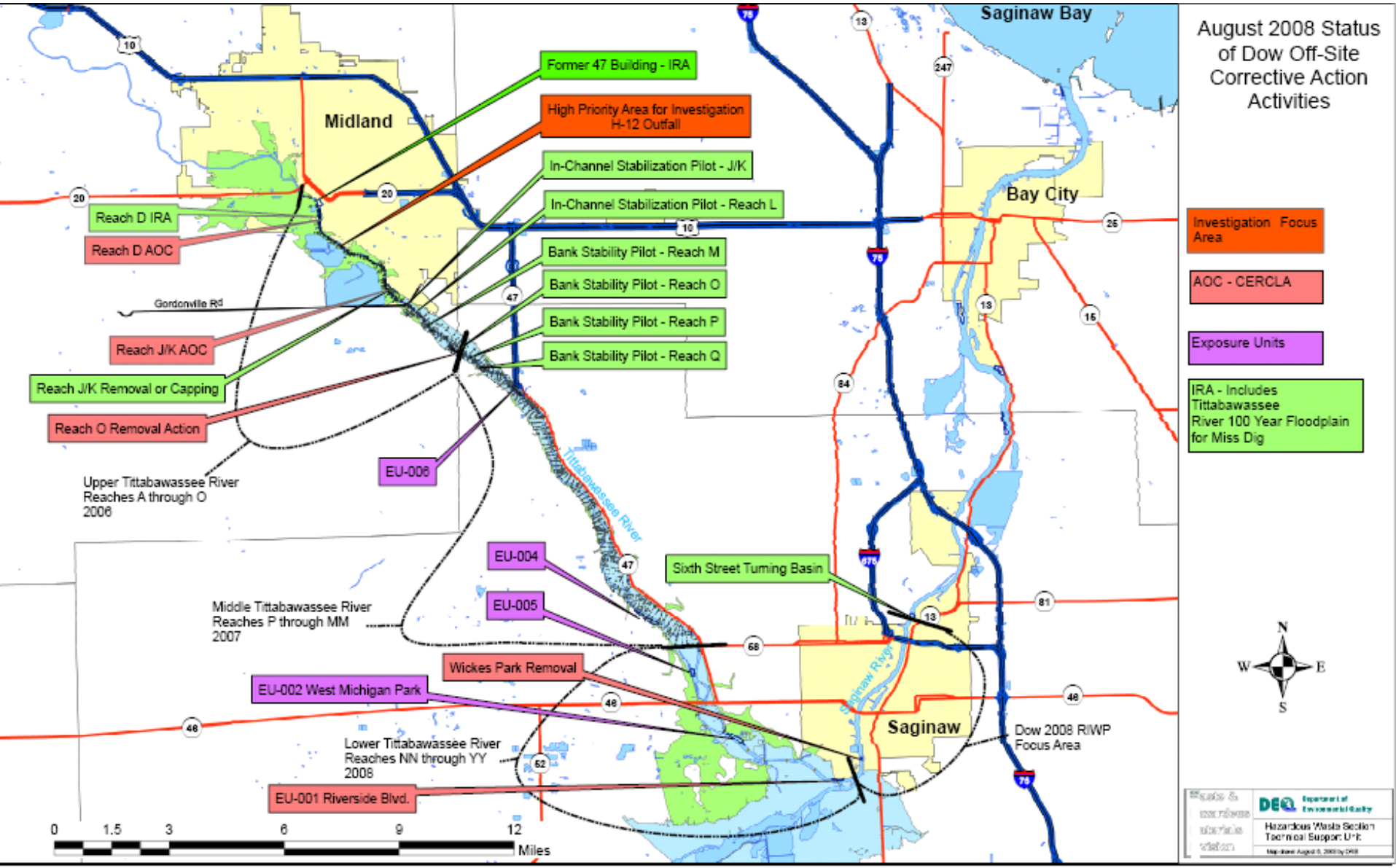

August 2008 Status of Dow Off-Site Corrective Action Activities
Saginaw Bay
Midland
Bay City
Saginaw
Former 47 Building - IRA
High Priority Area for Investigation H-12 Outfall
In-Channel Stabilization Pilot - J/K
In-Channel Stabilization Pilot - Reach L
Bank Stability Pilot - Reach M
Bank Stability Pilot - Reach O
Bank Stability Pilot - Reach P
Bank Stability Pilot - Reach Q
Reach D IRA
Reach D AOC
Gordonville Rd
Reach J/K AOC
Reach J/K Removal or Capping
Reach O Removal Action
EU-006
Upper Tittabawassee River Reaches A through O 2006
Tittabawassee River
EU-004
EU-005
Middle Tittabawassee River Reaches P through MM 2007
Sixth Street Turning Basin
Wickes Park Removal
EU-002 West Michigan Park
Lower Tittabawassee River Reaches NN through YY 2008
EU-001 Riverside Blvd.
Saginaw River
Dow 2008 RIWP Focus Area
0 1.5 3 6 9 12
Miles
Investigation Focus Area
AOC - CERCLA
Exposure Units
IRA - Includes Tittabawassee River 100 Year Floodplain for Miss Dig
N
W
E
S
DEQ
Hazardous Waste Section
Technical Support Unit

Background

- **Area of Contamination:** Lower 24 miles of Tittabawassee River and floodplain, the Saginaw River (25 miles), and portions of Saginaw Bay
- **Primary contaminants:** Dioxins and furans
- **Other contaminants:** Chlorobenzenes, parathion, chlorostyrenes, hexachlorobutadiene, lindane, others
  - Important not to lose track of these in overall investigation/remediation process
- **Primary Source:** Dow Chemical, Midland, Michigan
- **Target population:** People living along the Tittabawassee and Saginaw Rivers, recreational users of the Rivers and Bay

Current Part 111/RCRA Activity

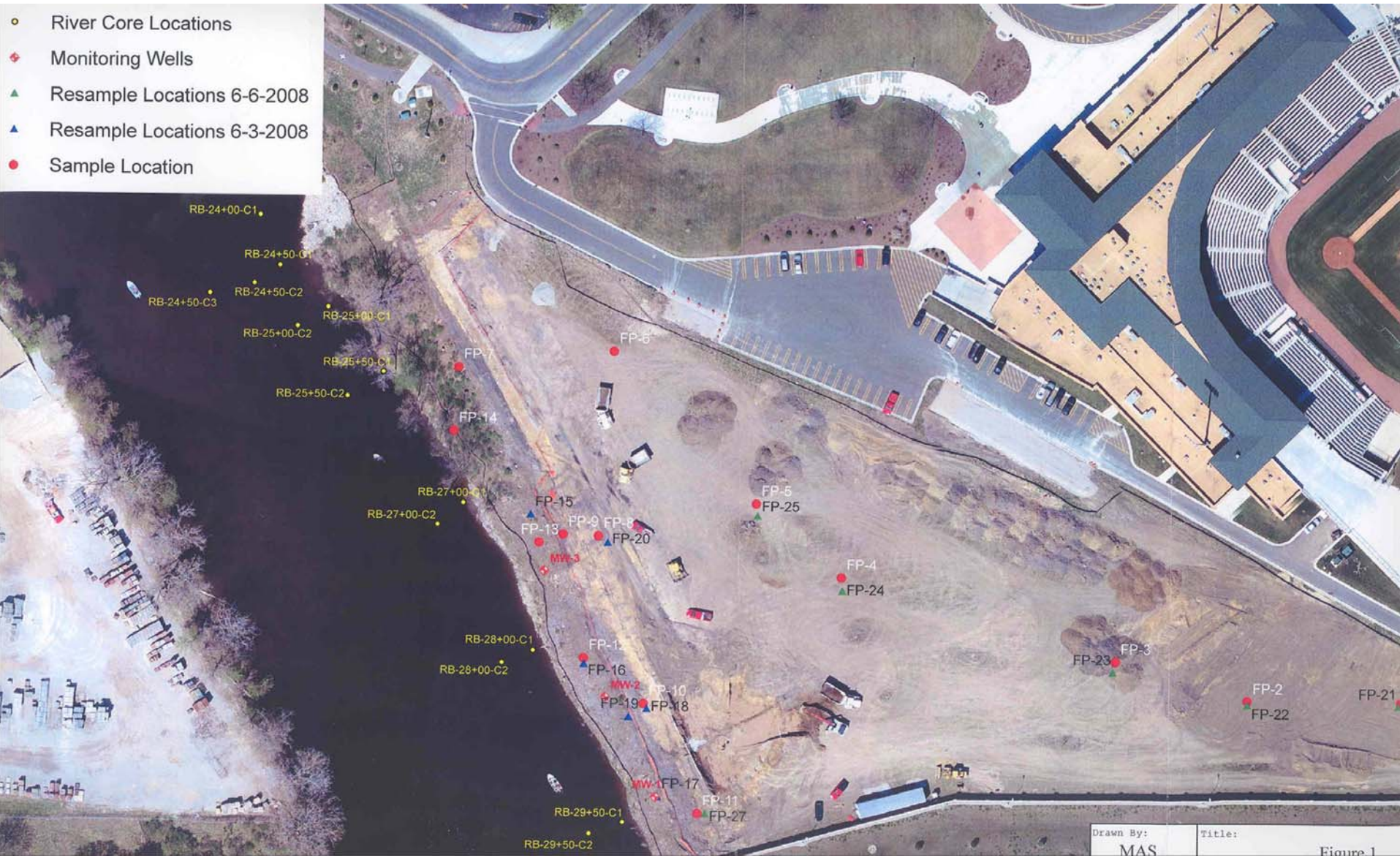
- **Tittabawassee River Sampling and Early Action Programs**
  - Uses a methodical approach to investigate and remediate from source (on-site) to endpoint of contamination from facility
  - Uses intermediate source control measures such as Interim Response Activities and “pilot” feasibility studies


August 2008 Status of Dow Off-Site Corrective Action Activities
Saginaw Bay
Midland
Bay City
Saginaw
Former 47 Building - IRA
High Priority Area for Investigation H-12 Outfall
In-Channel Stabilization Pilot - J/K
In-Channel Stabilization Pilot - Reach L
Bank Stability Pilot - Reach M
Bank Stability Pilot - Reach O
Bank Stability Pilot - Reach P
Bank Stability Pilot - Reach Q
Reach D IRA
Reach D AOC
Gordonville Rd
Reach J/K AOC
Reach J/K Removal or Capping
Reach O Removal Action
EU-006
Upper Tittabawassee River Reaches A through O 2006
Tittabawassee River
EU-004
EU-005
Middle Tittabawassee River Reaches P through MM 2007
Sixth Street Turning Basin
Wickes Park Removal
EU-002 West Michigan Park
Lower Tittabawassee River Reaches NN through YY 2008
EU-001 Riverside Blvd.
Saginaw River
Dow 2008 RIWP Focus Area
0 1.5 3 6 9 12
Miles
Investigation Focus Area
AOC - CERCLA
Exposure Units
IRA - Includes Tittabawassee River 100 Year Floodplain for Miss Dig
N
W
E
S
DEQ
Hazardous Waste Section
Technical Support Unit

IRAs and High Priority Investigation and Remedial/Pilot Activities in 2009

- **Near Plant Source Areas**
  - **Former 47 Building - “Founders Park” IRA – H-14**
  - **Reach D IRA – H-13**
  - **Historic Outfall Investigation – H-12**
  - **2009 RGIS Upgrade**
- **Tittabawassee Bank Stabilization and Monitoring Pilots**
- **Tittabawassee River “Down Stream” In-Channel Deposits Enhanced Monitoring and Evaluation (e.g., Reach J)**
- **GeoMorph® Update**
  - **IRA residential property decision tree evaluation**
- **Utility Worker Notification – Miss Dig**
- **Advisory Signage**
- **Midland Area Soils Presumptive Remedy Update**

Former 47 Building Area



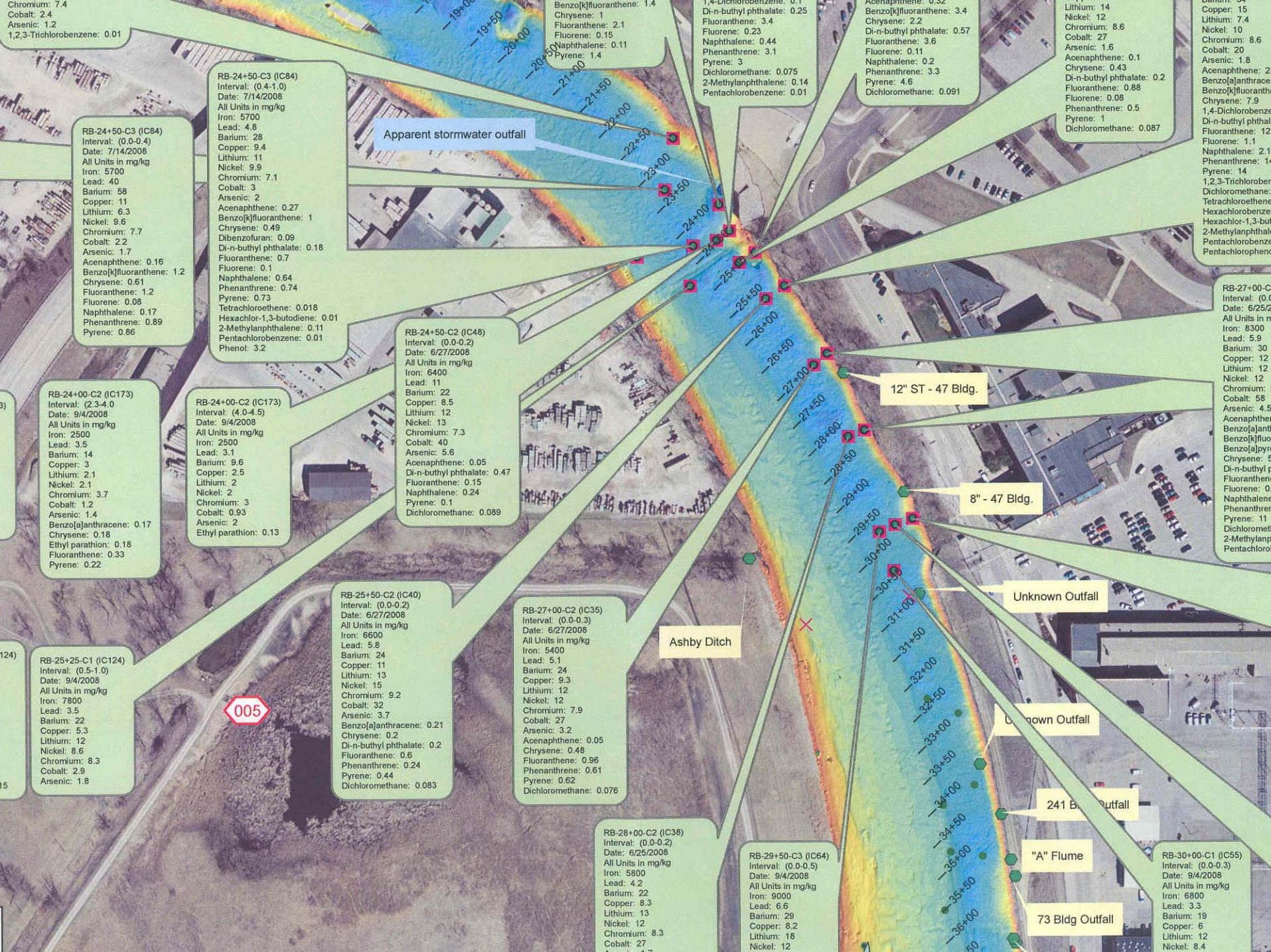
Former 47 Building IRA

- **Historic chlor-alkali cell waste on upland soil, river bank and in river sediments**
  - **High levels of furans**
  - **Other contaminants also of concern**
  - **Subsurface contamination with some volatile organic compounds**
- **Upland work substantially complete**
  - **Installation of wells and some additional borings**
  - **Long term operation and maintenance**
    - **Maintain capped area**
    - **Monitor groundwater for contamination and flow direction**
- **Adjacent sediments under investigation**
  - **Further sediment investigation now that river level is coming down**
  - **Capping and/or removal in 2009**
  - **Want to comprehensively address all contamination**
- **Schedule**
  - **Complete characterization: 6/1/09**
  - **Corrective Action Plan and Summary of Data: 7/1/09**
  - **Implementation in 2009**
- **IRA consistent with anticipated final corrective action in this area**

DEQ

EPA

- Historic source material
- High furan content
- Very similar contamination to that found in soils and sediments downstream


Chromium: 7.4
Cobalt: 2.4
Arsenic: 1.2
1,2,3-Trichlorobenzene: 0.01
Benzo[k]fluoranthene: 1.4
Chrysene: 1
Fluoranthene: 2.1
Fluorene: 0.15
Naphthalene: 0.11
Pyrene: 1.4
Di-n-buthyl phthalate: 0.25
Fluoranthene: 3.4
Fluorene: 0.23
Naphthalene: 0.44
Phenanthrene: 3.1
Pyrene: 3
Dichloromethane: 0.075
2-Methylanphthalene: 0.14
Pentachlorobenzene: 0.01
Benzo[k]fluoranthene: 3.4
Chrysene: 2.2
Di-n-buthyl phthalate: 0.57
Fluoranthene: 3.6
Fluorene: 0.11
Naphthalene: 0.2
Phenanthrene: 3.3
Pyrene: 4.6
Dichloromethane: 0.091
Lithium: 14
Nickel: 12
Chromium: 8.6
Cobalt: 27
Arsenic: 1.6
Acenaphthene: 0.1
Chrysene: 0.43
Di-n-buthyl phthalate: 0.2
Fluoranthene: 0.88
Fluorene: 0.08
Phenanthrene: 0.5
Pyrene: 1
Dichloromethane: 0.087
Copper: 15
Lithium: 7.4
Nickel: 10
Chromium: 8.6
Cobalt: 20
Arsenic: 1.8
Acenaphthene: 2
Benzo[a]anthrace
Benzo[k]fluoranth
Chrysene: 7.9
1,4-Dichlorobenze
Di-n-buthyl phthal
Fluoranthene: 12
Fluorene: 1.1
Naphthalene: 2.1
Phenanthrene: 14
Pyrene: 14
1,2,3-Trichlorober
Dichloromethane:
Tetrachloroethene
Hexachlorobenze
Hexachlor-1,3-but
2-Methylanphthal
Pentachlorobenze
Pentachlorophenc
RB-24+50-C3 (IC84)
Interval: (0.0-0.4)
Date: 7/14/2008
All Units in mg/kg
Iron: 5700
Lead: 40
Barium: 58
Copper: 11
Lithium: 6.3
Nickel: 9.6
Chromium: 7.7
Cobalt: 2.2
Arsenic: 1.7
Acenaphthene: 0.16
Benzo[k]fluoranthene: 1.2
Chrysene: 0.61
Fluoranthene: 1.2
Fluorene: 0.08
Naphthalene: 0.17
Phenanthrene: 0.89
Pyrene: 0.86
RB-24+50-C3 (IC84)
Interval: (0.4-1.0)
Date: 7/14/2008
All Units in mg/kg
Iron: 5700
Lead: 4.8
Barium: 28
Copper: 9.4
Lithium: 11
Nickel: 9.9
Chromium: 7.1
Cobalt: 3
Arsenic: 2
Acenaphthene: 0.27
Benzo[k]fluoranthene: 1
Chrysene: 0.49
Dibenzofuran: 0.09
Di-n-buthyl phthalate: 0.18
Fluoranthene: 0.7
Fluorene: 0.1
Naphthalene: 0.64
Phenanthrene: 0.74
Pyrene: 0.73
Tetrachloroethene: 0.018
Hexachlor-1,3-butodiene: 0.01
2-Methylanphthalene: 0.11
Pentachlorobenzene: 0.01
Phenol: 3.2
Apparent stormwater outfall
RB-24+50-C2 (IC48)
Interval: (0.0-0.2)
Date: 6/27/2008
All Units in mg/kg
Iron: 6400
Lead: 11
Barium: 22
Copper: 8.5
Lithium: 12
Nickel: 13
Chromium: 7.3
Cobalt: 40
Arsenic: 5.6
Acenaphthene: 0.05
Di-n-buthyl phthalate: 0.47
Fluoranthene: 0.15
Naphthalene: 0.24
Pyrene: 0.1
Dichloromethane: 0.089
RB-24+00-C2 (IC173)
Interval: (2.3-4.0
Date: 9/4/2008
All Units in mg/kg
Iron: 2500
Lead: 3.5
Barium: 14
Copper: 3
Lithium: 2.1
Nickel: 2.1
Chromium: 3.7
Cobalt: 1.2
Arsenic: 1.4
Benzo[a]anthracene: 0.17
Chrysene: 0.18
Ethyl parathion: 0.18
Fluoranthene: 0.33
Pyrene: 0.22
RB-24+00-C2 (IC173)
Interval: (4.0-4.5)
Date: 9/4/2008
All Units in mg/kg
Iron: 2500
Lead: 3.1
Barium: 9.6
Copper: 2.5
Lithium: 2
Nickel: 2
Chromium: 3
Cobalt: 0.93
Arsenic: 2
Ethyl parathion: 0.13
RB-25+50-C2 (IC40)
Interval: (0.0-0.2)
Date: 6/27/2008
All Units in mg/kg
Iron: 6600
Lead: 5.8
Barium: 24
Copper: 11
Lithium: 13
Nickel: 15
Chromium: 9.2
Cobalt: 32
Arsenic: 3.7
Benzo[a]anthracene: 0.21
Chrysene: 0.2
Di-n-buthyl phthalate: 0.2
Fluoranthene: 0.6
Phenanthrene: 0.24
Pyrene: 0.44
Dichloromethane: 0.083
RB-25+25-C1 (IC124)
Interval: (0.5-1.0)
Date: 9/4/2008
All Units in mg/kg
Iron: 7800
Lead: 3.5
Barium: 22
Copper: 5.3
Lithium: 12
Nickel: 8.6
Chromium: 8.3
Cobalt: 2.9
Arsenic: 1.8
RB-27+00-C2 (IC35)
Interval: (0.0-0.3)
Date: 6/27/2008
All Units in mg/kg
Iron: 5400
Lead: 5.1
Barium: 24
Copper: 9.3
Lithium: 12
Nickel: 12
Chromium: 7.9
Cobalt: 27
Arsenic: 3.2
Acenaphthene: 0.05
Chrysene: 0.48
Fluoranthene: 0.96
Phenanthrene: 0.61
Pyrene: 0.62
Dichloromethane: 0.076
RB-27+00-C
Interval: (0.0
Date: 6/25/2
All Units in m
Iron: 8300
Lead: 5.9
Barium: 30
Copper: 12
Lithium: 12
Nickel: 12
Chromium:
Cobalt: 58
Arsenic: 4.5
Acenaphthe
Benzo[a]ant
Benzo[k]fluo
Benzo[a]pyre
Chrysene: 5
Di-n-buthyl p
Fluoranthene
Fluorene: 0.
Naphthalene
Phenanthren
Pyrene: 11
Dichloromet
2-Methylanp
Pentachloro
12" ST - 47 Bldg.
8" - 47 Bldg.
Unknown Outfall
Ashby Ditch
241 B... Outfall
"A" Flume
73 Bldg Outfall
RB-28+00-C2 (IC38)
Interval: (0.0-0.2)
Date: 6/25/2008
All Units in mg/kg
Iron: 5800
Lead: 4.2
Barium: 22
Copper: 8.3
Lithium: 13
Nickel: 12
Chromium: 8.3
Cobalt: 27
RB-29+50-C3 (IC64)
Interval: (0.0-0.5)
Date: 9/4/2008
All Units in mg/kg
Iron: 9000
Lead: 6.6
Barium: 29
Copper: 8.2
Lithium: 18
Nickel: 12
RB-30+00-C1 (IC55)
Interval: (0.0-0.3)
Date: 9/4/2008
All Units in mg/kg
Iron: 6800
Lead: 3.3
Barium: 19
Copper: 6
Lithium: 12
Nickel: 8.4
005
19+00
19+50
20+00
20+50
21+00
21+50
22+00
22+50
23+00
23+50
24+00
24+50
25+00
25+50
26+00
26+50
27+00
27+50
28+00
28+50
29+00
29+50
30+00
30+50
31+00
31+50
32+00
32+50
33+00
33+50
34+00
34+50
35+00
35+50
36+00

Reach D

Reach D

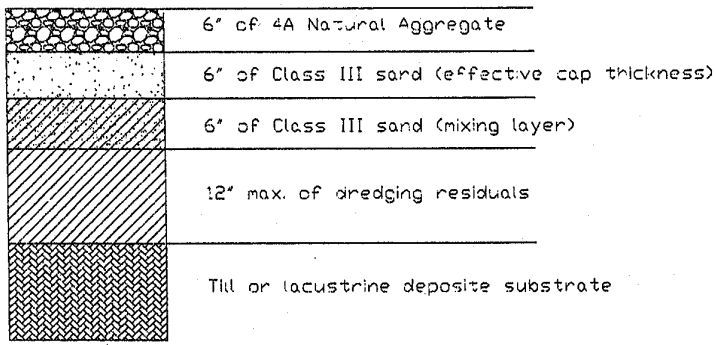
- **Transition from CERCLA Removal Action Process back to the Operating License corrective action process**
- **CERCLA Order did not specifically address contaminants other than dioxins and furans**
  - Additional work necessary to cap or remove other contaminants (e.g., hexachlorobenzene, parathion, dichlorobenzenes, etc.)
  - Additional characterization, toxicity testing, design of cap, etc. as part of IRA work plan – material inside cell is toxic to invertebrates
  - Approval of capping plan “inside cell” to address residual contamination from dredging – many details to be worked out for implementation in 2009 field season.
  - Characterization on-going “outside cell” to determine what additional material needs remediation (e.g., removal, capping, etc.)
    - Toxicity testing
  - Removal of sheet piling in 2009
  - Scour adjacent to sheet piling has resulted in loss of some sediment and exposure of contaminated materials at the river bottom
- **IRA consistent with anticipated final corrective action in this area**

Reach D

- **Capping will require long term monitoring and maintenance**
- **Additional work if not determined to be effective via monitoring**

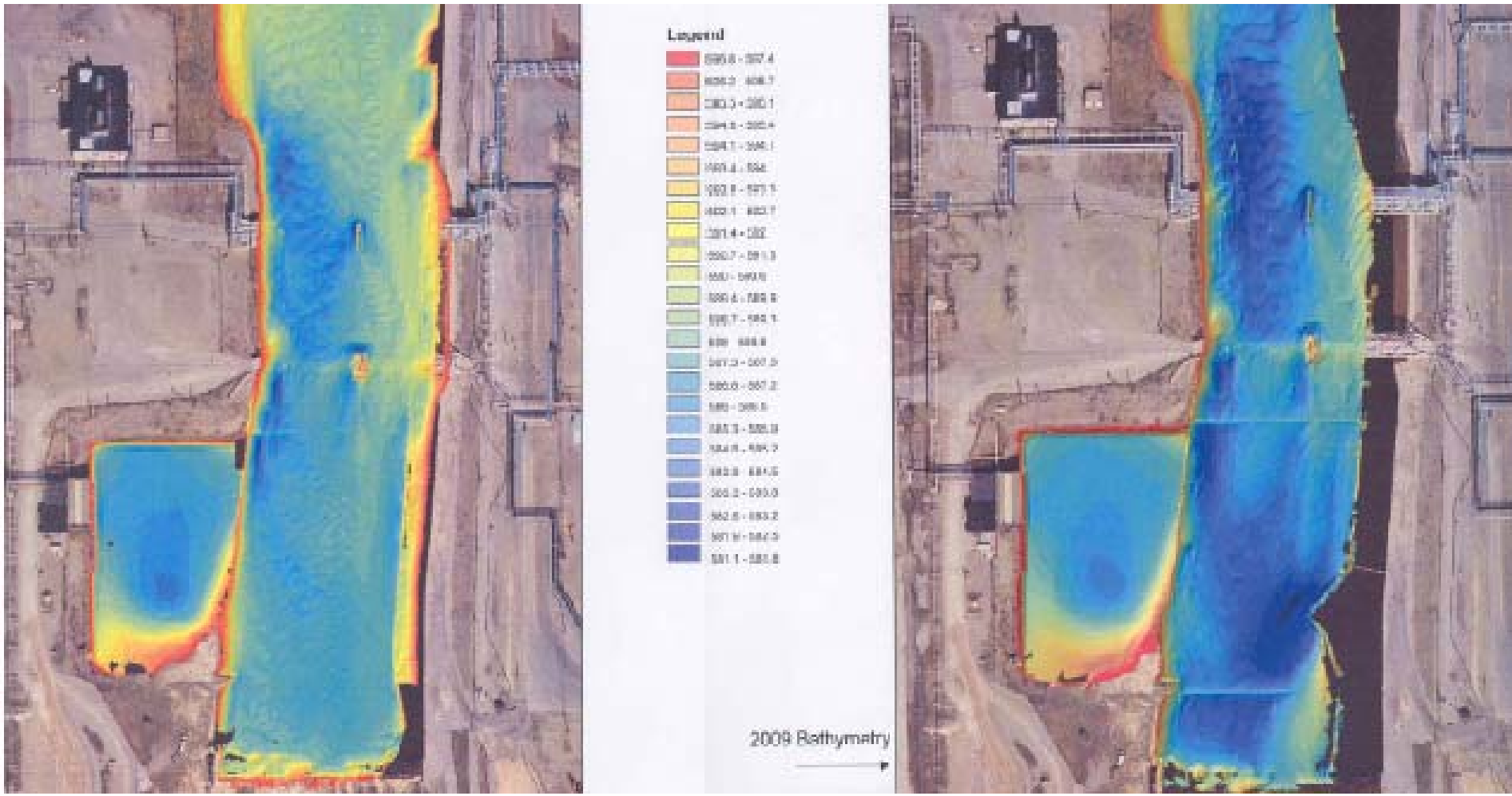
Significant non-dioxin/furan contamination outside of sheet piling to be addressed.

Reach D Sediment Cap Design Section



2007 Bathymetry

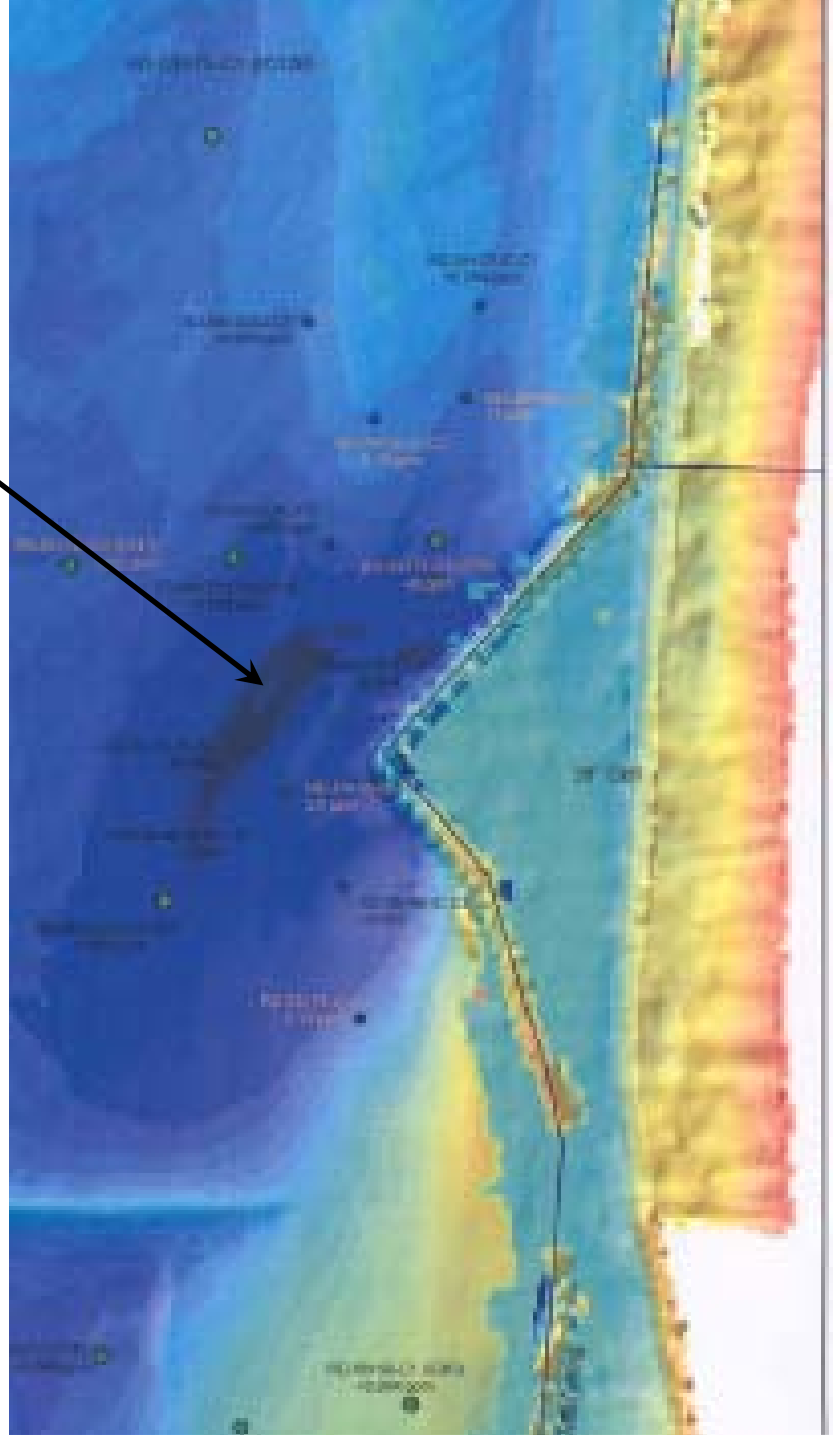
2009 Bathymetry



Draft 5/4/09

2009 Bathymetry - Reach D

Scour Area

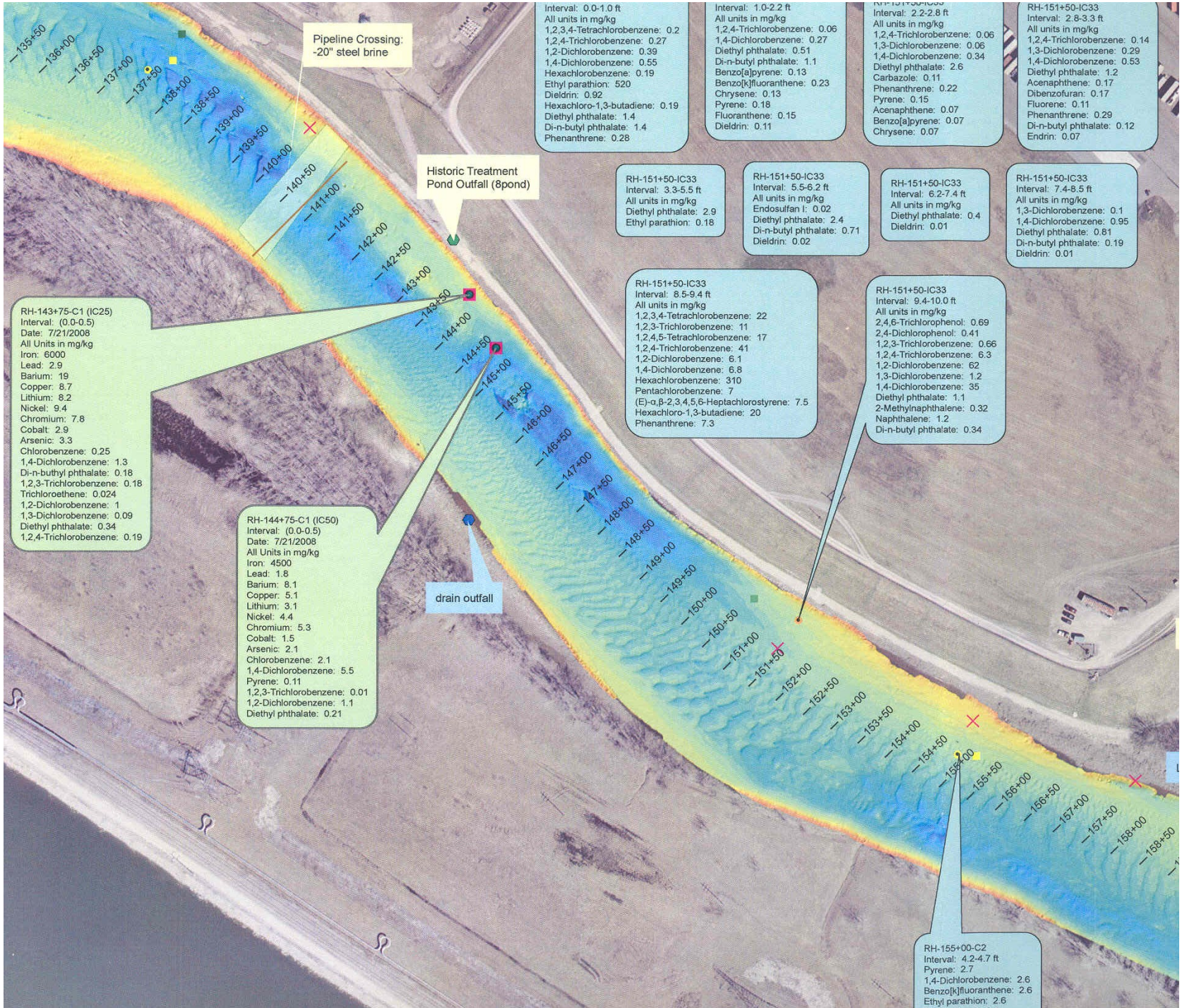


Draft 5/4/09

Outfall Investigation in Vicinity of Dow Plant Site (H-12 Outfall Investigation)

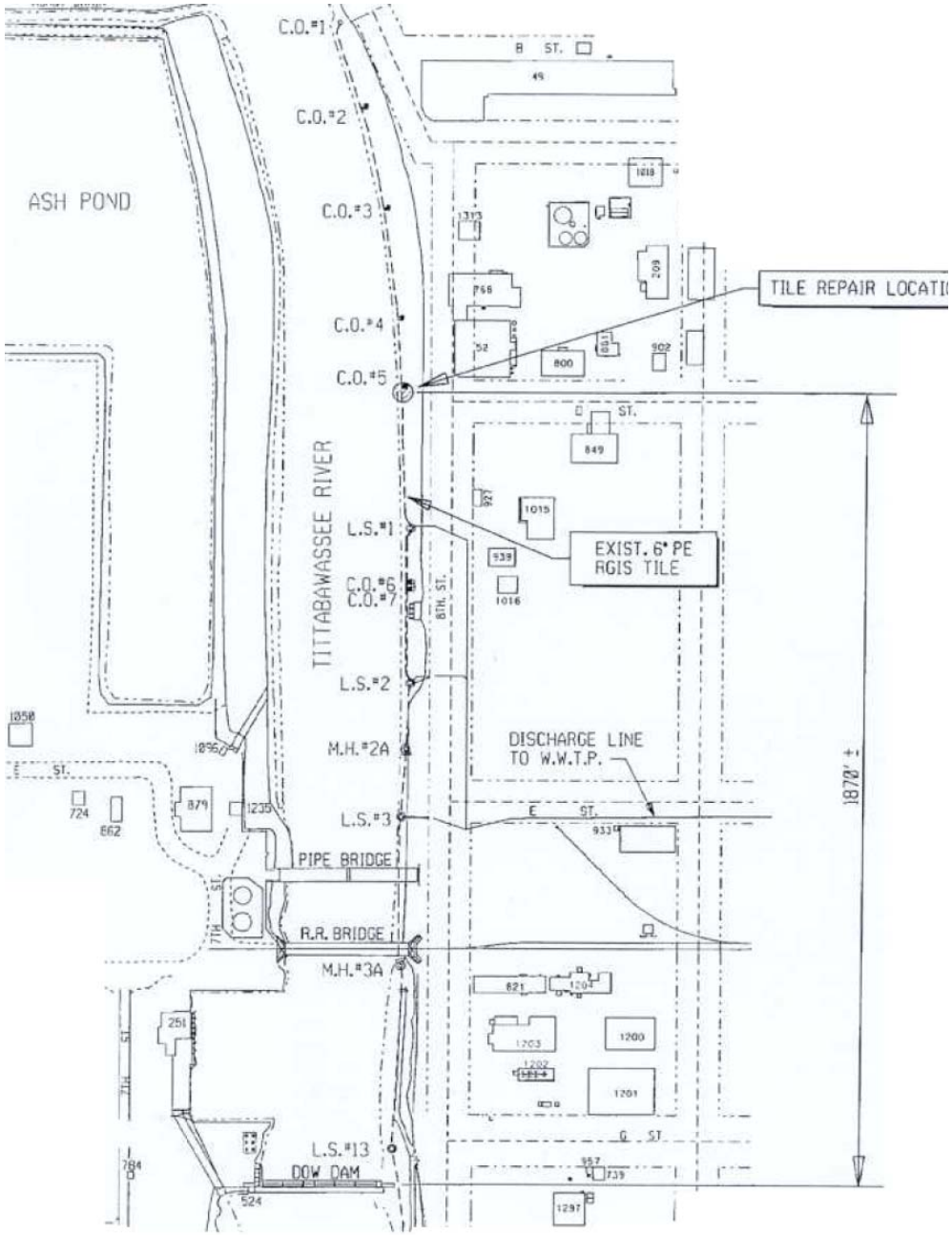
- **Part of License Compliance Schedule - currently not an IRA**
  - H = High Priority in Operating License
- **Work Plan submitted to MDEQ - investigation is underway**
- **Source Area work – other high concentration deposits (e.g., Reach D) to be identified and remediated**
  - Not only dioxins and furans; other contaminants significant and present at elevated concentrations
  - Dioxins and furans not necessarily co-located with other contaminants of concern
- **Working upstream to downstream**
- **Areas for further evaluation to see if IRAs are appropriate prior to final remedy (e.g. toxicity testing, bed measurements, etc.)**
  - **Reach D – Outside the sheet piling**
  - **Reach H – Ethyl parathion/hexachlorobenzene area**
- **Iterative Process**
- **Good progress being made**

H-12 Historic Outfalls


Pipeline Crossing:
-20" steel brine
Historic Treatment
Pond Outfall (8pond)
drain outfall
RH-143+75-C1 (IC25)
Interval: (0.0-0.5)
Date: 7/21/2008
All Units in mg/kg
Iron: 6000
Lead: 2.9
Barium: 19
Copper: 8.7
Lithium: 8.2
Nickel: 9.4
Chromium: 7.8
Cobalt: 2.9
Arsenic: 3.3
Chlorobenzene: 0.25
1,4-Dichlorobenzene: 1.3
Di-n-buthyl phthalate: 0.18
1,2,3-Trichlorobenzene: 0.18
Trichloroethene: 0.024
1,2-Dichlorobenzene: 1
1,3-Dichlorobenzene: 0.09
Diethyl phthalate: 0.34
1,2,4-Trichlorobenzene: 0.19
RH-144+75-C1 (IC50)
Interval: (0.0-0.5)
Date: 7/21/2008
All Units in mg/kg
Iron: 4500
Lead: 1.8
Barium: 8.1
Copper: 5.1
Lithium: 3.1
Nickel: 4.4
Chromium: 5.3
Cobalt: 1.5
Arsenic: 2.1
Chlorobenzene: 2.1
1,4-Dichlorobenzene: 5.5
Pyrene: 0.11
1,2,3-Trichlorobenzene: 0.01
1,2-Dichlorobenzene: 1.1
Diethyl phthalate: 0.21
RH-151+50-IC33
Interval: 0.0-1.0 ft
All units in mg/kg
1,2,3,4-Tetrachlorobenzene: 0.2
1,2,4-Trichlorobenzene: 0.27
1,2-Dichlorobenzene: 0.39
1,4-Dichlorobenzene: 0.55
Hexachlorobenzene: 0.19
Ethyl parathion: 520
Dieldrin: 0.92
Hexachloro-1,3-butadiene: 0.19
Diethyl phthalate: 1.4
Di-n-butyl phthalate: 1.4
Phenanthrene: 0.28
RH-151+50-IC33
Interval: 1.0-2.2 ft
All units in mg/kg
1,2,4-Trichlorobenzene: 0.06
1,4-Dichlorobenzene: 0.27
Diethyl phthalate: 0.51
Di-n-butyl phthalate: 1.1
Benzo[a]pyrene: 0.13
Benzo[k]fluoranthene: 0.23
Chrysene: 0.13
Pyrene: 0.18
Fluoranthene: 0.15
Dieldrin: 0.11
RH-151+50-IC33
Interval: 2.2-2.8 ft
All units in mg/kg
1,2,4-Trichlorobenzene: 0.06
1,3-Dichlorobenzene: 0.06
1,4-Dichlorobenzene: 0.34
Diethyl phthalate: 2.6
Carbazole: 0.11
Phenanthrene: 0.22
Pyrene: 0.15
Acenaphthene: 0.07
Benzo[a]pyrene: 0.07
Chrysene: 0.07
RH-151+50-IC33
Interval: 2.8-3.3 ft
All units in mg/kg
1,2,4-Trichlorobenzene: 0.14
1,3-Dichlorobenzene: 0.29
1,4-Dichlorobenzene: 0.53
Diethyl phthalate: 1.2
Acenaphthene: 0.17
Dibenzofuran: 0.17
Fluorene: 0.11
Phenanthrene: 0.29
Di-n-butyl phthalate: 0.12
Endrin: 0.07
RH-151+50-IC33
Interval: 3.3-5.5 ft
All units in mg/kg
Diethyl phthalate: 2.9
Ethyl parathion: 0.18
RH-151+50-IC33
Interval: 5.5-6.2 ft
All units in mg/kg
Endosulfan I: 0.02
Diethyl phthalate: 2.4
Di-n-butyl phthalate: 0.71
Dieldrin: 0.02
RH-151+50-IC33
Interval: 6.2-7.4 ft
All units in mg/kg
Diethyl phthalate: 0.4
Dieldrin: 0.01
RH-151+50-IC33
Interval: 7.4-8.5 ft
All units in mg/kg
1,3-Dichlorobenzene: 0.1
1,4-Dichlorobenzene: 0.95
Diethyl phthalate: 0.81
Di-n-butyl phthalate: 0.19
Dieldrin: 0.01
RH-151+50-IC33
Interval: 8.5-9.4 ft
All units in mg/kg
1,2,3,4-Tetrachlorobenzene: 22
1,2,3-Trichlorobenzene: 11
1,2,4,5-Tetrachlorobenzene: 17
1,2,4-Trichlorobenzene: 41
1,2-Dichlorobenzene: 6.1
1,4-Dichlorobenzene: 6.8
Hexachlorobenzene: 310
Pentachlorobenzene: 7
(E)-α,β-2,3,4,5,6-Heptachlorostyrene: 7.5
Hexachloro-1,3-butadiene: 20
Phenanthrene: 7.3
RH-151+50-IC33
Interval: 9.4-10.0 ft
All units in mg/kg
2,4,6-Trichlorophenol: 0.69
2,4-Dichlorophenol: 0.41
1,2,3-Trichlorobenzene: 0.66
1,2,4-Trichlorobenzene: 6.3
1,2-Dichlorobenzene: 62
1,3-Dichlorobenzene: 1.2
1,4-Dichlorobenzene: 35
Diethyl phthalate: 1.1
2-Methylnaphthalene: 0.32
Naphthalene: 1.2
Di-n-butyl phthalate: 0.34
RH-155+00-C2
Interval: 4.2-4.7 ft
Pyrene: 2.7
1,4-Dichlorobenzene: 2.6
Benzo[k]fluoranthene: 2.6
Ethyl parathion: 2.6

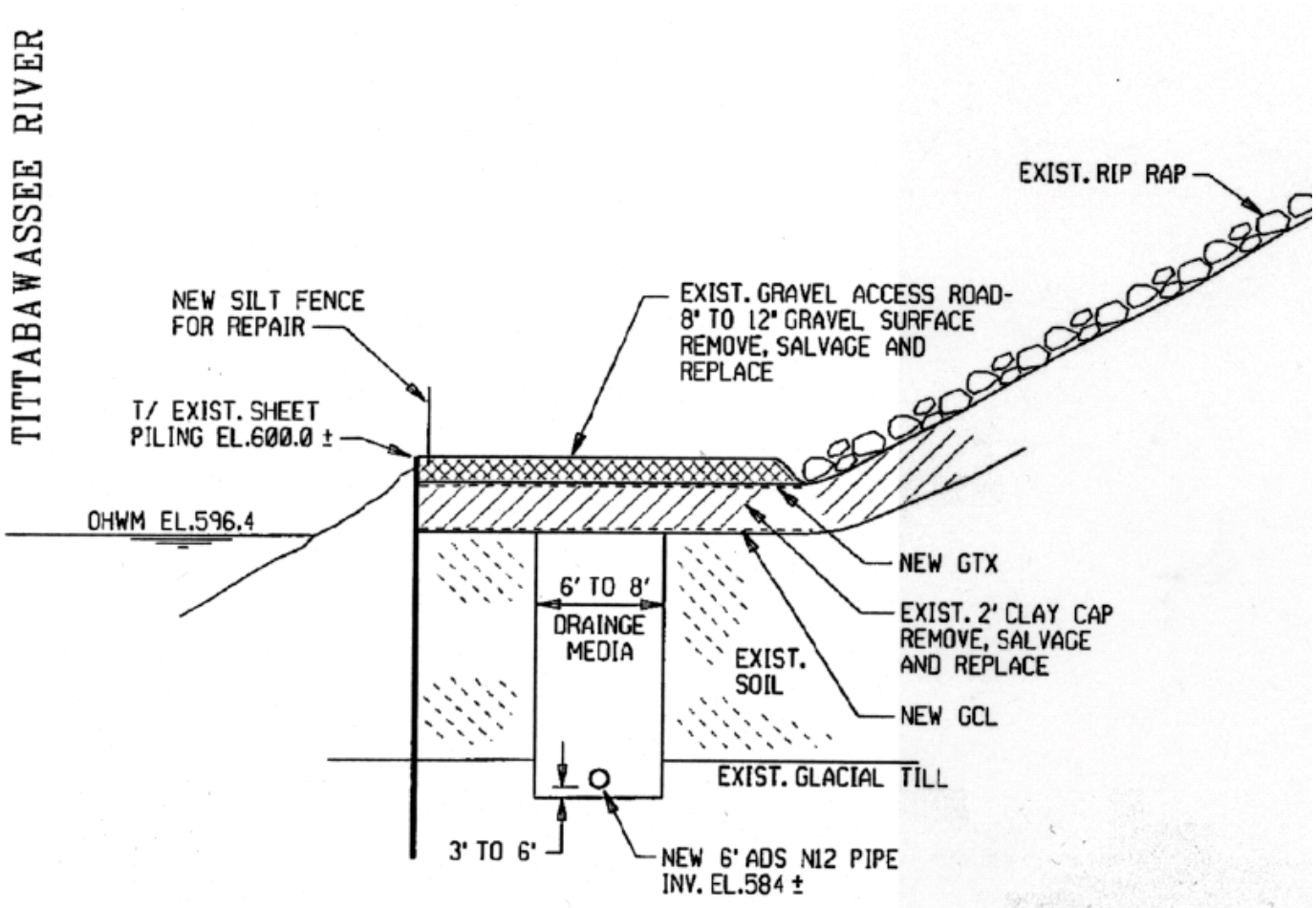
RGIS 09 Repair

- Small section of blocked tile to be repaired
- Proactive repair – currently scheduled for next week
- Located about 1700 feet upstream of Dow Dam
- RGIS is critical component of corrective action as it prevents release of contaminated groundwater into the Tittabawassee River



RGIS 09 Repair Location

RGIS 09 Repair Cross Section



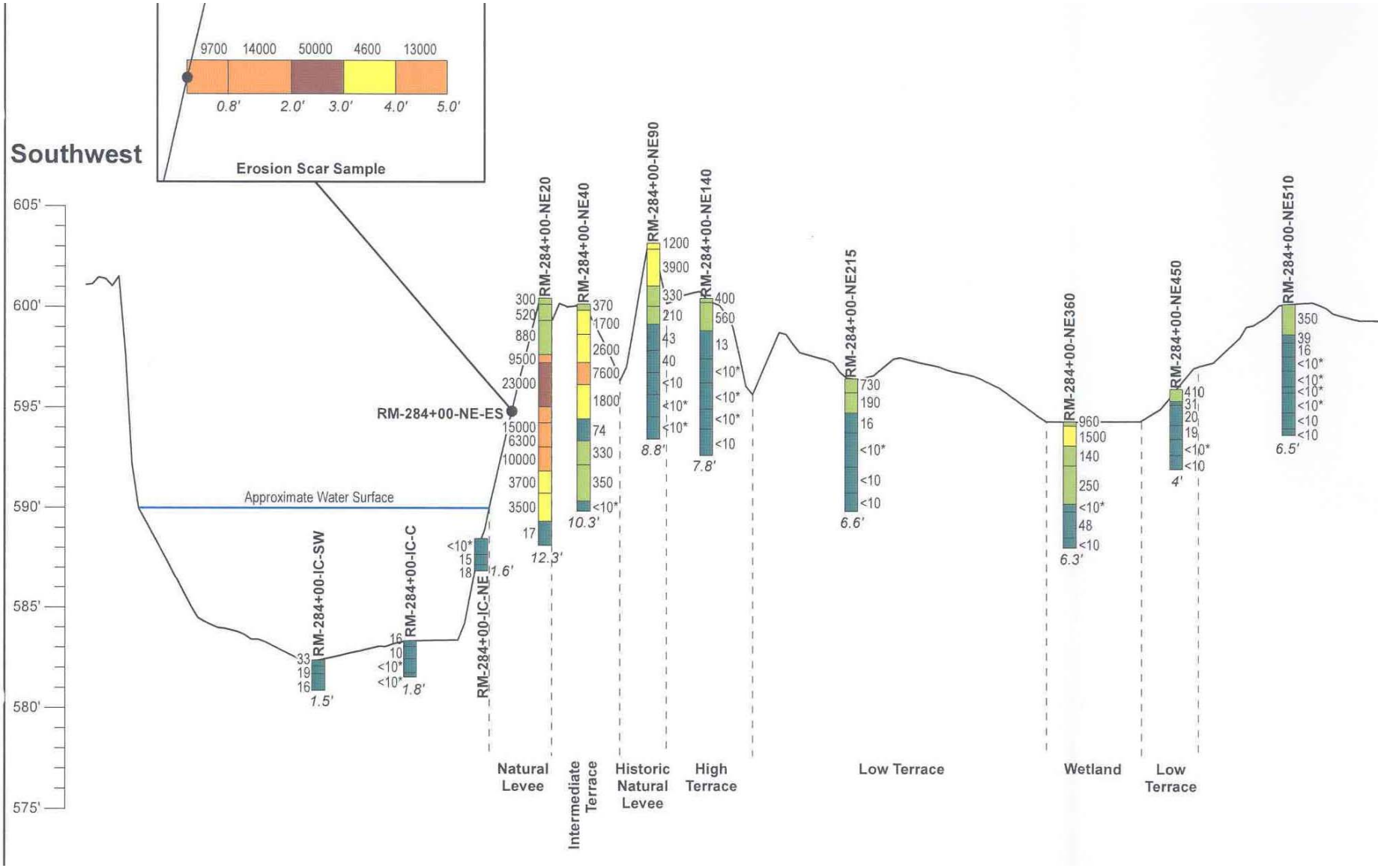
Bank Stabilization – Eroding Banks

Eroding Bank Stabilization - Tittabawassee River

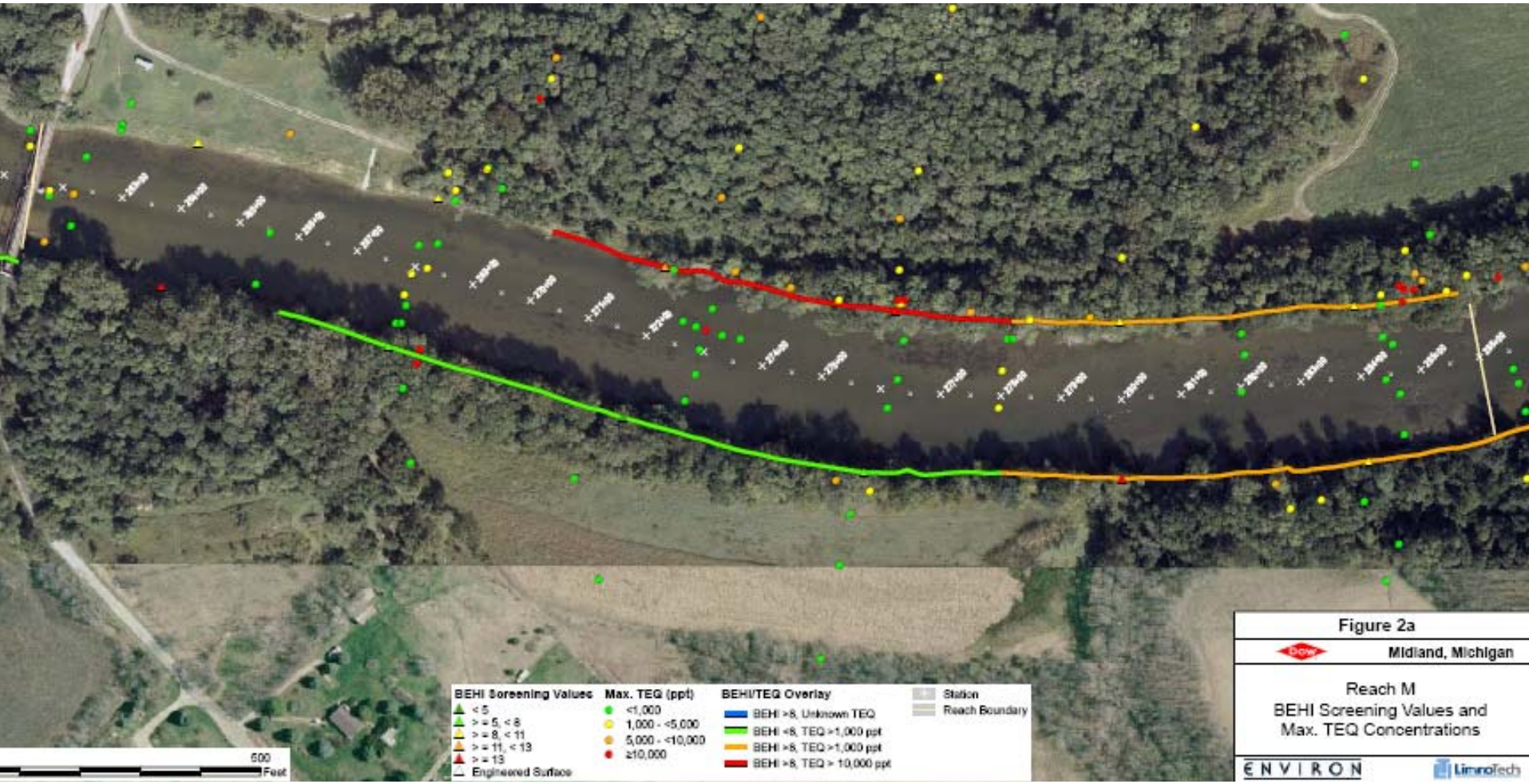
- **High levels of dioxin/furan in bank "levee" deposits**
- **Active source of contamination into the river as these banks erode**
- **Bank erosion is significant and widespread**
- **Consistent with EPA/MDEQ guidance to control sources first**
- **Pilot different technologies - "softer footprint" where possible**
  - 4 pilot stabilization areas
  - 3 additional areas – monitoring only
- **MDEQ approval of Pilot Work Plan on July 10, 2008**

Eroding Bank Stabilization - Tittabawassee River

- **Canopy management (tree trimming) over winter and early spring**
- **Other downstream areas for stabilization in Reach M in 2009**
  - **Water levels need to go down**
- **Monitoring Plan under review in coordination with NRDA Trustees**


Southwest
9700 14000 50000 4600 13000
0.8' 2.0' 3.0' 4.0' 5.0'
Erosion Scar Sample
605'
600'
595'
590'
585'
580'
575'
Approximate Water Surface
RM-284+00-NE-ES
RM-284+00-IC-SW
33 19 16 1.5'
RM-284+00-IC-C
16 10 <10* <10* 1.8'
RM-284+00-IC-NE
<10* 15 18 1.6'
RM-284+00-NE20
300 520 880 9500 23000 15000 6300 10000 3700 3500 17 12.3'
RM-284+00-NE40
370 1700 2600 7600 1800 74 330 350 <10* 10.3'
RM-284+00-NE90
1200 3900 330 210 43 40 <10 <10* <10* 8.8'
RM-284+00-NE140
400 560 13 <10* <10* <10* <10 7.8'
RM-284+00-NE215
730 190 16 <10* <10 <10 6.6'
RM-284+00-NE360
960 1500 140 250 <10* 48 <10 6.3'
RM-284+00-NE450
410 31 20 19 <10* <10 4'
RM-284+00-NE510
350 39 16 <10* <10* <10* <10* <10 <10 6.5'
Natural Levee
Intermediate Terrace
Historic Natural Levee
High Terrace
Low Terrace
Wetland
Low Terrace

Eroding Bank Stabilization - Example Pilot Area




Summer 2008

Summer 2008


Summer 2008


Fall 2008

February 2009 – Ice and flood flows along bank at Freeland

February 2009 – Ice and flood damage at Reach J/K remediation area


Spring 2009


Spring 2009


Monitoring banks in different conditions to determine where efforts are best applied


Outside meander bend below Imerman Park
October 2008

January 2009

February 2009


March 2009


April 2009


Outside meander bend below Imerman Park
October 2008


Tittabawassee River In-Channel Deposits

“In-Channel” Considerations for IRAs

- **How stable is it?**
- **How exposed are the elevated concentrations?**
- **Are there uncontrolled sources upstream that make recontamination of the area likely?**
- **Can it be efficiently removed or controlled now?**
- **What additional information do we need to make a decision about early action?**

Surface Concentrations


Reach J/K In-
Channel Deposit

Tittabawassee River In-Channel Deposits

- **Address surface concentrations that are high**
  - Reach J/K - TEQ/Parathion
- **Collect additional data to determine/verify stability of deposits Dow is proposing to leave in place in the short term (field validation of modeling)**
  - Reach J/K
  - Reach L and others – data to be provided in June 1 GeoMorph® Report or sooner
- **Comparison of channel conditions between 2008 and 2009**
  - Bathymetry
  - Erosion pins
  - Scour chains
- **Conduct sediment toxicity testing**
- **Reach J/K data in from 2008**
  - Under review
  - Toxicity does not appear to be acute
  - Does not appear to be eroding based on Fall 2008 data - need to see spring data which would capture effects of winter/spring flood events

Example - Erosion Pins/Scour Chains

● Erosion Pin
○ Scour Chain

▲ Stations
Reach Boundary

Notes:
1) In-channel base layer is 2008 bathymetry data. Tan colors indicate shallower areas.

2) Overbank base layer is 2006 aerial photography.

0 25 50 100 Feet

N

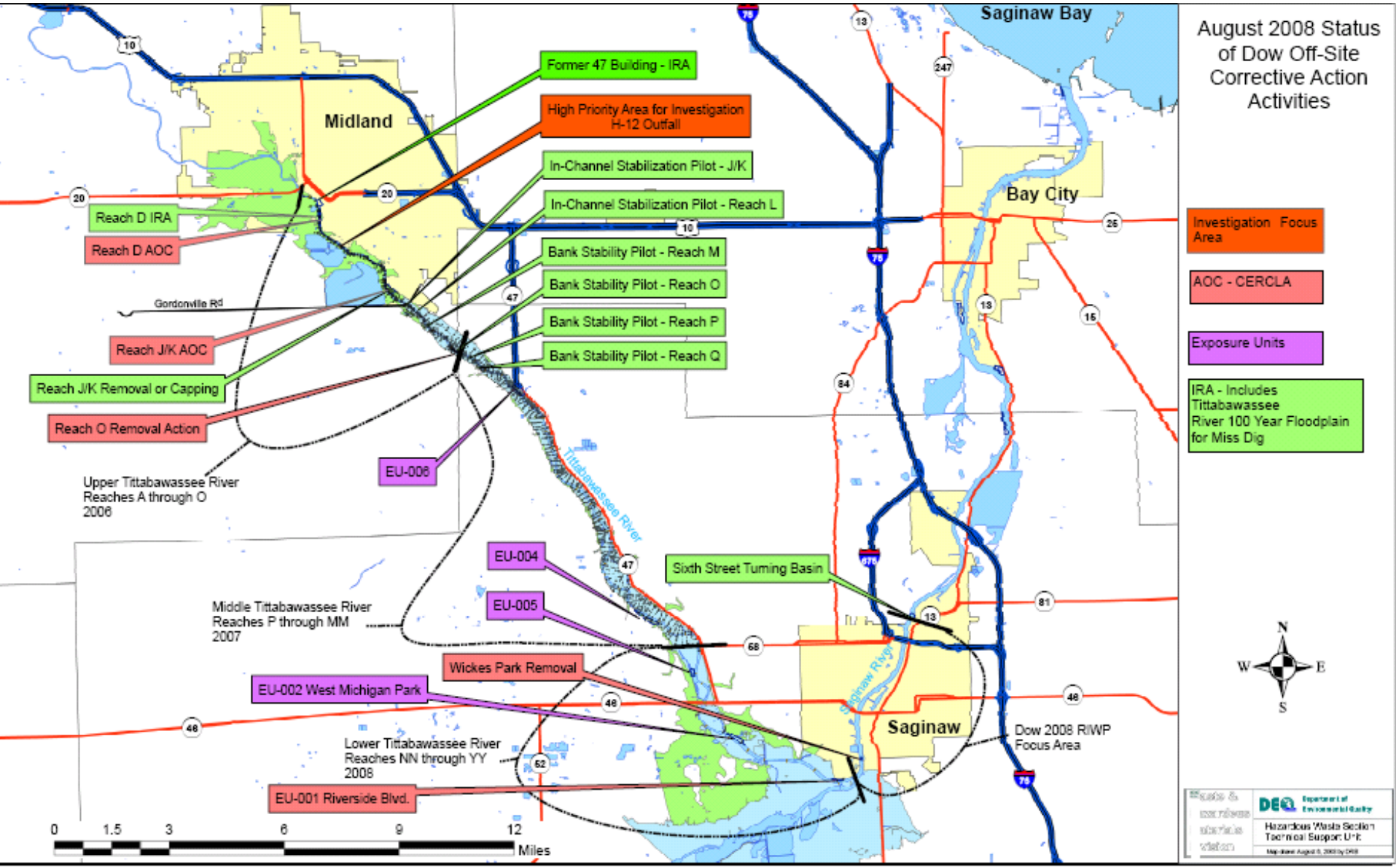
ATS

Drawn By: BRS	Date: July 30, 2008
Checked By: CR	Edited By: BRS

GeoMorph® Site Characterization

Upper Reach L

Upper Tittabawassee River
Midland, MI


August 2008 Status of Dow Off-Site Corrective Action Activities
Saginaw Bay
Midland
Bay City
Saginaw
Former 47 Building - IRA
High Priority Area for Investigation H-12 Outfall
In-Channel Stabilization Pilot - J/K
In-Channel Stabilization Pilot - Reach L
Bank Stability Pilot - Reach M
Bank Stability Pilot - Reach O
Bank Stability Pilot - Reach P
Bank Stability Pilot - Reach Q
Reach D IRA
Reach D AOC
Gordonville Rd
Reach J/K AOC
Reach J/K Removal or Capping
Reach O Removal Action
EU-006
Upper Tittabawassee River Reaches A through O 2006
Tittabawassee River
EU-004
EU-005
Middle Tittabawassee River Reaches P through MM 2007
Sixth Street Turning Basin
Wickes Park Removal
EU-002 West Michigan Park
Lower Tittabawassee River Reaches NN through YY 2008
EU-001 Riverside Blvd.
Saginaw River
Dow 2008 RIWP Focus Area
0 1.5 3 6 9 12
Miles
Investigation Focus Area
AOC - CERCLA
Exposure Units
IRA - Includes Tittabawassee River 100 Year Floodplain for Miss Dig
N
W
E
S
DEQ
Hazardous Waste Section
Technical Support Unit

Tittabawassee River GeoMorph® Investigation Report

- MDEQ approval of the June 30, 2008, GeoMorph® sampling plan on July 10, 2008
- Complete initial soil and sediment characterization work for the Tittabawassee River
- Report due June 1, 2009
- Finish remaining “in-channel” sediment characterization (from Freeland Road bridge to confluence)
- Floodplain work that has not been completed due to property access issues
  - More work necessary “best efforts” to gain access
- Additional work necessary to complete investigation phase and move into feasibility studies and corrective measures design(s)
  - Analysis of archived samples from Lower Tittabawassee River where necessary to fill out nature and extent
- IRA Follow up work – decision tree
  - Report submitted April 15, 2009

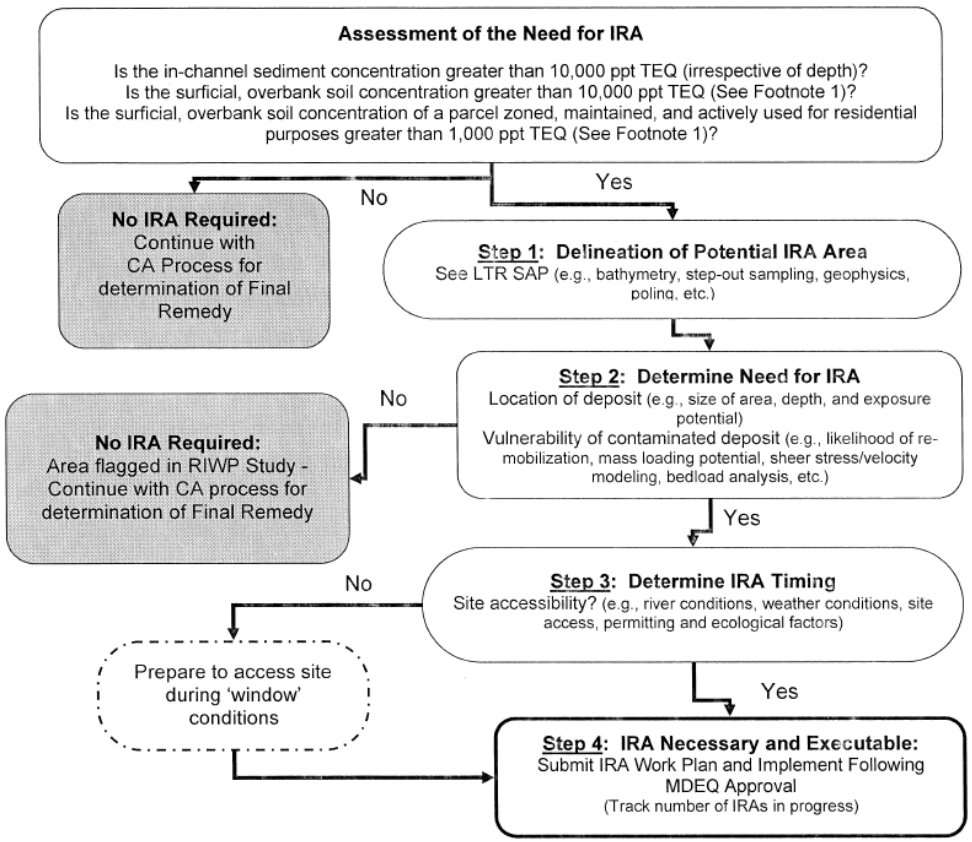
IRA/PCAP Residential Decision Tree

- **Step out sampling if trigger levels are exceeded**
  - In-channel sediments - 10,000 ppt at any depth
  - Overbank soil - 10,000 ppt in top 1 foot on any property
  - Residential property soil - 1,000 ppt in top 1 foot *in areas that are in active residential use (update from 2007)*
- **Evaluate extent, exposure potential, vulnerability to migrate, etc.**
- **Determine if IRA or PCAP is appropriate before final remedial action**
- **In process of evaluating April 15, 2009 IRA Report**
  - **Have returned the report to Dow for additional work (5/4/09)**
  - **Evaluate concentrations across property lines**

Tittabawassee River IRA Implementation Decision Tree for Furans and Dioxins

6/26/08

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



Footnote 1: Definition of 'surficial soils' is the upper one foot interval. For eroding bank samples, interval is within one foot of bank surface.

IRA Implementation Decision Tree
Step 2 and 3 Report

Tittabawassee River and
Floodplain Soils
Midland, Michigan

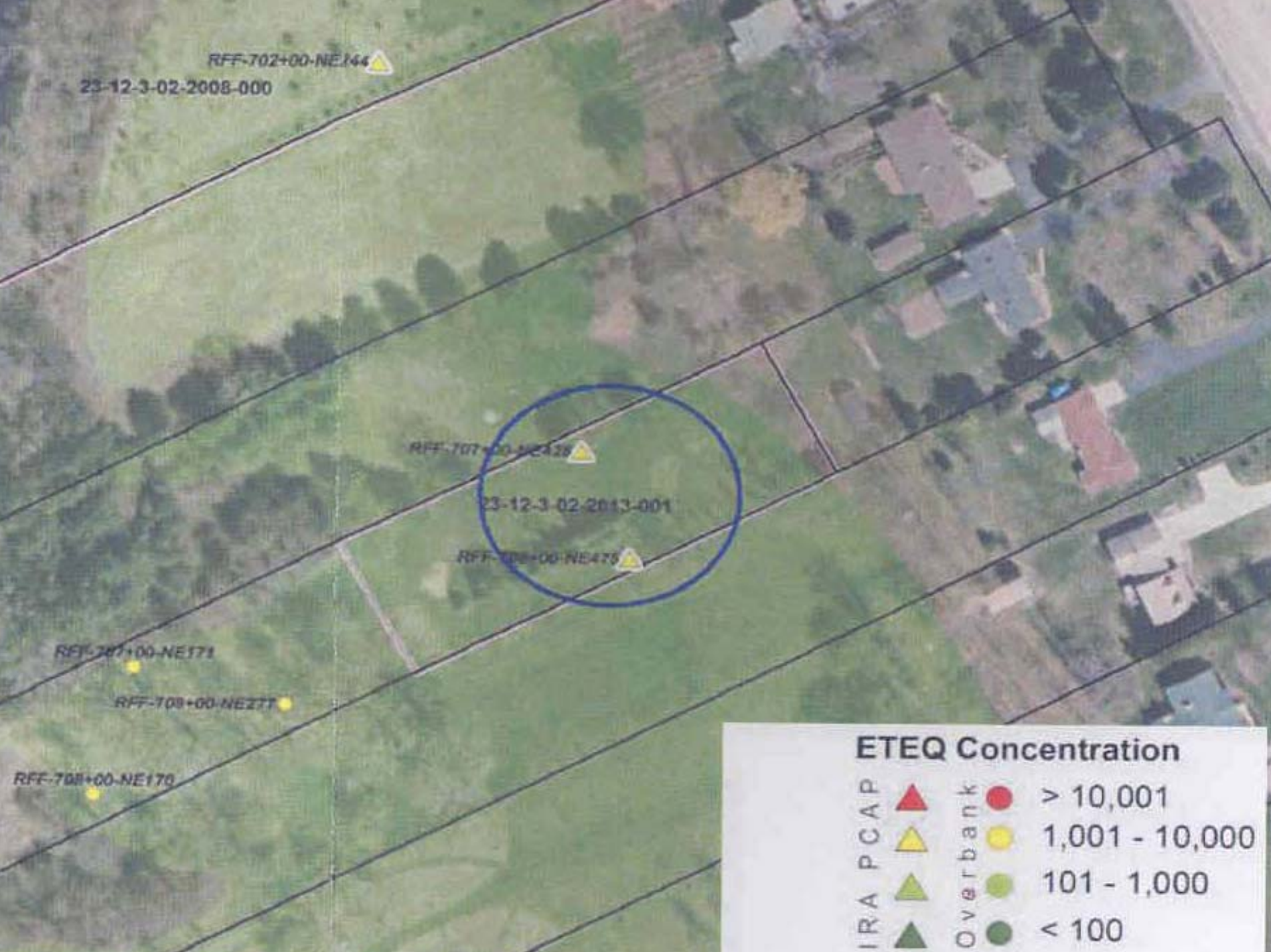
Prepared for:

The Dow Chemical Company
1790 Building
Midland, Michigan 48674

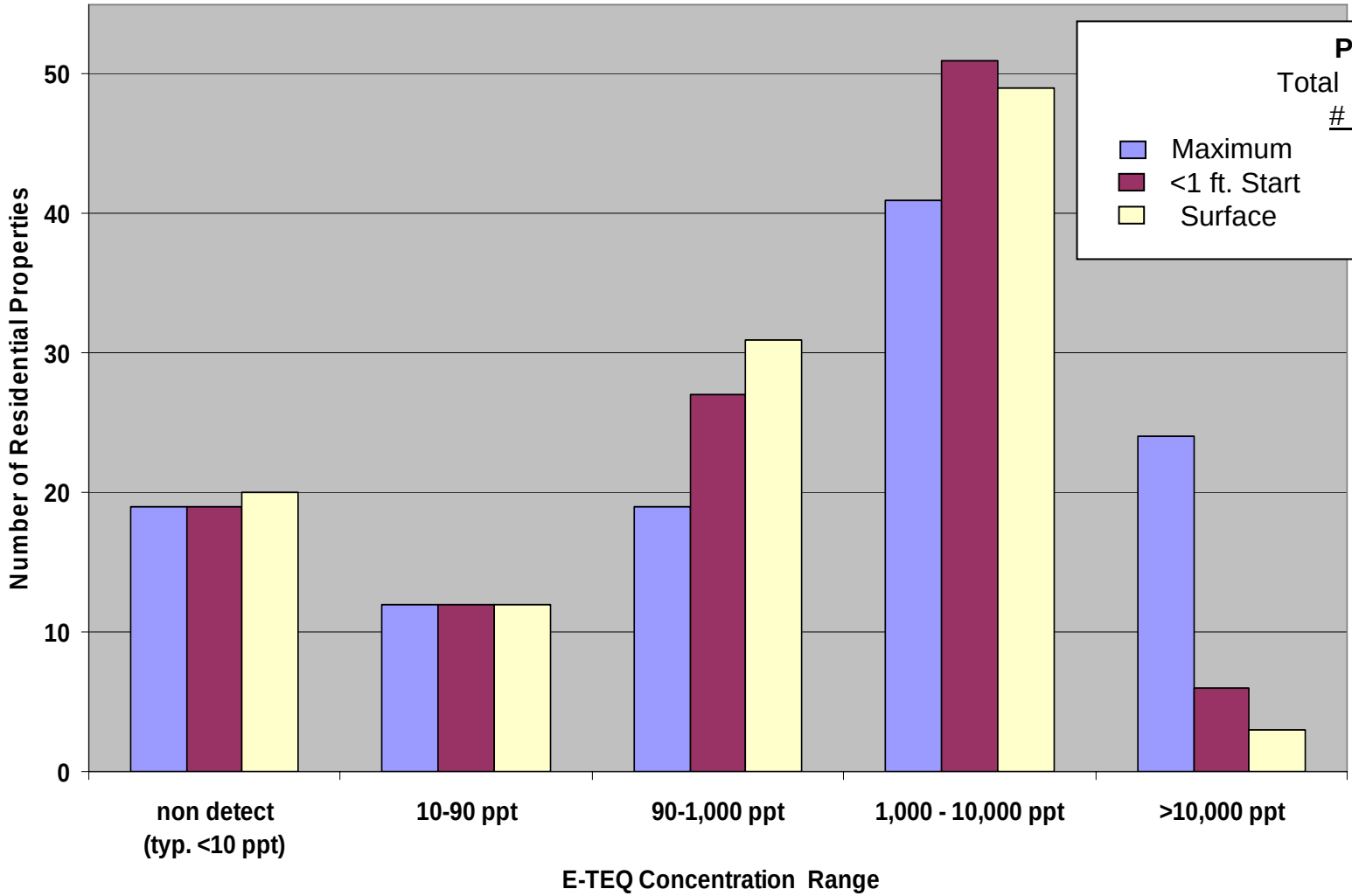
Prepared by:

Ann Arbor Technical Services, Inc.
290 South Wagner Road
Ann Arbor, Michigan 48103

April 15, 2009


RFF-702+00-NE144
23-12-3-02-2008-000
23-12-3-02-2013-001
RFF-709+00-NE171
RFF-709+00-NE277
RFF-708+00-NE170
ETEQ Concentration
> 10,001
1,001 - 10,000
101 - 1,000
< 100
Overbank
IRA PCAP

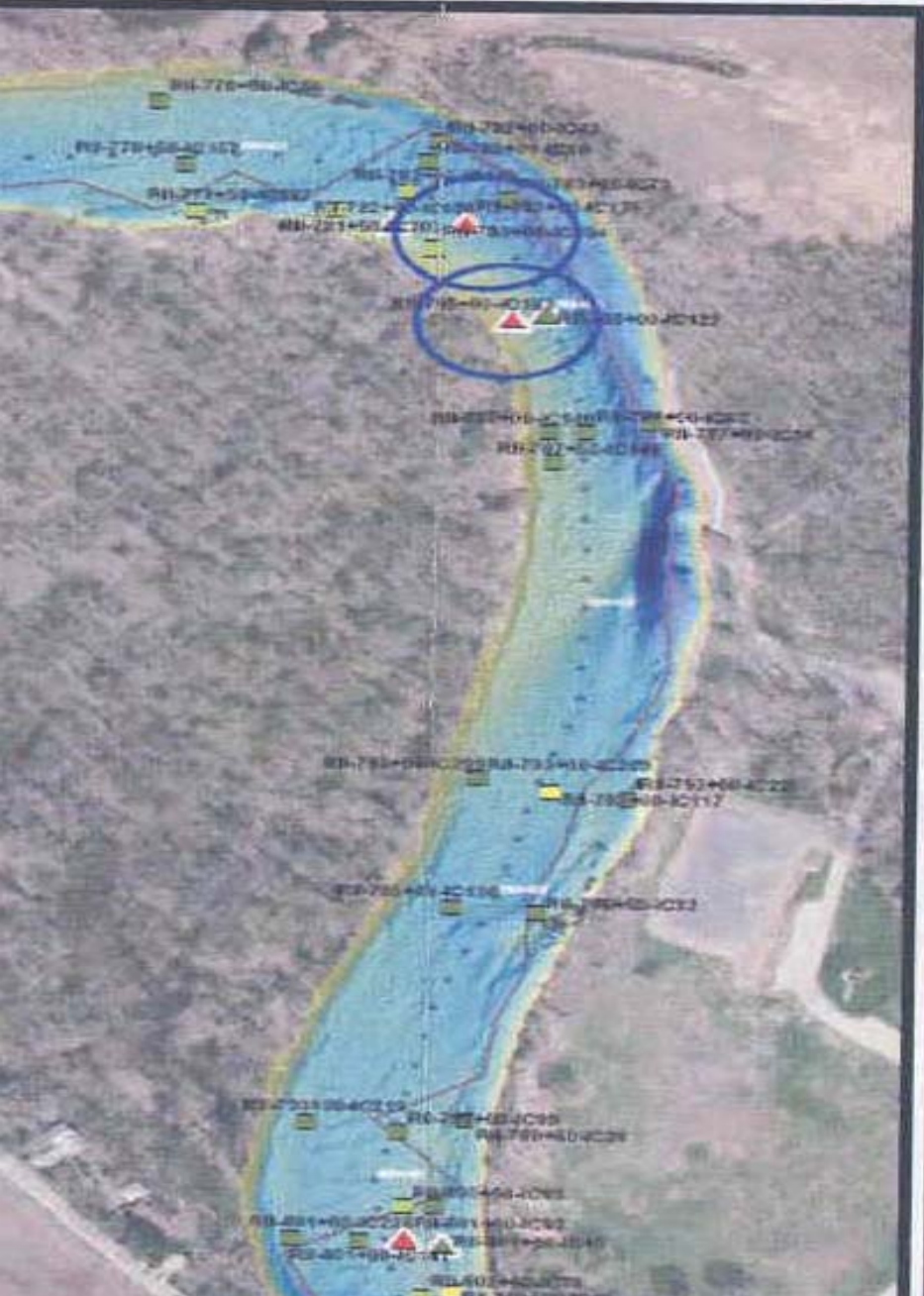
Middle and Lower Tittabawassee Floodplain Residential Properties
Summary of Estimated Dioxin/Furan TEQ Concentration Ranges



	Properties	Locations
Total	115	718
	# > 1,000 ppt (% of total)	
Maximum	65 (57%)	362 (50%)
<1 ft. Start	57 (50%)	324 (45%)
Surface	52 (45%)	269 (37%)

TEQ Concentrations and Bathymetry

nchannel ETEQ Surface Sample Results



Inchannel ETEQ Max Sample Resul

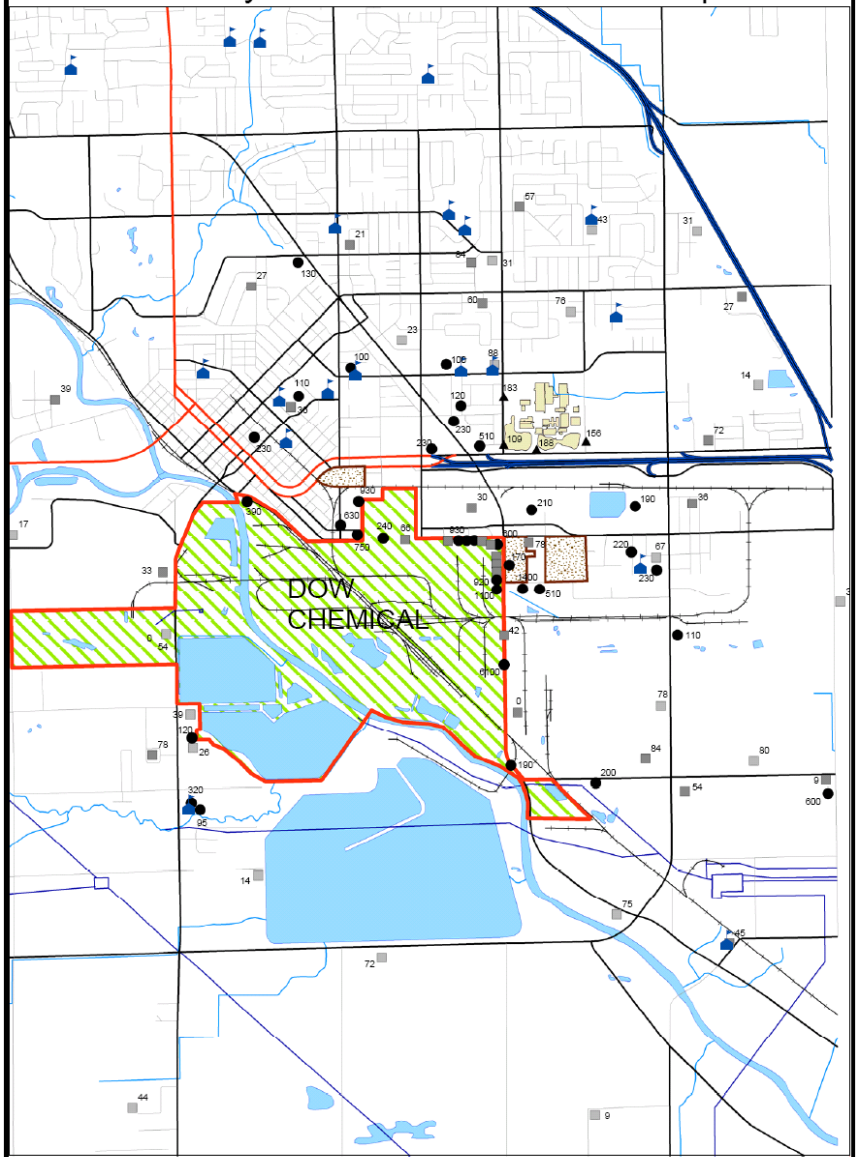
Midland Presumptive Approach

- Soil contamination located primarily north and east of Dow Plant site
- Dioxins and furans as typically less than 1000 ppt TEQ but greater than 200 ppt over large residential areas
- Very limited soil data
- Dow proposal is to use air modeling to identify “presumptive remedy” areas and to use limited soil data for model validation
- This is an alternative approach to the development of a “site specific” soil criteria with independent peer review

Midland Presumptive Approach

- Initial discussions with Dow and the City of Midland were held in 2008 on a “presumptive remedy approach”
- Since then, MDEQ has been working with Dow to further develop a strategy
- Dow submitted a work plan outline late yesterday (May 5, 2009)
- Plan is under review
- MDEQ has committed to further discussion with the City of Midland
- More details to follow

Summary of Midland Area Dioxin Samples



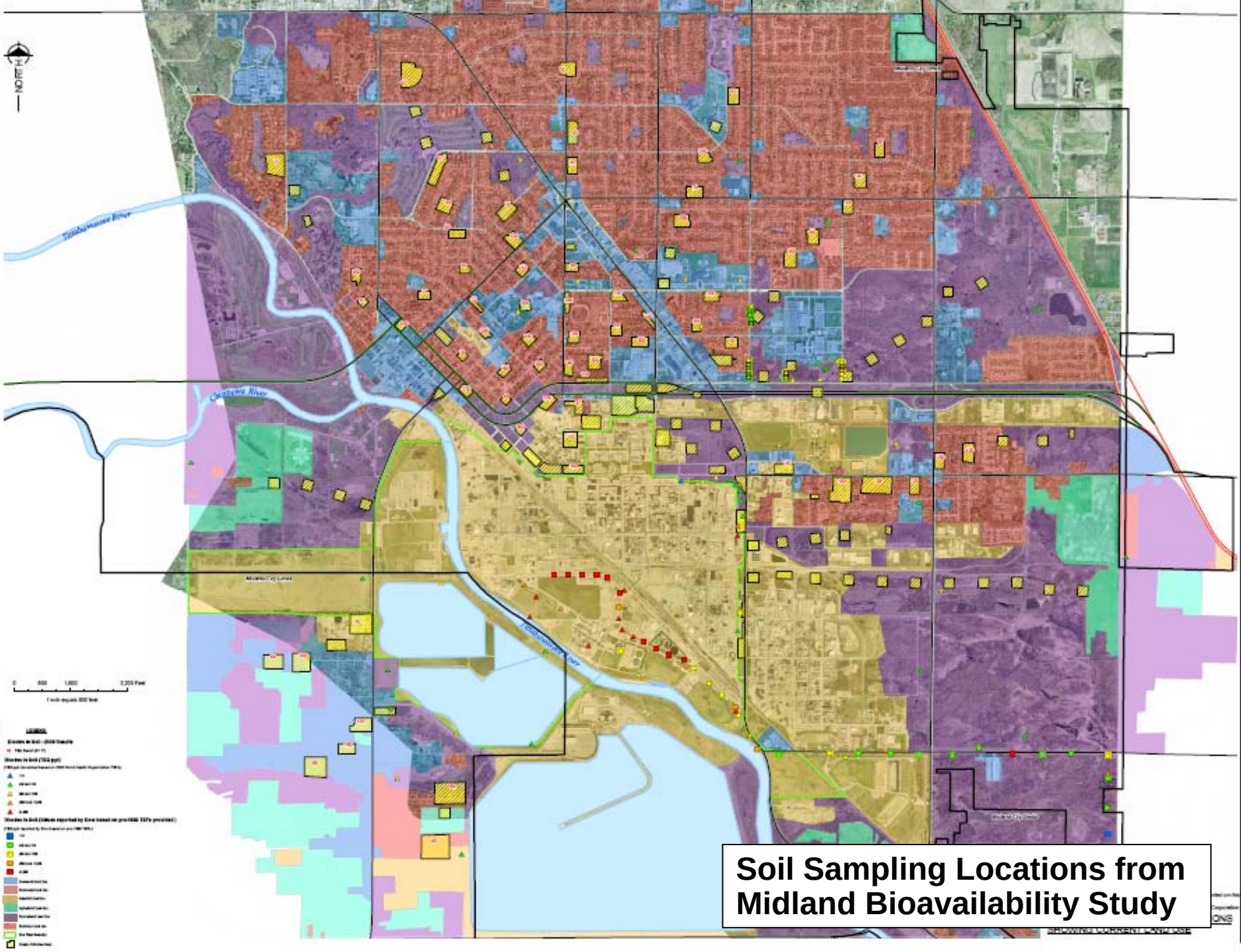
Summary of Dow, U.S. EPA & MDEQ Dioxin Data from 1983, 1984, 1996, and 1998

- Less than 90 ppt TEQ
- Exceeds 90 ppt TEQ
- Exceeds 90 ppt TEQ (Average of Multiple Samples)

IRA Neighborhoods

Notes:
1. 1983 and 1984 data is estimated using 2,3,7,8-TCDD concentrations and congener profile information.
2. DEQ samplings conducted in public rights of way, public school grounds and public parks.

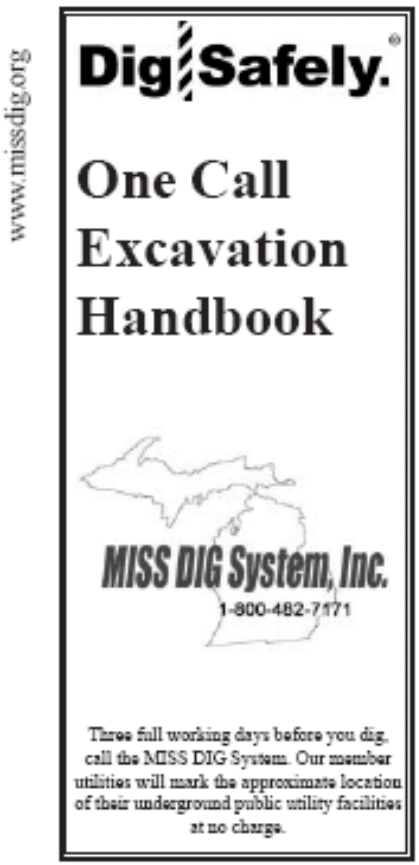
August 25, 2005


NORTH
Tittabawassee River
Chippewa River
Tittabawassee River
Soil Sampling Locations from
Midland Bioavailability Study

Update Signs to be Consistent with Updated Fish Advisory

- **Department of Community Health available after meeting to discuss**
- **Advisories have become more stringent**
- **Signs need to be updated – funding dependent**

Disturbance and Management of Soils in Areas with Potential Dioxin/Furan Contamination



- Mechanism to let utility workers know about large areas of contamination and suggested precautions for working in soil

- Miss Dig is an example of a type of mechanism that could be used to notify utility workers/contractors of potential contamination when working in Tittabawassee River floodplain south of Midland

- Development of “Management of Disturbed Soils and Dredged Sediments” booklet

- Work plan submitted by Dow on October 10, 2008. Approved by Miss Dig Board during their March 2009 meeting. Contract being developed.

Disturbance and Management of Soils in Areas with Potential Dioxin/Furan Contamination

Contact Information

Al Taylor - MDEQ
517-335-4799
taylora@michigan.gov

Art Ostaszewski - MDEQ
517-335-1119
ostaszewskia@michigan.gov

Cheryl Howe – MDEQ
517-373-9881
howec@michigan.gov

Greg Rudloff – U.S. EPA
312-886-0455
Rudloff.Gregory@epamail.epa.gov