Area B Groundwater Investigation Fort Detrick

Progress Report to the RAB

February 6, 2013

John Cherry

ARCADIS

Overview of Topics

- Work Completed Since November RAB Meeting and Project Status
- Summary of Round 2 Data (September 2012)
- Vertical Contaminant Distribution
- Carroll Creek Surface Water Sampling
- Summary and Next Steps

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Work Completed Since the Last RAB

- Draft Conceptual Site Model (CSM) report submitted to EPA/MDE and distributed to the RAB tonight.
  - Provides a comprehensive overview of the site conditions including nature and extent of contamination.
  - Includes validated data from work completed through the April sampling round.
- Data from September 2012 groundwater and surface water sampling event have been validated and draft report provided to the Army. This data to be discussed tonight.

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Work Completed Since the Last RAB

- Initial phase of vapor intrusion sampling completed at 4 off-post and 1 on-post building.
  - 3 sub-slab gas samples collected at each location.
  - Samples undergoing laboratory analysis
- Continued negotiation of rights of entry for additional off-post shallow and deep drilling locations.

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Status of Original RI Work Plan Activities

ü Existing well assessment and repair	Feb 2011 to Apr 2011
ü New well installation (onsite)	April 2011 to Mar 2012
ü Direct Push Investigation	March 2012
ü Spring and Seep Surveys	March 2012
ü Groundwater/Surface Water Sampling	April 2012 /Sept 2012
► **Vapor Intrusion Sampling** (Round 1 Sampling completed since last RAB)	Jan 2013 (Round 1) **Spring 2013 (Round 2)**
► **Dye trace study**	**Spring 2013**

Grey = completed

Additional Investigation Phases

Additional investigation activities are planned for 2013 to address technical data needs in order to determine the path forward.

- **Supplemental Shallow Direct Push Drilling** **Summer 2013**

  Approximately 14 off-post locations to supplement the DPT work completed in 2012.

- **Additional on-post & off-post deep drilling** **Summer 2013**

  in three areas:

  - southwest of B-11

  - near existing B-11 borings, but deeper

  - east of Area B and east of Carroll Creek

The Army and ARCADIS are meeting with EPA and MDE in February '13 to reach agreement on these next investigation phases.

Status of CERCLA Process

- Remedial Investigation
  - Data collection and development of CSM
  - Future phase will include a full risk assessment as required by CERCLA

Current Phase

Interim Phase

Interim Remedial Action (connection of select residences to municipal water)

Future Phases

- Feasibility Study (Assessment of possible remedies)
- Proposed Plan (Public document to solicit input on preferred remedy)
- Record of Decision (Final legal document selecting remedy)
- Remedial Action (Implement Final Remedy)

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Summary of Round 2 Data

September 2012

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Area B Site-Wide Sampling (2012)

- Two site-wide sampling events were completed in 2012:
  - Spring 2012 (Round 1)
    - Groundwater, surface water, sediment sampling.
    - Final validated results presented during July and Nov 2012 RABs and presented in Draft CSM report.
  - Fall 2012 (Round 2)
    - Groundwater and surface water sampling.
    - Final validated results summarized during tonight's RAB.

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Round 2 Sampling Scope

- Groundwater elevation measurements at 168 locations to assess groundwater flow direction, including monitoring wells, piezometers, and surface water gauges.
- 76 groundwater monitoring wells tested for VOCs, SVOCs, PCBs, metals, dioxins, herbicides, pesticides, and other parameters.
- 30 surface water samples collected along Carroll Creek and its tributaries and tested for VOCs, SVOCs, PCBs, metals, and pesticides.

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September 2012 Data Summary

- Results from the Fall 2012 sampling event are very similar to results from the April 2012 sampling event.
- Solvents are the main contaminant and are present at part per million (ppm) levels in the vicinity of B-11 in groundwater.
  - Note: 1 ppm = 1000 ppb or 1000 micrograms/liter (ug/L)
- All round 2 chemical data will be included in a supplemental report addendum to the CSM.

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VOC Sampling Results Summary
Round 1 (Spring ‘12) and Round 2 (Fall ’12)

- 41 VOCs detected in monitoring wells; 11 detected above their respective drinking water standards (MCLs).
- TCE is the most commonly detected VOC.
- Solvents are the main contaminant and are present at part per million levels in the vicinity of B-11, but at much lower levels elsewhere across Area B.
- Solvents are present at much lower levels in shallow groundwater and surface water off-site to the east of Area B.

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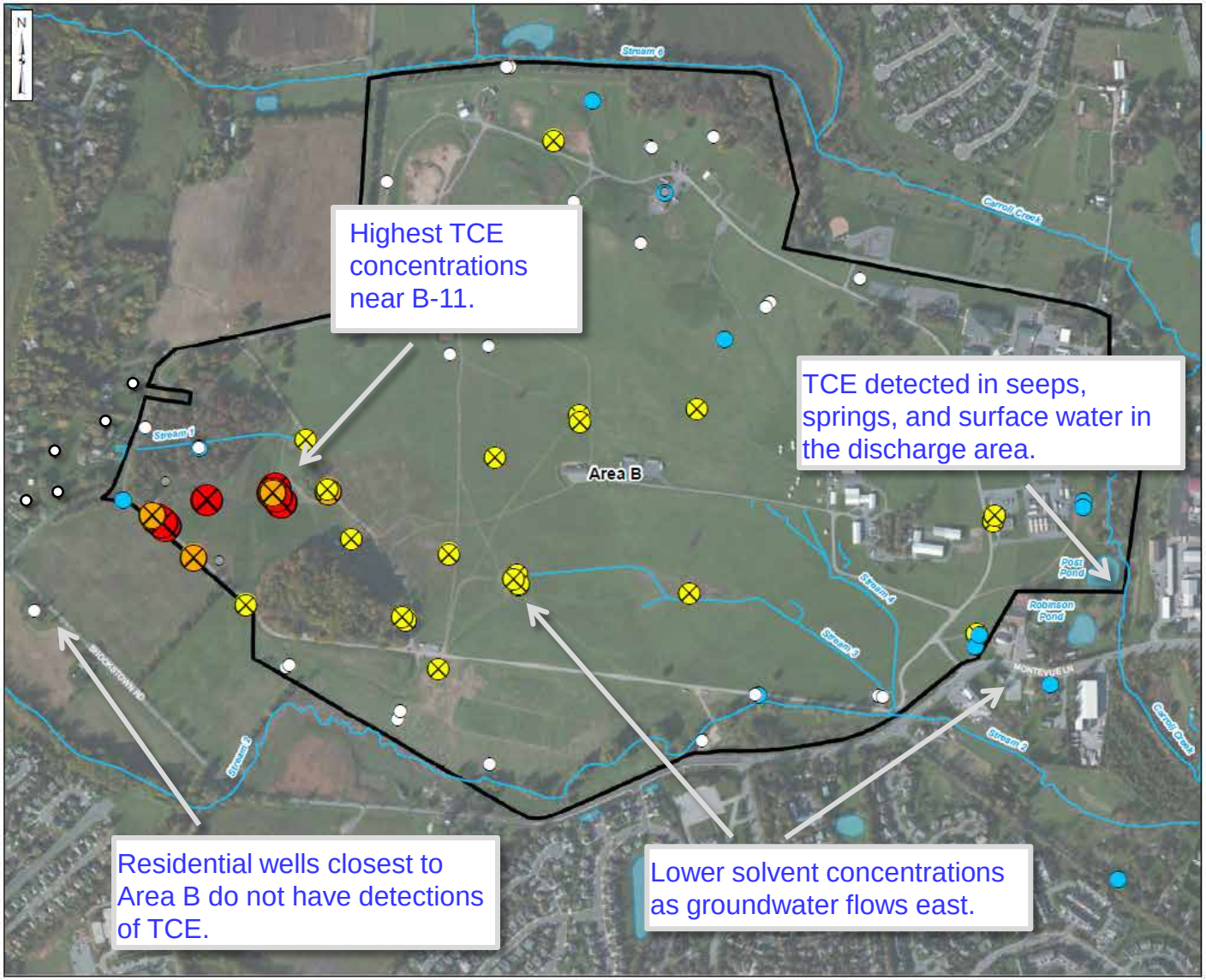
TCE in Groundwater Sept 2012



Legend

- Fort Detrick Boundary
- Stream
- Water Body

TCE Concentration

- Non-Detect
- 5 ug/L or less
- >5 to 80 ug/L
- >80 to 1,000 ug/L
- > 1,000 ug/L
- Dry Well not sampled in Round 2

X = Exceeds drinking water standard

Notes:
1) Aerial imagery accessed on 01/16/2012 through BING Maps Aerial via ArcGIS Online Layer Packages by ESRI (12/1/2010) ((c) 2010 Microsoft Corporation and its data suppliers).
3) TCE = Trichloroethene
4) Drinking water standard for TCE = 5 ug/L

0 500 1,000
Feet

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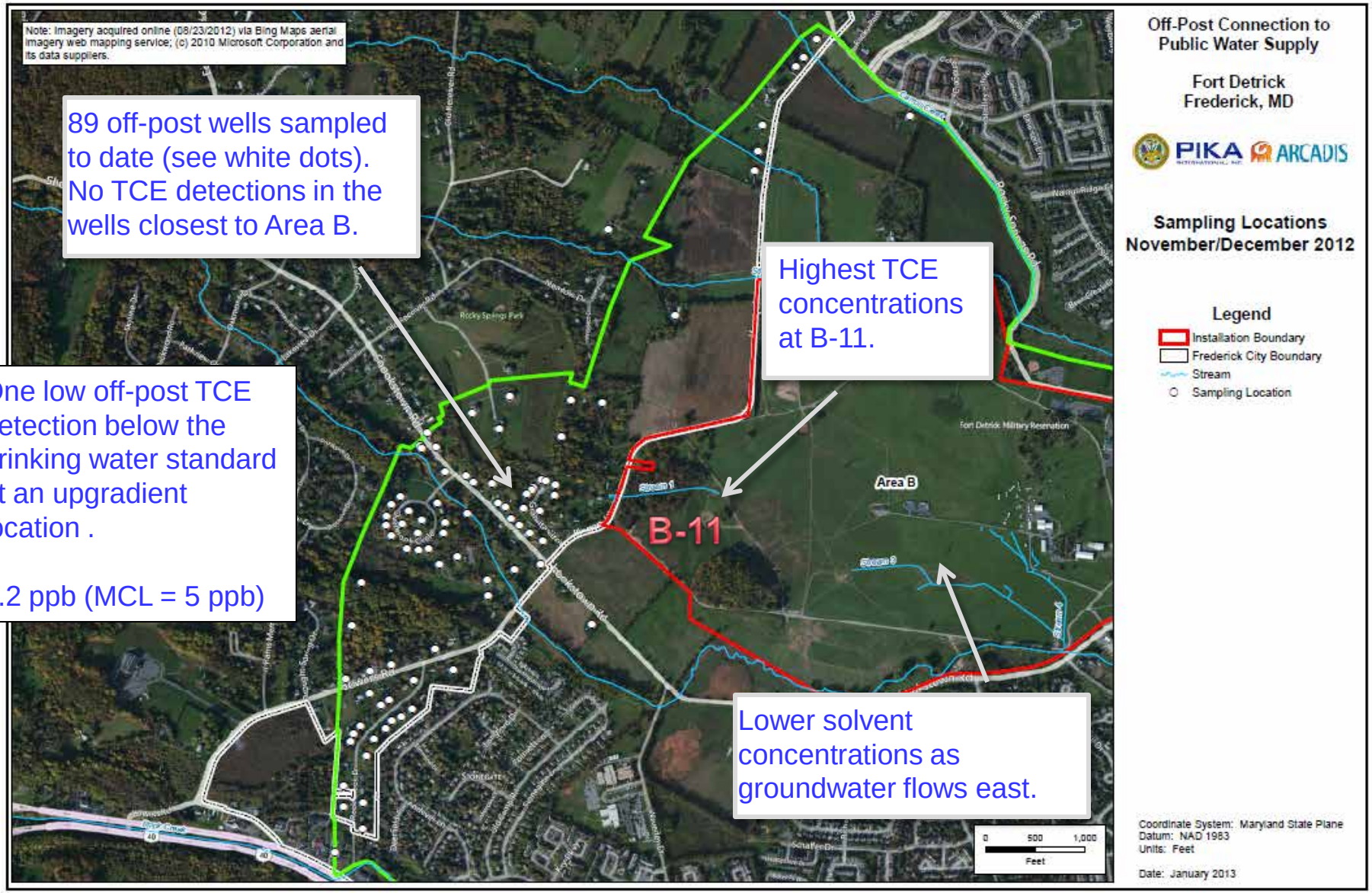
Groundwater Sampling
TCE Concentrations
September 2012

Area B Groundwater Investigation
Fort Detrick
Frederick, MD

Off-Post Sampling Locations



89 off-post wells sampled to date (see white dots). No TCE detections in the wells closest to Area B.

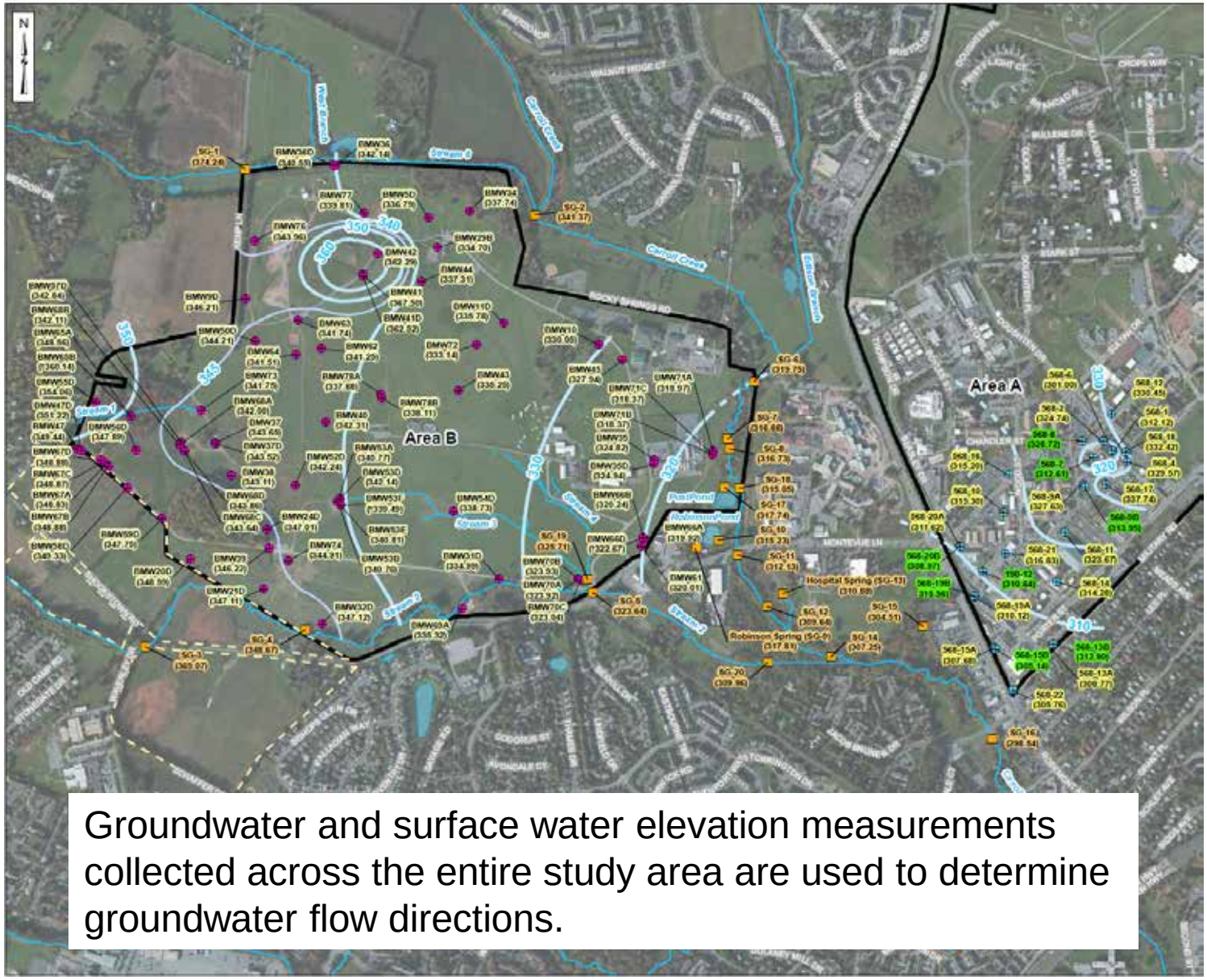
Highest TCE concentrations at B-11.

One low off-post TCE detection below the drinking water standard at an upgradient location .

0.2 ppb (MCL = 5 ppb)

Lower solvent concentrations as groundwater flows east.

Groundwater Contours



Groundwater and surface water elevation measurements collected across the entire study area are used to determine groundwater flow directions.

- Generalized groundwater flow direction is determined using the extensive network of elevation measuring locations.
- Contouring groundwater elevations is used to assess groundwater flow directions.

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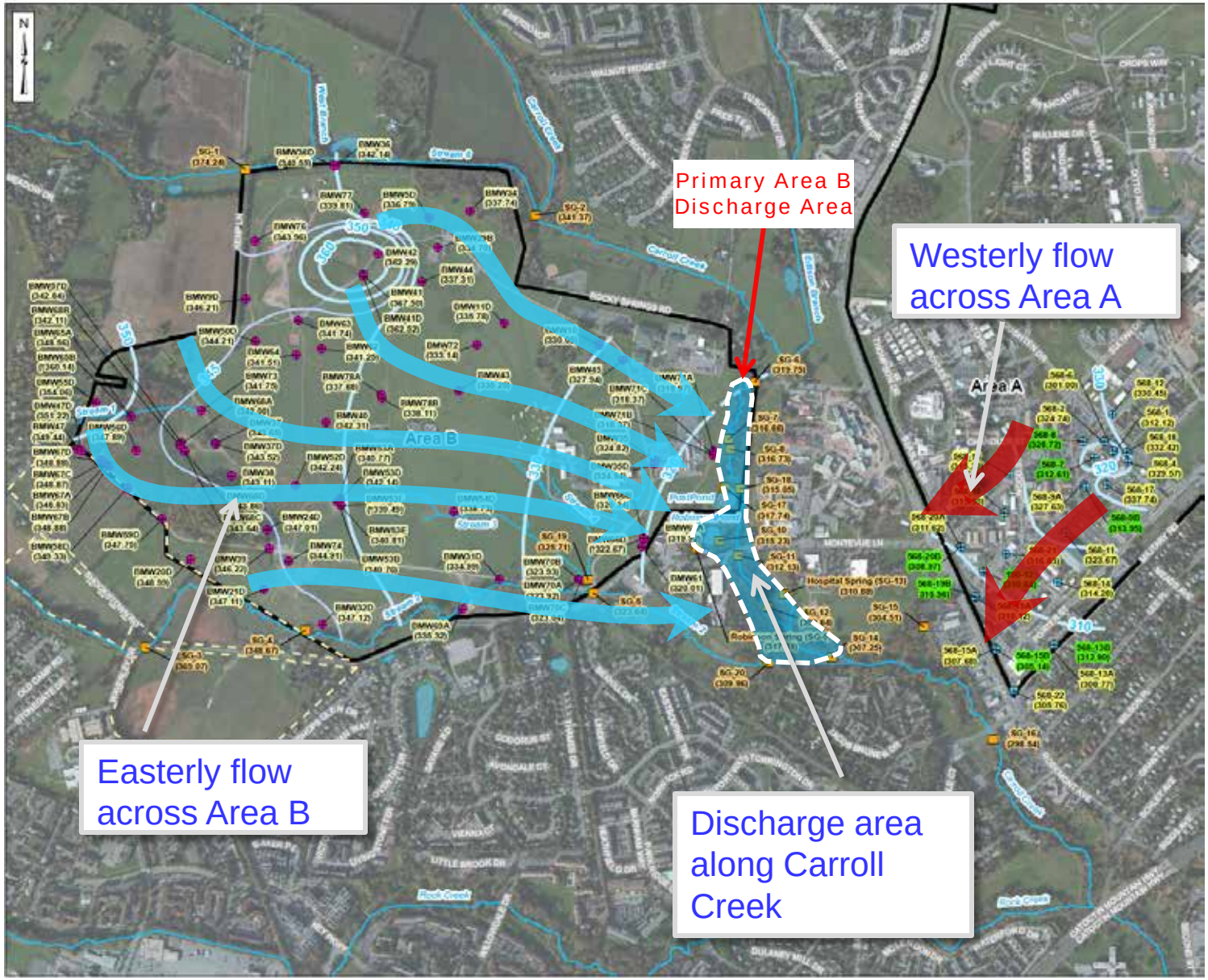
Groundwater Contours



- Generalized groundwater flow direction is determined using the extensive network of elevation measuring locations.
- Contouring groundwater elevations is used to assess groundwater flow directions.

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Vertical Contaminant Distribution

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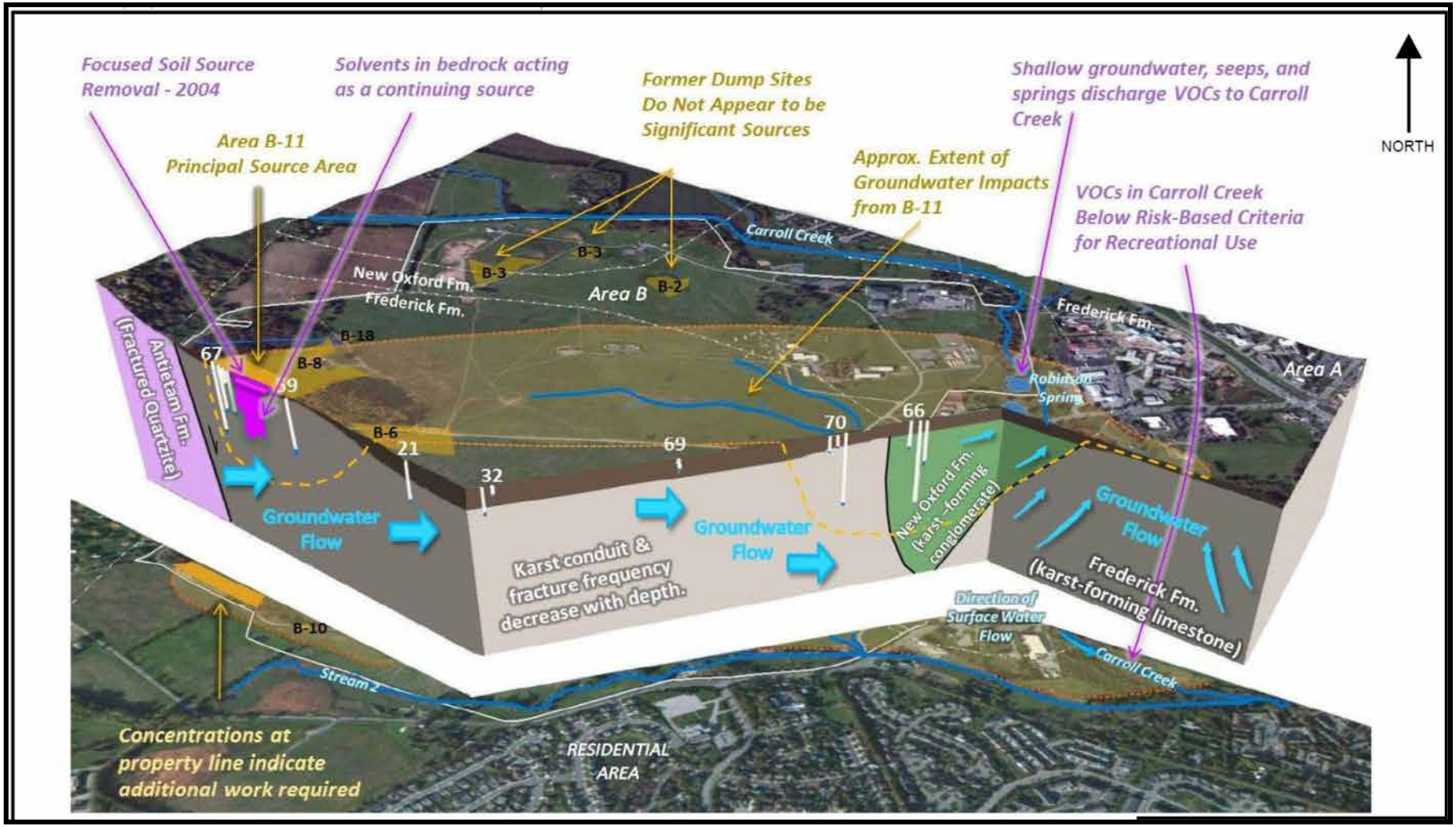
Area B Conceptual Site Model Review



Legend

- Streams
- Spring
- B-11 Boundary
- Trichloroethene in Groundwater
- Groundwater Flow Direction
- Geologic Contact

Aerial Source: ArcGIS Online Bing Imagery accessed 6/13/2012 via ArcGIS 10.

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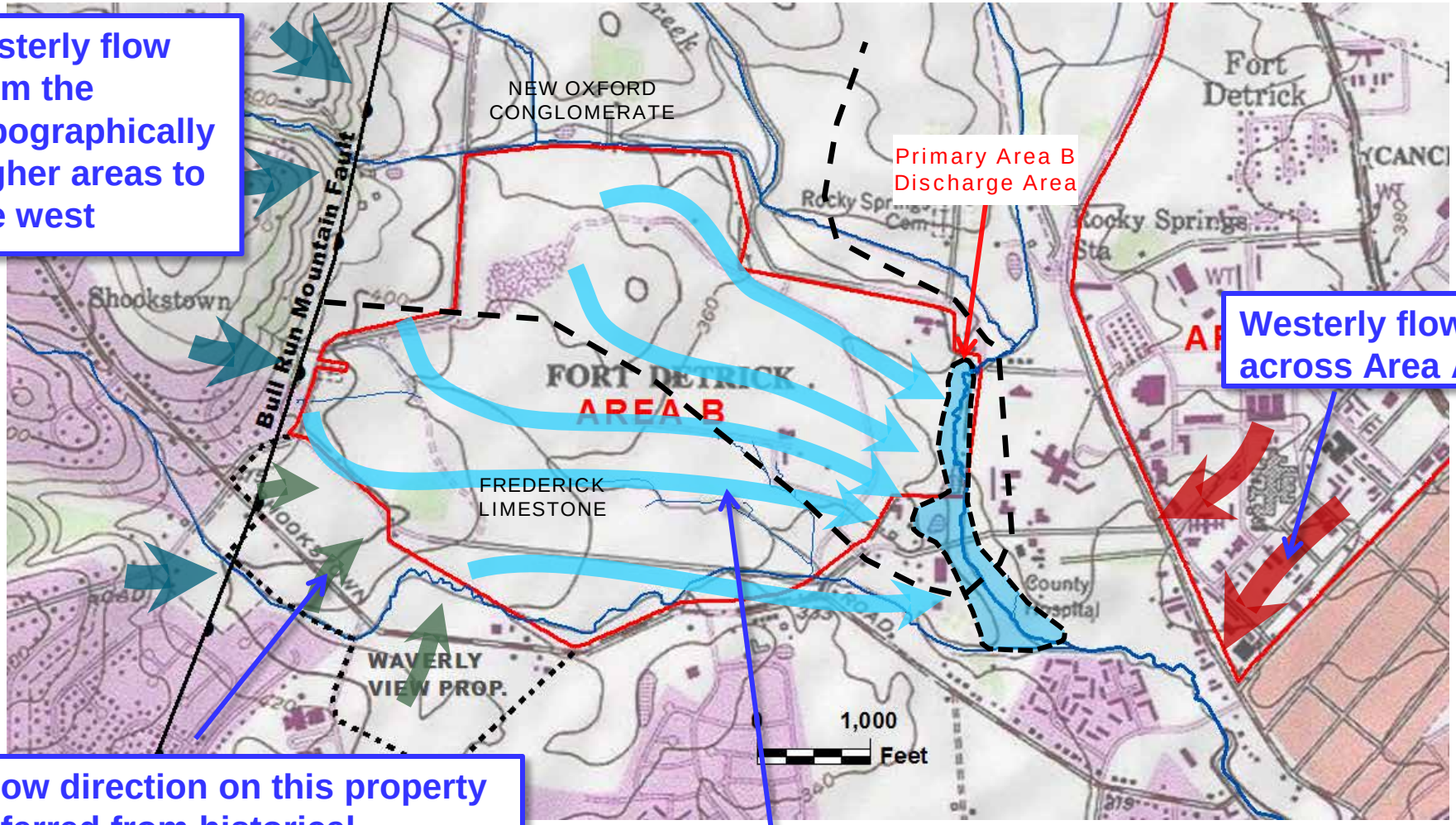
Generalized Patterns of Groundwater Flow



Easterly flow from the topographically higher areas to the west

Westerly flow across Area A

Flow direction on this property inferred from historical measurements in existing monitoring wells

Easterly flow across Area B

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Cross-Section Locations

The next slide shows a "layer-cake" cross section along this line from west to east (A to A')

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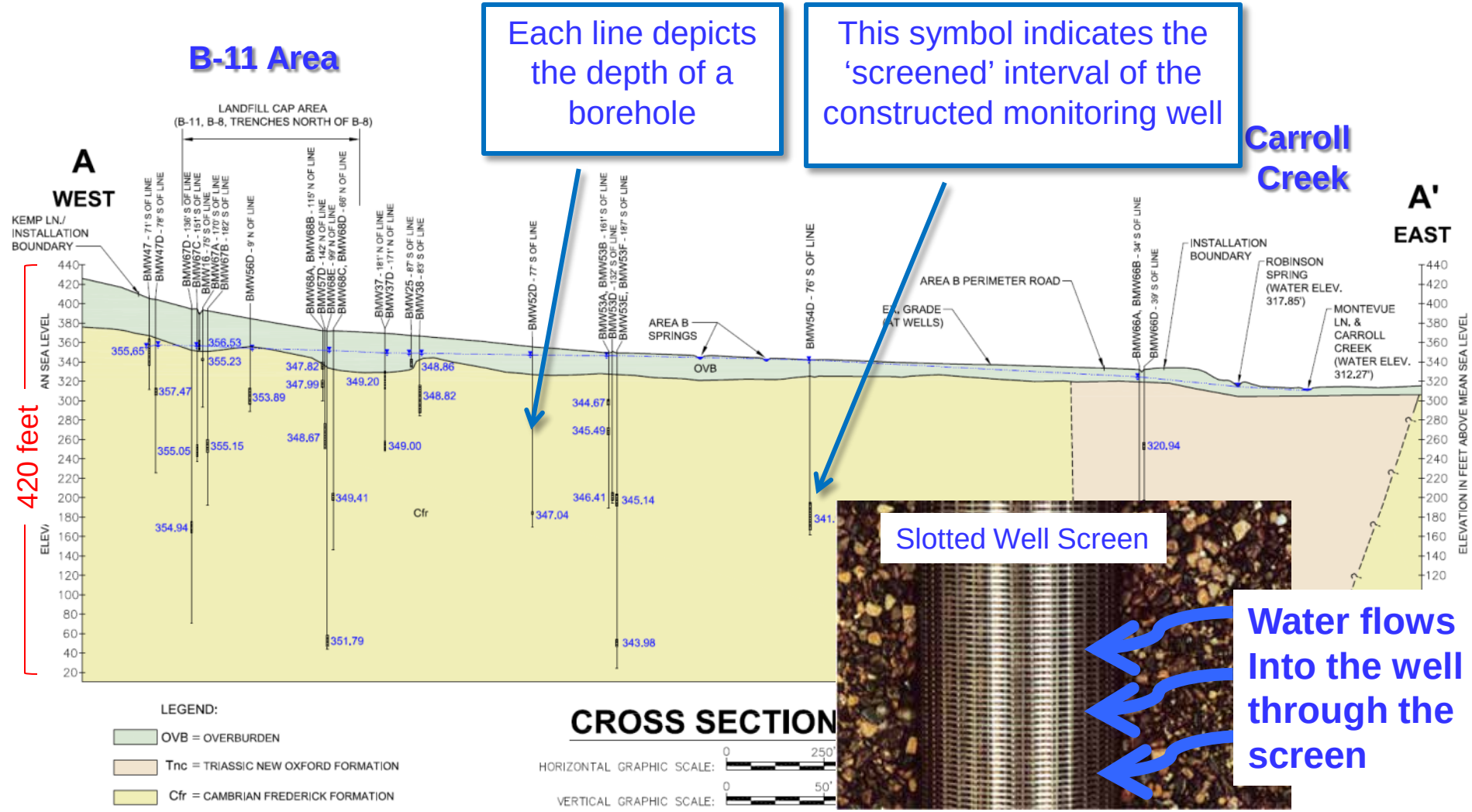
Cross-Section Showing Vertical Distribution of Select Wells Across Area B from West to East



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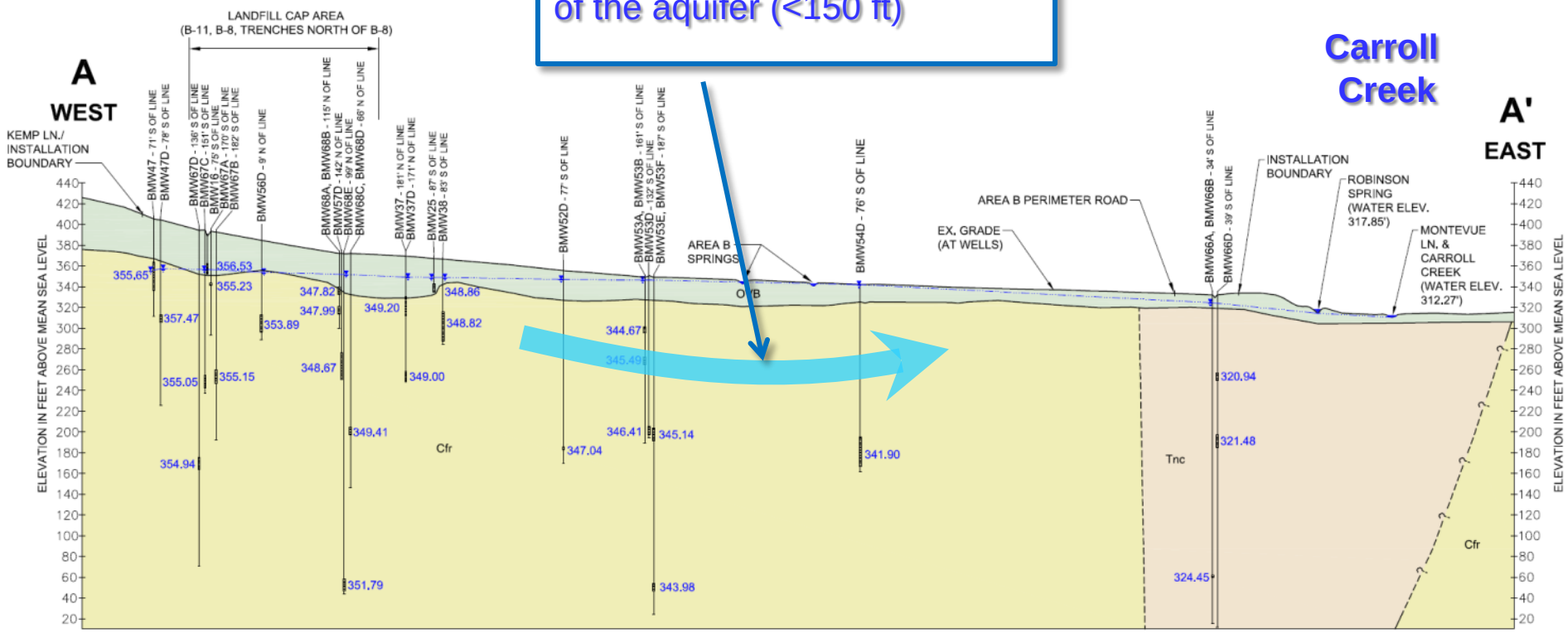
General Drilling Observations

The bulk of the groundwater flows in the shallower portions of the aquifer (<150 ft)



LEGEND:

- OVB = OVERBURDEN
- Tnc = TRIASSIC NEW OXFORD FORMATION
- Cfr = CAMBRIAN FREDERICK FORMATION

CROSS SECTION A-A'

HORIZONTAL GRAPHIC SCALE: 0 250' 500'

VERTICAL GRAPHIC SCALE: 0 50' 100'

Horizontal Scale (0-500')
Vertical Scale (0-100')

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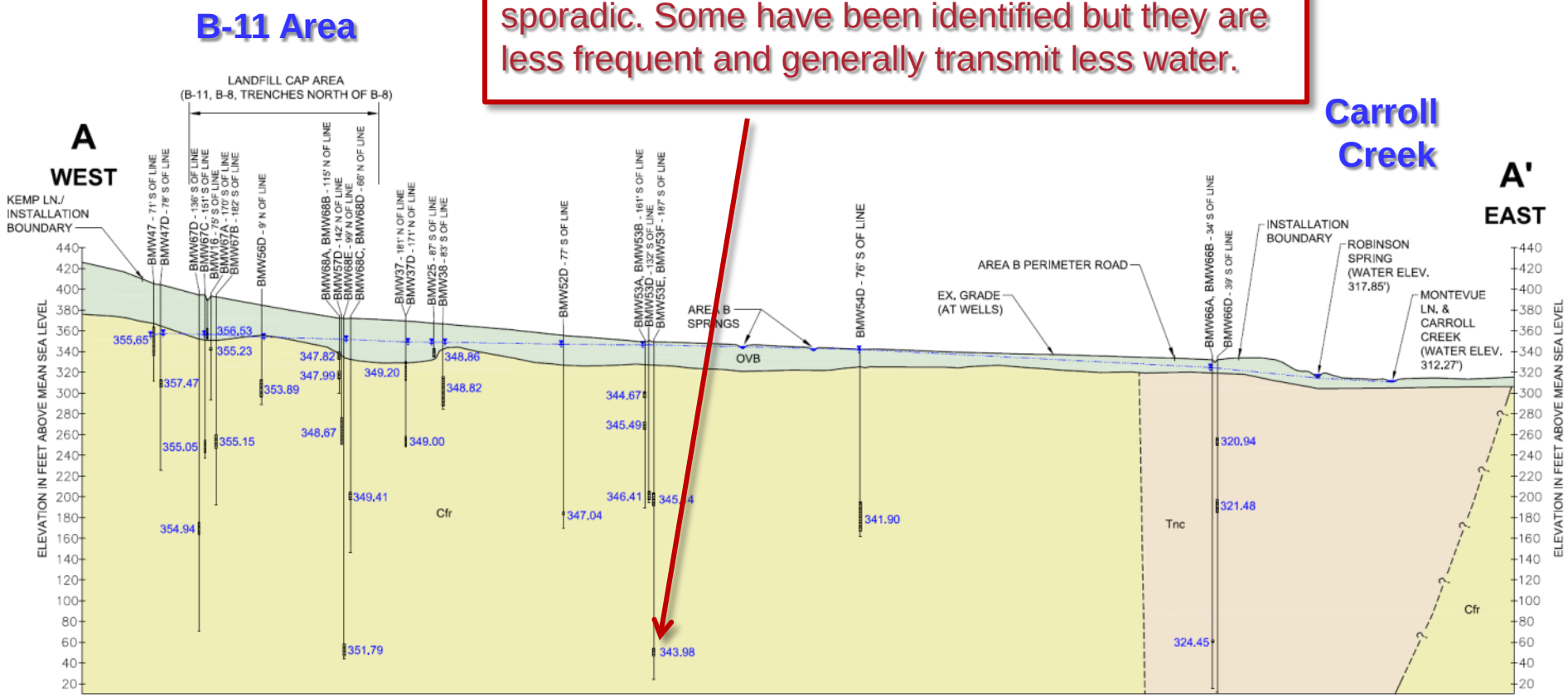
General Drilling Observations

At deeper depths, fractures and voids are more sporadic. Some have been identified but they are less frequent and generally transmit less water.



Horizontal Scale (0-500')
Vertical Scale (0-100')

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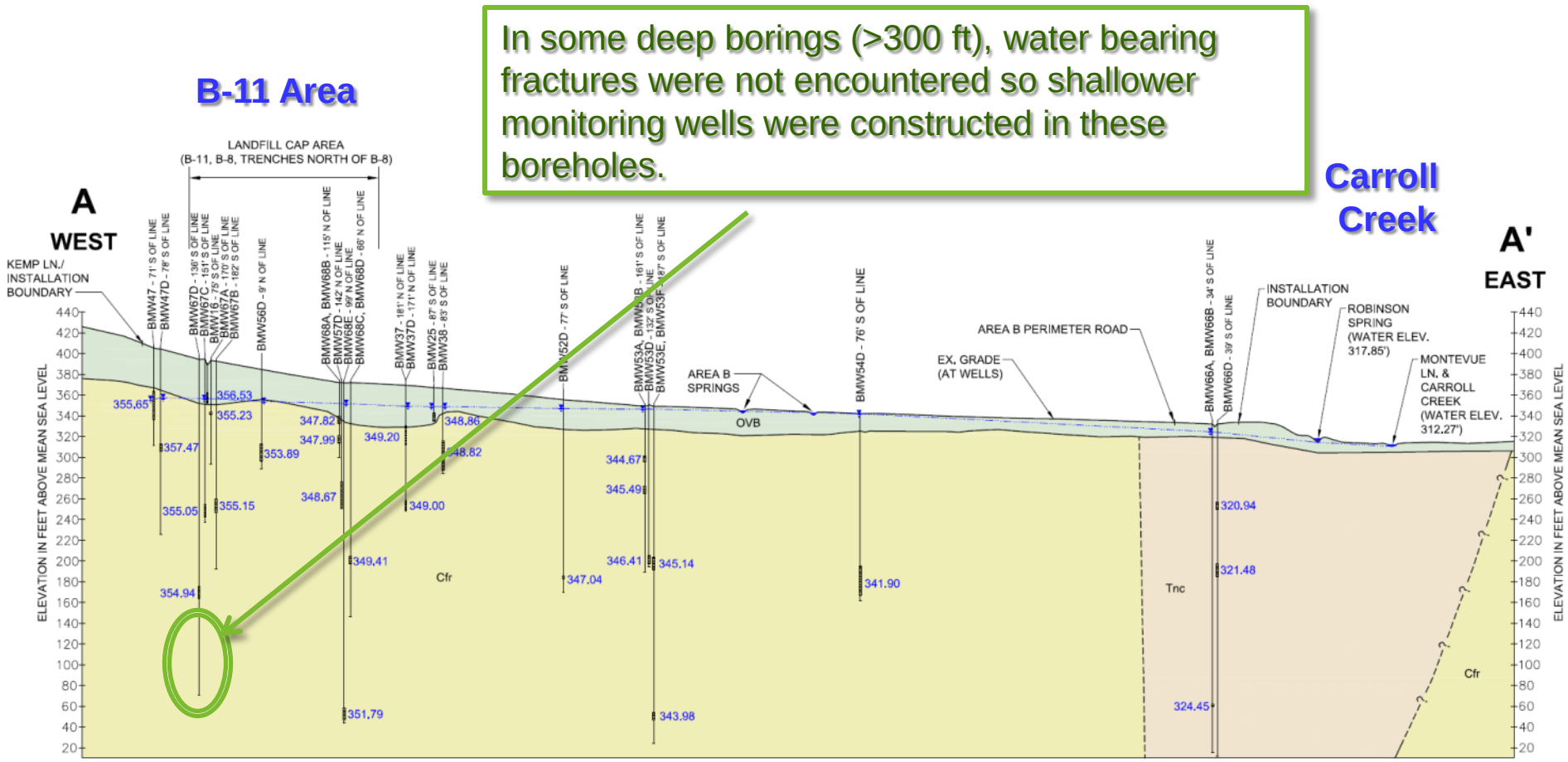
General Drilling Observations

In some deep borings (>300 ft), water bearing fractures were not encountered so shallower monitoring wells were constructed in these boreholes.



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HORIZONTAL GRAPHIC SCALE: 0 250' 500'

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Horizontal Scale (0-500')
Vertical Scale (0-100')

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Deep Borings (>300 ft)

Boring ID	Total Boring Depth	Well Construction Depth(s)
53E/F	325’	145-160’ 295-305’ «
65A/B	327’	112-127’ 298-313’ «
66A/B	320’	75-85’ 135-150’
67D	325’	220-235’’
68E	328’	313-328’ «
69B/C	325’	-none-
70C	325’	221-231’
71B/C	325’	170-180’ 222-232’
78B	325’	140-150’

« = Wells > 300 ft deep

- 9 borings have been drilled to 320 ft or deeper.
- At most deep borings, no deep water bearing fractures were observed.
- EPA, MDE, Army, and ARCADIS technical staff reviewed the drilling information and concurred on the well construction plans.
- 3 deep wells have been constructed to date >300 ft. Deep wells were not warranted in the other 6 deep borings based on drilling observations.

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Deep Borings (>320 ft)

= deep boring >320 ft deep « = Well constructed > 300 ft deep

Legend

- Fort Detrick Boundary
- Stream
- Water Body

TCE Concentration

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0 500 1,000
Feet

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Groundwater Sampling
TCE Concentrations
September 2012

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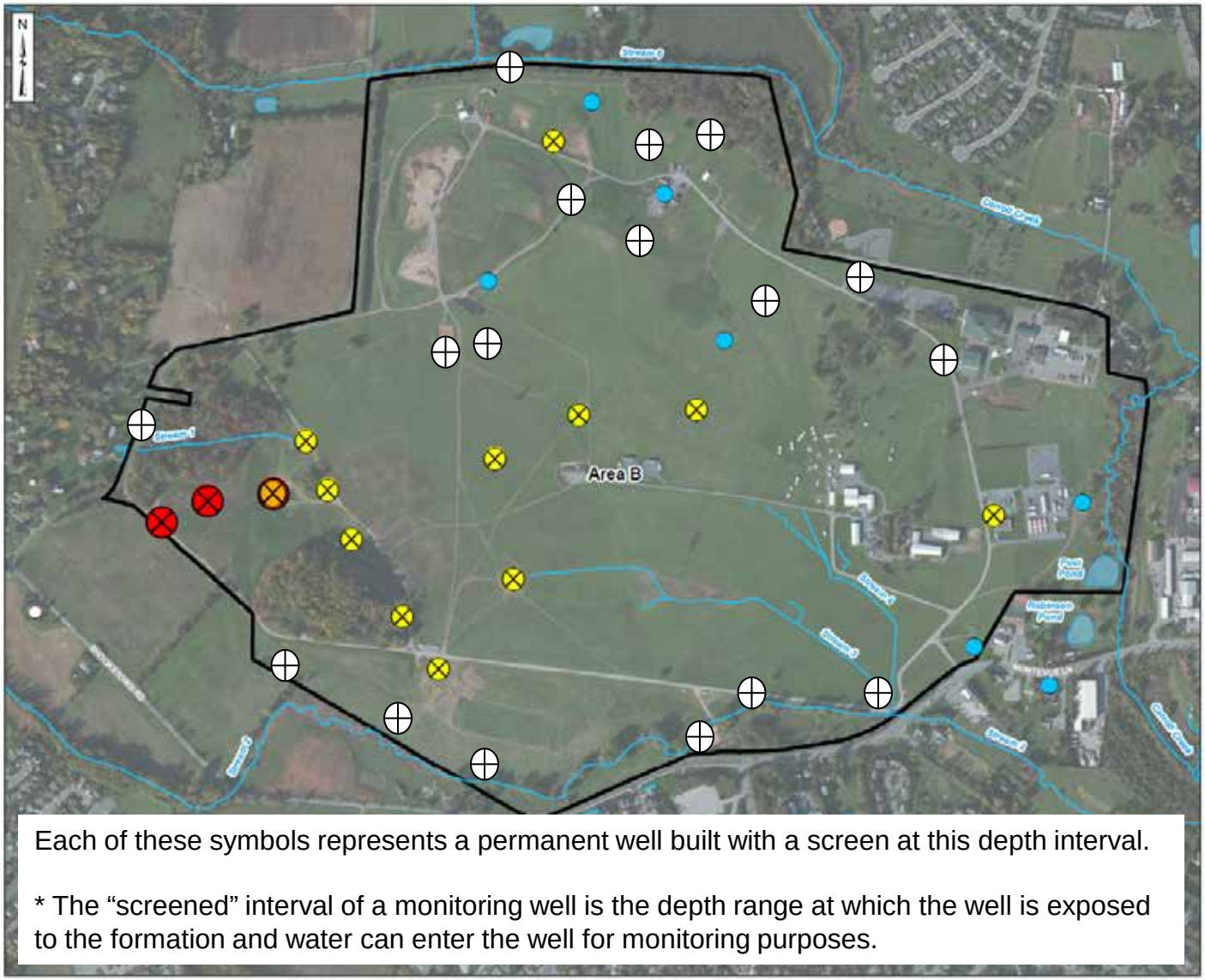
Fort Detrick
Frederick, MD

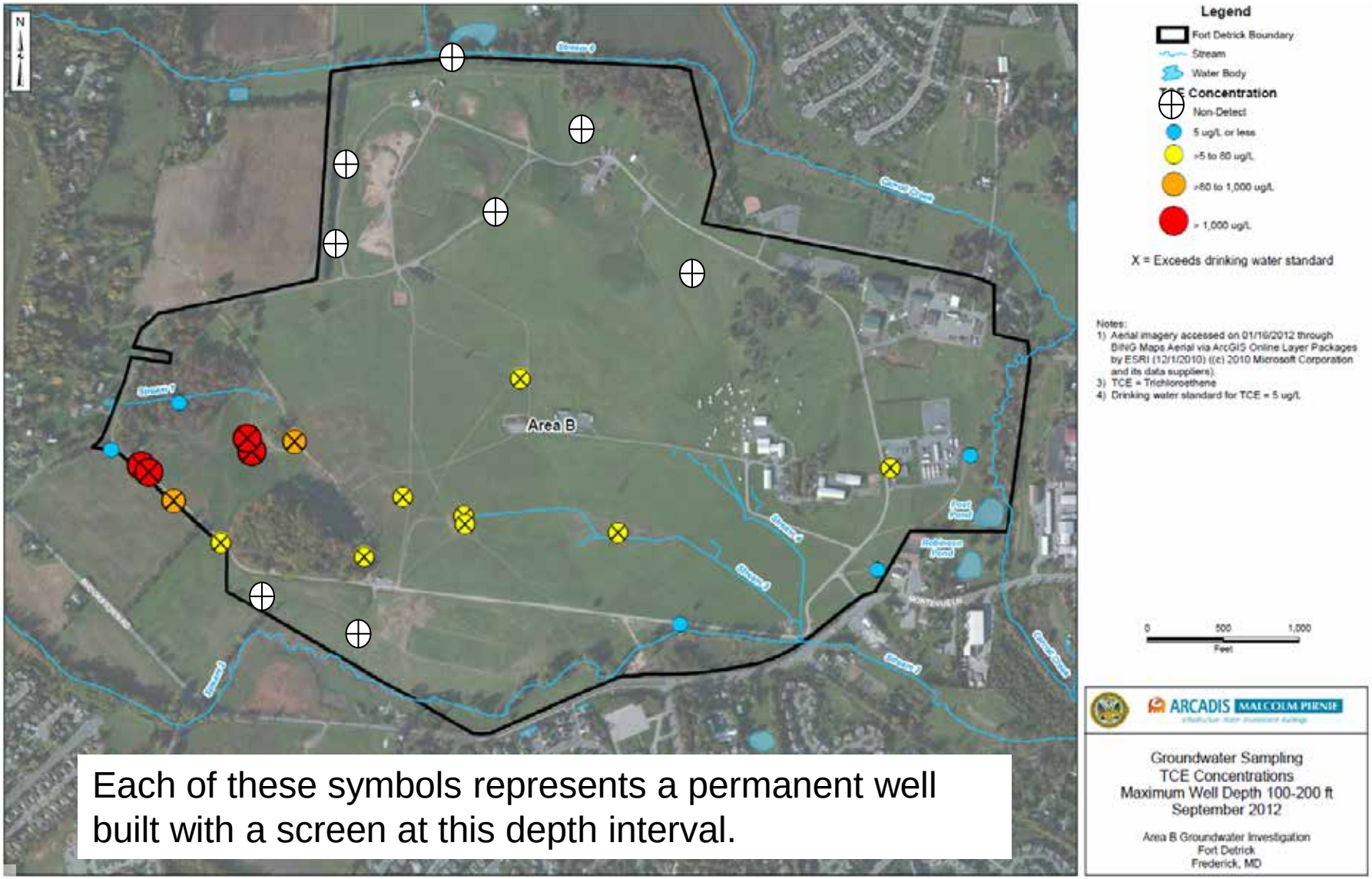
Monitoring Wells Screened* from 7-100 ft Deep



Each of these symbols represents a permanent well built with a screen at this depth interval.

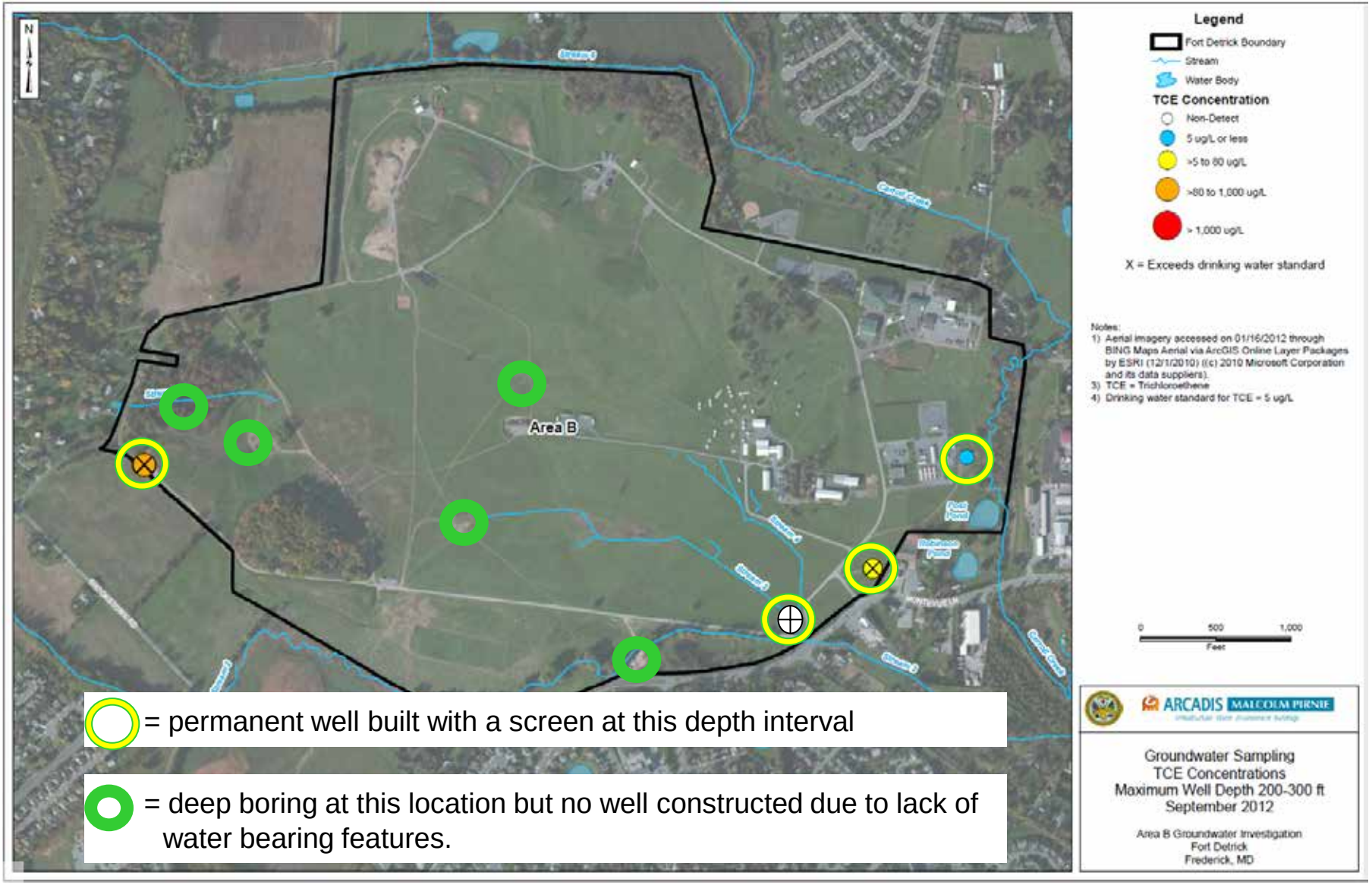
* The “screened” interval of a monitoring well is the depth range at which the well is exposed to the formation and water can enter the well for monitoring purposes.

Monitoring Wells Screened from 100-200 ft Deep

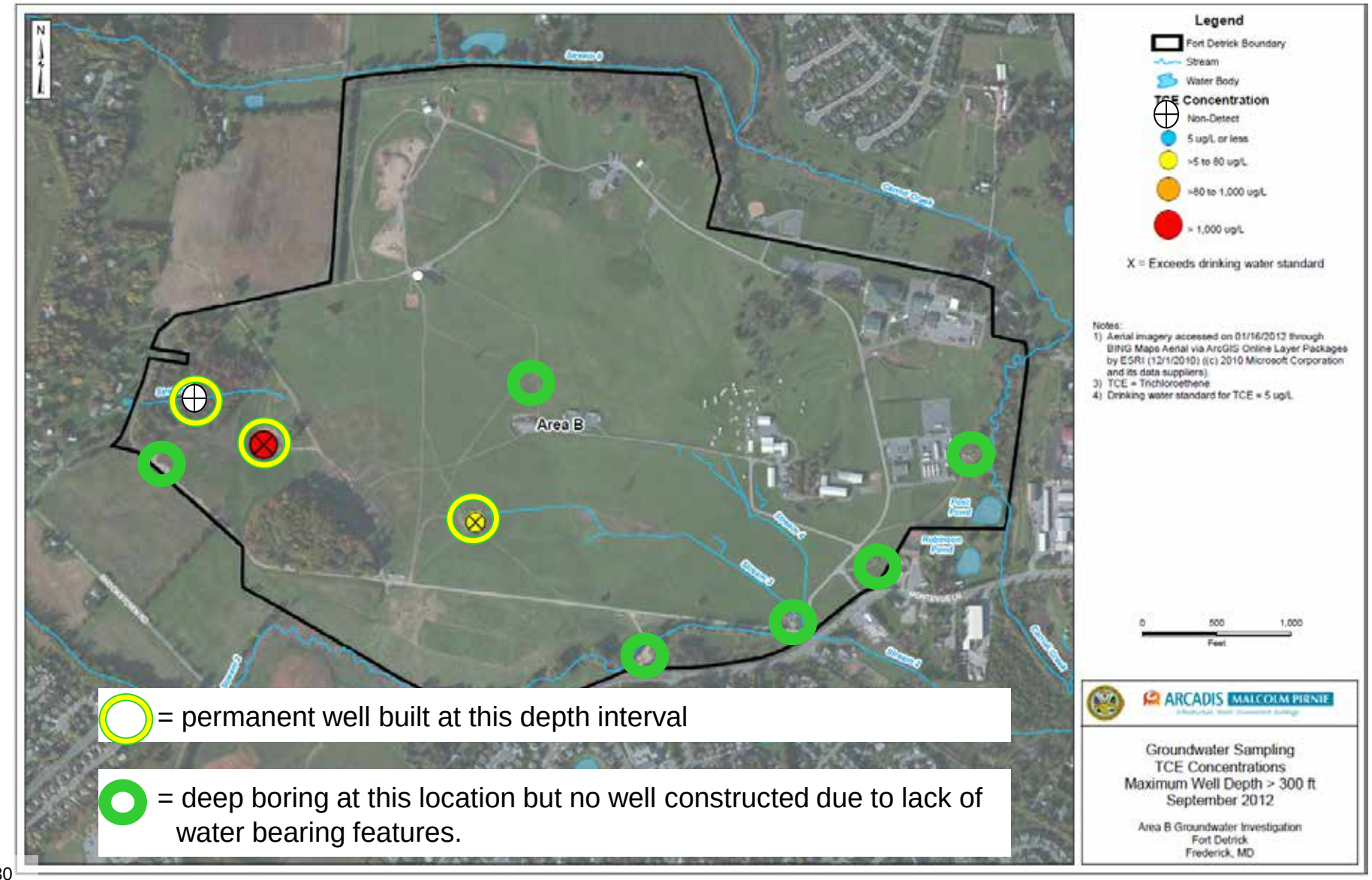


Each of these symbols represents a permanent well built with a screen at this depth interval.

Monitoring Wells Screened from 200-300 ft Deep



Monitoring Wells Screened >300 ft Deep



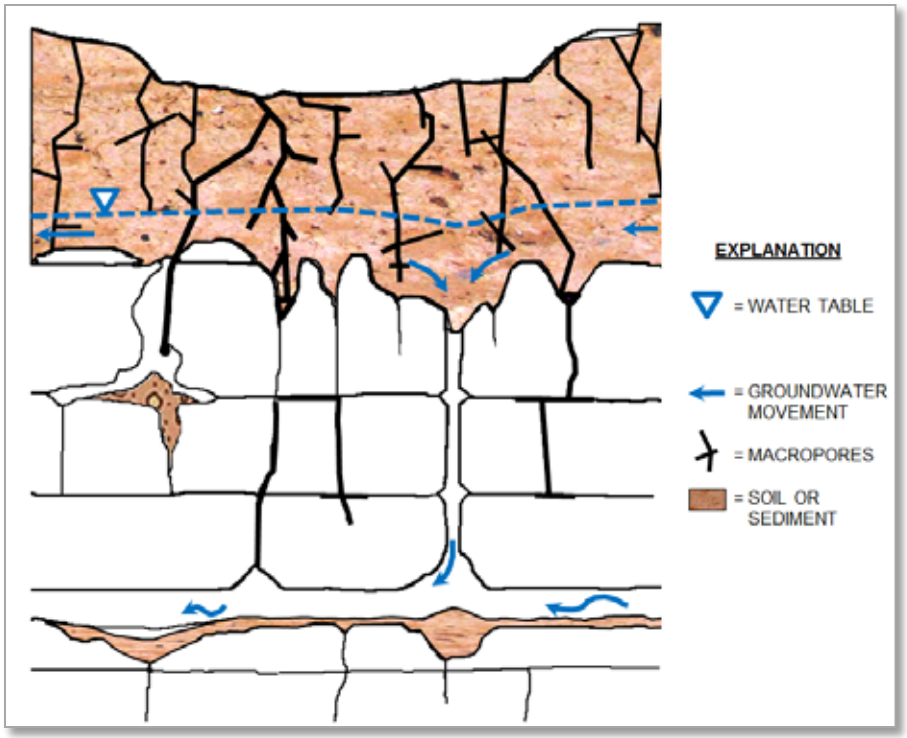
Review of Karst and DNAPL Behavior in Karst

- The next slides use a hypothetical sketch to review key concepts in karst geology, DNAPL contamination in karst geology, and drilling/investigation considerations in karst environments.

Definitions:

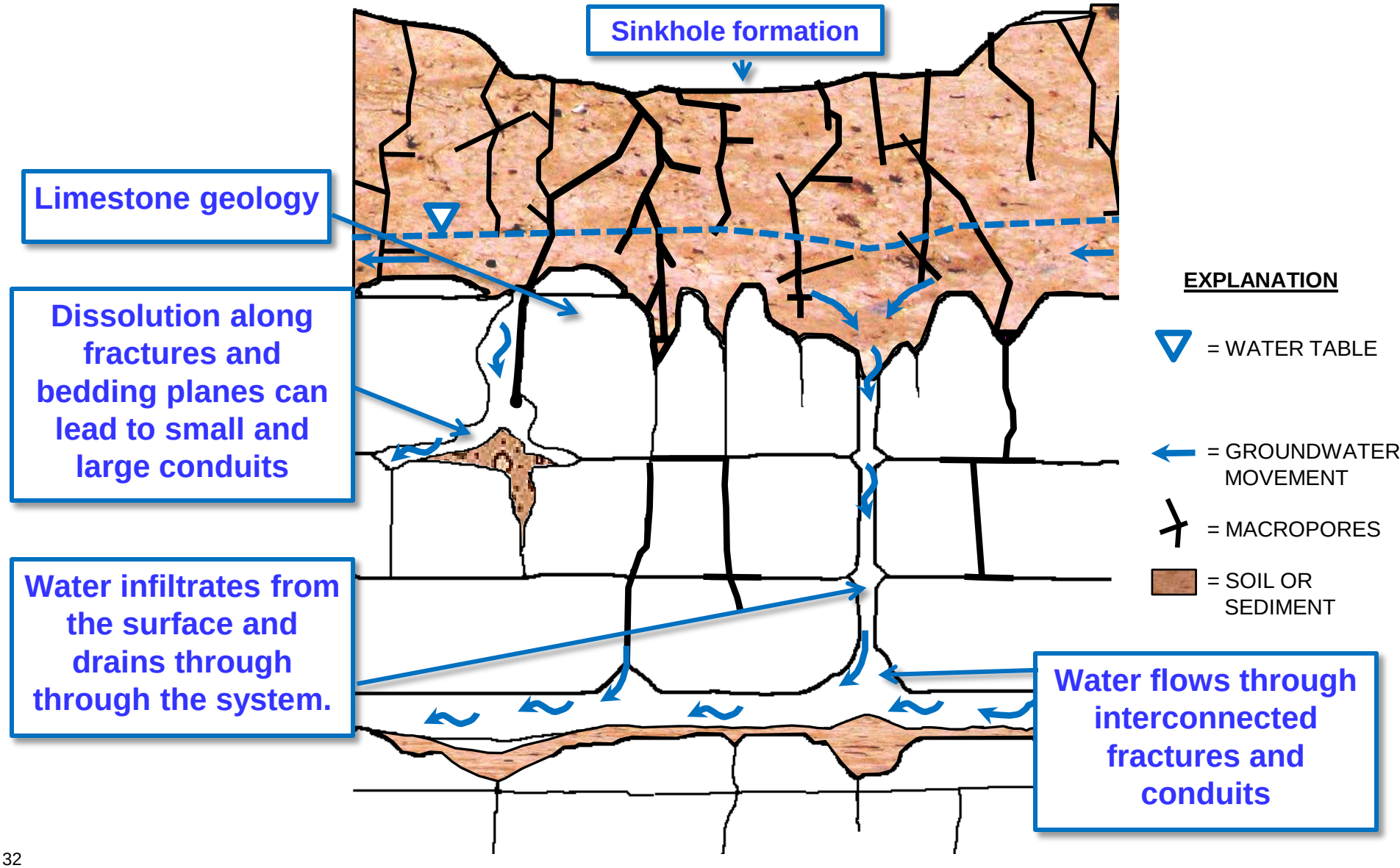
Karst: geologic formation shaped by dissolution of soluble rock resulting in surficial features such as sink holes and subterranean drainage networks of solution-widened fractures.

DNAPL: (Dense Non-Aqueous Phase Liquid) A liquid that is denser than water, does not readily dissolve in water, and tends to sink below the water table. TCE and PCE are both DNAPLs.



Understanding Karst Geology

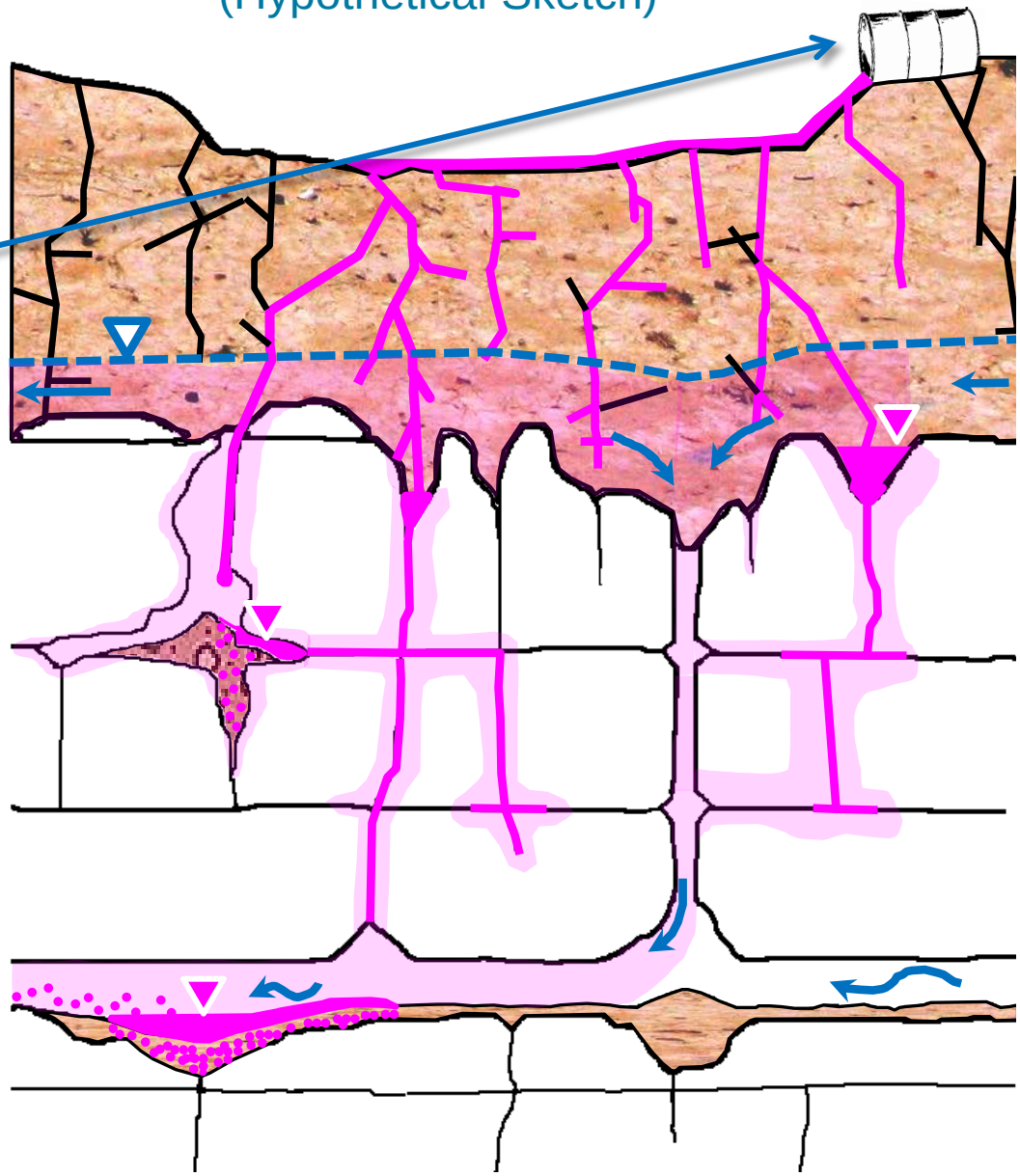
(Hypothetical Sketch)



Understanding Karst and DNAPL Behavior in Karst

(Hypothetical Sketch)

Assume a hypothetical DNAPL release



EXPLANATION

= WATER TABLE

= DNAPL POOL

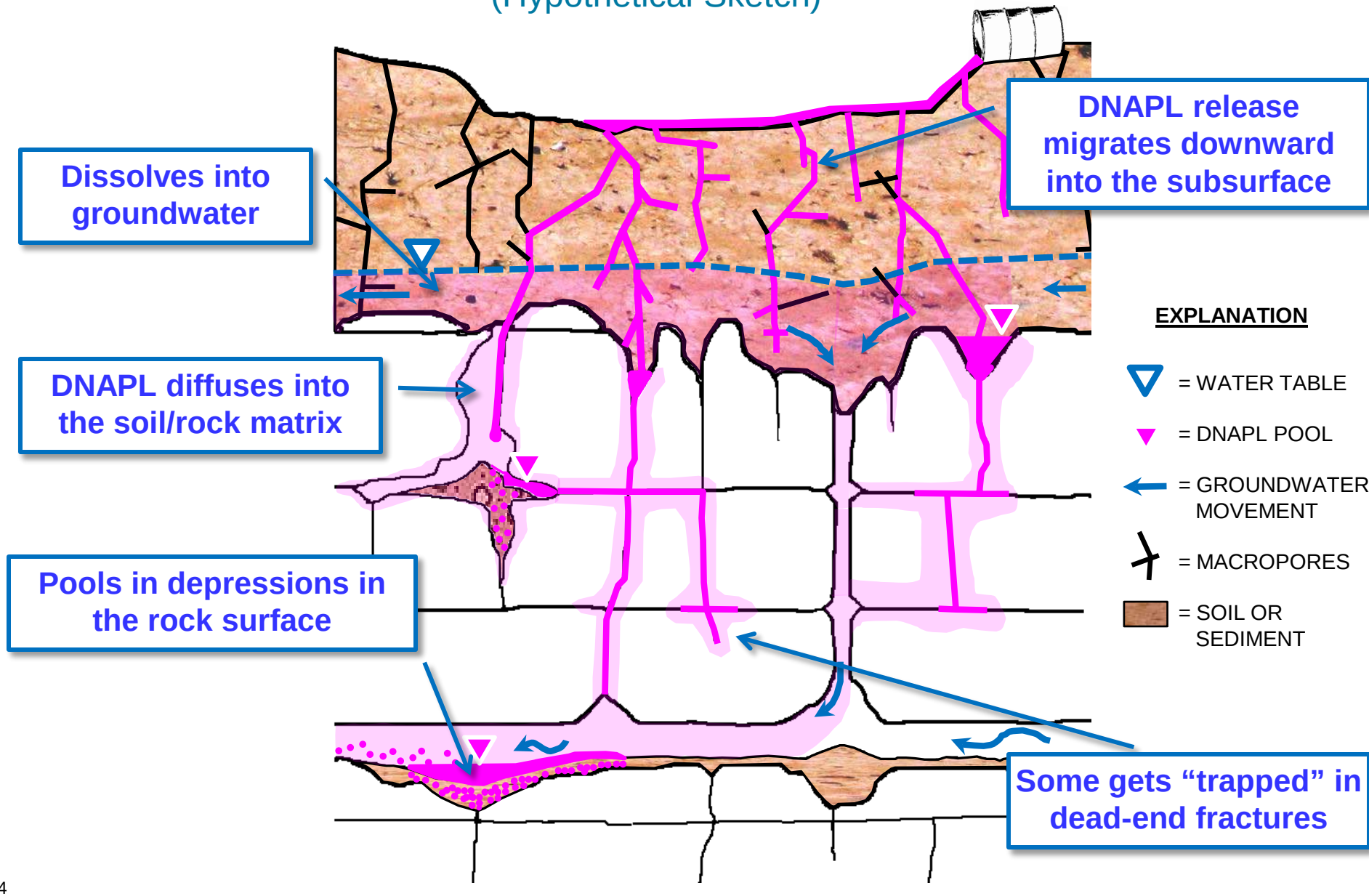
= GROUNDWATER MOVEMENT

= MACROPORES

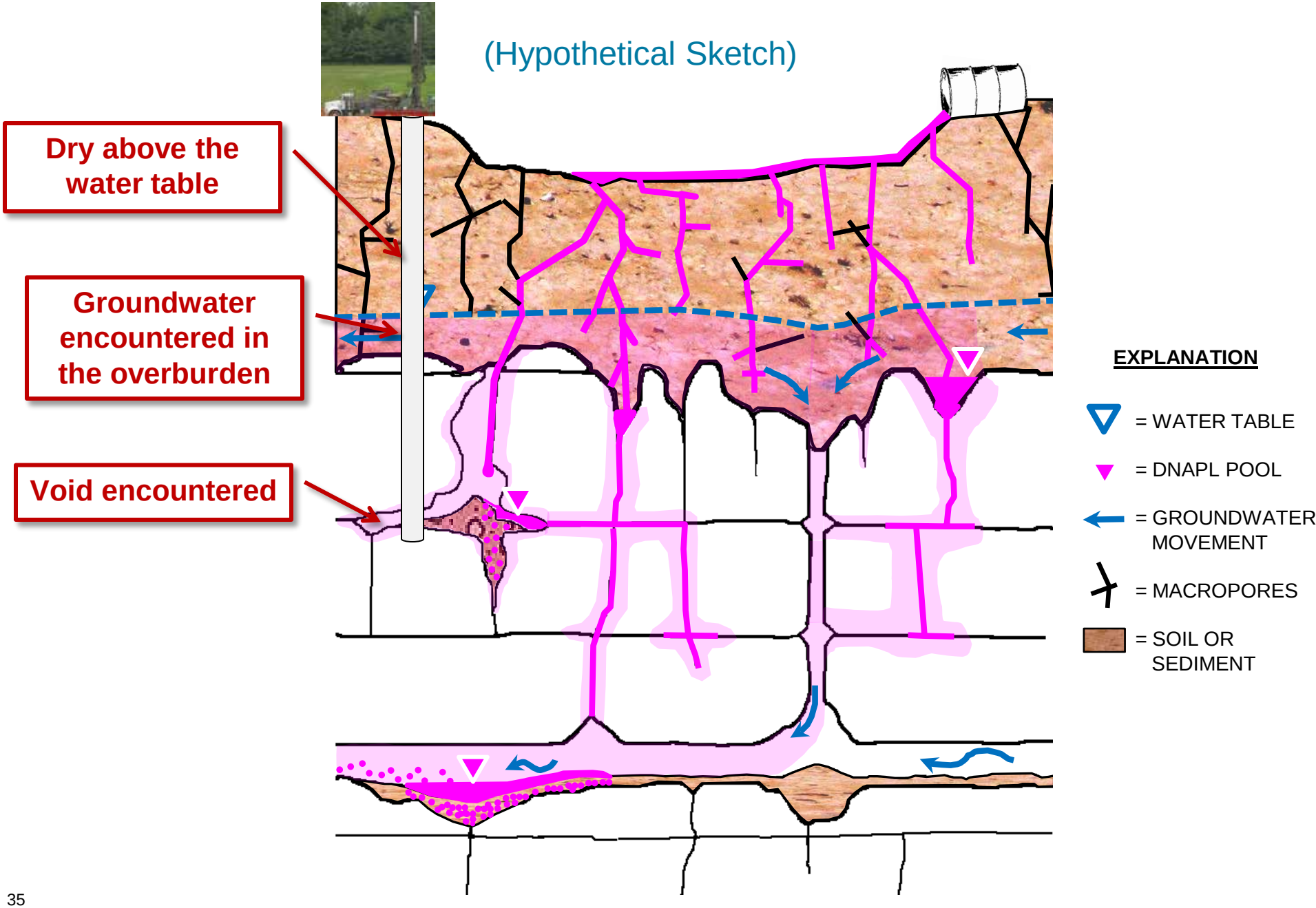
= SOIL OR SEDIMENT

Understanding How DNAPL Behaves in Karst

(Hypothetical Sketch)



Hypothetical Observations During Drilling



Hypothetical Observations During Drilling

(Hypothetical Sketch)

Dry fractures; no water.

Zone with no fractures; solid rock.

Significant void and water bearing zone.

No fractures or fractures with little water.

EXPLANATION

= WATER TABLE

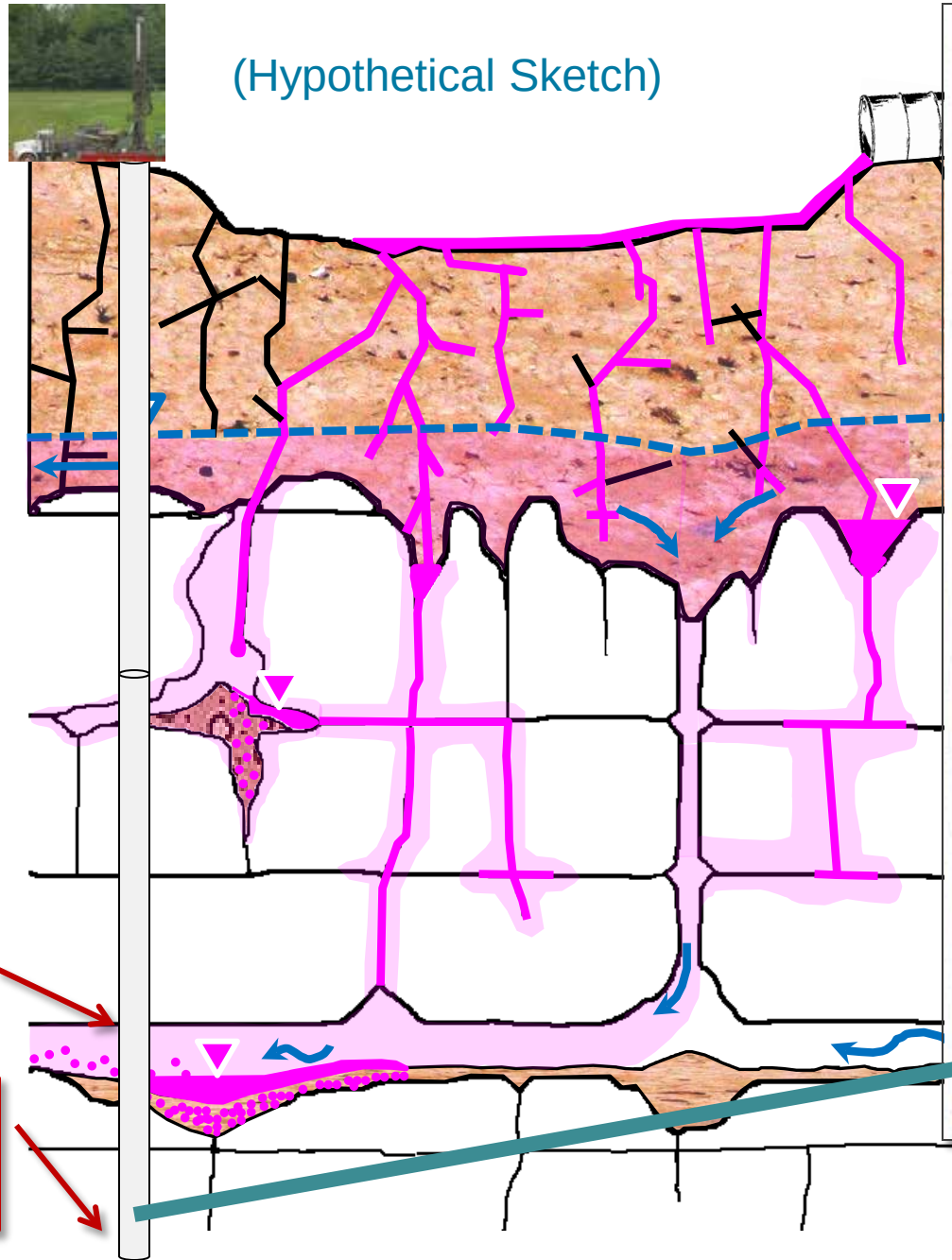
= DNAPL POOL

= GROUNDWATER MOVEMENT

= MACROPORES

= SOIL OR SEDIMENT

Hypothetical Observations During Drilling



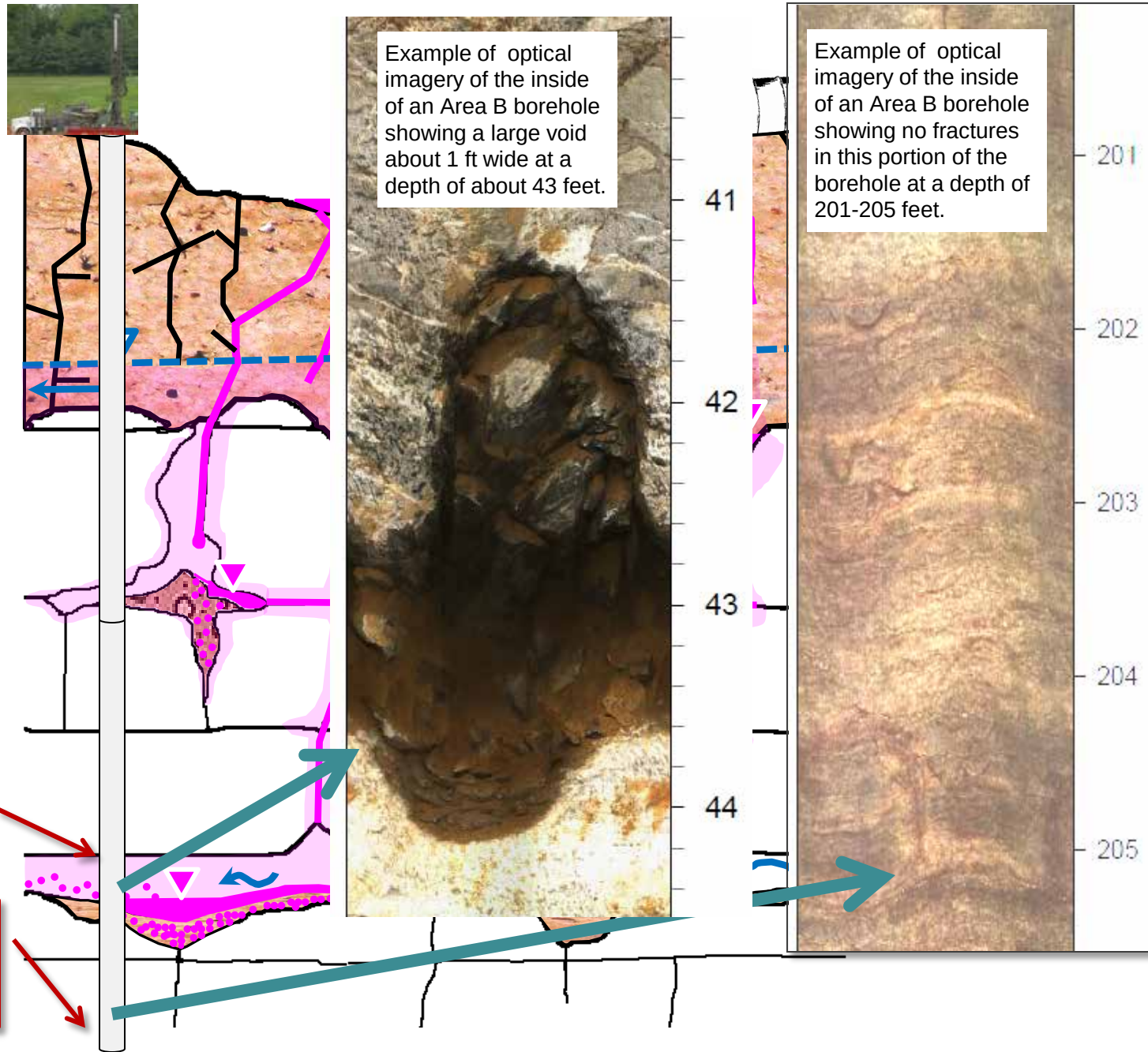
Example of optical imagery of the inside of an Area B borehole showing no fractures in this portion of the borehole at a depth of 201-205 feet.

Significant void and water bearing zone.

No fractures or fractures with little water.

Hypothetical Observations During Drilling

Note: Optical and acoustical televiewer imagery were included in the suite of technologies used during the recent Area B drilling activities to aid in identifying appropriate zones for screening newly constructed monitoring wells. Examples are provided here to show how this imagery can help visually identify potentially water-bearing fractures and voids across the entire depth of the borehole.

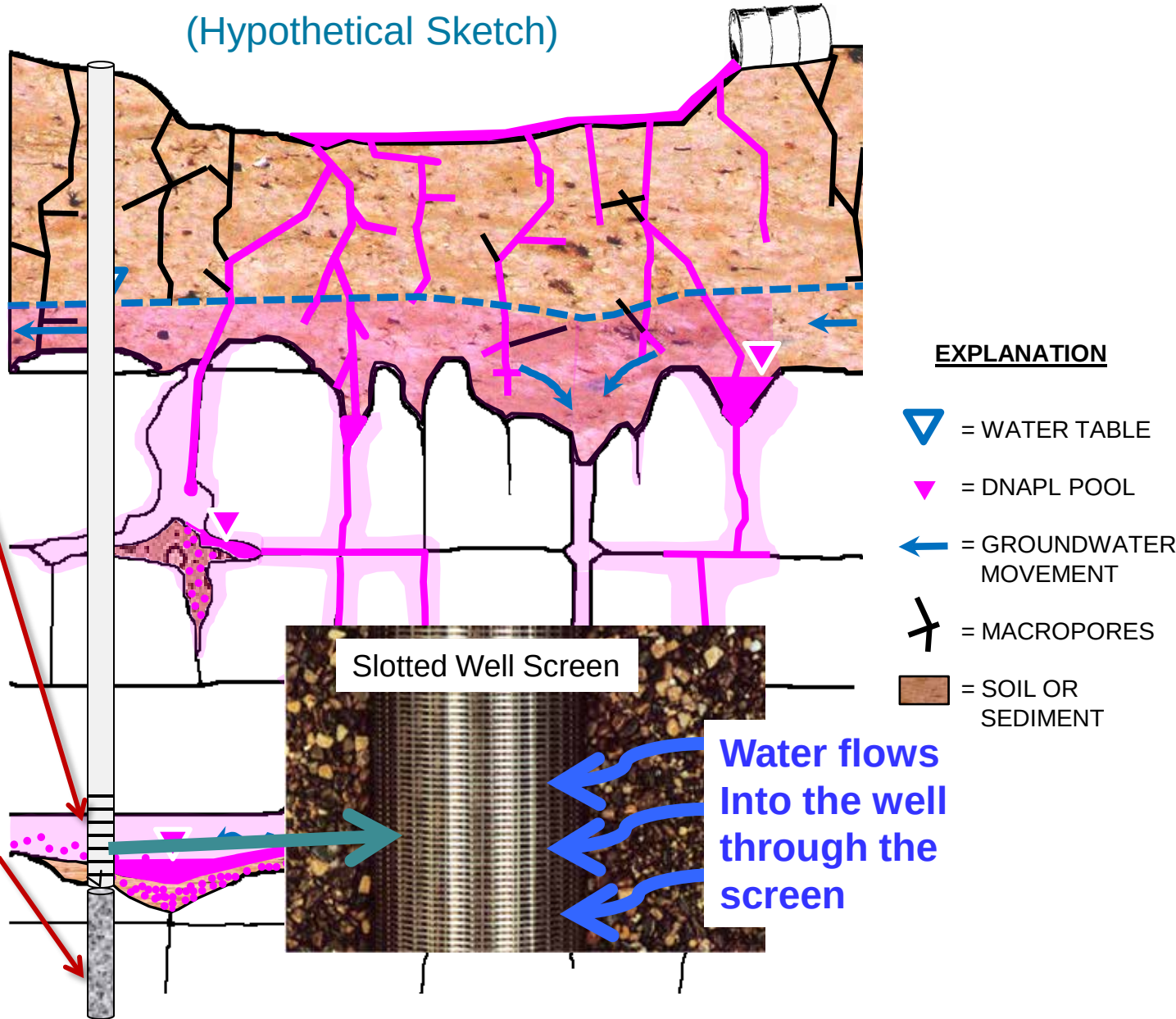


Significant void and water bearing zone.

No fractures or fractures with little water.

Constructing a Monitoring Well Based on Drilling Observations

(Hypothetical Sketch)



Construct well to target fracture zones with water and/or contamination.

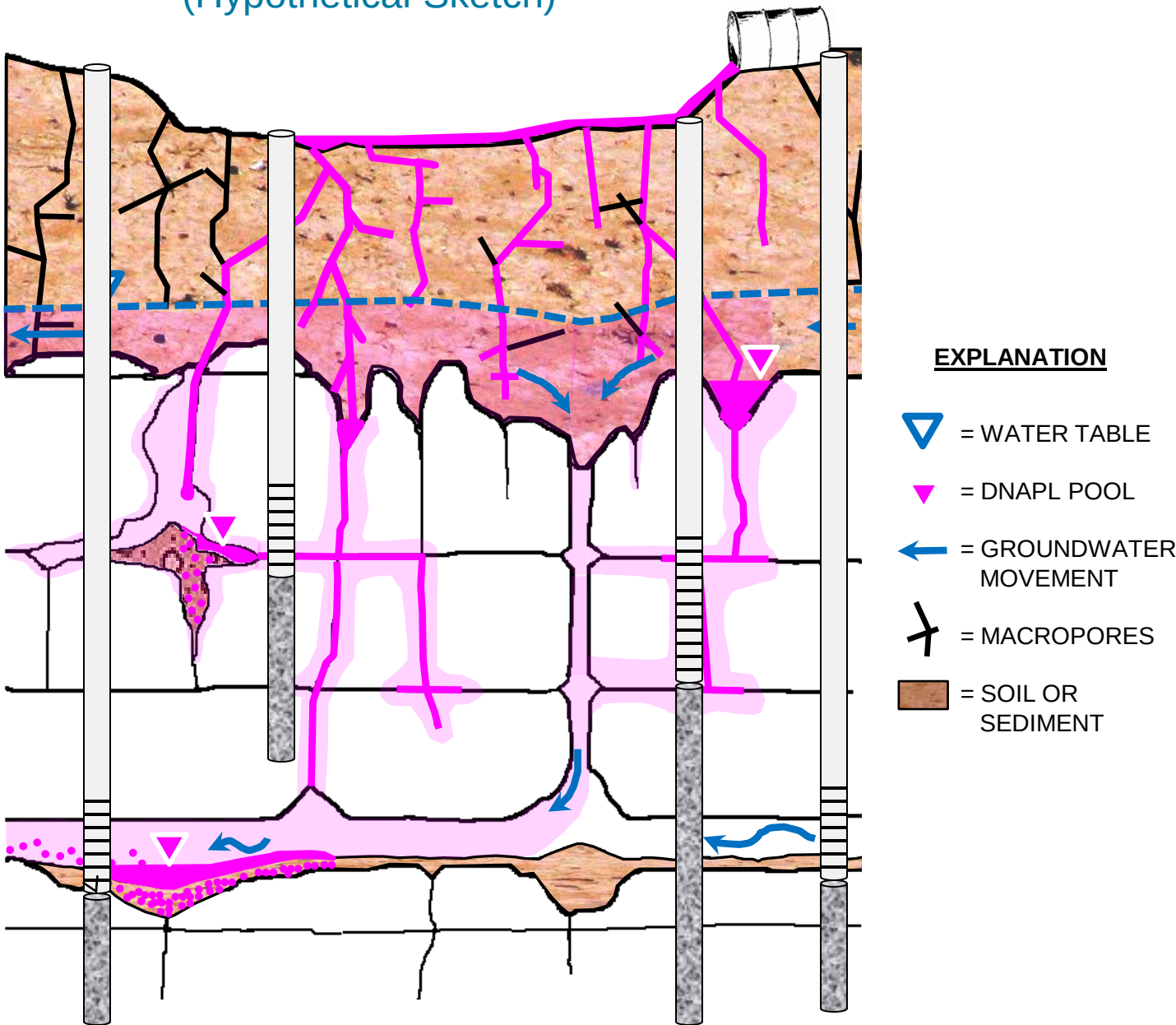
Grout up deeper portions of the borehole with no water.

Drilling Considerations

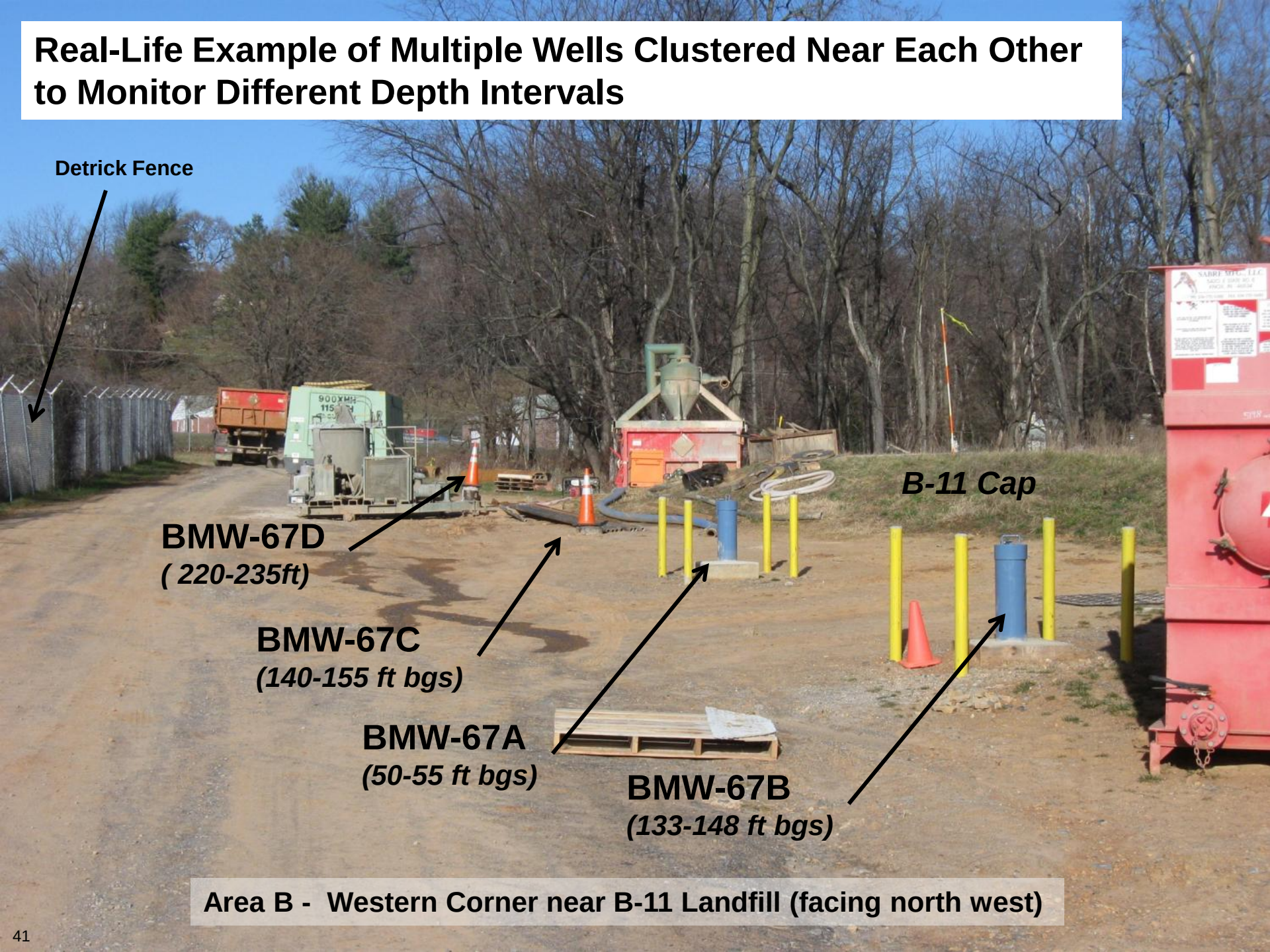
(Hypothetical Sketch)

Example of multiple wells constructed in a source area to target different depths.

Drilling observations, geophysical logging, and sampling used to target specific zones for long-term monitoring wells.

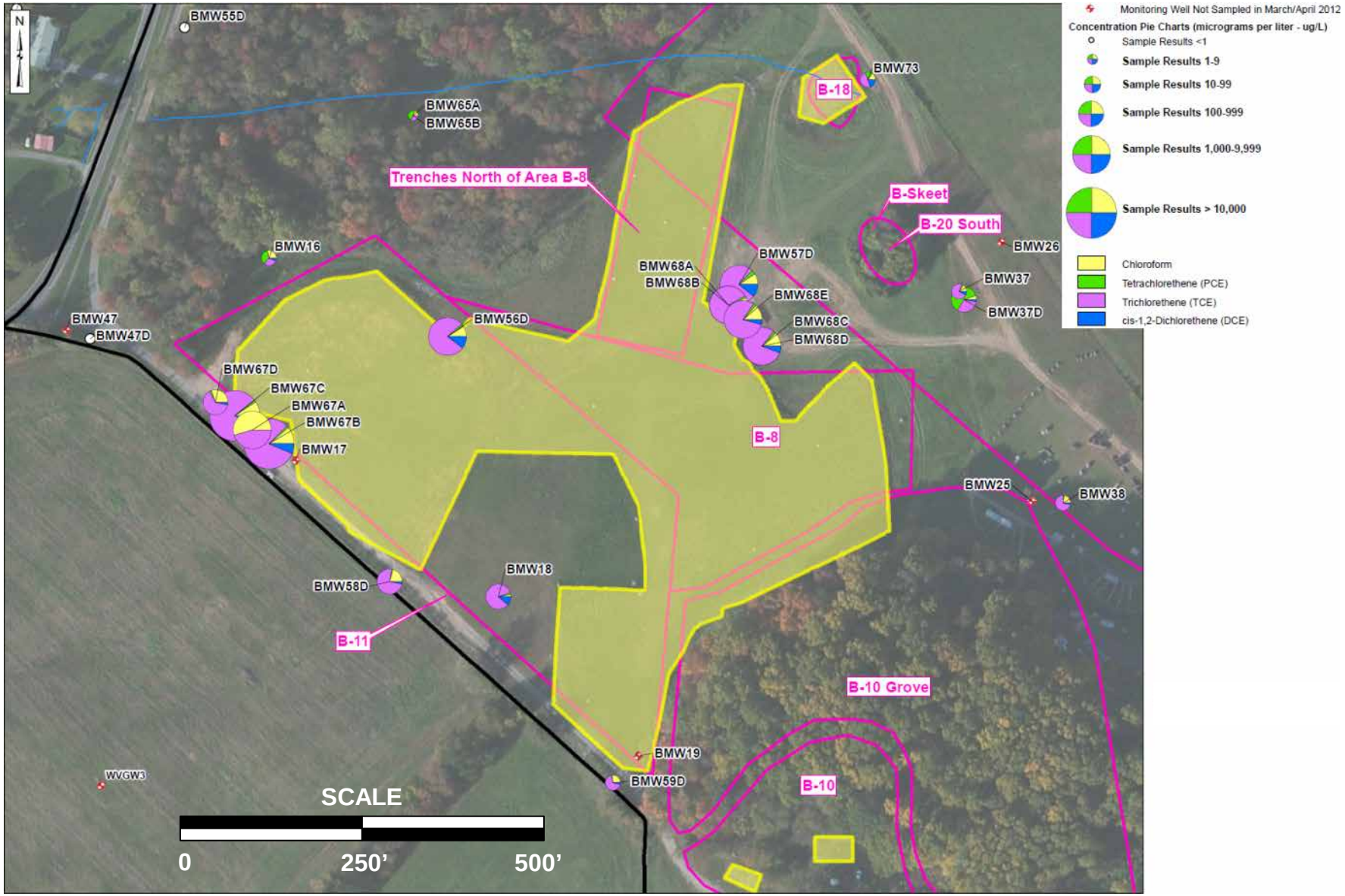


Real-Life Example of Multiple Wells Clustered Near Each Other to Monitor Different Depth Intervals



Area B - Western Corner near B-11 Landfill (facing north west)

Vertical Distribution of VOCs



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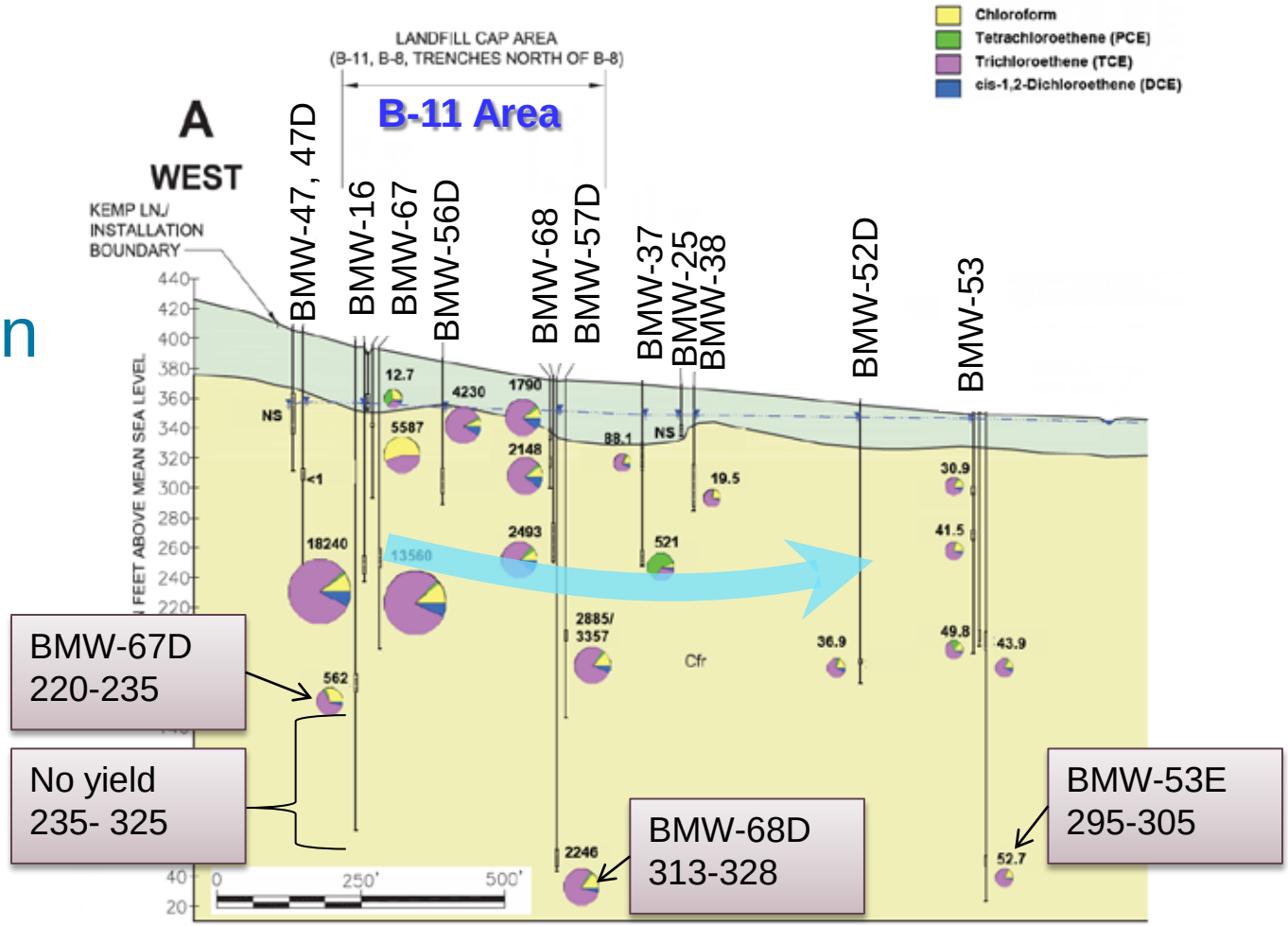
Vertical Distribution of VOCs

Currently known vertical distribution of major VOCs



= groundwater flow direction

Pie charts sizes reflect relative concentration of VOCs. Larger pie charts have higher concentrations than smaller pie charts.

Carroll Creek Surface Water Sampling

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Carroll Creek Sampling

Two rounds of surface water sampling have been completed along Carroll Creek and its tributaries:

- April 2012
- September 2012 (including 5 additional downstream testing locations)

Samples were analyzed for VOCs, PCBs, SVOCs, Metals, and Pesticides.

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Carroll Creek VOC Data

As reported during the July 2012 RAB, site related contaminants have been detected at low concentrations in Carroll Creek.

For the Round 2 sampling (Sept 2012), TCE concentrations in Carroll Creek are:

- Below drinking water standards (MCLs)
- Below human health screening criteria for recreational use of the creek (for child or adult)
- Below human health screening criteria for ingestion of fish from the creek

-No risks for these activities

-Carroll Creek is not used as a drinking water source

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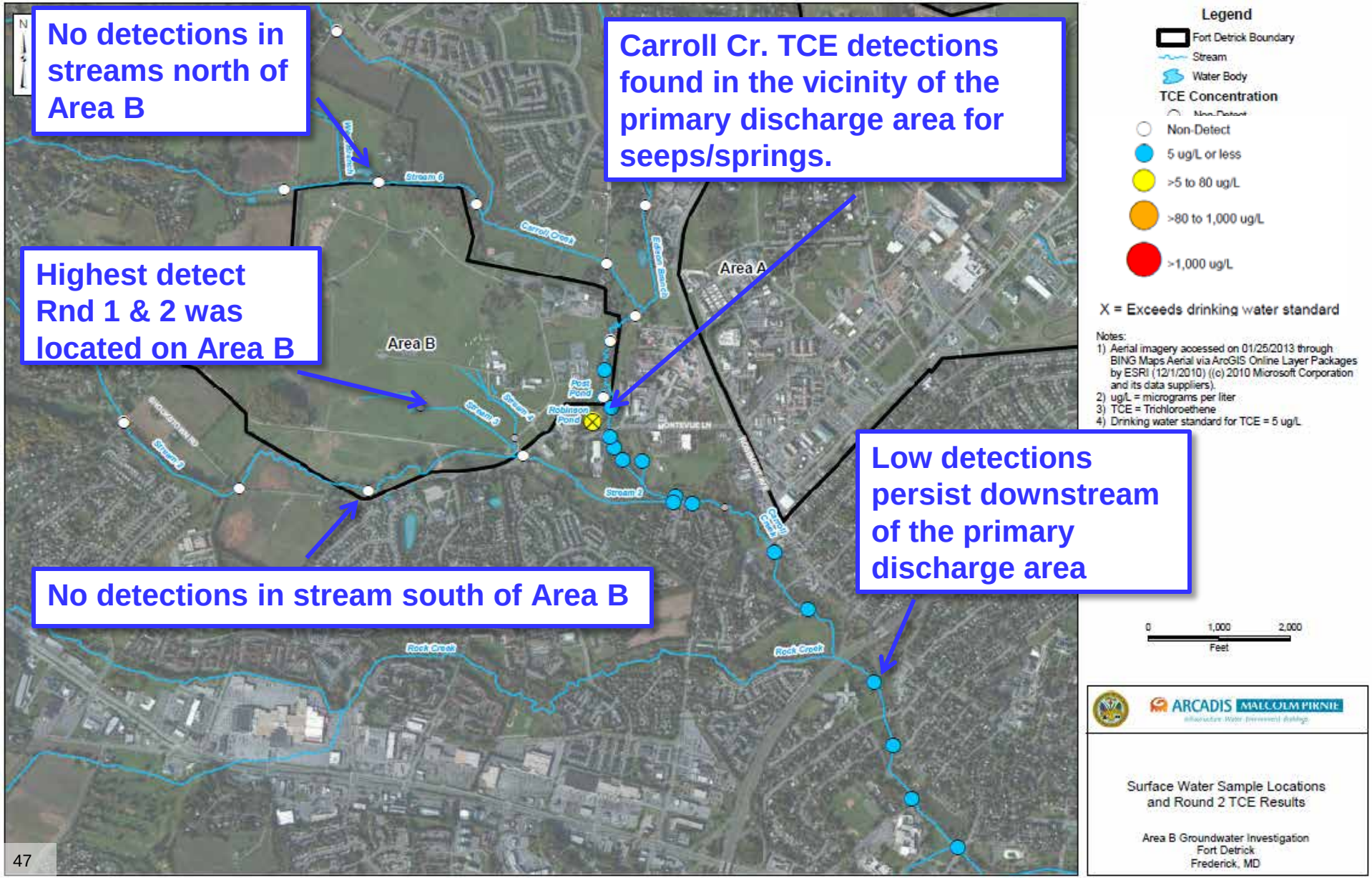
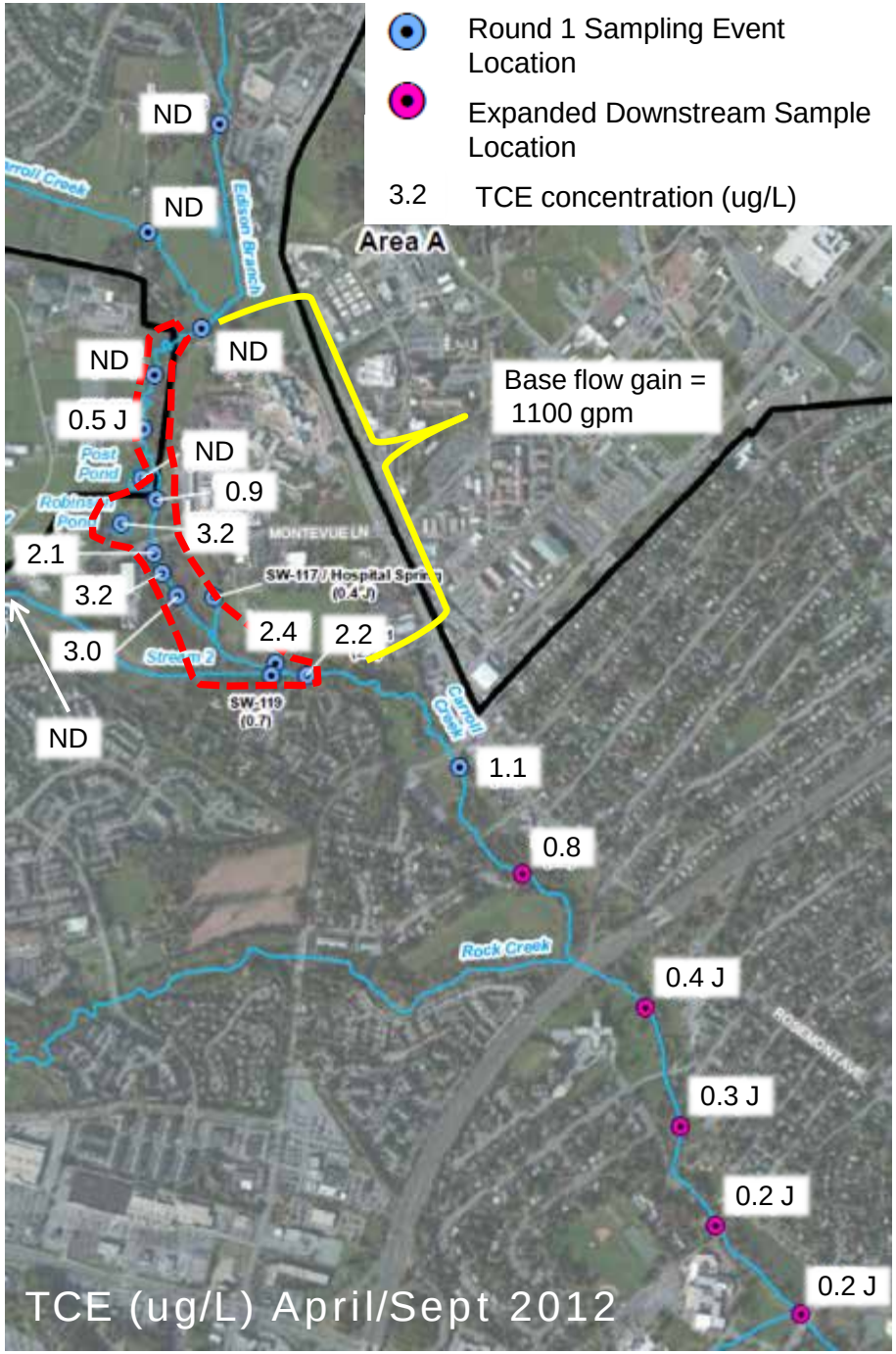
TCE in Surface Water Sept 2012



Surface Water



- Preliminary analysis suggests concentrations consistent with loading from springs in primary discharge area (red outline).
- Potential alternate sources may have minor effect.
- Downstream transport suggests attenuation due to dilution and volatilization.

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Summary and Next Steps

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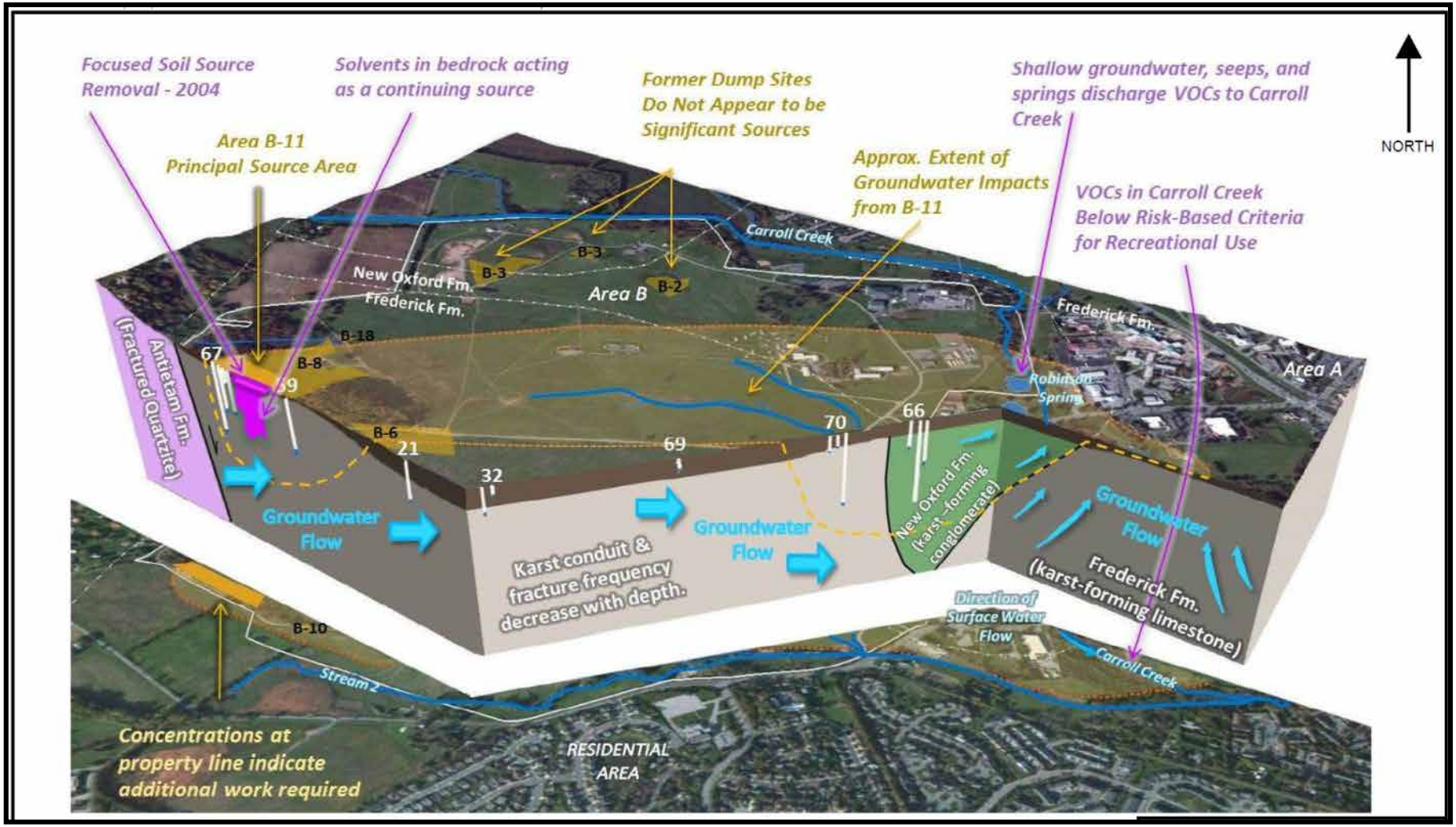
Area B Conceptual Site Model Review



Legend

- Streams
- Spring
- B-11 Boundary
- Trichloroethene in Groundwater
- Groundwater Flow Direction
- Geologic Contact

Aerial Source: ArcGIS Online Bing Imagery accessed 6/13/2012 via ArcGIS 10.

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Next Steps

- Conduct dye trace studies to assess deep groundwater flow (Spring/Summer 2013)
- Conduct round 2 vapor intrusion sampling (Spring 2013)
- Complete supplemental off-post DPT drilling (Summer 2013)
- Follow-on drilling activities and supplemental investigations based on identified data needs (Summer 2013)

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Data Needs Identified in the Conceptual Site Model (CSM) Report

- The CSM report compiles historical investigation data and identifies several data needs.
- These data needs will be discussed with EPA and MDE and incorporated into a work plan amendment.
- Completion of this supplemental work will be dependent on reaching access agreements with off-post property owners.

Potential data needs (pending access agreements):

- Vertical delineation downgradient of B-11 to depths greater than 325 ft
- Horizontal delineation southwest/south of B-11 area on the Waverly Property
- Horizontal delineation east of Carroll Creek (underflow?)

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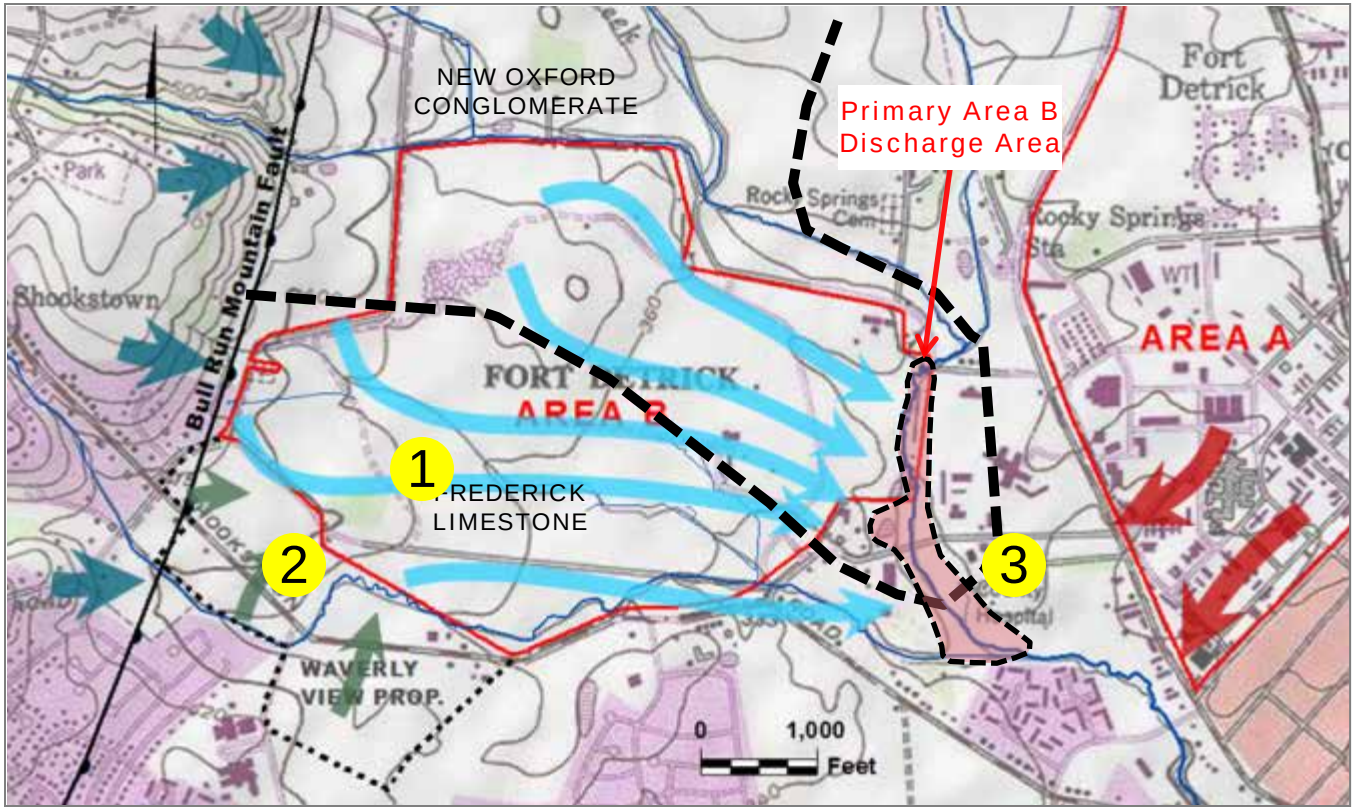
Focus Areas For Next Investigation Phase (2013)

1. Vertical delineation downgradient of B-11 to depths greater than 325 ft
2. Delineation south of B-11 area (Waverley Property)
3. Horizontal delineation east of Carroll Creek (underflow)

Generalized patterns of flow



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Questions and Discussion

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