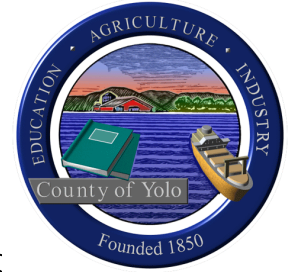


Intercontinental Landfill Research Symposium



October 13-16, 2002, Asheville, N.C., USA



Yolo County's Accelerated Anaerobic and Aerobic Composting (Full-Scale Controlled Landfill Bioreactor) Project

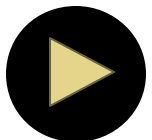
Ramin Yazdani, Project Manager

Yolo Count Planning and Public Works Department

Division of Integrated Waste Management

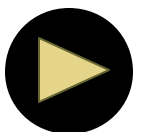
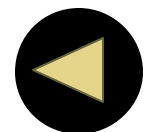
Ramin.Yazdani@yolocounty.org (530) 666-8848

1/21/2003



Presentation

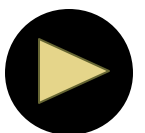
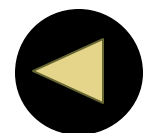
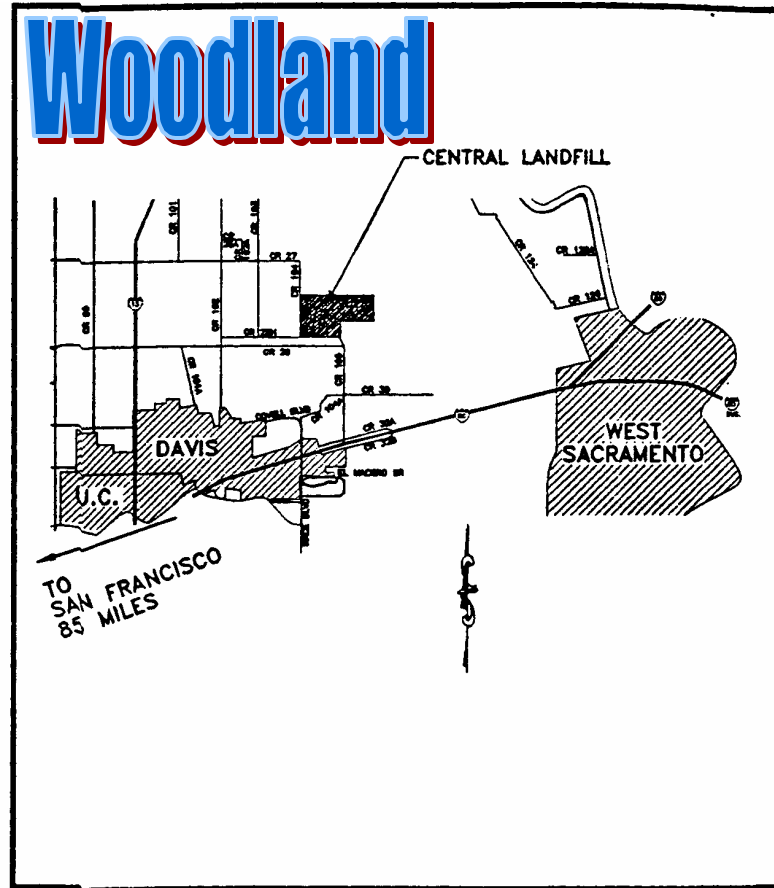
- **Project Site**
- **Design differences**
- **Project partners**
- **Project Goals and Objectives**
- **Achievements to Date**
- **Design and Construction Challenges**
- **Economics**
- **Future Tasks**
- **Conclusions**



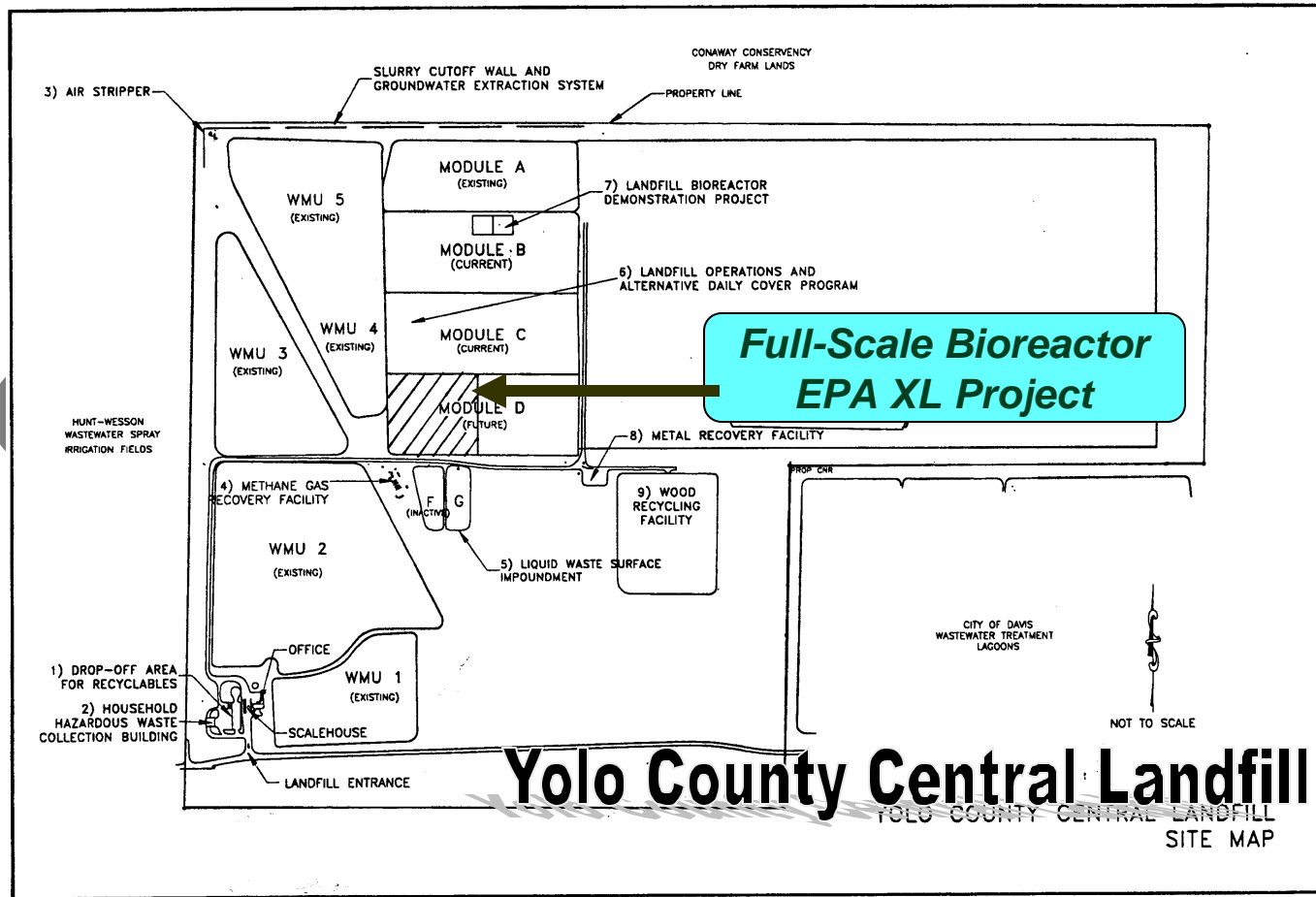
Project Location Map

LOCATION MAP

California

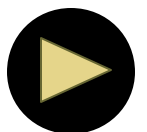
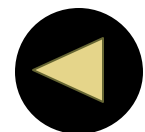
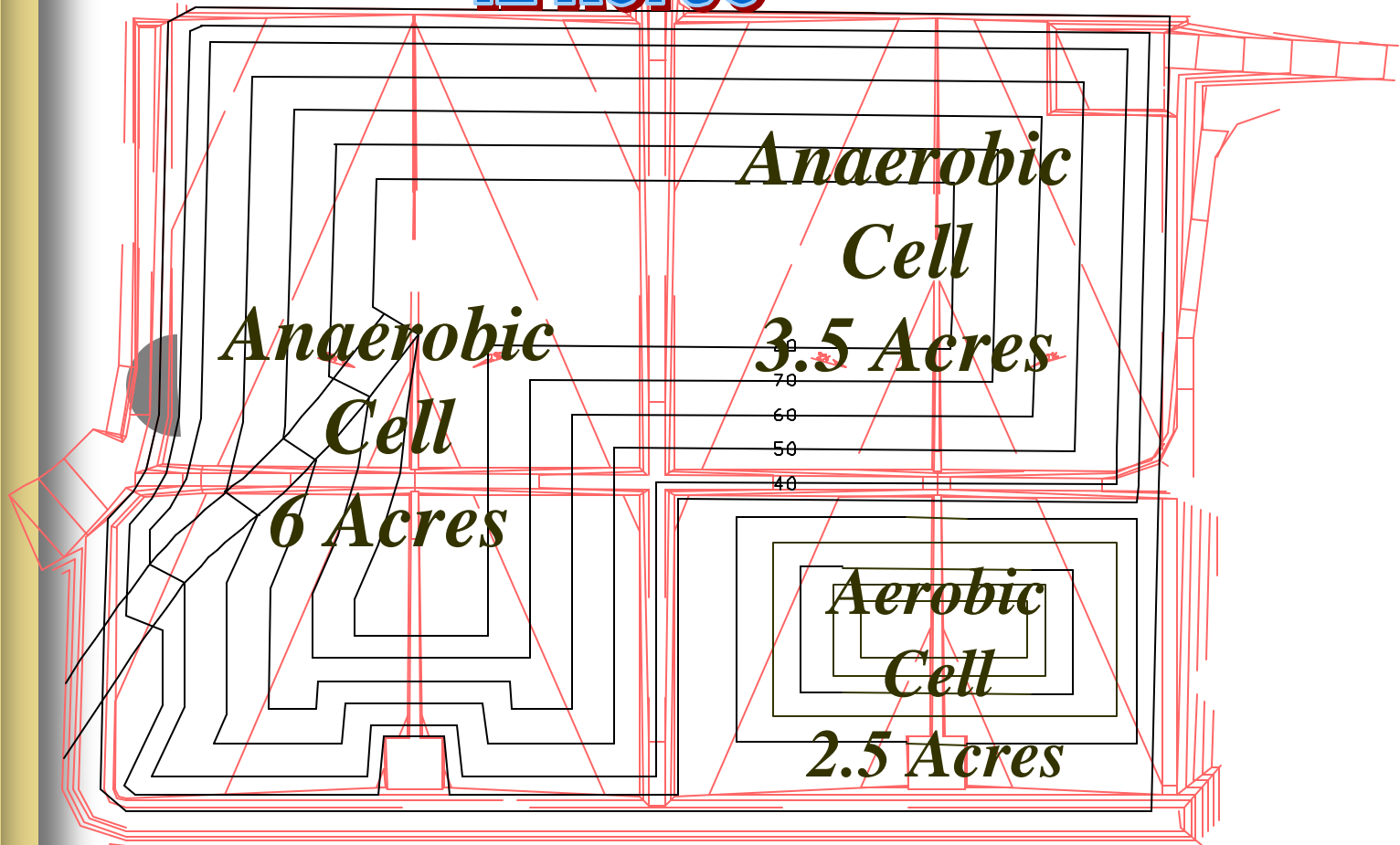


Project Site Map



Project Site Map

12 Acres



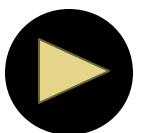
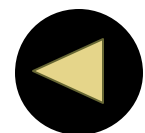
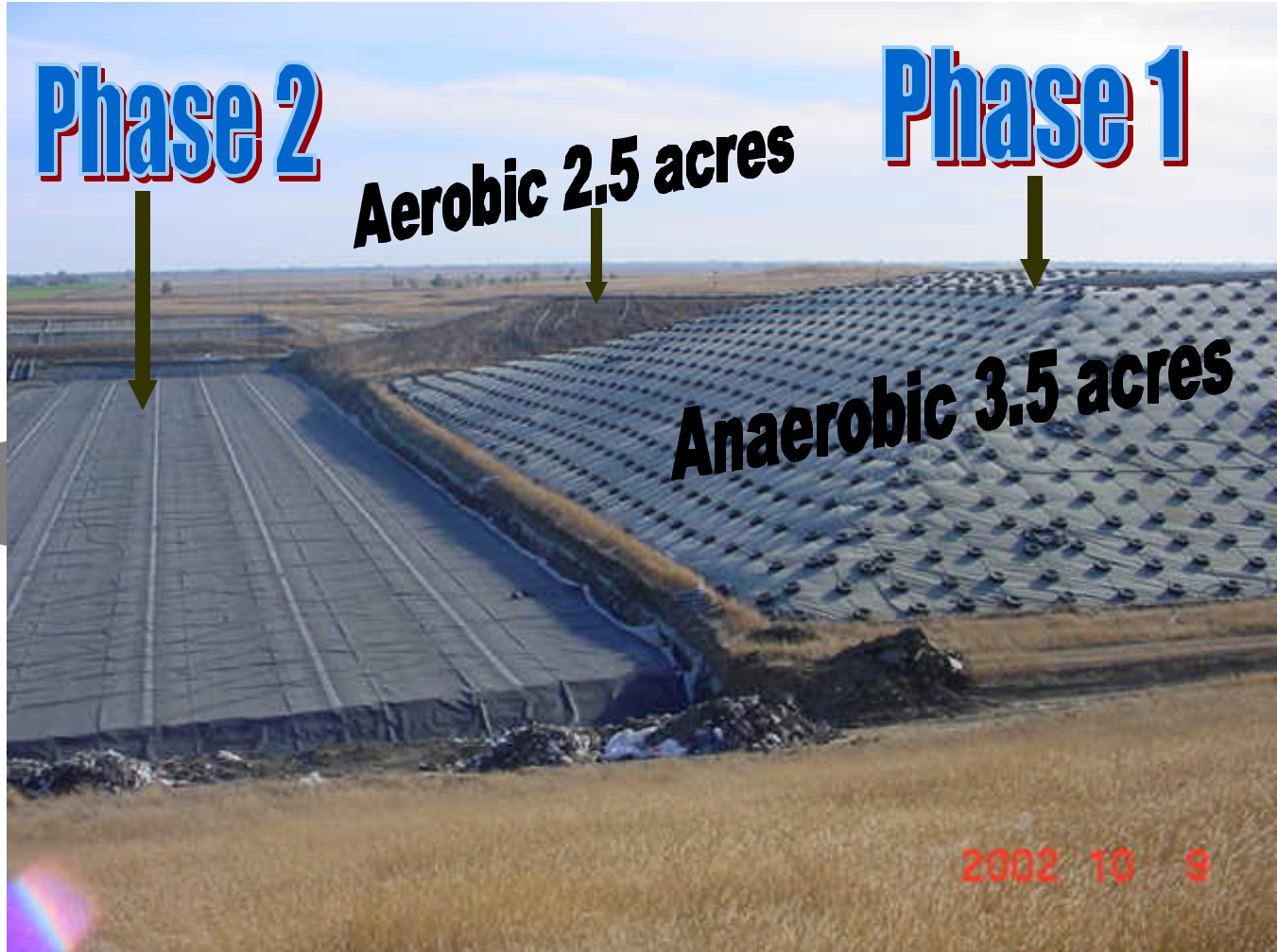
Project Phase 1 & 2

- **Phase 2**

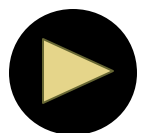
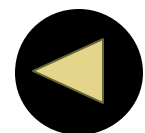
Aerobic 2.5 acres

Phase 1

Anaerobic 3.5 acres

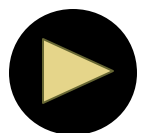
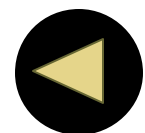


Project Site Map



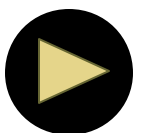
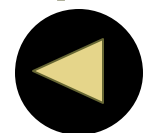
Design Differences from a Conventional Landfill

- **Primary composite liner better than Subtitle D and CA Title 27 prescriptive standards**
- **Clay permeability better (6×10^{-9} cm/sec) than 1×10^{-7} cm/sec**
- **Secondary containment (40 mil HDPE) to protect groundwater**
- **Leak testing of primary liner system to locate pin holes**



Design Differences from a Conventional Landfill

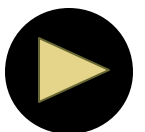
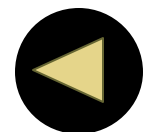
- **No soil cover used within the waste mass as daily or intermediate cover**
- **Horizontal gas collection system installed at 40 to 80 feet at each lift**
- **Install pressurized horizontal leachate injection lines within the same trench as the gas collection system**
- **Install temperature, pressure transducers, tubes, and moisture sensors to collect real time data**
- **Use real time monitoring (SCADA) system**



Project Partners & Funding

● Project Partners:

- Yolo County-DIWM (\$2,753,000)
- California Energy Commission-PIER (\$1,154,250)
- National Energy Technology Laboratory, U.S. DOE (\$563,000)
- California Integrated Waste Management Board (\$400,000)
- Institute for Environmental Management (Tech. Support)
- U.S. Environmental Protection Agency
- Solid Waste Association of North America
- California State Regional Water Quality Control Board
- California State Water Resources Control Board
- California Air Resources Control Board
- Yolo-Solano Air Quality Management District
- Yolo County Environmental Health



Project Goals and Objectives

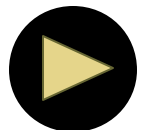
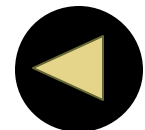
- **Collect technical and economic data to demonstrate full-scale operation as beneficial**
- **Provide technical solution to permitting and regulatory constrains in the commercialization of this technology**
- **U.S. EPA XL project (“eXcellence and Leadership”)**



Regulatory Requirements

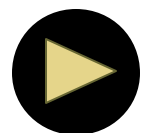
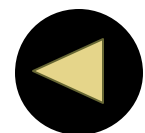
● What is EPA Project XL?

- Project XL, stands for “eXcellence and Leadership”
- It is a national pilot program that tests innovative ways of achieving better and more cost-effective public health and environmental protection
- Under EPA Project XL Yolo County can obtain state and federal regulatory flexibility to implement innovative Full-scale Bioreactor
- The goal is to engage those parties affected by environmental regulations and policies to find solutions that work better than those currently mandated
- What is learned will be applied broadly to improve public health and environmental protection



EPA XL Project Schedule

- Project XL application submitted in 1999
- Permits issued by CA State Agencies-6/2000
- Final Project Agreement signed-9/2000
- Federal rule making completed by EPA-8/2001
- Construction (2000-2002)
- Data collection and reporting (2001-2005)



Project Objectives

- **Full-scale operation to accelerate waste decomposition through liquid addition without liquid head build up over the base liner**
- **Efficient capture of nearly all methane generated without an impact to the local air quality**
- **Document capital and operation's cost of project - commercialization**



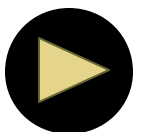
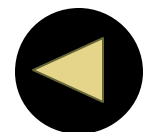
Achievements to Date

- **Construction of base liner system**



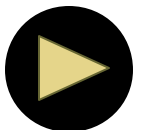
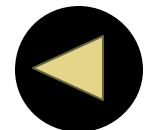
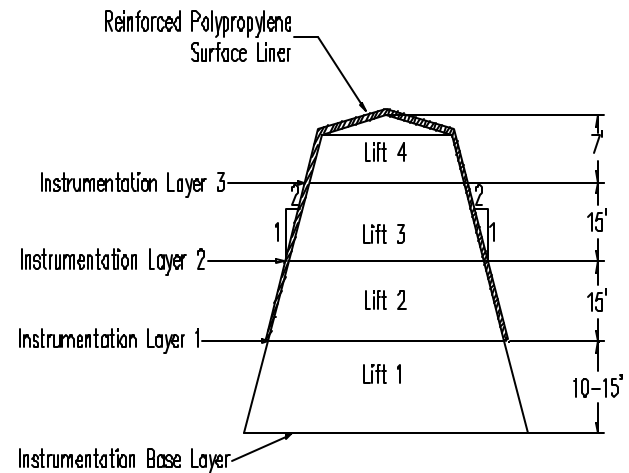
Achievements to Date

- **Construction of landfill waste filling**



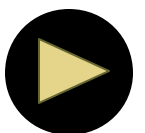
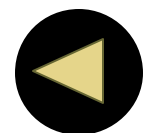
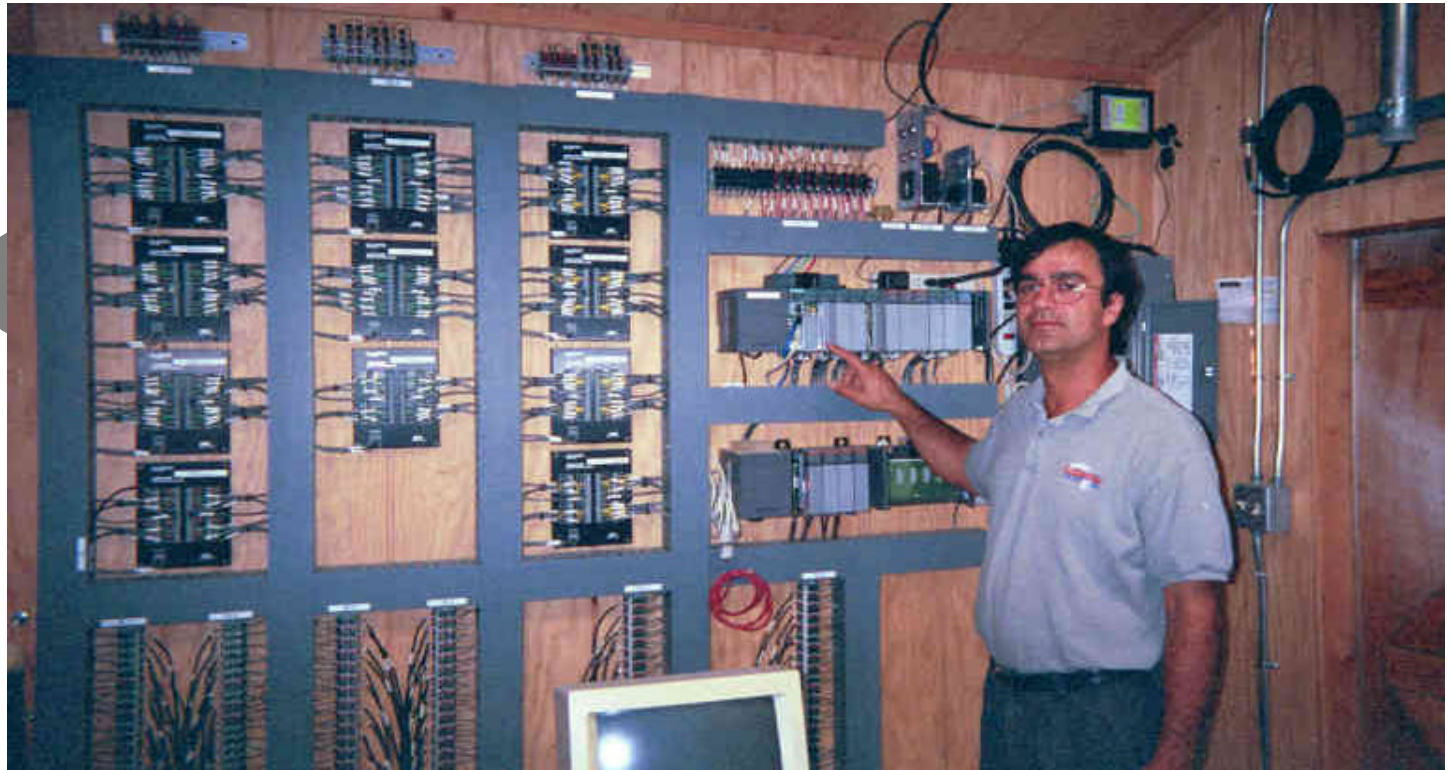
Achievements to Date

- **Construction of the instrumentation system**

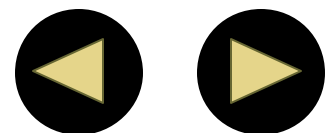
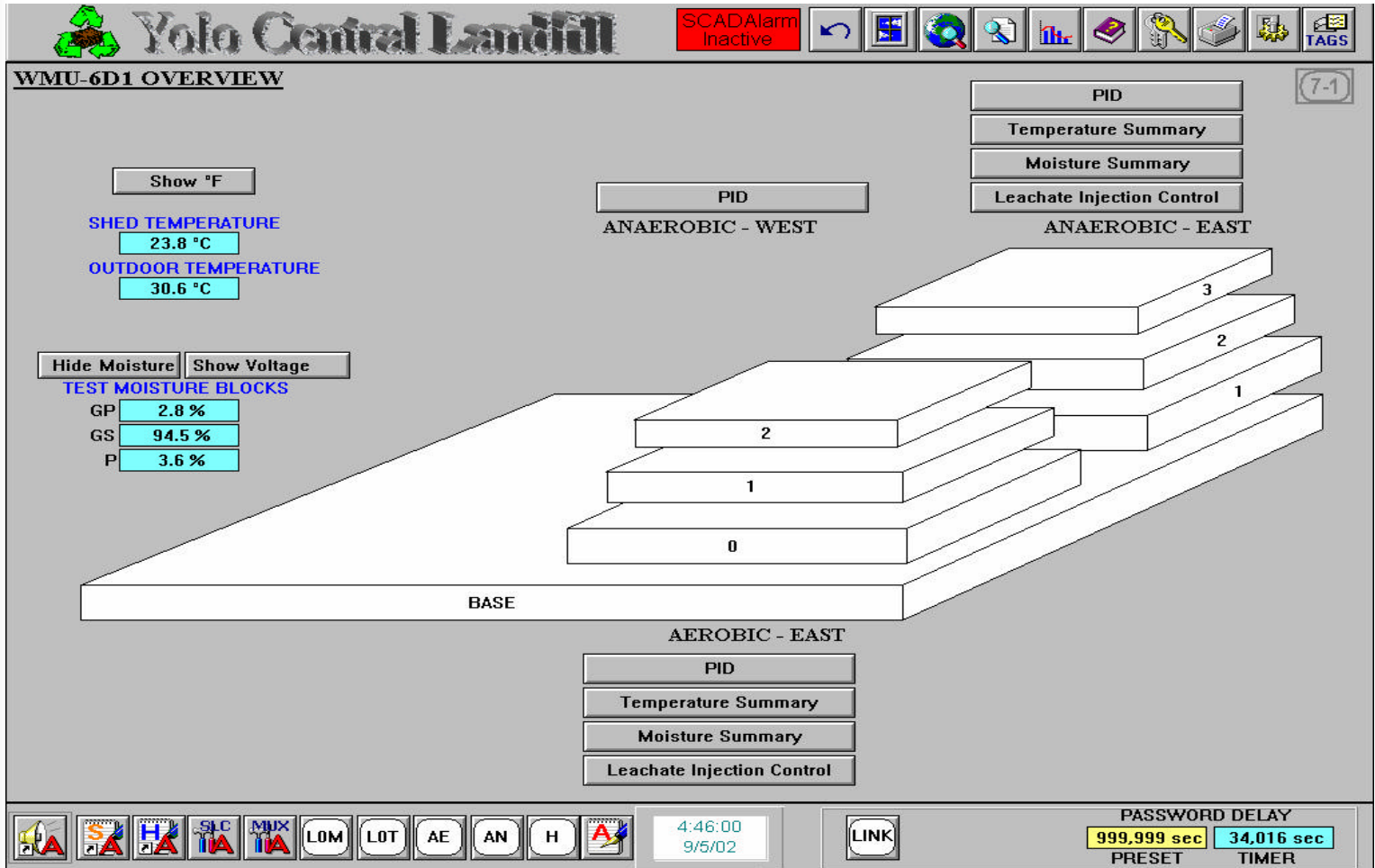


Achievements to Date

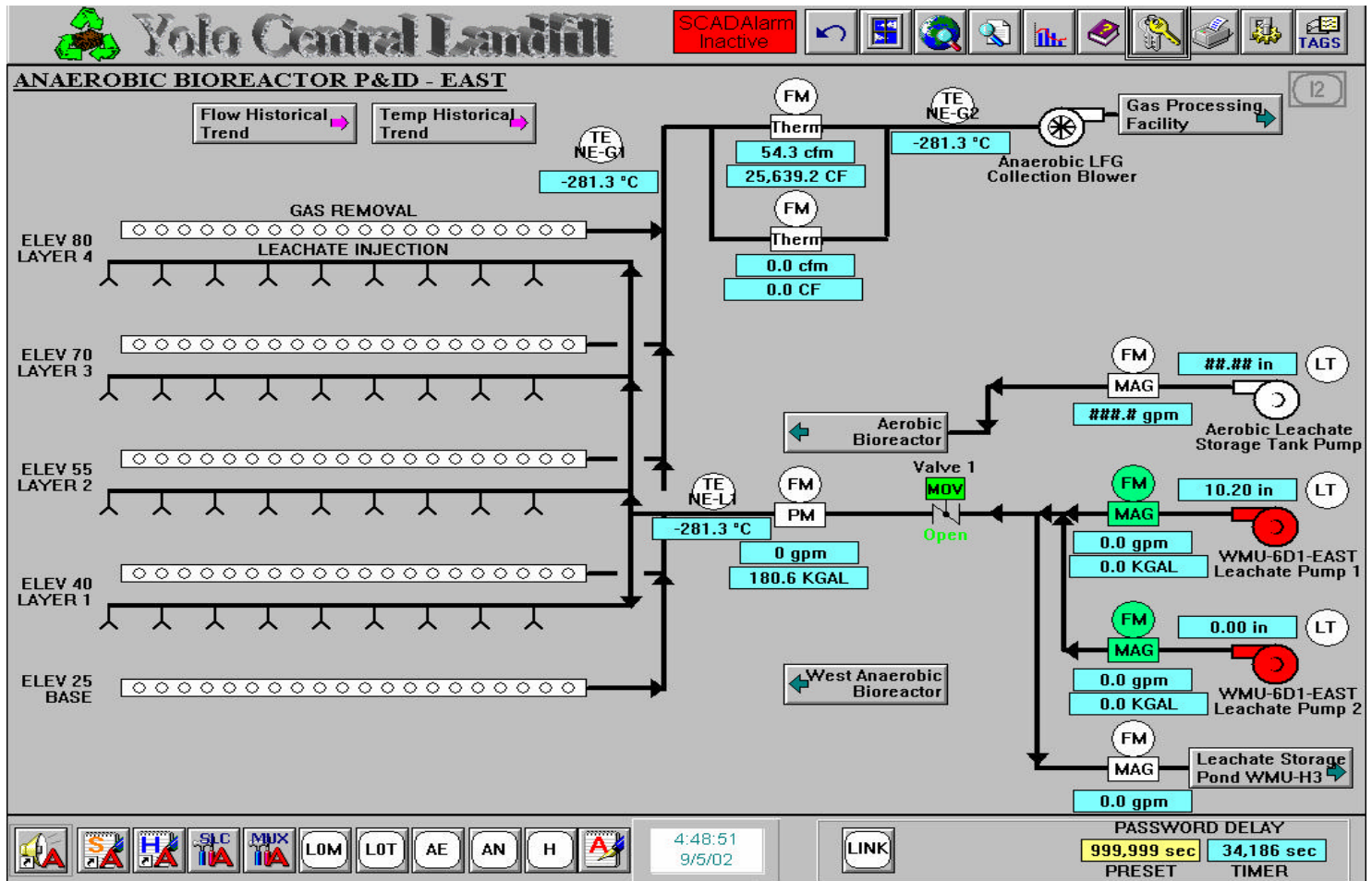
- **Construction of the SCADA System**



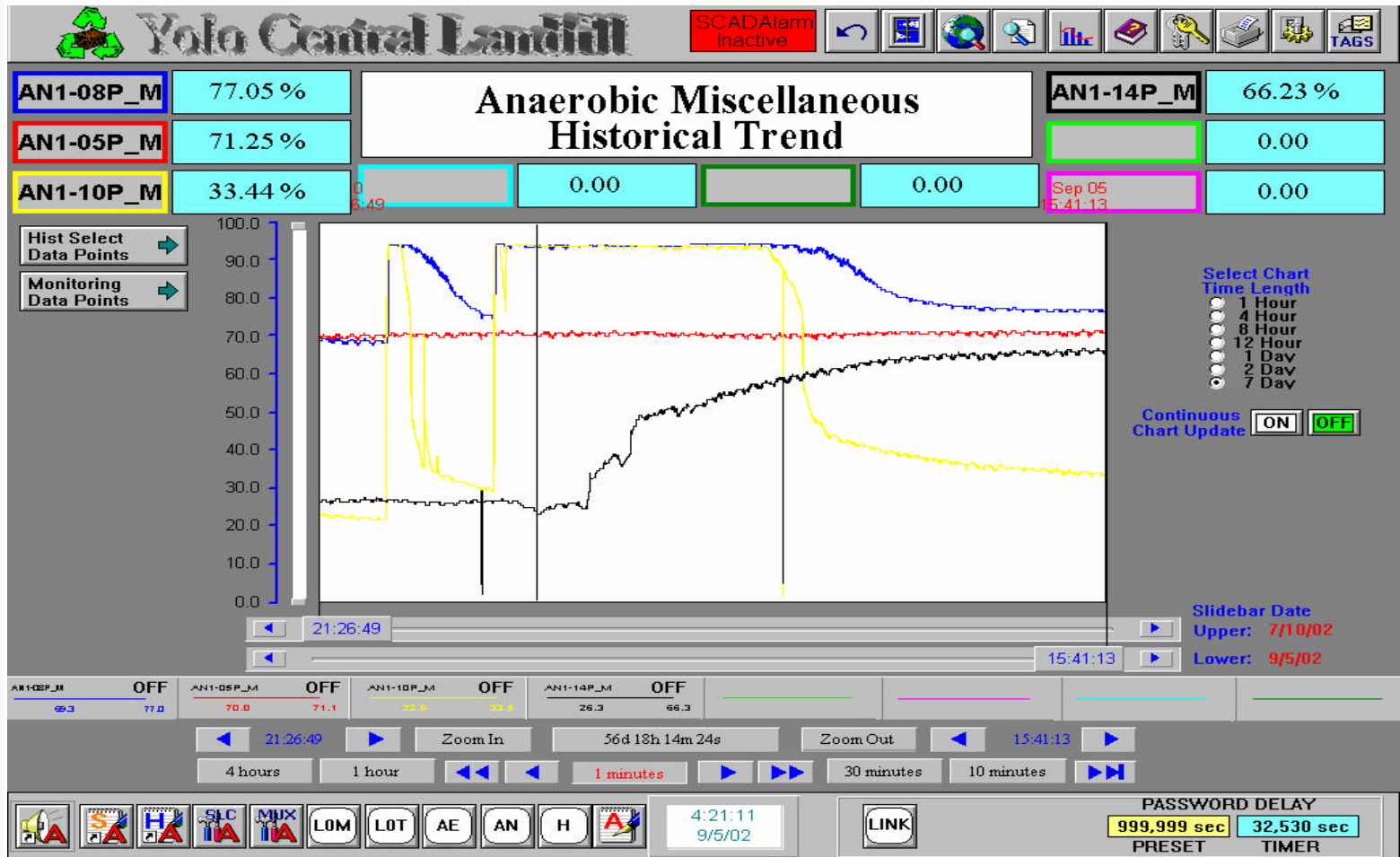
SCADA System for Bioreactor




SCADA-Leachate Injection System



SCADA Real Time Data




SCADA Control for Leachate Injection System



Yolo Central Landfill

SCADA Alarm
Inactive



ANAEROBIC LEACHATE INJECTION CONTROL A


Layer 3 & 4 Control

Max # of Solenoid Valves Open at any Time: **1**

LAYER 1							Central Control			
	Call	Enable/Disable	Schedule A Start Time	Schedule B Start Time	Schedule A&B Duration		Auto/Manual	Manual On/Off		
Valve 1	Close	En Dis	0:00	0:00	0 min		Auto	Manual	ON OFF	
Valve 2	Close	En Dis	0:00	0:00	0 min		Auto	Manual	ON OFF	
Valve 3	Close	En Dis	0:00	0:00	0 min		Auto	Manual	ON OFF	
Valve 4	Close	En Dis	0:00	0:00	0 min		Auto	Manual	ON OFF	
Valve 5	Close	En Dis	0:00	0:00	0 min		Auto	Manual	ON OFF	
Valve 6	Close	En Dis	0:00	0:00	0 min		Auto	Manual	ON OFF	
Valve 7	Close	En Dis	0:00	0:00	0 min		Auto	Manual	ON OFF	
Valve 8	Close	En Dis	0:00	0:00	0 min		Auto	Manual	ON OFF	

LAYER 2							Central Control			
	Call	Enable/Disable	Schedule A Start Time	Schedule B Start Time	Schedule A&B Duration		Auto/Manual	Manual On/Off		
Valve 1	Close	En Dis	0:00	0:00	0 min		Auto	Manual	ON OFF	
Valve 2	Close	En Dis	0:00	0:00	0 min		Auto	Manual	ON OFF	
Valve 3	Close	En Dis	0:00	0:00	0 min		Auto	Manual	ON OFF	
Valve 4	Close	En Dis	0:00	0:00	0 min		Auto	Manual	ON OFF	
Valve 5	Close	En Dis	0:00	0:00	0 min		Auto	Manual	ON OFF	
Valve 6	Close	En Dis	0:00	0:00	0 min		Auto	Manual	ON OFF	
Valve 7	Close	En Dis	0:00	0:00	0 min		Auto	Manual	ON OFF	

SLC Time: **0:00**



4:47:01
9/5/02

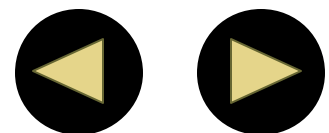
LINK

PASSWORD DELAY

999,999 sec

34,077 sec

PRESET TIMER



SCADA- Real Time Data Export to Database

Yolo Central Landfill SCADA Alarm Inactive

HISTORICAL DATA EXPORT B - ANAEROBIC TEMP

Base Layer Historical Dump Anaerobic Moist Historical Dump

Press Button to Select Tagnames

1 Start Date
Year has to be between 1997 and 2030!
Month: 09, Day: 04, Year: 2002

2 Duration Time
5
Minutes

3 Interval Time
1
Minutes
Max 4 Weeks

4 Start Time 5:00 p.m.

5 Filename (8 Letter Max)
C:\TEMP\ZTEMP.CSV

Setup Summary

Start Date	Start Time	Duration	Interval
09/04/02	17:00:00	5m	1m

tags selected 0
"\$DATE,\$TIME"
...
...

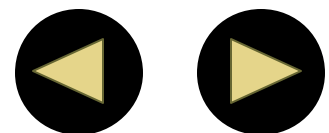
EXPORT HISTORICAL FILES

1. SELECT START DATE (MONTH, DATE, YEAR).
2. SELECT DURATION TIME UNITS, THEN TIME.
3. SELECT INTERVAL TIME UNITS, THEN TIME.
4. SELECT START TIME.
5. SELECT DIRECTORY & FILENAME TO SAVE TO.
6. SELECT TAGNAMES TO EXPORT. (8 MAX).
7. PRESS "EXPORT" BUTTON.
8. TO CLEAR SELECTED TAGS, PRESS "RESET".

7 EXPORT **8 RESET**

4:49:54 9/5/02 LINK

PASSWORD DELAY
999,999 sec 34,249 sec
PRESET TIMER



Yolo Bioreactor Home Page

BLMS-HOME - Microsoft Internet Explorer

Bioreactor Landfill Monitoring System

Division of Intergrated Waste Management, Planning and Public Works, County of Yolo, California

- [Produce Graphical Report](#)
- [Generate XY Graph \(2D\)](#)
- [Generate Map](#)
- [Open Grapher](#)
- [Open Surfer](#)
- [Produce Tabular Report](#)
- [Generate Tabular Report](#)
- [Open Crystal](#)
- [Load Data Electronically](#)
- [Wonderware Data](#)
- [Field Parameter](#)
- [Analytical Parameter](#)
- [Survey Data](#)
- [Enter, Update, Query Data](#)
- [Application](#)
- [Reference](#)
- [About](#)
- [BLMS](#)
- [Bioreactor Landfill Project](#)
- [Project Team](#)
- [Exit](#)
- [Home](#)



The Yolo County Central Landfill is demonstrating an innovative landfill management strategy called "enhanced or controlled" landfilling to manage solid waste. Controlled landfilling has the potential to provide reliable energy generation from solid waste, as well as significant environmental and solid waste management benefits such as reduced pollution threat, reduction of greenhouse gas emissions, landfill life extension, and reduced post-closure maintenance.



Yolo Bioreactor-Web Based Data Extraction and Graphing

BLMS-HOME - Microsoft Internet Explorer

Bioreactor Landfill Monitoring System

Division of Intergrated Waste Management, Planning and Public Works, County of Yolo, California

Produce Graphical Report
Generate XY Graph (2D)
Generate Map
Open Grapher
Open Surfer
Produce Tabular Report
Generate Tabular Report
Open Crystal
Load Data Electronically
Wonderware Data
Field Parameter
Analytical Parameter
Survey Data
Enter, Update, Query Data
Application
Reference

Generate XY Graph

How To ?

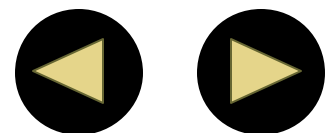
Parameter: Location: or Area: or

StartDate: EndDate:

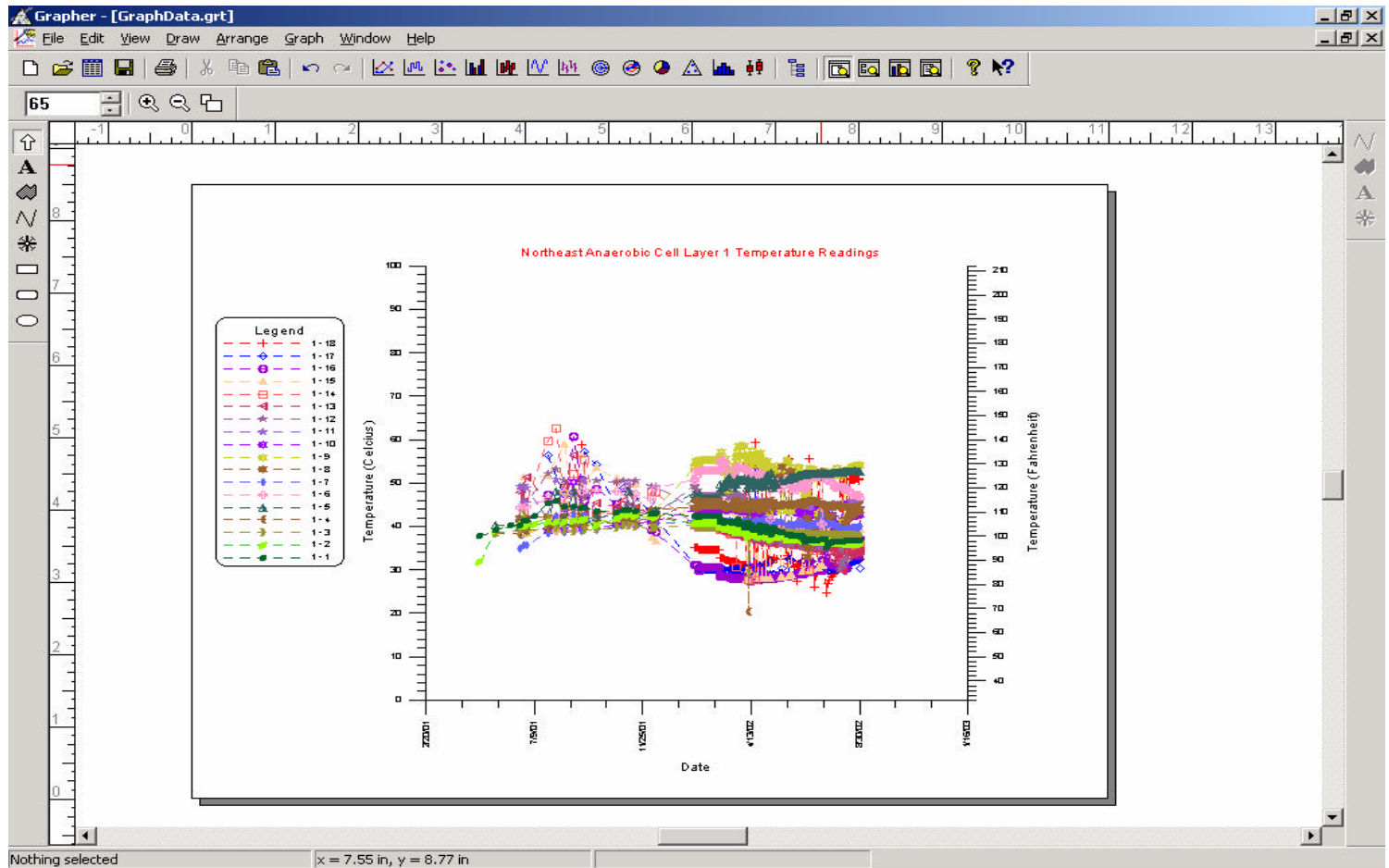
Other available files. Double click on file name to generate XY Graph.

GP-MOISTURE_AN2GPM_Mar1302_Apr1802.txt	2235	7/22/02	4:56:21 PM	
GS-MOISTURE_AN2GSM_Mar1302_Apr1802.txt	2458	7/22/02	4:56:21 PM	
MOISTURE_C1M_Nov2201_Dec601.txt	720	7/22/02	4:56:22 PM	
MOISTURE_C24M_Mar2802_Apr502.txt	0	8/27/02	4:31:50 PM	
MOISTURE_C2M_Jan2802_Jun502.txt	0	8/13/02	4:37:30 PM	
MOISTURE_C2M_Nov2201_Dec601.txt	1347	7/22/02	4:56:22 PM	
MOISTURE_C3M_Nov2201_Dec601.txt	1317	7/22/02	4:56:22 PM	
MOISTURE_CTLCell_Nov2201_Dec601.txt	543	7/22/02	4:56:22 PM	
MOISTURE_E1M_Nov2201_Dec601.txt	697	7/22/02	4:56:22 PM	
MOISTURE_E2AM_Nov2201_Dec601.txt	954	7/22/02	4:56:22 PM	
MOISTURE_E2M_Nov2201_Dec601.txt	2006	7/22/02	4:56:23 PM	
MOISTURE_E3M_Nov2201_Dec601.txt	1941	7/22/02	4:56:23 PM	
MOISTURE_ENHCell_Nov2201_Dec601.txt	683	7/22/02	4:56:23 PM	
PRESSURE_A0P_Mar1202_Apr1902.txt	1043	8/7/02	9:31:26 AM	
PVC-MOISTURE_AE015PVCM_Mar2802_Apr502.txt	277	7/22/02	4:56:24 PM	
PVC-MOISTURE_AE0PVCM_Mar2802_Apr502.txt	339	7/22/02	4:56:24 PM	
PVC-MOISTURE_AE1PVCM_Mar2802_Apr502.txt	1866	7/22/02	4:56:24 PM	
PVC-MOISTURE_AE2PVCM_Mar2802_Apr502.txt	1311	7/22/02	4:56:24 PM	

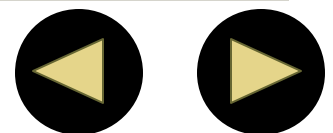
Start | BLMS-HOME - Microsof... | 2:55 PM



Yolo Bioreactor-Sample 2D Graphs from Database

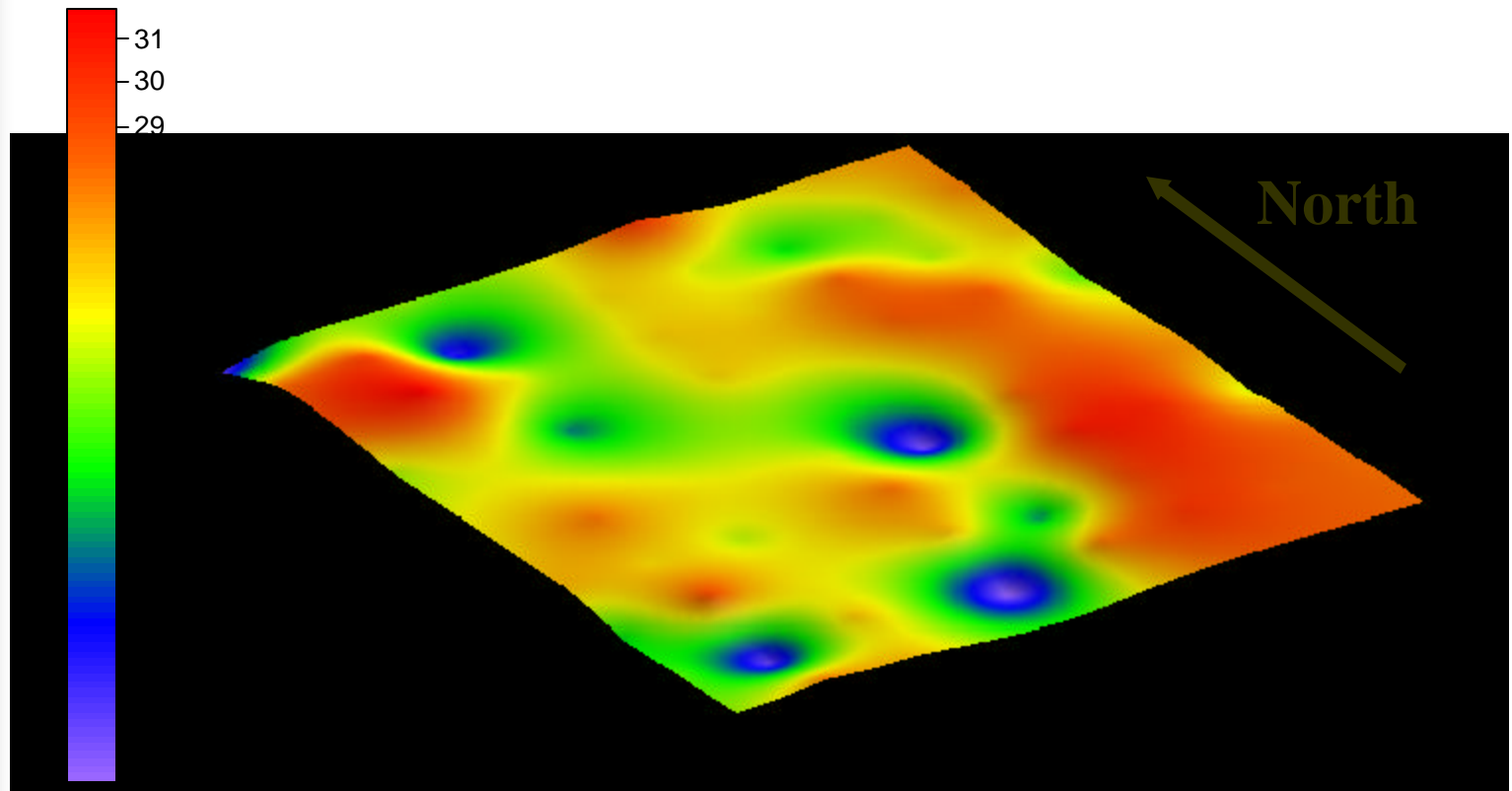


1/21/2003

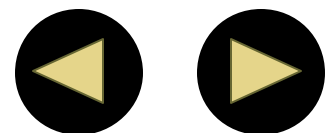


Bioreactor Bottom Liner Temp.

Temperature (degree C)

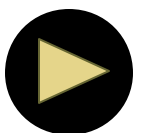
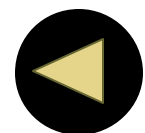


1/21/2003



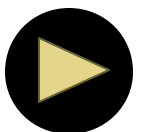
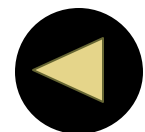
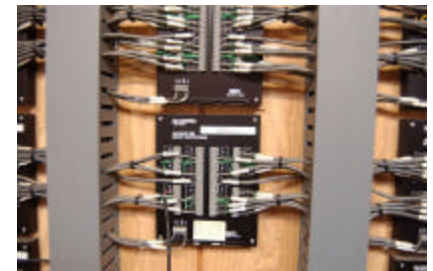
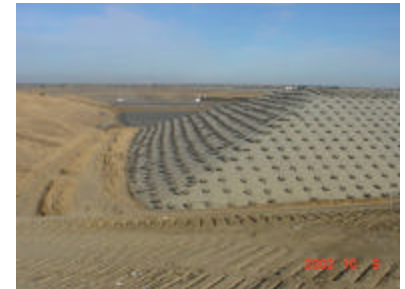
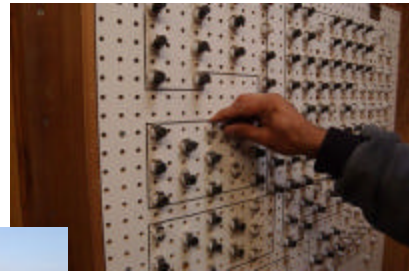
Achievements to Date

- **Construction of landfill gas collection and removal system**



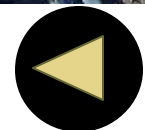
Achievements to Date

- **Collection of 2×10^6 SCF fugitive landfill gas (45% methane) from 3.5 acre anaerobic bioreactor before water addition**



Achievements to Date

- **Construction of leachate recirculation and pumping system**
- **Injected of over 850,000 gallons of leachate in the anaerobic 3.5 acre landfill**



Achievements to Date

- **Construction of final cover system**



1/21/2003

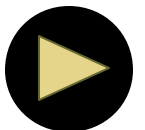
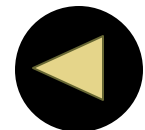


Achievements to Date

- **First waste sampling and testing**



1/21/2003

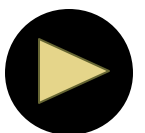
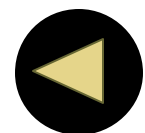


Achievements to Date

- **First waste Settlement Survey**

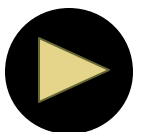
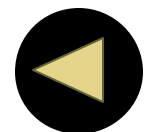


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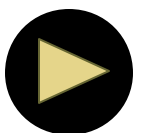
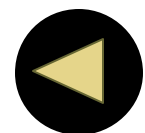
Achievements to Date

- **Fugitive methane emissions monitoring using FID/PID Vapor Analyzer (FOXBORO TVA-1000)**



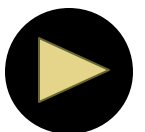
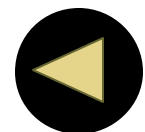
Achievements to Date

- **Landfill gas sampling (LANDTECH GEM-500) and laboratory testing**
- **Leachate sampling and laboratory testing**



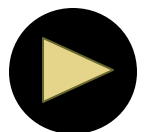
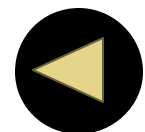
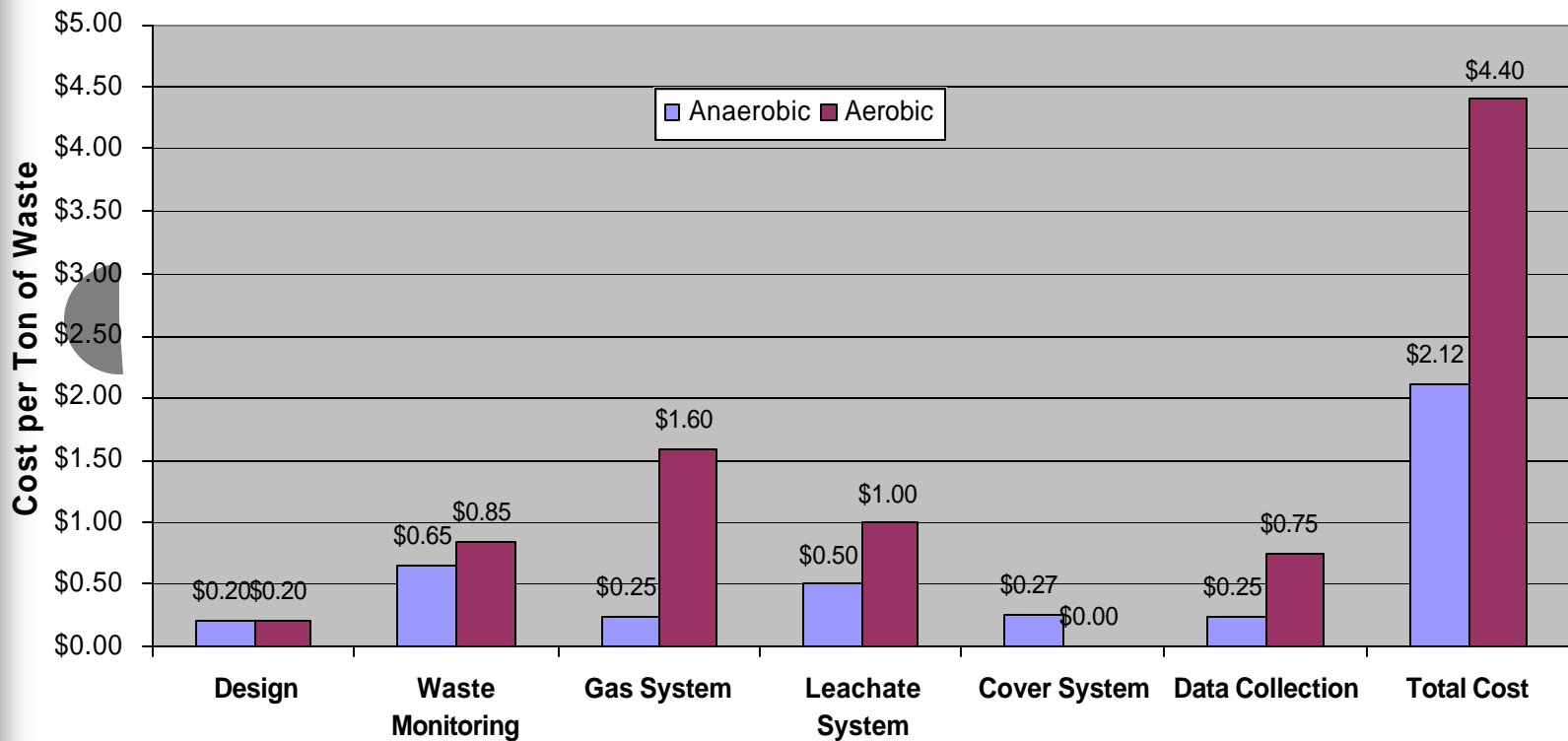
Design and Construction Challenges

- **Liner cap design and construction**
- **Installation of instrumentation after waste filling**
- **Securing installed liner and penetration of pipes through the cap**
- **HDPE Injection lines-drilling and installing fittings**
- **Pressurized Leachate injection system-inspection for leaks**



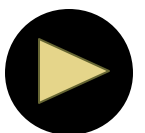
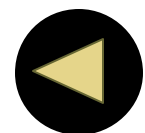
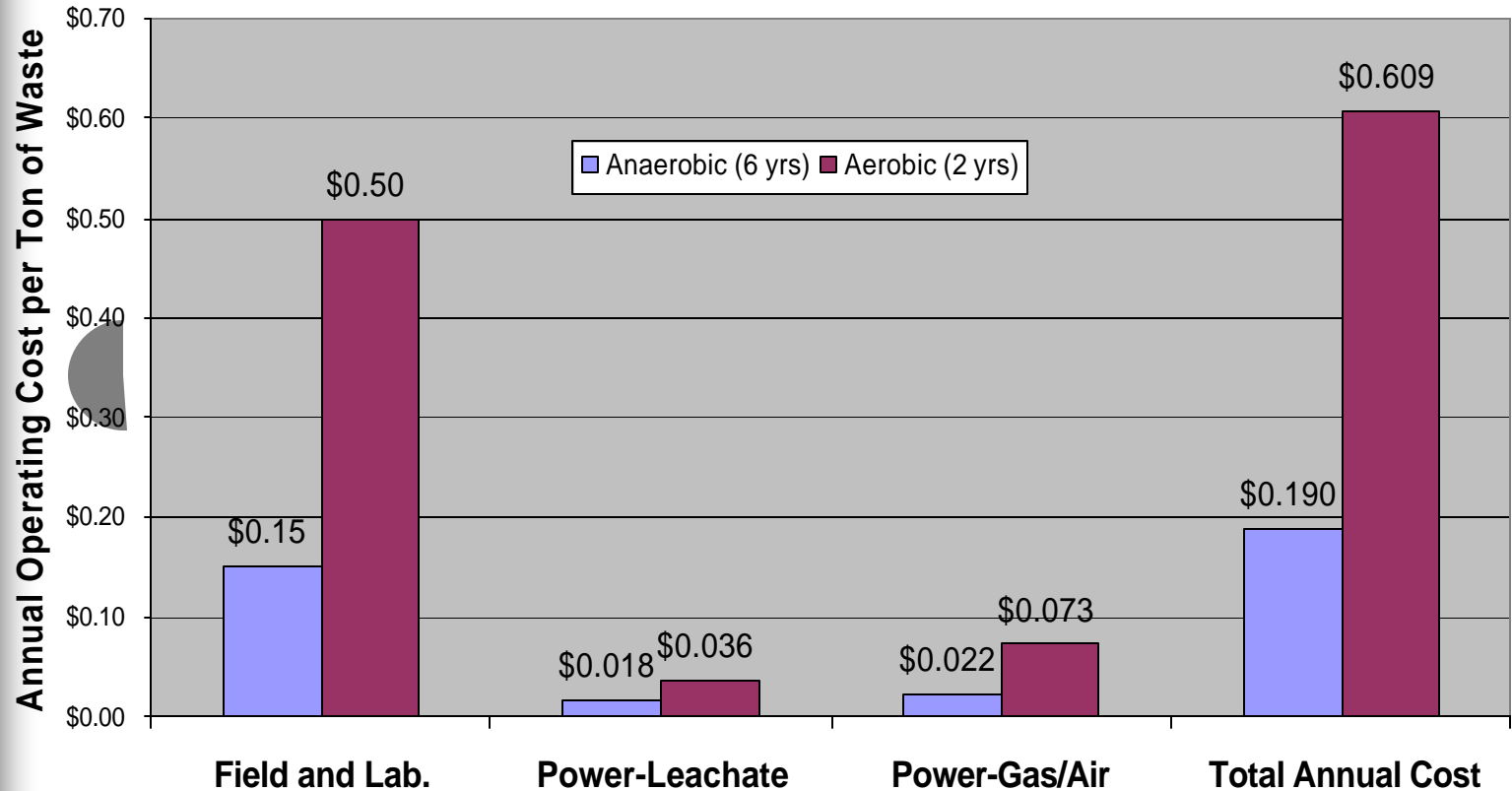
ECONOMICS- Capital Cost for Bioreactor

Capital Cost per Ton of Waste
(360,000 tons, 12 acres, 1,200 lbs/c.y.)



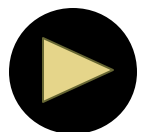
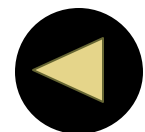
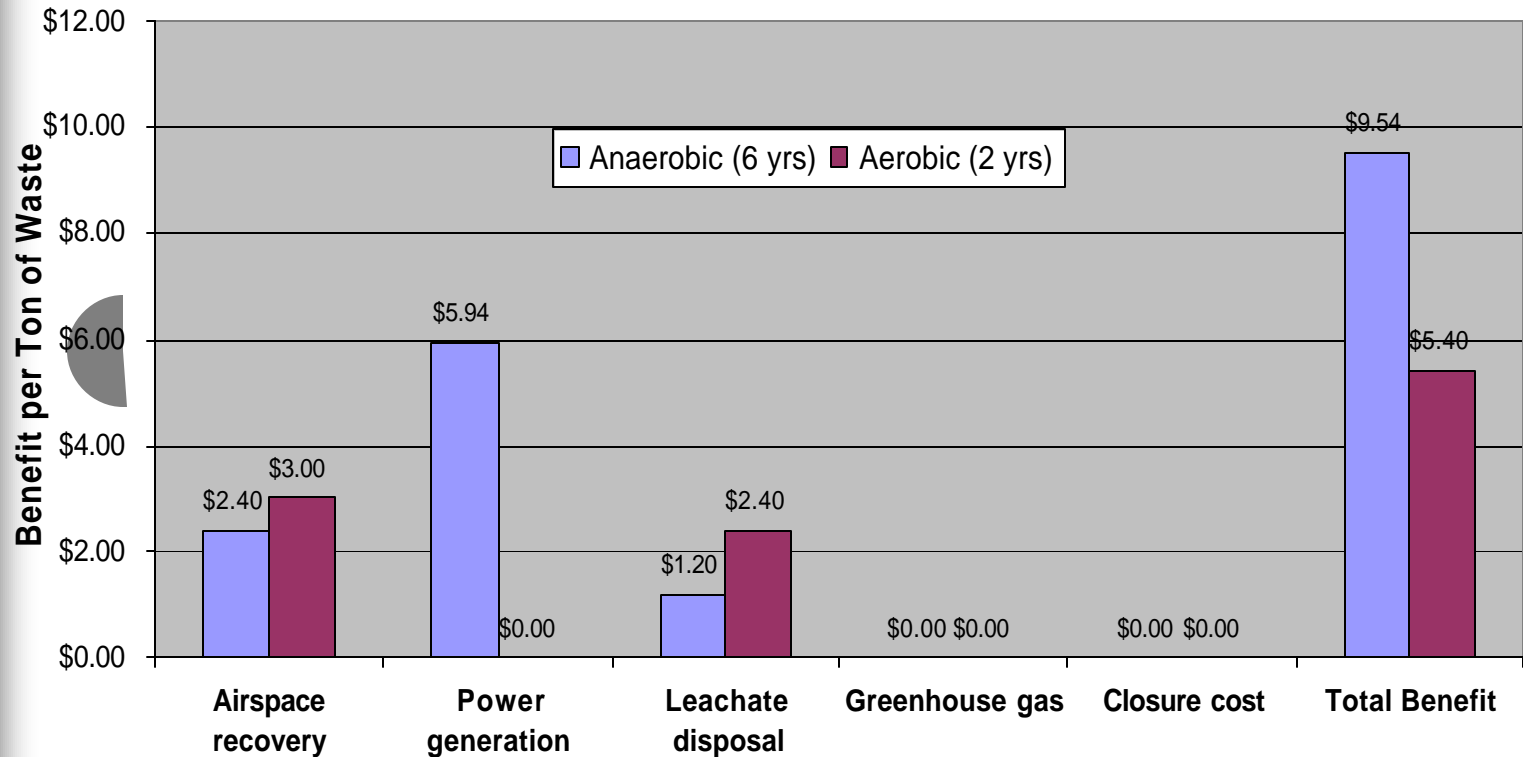
Annual Operating Cost Estimate

Annual Operating Cost per Ton of Waste
(360,000 tons, 12 acres, 1,200 lbs/c.y.)



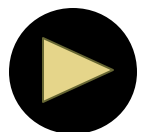
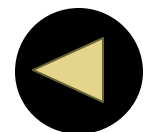
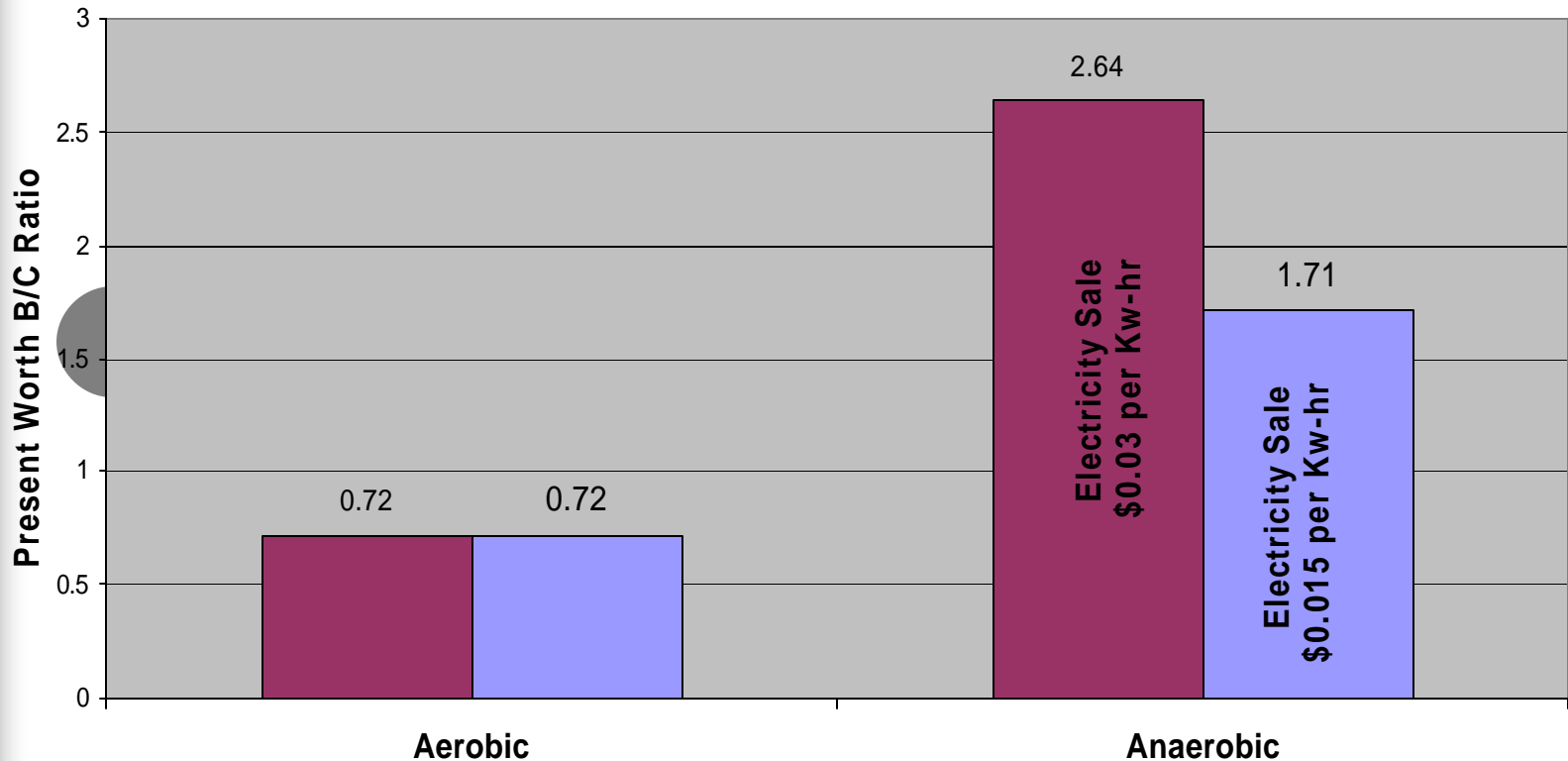
Benefits of Bioreactors

Total Benefit per Ton of Waste
(360,000 tons, 12 acres, 1,200 lbs/c.y.)



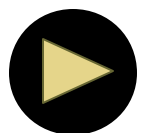
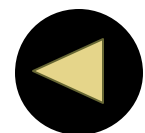
Present Worth Benefit/Cost

Present Worth Benefit Cost Ratio
(360,000 tons, 12 acres, 1,200 lbs/c.y.)



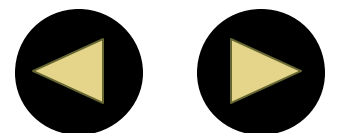
Remaining Tasks for the 3.5 acre Anaerobic Bioreactor

- **Complete the second surveying event to monitor waste settlement**
- **Conduct the second round of waste sampling and testing**
- **Perform surface scan monitoring for methane emissions**
- **Monitor and sample leachate**
- **Monitor and sample landfill gas**
- **Report results**



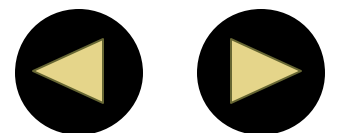
Remaining Tasks for the 6 acre Anaerobic Bioreactor

- **Complete installation of instrumentation and monitoring system**
- **Complete installation of the surface liner system**
- **Complete installation of the leachate injection and pumping system**



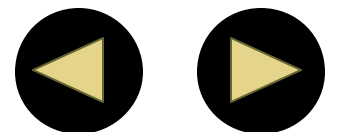
Remaining Tasks for the 6 acre Anaerobic Bioreactor

- **Complete installation of the landfill gas collection and removal system**
- **Conduct the second round of waste sampling and testing**
- **Complete the first surveying event to monitor waste settlement**
- **Install, and troubleshoot the SCADA system**



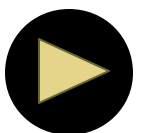
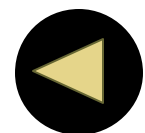
Remaining Tasks for the 6 acre Anaerobic Bioreactor

- **Perform surface scan monitoring for methane emissions**
- **Monitor and sample leachate**
- **Monitor and sample landfill gas**
- **Begin operation and report results**



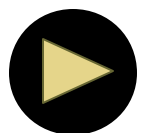
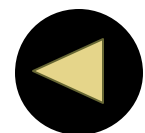
Remaining Tasks for the 2.5 acre Aerobic Bioreactor

- **Complete installation of blower and piping**
- **Complete installation of the biofilter**
- **Begin liquid injection and air suction**
- **Perform surface scan monitoring for methane emissions**
- **Monitor and sample leachate**
- **Monitor and sample biofilter air samples**
- **Begin operation and report results**



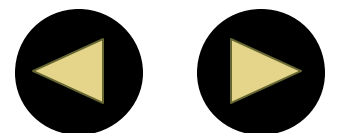
Conclusions

- **Bioreactors can be:**
 - **Designed to protect the environment more than the conventional landfills**
 - **Be operated in a safe manner**
 - **Be Constructed with normal equipments**
 - **Instrumentations be installed as filling**
 - **Early gas collection under cover to reduce fugitive emissions via horizontal layers**
 - **Inject leachate slowly to not impact head over the liner within waste lifts**



Conclusions

- **Bioreactors can be:**
 - **Inject leachate horizontally within the waste to distribute moisture**
 - **Be design to be operated by SCADA system**
 - **Collect real-time field data for monitoring and control**
 - **Create a master database for data management and reporting**
 - **Economical to construct and operate**



THE END

*Thank
You!*

