# AREA B GROUNDWATER INVESTIGATION

Progress Report to the RAB
June 15 2011

Imagine the result

ARCADIS MALCOLM PIRNIE

# Overview of Topics

- Brief background of Area B and previous work
- Objectives of the current phase of work
- Brief summary of historical surface water data
- Status of field activities -- started in February 2011
- Review the schedule and anticipated path forward

# Background and Objectives

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# Previous Studies/Action

- The Army has been doing groundwater investigations at Area B since 1974
- Bulk of the work conducted between 1992 up to the present
- 76 monitoring wells have been installed and sampled
- Surface water/sediment/soil sampling has been conducted
- Dye trace studies completed
- Waste removal and capping completed in former disposal areas.

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# Objectives of Current Study

- Further assess the depth and extent of the known contamination
- Further assess the full range of possible chemical compounds
- Further assess groundwater flow directions including potential deep groundwater flow under Carroll Creek
- Further assess the potential for vapor intrusion into on and off site buildings

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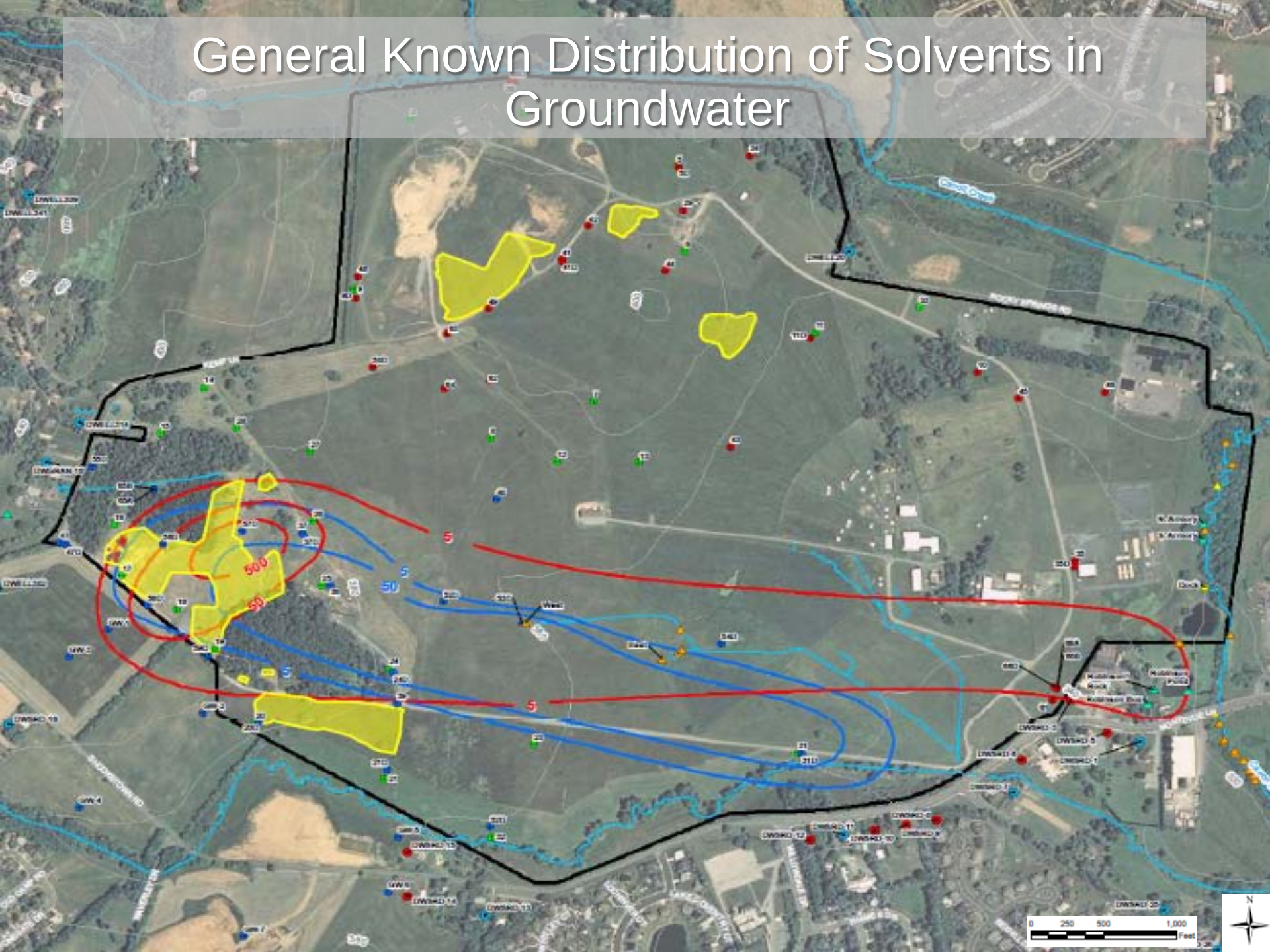
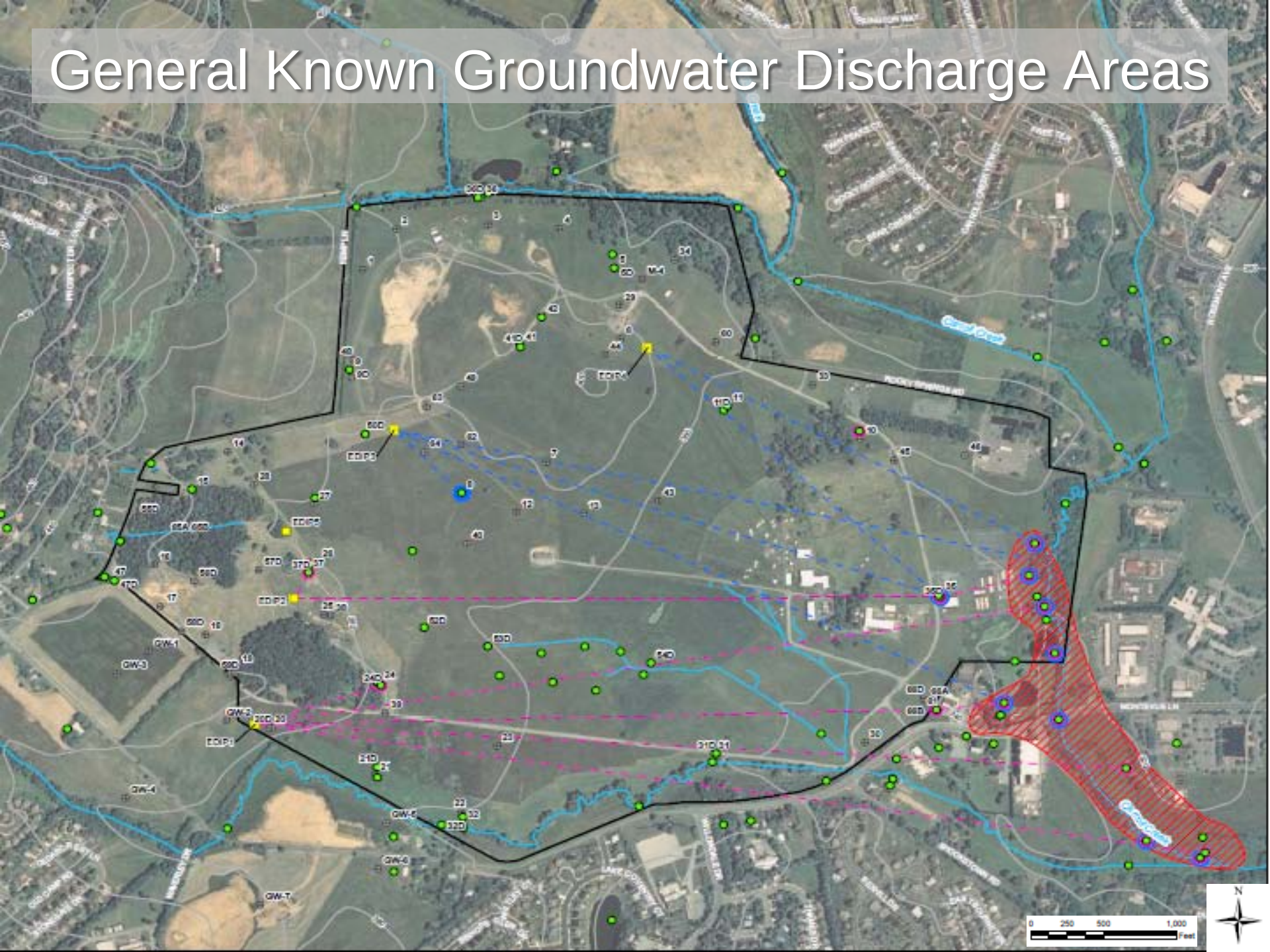
# General Known Distribution of Solvents in Groundwater



# General Known Groundwater Discharge Areas


Coal Creek
Rocky Branch Rd
Montebello Ln
Willowbrook Dr
Wilmington Rd
Kendall Dr
Lake Point Ct
Hazelwood Dr
Hollywood Dr
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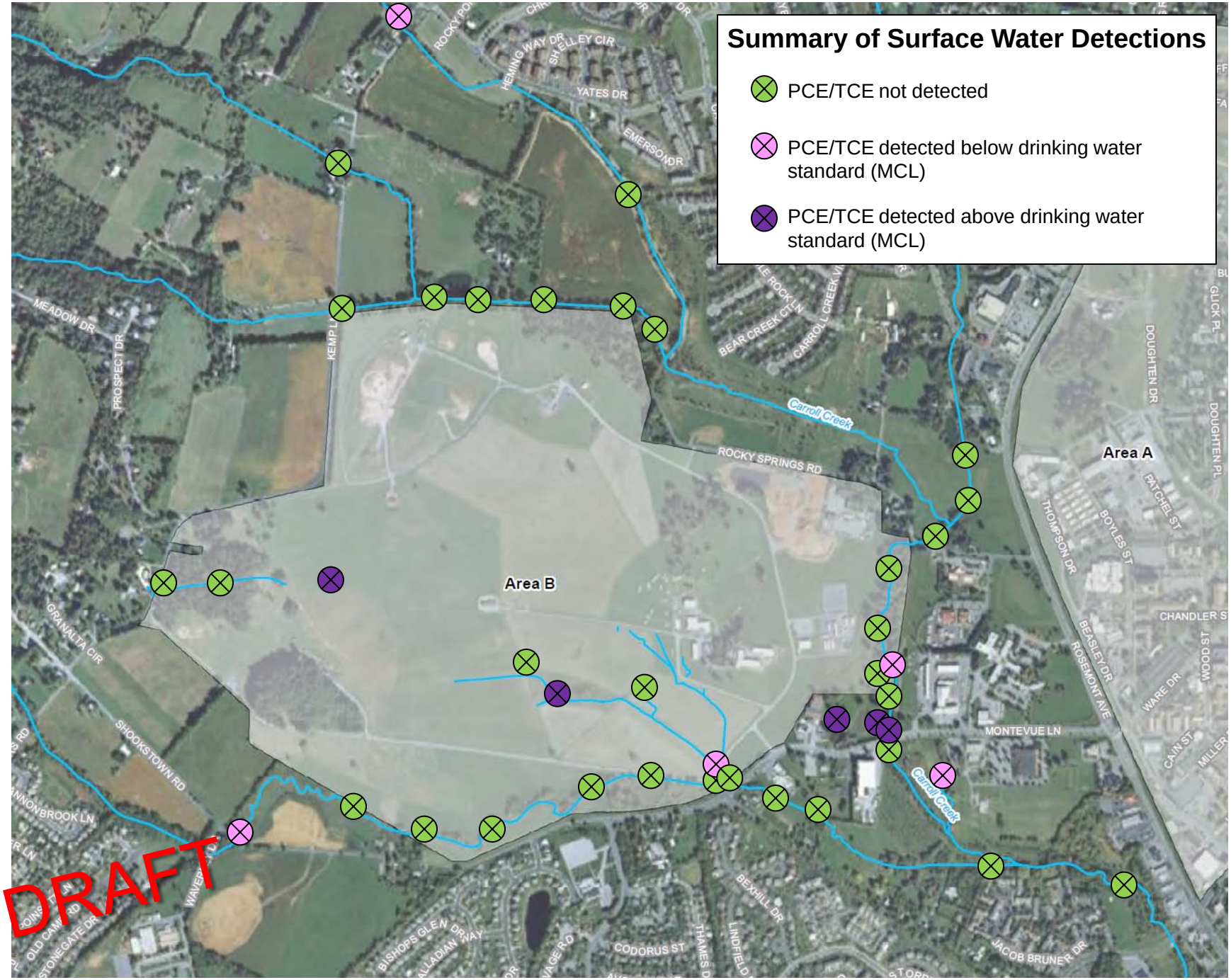
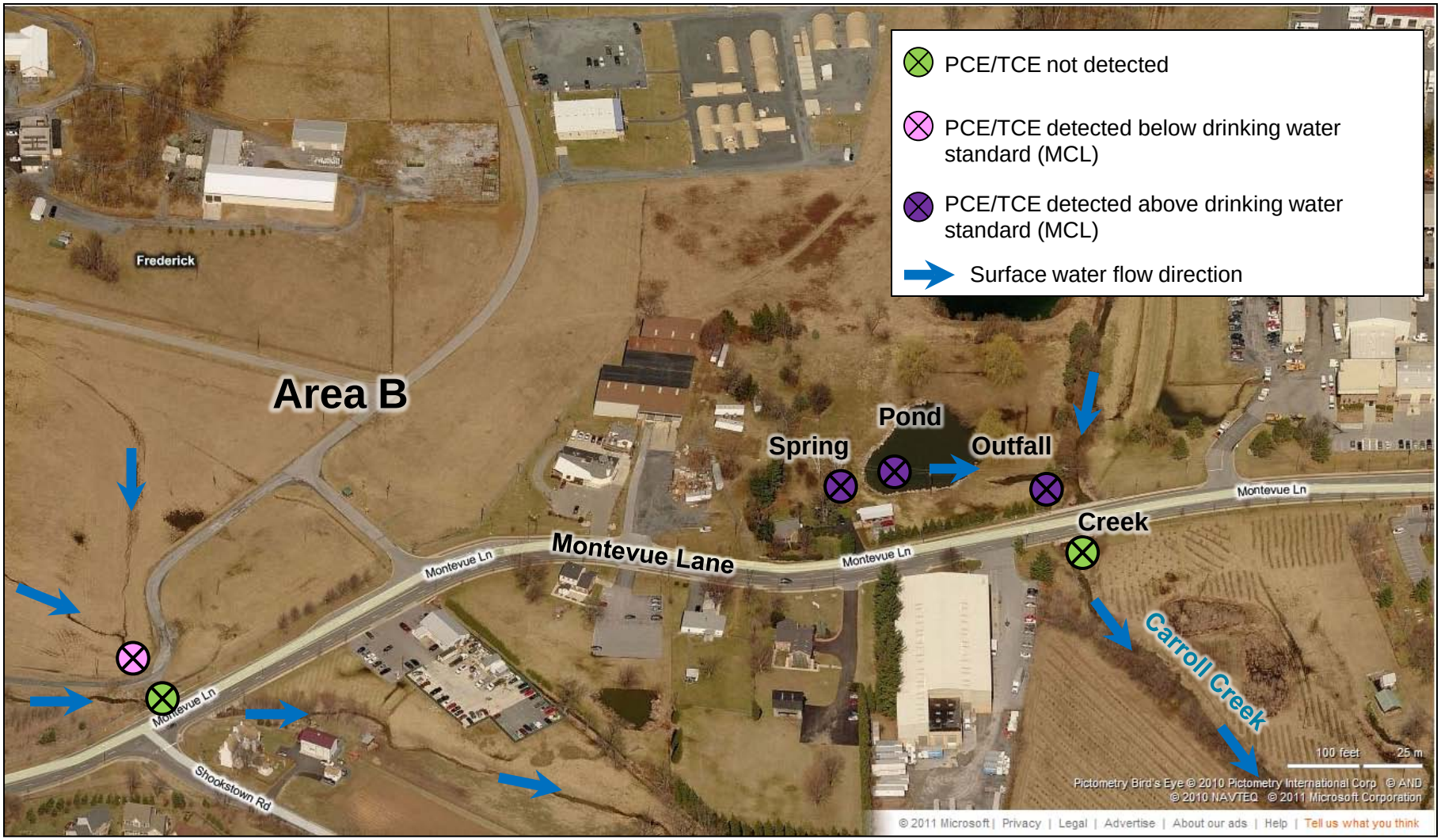
# Historical Surface Water Data




Aerial Source: ESRI, ArcGISOnline, Aerial Photo

# Solvent Dilution Rapidly In Surface Water




Aerial Source: Pictometry Birdseye (c) 2010 Pictometry International Corp (c) and (c) 2010 NAVTEQ (c) 2010 Microsoft Corp.

- Low or non-detect concentrations found downstream of detections.

# Status of Work Completed or in Progress

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# Status of Work

| | |
|---|---|
| Existing well assessment and repair (Camera and horizontal flowmeter surveys) | February 2011 to April 2011 |
| New well installation | April 2011 to Fall 2011 |
| Dye trace study | Pending ROEs |
| Spring and Seep Surveys | Pending ROEs |
| Direct Push Investigation | Pending ROEs |
| Vapor Intrusion Sampling | Pending ROEs |
| Groundwater/Surface Water Sampling | 2011/2012 |

# EXISTING WELL ASSESSMENT

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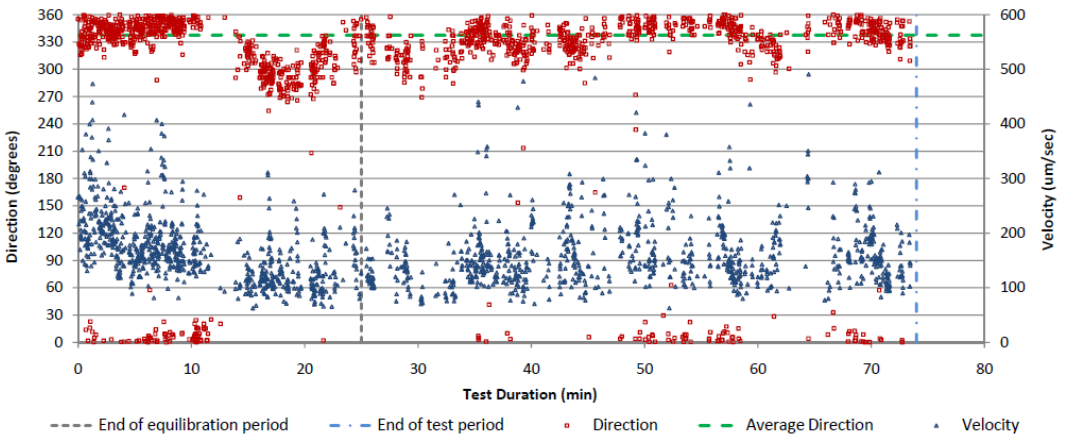
# Existing Well Assessment & Repair

- Assessed all wells inside the Area B Boundary
- Completed 91 down-hole video logs to assess condition of screen/sediment load in bottom of existing wells and confirm well specs.
- Redeveloped 29 existing wells to remove sediment and ensure representative groundwater samples.
- Completed general well repairs to surface casings such as replacing damaged hinges, damaged lids, and damaged stick up casings. More extensive repairs or well abandonments to be recommended to EPA/MDE.
- Completed 78 horizontal flow meter surveys in 38 existing wells to assess local flow directions at each well

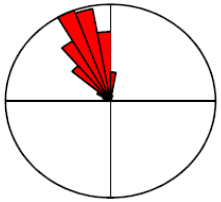
# Horizontal Flow Meter Survey

**Fort Detrick Area B**
**Horizontal Borehole Flowmeter Study**

*Location:* **BMW55D(78)**
*Validation Result:* *Acceptable*



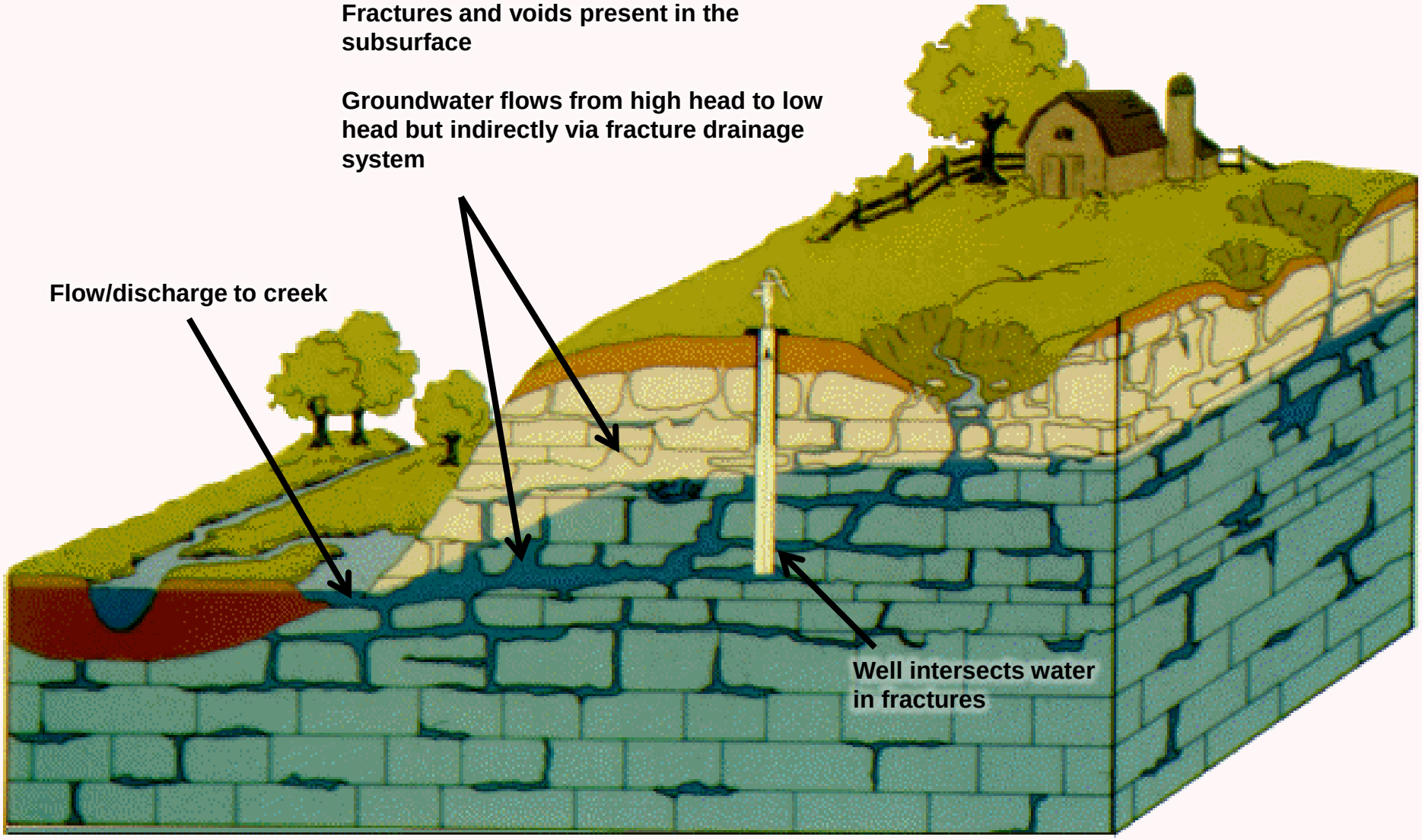

| *Test Statistics* | | *Rose Diagram of Flow Direction After Equilibration* |
|---|---|---|
| Duration of full test: | 74.0 minutes | |
| Total number of colloid tracks | 1631 | |
| End of equilibration period | 25 minutes | |
| Duration of test after equilibration | 49.0 min | |
| No. of colloid tracks after equlibration | 873 | |
| **Cross-Borehole Direction** | | |
| Average | 337 degrees | |
| Standard Deviation | 21 degrees | |
| **Cross-Borehole Velocity** | | |
| Average | 160 um/sec | Notes: |
| Standard Deviation | 61 um/sec | |



6/10/2011

- 78 test intervals to assess micro-scale flow directions within existing wells

# General Groundwater Flow in Limestone/Karst



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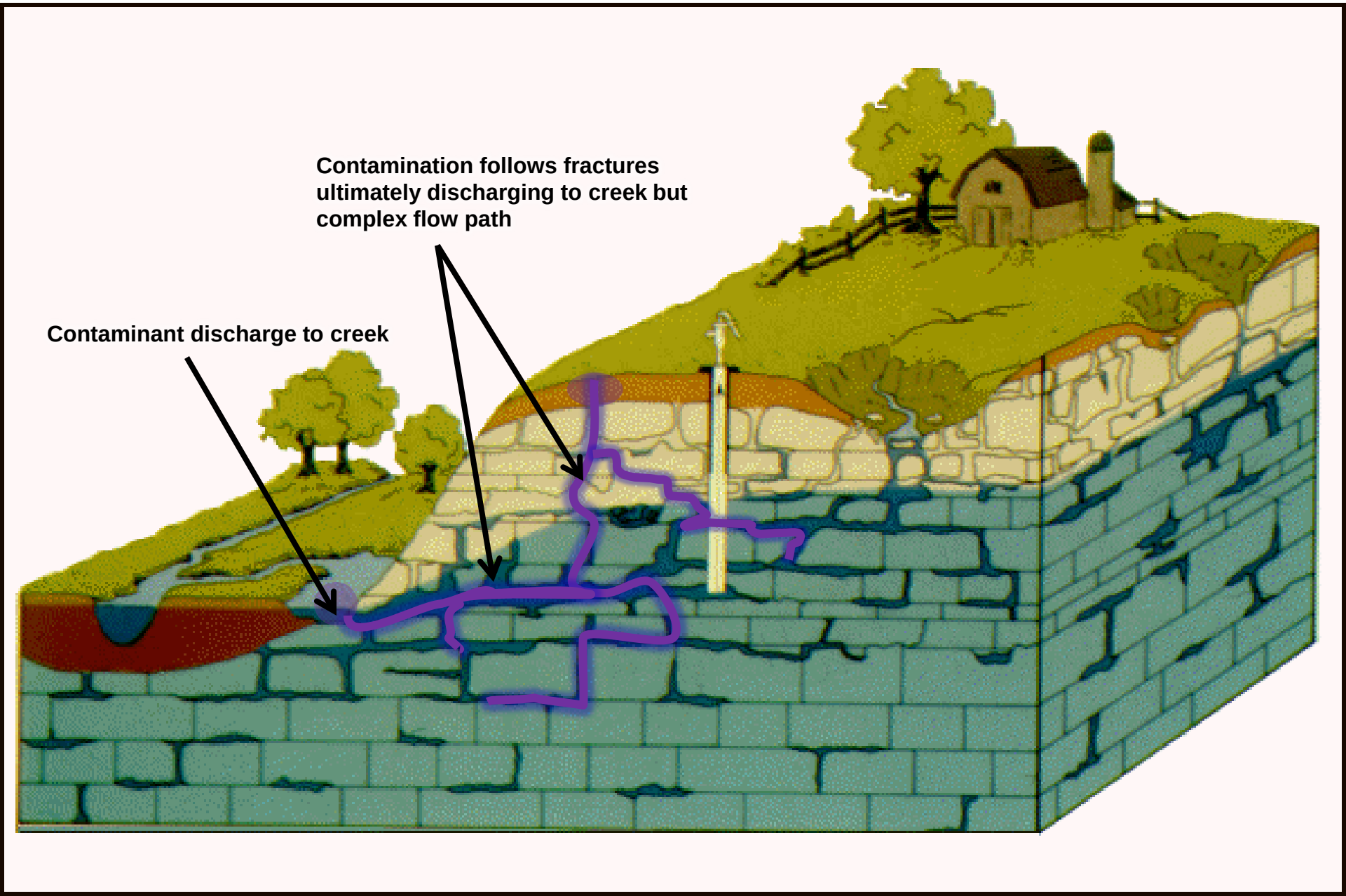
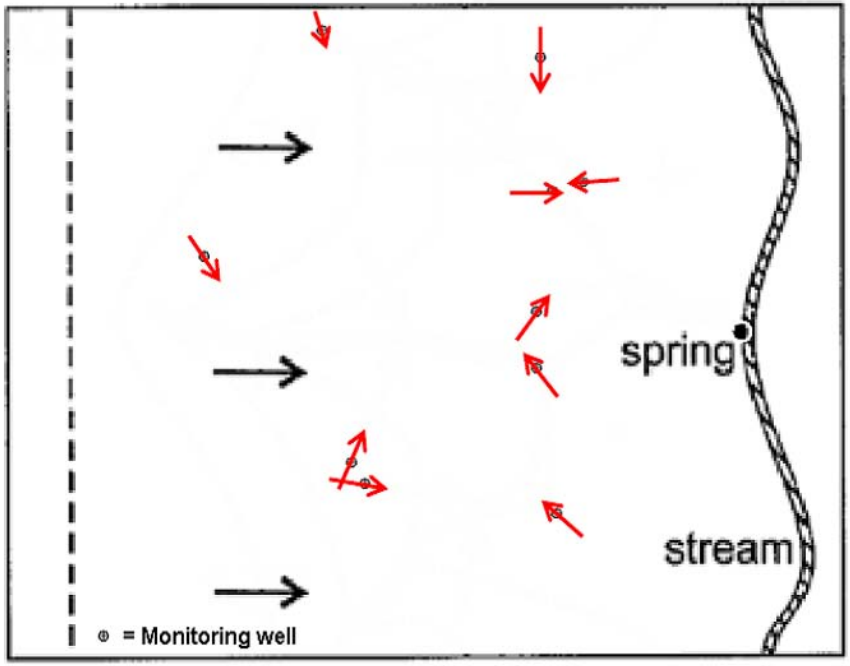


# Horizontal Flow Meter Survey

**Figure 1**: Plot of hypothetical flow meter results. Black arrows indicate generalized groundwater flow direction (toward stream). Red arrows indicate hypothetical local flow directions obtained from horizontal flow meter.

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# Groundwater Flow Similar to River Drainage System

**Figure 1**: Black arrows indicate generalized groundwater flow direction (toward stream) if in sand aquifer. Red arrows indicate hypothetical flow directions obtained from horizontal flow meter in karst aquifer.

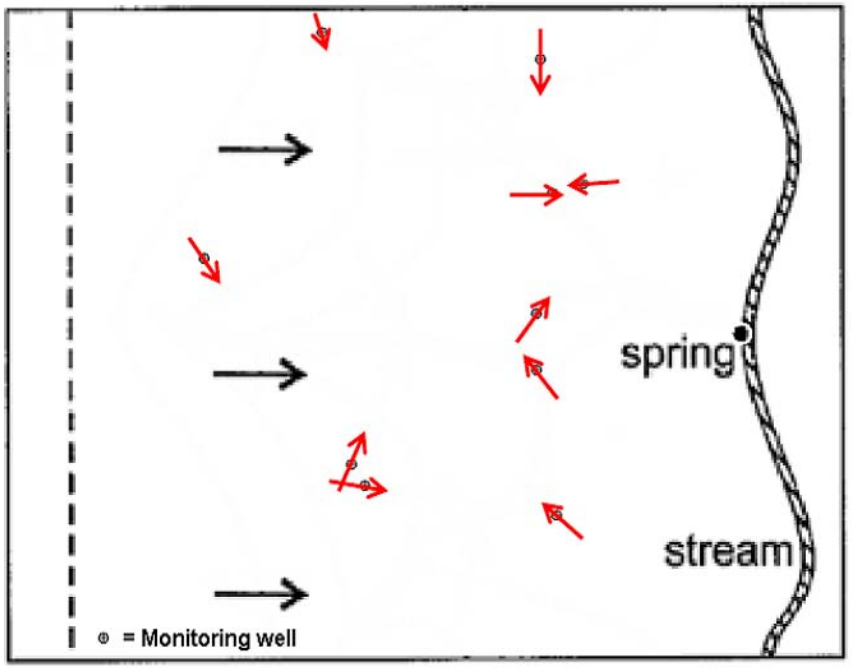
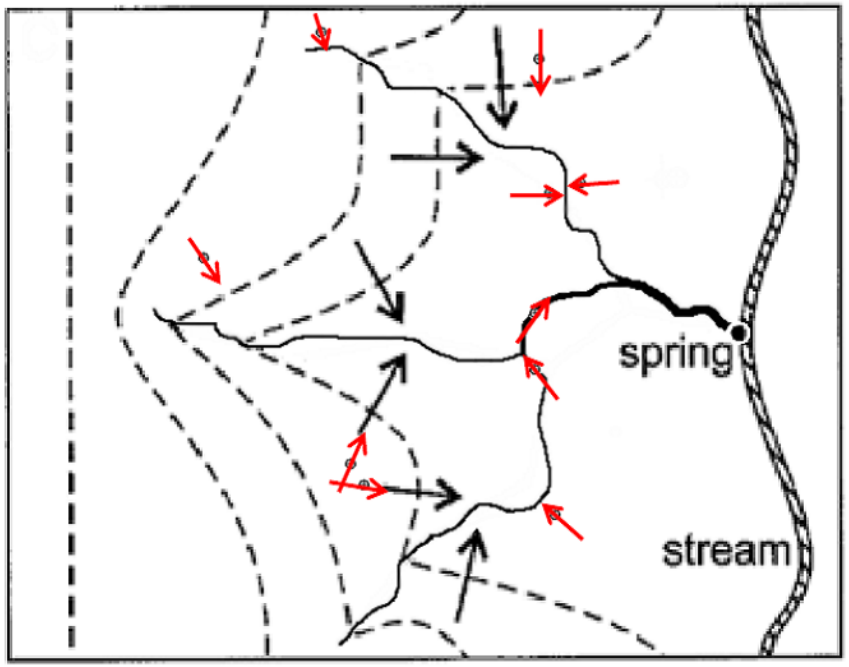



**Figure 2**: With conduit network and flow field superimposed on the figure, it is evident that the flow directions obtained from the flow meter represent actual if complex flow conditions.



# WELL DRILLING

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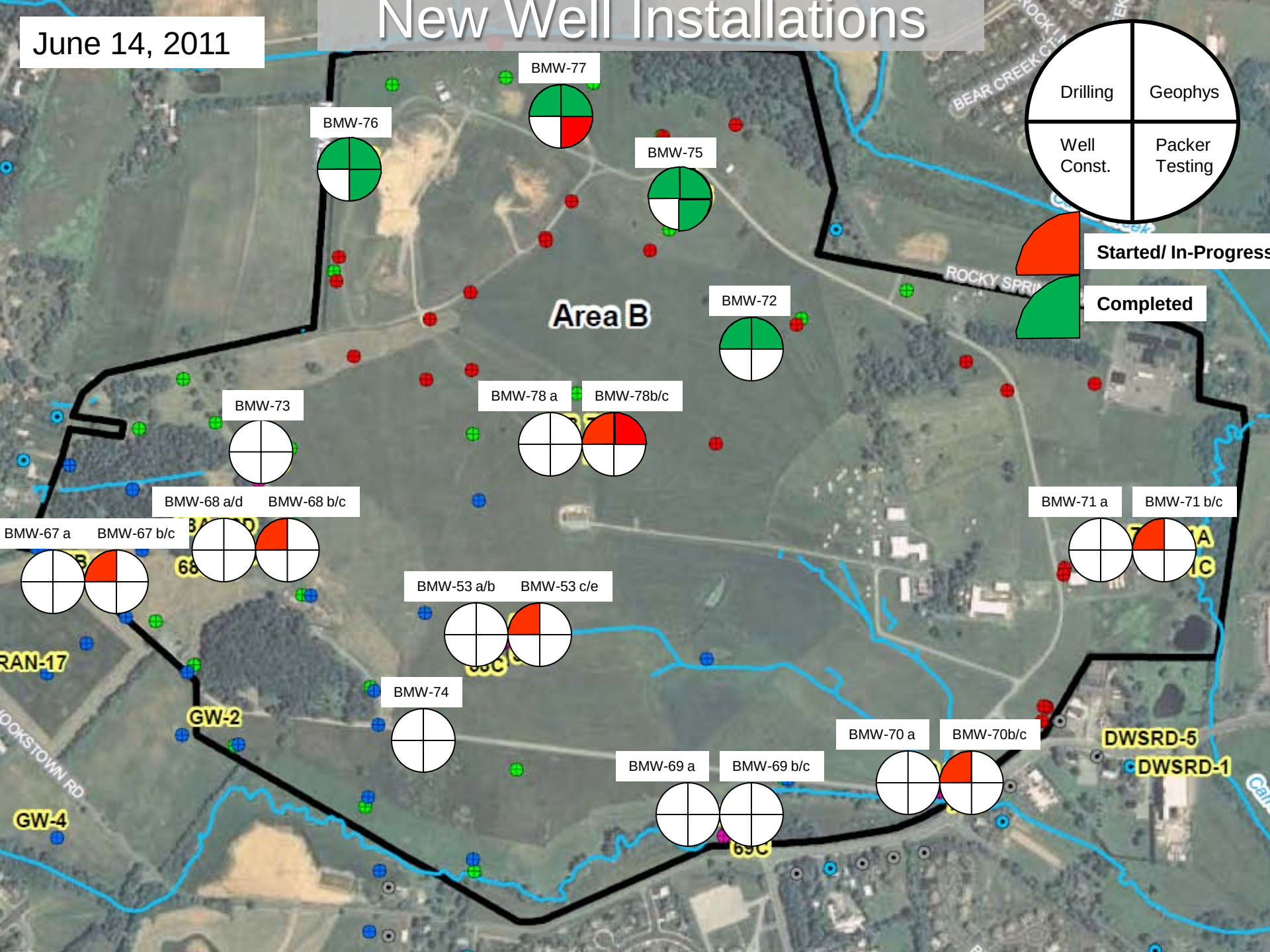
# New Well Installations

June 14, 2011

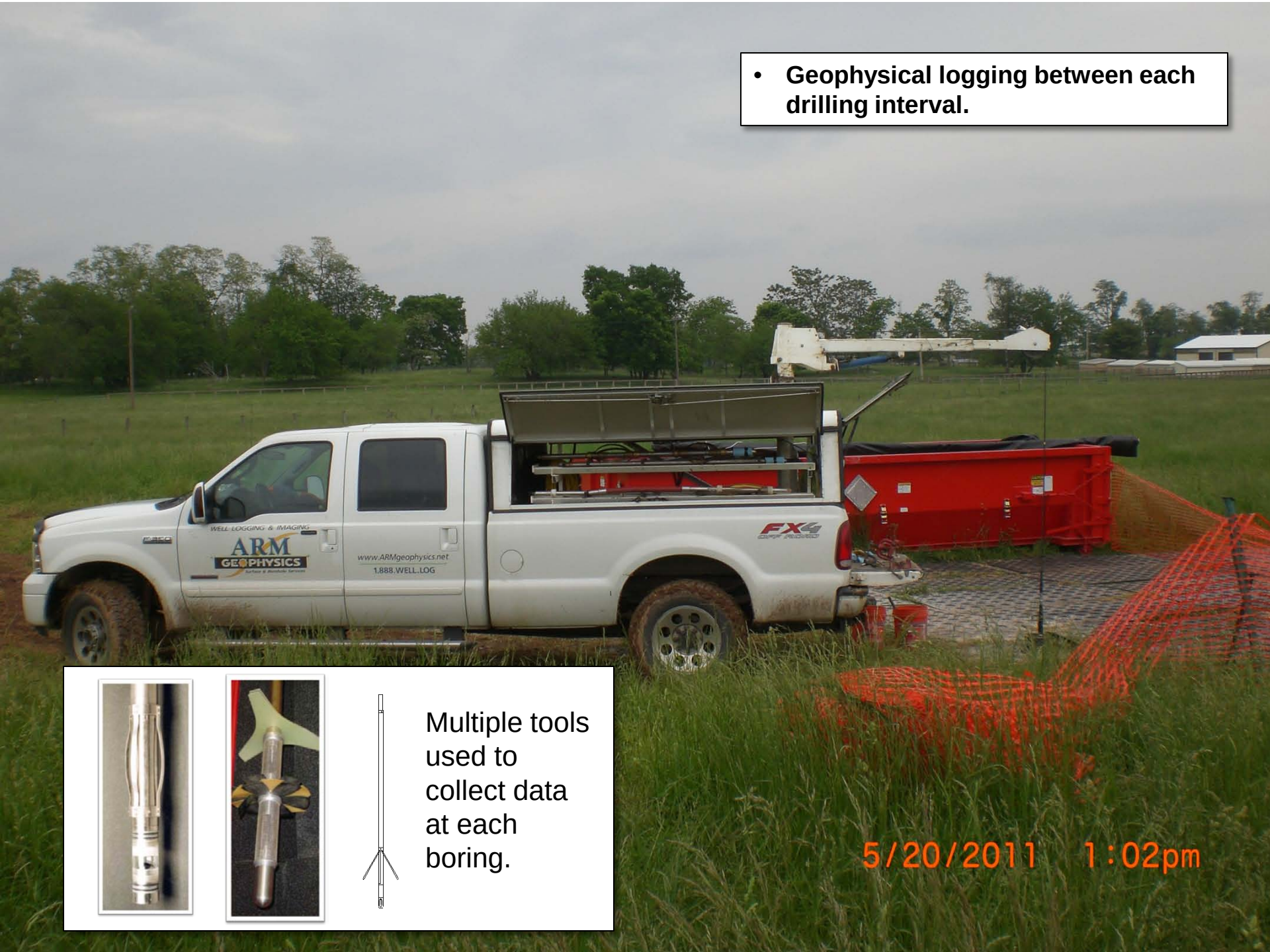


- **Two drill rigs/crews operating simultaneously**
- **10 day on/ 4 day off work schedule**
- **Currently in 5th 10-day drilling shift**

- Two drill rigs/crews operating simultaneously
- 10 day on/ 4 day off work schedule
- Currently in 5th 10-day drilling shift

Continuous Air Monitoring During Drilling

- **Geophysical logging between each drilling interval.**



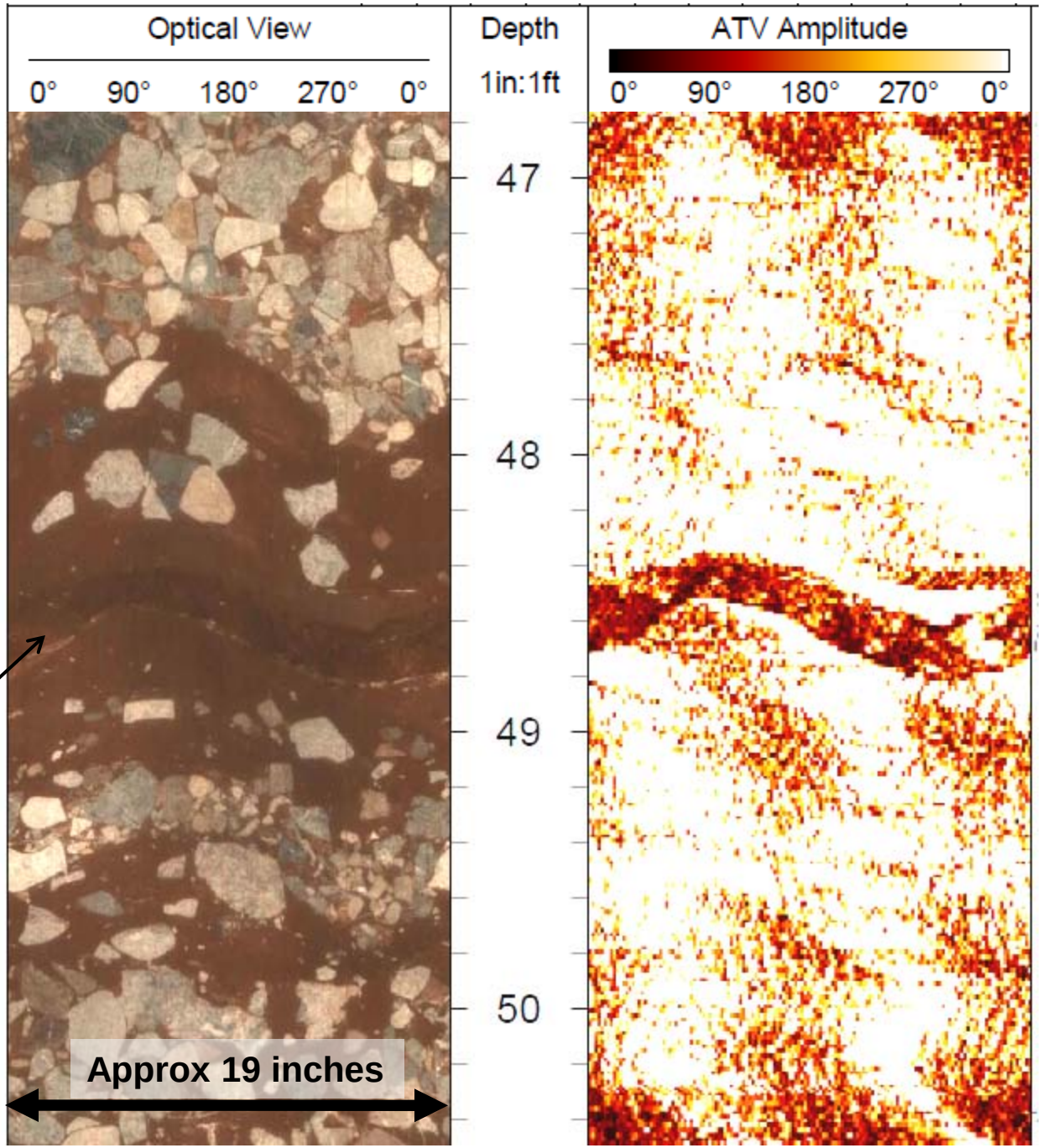

Multiple tools used to collect data at each boring.

# Geophysical Logging

**Multiple tools used to help characterize the subsurface:**

- **Identify water-bearing zones,**
- **Select intervals for sampling, and**
- **Determine zones for screening permanent wells.**

**Fracture clearly visible on the Optical and Acoustical Televiewer Logs**




**Boring ID: BMW-72**

# Down Hole Video Camera

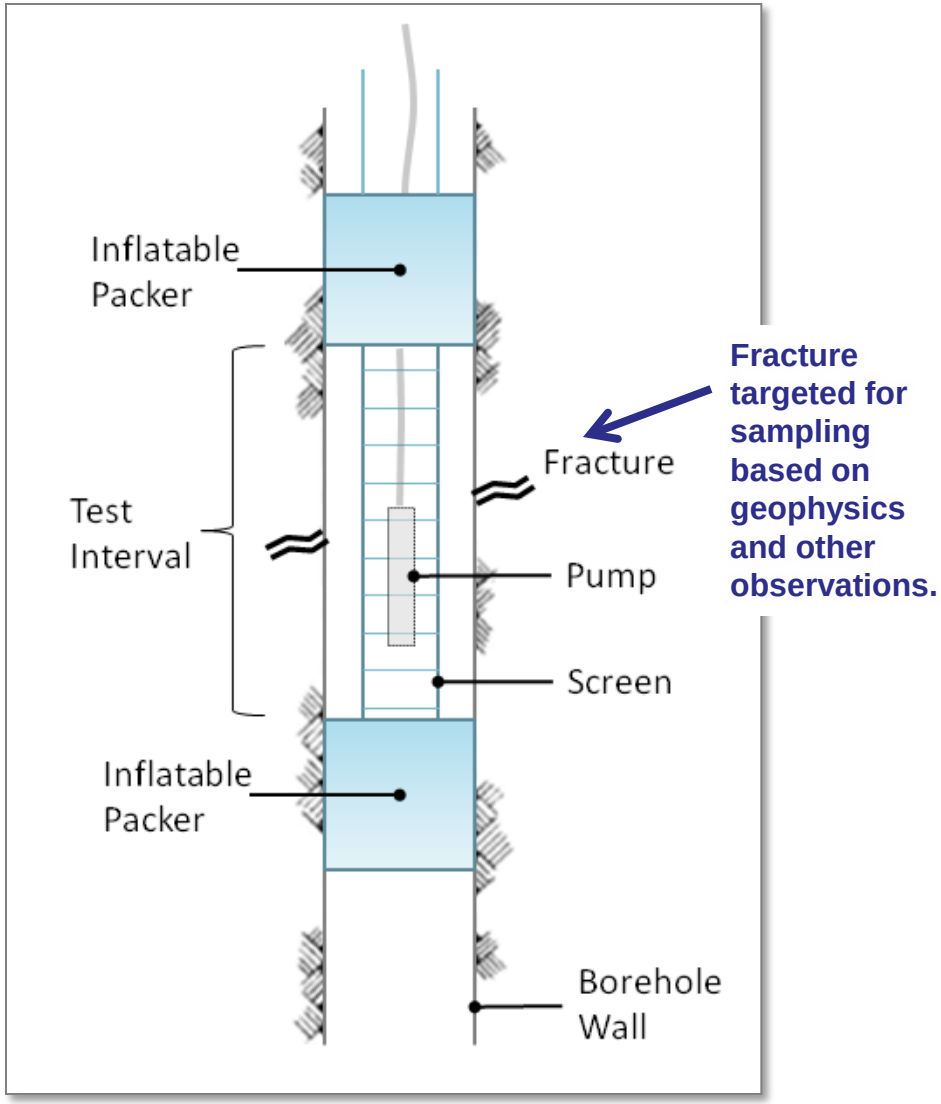
High resolution camera is run down selected boreholes to provide a clear image of subsurface

Drilling information, geophysical information, and video all assist in location of fractures groundwater may be travelling in

Show Video log

# Packer Testing

(Groundwater Sampling at Targeted Zones)

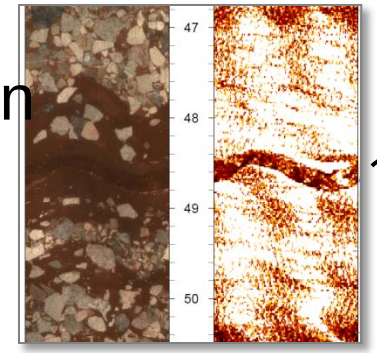


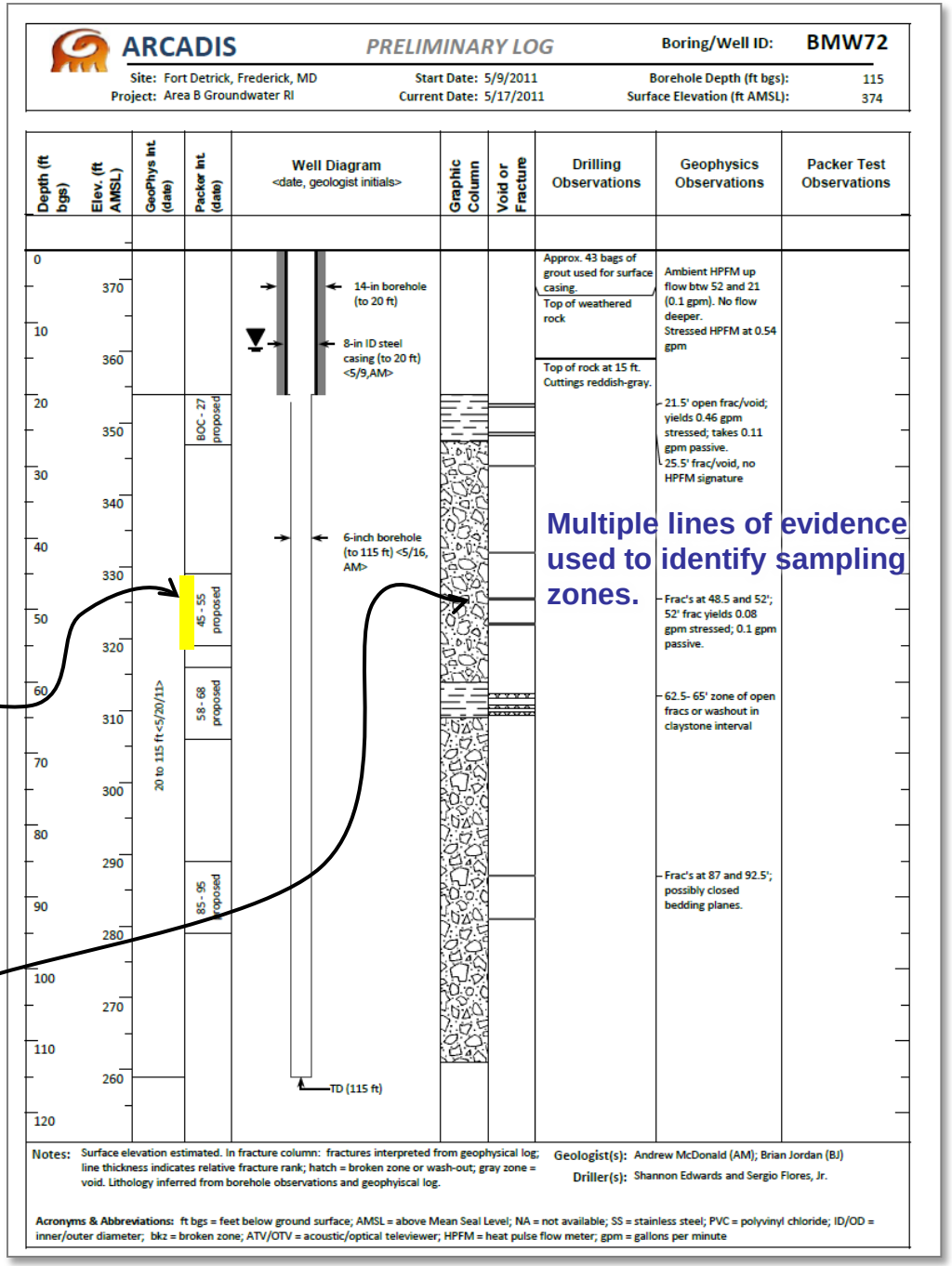

**Fracture targeted for sampling based on geophysics and other observations.**

# Boring Logs

Observations from drilling, geophysical logging, and videos recorded on well logs.

Data is integrated and used by the partnership to determine how the well should be built to obtain the most useful data




**Boring ID: BMW-72**

# Well Drilling Path Forward

Continue to collect subsurface data

Continue to work interactively with EPA and MDE to select appropriate intervals of the subsurface to install well screens

Drilling will continue for several months

# Future Work

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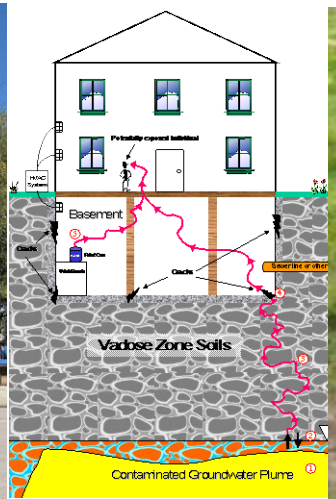
# Future Work

| | |
|---|---|
| Dye trace study | Evaluate deep groundwater flow and the potential for off-site migration under Carroll Creek. |
| Spring and Seep Surveys | Identify and sample discharge areas where groundwater flows into surface water. |
| Direct Push Drilling | 59 off-post borings to assess shallow groundwater contamination. |
| Vapor Intrusion Sampling | Collect sub-slab and indoor air samples at 6 buildings to assess potential impacts from shallow contamination. |
| Groundwater/Surface Water Sampling | Comprehensive sampling of existing/new wells and surface water for broad suite of chemicals. |



# Schedule & Path Forward

- Drilling continues through to Fall 2011
- Comprehensive sampling can only be done after all new wells installed
- Other planned work dependant on obtaining Right of Entry Agreements (ROEs) from private property owners
- ROEs are in process with all property owners contacted, briefed and provided with agreements
- 35% of the properties have agreed. Continue discussions with others including the City and County.

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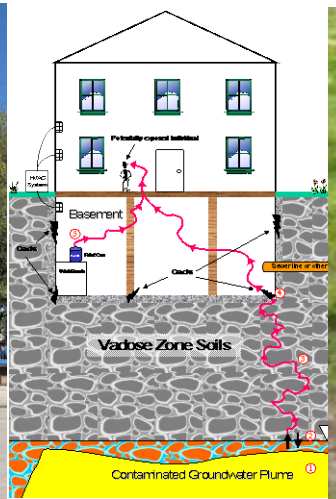
# Future Work – Pending ROEs

| | |
|---|---|
| Dye trace study | Fall 2011 |
| Spring and Seep Surveys | Fall 2011 |
| Direct Push Investigation | Fall 2011 |
| Vapor Intrusion Sampling | Fall 2011 |
| Groundwater/Surface Water Sampling | Spring/Fall 2012 |