



*Florida International University*  
*Miami- FL*

*Post Closure Care Project for*  
*Florida Landfills*

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# *Introduction*

**Aim: To develop a performance based methodology that can be used as a decision making tool to reduce the post closure care (PCC) period of Florida landfills**

**This project is funded by State University System of Florida, Hinkley Center for Solid and Hazardous Waste Management.**

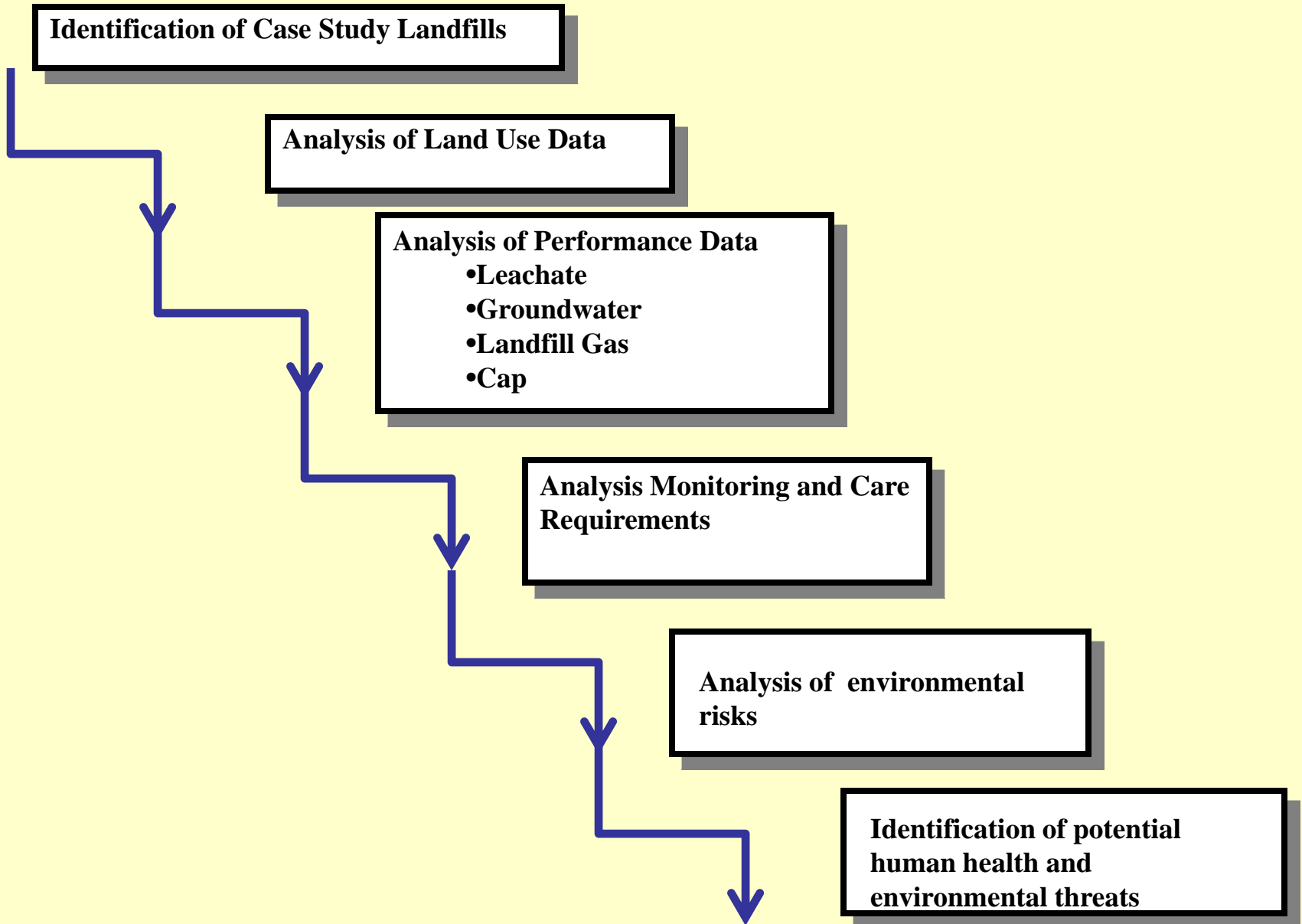


**The partners**



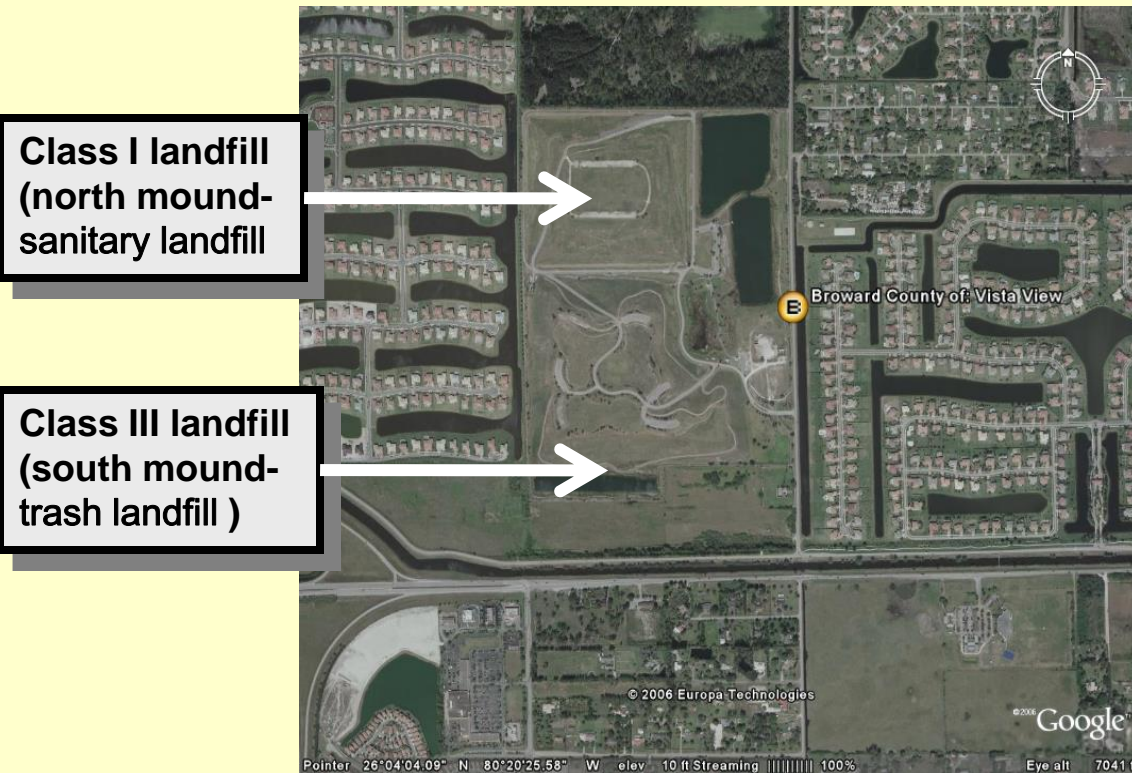
**The data for Davie Landfill are provided by Broward County Waste and Recycling Services Solid Waste Operations Division**

# *PCC Period Assessment Tasks*



# *Vista View Park (Davie Landfill)*

## *Broward/FL*



**December 1987- Landfill was officially closed**

**July 2003 - Vista View Park was opened the public**



# *Design Features*

## *Cap Feature*



A two-foot thick, compacted, limerock cover

A total of 31,969 tons of limerock were used as landfill cover material

## *Leachate Collection System, LCS*

The south mound (trash landfill) is unlined

The north mound (sanitary landfill) is lined and made up of 14 cells



Leachate to City of Sunrise wastewater treatment plant.

## *Gas collection*



33 gas extraction wells

collected gases eliminate through an enclosed flare

## *Surface water*



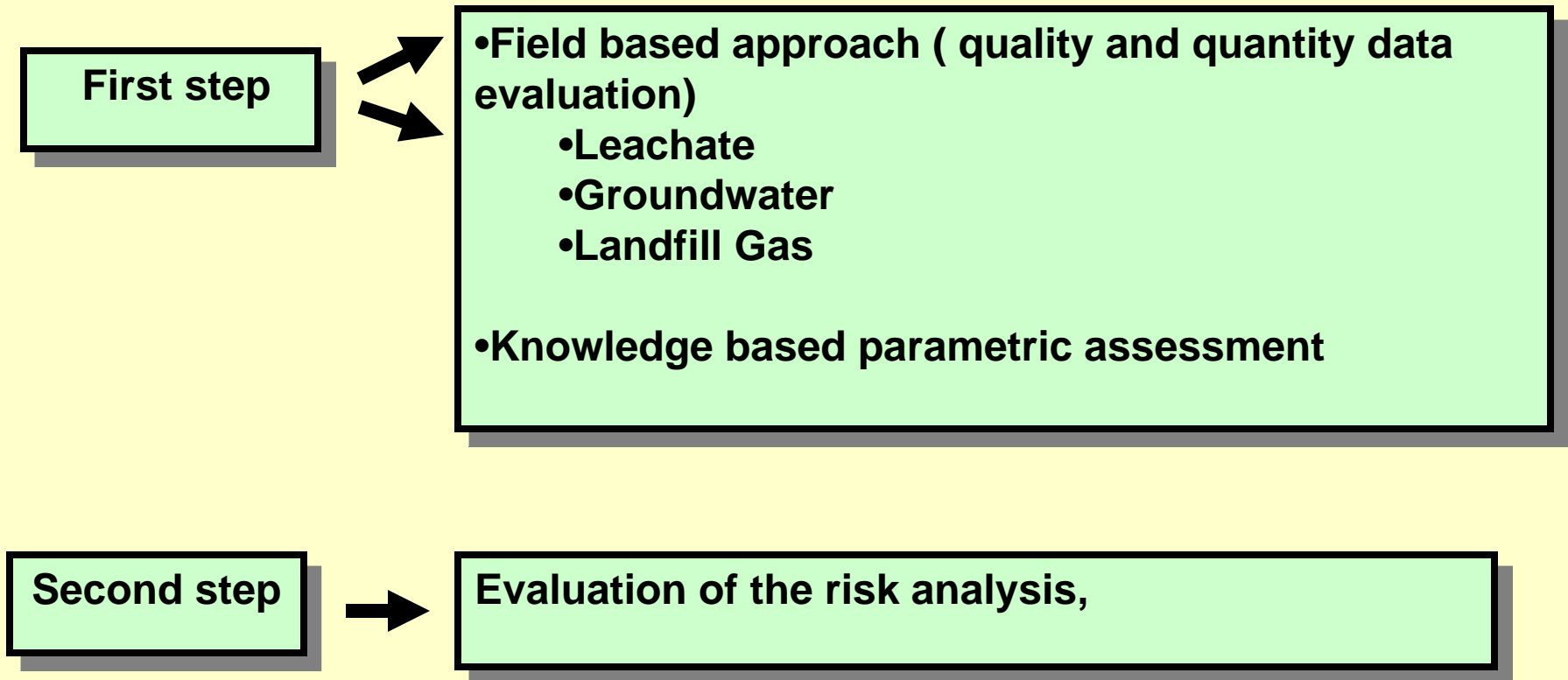
All surface water runoff is channeled to borrow lakes

## *Ground water*

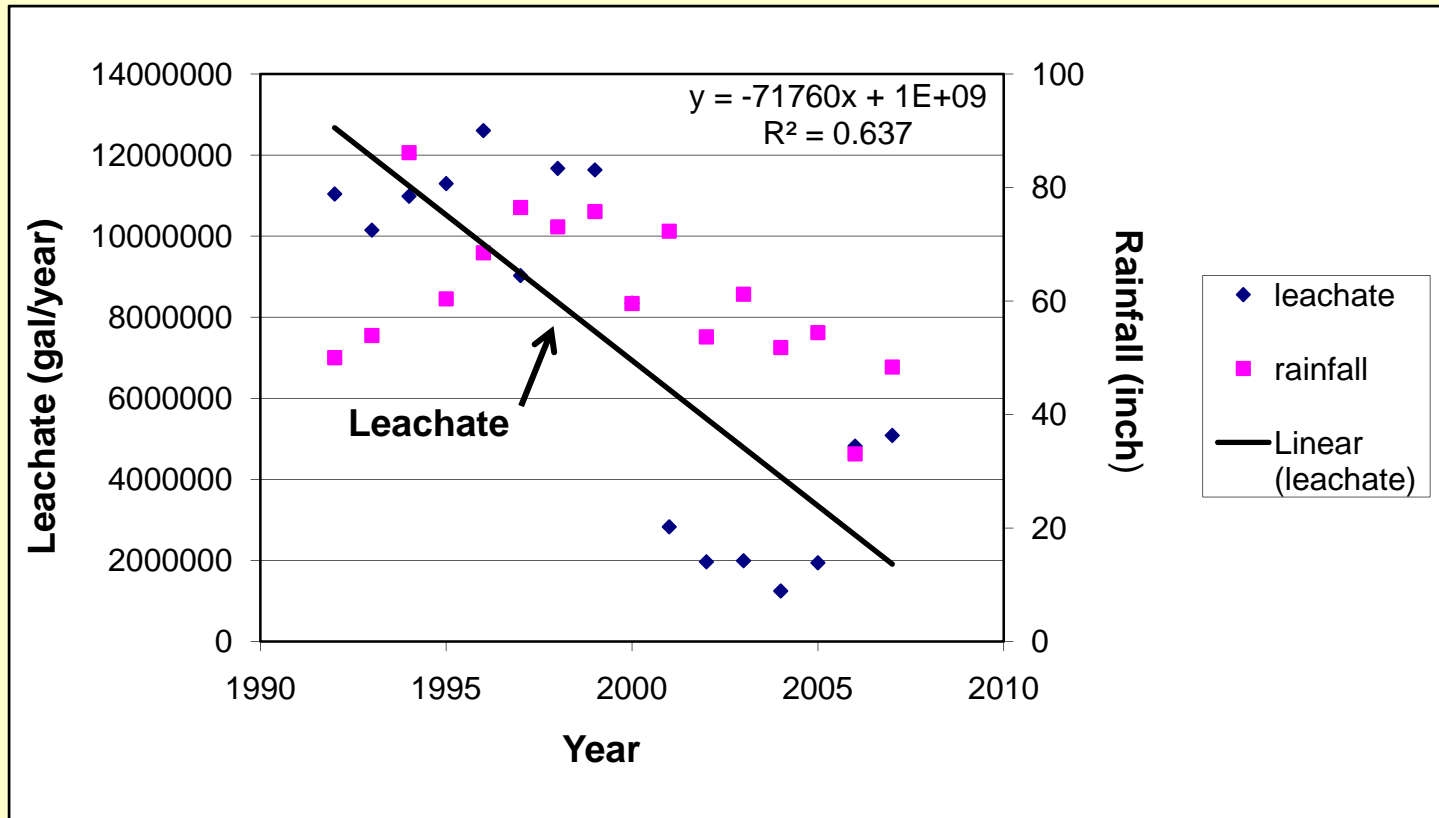


There are 22 G.W monitoring well. Sampled semiannually

# *Methods used for PCC assessment*

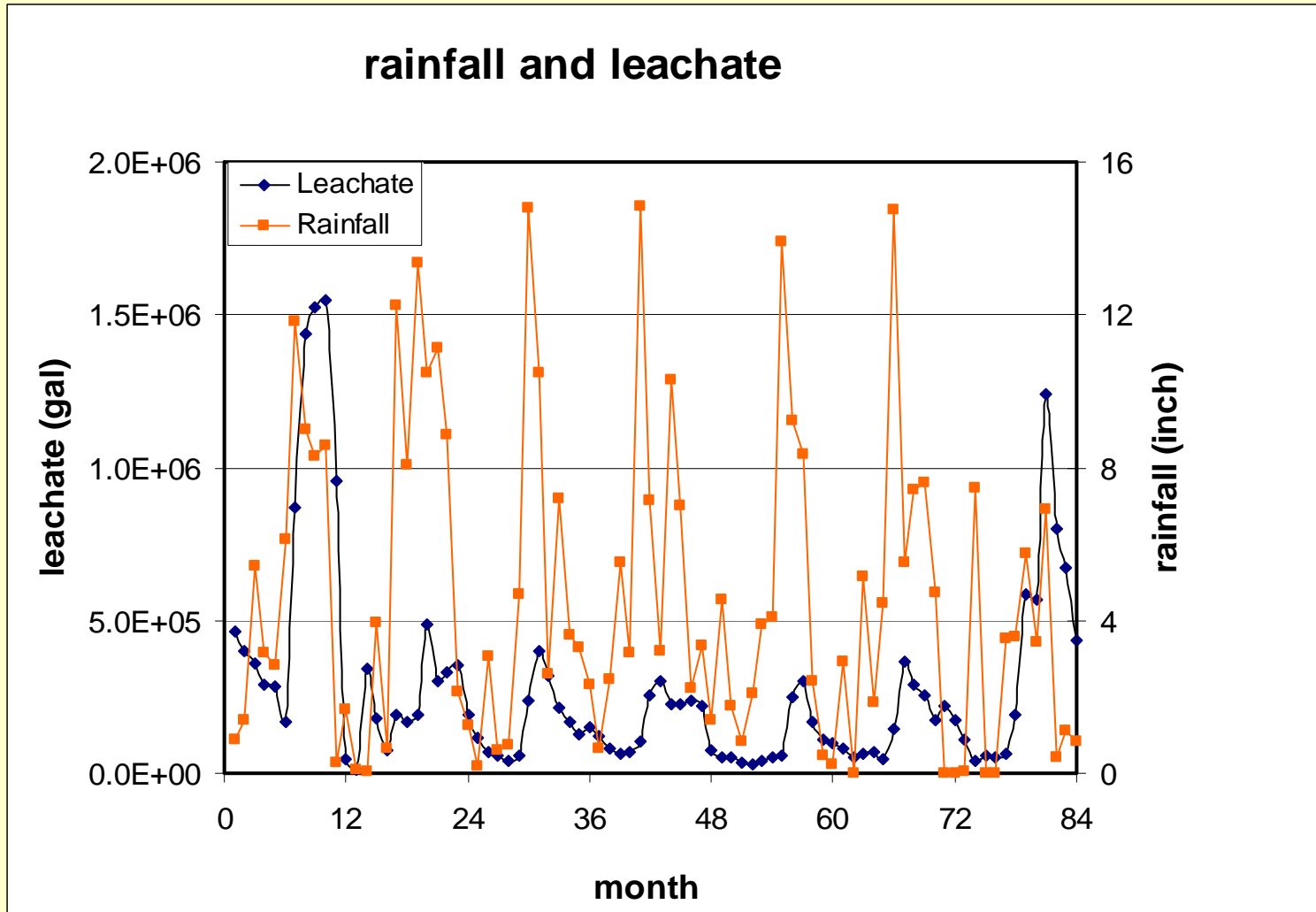


# *Leachate Quantity*



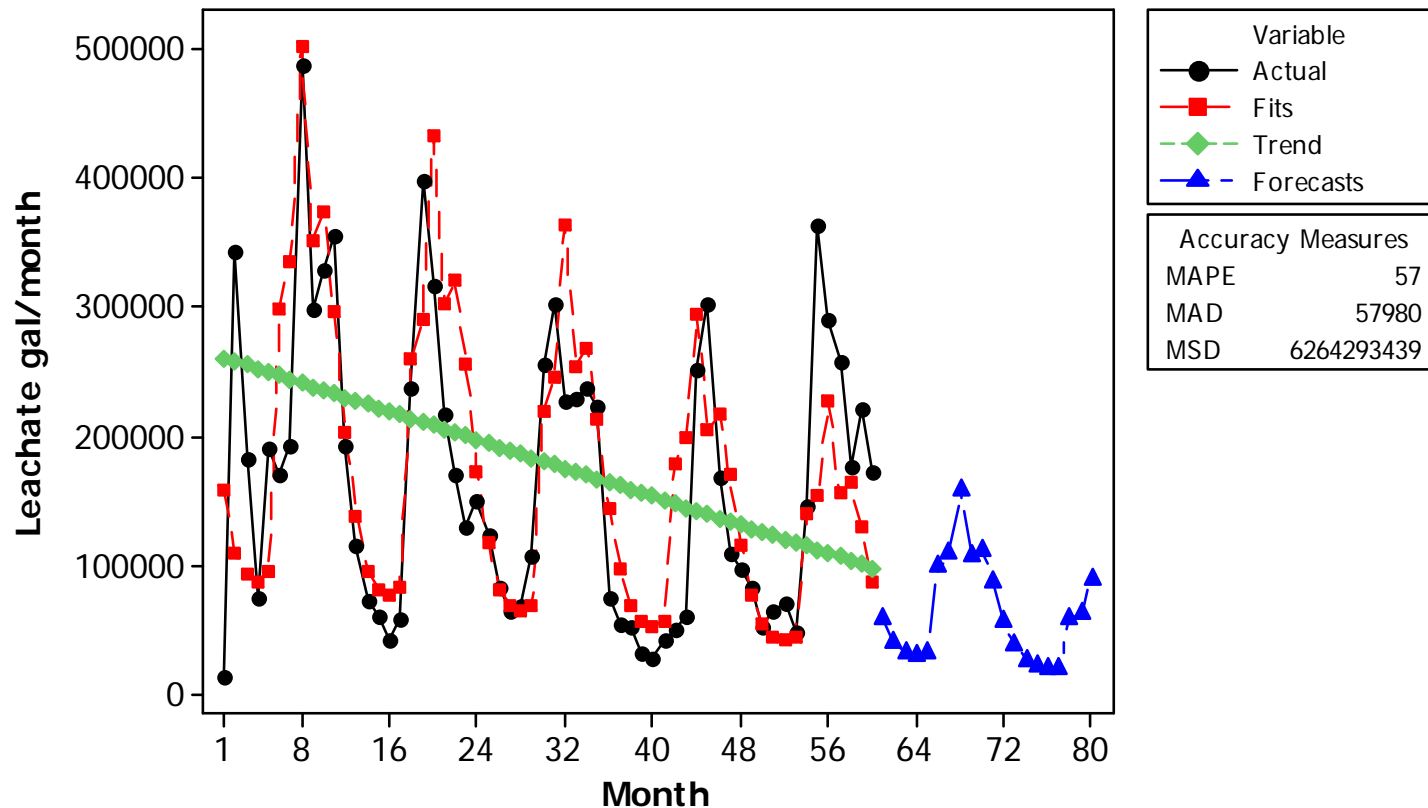
Available data are from 1990 to 2008

# Monthly Total Leachate vs Total Rainfall



# *Leachate Quantity Prediction with time series analysis*

**Time Series Decomposition Plot for Leachate**  
Multiplicative Model



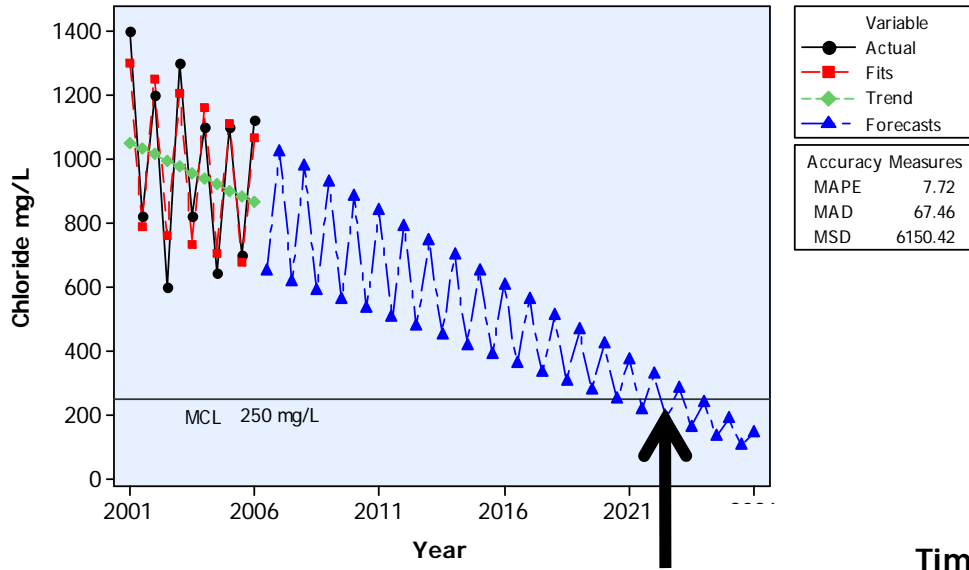
# *Leachate Quality*

- **Total 49 parameters monitoring**
- **Available data April 2001-April 2008**
- **26 parameters non detected (always below detection limit)**
- **8 parameters always above MCL**
- **10 parameters below MCL**

<b>Below MCL</b>	<b>Above MCL</b>
<b>1,4-Dichlorobenzene</b>	<b>Chloride</b>
<b>Chlorobenzene</b>	<b>Bicarbonate</b>
<b>cis-1,2-Dichloroethylene</b>	<b>Sodium</b>
<b>Dichlorodifluoromethane</b>	<b>Ammonium as N</b>
<b>Ethylbenzene</b>	<b>Iron</b>
<b>Methyl-tert-butyl ether (MTBE)</b>	<b>Benzene</b>
<b>Tetrachloroethene</b>	<b>Vinyl Chloride</b>
<b>Toluene</b>	<b>Total Dissolved Solids</b>
<b>Xylenes</b>	
<b>Total BTEX</b>	

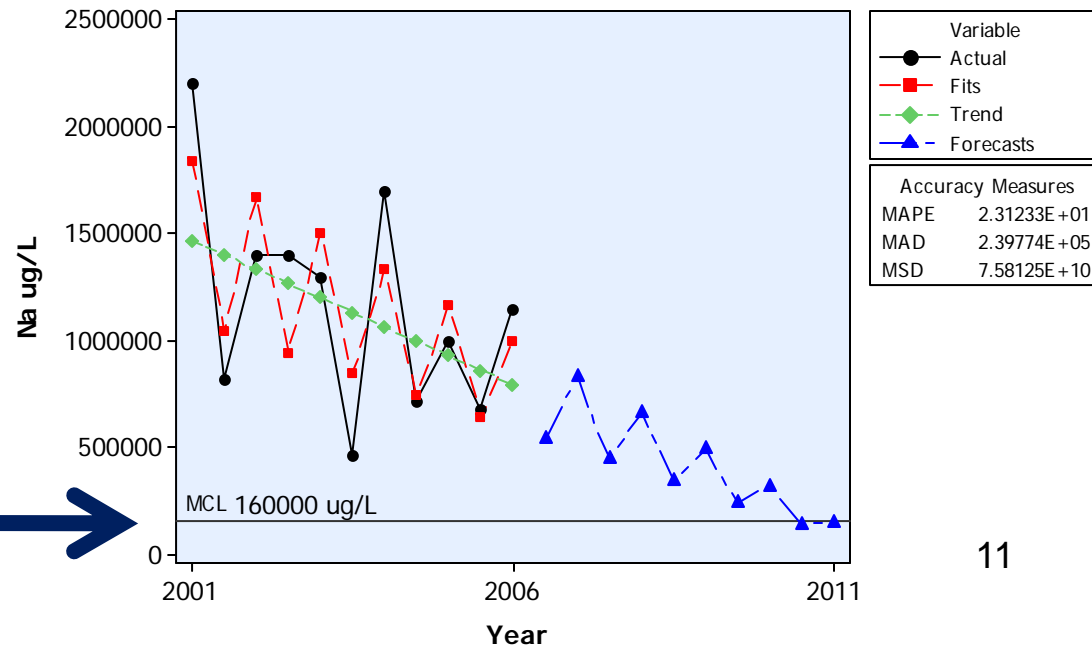
# Chloride and Sodium Trend and Forecast

**Time Series Decomposition Plot for Chloride**  
Multiplicative Model



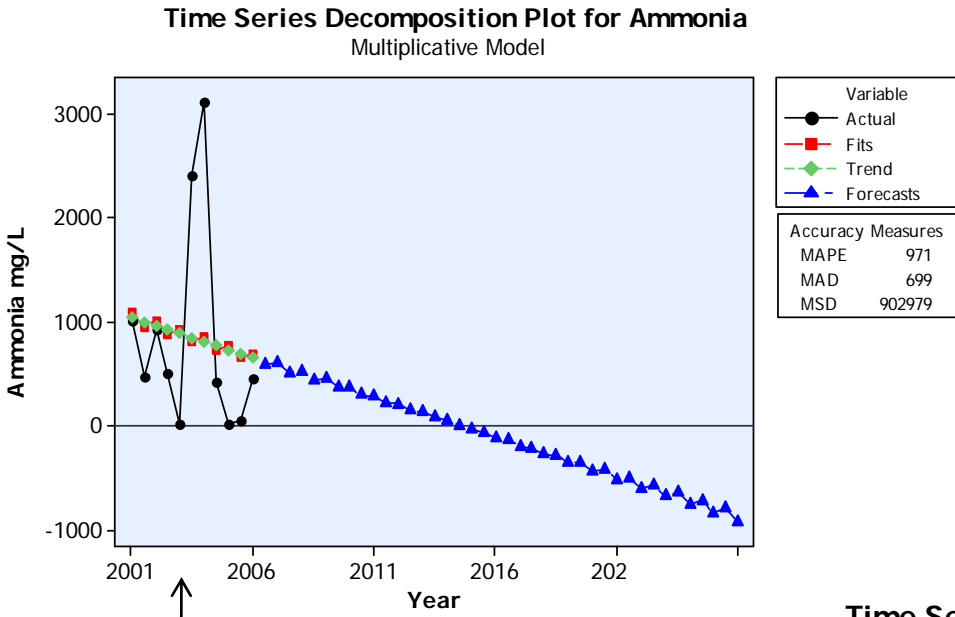
MCL will be reached in 2021

**Time Series Decomposition Plot for Sodium**  
Multiplicative Model



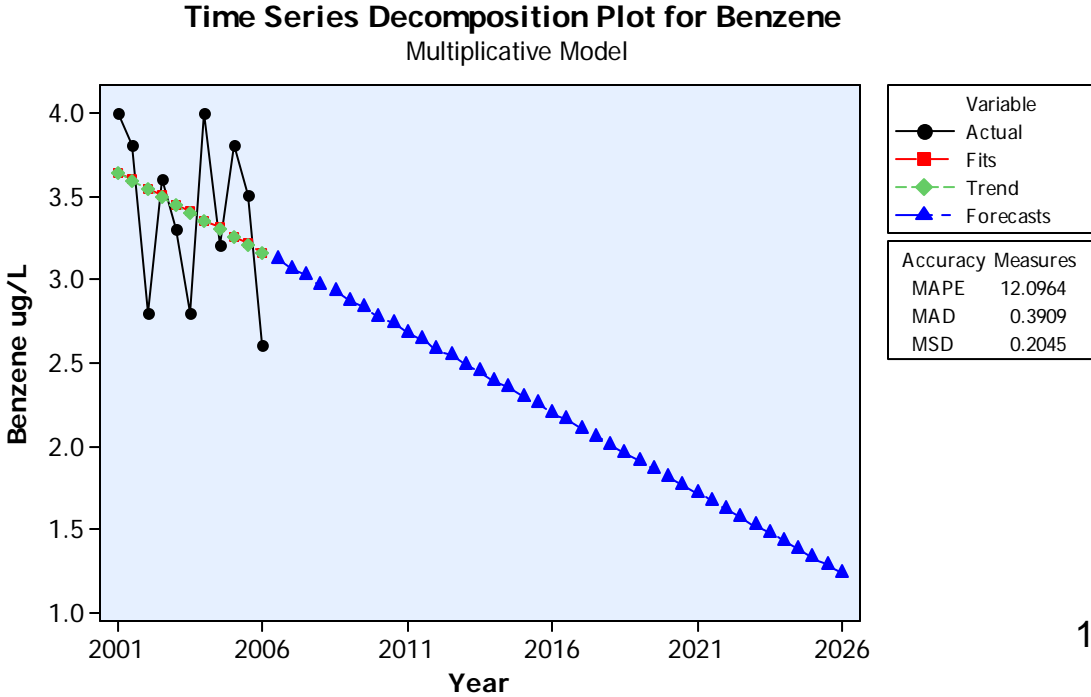
MCL will be reached in 2011

# Ammonia and Benzene Trend and Forecast



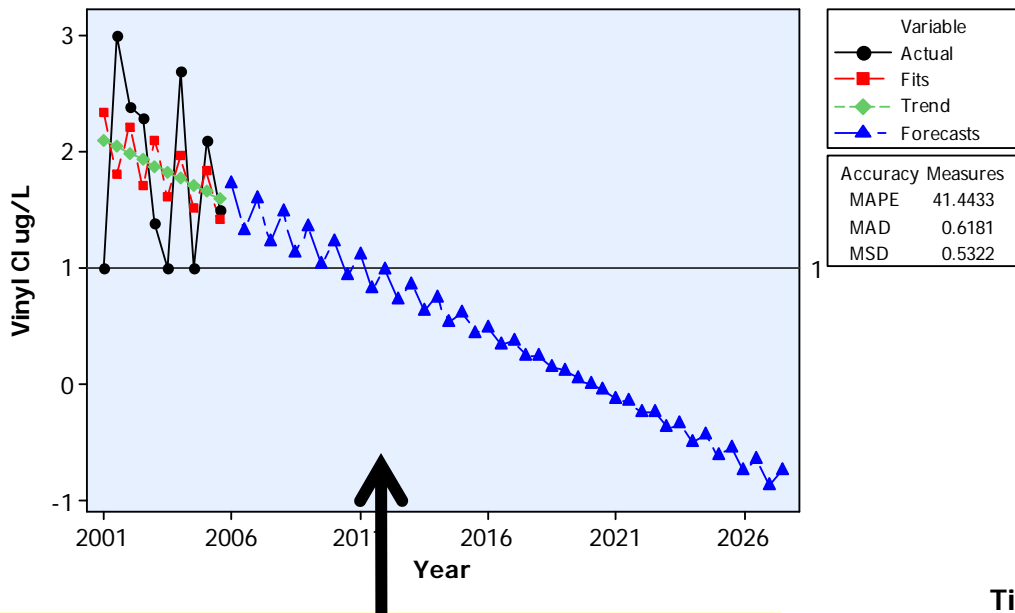
**Ammonia**  
Projections indicate decrease  
Observations indicate steady trend

**Benzene**  
Projections indicate decrease  
Observations indicate steady trend



**Time Series Decomposition Plot for Vinyl Chloride**

Multiplicative Model



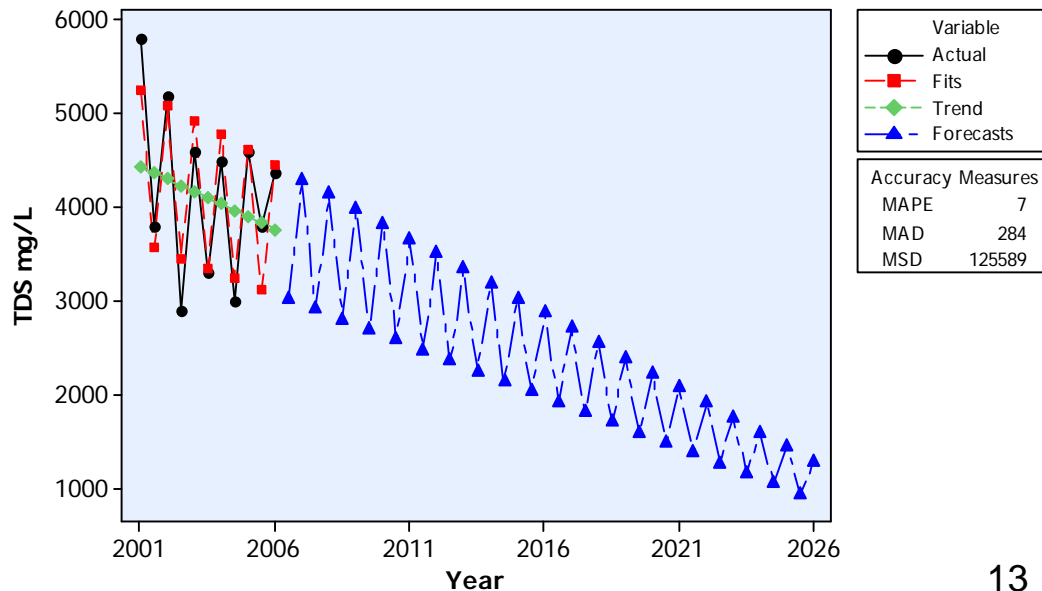
MCL will be reached in 2012

# *Vinyl Chloride and TDS*

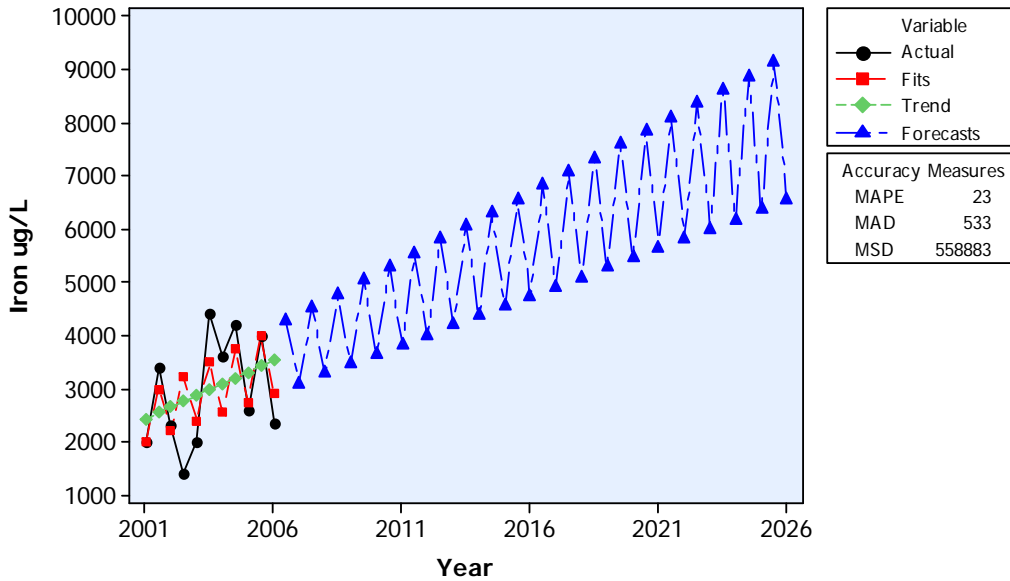
## *Trend and Forecast*

**Time Series Decomposition Plot for TDS**

Multiplicative Model



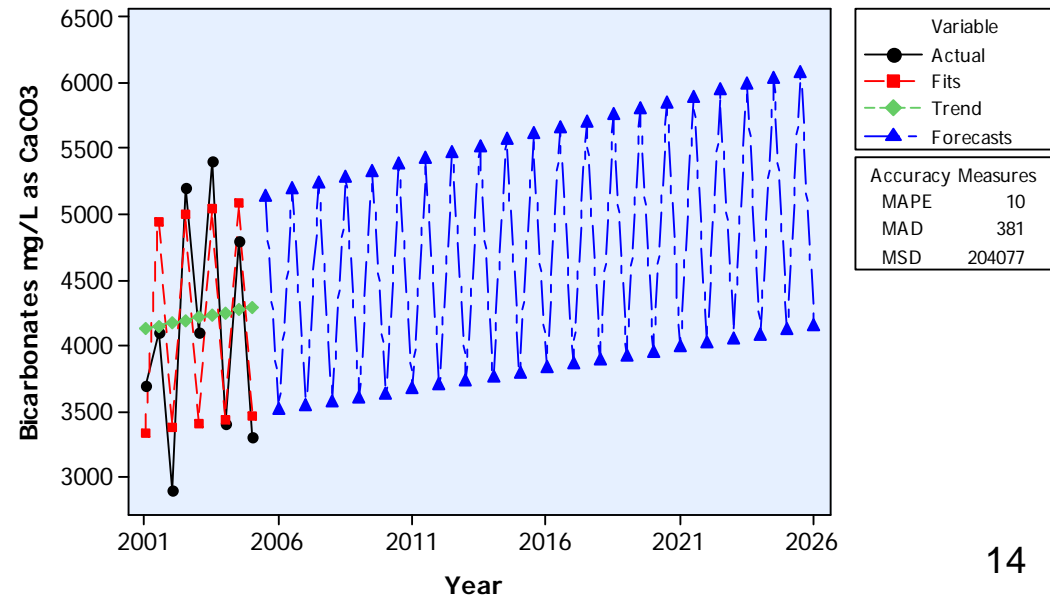
**Time Series Decomposition Plot for Iron**  
Multiplicative Model



# *Iron and Bicarbonate Trend and Forecast*

**Iron and Bicarbonate have increasing trend**

**Time Series Decomposition Plot for Bicarbonates**  
Multiplicative Model

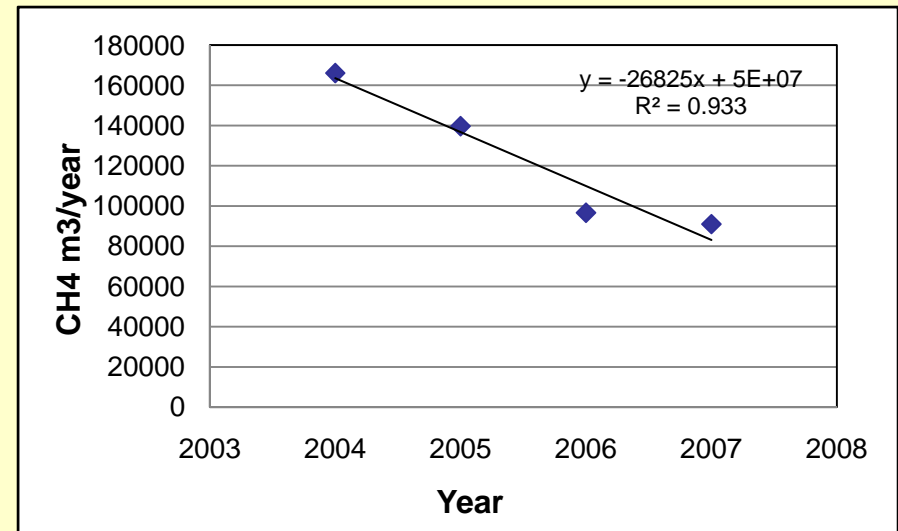
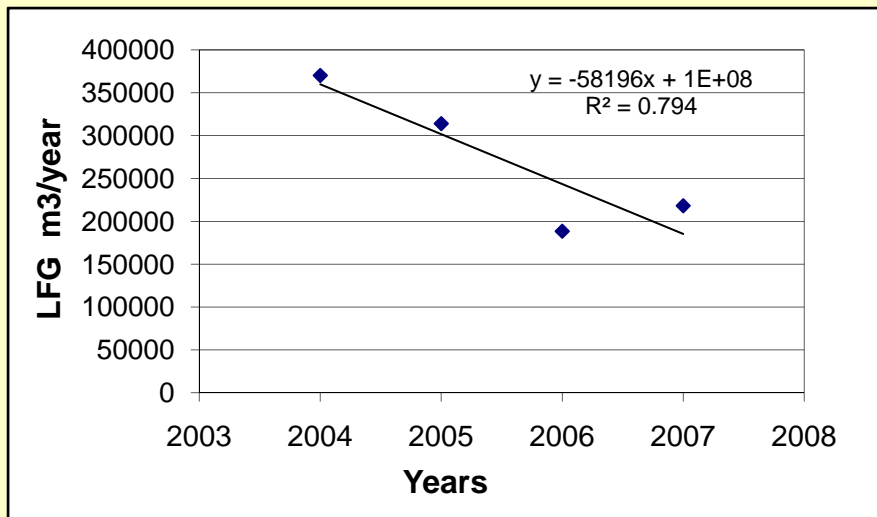


# *Recommendations for Leachate Monitoring*

- Significantly reduce or stop the monitoring frequency for **non detected parameters**
- Reduce monitoring frequency for parameters **below MCL limits**
- Continue monitoring parameters **above MCL limits**
- Refine projections of parameters above MCL limits as more data became available

# Landfill Gas Projections

- Data available from 2004-2008
- No graphical prediction for Total LFG and Current LFG to calculation of remaining LFG
- Use LANDGEM to find closest numbers for real LFG/year and CH<sub>4</sub> quantity



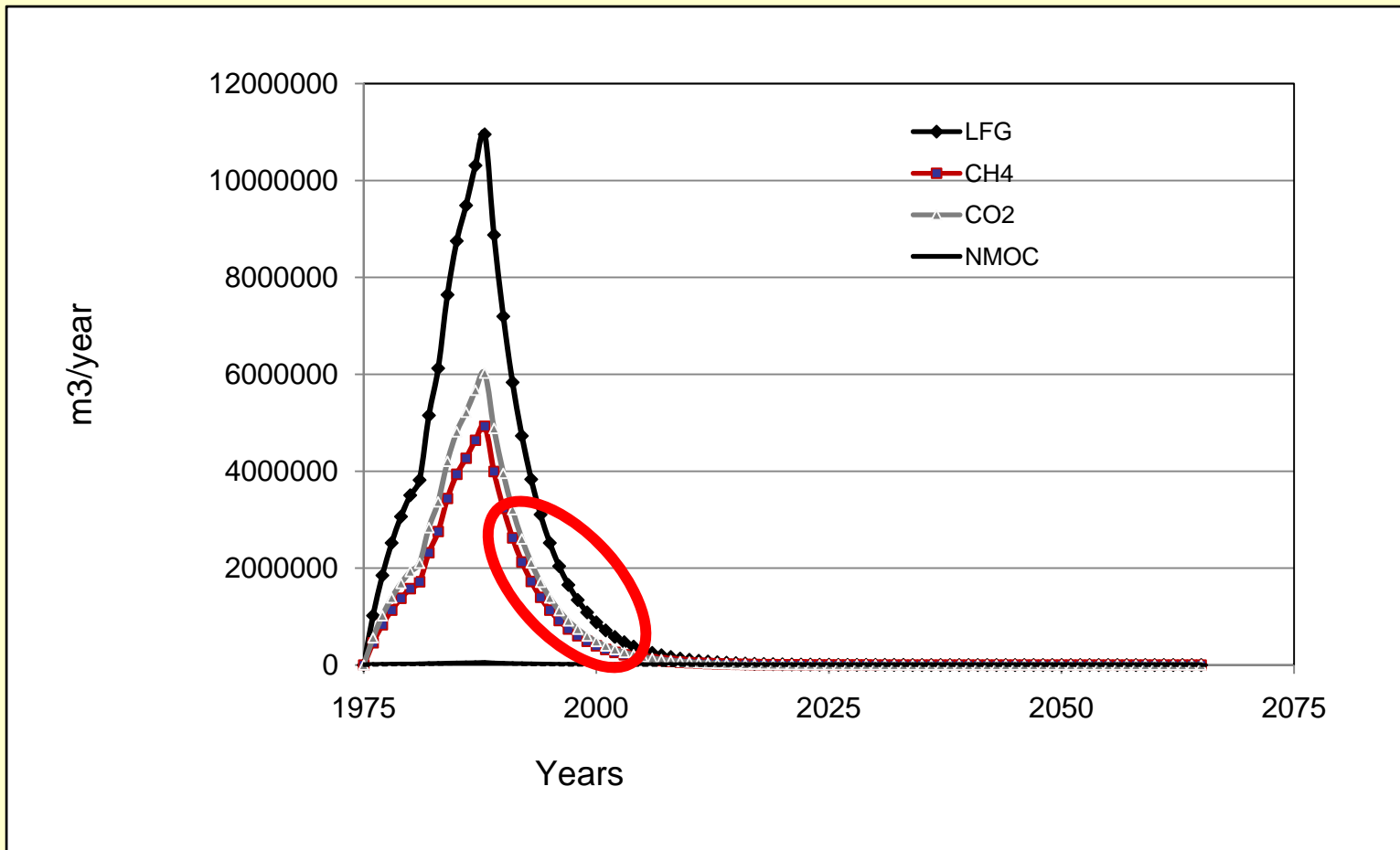
# *Comparison LANDGEM and Real Data*

- Run the LANDGEM for closest value for the real data
- **k: 0.21** 1/year
- **Lo: 22** m3/MG
- Methane content **45%**

Years	Real Data LFG m3/year	CH4 m3/year	LANDGEM LFG m3/year	CH4 m3/year	CH4 % Difference	LFG %Difference
2004	370232.5	166098.8	380454.1	171204.3	3	2.7
2005	314018.2	139673.8	308390.1	138775.5	0.6	1.8
2006	188392.5	96618.44	249976.1	112489.3	14.1	24.6
2007	218121.6	91035.01	202626.7	91182.03	0.2	7.6

# *LFG Results*

- Total gas values calculated from Landgem model.
- Model estimates total LFG and current LFG, remaining LFG is 0.5%
- After the year 2032 total LFG projected to be below 1000 m<sup>3</sup>/year



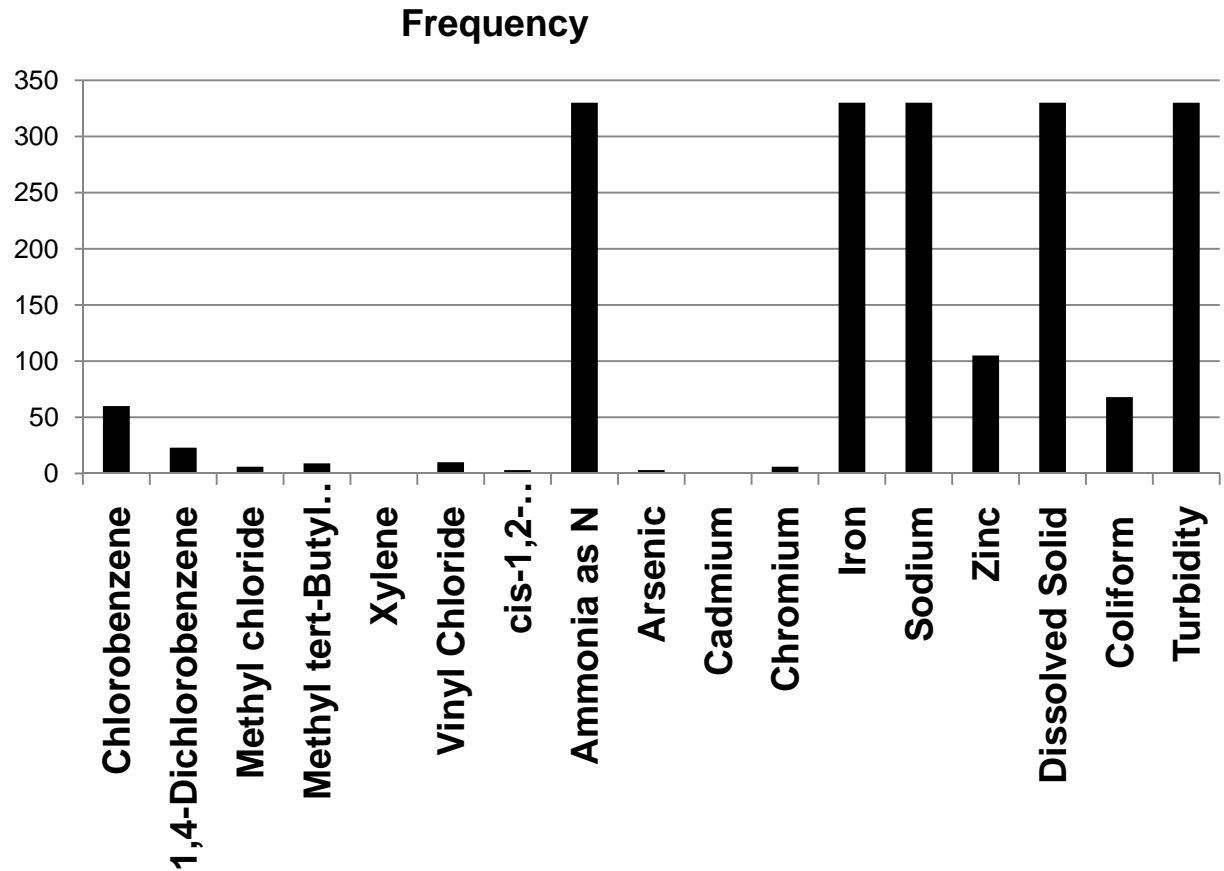
# *Groundwater Monitoring*

- There are 22 GW monitoring wells.
- The monitoring frequency is biannual. (April and September) .
- Total 53 parameter are monitored.
- Available data are from April 2001 to April 2008.
- 35 parameters organic compounds
- 11 parameters inorganic compounds.
- 32 parameters non detected parameters
- 5 parameters above MCL limits
- 11 parameters below MCL limits  
(however, public health concern)

<b>Below MCL</b>	<b>Above MCL</b>
1,4-Dichlorobenzene	Sodium
Chlorobenzene	Iron
1,2-Dichloroethylene	Total Dissolved Solids
Methyl Chloride	Ammonium as N
Xylenes	Vinyl Chloride
Methyl-tert-butyl ether (MTBE)	Coliform
Arsenic	
Cadmium	
Chromium	
Zinc	

# *Detection Frequency of Contaminants of Concern from 22 GW monitoring wells, monitored biannually*

Compound	Frequency
Chlorobenzene	60
1,4-Dichlorobenzene	23
Methyl chloride	6
Methyl tert-Butyl Ether	9
Xylene	1
Vinyl Chloride	10
cis-1,2-Dichloroethylene	3
Ammonia as N	330
Arsenic	3
Cadmium	1
Chromium	6
Iron	330
Sodium	330
Zinc	105
Dissolved Solid	330
Coliform	68
Turbidity	330



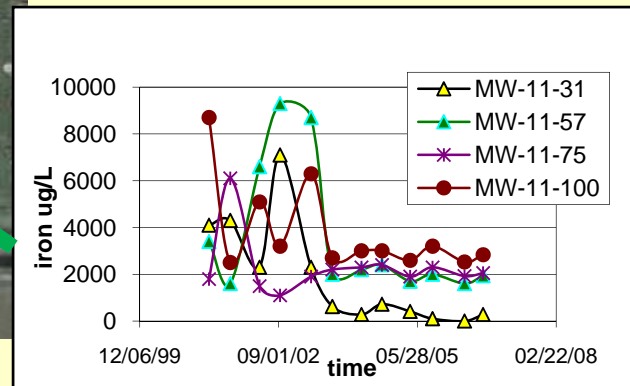
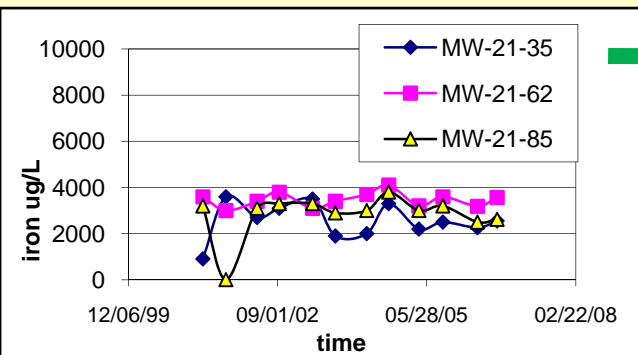
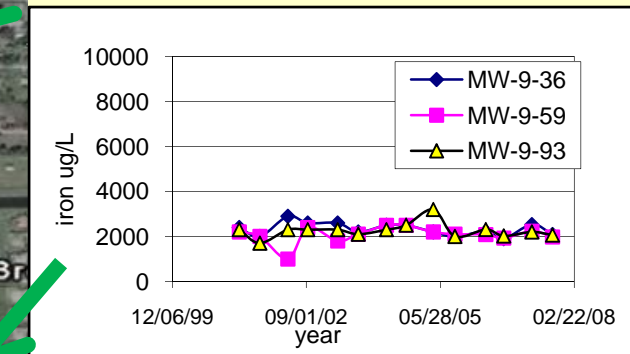
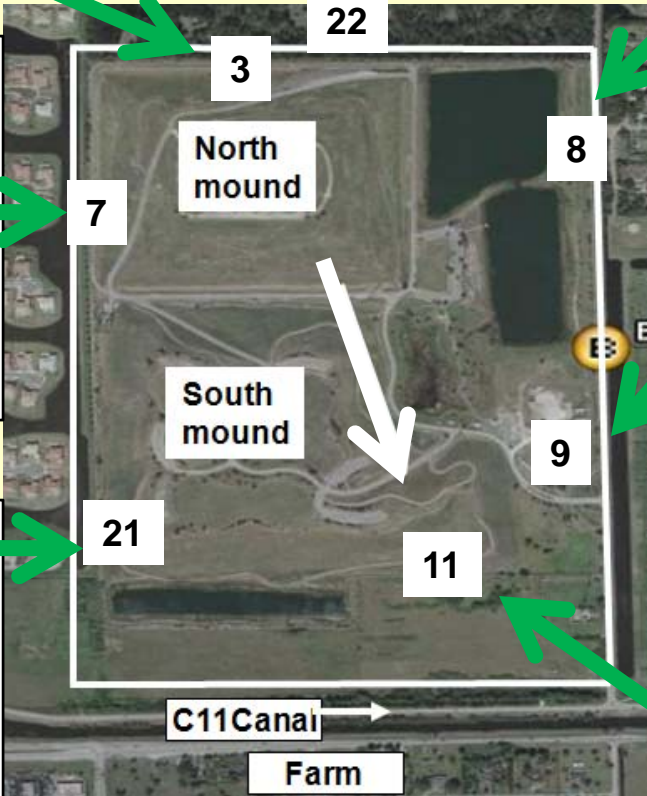
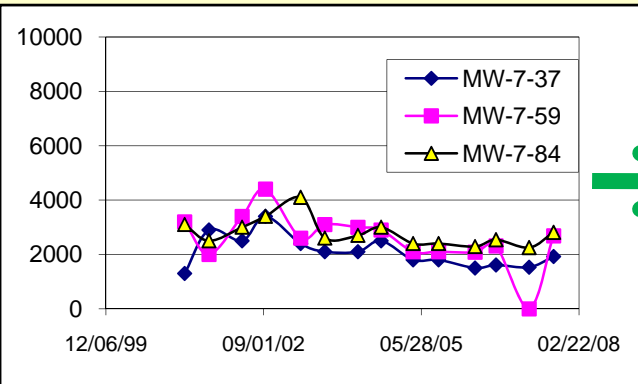
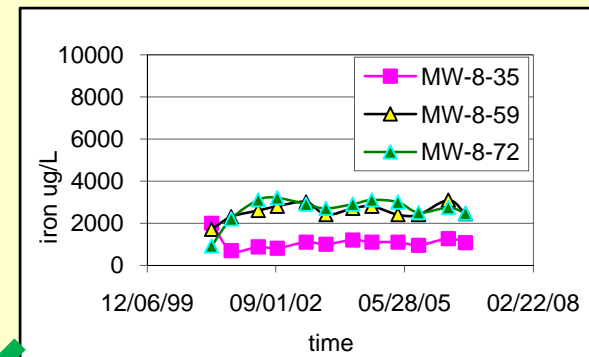
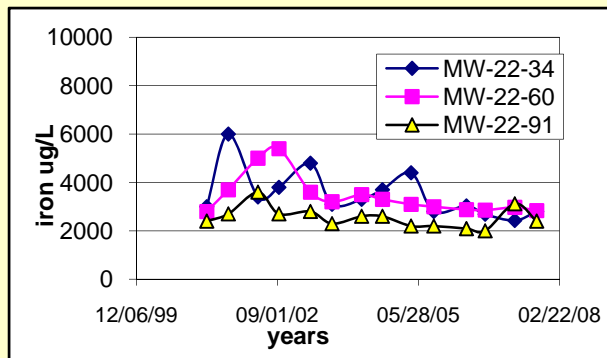
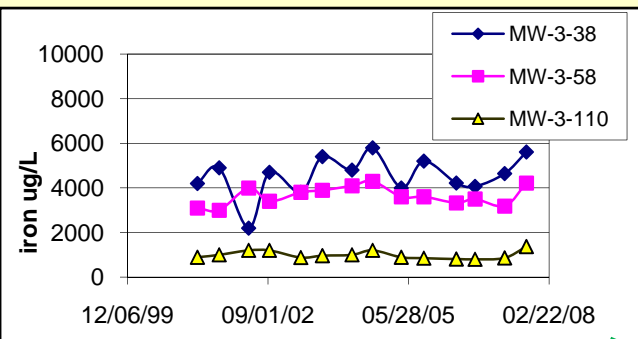
# *Most Frequently Detected Parameters for each well always above MCL*

- Iron
- Ammonia as N
- TDS
- Sodium
- Turbidity

Monitored in all GW wells



# IRON



# Parameters below MCL for each well -Organics

**GW 3-38**

Chlorobenzene  
1,4-Dichlorobenzene  
Methyl chloride  
Methyl tert-Butyl Ether  
Xylene

**GW 3-58**

Chlorobenzene  
1,4-Dichlorobenzene  
Methyl chloride  
Methyl tert-Butyl Ether

**GW 22-34**

Methyl chloride  
Methyl tert-Butyl Ether

**GW 22-34**

Methyl tert-Butyl Ether

**GW 7-37**

Chlorobenzene

**GW 7-59**

Chlorobenzene  
1,4-Dichlorobenzene  
Methyl chloride  
Methyl tert-Butyl Ether

**GW 7-84**

Methyl tert-Butyl Ether

**GW 21-35,62,85**

No organics

**GW 8-35,59,72**

No organics

**GW 9-93**

Chlorobenzene  
1,4-Dichlorobenzene

**GW 11-31**

Methyl chloride

**GW 11-100**

Chlorobenzene  
1,4-Dichlorobenzene  
Methyl chloride  
Vinyl Chloride  
cis-1,2-Dichloroethylene

**GW 11-57**

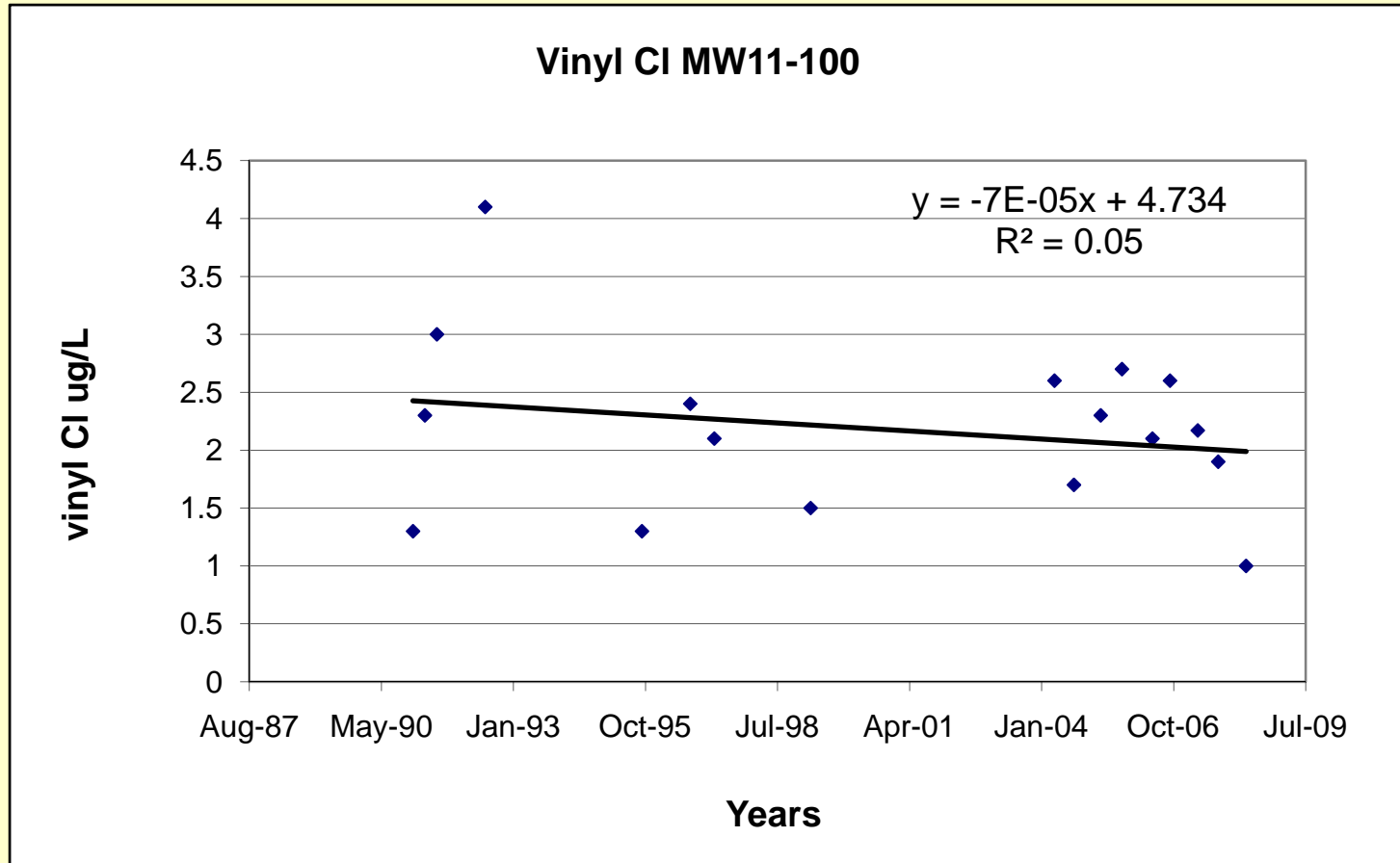
Chlorobenzene  
Vinyl Chloride

**GW 11-75**

Chlorobenzene  
Methyl chloride

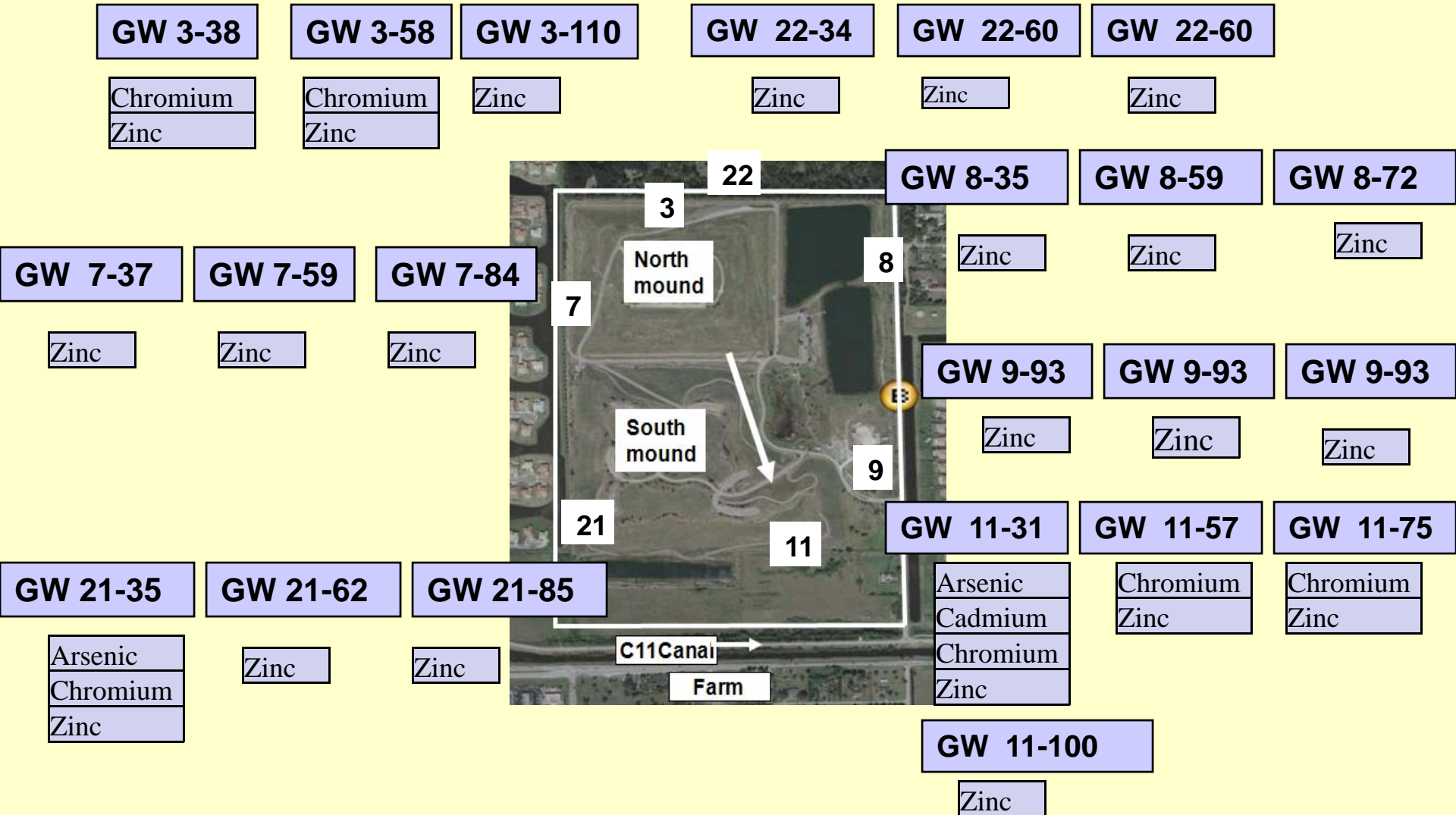


# *Vinyl Chloride*



**Observations indicate steady trend**

# Parameters below MCL for each well - Metals



# *Recommendations for GW Monitoring*

- Significantly reduce or stop the monitoring frequency for **non detected parameters**
- Reduce monitoring frequency for
  - Methyl chloride
  - Methyl tert-Butyl Ether
  - Xylene
  - 1,2-Dichloroethylene
  - Chromium
- Continue monitoring parameters for **above MCL limits and**
  - Chlorobenzene
  - 1,4-Dichlorobenzene
  - Vinyl Chloride
  - Cadmium
  - Arsenic
  - Zinc
- Refine projections of parameters above MCL limits as more data became available

# *Anticipated Outcome*

*The outcome of the project will be a PCC period guidance document incorporating risk assessment for Florida landfills.*

*Thank you*