RACER Lansing Project Update

Plants 2, 3 & 6

Lansing, Michigan

December 17, 2014

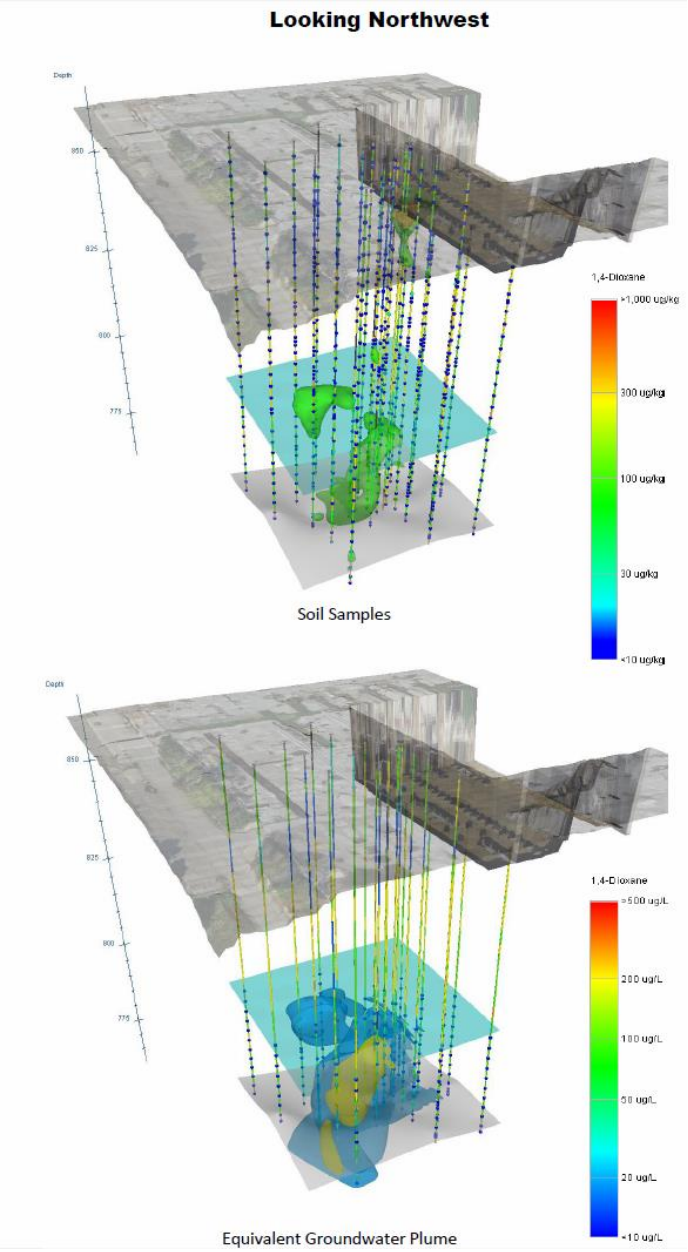
ARCADIS

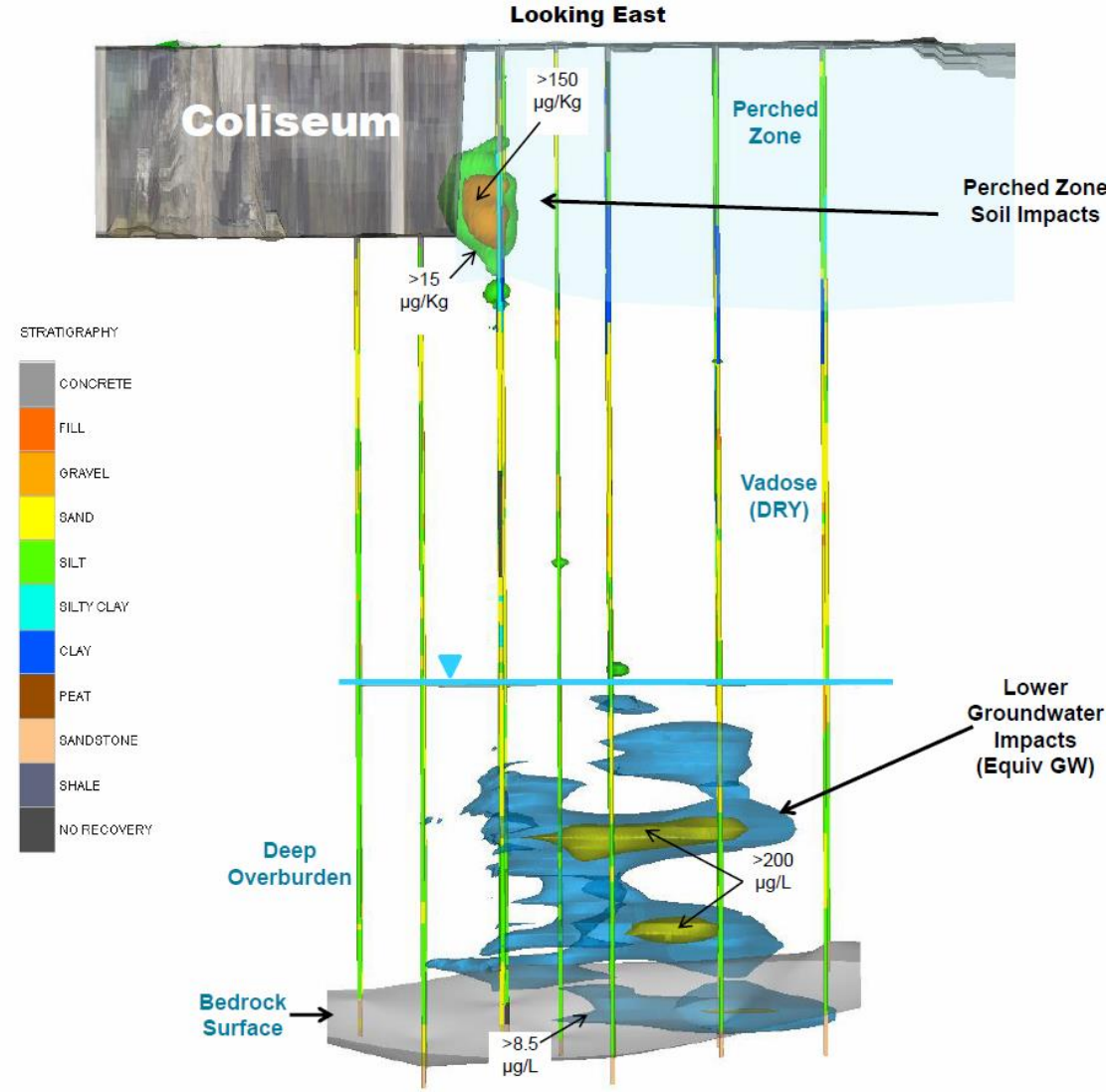
Agenda

- Redevelopment Update
- Pre-Design: Lower 1,4-D Source Area Report
- Plant 2 Deeper LNAPL Evaluation
- 3rd Quarter Sampling Results – Adams Plating
- Area 16 Decision Unit Evaluation
- Pre-Design: Hydraulic Testing Results
- Additional Items
  - BWL Letter/Response
  - PFM Data Update
  - Stormwater, Plant 6 Pre-Excavation Sampling, Demo related clarifier and concrete sampling, Coliseum filling
- Approximate Schedule

Pre-Design: Lower 1,4-Dioxane Source Area Report

Lower 1,4-Dioxane Source Area





Lower 1,4-Dioxane Source Area Report

- Perched zone impacts are limited in extent
  - Mass tied up in low permeability, unsaturated till
  - Leach testing indicates 1,4-dioxane could leach, but hydraulic characteristics suggest in-situ leaching limited
- Concentrations of other VOCs are generally low and do not impact the lower plume
- Footprint of the lower 1,4-dioxane plume smaller than previous estimates
- The total mass of the plume suggests that greater than 90% of the 1,4-dioxane released is located downgradient of the source area

Plant 2 LNAPL

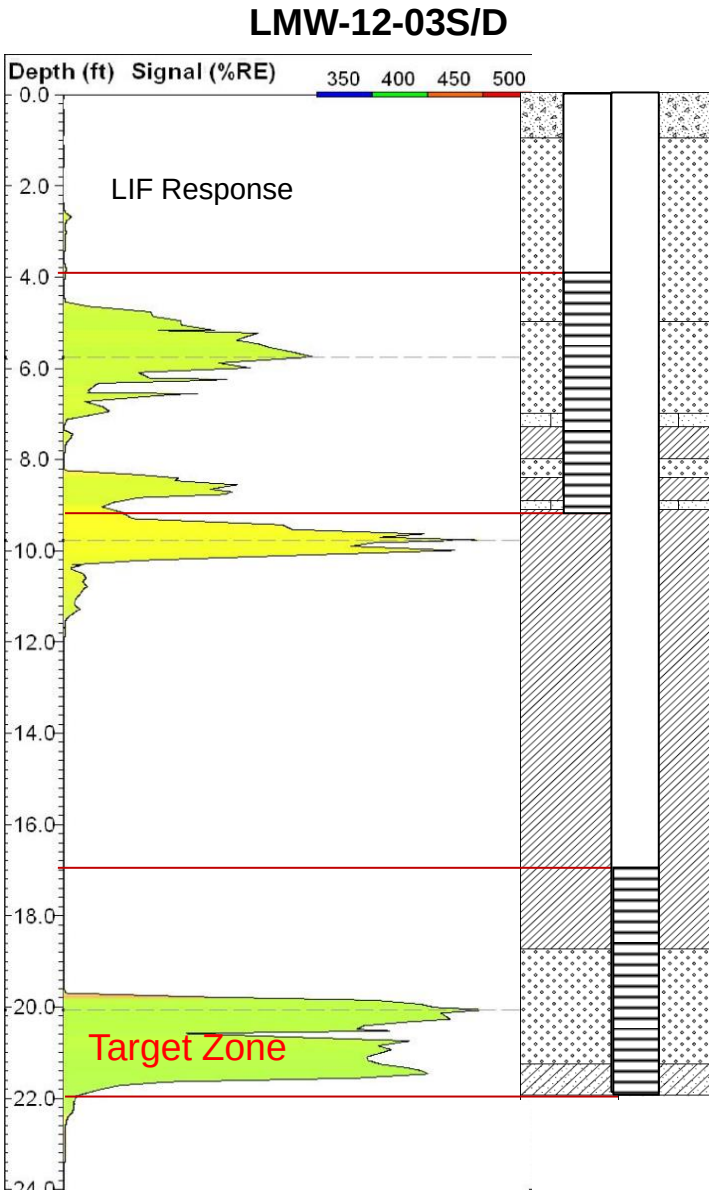
Plant 2 LNAPL Additional Scope

Drilling

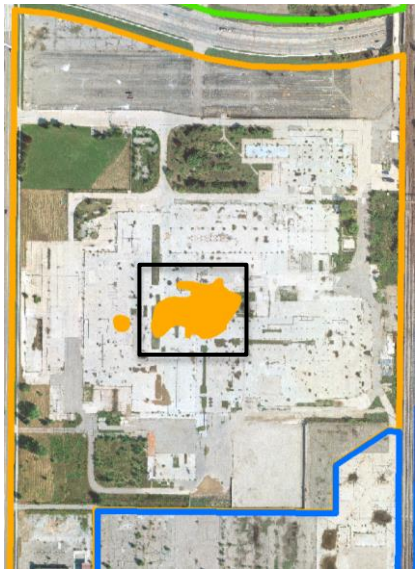
- Completed 6 soil borings
  - Collect soil sample from deeper LNAPL interval
- When deeper permeable zone encountered, installed monitoring well within lower zone

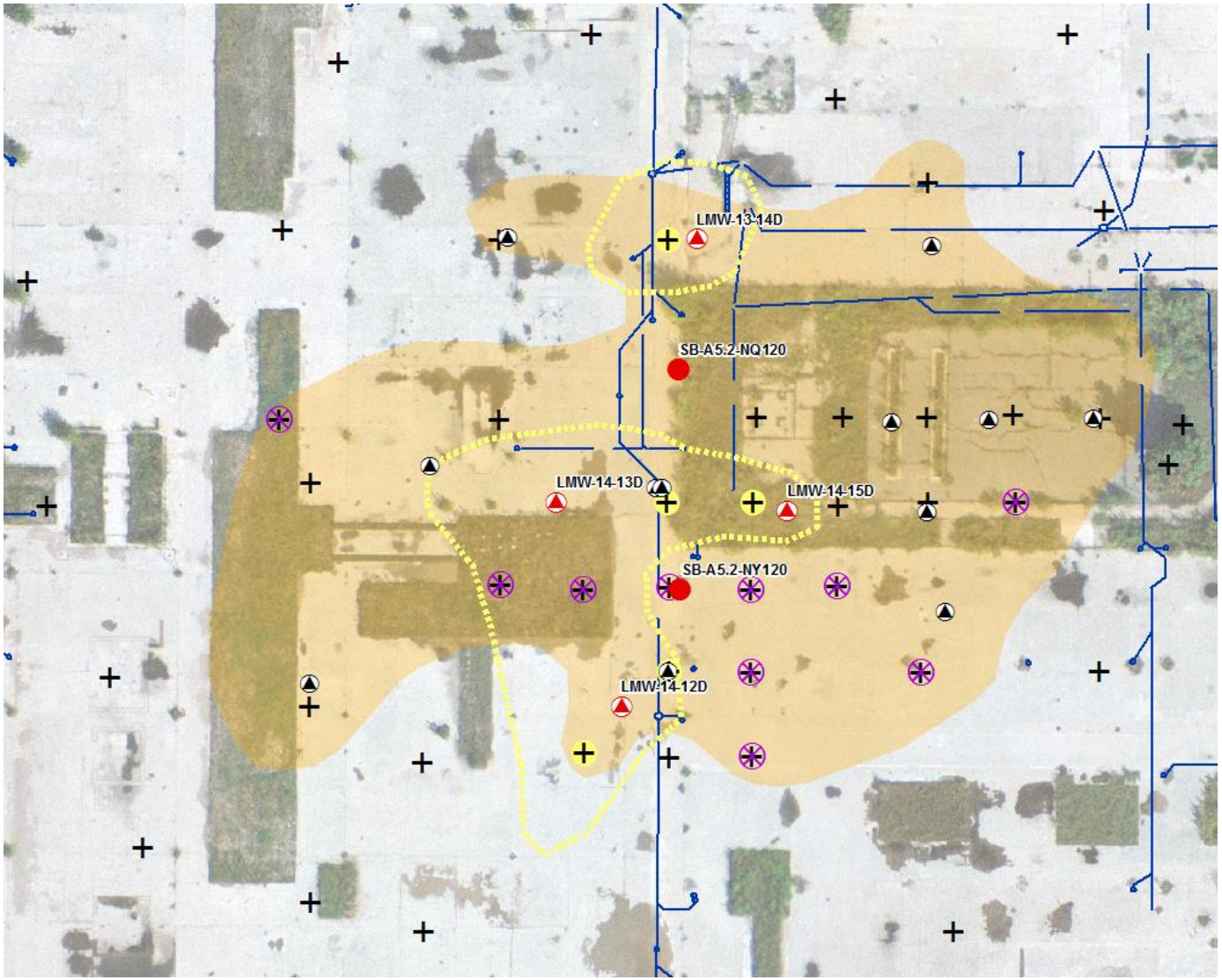
LNAPL Sampling

- Collected samples from shallow LNAPL wells
  - LMW-12-10, PMW-01 and LMW-12-08
- Monitoring thickness in new (deep) wells and collecting samples as available



Plant 2 Deeper LNAPL





LEGEND

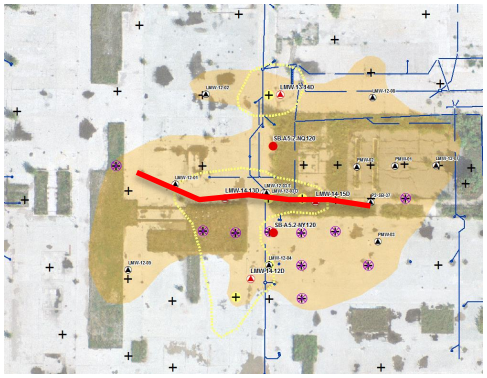
- NEW SOIL BORING
- NEW SOIL BORING/DEEPER LNAPL MONITORING WELL
- PREVIOUS LNAPL WELL

LIF DATA

- LIF BORING 2012
- LIF BORING REFUSAL <15'
- LIF DEEPER RESPONSE LOWER
- APPROXIMATE EXTENT DEEPER LNAPL
- STORM SEWER
- APPROXIMATE EXTENT SHALLOW LNAPL

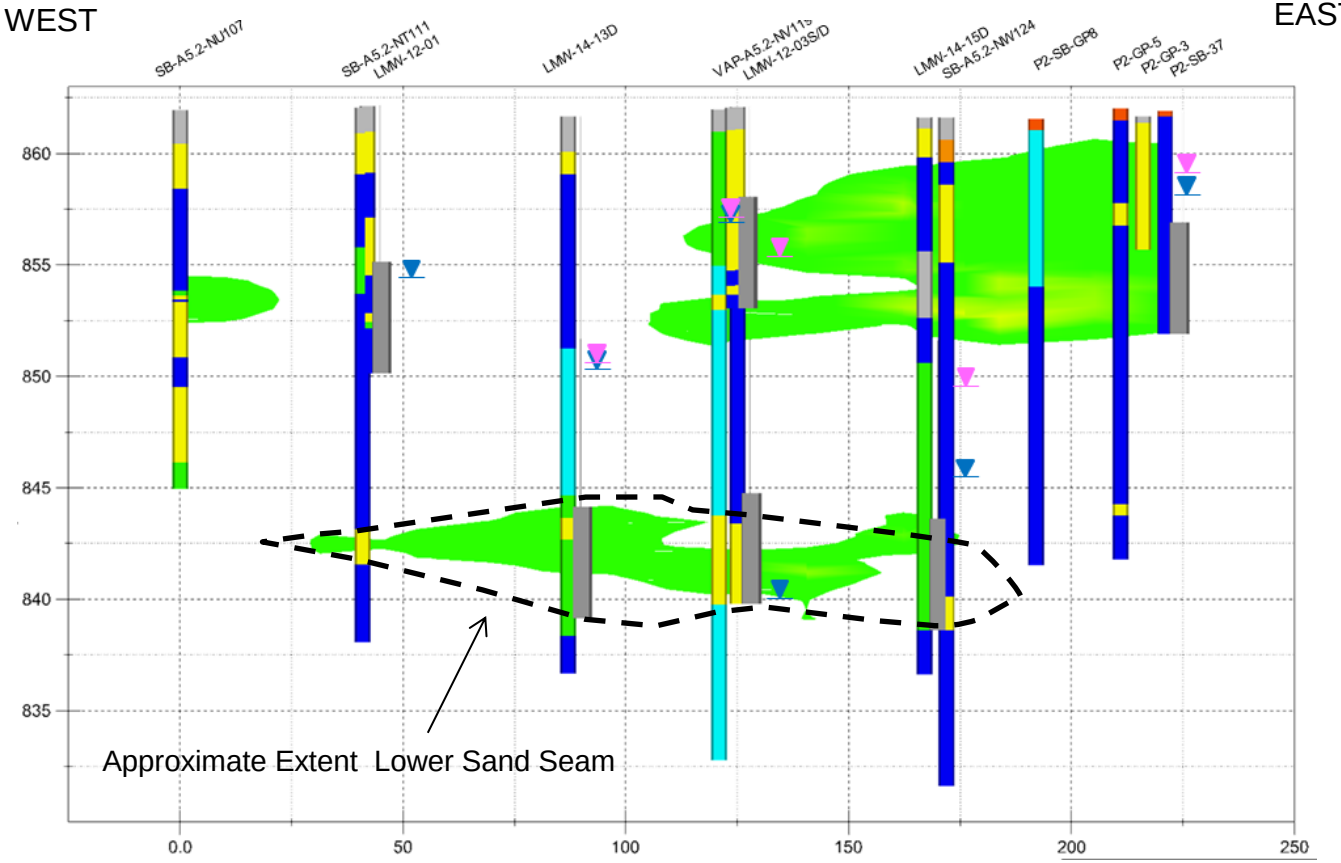
3D Model

Plant 2 LNAPL Cross-Section



WEST

EAST



STRATIGRAPHY

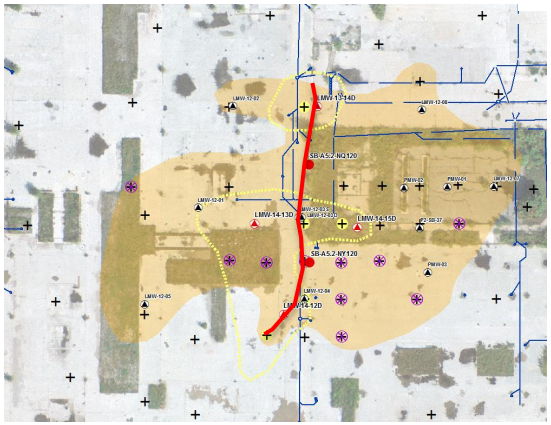
- CONCRETE/ASPHALT/TOPSOIL
- FILL
- GRAVEL/GRAVELLY SAND
- SAND
- SANDY SILT/SILT
- SANDY/SILTY CLAY
- CLAY
- PEAT
- SANDSTONE
- SHALE
- NO RECOVERY

Approximate LNAPL elevation
Approximate groundwater elevation

Approximate extent LNAPL

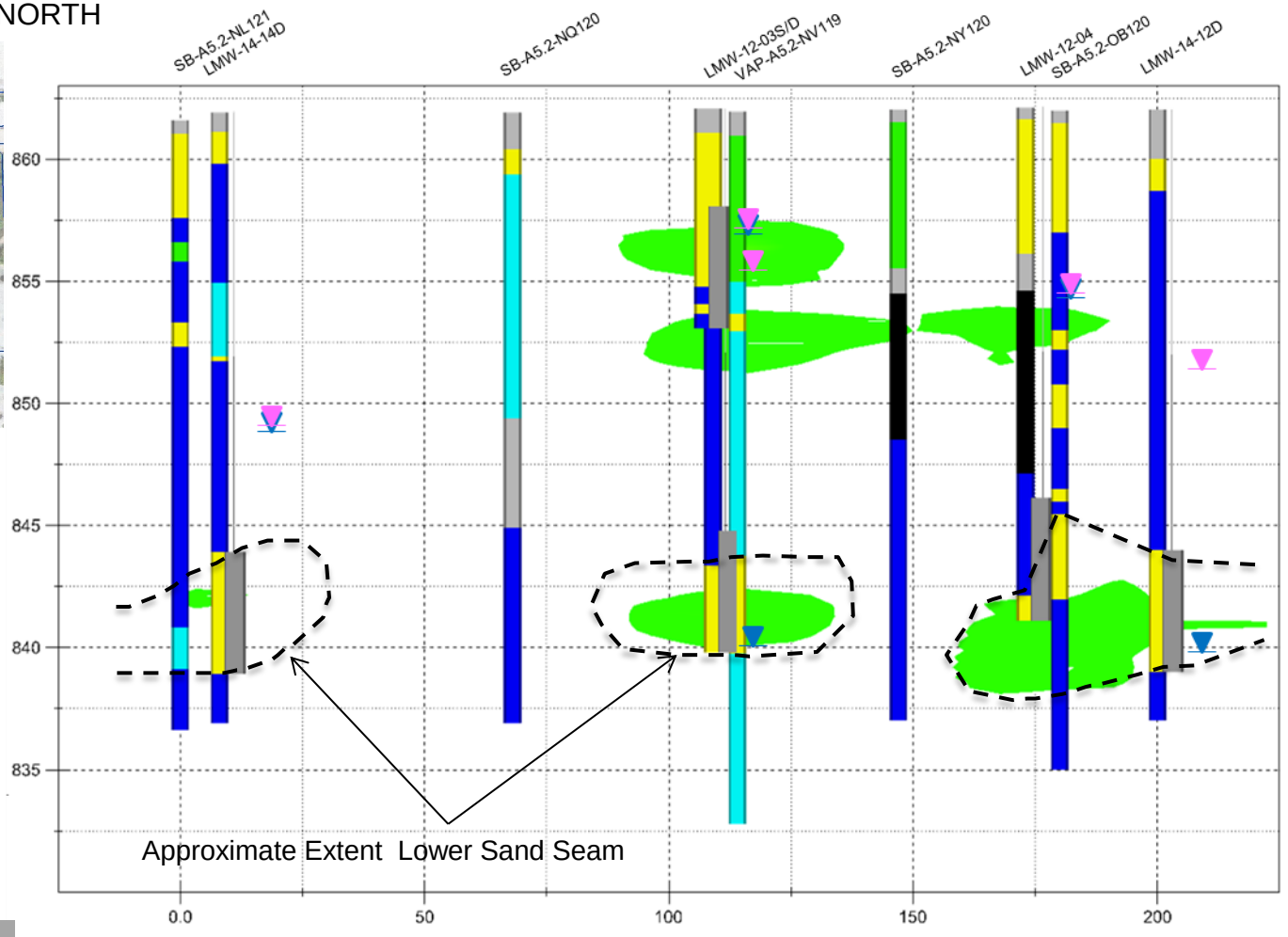
Well Screen

Plant 2 LNAPL Cross-Section



NORTH

SOUTH



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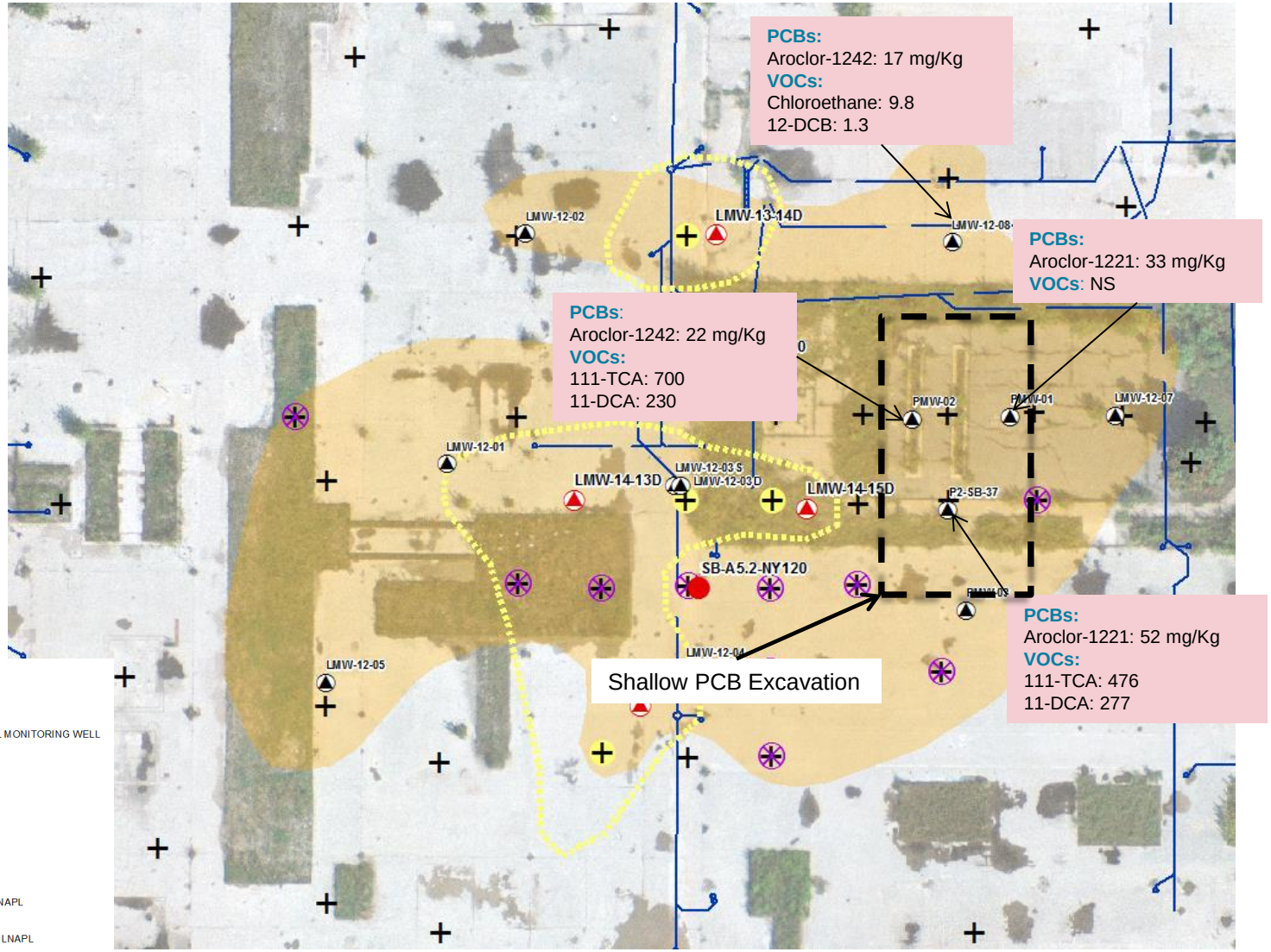
Approximate LNAPL elevation

Approximate groundwater elevation

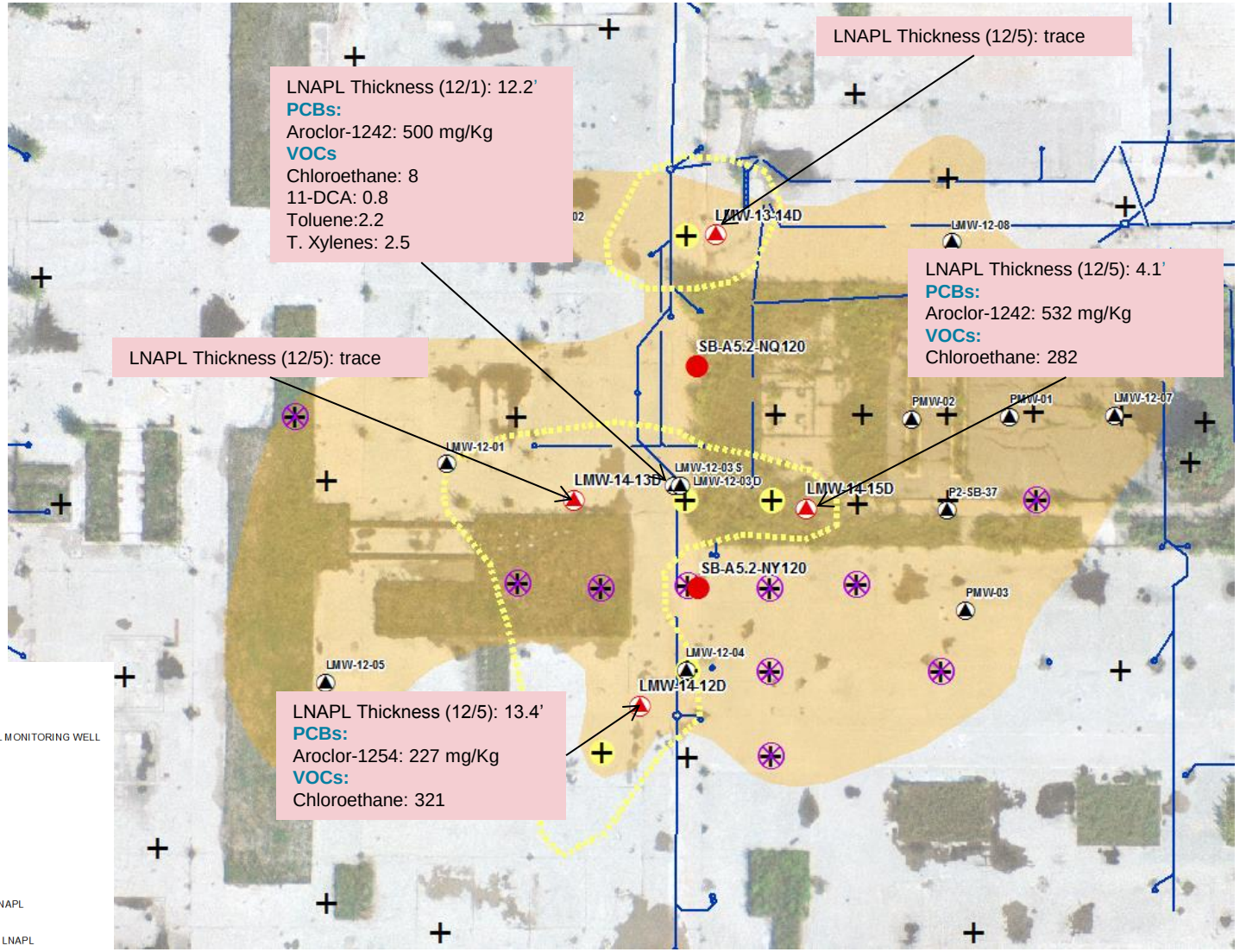
Approximate extent LNAPL

Well Screen

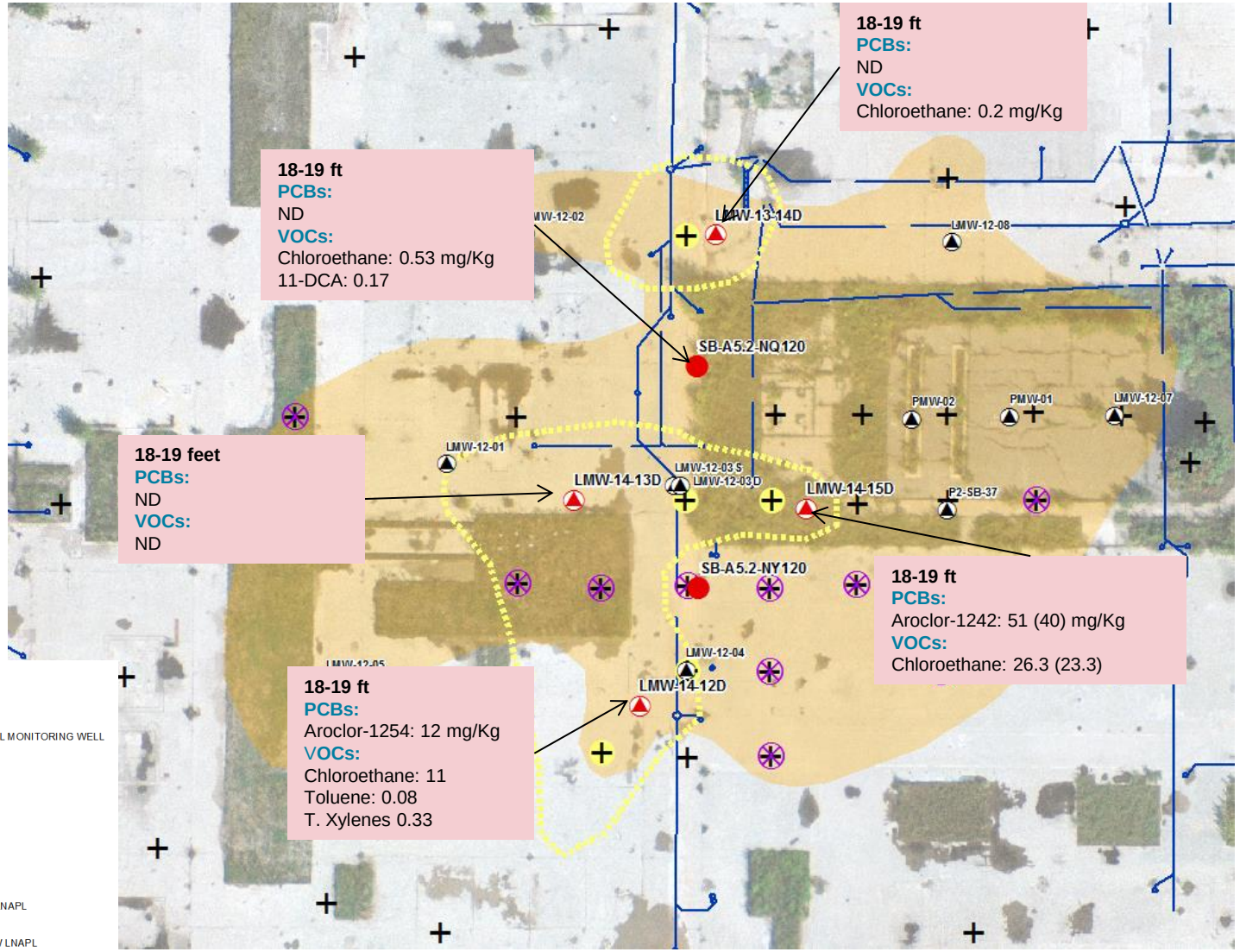
Plant 2 LNAPL Analytical - Shallow



Plant 2 LNAPL Analytical - Deeper



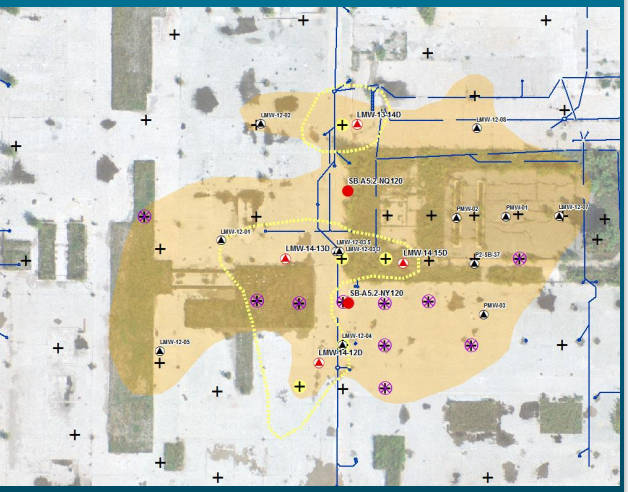
Plant 2 LNAPL Soil Analytical - Deeper



Summary

- Deeper LNAPL associated with a sand lens located between ~18 and 22 ft bgs
  - Confined conditions
  - Likely migrated deeper during lower water levels
- Deeper LNAPL characterized by higher concentrations of PCBs (227-546 ppm) and limited VOCs
- Shallow LNAPL characterized by relatively low PCBs (17-52 ppm) with TCA & DCA
  - 1,4-dioxane not detected (<3 ppm)
- Sand lens and deeper LNAPL delineated by surrounding soil and LIF borings

Path Forward



- Continue monitoring LNAPL thickness
  - Collect samples from LMW-14-13D & 14D, if possible
- Complete additional bail-down testing, as appropriate to verify LNAPL transmissivity
- Based on results, check risk and mobility
  - assume stable/not migrating
  - no risk of exposure
- Current proposed remedy adequate
  - add TSCA notification to deed restriction

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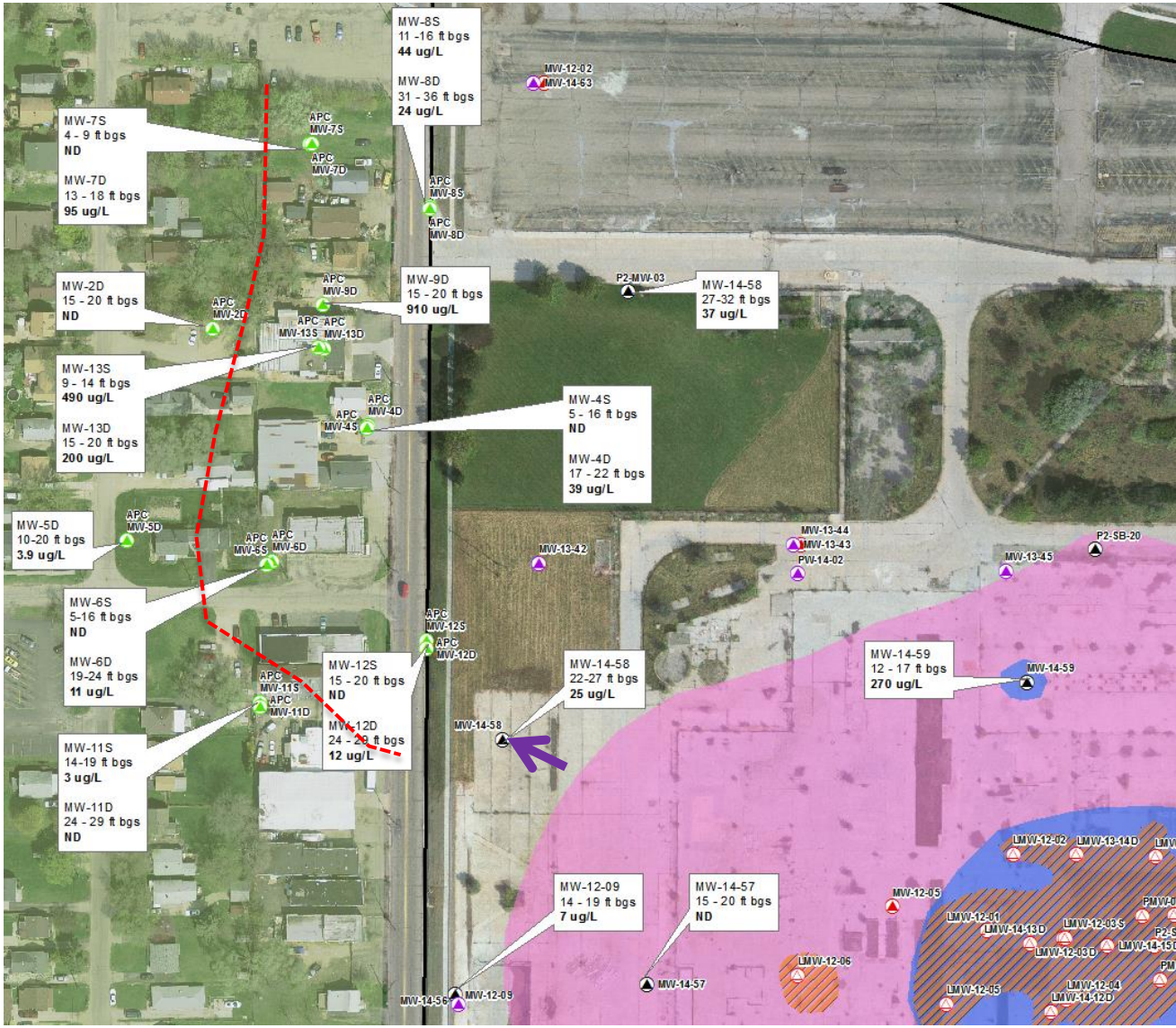
3rd Quarter Groundwater Sampling

Adams Plating 1,4-Dioxane Results

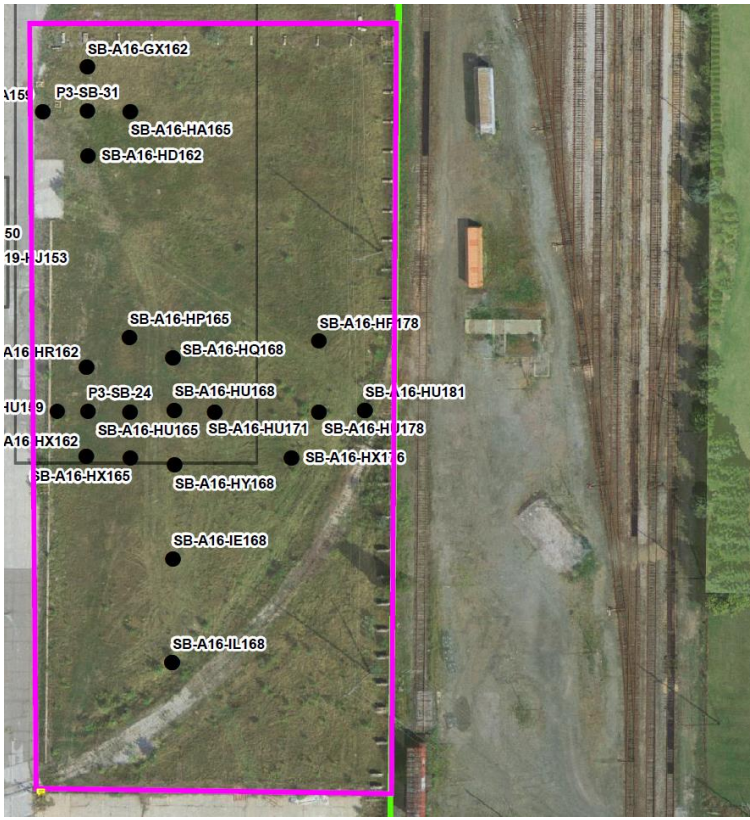
- APC results October 2014
- Unclear if perched 1,4-dioxane at MW-14-58 associated with APC or RACER
- APC Plume not defined vertically



Area 16 Update

Area 16 Soil Evaluation

- Evaluated potential exposure scenarios
  - On-site: potential future site workers
  - Off-site: park east of RR property
- Compared maximum detected soil concentrations to residential criteria
  - Direct contact
  - Inhalation of volatiles
  - Inhalation of particulates
- Identified constituents of potential concern (COPCs)
  - Surface soil (0-2 feet bgs): arsenic, lead
  - Combined surface and subsurface soil (0-15 feet bgs): arsenic, lead, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene



Area 16 Soil Evaluation

- Calculated 95% upper confidence limit on the mean (UCL) using USEPA's ProUCL software for an approximately 2.9-acre decision unit around Area 16

COPC	Frequency of Detection	Maximum Detected (mg/kg)	Residential Direct Contact Criteria (RDC) (mg/kg)	Number of Exceedances	95% UCL (mg/kg)	Does 95% UCL Exceed RDC?
Surface Soil (0-2 ft bgs)						
Arsenic	18/18	15.1	7.6	2	6.7	No
Lead	15/15	427	400	1	162	No
Surface and Subsurface Soil (0-15 feet bgs)						
Arsenic	48/48	16.7	7.6	6	4.2	No
Lead	40/40	7,230	400	3	1037	YES (a)
Benzo(a)anthracene	16/31	36	20	1	6.5	No
Benzo(a)pyrene	15/31	33	2	1	6.0	YES
Benzo(b)fluoranthene	17/31	62	20	1	11.1	No

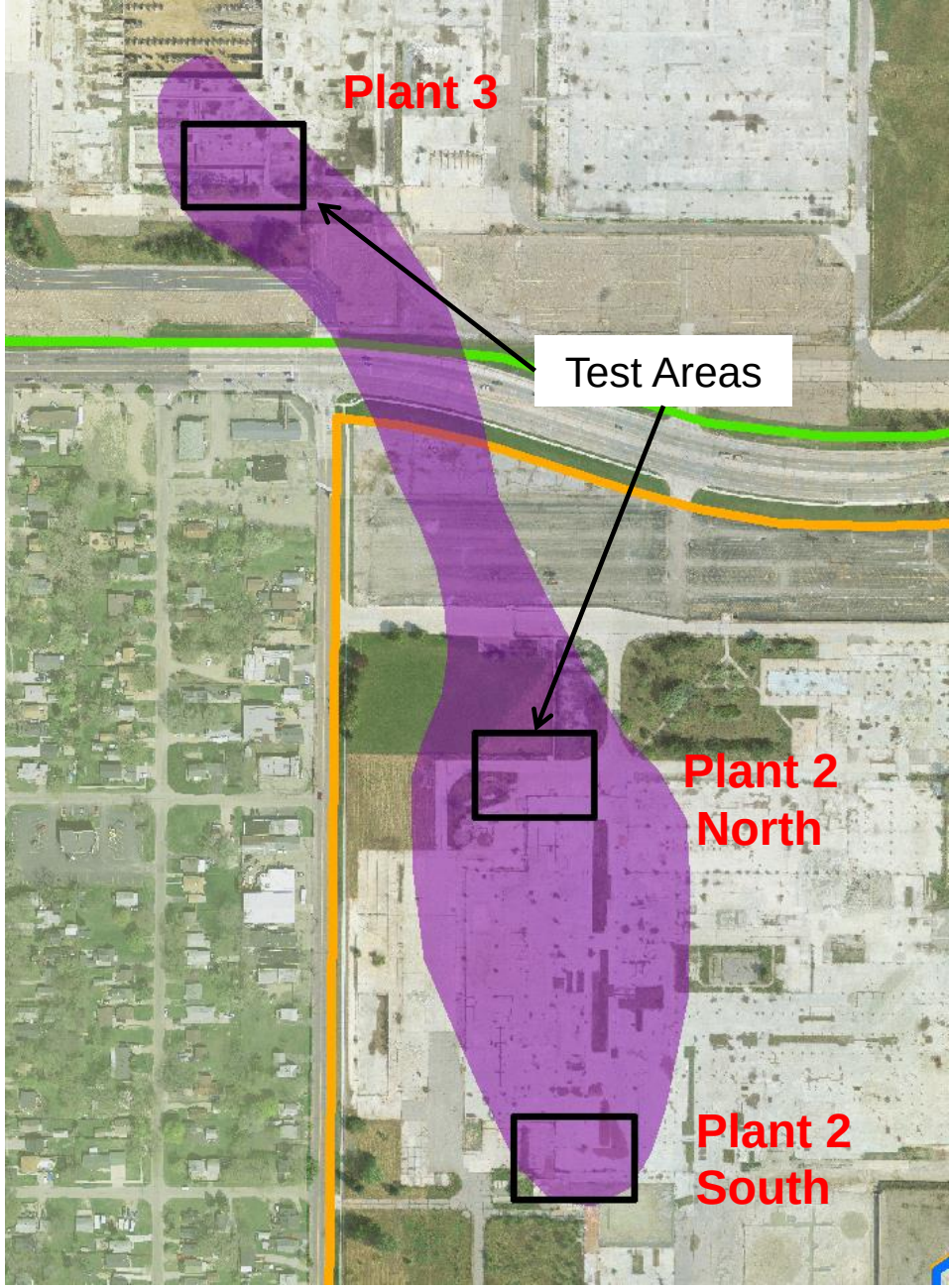
(a) USEPA guidance recommends the use of the arithmetic average as the exposure point concentration for lead. The calculated arithmetic average lead concentration is 243 mg/kg, which is below the RDC criterion of 400 mg/kg.

- Results
  - Subsurface soil impacts (i.e. lead & benzo(a)pyrene) can be left in place with a deed restriction
  - If surface soil concentrations at park are similar to or less than Area 16, soil conditions do not pose an unacceptable risk
  - Memo to MDEQ will be prepared to summarize this evaluation

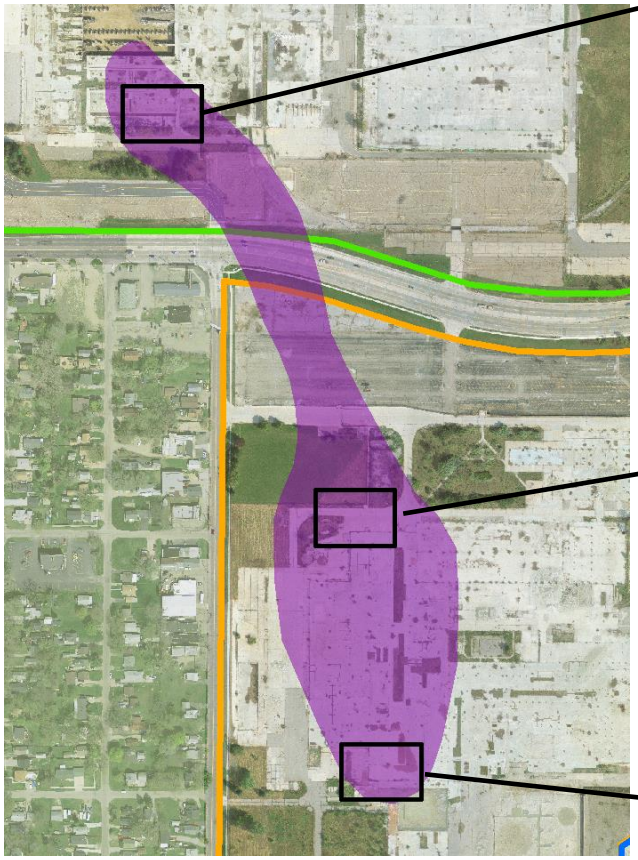
Pre-Design: Lower 1,4-Dioxane Hydraulic Testing

Scope of Work

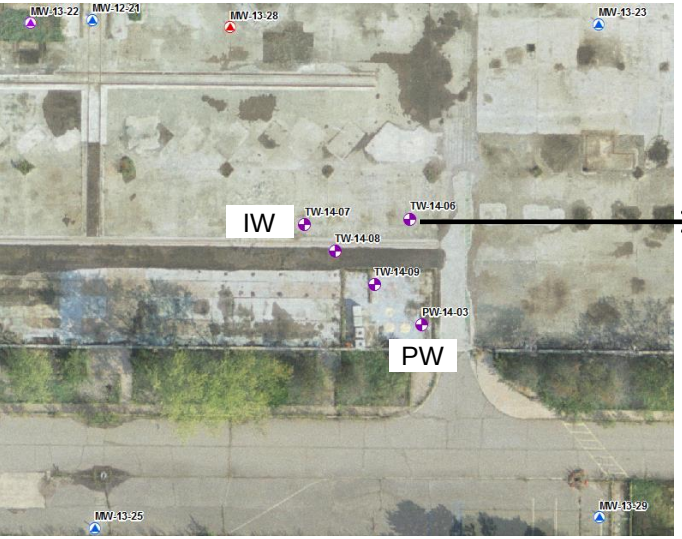
- Step Extraction Test
- Long-Term Pumping Test
- Long-Term Injection Test (P2N & P3 Only)
- Recirculation Test

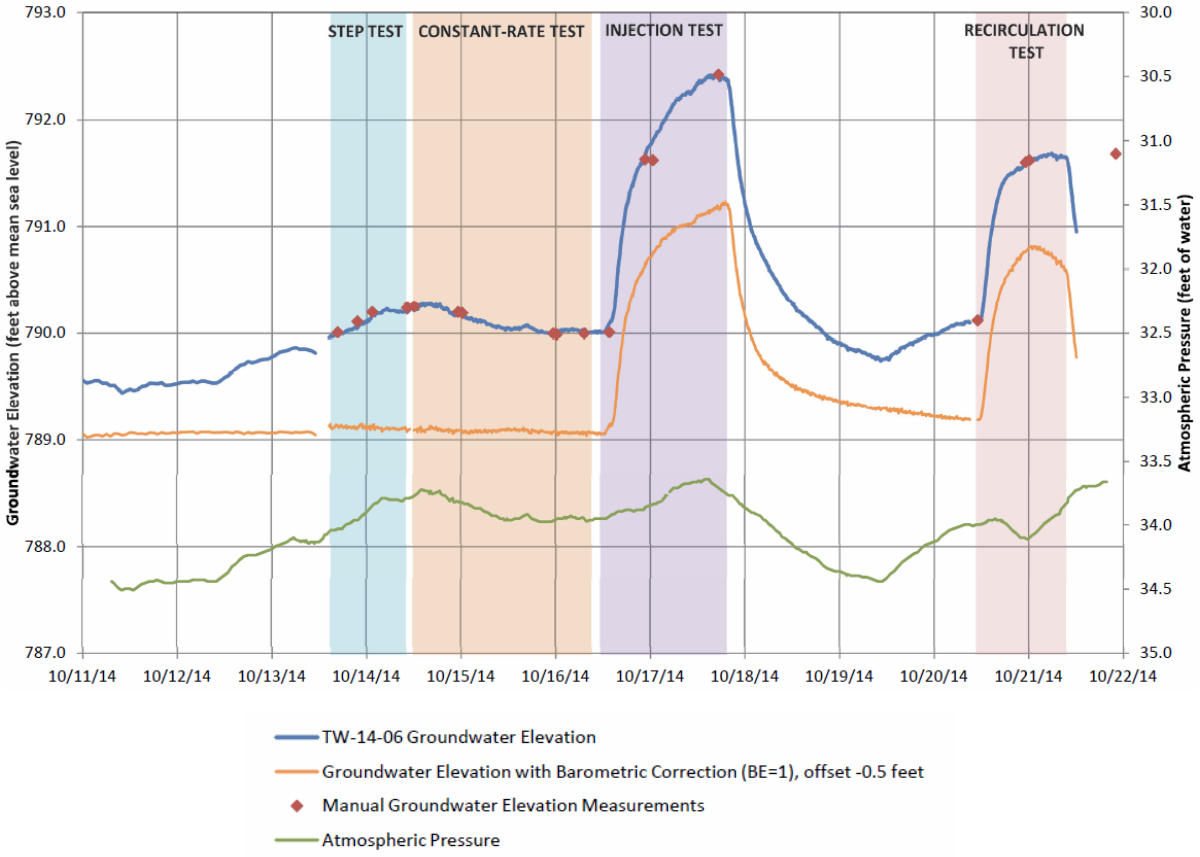


Well Locations



Hydrograph – Plant 3





- Pumping rate: 0.3 gpm
- Injection Rate: 5.0 gpm
- Drawdown due to pumping not evident in monitoring wells

Area	Data Analyzed	Start Date/Time	Duration (hours)	Rate (gpm)	Estimated K (ft/day)
P3	Injection Test	10/16/2014 13:38	30	(Inj.) 5.0	8.7 - 16.4

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Hydraulic Parameters – Plant 3 Injection Test

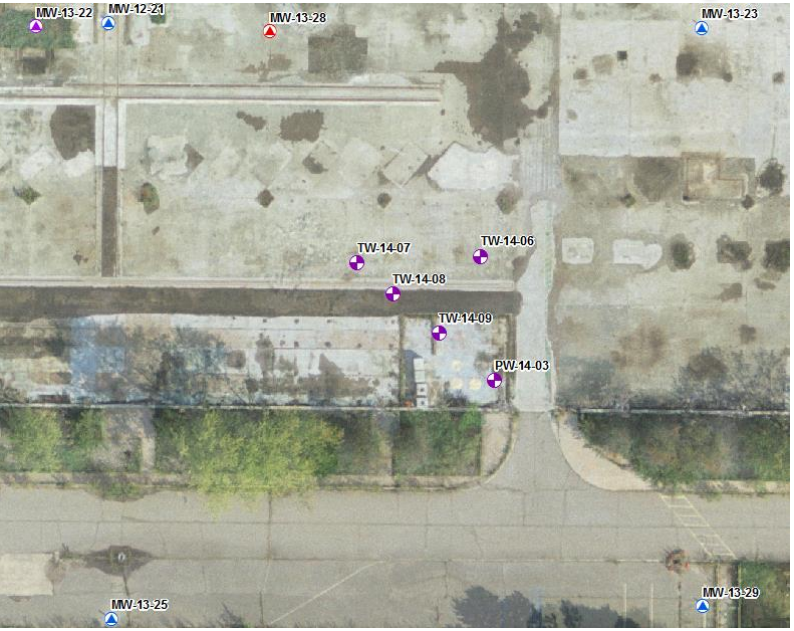
LEGEND

- DEEP OVERBURDEN MONITORING WELL
- WEATHERED BEDROCK MONITORING WELL
- BEDROCK MONITORING WELL
- HYDRUALIC TESTING WELLS
- PROPERTY BOUNDARY

MD – Maximum Displacement
K – Hydraulic Conductivity
NR – No Response

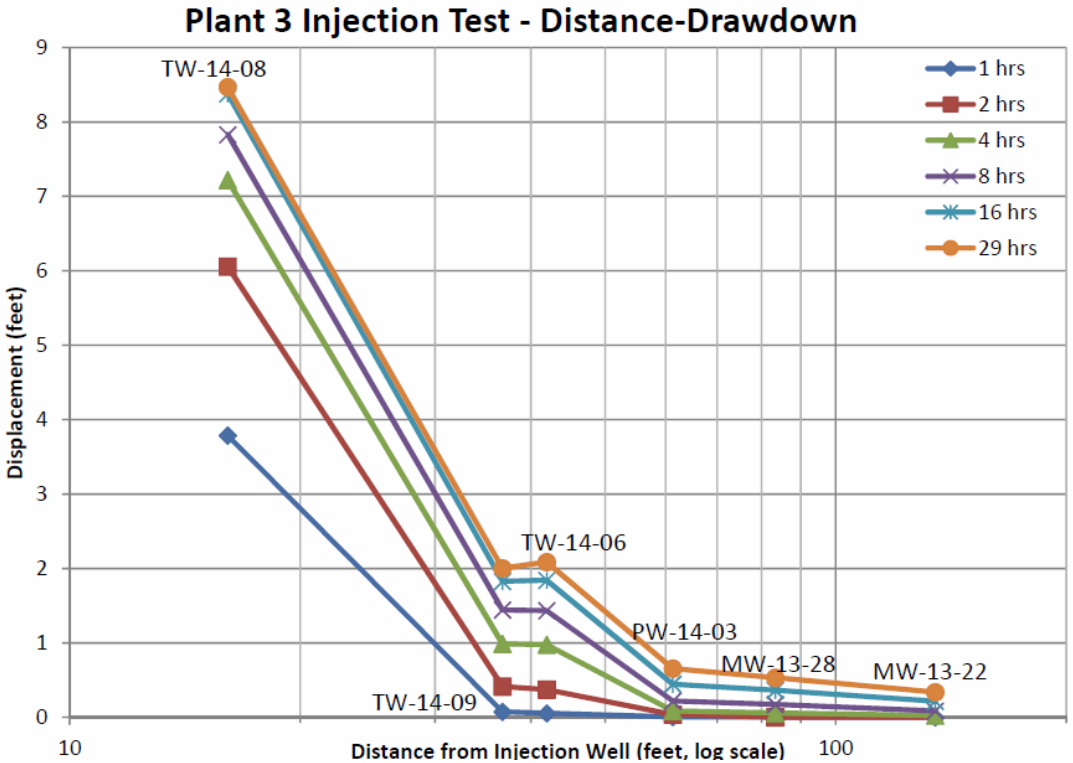
- Response in up-gradient bedrock and weathered bedrock wells
- No response in deep overburden

Distance vs. Displacement – Plant 3

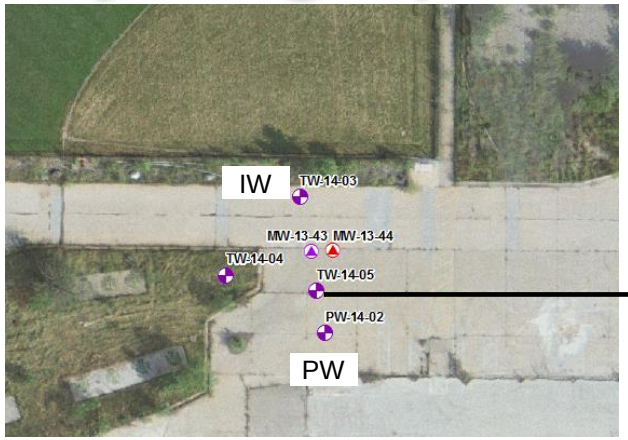


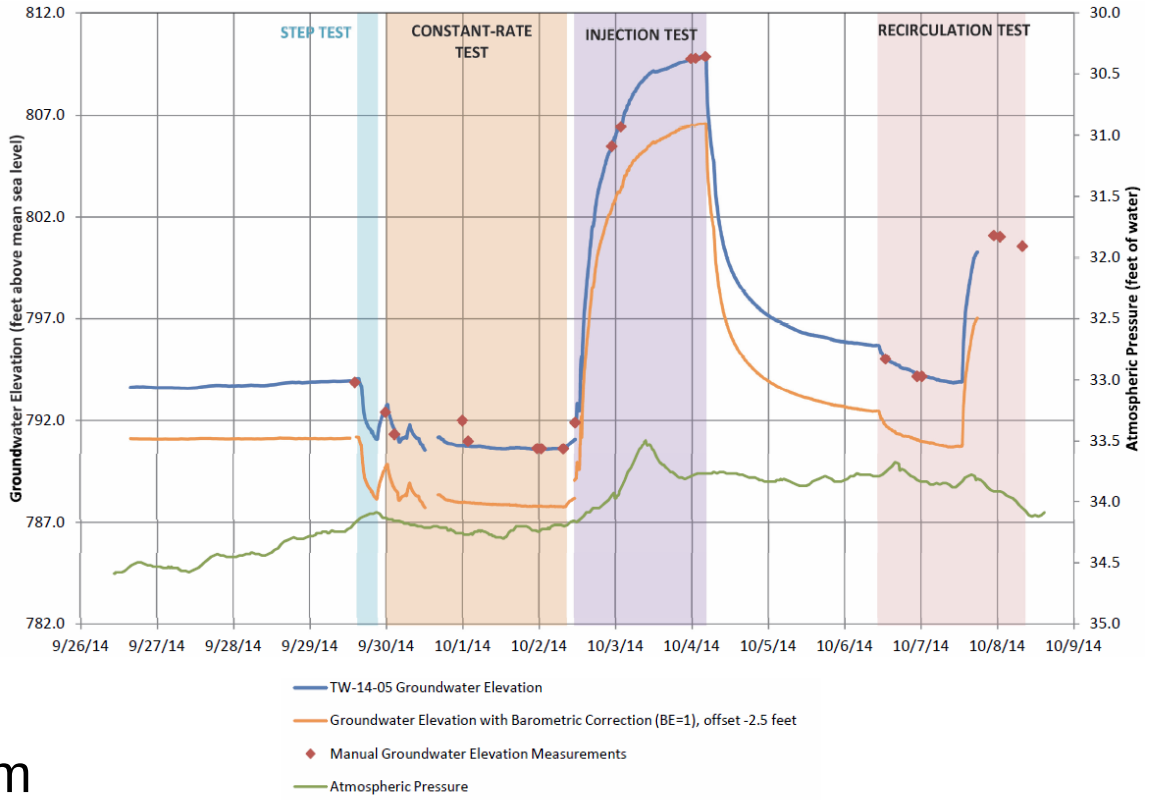
Displacement at selected times during injection test (ft)

Well ID	Distance (ft)	1 hrs	2 hrs	4 hrs	8 hrs	16 hrs	29 hrs
TW-14-07	0.0	70.46	68.15	67.90	70.56	69.13	69.45
TW-14-08	16	3.79	6.06	7.22	7.83	8.38	8.47
TW-14-09	37	0.07	0.42	0.99	1.44	1.83	2.00
TW-14-06	42	0.05	0.37	0.98	1.43	1.84	2.09
PW-14-03	61	0.01	0.03	0.09	0.22	0.45	0.66
MW-13-28	83	0.00	0.00	0.06	0.17	0.36	0.53
MW-13-22	135	0.00	0.00	0.02	0.08	0.22	0.34



Hydrograph – Plant 2



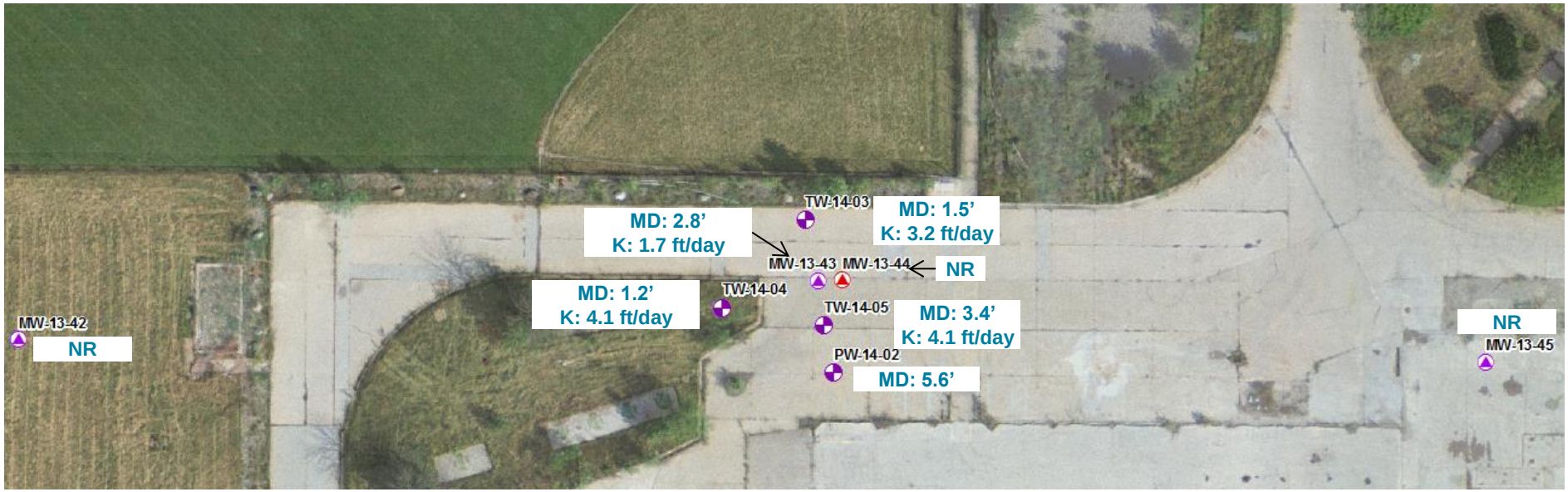


- Pumping Rate: 0.5 gpm
- Injection Rate: 6.1 - 8 gpm

Area	Data Analyzed	Start Date/Time	Duration (hours)	Rate (gpm)	Estimated K (ft/day)
P2N	CRT - early time	9/29/2014 15:13	15	1.2, 0.9	0.8 - 2.5
P2N	CRT - late time	9/30/2014 16:31	40	0.5	1.7 - 4.1
P2N	Injection Test	10/2/2014 13:18	39	(Inj.) 6.1 - 8	1.9 - 3.2

CRT = Constant Rate Test

Hydraulic Parameters – CRT Plant 2 North



- Pumping Data
- No response in bedrock
- No response in weathered bedrock east-west

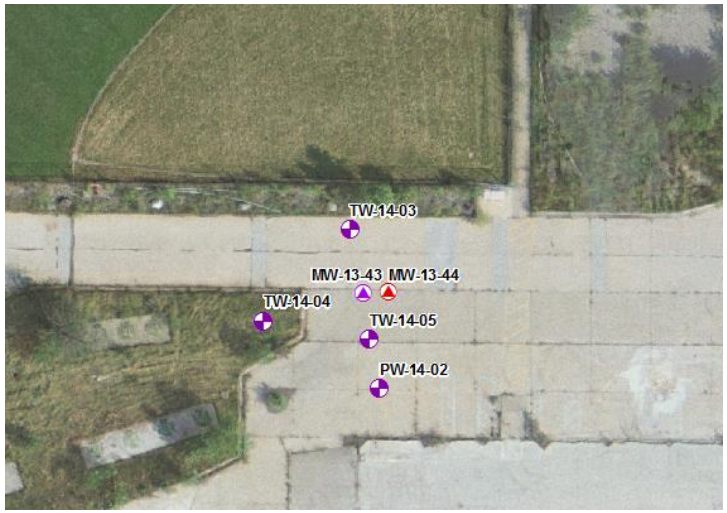
LEGEND

- DEEP OVERBURDEN MONITORING WELL
- WEATHERED BEDROCK MONITORING WELL
- BEDROCK MONITORING WELL
- HYDRUALIC TESTING WELLS
- PROPERTY BOUNDARY

MD – Maximum Displacement
K – Hydraulic Conductivity
NR – No Response

Note: Late Time Data Results

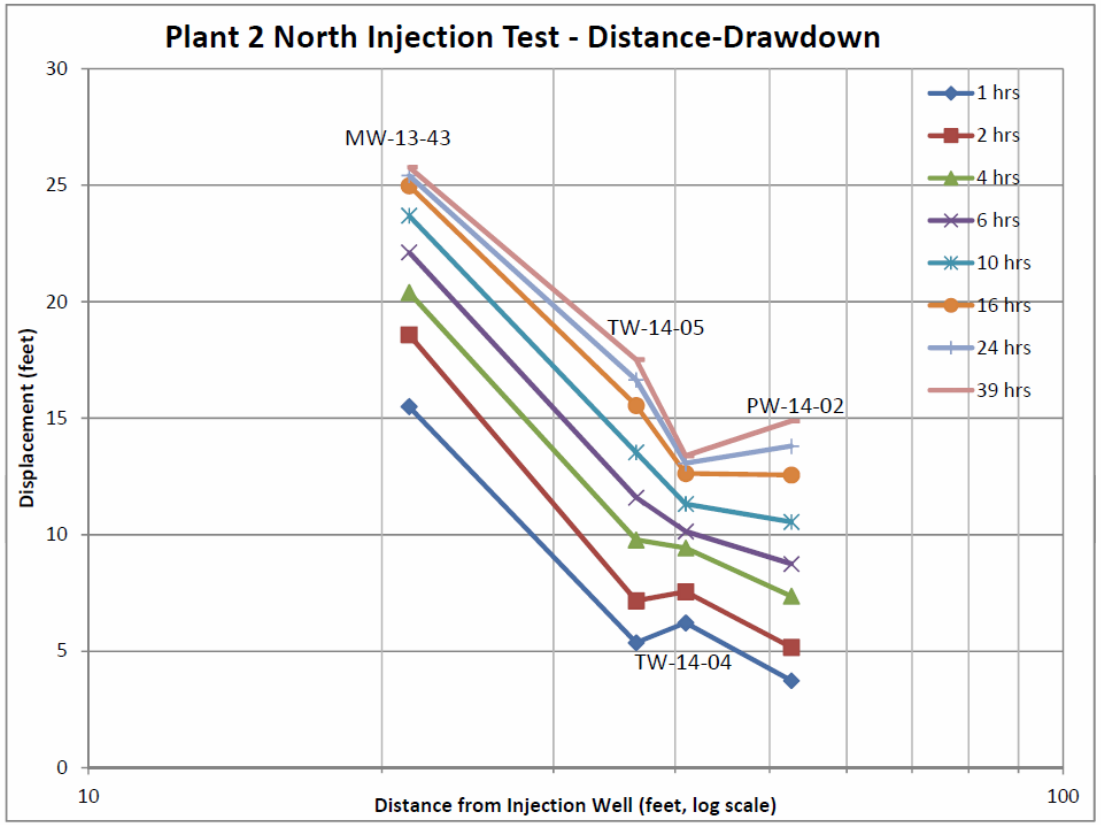
Distance vs. Drawdown – Plant 2



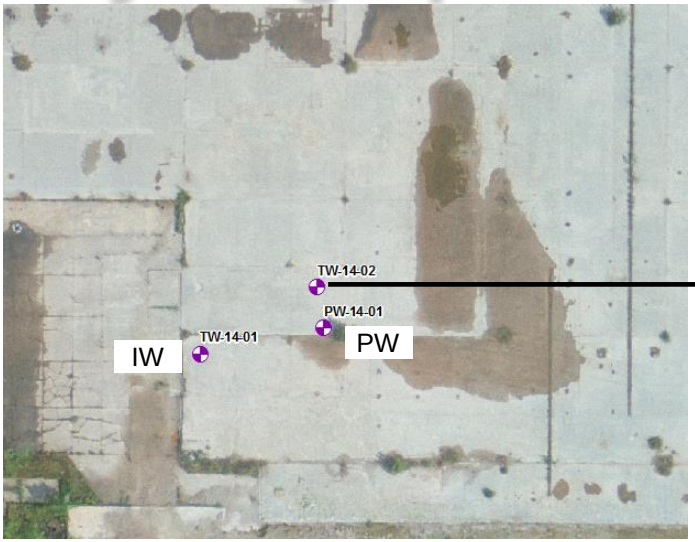
Displacement at selected times during injection test (ft)

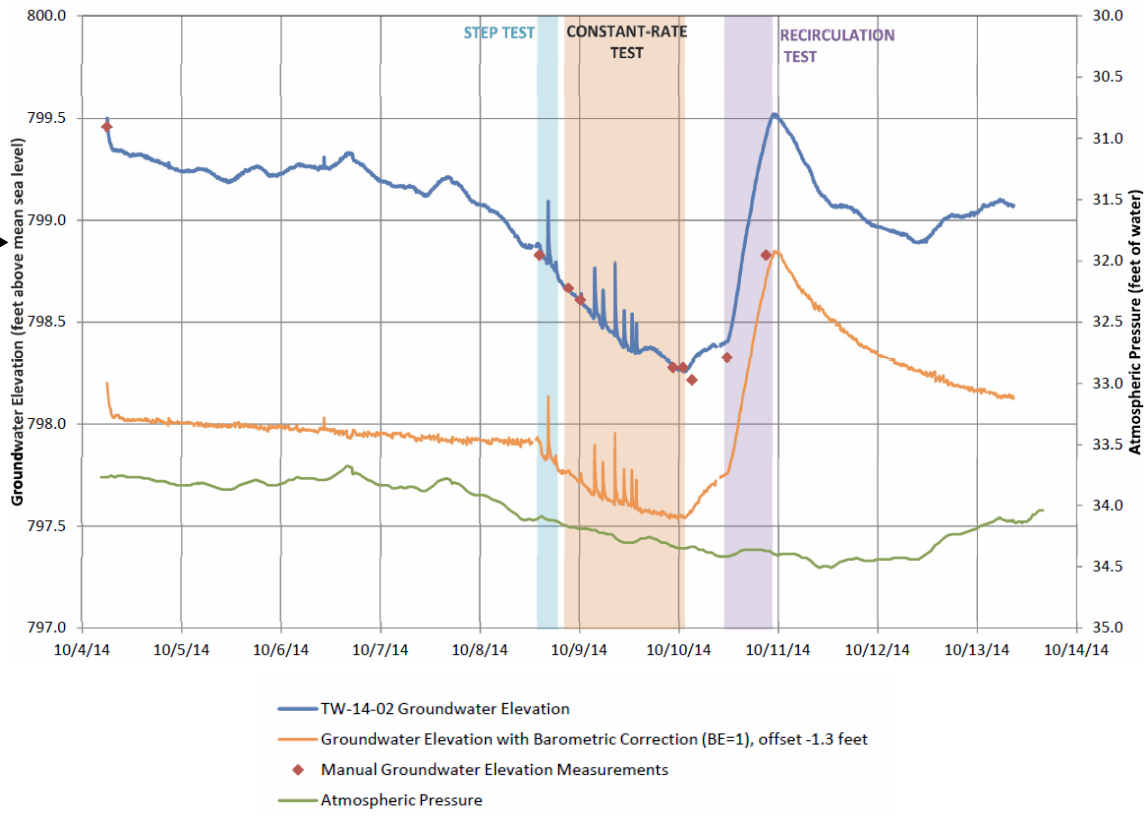
Well ID	Distance (ft)	1 hrs	2 hrs	4 hrs	6 hrs	10 hrs	16 hrs	24 hrs	39 hrs
TW-14-03	0.5	66.33	66.30	66.63	66.04	66.20	66.00	65.60	65.66
MW-13-43	21	15.50	18.59	20.40	22.12	23.70	24.98	25.42	25.78
TW-14-05	36	5.37	7.17	9.78	11.60	13.54	15.55	16.65	17.52
TW-14-04	41	6.22	7.55	9.43	10.14	11.32	12.63	13.07	13.38
PW-14-02	53	3.74	5.17	7.36	8.75	10.55	12.57	13.80	14.88

- Increase in head at PW during injection allowed increase in pumping rate



Hydrograph – Plant 2 South





- No constant rate injection test performed
- Pumping Rate: 0.1 gpm
- Injection Rate: 0.8 gpm

Area	Data Analyzed	Start Date/Time	Duration (hours)	Rate (gpm)	Estimated K (ft/day)
P2S	CRT- late time	10/8/2014 20:51	28	0.1	0.7 - 1.3
P2S	CRT - full duration	10/8/2014 13:58	35	0.5, 0.25, **0.1**	0.6 - 1.0

CRT = Constant Rate Test

Hydraulic Parameters – CRT Plant 2 South

- Pumping Data
- Response limited by pumping rate

LEGEND

- DEEP OVERBURDEN MONITORING WELL
- WEATHERED BEDROCK MONITORING WELL
- BEDROCK MONITORING WELL
- HYDRUALIC TESTING WELLS
- PROPERTY BOUNDARY

MD – Maximum Displacement
K – Hydraulic Conductivity
NR – No Response

Note: Late Time Data Results

Recirculation Test Summary

Pumping Well	Plant	Pumping Alone			During Injection		
		Rate (gpm)	Drawdown (feet)	Specific Capacity (gpm/ft)	Rate (gpm)	Drawdown (feet)	Specific Capacity (gpm/ft)
PW-14-01	P2S	0.1	7.92	**0.01**	0.1	4.6	**0.02**
PW-14-02	P2N	0.5	5.61	**0.09**	1.5	5.25	**0.29**
PW-14-03	P3	0.3	6.92	**0.04**	0.4	8.13	**0.05**

- In each case, pumping capacity was increased during recirculation

Summary

- Hydraulic conductivity higher in the Grand River Formation
  - Grand River: 9 - 16 ft/day
  - Saginaw: 0.8 - 4 ft/day
- The vertical anisotropy is higher in the Saginaw Formation consistent with CSM
- Extraction is limited by the saturated thickness of the weathered bedrock
  - Easier to inject than extract
- Specific capacity can be increased by recirculation
- Due to limited stress applied during the tests, storage parameters not quantified

Path Forward

Design of the remedy may include:

- Additional injection / flushing
- Bio-augmentation/stimulation
- Oxidant Injection

Injection-heavy remedy requires additional quantification of weathered bedrock unit:

- Tracer study options:
  - Dose Response (porosity)
  - Downgradient monitoring (velocity)
  - ISCO pilot study (oxidant demand/design parameters)

Other Items

BWL Comment Letter

LANSING BWL
Hometown People. Hometown Power.

November 11, 2014

Dave Favero
Deputy Cleanup Manager, RACER Trust
500 Woodward Avenue, Suite 1510
Detroit, MI 48226

Mr.Favero,

Thank you for providing us the opportunity to comment on the transducer study report and on the Stability Assessment of the 1,4 dioxane plume near General Motors Plants, 2,3 and 6 in the City of Lansing and in Lansing Township. We appreciate the effort you have made to include the BWL in these discussions and look forward to our continued collaboration. Our comments follow.

With regard to the transducer study, we had observed downward vertical gradients at the RACER site, and were concerned about the potential for downward migration into deeper bedrock zones that might not be monitored by RACER. After looking more closely at the vertical gradient and transducer study data with respect to geology, we noted that pumping had little effect on water levels for monitoring wells screened in the Saginaw formation (southern portion of the RACER site) where hydraulic gradients were greatest, while pumping had the greatest effect on water levels for monitoring wells screened in the Grand River formation (closer to the "coliseum"), where vertical gradients were not strongly downward. These observations suggest that the drawdown observed during the pumping tests were a result of horizontal transmittal of pressure head through the more permeable Grand River formation, while the Saginaw formation present beneath the southern portion of the RACER site is less permeable. In other words, it appears the hydraulic connection is poor where vertical gradients are large, and vertical gradients are not strongly downward where the hydraulic connection is good. Together these two geologic conditions improve our confidence that the plume will not readily migrate downward into the Saginaw formation.

We do have some concerns with the September 17, 2014 Stability Assessment. The Mann-Kendall test can be effective but should be accompanied by a companion analysis (graphical, statistical or other) that demonstrates a mechanism, such as biodegradation, to explain plume stability. Also, the Mann-Kendall generally requires eight samples to achieve statistical validity and none of the evaluated points show that many samples. We would like to see the Mann-Kendall results based on at least eight samples at each point. We also noted that the section on implications for remediation of the deep overburden/weathered bedrock (Section 3.3) was not updated with results of the passive flux meter assessment. This information should be included in the assessment. Because of these and other issues, we have heightened concern that confining monitoring to an unnamed "subset of COCs and monitoring wells" will not be adequate to prove plume stability. We would feel most confident in the assessment if monitoring of COCs in wells both within and downgradient of the plume continues, at a minimum, until the above concerns are addressed.

Again, thank you for the opportunity to comment. If you have questions please don't hesitate to call.

Sincerely,

Bill Maier
Water Quality Administrator
Office Phone: 517-702-6813
email: wfm@lbwl.com

1201 S. Washington Ave | PO Box 13007 | Lansing, MI | 48901-3007 | 517-702-6006 | www.lbwl.com

RE: PFM/Transducer Study & Geochem/Plume Stability Assessment

- Agree that vertical migration and risk to Saginaw Aquifer appears limited based on transducer study
- Concerned regarding preliminary statistical analysis for plume stability
  - Request analysis with additional samples
  - Request continued robust monitoring program

Response to BWL Comment Letter

Acknowledged the need for a continued robust monitoring program

- Provided approved Interim Groundwater Monitoring Plan
- Emphasized need to continually evaluate the plume stability
- Annual report forthcoming will build on preliminary plume stability analysis

Passive Flux Meter Analysis - Revision

Passive Flux Meters provide “Darcy Velocity”

$$V = K\,i$$

K = hydraulic conductivity

i = hydraulic gradient

- 25 - 80 ft/year

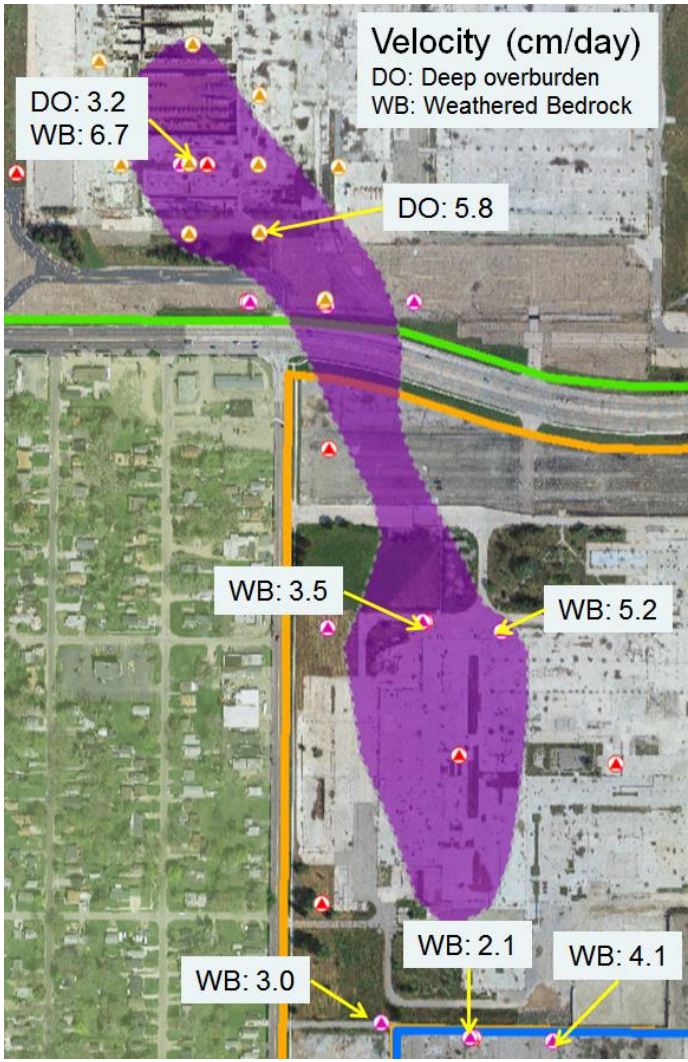
Requires porosity to convert to seepage (plume) velocity:

$$v = Ki / n$$

n = porosity

Overlooked during preliminary analysis - Darcy velocity was presented as seepage velocity

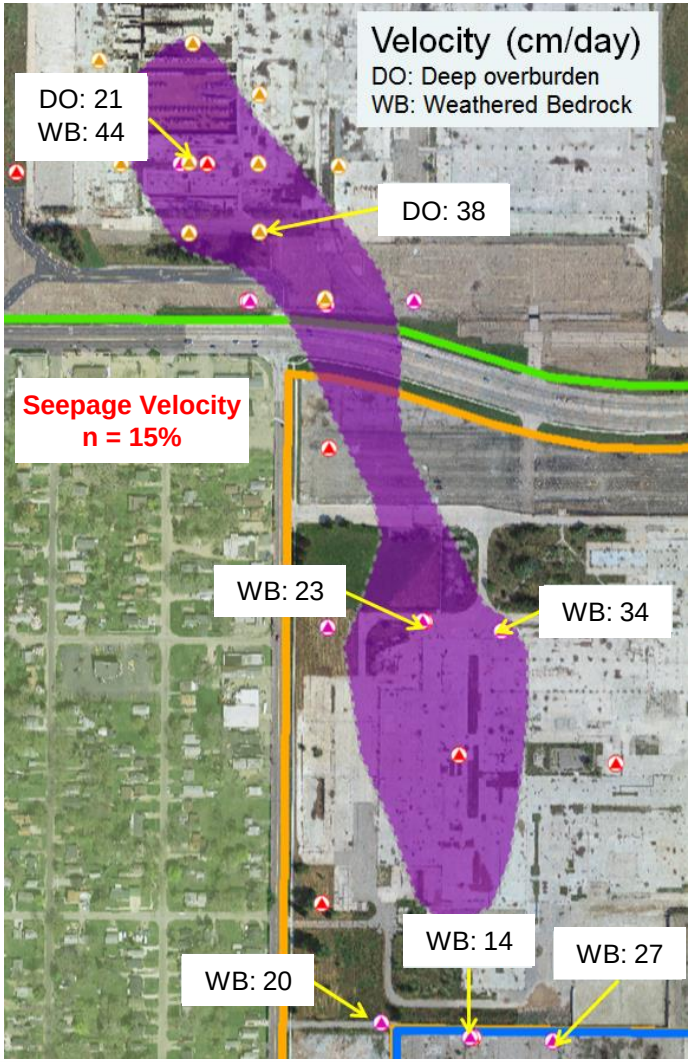
PFM Summary Graphic, April 2014



ARCADIS

Passive Flux Meter Analysis - Revision

- Porosity will likely range between 2% (fractured media) and 15% (porous media)
  - Hydraulic testing suggests more porous than fractured
  - @ 15% seepage velocity = 170 to 525 ft/yr
- There is also retardation factor (R*) that will inhibit plume migration
  - Limited for 1,4-dioxane
  - Plume velocity = v/R
- Site specific parameters for weathered bedrock indicate R will range from 1.01 to 1.5
  - Example: Plume velocity at porosity of 15% and R=1.5 would be 113 to 350 ft/yr
- Tracer study would provide a better measure of porosity



* $R = 1 + r_b k_d / n$

Various Other Site Activities

- GSI/MS4
- Plant 6 pre-excavation sampling
  - Sampling completed for Areas 5.7 and Area 9 in November
  - Provide results to MDEQ Jan-Feb 2015
- Demo related concrete slab PCB sampling
  - Sampling completed 12/4/14, results pending
- Demo-related clarifier sampling
  - Sampling of clarifier sludge indicated low concentrations of PCBs (0.5 mg/L)
    - Clarifier water ND
  - Oil storage vault – floating sludge 1.1 mg/L PCBs
    - Water ND
  - Water/sediment may require pre-treatment or offsite disposal
- Coliseum backfilling
  - Filling of the coliseum began 12/3/14
  - Fill sampling report in progress

Schedule of Key Upcoming Events

- December 12, 2014 – Complete 4th quarter groundwater sampling
- December 19, 2014 – Follow-up response to the BWL
- December/January, 2014-15 – Hydraulic Testing Memo to MDEQ
- First Quarter 2015 – Tracer study work plan submittal (probable need for BA)
- January 2015 - Technical Meetings with BWL/Westside/City
- February 2015 – Follow-up reporting for Plant 2 LNAPL, Area 16, Plant 6 excavation sampling
- February-March 2015 – First quarter GW sampling (quarterly event)
- April 2015 – Annual GW monitoring report
- Spring/Summer 2015 – Plant 2 & 6 Site Excavations
- RFI/CMS – Additional review / approval ?


Imagine the result