

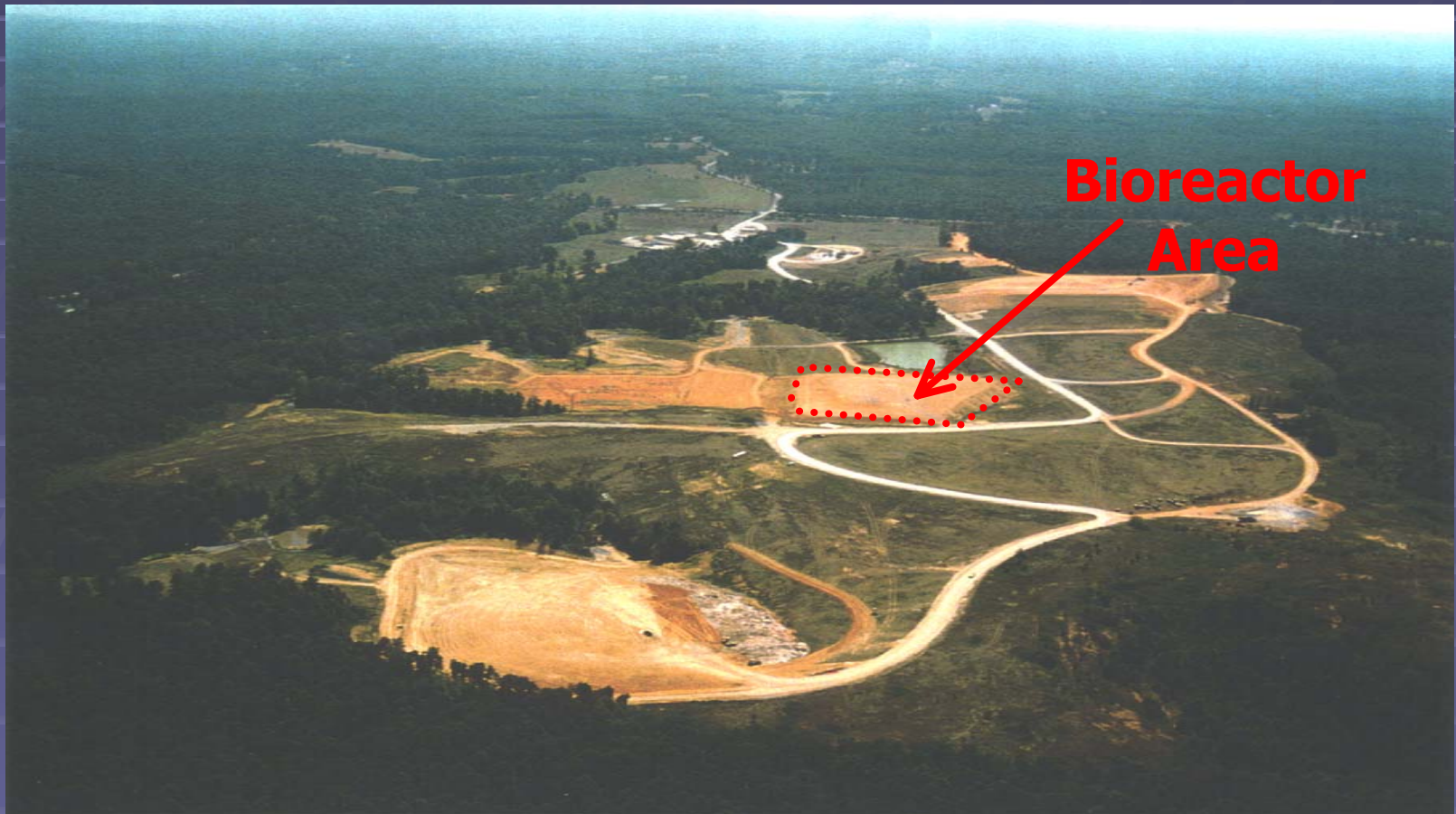
# **WILLIAMSON COUNTY AERATED BIOREACTOR LANDFILL: OPERATIONS AND PERFORMANCE**



**Presented by  
Civil & Environmental Consultants  
for the  
U.S. Environmental Protection Agency  
Workshop On Bioreactor Landfills  
February 27-28, 2003**



# WILLIAMSON COUNTY LANDFILL



# **WILLIAMSON COUNTY BIOREACTOR FACT SHEET**

- **Waste footprint = 6 acres (2.43 hectares) at base**
- **Maximum waste depth is approximately 40 feet (12.2 meters)**
- **Total original waste tonnage = 69,880 short tons or 63,394 Mg**
- **Site is currently closed; received wastes from 1995 to 1998**



# **WILLIAMSON COUNTY BIOREACTOR FACT SHEET**

- **Shape of subject area resembles a truncated pyramid with steep sideslopes (Avg 1.5:1)**
- **Retrofit operation only. No pre-processing of wastes occurred before placement. No new waste placement is taking place**



# **WILLIAMSON COUNTY BIOREACTOR FACT SHEET**

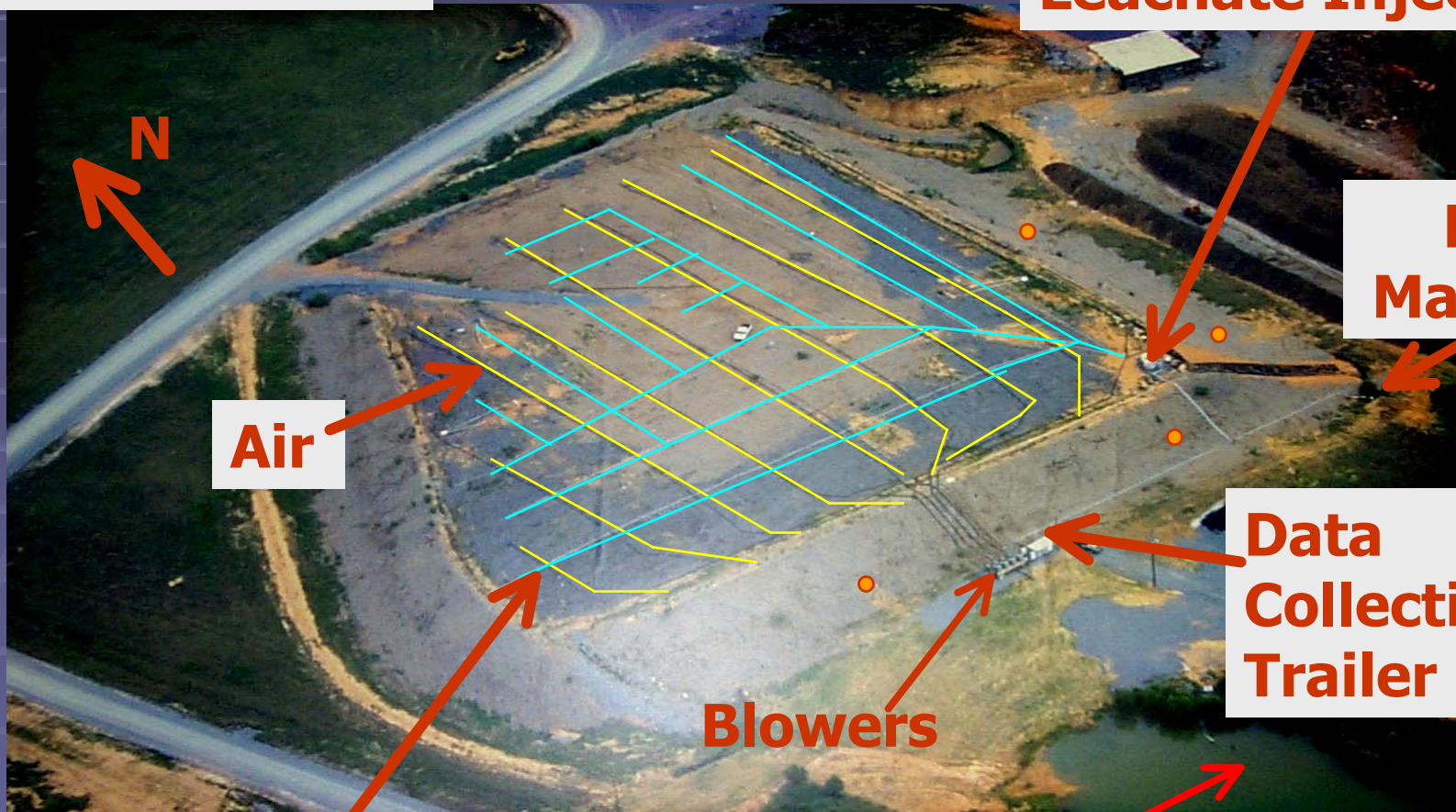
- **Site has been operating continuously as a forced-aeration bioreactor landfill since October 17, 2000 (with periodic shut-downs for maintenance and repair)**
- **Leachate, and occasionally storm water, is pumped into the mass via vertical screened wells**
- **This is a “temperature-feedback” operation**



# SYSTEM LAYOUT

Monitoring Locations  
For Leachate Head

Mix Tank For  
Leachate Injection



LCS  
Manhole

Air

Data  
Collection  
Trailer

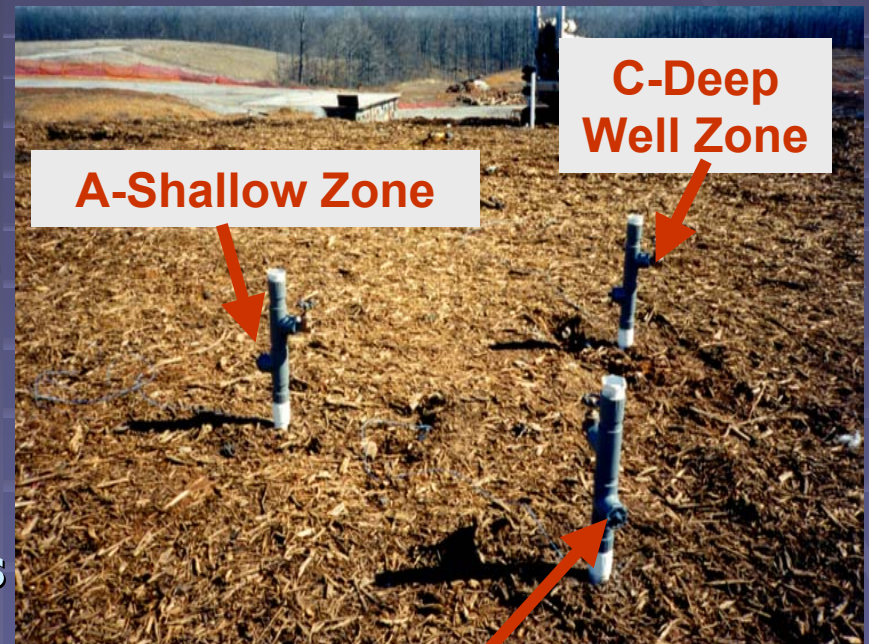
Blowers

Leachate

Storm Water Pond

# COMPRESSED AIR INJECTION

- Three 1000 acfm (28.3 m<sup>3</sup>/min) blowers are utilized on-site
  - Compressed air is injected into the waste via vertical screened wells
  - Preliminary figures: Average air injection as of Feb 2003 =  
\*27.5 acfm per well  
(95% C.I. = [20.78, 34.15])
- \* Based on most recent operations when system was running effectively



**B-Intermediate Depth Zone**

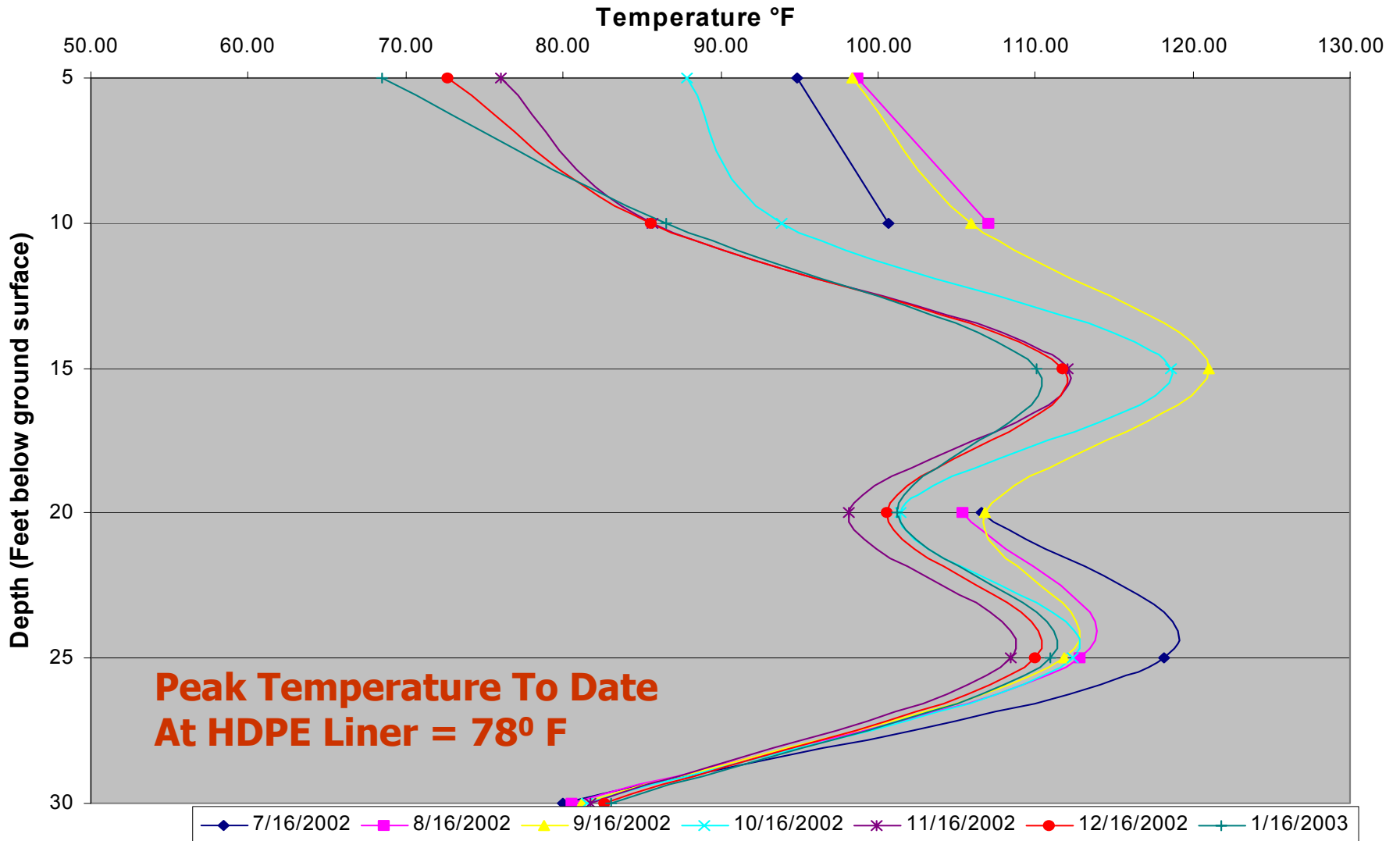
# OPERATIONAL ZONES (JULY 2002 TO JANUARY 2003)





# ZONE C TEMPERATURE PROFILE

Temperature vs Depth  
Zone C

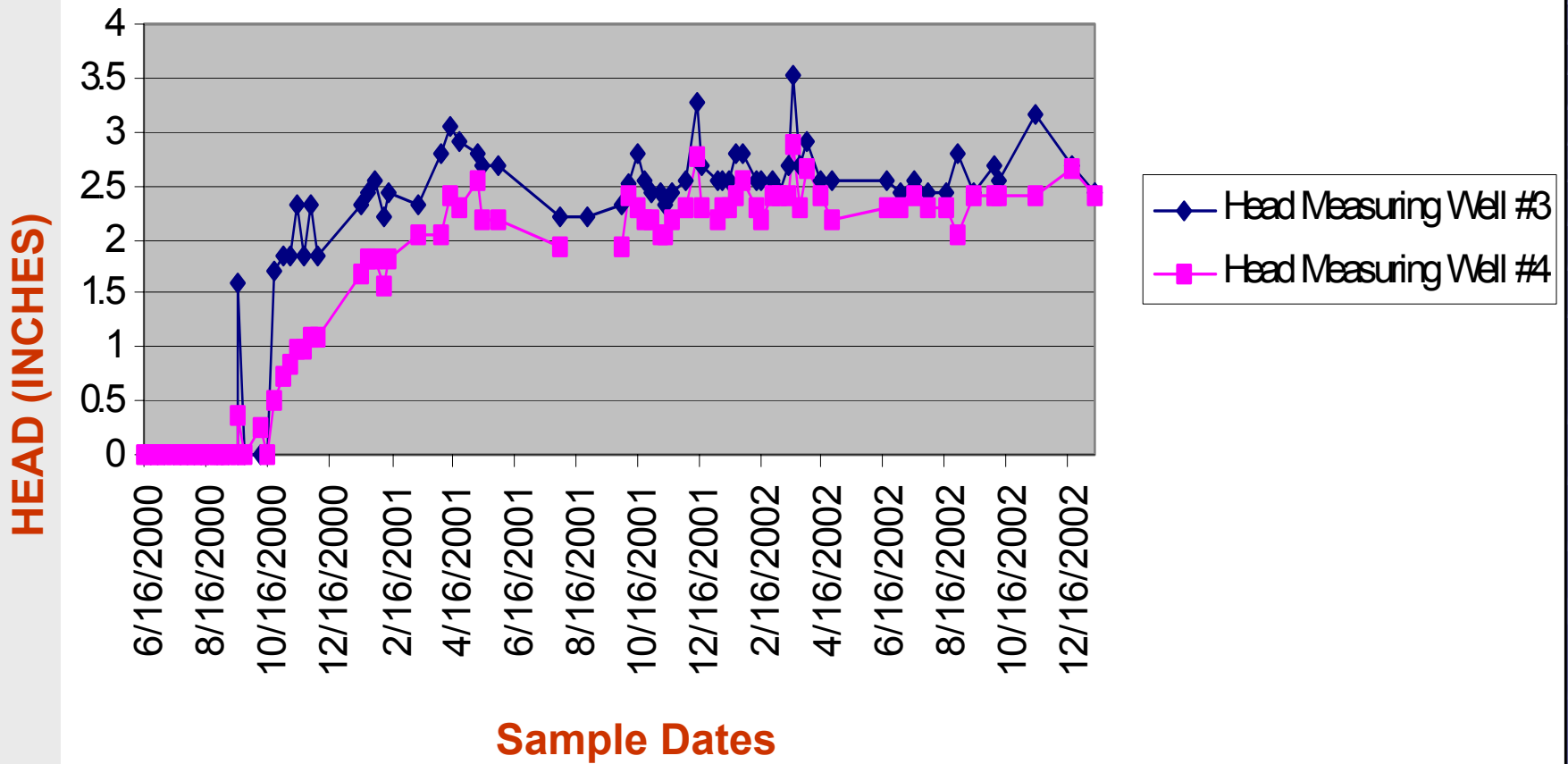


# LEACHATE INJECTION AND COLLECTION

- **Composite-lined base with a granular-material underdrain LCS**
- **All leachate flow drains towards the southeast corner of the footprint**
- **Injected volume of leachate/storm water to date is approximately 4.8 million gallons (18.2 million liters)**
- **Leachate injection rate has varied from 0.01 to 0.07 gallon/cy waste/day (0.05 to 0.35 liters/m<sup>3</sup> waste/day)**



# LEACHATE HEAD ON LINER



# WATER BALANCE

- Roughly 10% of injected leachate has emerged via the leachate
- Data suggests that gas and compressed air injection pressures are influencing moisture routing throughout waste matrix
- Surface lysimeters are being influenced by upward movement of internal leachate
- Exit gas has had saturated humidity levels since the start of air injection



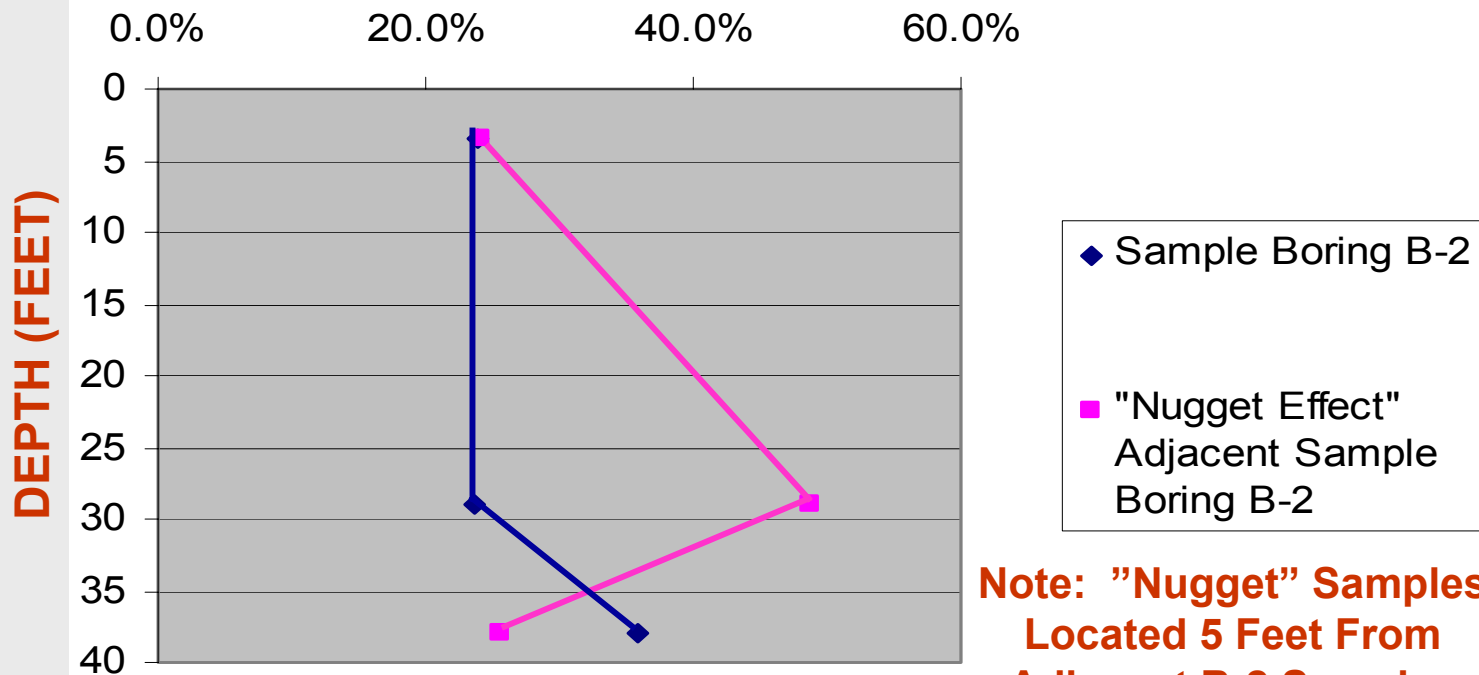
# MOISTURE DISTRIBUTION

- **The effectiveness of moisture distribution directly affects:**
  - **Air distribution**
  - **Water Availability for microorganisms**
- **Evidence of heterogeneous distribution of moisture, including saturated pockets and relatively dry areas**
- **For aerated systems, a tighter operating range of moisture content is needed**



# MOISTURE CONTENT DATA FROM OCTOBER 2002 SAMPLING EVENT

Moisture Content (Percent On Wet Weight Basis)



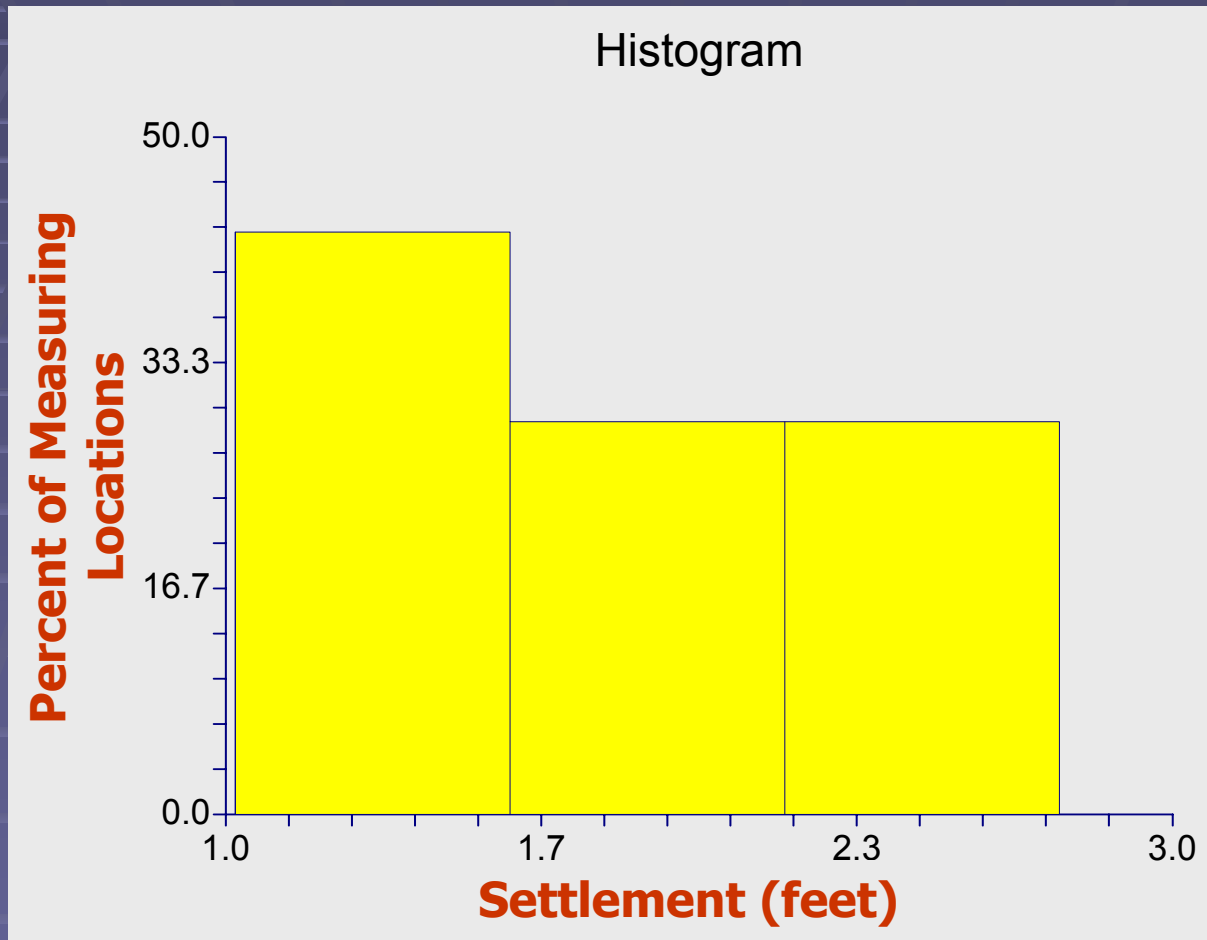
**Note: "Nugget" Samples Located 5 Feet From Adjacent B-2 Samples**

# NEEDED IMPROVEMENTS

- ***In-situ* moisture content measurements are necessary for effective operation relative to concerns over maintaining FAS**
- **For Retrofits - Improved methods and materials of construction in well and header system construction**
  - **auguring or sonic drilling for wells**
  - **greater well diameter**
  - **angular granular materials used in annular space backfill**
  - **HDPE pipe and fittings for header system**



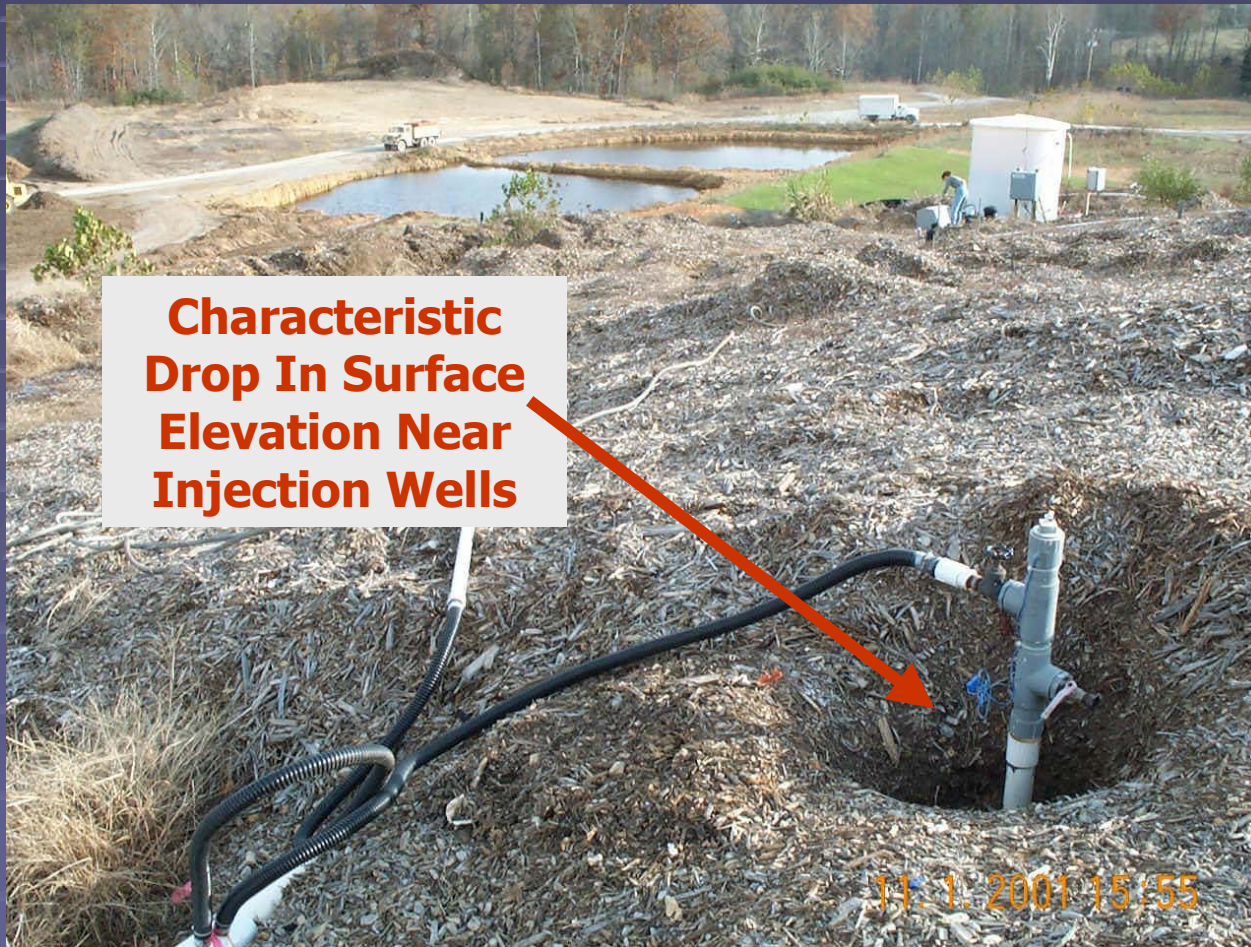
# SETTLEMENT (AS OF 1/28/03)



➤ Average Settlement Across Site = 22 inches or 4.9% of original avg. depth



# SETTLEMENT

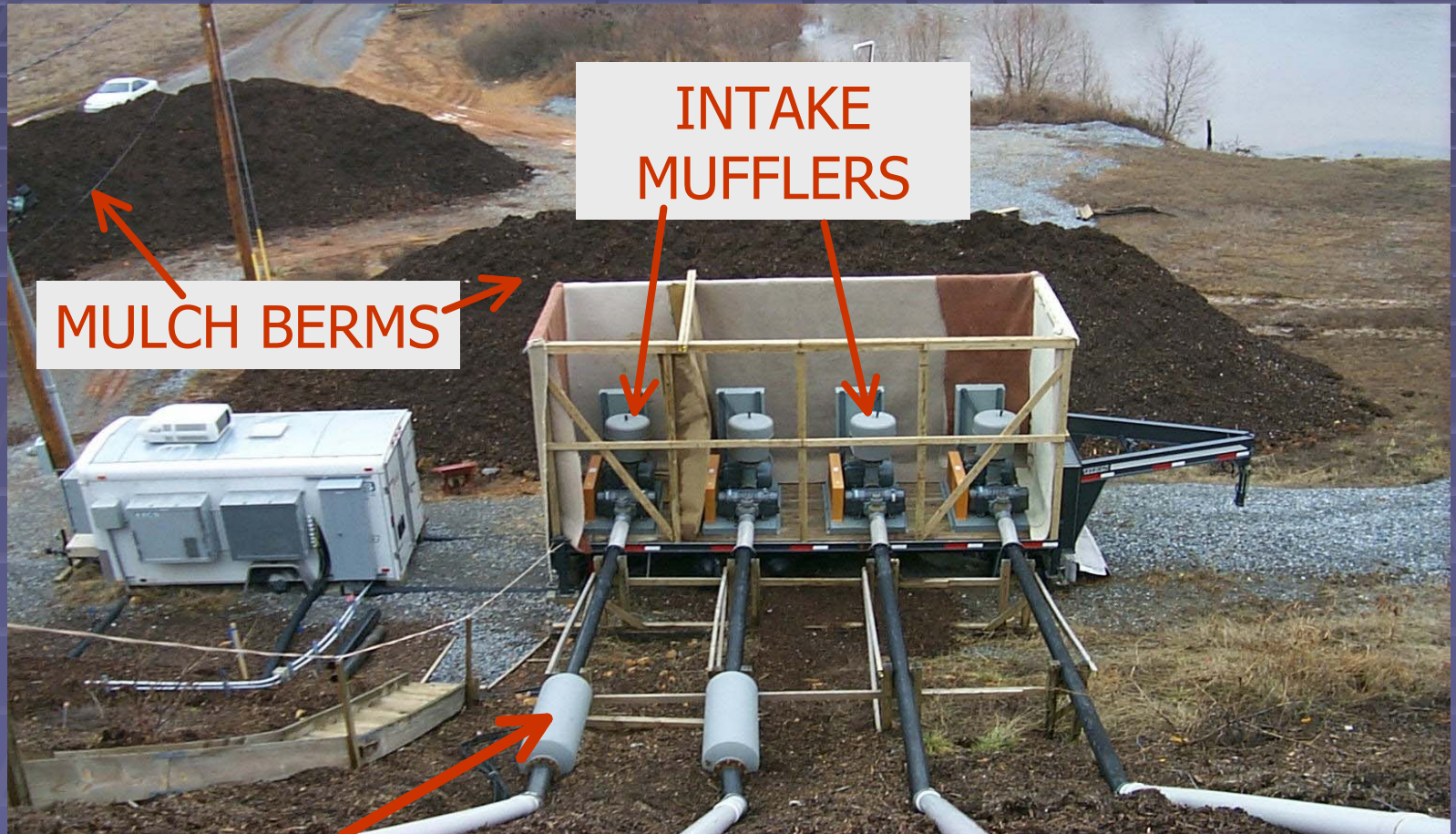


# OPERATIONAL PROBLEMS AND TROUBLESHOOTING

- **PROBLEM:** Noise from blowers (neighbor complaints)
  
- **SOLUTION:** Vibration dampeners on outlet air header pipes; mufflers on blower intakes; carpeted structure around blowers



# POSITIVE DISPLACEMENT BLOWERS WITH NOISE ABATEMENT MEASURES



MULCH BERMS

INTAKE  
MUFFLERS

DISCHARGE NOISE  
DAMPENERS

# OPERATIONAL PROBLEMS AND TROUBLESHOOTING

➤ **PROBLEM:** Maintaining air header pressure due to pipe leaks at cracks and due to inadequate sealing at joints

➤ **SOLUTION:**

➤ Replaced cracked pipe and all leaking joints

➤ Use HDPE pipe with butt-fused joints



# AIR HEADER LEAK

**Separation  
At PVC  
Glued  
Joints**



**Crack  
Formation  
In PVC  
Pipe**

# OPERATIONAL PROBLEMS AND TROUBLESHOOTING

## ➤ PROBLEM:

➤ Excessive air backpressures at air injection wells

➤ Related to the variability in waste/soil density and porosity (limited free air-space), volume of intermediate soil cover used, moisture content

➤ Related to the method of construction for the injection wells



# OPERATIONAL PROBLEMS AND TROUBLESHOOTING

- SOLUTION/RESPONSE:
- Construct waste cells in new bioreactor systems using methods to increase free air-space (waste processing, minimal compaction, shallow layering)
- Compare measured backpressures in the field using various delivery methods
- Internal examination of wells with down-hole camera



# OPERATIONAL PROBLEMS AND TROUBLESHOOTING

## ➤ PROBLEM: Thermocouples

- Sealing Connections
- Shielded wire was not used
- Accidental severing of Lines
- Wires wrapped around piping

## ➤ SOLUTION:

- Replacement of wire; use of shielded wire
- Shrink-Wrap Connections or replace with outdoor connectors (watertight)
- Remove wires from around piping





# PRECIPITATE AND CORROSION AT THERMOCOUPLE CONNECTOR



# OPERATIONAL PROBLEMS AND TROUBLESHOOTING

- **PROBLEM: Backflow/Surge of leachate from injection wells**
  - Leachate ejection onto base of wells
  - Backflow into air pipes when blowers are off)
  - Probable cause:
    - excessive internal gas production and associated pressures along with increasing heat



# LEACHATE BACKFLOW/SURGE



# LEACHATE BACKFLOW/SURGE



Leachate  
Surge

# LEACHATE SURGE



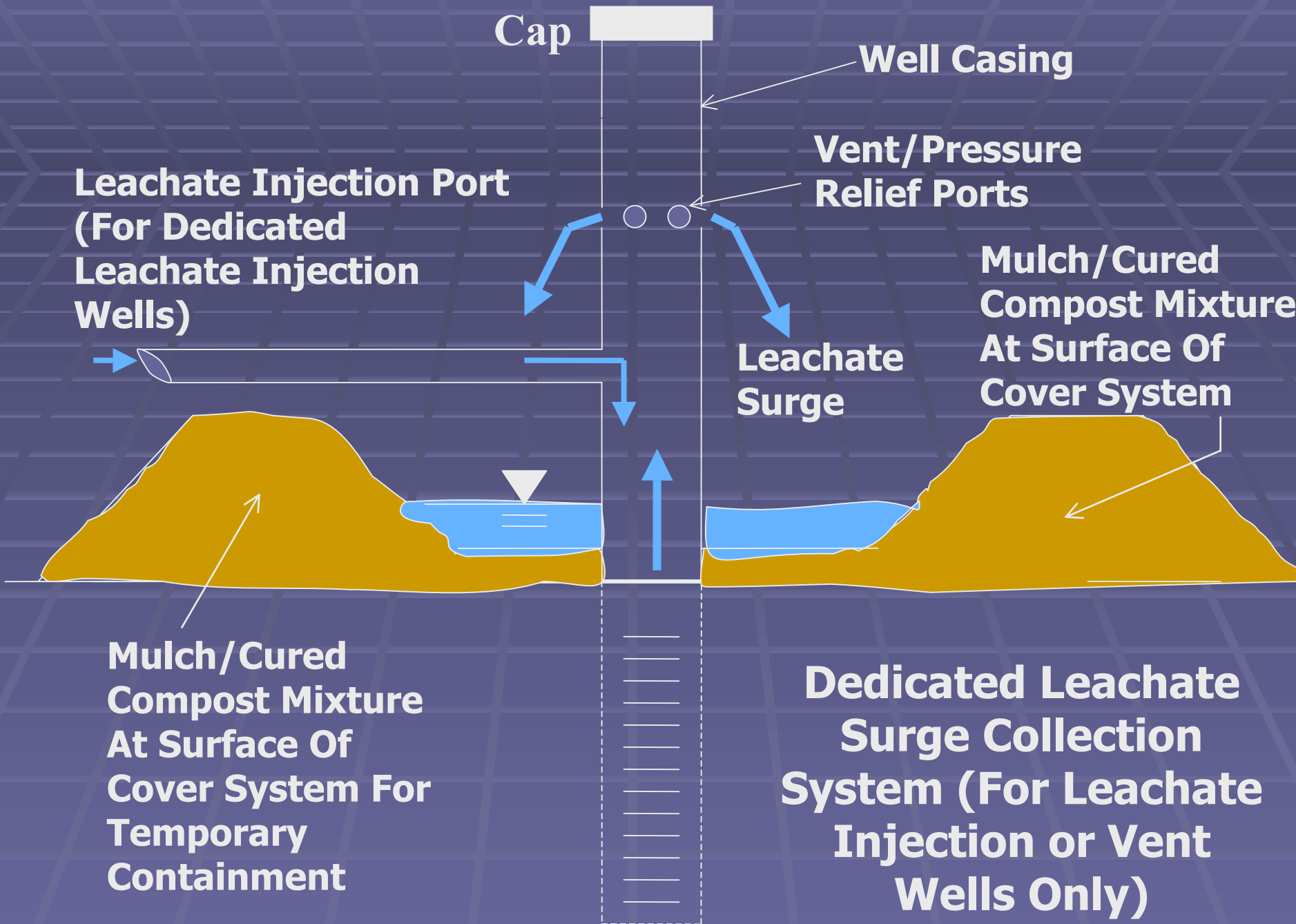
**Staining  
From  
Leachate  
Eruption  
From Well**

# **OPERATIONAL PROBLEMS AND TROUBLESHOOTING**

## **SOLUTION:**

- **Throttle valves at well heads;**
- **Construct mulch berms to contain surcharge and prevent it from leaving site as stormwater;**
- **Periodic leachate dosing;**
- **Check valves on air lines to prevent leachate backflow**





Cap

Well Casing

Vent/Pressure Relief Ports

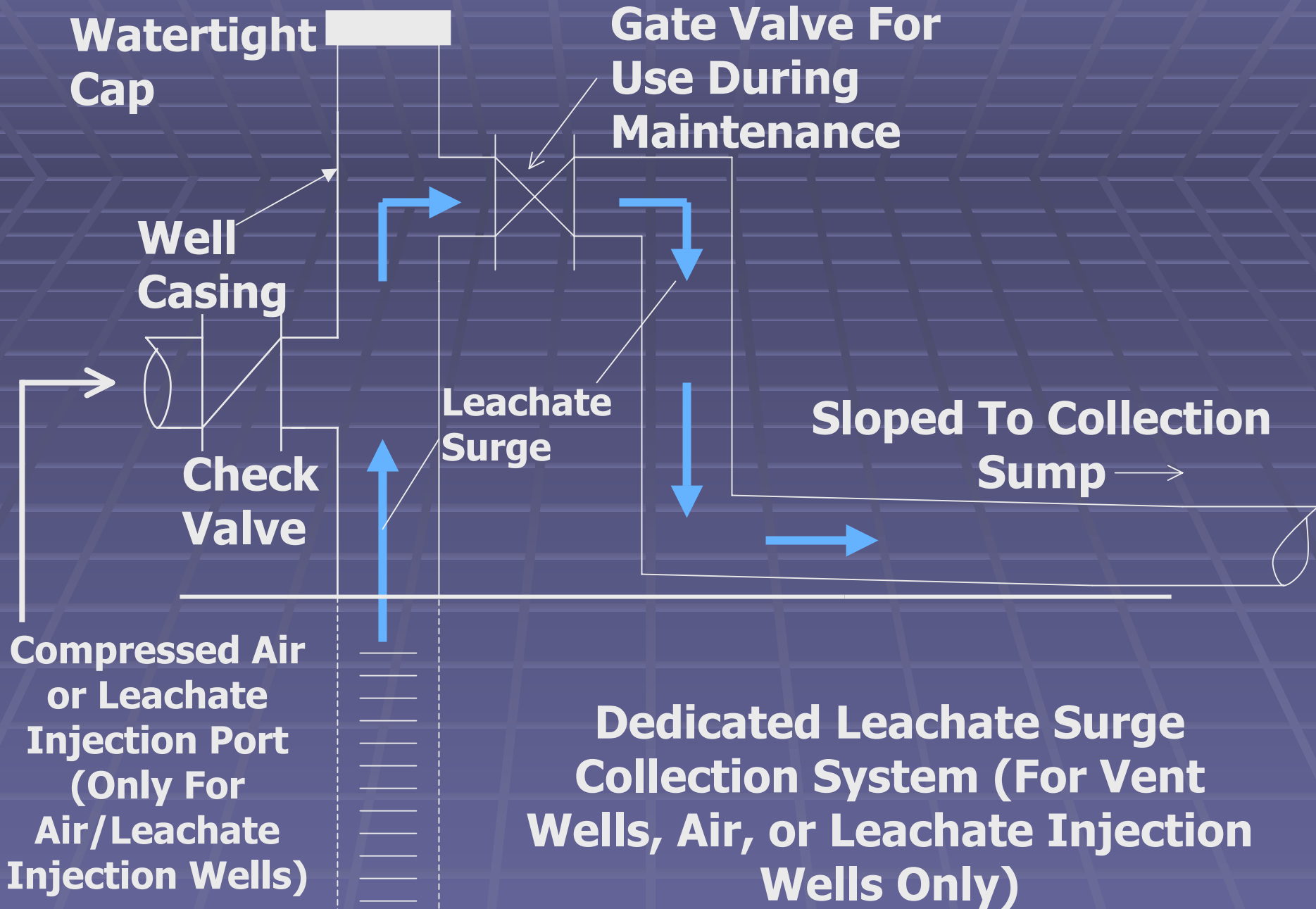
Leachate Injection Port (For Dedicated Leachate Injection Wells)

Mulch/Cured Compost Mixture At Surface Of Cover System

Leachate Surge

Mulch/Cured Compost Mixture At Surface Of Cover System For Temporary Containment

Dedicated Leachate Surge Collection System (For Leachate Injection or Vent Wells Only)





# **OTHER CONSIDERATIONS FOR BIOREACTOR OPERATIONS**

- **Avoid use of metal valves and other fittings due to corrosive nature of off-gases and leachate**
- **Be prepared for the possibility of dealing with damage from field mice and other animals**
- **Loop header distribution system**
- **Strategic locating of shut-off valves along headers for isolation**



# GEOTECHNICAL STABILITY

**EAST SLOPE  
FEB 27, 2001**



# GEOTECHNICAL STABILITY



**SOUTH SLOPE – MAY 7, 2002**

# GEOTECHNICAL STABILITY



**South Slope- May 2002**

# **RESPONSE TO GEOTECHNICAL STABILITY ISSUES**

- **Continued monitoring of slope movement via sideslope risers**
- **All injection wells (air and leachate) located near top edge of slope have been shut off**
- **Rock buttresses built along south sideslope**



# Civil & Environmental Consultants, Inc.

Would like to thank the United States Environmental Protection Agency for the opportunity to present this research at the 2003 Workshop for Landfill Bioreactors

