Landfill Impacts to Headwater Streams: Case Studies in West Central Virginia

DEQ
VIRGINIA DEPARTMENT OF ENVIRONMENTAL QUALITY

AMAAB Workshop

April, 2008

Overview

- Solid Waste Regulations
- Landfills
- Landfills and Water Quality Monitoring
- Case Studies and Remediation Methods
- Conclusion/Recommendations???

Virginia Solid Waste Management Regulations 9 VAC 20-80-10 *et. seq.*

- **Minimal landfill design criteria prior to 1993:**
  - Compacted soil or clay
  - Typically, valley fill in the western portion of the state
  - No requirements regarding separation of unit from groundwater or surface water
  - No requirements for the management of leachate generated
- **Modern landfill design, construction and operation criteria established in 1993 and based on 40 CFR 258:**
  - Composite liner (or alternate liner with equivalent performance)
  - Leachate collection & management
  - Groundwater (GW) & gas monitoring
  - Operation standards
  - Closure and post-closure care (PCC) standards

Solid Waste Regulations

9 VAC 20-80 Section 300 & 310

Detection

Monitor upper most aquifer for inorganic & organic constituents

Monitor semi-annually (or quarterly)

Significant increase over background

Move to Assessment Monitoring

Assessment

Expand list of constituents and continue to monitor SA

Develop GW Monitoring Plan

Establish GW Protection Standards (usually MCLs or an alternate limit)

Exceed GPS

Move to **Corrective Action**

Corrective Action

Nature & Extent Study (NES)

Assessment of Corrective Measures (ACM)

Corrective Action Program (CAP)

Corrective Action Monitoring Program (CAMP)

Termination of CA

Eligible for terminating CA when minimum of 3 years of monitoring without GPS exceedances

Supplemented with Surface Water and Biomonitoring

Common Type of Landfill in the Blue Ridge Region

- **Valley Fill**

- **Typically began receiving w**
- **Unlined, no leachate collection**
- **Waste placed in existing drainage valley with a berm constructed on down gradient side of fill area**
- **Piped underdrains used to move surface water and springs downgradient**
  - **"*Headwater streams have been buried*"**

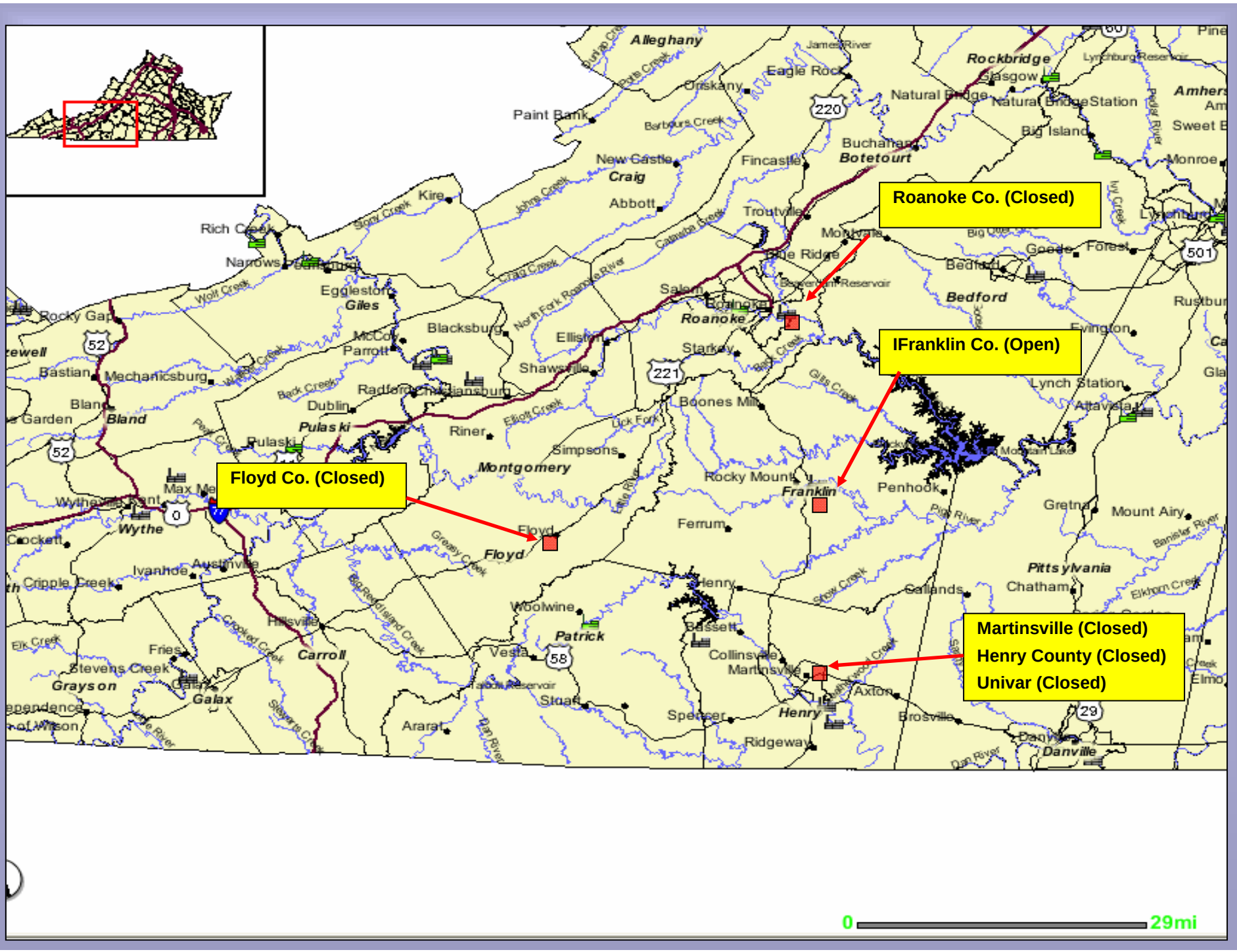
Problems with landfills & stream monitoring

- Small springs and streams historically overlooked
- Usually no upstream reference site
- Limited data from comparable ecoregion reference sites
- Prior to 1980's, hazardous wastes (e.g., spent solvents) were managed in sanitary landfills
- Surface water impacts from leachate difficult to define and regulate
- Limited resources for chemical sampling

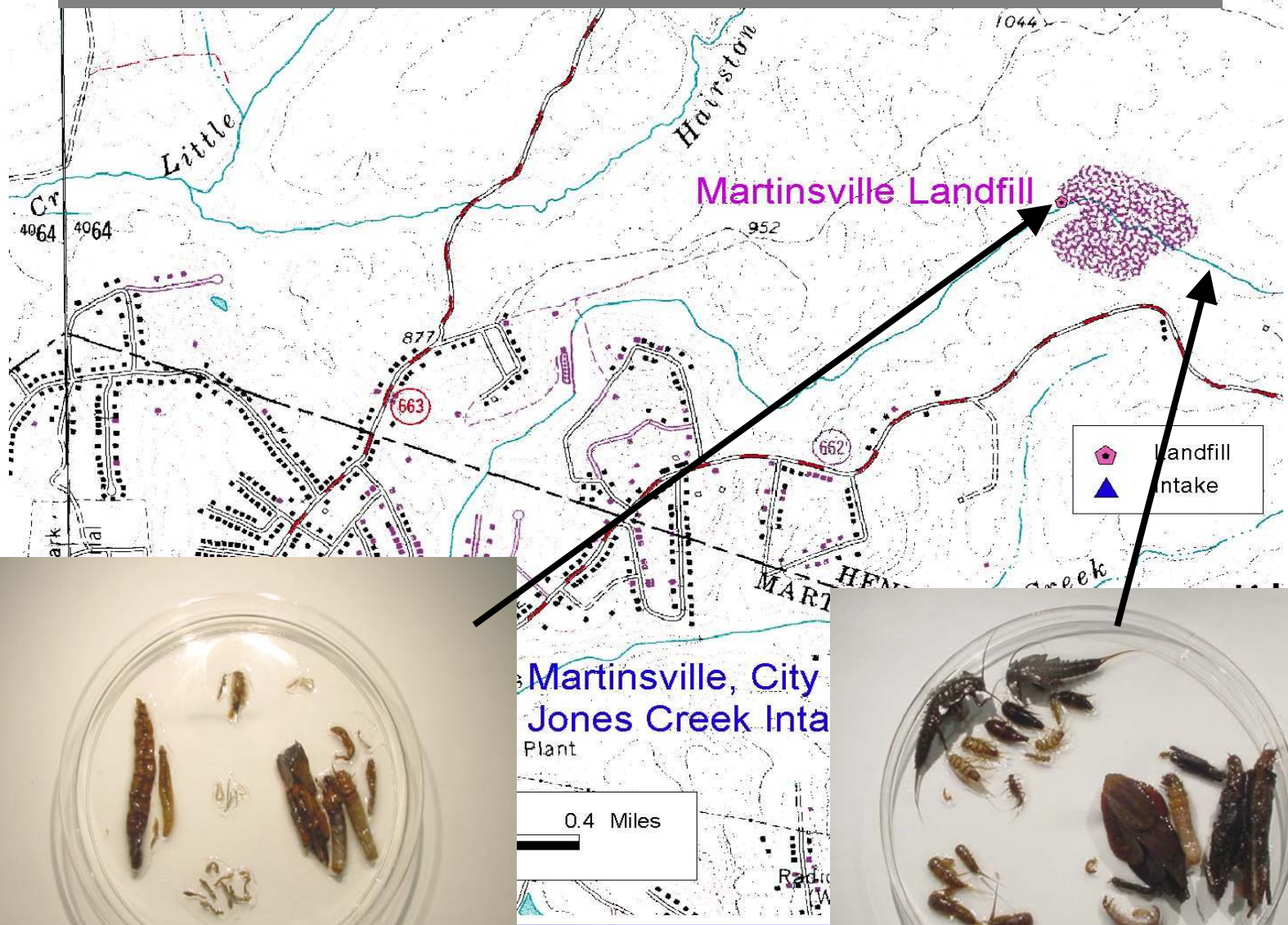
Sources of Constituents of Concern

Furniture Manufacturing

Permitted Hazardous
Waste Management Sites
(e.g., solvent recycling)


Roanoke Co. (Closed)
IFranklin Co. (Open)
Floyd Co. (Closed)
Martinsville (Closed)
Henry County (Closed)
Univar (Closed)
0
29mi

Martinsville Landfill Survey – January 2003



Below landfill, SCI = 47.1 (only 34 organisms), Ethyl benzene, Total Xylenes

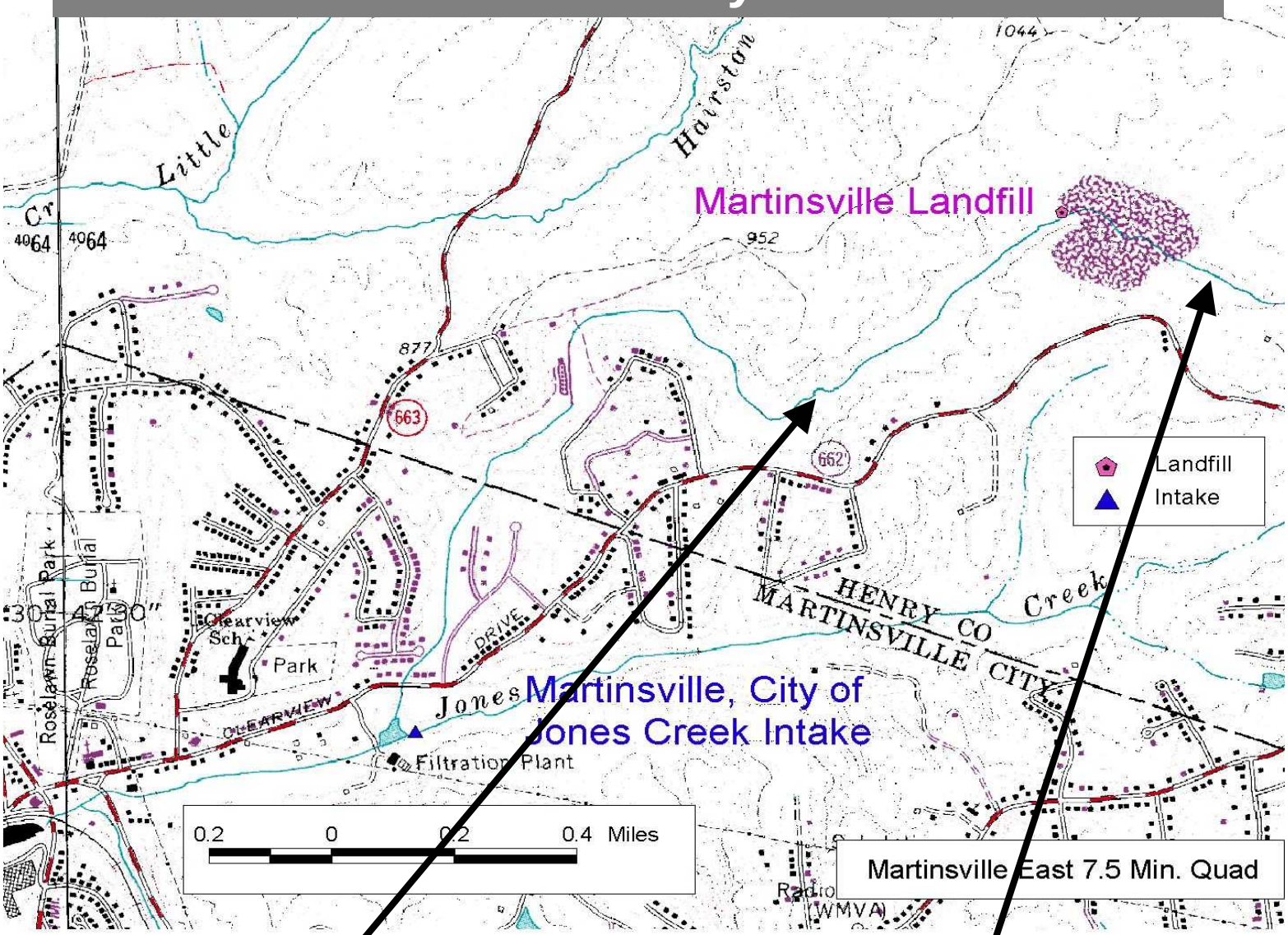
Above landfill, SCI = 68.4

HABITAT IMPACTS

Iron bacteria occur in thick mats below landfills and other disturbed land with buried organic material especially when dissolved oxygen and pH are low

Sphaerotilus (i.e., sewage fungus) occurs in thick growths below malfunctioning waste water treatment plants with high organic waste loads

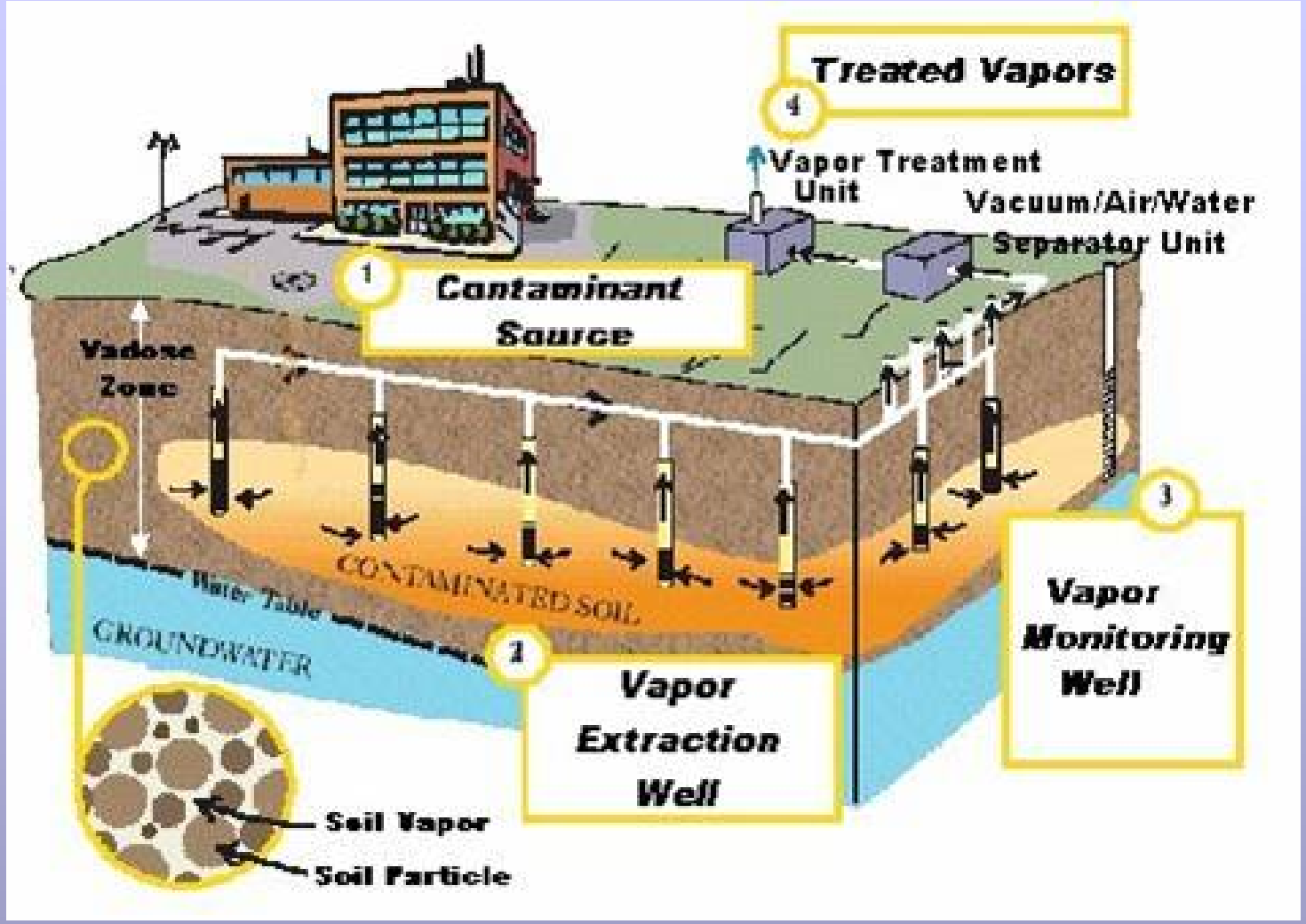
Martinsville Landfill Survey – December 2006



Below landfill, SCI = 57.4 (3x sorting effort)

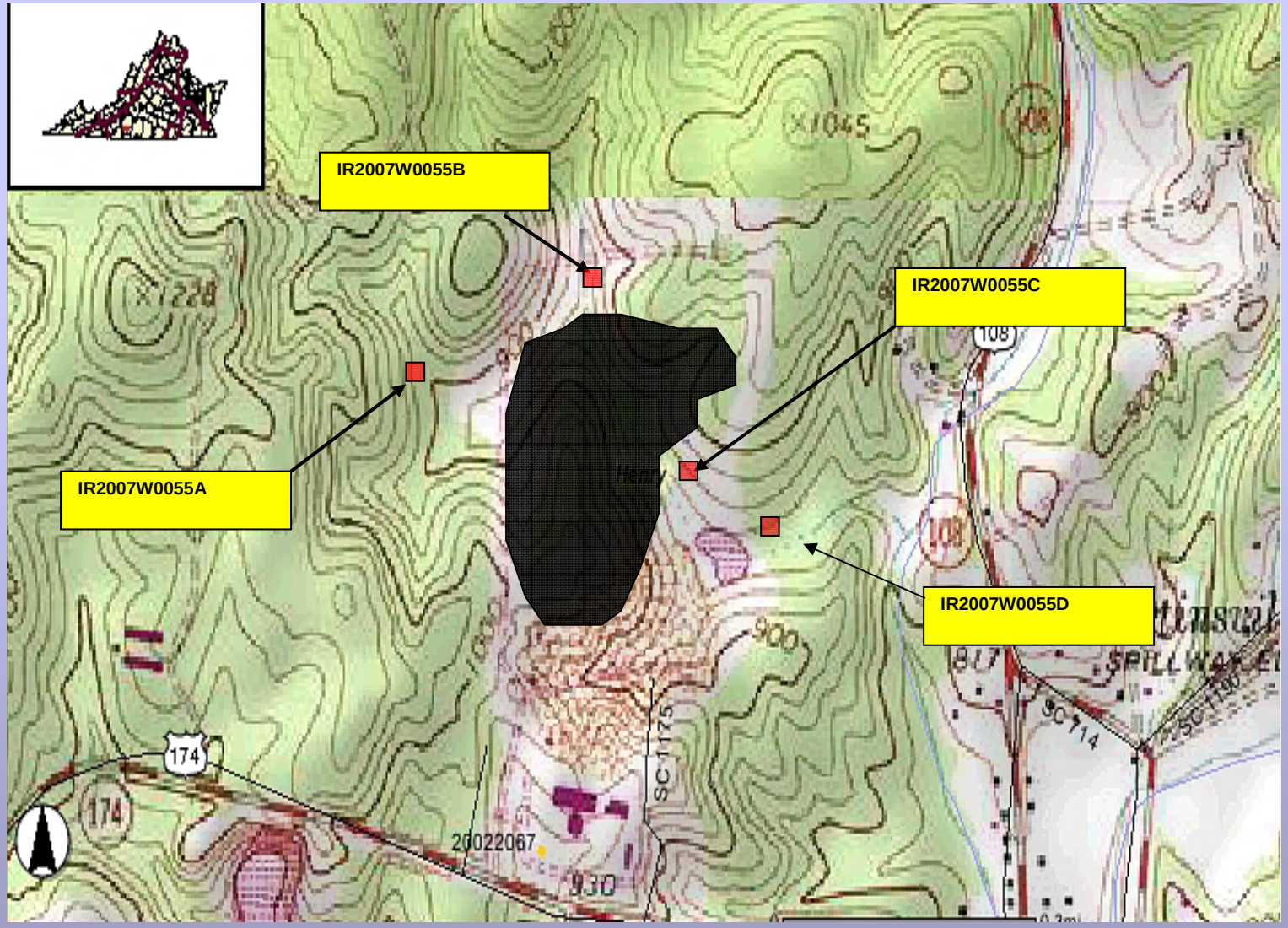
Above landfill, SCI = 76.8

Soil Vapor Extraction



- Passive soil vents in two former liquid disposal areas
- Monitored Natural Attenuation in down-gradient plume

Henry County Landfill Survey – August 2006

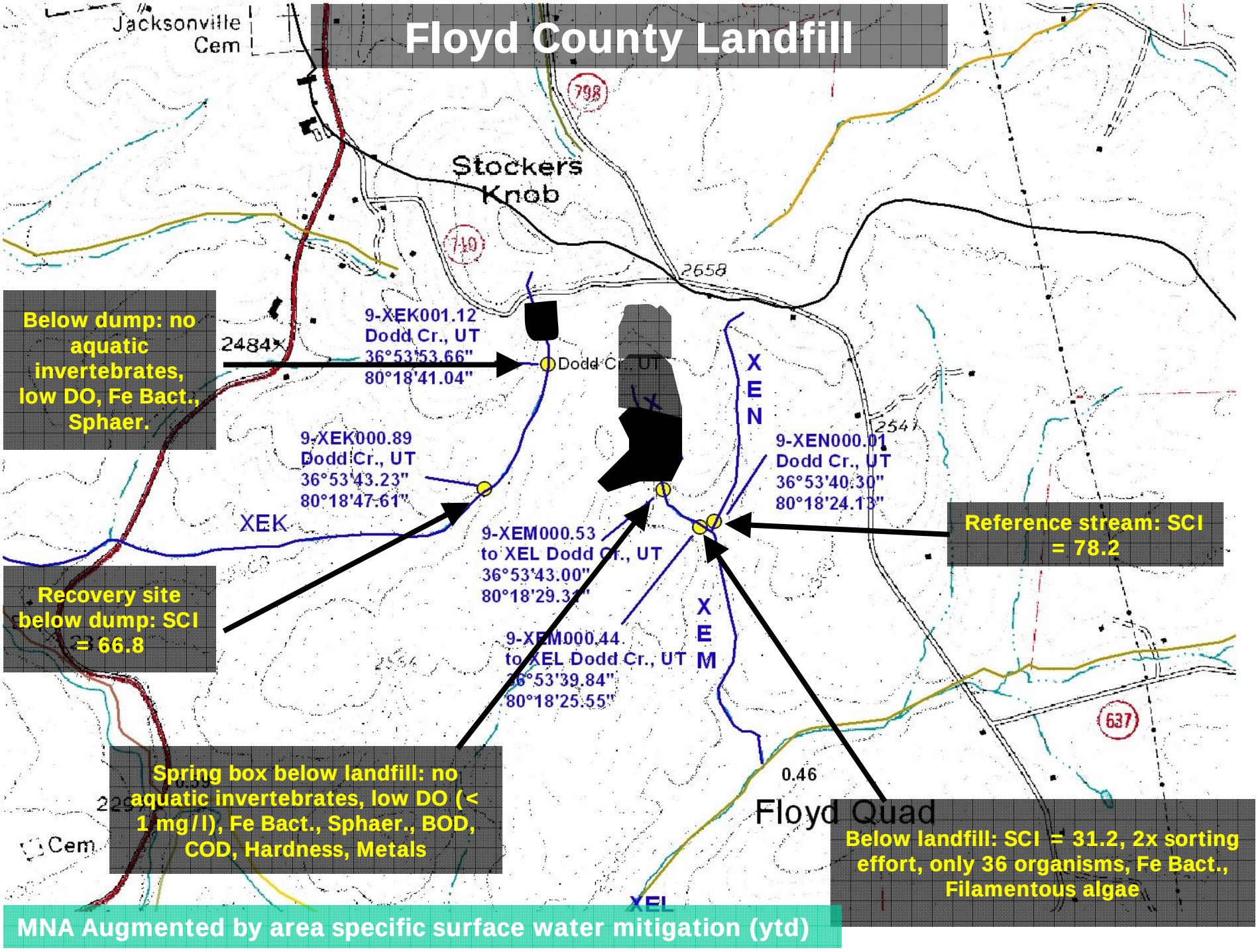


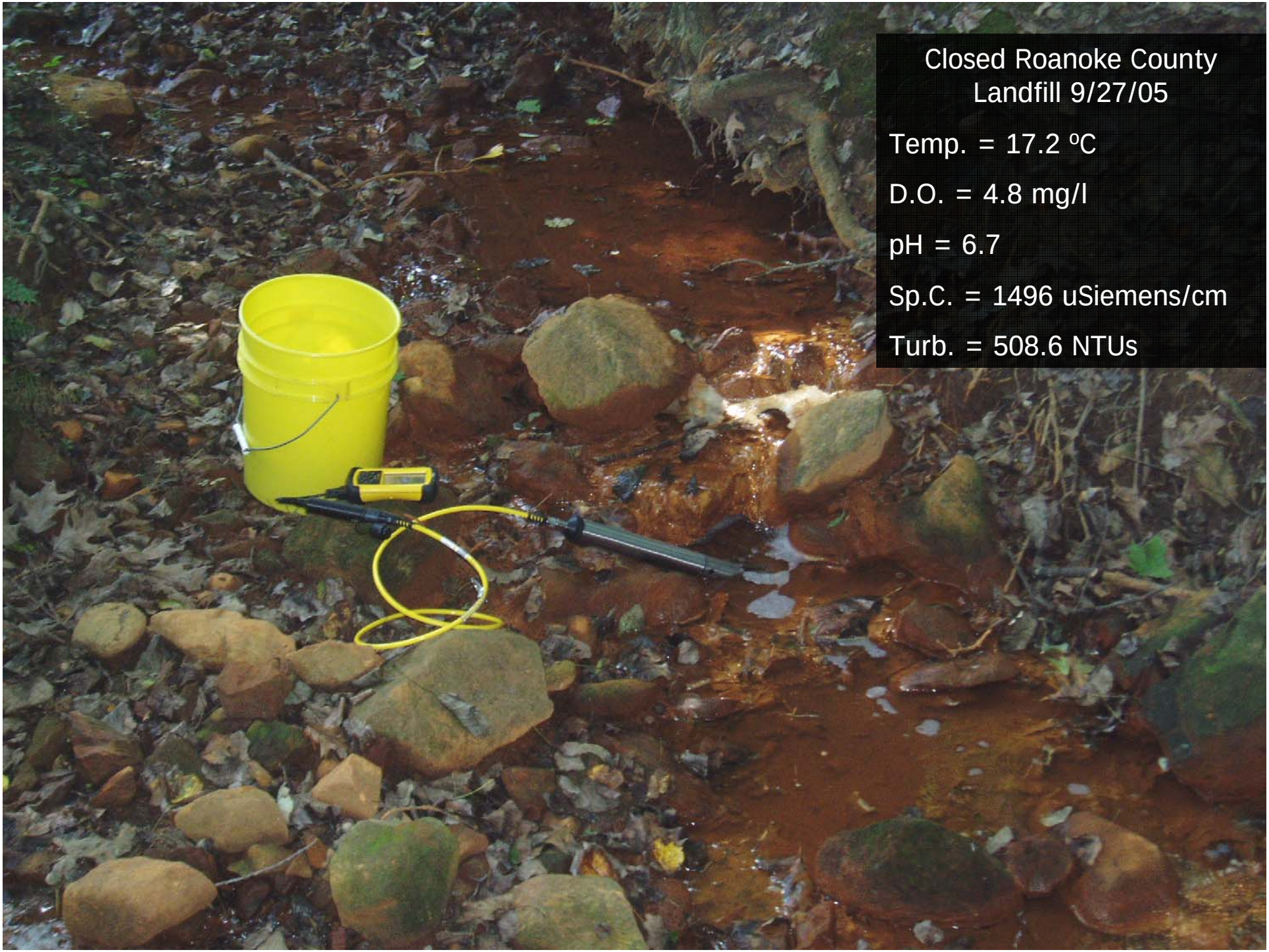
Iron fixing bacteria impacts to substrate

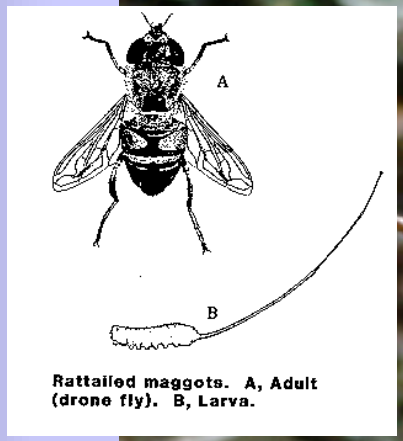
VOCs below outfall:
Benzene
Chlorobenzene
1, 4-Dichlorobenzene
1, 1-Dichloroethane

T = 20.5 C
DO = 2.0 mg/l
pH = 5.5
SpC = 630 uS/cm

Partial release from Post-Closure Care (no GW program, only gas monitoring)


Floyd County Landfill
Jacksonville Cem
Stockers Knob
798
710
2658
2484
2547
Below dump: no aquatic invertebrates, low DO, Fe Bact., Sphaer.
9-XEK001.12
Dodd Cr., UT
36°53'53.66"
80°18'41.04"
Dodd Cr., UT
X
E
N
9-XEK000.89
Dodd Cr., UT
36°53'43.23"
80°18'47.61"
9-XEN000.01
Dodd Cr., UT
36°53'40.30"
80°18'24.13"
XEK
Reference stream: SCI = 78.2
Recovery site below dump: SCI = 66.8
9-XEM000.53
to XEL Dodd Cr., UT
36°53'43.00"
80°18'29.31"
9-XEM000.44
to XEL Dodd Cr., UT
36°53'39.84"
80°18'25.55"
X
E
M
637
0.46
Floyd Quad
Spring box below landfill: no aquatic invertebrates, low DO (< 1 mg/l), Fe Bact., Sphaer., BOD, COD, Hardness, Metals
Cem
Below landfill: SCI = 31.2, 2x sorting effort, only 36 organisms, Fe Bact., Filamentous algae
XEL
MNA Augmented by area specific surface water mitigation (ytd)


Closed Roanoke County Landfill 9/27/05
Temp. = 17.2 ºC
D.O. = 4.8 mg/l
pH = 6.7
Sp.C. = 1496 uSiemens/cm
Turb. = 508.6 NTUs



Rattailed maggots. A, Adult (drone fly). B, Larva.

Leachate collected in ponds and transferred to WWTP
Passive vapor extraction to be maintained until at least 2026

Univar – chemical manufacturing plant

Chemical storage tank

Trench along stream for air injection

Vapor treatment system

Passive Air Injection

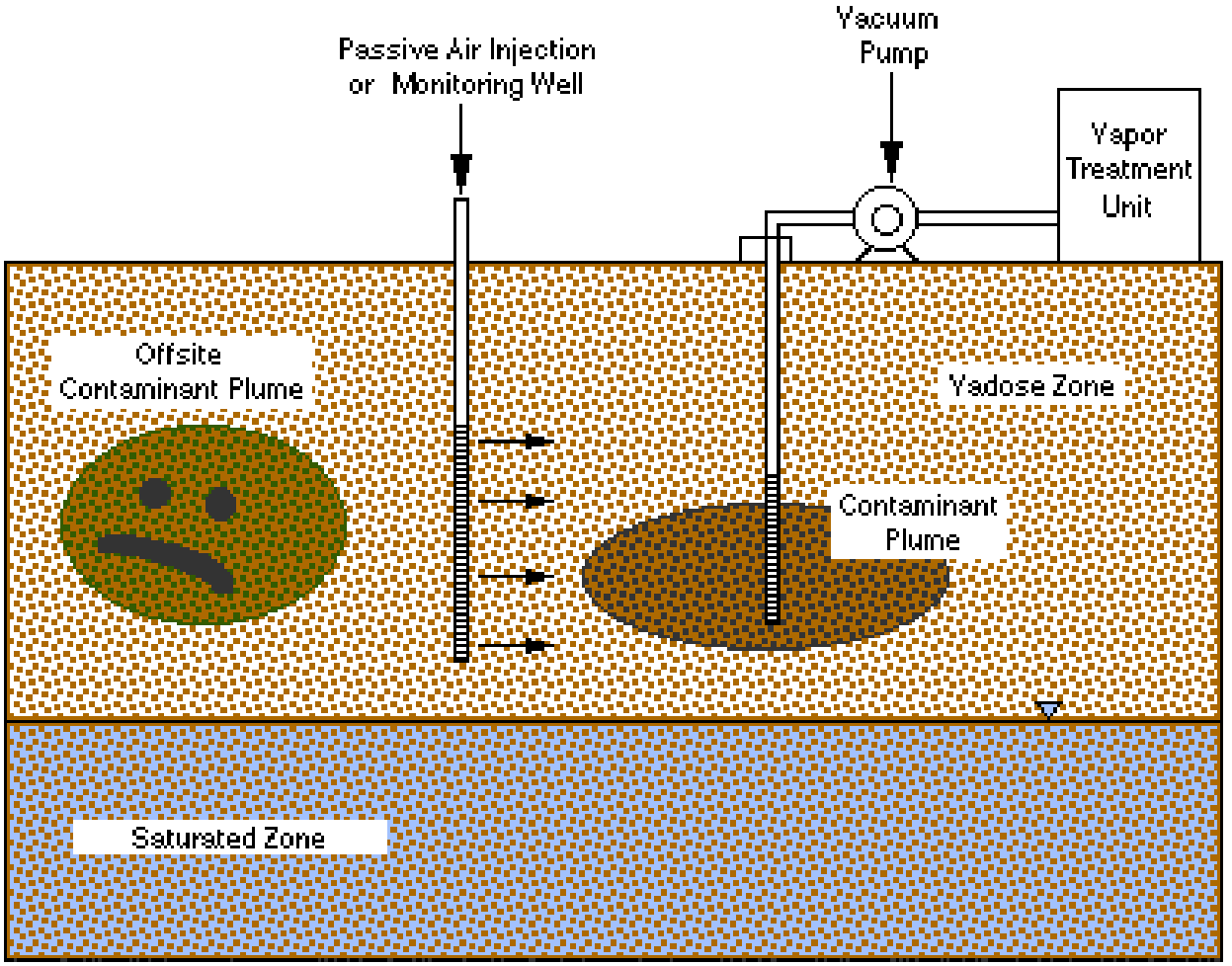


Figure 4: Passive Air Injection to Avoid Offsite Contaminant Migration

Benning and Sabalowsky 1998. CE 4594 Civil Engineering Dept., VPI&SU

Franklin County Landfill

Impacted stream

Pump and treat groundwater with air stripping
VPDES permit to discharge to larger stream

Iron deposits on (in) invertebrates

Use bugs to measure metals and look for potential affects through enzyme activity analyses

Summary

- **Biological monitoring surveys have been useful in detecting impacts below landfills**
- **Chemical monitoring at outfalls reinforce assessments**
- **Biomonitoring data can be useful in guiding corrective action**
- **Several facilities implementing methods to remove COCs from soil or GW**

Potential chemical parameter list to correlate with biomonitoring analyses:

- **VOCs, SVOCs, BOD**
- **COD, heavy metals, TOC**