Wickes Manufacturing TCE Plume Site
Mancelona, Michigan

December 2017
What is TCE?

- Trichloroethylene (TCE)
- Common Industrial Solvent
- Known Human Carcinogen
- Federal and State Safe Drinking Water of 5 µg/L or 5 ppb
- State Surface Water Protection Standard of 200 µg/L or 200 ppb
- Tier I vapor intrusion groundwater screening level is under review (Proposed level is 0.073 µg/L per Draft September 2017 guidance; however, the typical laboratory detection level for TCE in groundwater ranges from 0.5 to 1 µg/L)
Just How Much is 1 ppb?

- 1 inch in 16,000 miles
- 1 second in 32 years
- 1 cent in $10,000,000
- 1 pinch of salt in 10 tons of potato chips
- 1 square foot in 36 square miles
History of Site

• Mount Clemens Industries, Inc. – auto parts manufacturing (1947-1967).
• TCE was discarded on the ground where it seeped through the soil and into the groundwater below the property
• After 1967 Site operated as Wickes Manufacturing, then Dura Automotive
• Site is an ‘orphaned’ site; DEQ and EPA involved following the discovery of TCE in groundwater (1986).
• DEQ stepped in so that a key local employer was not liable.
• Early stage State funds were used to:
  ✓ Sample residential wells for TCE
  ✓ Supply bottled water to impacted residents in Mancelona
  ✓ Support municipal water infrastructure system / creation of Mancelona Area Water and Sewer Authority (MAWSA)
1962 Aerial Photograph

FORMER FINAL EFFLUENT POND

FORMER UNTREATED WASTE SEEPAGE LAGOONS
1981 Aerial Photograph

- Former Final Effluent Pond
- Former Unlined Industrial Waste Landfill
- Use of Untreated Waste Seepage Lagoon discontinued in 1972
- Former Treated Waste Settling Lagoons
1992 Aerial Photograph

- Former Final Effluent Pond
- Former Treated Waste Settling Lagoons and Industrial Waste Landfill Removed in 1988/89
- Facility Expansion Covers Former Untreated Waste Seepage Lagoon Locations
- Monitoring Wells Installed by the EPA in 1986
Source Area Removal – Similar to Work Performed at Former Treated Waste Settling Lagoons in 1988/1989
DEQ Partners

• Environmental Assessment (AMEC)
  – Source Area Evaluations (e.g., 2017 soil gas assessment)
  – Remedial Investigations (e.g., 2017 monitoring well network expansion & downgradient vapor intrusion assessment)
  – Risk Assessment: Protection of Human Health and Environment
  – Feasibility Study / Evaluation of Remediation Options
  – Ongoing Groundwater and Pore Water/Surface Water Sampling
  – Ongoing Hydrogeologic characterization
  – Ongoing Public Outreach Support

• On-going Residential Well Sampling Program (Health Department) & Well First Policy

• Expansion of the Municipal Water System (MAWSA)
DEQ Past Investigations

• DEQ worked with community and then-current property owner to define extent of problem and replace impacted groundwater supply in and around Mancelona

• DEQ groundwater investigations begin in 1999

• Investigations began at the plant and moved northwesterly, which is the direction of the groundwater flow

• No significant residual sources found during investigations at the Site

• 129 existing permanent monitoring wells installed

• Extensive vertical groundwater profiling (e.g., 2004, 2007 and 2015)
DEQ Current Investigations

• Annual Groundwater Monitoring Program:
  - Sample select monitor wells in Spring and Fall of each year
  - Gauge depth to water / generate groundwater flow maps
  - Sample the Cedar River and pore water near the river annually
• Sample annually / semi-annually residential wells near the plume
• Additional 2017 Activities
  - Expand sentinel monitoring well network (Windy Hill Trail & Shanty Creek)
  - Soil Gas evaluation (Source Area – follow up to expanded groundwater sampling in source area in 2016 & Downgradient)
  - Assess groundwater discharge to Shanty Creek
  - Assess affect of Cedar River Well Field (CRWF) pumping regime on aquifer(s) following 2016 high pressure water line installation (Mancelona well fields to the CRWF)
Challenges

- Footprint exceeds 4,000 acres;
- North Lobe vents to Cedar River (TCE levels are below 200 µg/L);
- West Lobe moves toward Lake Bellaire / Shanty Creek;
- TCE occurs in three different water bearing zones in the glacial soils: Shallow, Intermediate and Deep;
- TCE has been found as deep as 500 feet below ground surface.
- No significant natural degradation of TCE is observed.
Conceptual Site Model

SOURCE: TCE RELEASED ON THE GROUND AND/OR IN UNLINED SEEPAGE LAGOONS OVER A PROLONGED PERIOD

"Clean Water Blanket" low Volatilization potential

TCE IMPACTED GROUNDWATER

MANCELONA WELL FIELD
2008 Feasibility Study

- Risk Evaluation
  - TCE presents a drinking water risk; TCE is human carcinogenic (EPA, 2011). The drinking water criteria is 5 µg/L.
  - TCE is a threat to macroinvertebrates where groundwater vents to surface water (GSI) above the GSI criteria of 200 µg/L.
  - Evaluate potential for TCE to off-gas from groundwater and create an inhalation risk.
2008 Feasibility Study

• Options Considered:
  – In-situ Destruction/Degradation Remedies
    Elevated dissolved oxygen and low total organic carbon in saturated zones prevent effective in-situ treatment, for example:
      o Nanoscale iron
      o Enhanced Bioremediation
  – Groundwater Extraction and Ex-situ Treatment (via Carbon or Air Stripper)
  – Hydraulic Control — Extract groundwater and pump back into the aquifer(s) to “steer” plume away from specific receptors
  – Monitor; restrict installation of new wells, replace or treat water supply wells
Groundwater Risks - TCE in Shallow Groundwater

CRWF *Does not* withdraw water from this zone

Residential Wells use water from different depths within this zone – Health Department Monitoring / municipal water replacement per FS.

MAWSA Wells:
Upgradient of Wickes Site
Shallow Zone

Plume is ~160 feet ABOVE the CRWF screens. Shallow groundwater flows to the northwest near the CRWF but to southwest at leading edge of the plume. TCE is estimated to move at ~450-625 feet per year.

Based upon data to date, science shows TCE will move past the well field without ever impacting the drinking water.
**Intermediate Zone**

TCE moves at ~100 feet per year (slower because there is more silt and clay).

This zone is ~80 feet ABOVE CRWF screens.

Intermediate Zone is separated from the Deep Zone by an aquitard (low permeability layer) that varies in thickness (5-feet to 50+feet)

The DEQ continues to monitor the intermediate zone and the underlying CRWF aquifer
TCE in Groundwater – Deep Zone

**Deep Zone**

TCE moves at less than 50 feet per year (more clay and silt).

Very low levels of TCE (1.0 to 1.2 ppb) have been detected at MW-Xd, where clays are very thin.

Sampling shows TCE detected at MW-Xd is not related to TCE detected to the southwest.

The DEQ continues to monitor pumping stresses and TCE extent in the Deep Zone, particularly near the CRWF.

MAWSA also samples CRWF wells for TCE (never detected).
Cedar River Well Field (CRWF)

- Supplies drinking water to the MAWSA.
- CRWF service area decreased after high pressure line upgrade from Mancelona in 2016 (less use).
- Is located lateral to current position of the west lobe of the shallow TCE plume (turning toward Shanty Creek).
- CRWF well screens, depth where water is pumped from the ground, are located in the Deep Zone or the “CRWF Aquifer” (575-feet below ground surface).
Measuring Pumping Response in Shallow, Intermediate and Deep Wells near the CRWF – Pre-Water Main Expansion

No measurable Change

No Pattern during event (<0.1’)

<1’

>6’

>13’

Water Source for the CRWF
Hydraulic Testing – Groundwater Connections at the CRWF

• Pumping at the CRWF causes water levels in the Deep Zone to drop.
• Potential movement of water from Intermediate Zone to Deep Zone is enhanced by water level drop (downward vertical gradient).
• CRWF operates at 100 – 200 gallons per minute (gpm); occasionally 900 gpm
• No pumping-related water level drops observed in the Shallow Zone.
• Pumping tests concluded the water level in the Intermediate Zone dropped slightly when the CRWF was pumped at maximum capacity of (~900 gpm).
In 2016 a high pressure water main was extended from Mancelona to the CRWF to:

- Reduce volume of CRWF water used
- Reduce pumping frequency
- Plans in place to increase water storage capacity at the CRWF to further reduce need for high pumping rates.

**Hydraulic Testing – Water Main Extension**

![Graph showing drawdown in Well MW-6uCRWF with high rate events]

- High rate event (hydrant flushing)
- High rate events common (Pre-Expansion)
Early Detection

• In 2017 Nine new monitoring wells were installed strategically between potential downgradient receptors and the leading edge of the TCE plume (3 along Windy Hill, 5 near Shanty Creek and 1 along Del Mason Road).
• The new well nests will allow monitoring of “first detection” of TCE in each zone to continue as TCE moves beyond the CRWF area into areas where more residential wells occur.
• Early detection monitoring wells are being sampled twice a year.
• The new wells provide greater control on groundwater flow direction to enhance projection of plume movement in the future.
• As an additional safe guard, MDEQ contracts the Health Department to sample residential wells near the leading edge of TCE in groundwater.
Cedar River Sampling (Fall 2017) - TCE “Vents” to the Cedar River

- TCE is not detected in downstream river samples because TCE moves from the river to the air readily.
- Biological surveys find no adverse affects on the river’s ecology.
- TCE is not detected across the river.
- TCE in groundwater near the Cedar River is below 200 ppb.
Surface Water - Shanty Creek

- Four Stream Gauging & Flow Measurement Locations
- Seasonal flow variation assessed December 2016, May 2017 and September 2017 to evaluate average groundwater flux into Shanty Creek.
- Shanty Creek discharges to the Grass River

SG-2 Pond outfall

SG-3 Measured profile (Typ.)

SG-4 Upstream of M-88 Crossing
Results: In only ~1,200 feet Shanty Creek’s flow increases by ~3,200 gpm (continuously)

• Leading edge of plume ~3200 feet to northeast (~5-7 years travel time)

• TCE in groundwater above 200 ppb is ~2.1 miles upgradient (~18-25 years travel time)
Soil Vapor – 2017 Source Area

- Soil & water table sources?
- Geophysical Survey
- Installed soil vapor probes at 23 locations (typ. depth 5 feet)
- Nested soil vapor probes & paired groundwater samples to assess volatilization from water table
- Collected soil samples at soil vapor probe depths
- Installed temporary points to assess vapor cloud extent
Soil Vapor – 2017 Source Area Preliminary Summary

- Soil vapor cloud under the former building exceeds non-residential screening levels.
- **Additional results pending**
- TCE in vapor typ. increases with depth (water table)
- Low-level soil TCE results (consistent with 2006 source area investigation results)
Soil Vapor – 2017 Downgradient Plume Assessment

12 Vapor and 11 Water sample locations.

Vapor intrusion less likely when:

- TCE not at water table
- Increasing depth to groundwater

TCE NOT detected in soil vapor above new, lower screening levels
Future Activities

DEQ has set aside funding to:

- Continue groundwater investigations to track the TCE’s movement in the groundwater
- Sample existing private drinking water wells near the TCE impacted groundwater area
- Provide bottle water to affected residents (as needed)
- Extend the public water system
- Connect residences to the extended public water system
- Continue to monitor conditions at the Cedar River and Shanty Creek
- Continue to assess the potential soil vapor pathway
Questions

Interactive website: https://infrastructure.amecfw.com/wickes/