Environmental Decisions

# Case Study: Technical & No Further Action Highlights

## BASF Corporation

### Bourke Avenue - Detroit

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# *Introduction*

- **Background & Objectives**
- **Site Characterization Findings**
- **Remedial Action Results**
- **Final Site Evaluation**
- **Site Closure Conditions**

***Tracking of Administrative Actions as We Go***

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# Introduction

- **Background**
  - Varnish/Paint Manufacturing Plant (1907 – 1999)
  - Closure & Building Demolition (1999 – 2001)
  - Site Characterization (1999 – 2004)
    - Site History & Geological Assessment
    - Soil Gas, Geophysics, & Soil Analyses
    - Site-Wide Random Sampling & Analysis (**Investigation (not zoned)** Parcels 1, 2, & 3)
    - Focused Sampling & Analysis (Parcel 2)
- **Objectives (Part 201 Closure)**
  - Beneficial Reuse of Parcels 1 and 3 (2004)
  - Remediation & Reuse of Parcel 2

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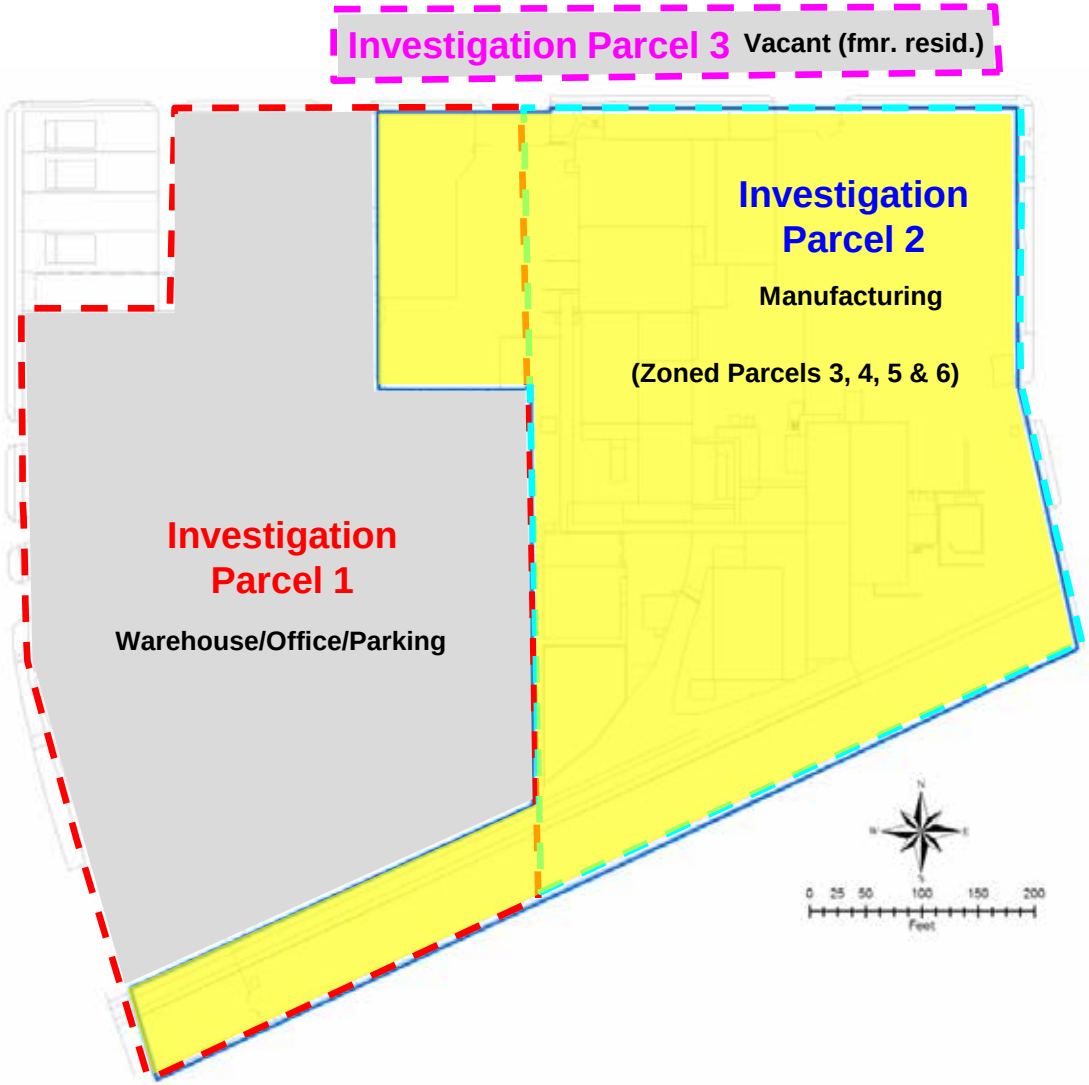
# Site Characterization




Sold in 2004

~7.5 Acres Subject to Part 201 Closure

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# Site Characterization

**General Assessment Scope:**

**Interior – Industrial/Commercial GSC**

**Boundary – Residential/Commercial GSC**

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# Site Characterization

- **General Geology**
  - Silty Sand to Silty Clay
  - Depth to Clay: 4.7-foot average
  - Clay Thickness: 30-70 Feet
- **General Hydrology**
  - Intermittent Perched (Moist) Conditions
  - No Usable Groundwater Above or Within Clay
  - No Groundwater Wells w/in Six Miles

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# Site Characterization

- **Soil Gas Survey**
  - Optimal tool for evaluating potential indoor air risks
  - Conducted on ~50-foot centered grid
  - Nearly 200 site-wide sample locations
  - Conducted prior to remediation
- **Results**
  - Maximum Xylenes - 209,000 ug/$M^3$
  - Maximum Ethylbenzene - 97,944 ug/$M^3$
  - Maximum Toluene - 223,000 ug/$M^3$

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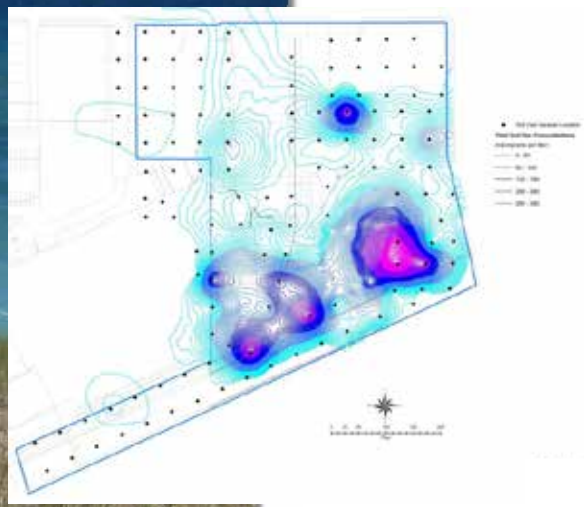
# Site Characterization



- **Evaluated using J&E v. 3.1 and highly conservative assumptions**
  - Residential use
    - 30-year exposure duration
    - 350 days/year frequency
  - Highest pre-remediation soil vapor concentrations
  - MDEQ default values
- **Results**
  - HQ < 1: No adverse health effects regarding exposure to individual COCs
  - HI < 1: No adverse health effects regarding exposure to aggregate of COCs
  - Future buildings will be restricted to slab-on-grade construction.

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# Site Characterization

## Recalculated Site-Specific Csat Criteria

S =Solubility (mg/L) (note: MDEQ uses ug/L units)
Pb =Dry bulk density (kg/L)
Kd =Distribution coeff. (Koc*Foc)
Koc =Water-organic carbon partition coeff.
Foc =Fraction organic carbon in soil
Ow =Water-filled soil porosity
Oa =Air-filled soil porosity
H' =Henry's Law Constant * (41)
TAF =Temperature adjustment factor

| Xylene | | | |
|---|---|---|---|
| Variables | MDEQ Defaults | Standard Variables(1) | Formula Inputs |
| S | | 192.35 | 192.35 |
| Pb | 1.50 | | 1.50 |
| Kd | | | 13.43 |
| Koc | | 789.92 | 789.92 |
| Foc | | 0.017 | 0.017 |
| Ow | 0.16 | | 0.16 |
| Oa | 0.09 | | 0.09 |
| H' | | 0.28 | 0.28 |
| TAF | 0.50 | | 0.50 |
| Recalculated $C_{sat}$ (mg/kg) = | | | 2,605 |

Link to Spreadsheets

Link to Photos

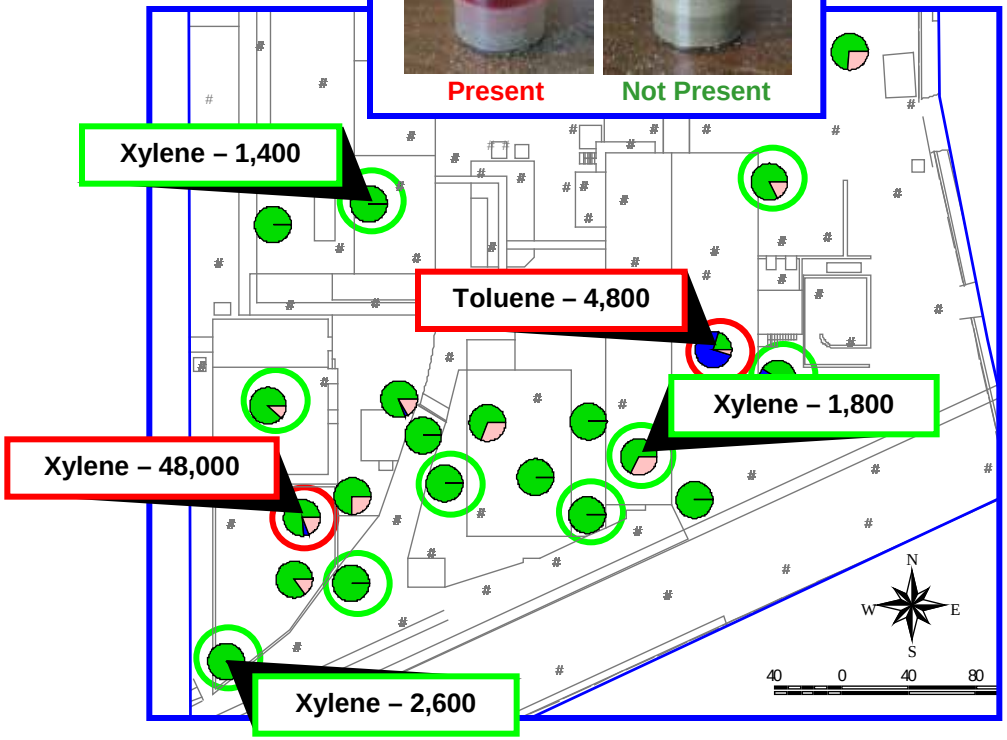
### Soil Saturation (Csat) Criteria

- Xylene – 150 mg/Kg
- Ethylbenzene – 140 mg/Kg
- Toluene – 250 mg/Kg

Xylene
Ethylbenzene
Toluene

### Hydrophobic Dye Analysis

Present Not Present




DEQ

# Remediation

- **Objectives**
  - Remove Concrete & Demolition Debris
  - Remove Unused Subsurface Utilities
  - Remove USTs and Piping
  - Remove Areas of Environmental Concern (AECs)
  - Restore Site for Beneficial Reuse

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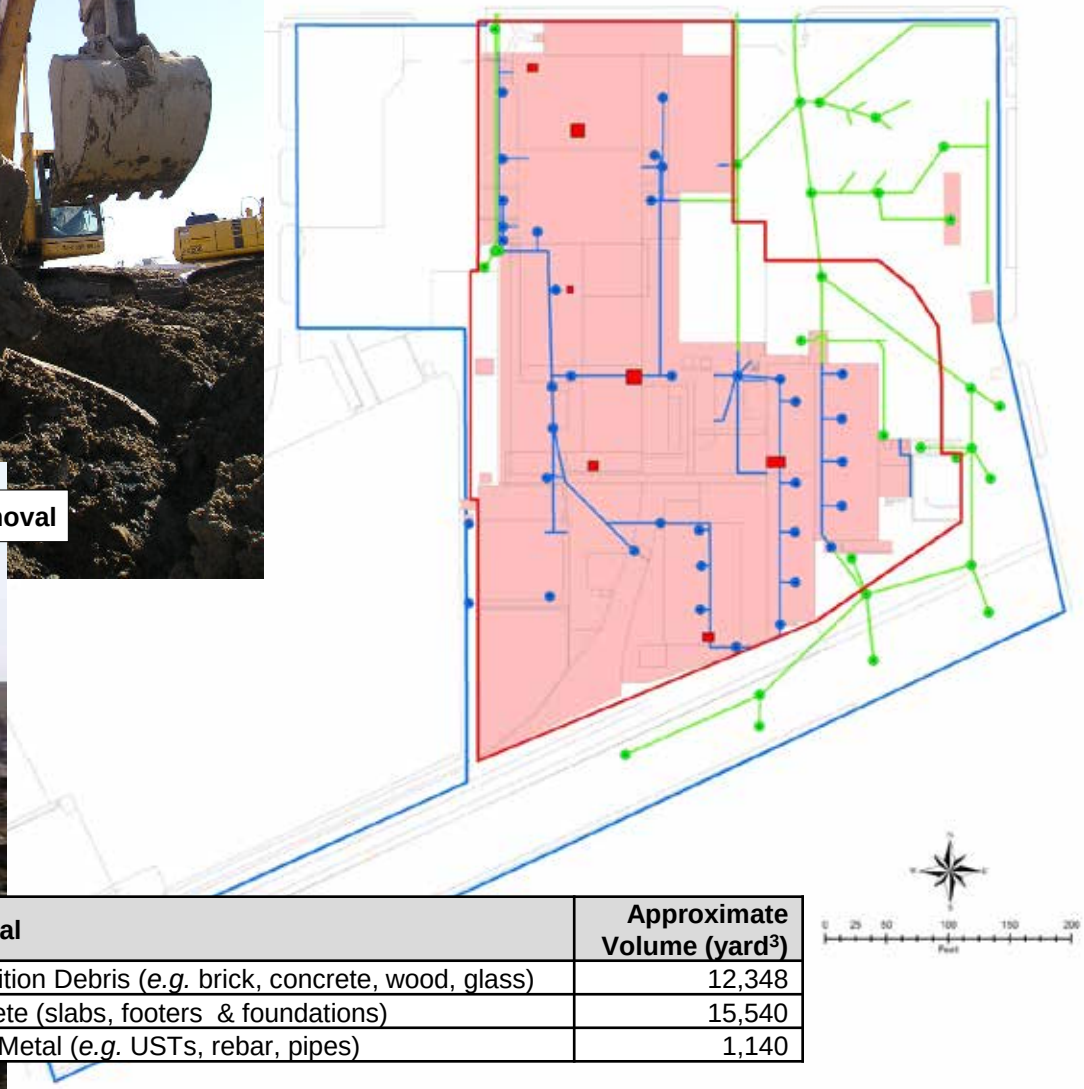
# Remediation

## Concrete & Utilities Removal

Concrete Foundation Removal



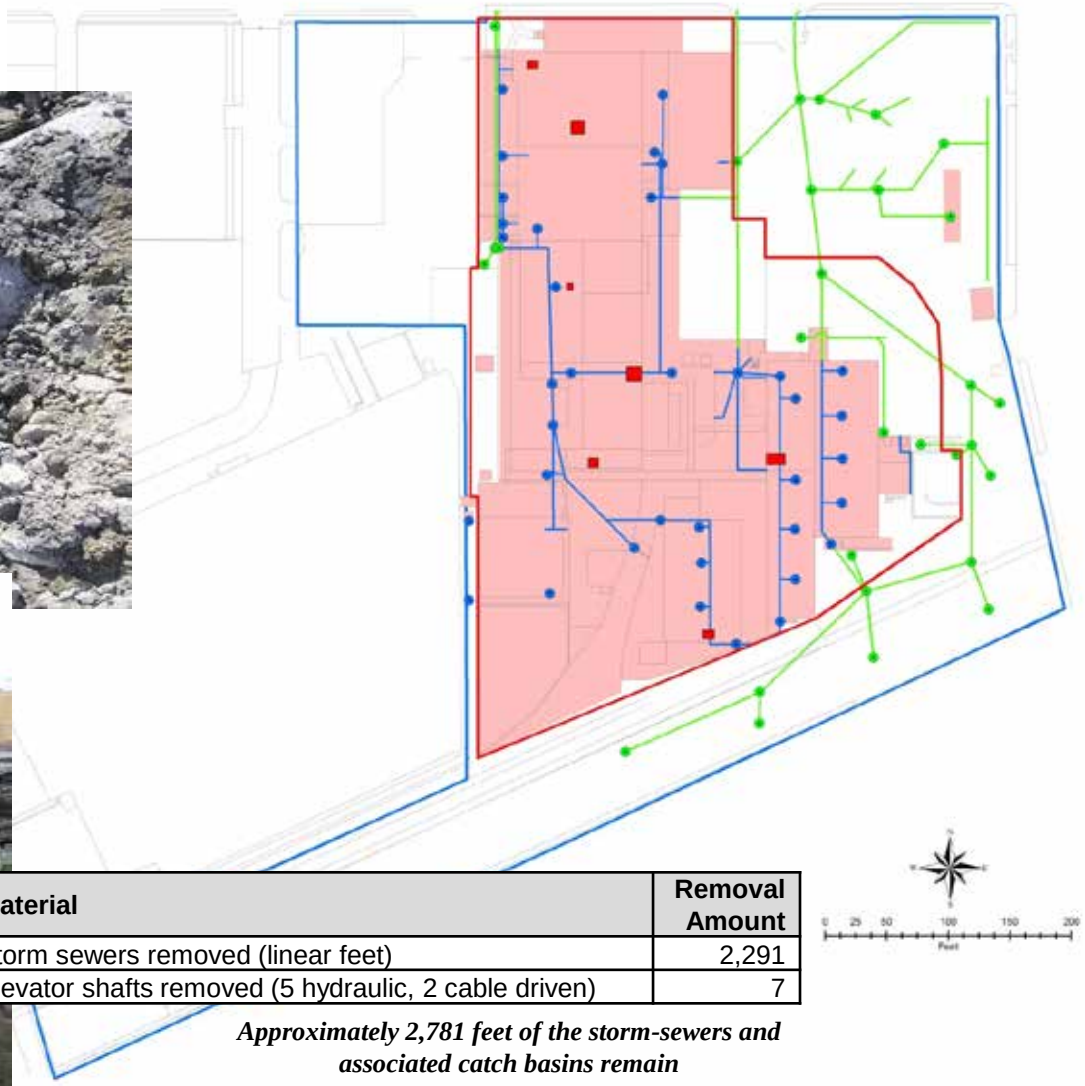

| Material | Approximate Volume (yard$^3$) |
|---|---|
| Demolition Debris (*e.g.* brick, concrete, wood, glass) | 12,348 |
| Concrete (slabs, footers & foundations) | 15,540 |
| Scrap Metal (*e.g.* USTs, rebar, pipes) | 1,140 |

# Remediation

## Concrete & Utilities Removal

Storm-Sewer Removal & Capping

Elevator Shaft Removal



| Material | Removal Amount |
|---|---|
| Storm sewers removed (linear feet) | 2,291 |
| Elevator shafts removed (5 hydraulic, 2 cable driven) | 7 |

*Approximately 2,781 feet of the storm-sewers and associated catch basins remain*

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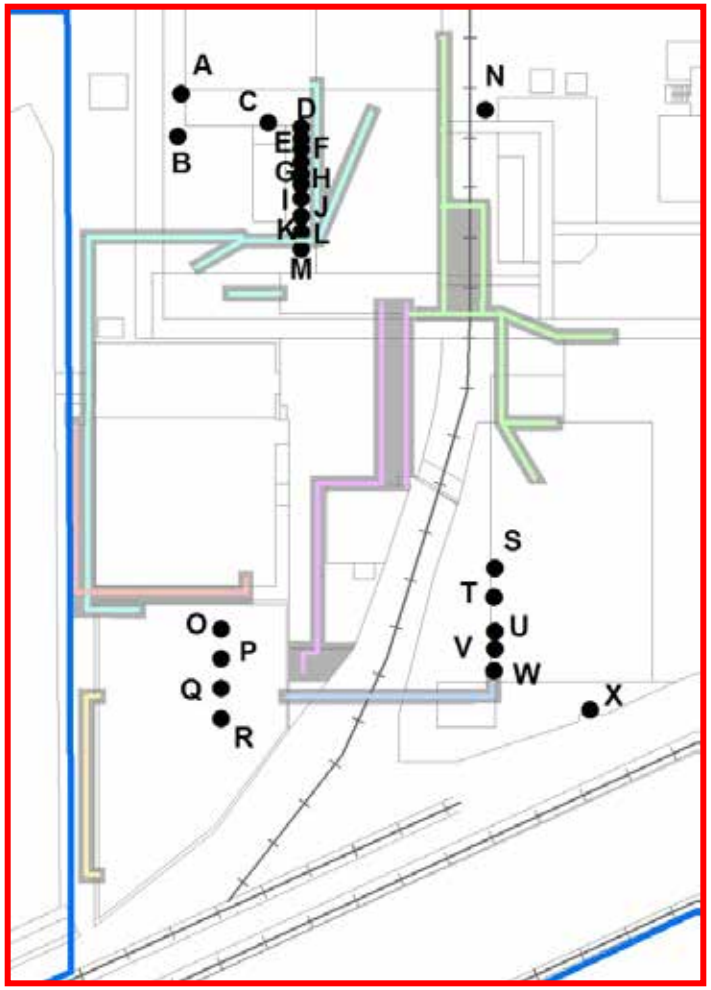
# Remediation

## UST/Piping Removal

See Table for Tank IDs



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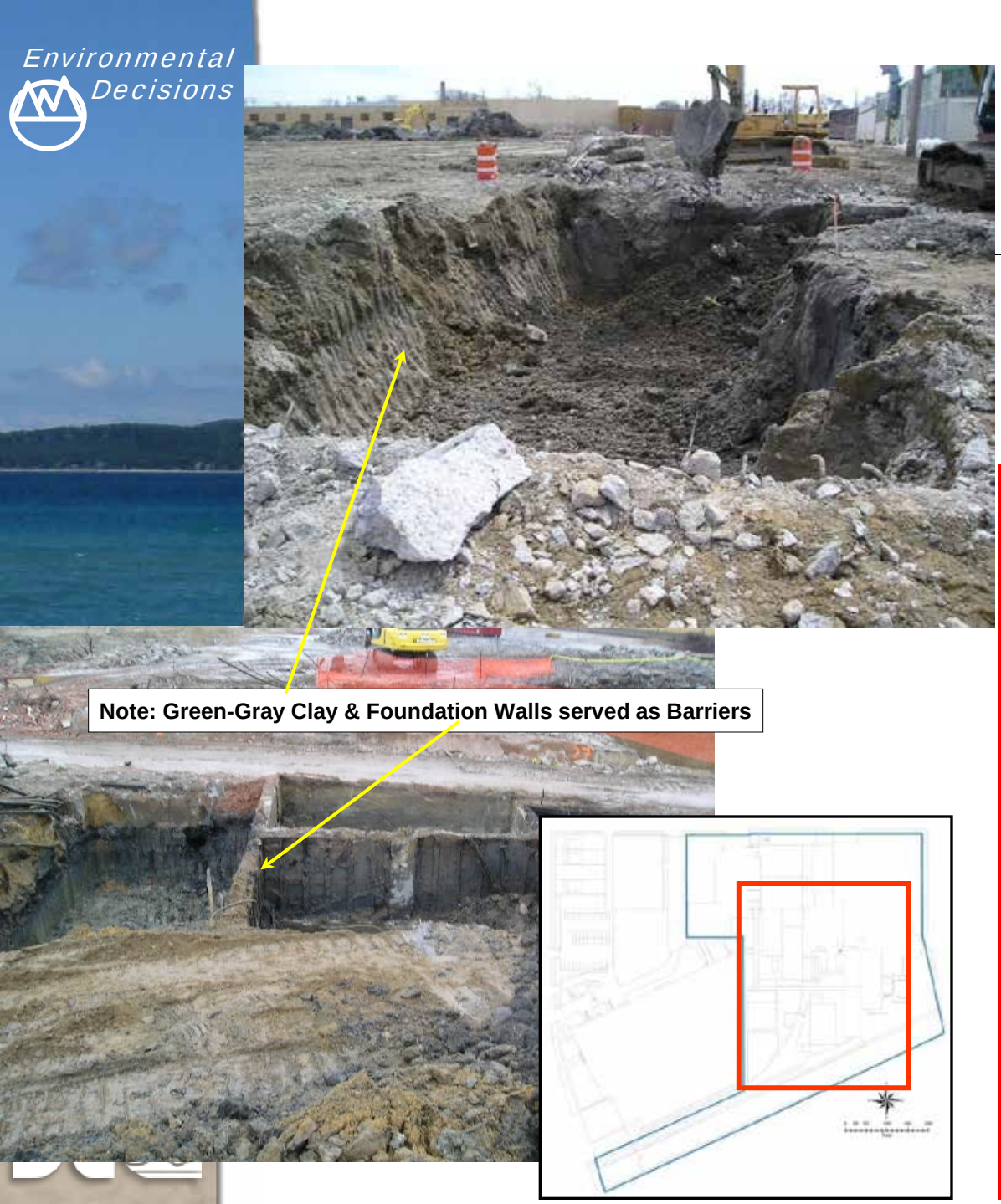
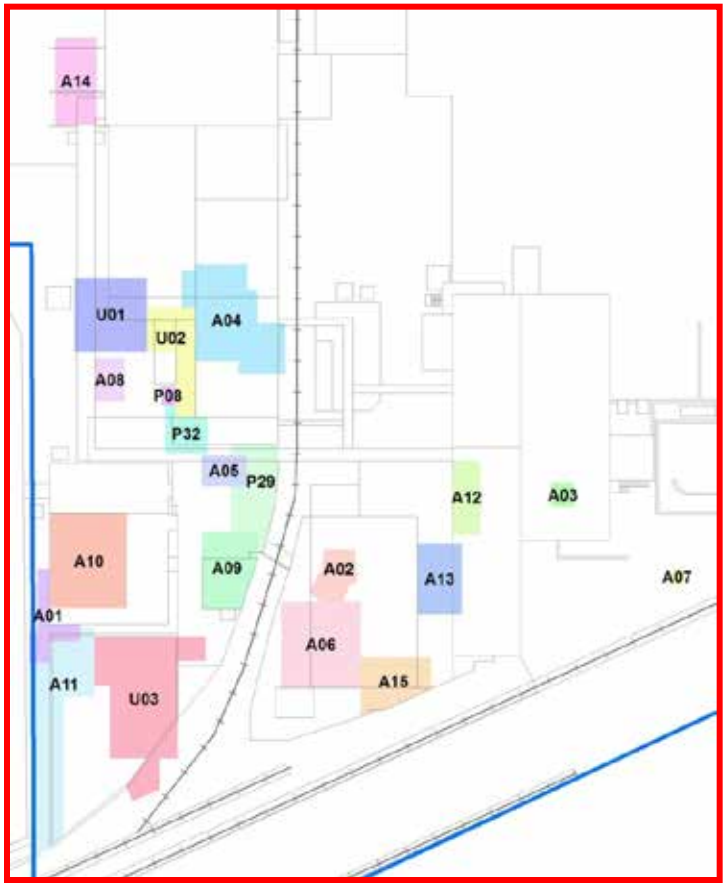
# Remediation

## AEC Removal

See Table for AEC IDs
(~9,300 yards$^3$ removed)



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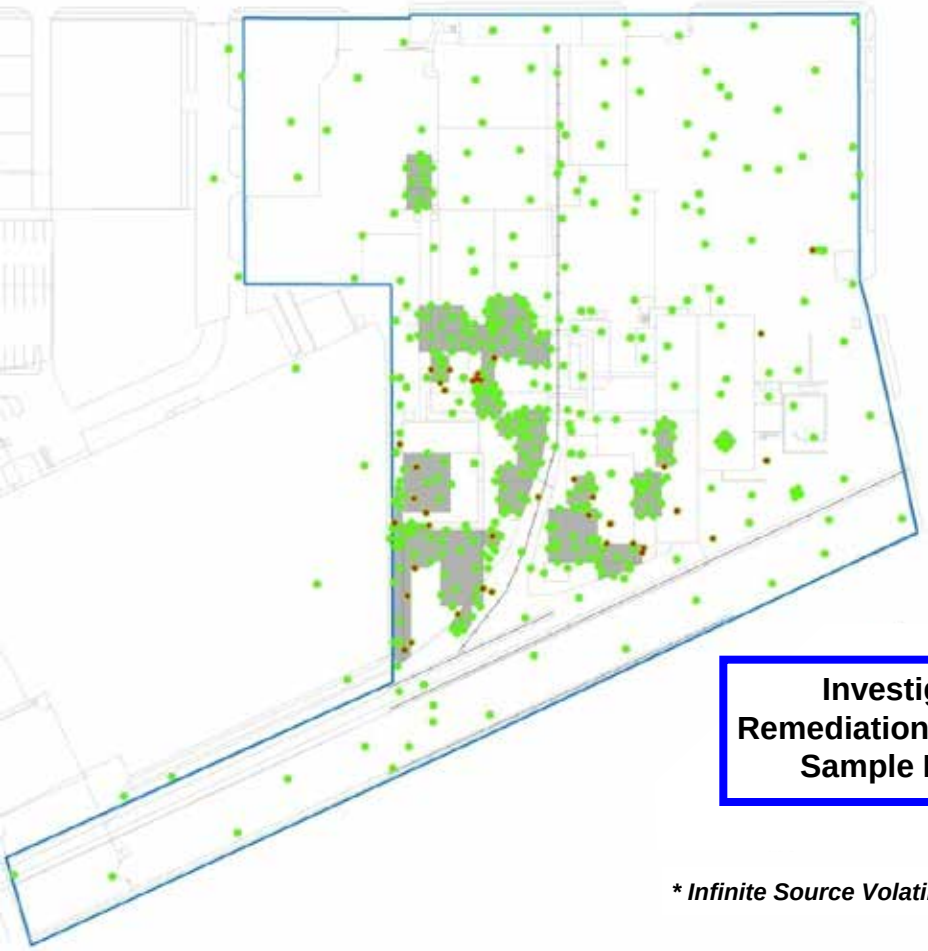
# Remediation

## AEC Removal



**Investigation & Remediation Confirmation Sample Locations**

**Ethylbenzene – Remaining Sample Locations**

140 mg/Kg – Csat
2,400 mg/Kg – VSIC*

| | |
|---|---|
| Count: | 501.000 |
| Min: | 0.025 |
| Max: | 860.000 |
| Average: | 15.120 |
| Std. Deviation: | 67.425 |
| 95% Conf. Intrvl.: | 5.904 |
| 95% UCL: | 21.024 |

**Toluene – Remaining Sample Locations**

250 mg/Kg – Csat
3,300 mg/Kg – VSIC*

| | |
|---|---|
| Count: | 455.000 |
| Min: | 0.025 |
| Max: | 470.000 |
| Average: | 3.090 |
| Std. Deviation: | 25.838 |
| 95% Conf. Intrvl.: | 2.374 |
| 95% UCL: | 5.464 |

**Xylene – Remaining Sample Locations**

150 mg/Kg – Csat
54,000 mg/Kg – VSIC*

| | |
|---|---|
| Count: | 503.000 |
| Min: | 0.075 |
| Max: | 2,600.000 |
| Average: | 63.264 |
| Std. Deviation: | 265.096 |
| 95% Conf. Intrvl.: | 23.167 |
| 95% UCL: | 86.431 |

** Infinite Source Volatile Soil Inhalation Criteria*

# Final Report?

## CONCLUSIONS

- **All Unused Concrete & Utilities Removed to City's Satisfaction (beyond requirements)**
- **No Known Remaining Sources**
- **Cleanup to Most Stringent Applicable Soil Criteria**
  - Site boundary conditions meet RC1 GSC
  - On-site conditions meet IC2 GSC except isolated locations where Generic Csat Criteria are exceeded
    - Csat investigation using hydrophobic dye and overall field observations find no indication of separate-phase conditions
    - Recalculated/site-specific Csat criteria make sense
- **Vapor intrusion evaluation finds no unacceptable risk**
- **Incomplete GW & SW Pathways**
- **BASF's IRDC Agreement and Restrictive Covenant Complete and Ready for Finalization**

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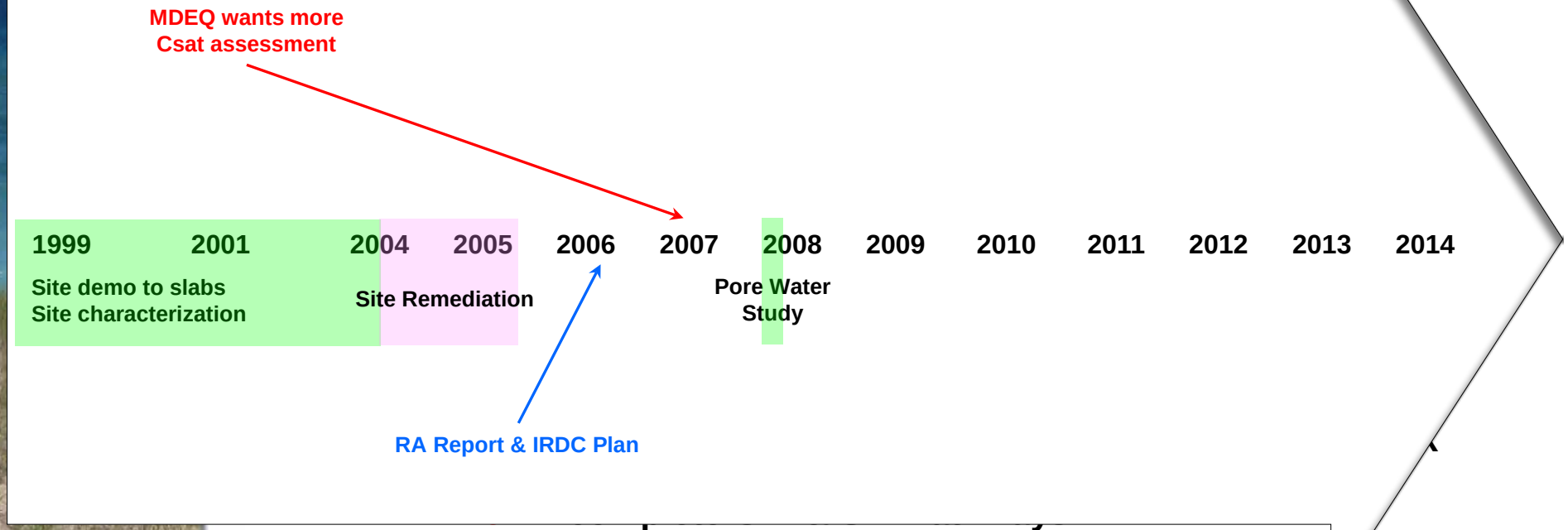
# Final Report?

## CONCLUSIONS

- All Unused Concrete & Utilities Removed to City's Satisfaction (beyond requirements)




- BASF's IRDC Agreement and Restrictive Covenant Complete and Ready for Finalization

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# Final Site Evaluation

## Separate Phase?

MDEQ Remediation & Redevelopment Division
Sep 28, 2007 Peer Review Group Meeting Notes

**Free Phase in Soils**
Peer Review Group

Prepared for the Introductory Meeting on September 28, 2007

## Effective Solubility – What is it?

- Pure phase solubility – one compound in water
- Effective solubility - calculates the solubility of a compound in water in the presence of other compounds
- Water (solvent) can only hold so much of a solute (contaminant compound)
- When determining the solubility of a compound we need to account for the other compounds that are competing to be dissolved

7

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# Final Site Evaluation

## Separate Phase?

MDEQ Remediation & Redevelopment Division
Sep 28, 2007 Peer Review Group Meeting Notes

**Example**

| Chemical/Product | Mass Weight | | Molecular Weight | | Moles | | Mole Fraction | | Solubility | | Effective Solubility |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | % | | g/mole | | Moles | | Unitless | | ug/L | | ug/L |
| Ethylbenzene (I) | 1.7 | / | 106.17 | = | 0.016 | → | 0.015 | x | 169000 | = | 2500 |
| 1,3,5-Trimethylbenzene | 0.98 | | 120.20 | | 0.0082 | | 0.0078 | | 61150 | | 480 |
| Toluene (I) | 8.1 | | 92.14 | | 0.088 | | 0.084 | | 526000 | | 44000 |
| Xylenes (I) | 9.0 | | 106.17 | | 0.085 | | 0.086 | | 186000 | | 16000 |
| Benzene (I) | 1.9 | | 78.11 | | 0.024 | | 0.023 | | 1750000 | | 40000 |
| Naphthalene | 0.25 | | 128.17 | | 0.002 | | 0.0019 | | 31000 | | 59 |
| 1,2,4-Trimethylbenzene | 3.0 | | 120.20 | | 0.025 | | 0.024 | | 55890 | | 1300 |
| Gasoline (Product) | 75.07 | | 105.00 | | 0.71 | | 0.75 | | ---------- | | --------- |

(Plus other compounds in matrix)

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# Final Site Evaluation

## Separate Phase?

Where: $S_{eff} = (M_i)(S_i)$ *Equation 1*

and

$S_{eff}$ = Effective Solubility (ug/L)

$M_i$ = Mole fraction of compound of interest

= $(W_i/MW_i)/(W_i/MW_i)_{total}$

$(W_i/MW_i)$ = Number of moles of chemical (i)

$(W_i/MW_i)_{total}$ = Number of moles of all chemicals in mixture

$W_i$ = Mass weight %

= Chemical (ug/L) / Total (ug/L) x 100

$MW_i$ = Molecular weight

$S_i$ = Pure-phase solubility of compound of interest.

**Summary of COCs in Remaining Soil & Effective Solubility Estimates at Locations having Highest Generic Csat Criteria Exceedances**

| Sample | TOS | Analyte | CAS | Result (ug/Kg) | $S_{eff}$ (ug/L) |
|---|---|---|---|---|---|
| 2004035 | 3.50 | Ethylbenzene | 100414 | 440,000 | **22,523** |
| | | Xylenes | 1330207 | 2,600,000 | **146,476** |
| 2026070 | 7.00 | Ethylbenzene | 100414 | 860,000 | **54,054** |
| | | Xylenes | 1330207 | 1,800,000 | **124,518** |
| 2039045 | 4.50 | Toluene | 108883 | 470,000 | **289,902** |
| | | Xylenes | 1330207 | 330,000 | **62,466** |

TOC – Top of sample (feet bgs)
*Seff* – Effective solubility (ug/L)

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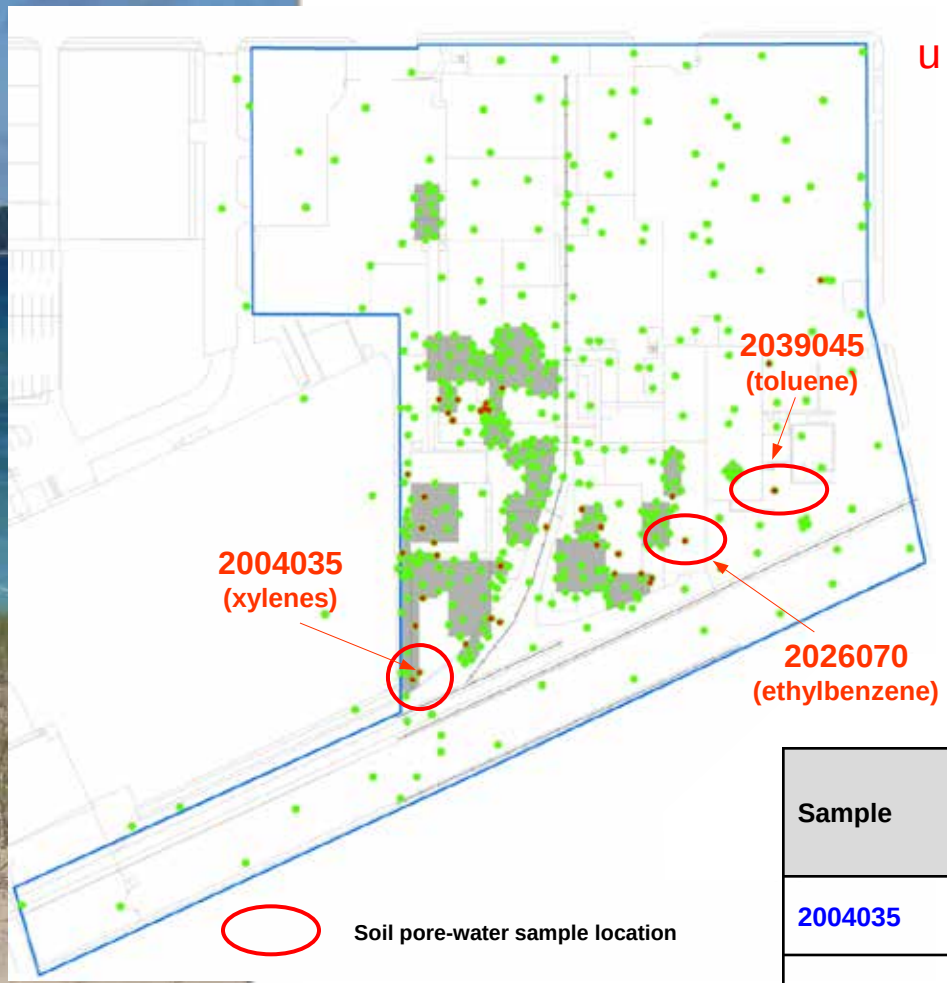
# Final Site Evaluation

## Separate Phase?




- **Effective Solubility ($S_{eff}$) Method***
  - Effective solubility defines concentration at which separate-phase conditions exist (for a specific compound of interest) based upon concentrations, mole weights, and solubility of all compounds in a soil sample
  - Separate-phase conditions do not exist if pore-water sample results are less than effective solubility values

**Conclusion: If separate phase does not exist at locations of highest remaining xylene, ethylbenzene, toluene concentrations, it does not exist at other remaining locations**

| Sample | TOS | Analyte | Soil Result (mg/Kg) | $S_{eff}$ (ug/L) | Pore Water Result (ug/L) | |
|---|---|---|---|---|---|---|
| 2004035 | 3.50 | Ethylbenzene | 440,000 | 22,523 | 86 | J |
| | | Xylenes | 2,600,000 | 146,476 | 130 | J |
| 2026070 | 7.00 | Ethylbenzene | 860,000 | 54,054 | 250 | U |
| | | Xylenes | 1,800,000 | 124,518 | 750 | U |
| 2039045 | 4.50 | Toluene | 470,000 | 289,902 | 900 | |
| | | Xylenes | 330,000 | 62,466 | 440 | |

*See attached Draft Technical Publication

# Final Report?

## CONCLUSIONS

- **All Unused Concrete & Utilities Removed to City's Satisfaction (beyond requirements)**
- **No Known Remaining Sources**
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  - Site boundary conditions meet RC1 GSC
  - On-site conditions meet IC2 GSC except isolated locations where Generic Csat Criteria are exceeded
    - Csat investigation using hydrophobic dye and overall field observations find no indication of separate-phase conditions
    - Pore-water study and effective solubility evaluation find no indication of separate-phase conditions
- **Vapor intrusion evaluation finds no unacceptable risk**
- **Incomplete GW & SW Pathways**
- **BASF's IRDC Agreement and Restrictive Covenant Complete and Ready for Finalization**

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# Final Report?

## CONCLUSIONS

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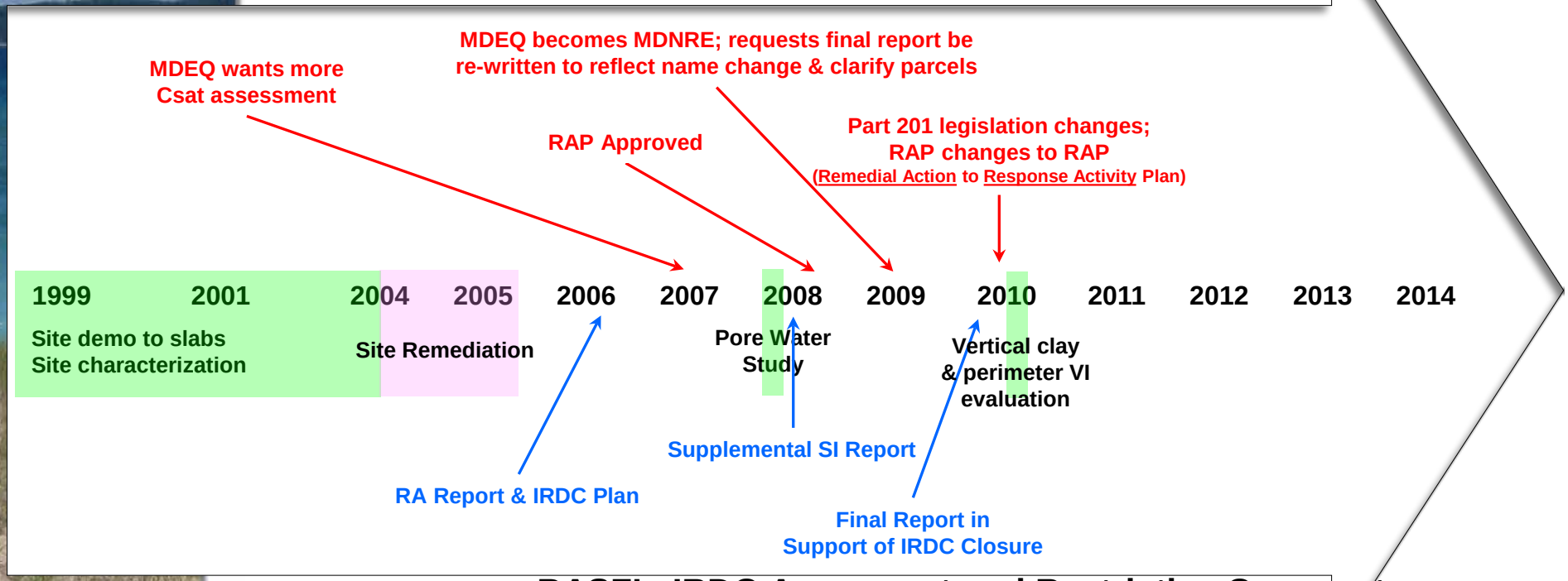


- BASF's IRDC Agreement and Restrictive Covenant Complete and Ready for Finalization

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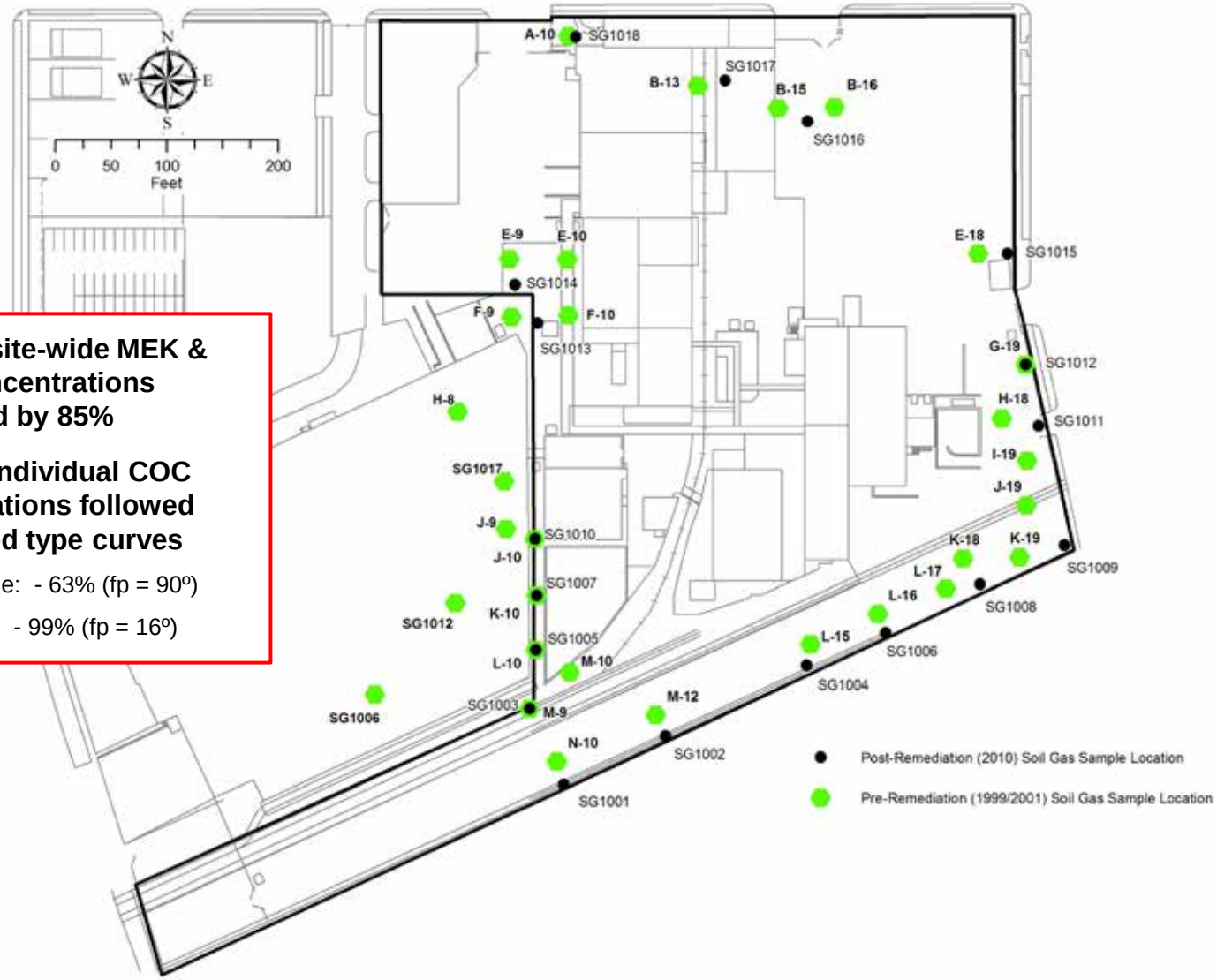
# Final Site Evaluation

## Vapor Intrusion?

- ü **Average site-wide MEK & BTEX concentrations decreased by 85%**
- ü **Average individual COC concentrations followed anticipated type curves**
  - § Xylene: - 63% (fp = 90º)
  - § MEK: - 99% (fp = 16º)



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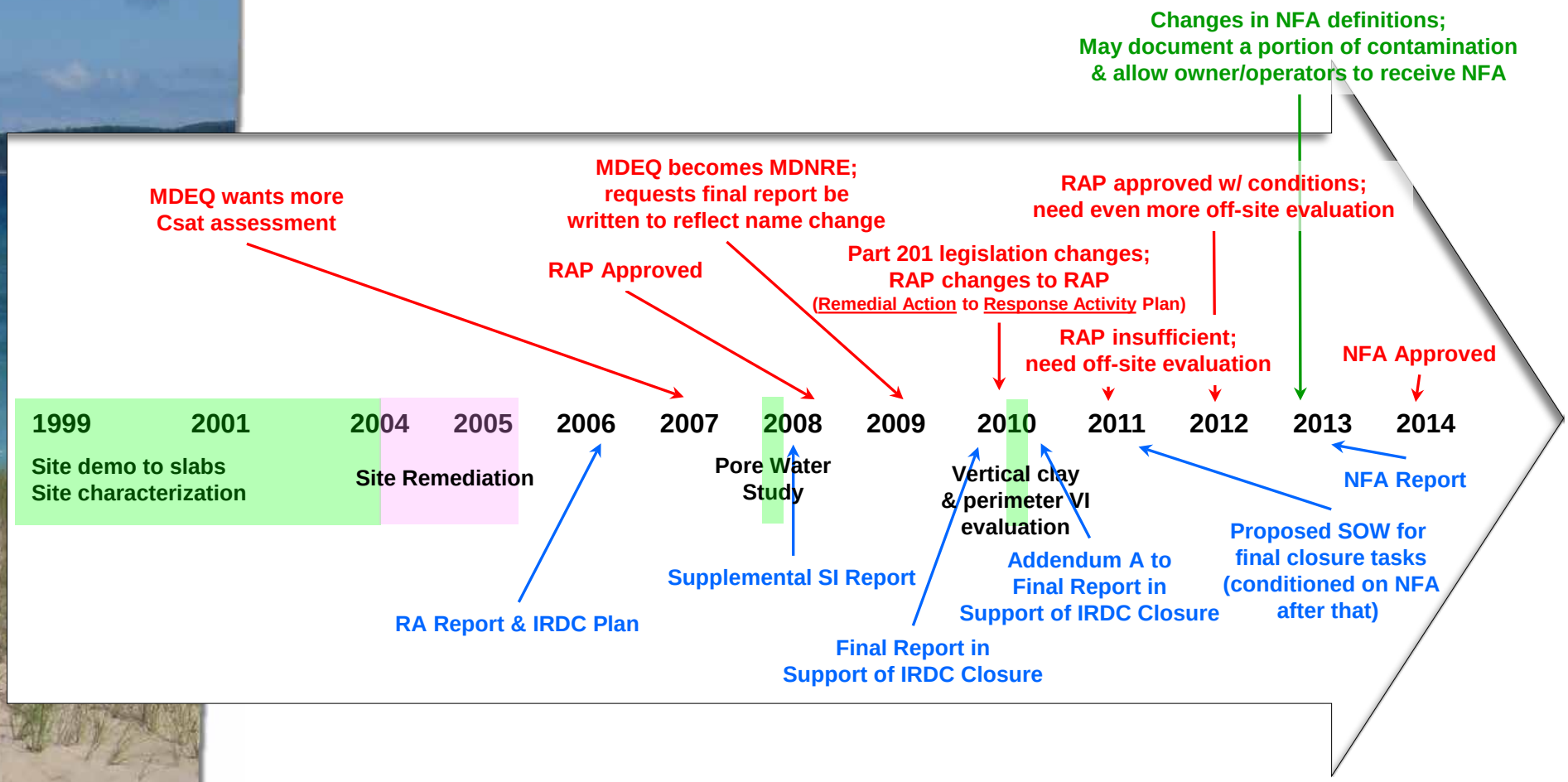
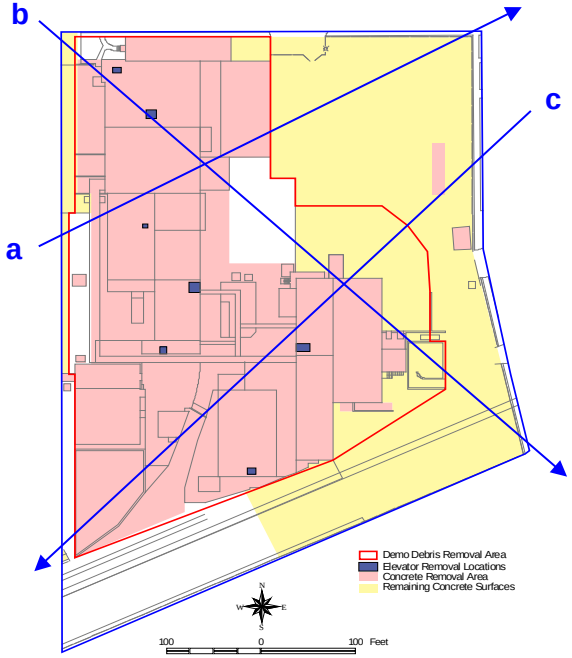
# Remedial & Administrative Time Line



# Site Closure Conditions



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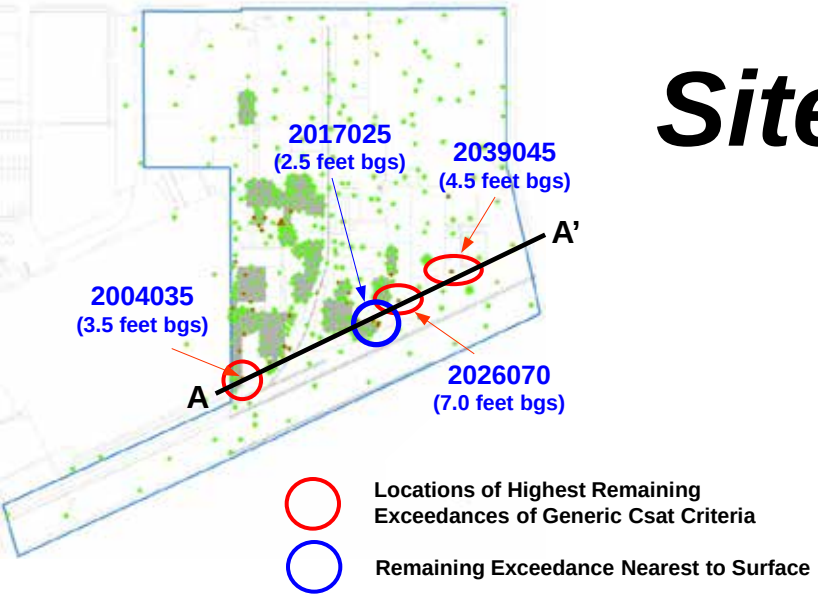
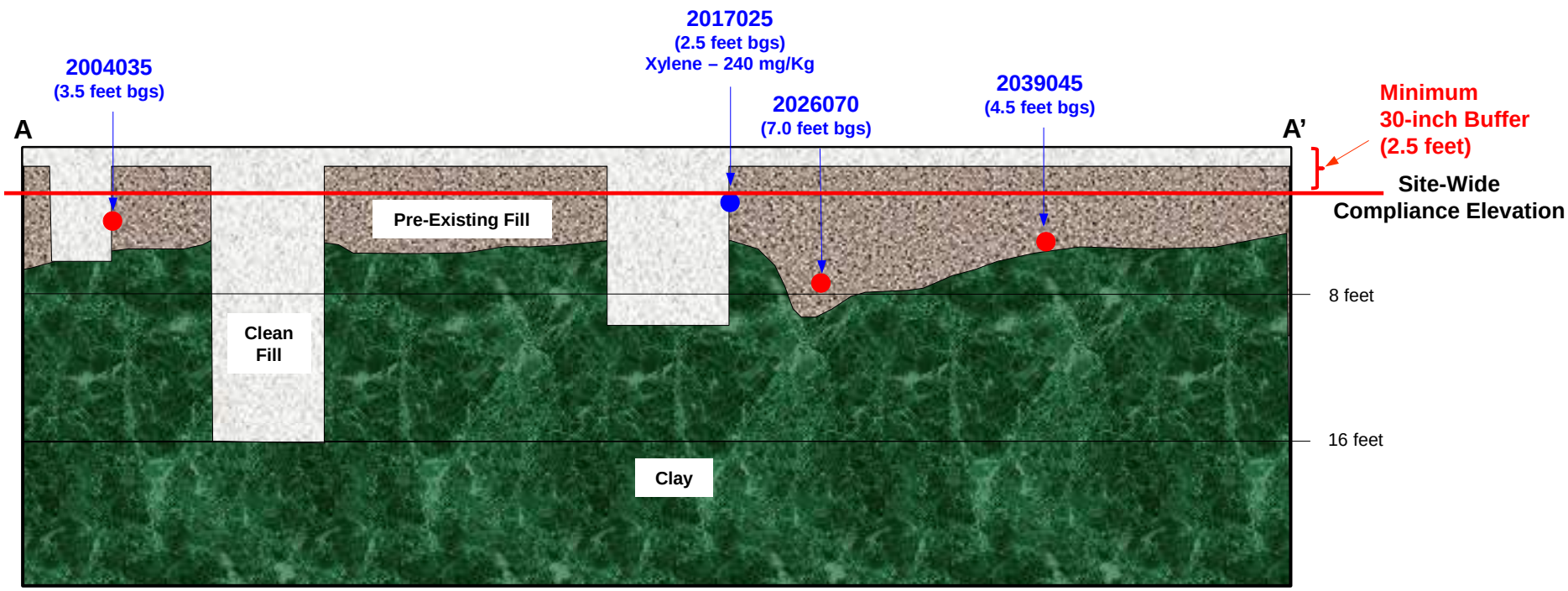



**No Further Action Approved** *(March 2014)*

- ü **Post-Closure Agreement for a Limited Non-Residential Remedial Action**
- ü **Restrictive Covenant**
- ü **Post-Closure Inspection & Maintenance (Annual Reporting)**




*Approximate 2x Vertical Exaggeration*

# Questions?