STEAM INJECTION LANDFILL BIOREACTORS

By

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STI Engineering

Biography

- Developed PPT For American Market – Over 1 Million Feet
- Worked On Nuclear PP., MX Missile, Many Dams, Dozens Of Landfills
- PPT Instructor At 4 Universities
- Worked In Solid Waste Industry For 30 Years
- Hold Several Patents
- Author Of Several Papers And A Book
- Member & Presenter At SWANA

BIOREACTOR LANDFILLS
vs.
DRY TOMB LANDFILLS

- Enhances biodegradation of organic waste
- Increases LFG production for waste-to-energy & Alternative Fuels
- Enhances settlement
- Recovers airspace
- Reduces organic related impacts while landfill is still in operation

STEAM INJECTION

- The intent is to increase the humidity of the landfill not to saturate the refuse
- More uniform distribution
- Only 1/1600th of the water required
- Enhanced settlement, water is not compressible
- Low temperature steam will biodegrade organics

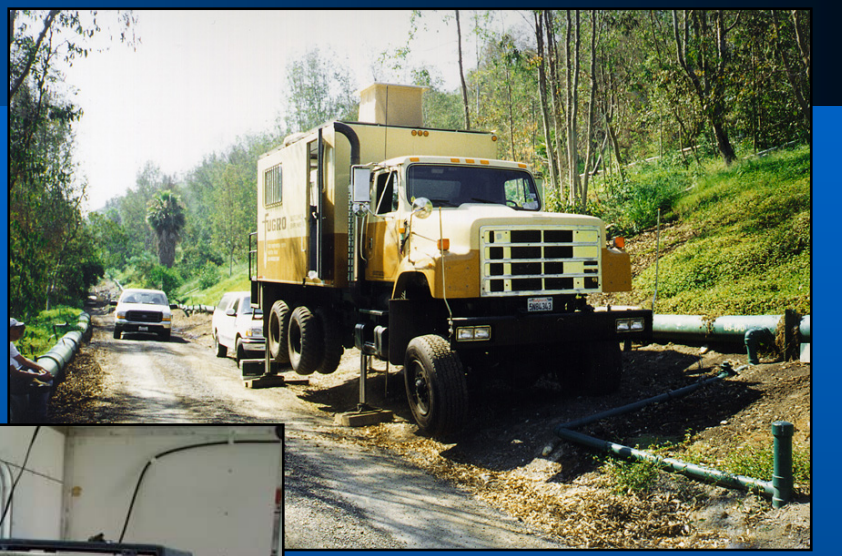
STEAM vs. LIQUID

- Steam warms refuse
- Steam moves in all directions
- Steam will not flood collectors
- Better moist. distribution
- Will not plug bottom drains
- Steam will not displace void spaces, more settle.
- Steam migration can be monitored easier, by temp.

- Liquid cools refuse
- Moves down & laterally under a head pressure
- Liquid could flood collect.
- Poor moist. distribution
- Could plug bottom drains
- Liquid will fill void spaces, inhibits settlement
- Liquid migration is difficult to monitor
- Liquid cannot

Description

- CPT and PPT Used to Characterize Subsurface Conditions



Description

- CPT Indicates Material Strength/ Density and Behavior Type: Cover Layers vs MSW
- PPT Indicates Liquid, Vacuum and/or LFG Pressure

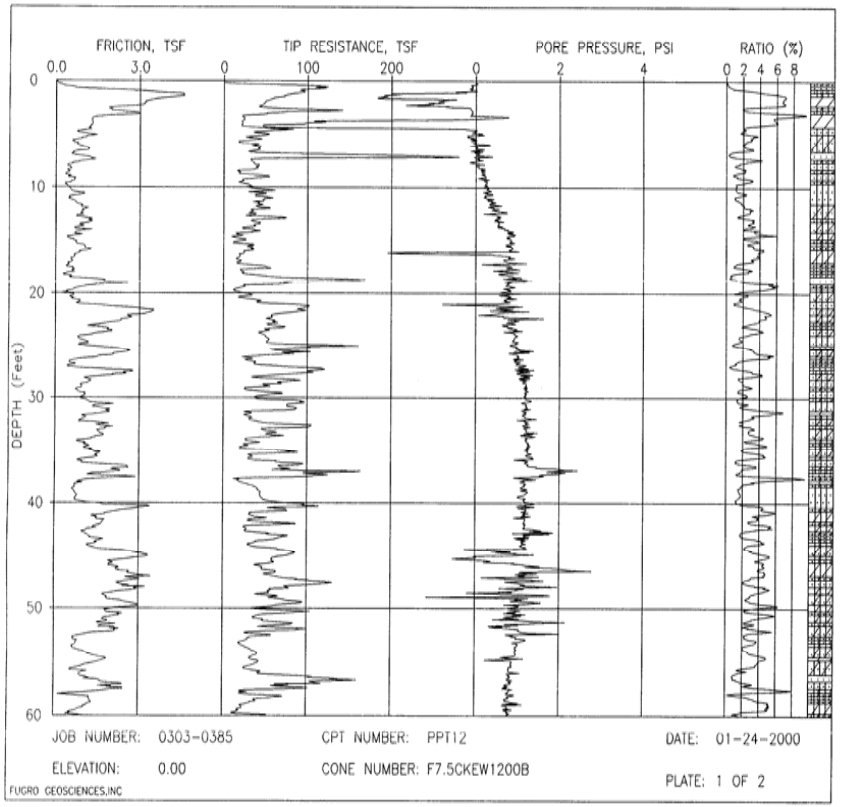
- Field Review of Data to Select Push-in Gas Well Locations and Screen Intervals

Interpretation of PPT Logs

- Identify Dense/Daily Cover Layers
- Distinguish Liquid and Gas Pressures
- Identify Zones of Vacuum
- Evaluate Zones of Low Density MSW
- Determine The Density Of Bottom Native Soils In Unlined Landfills

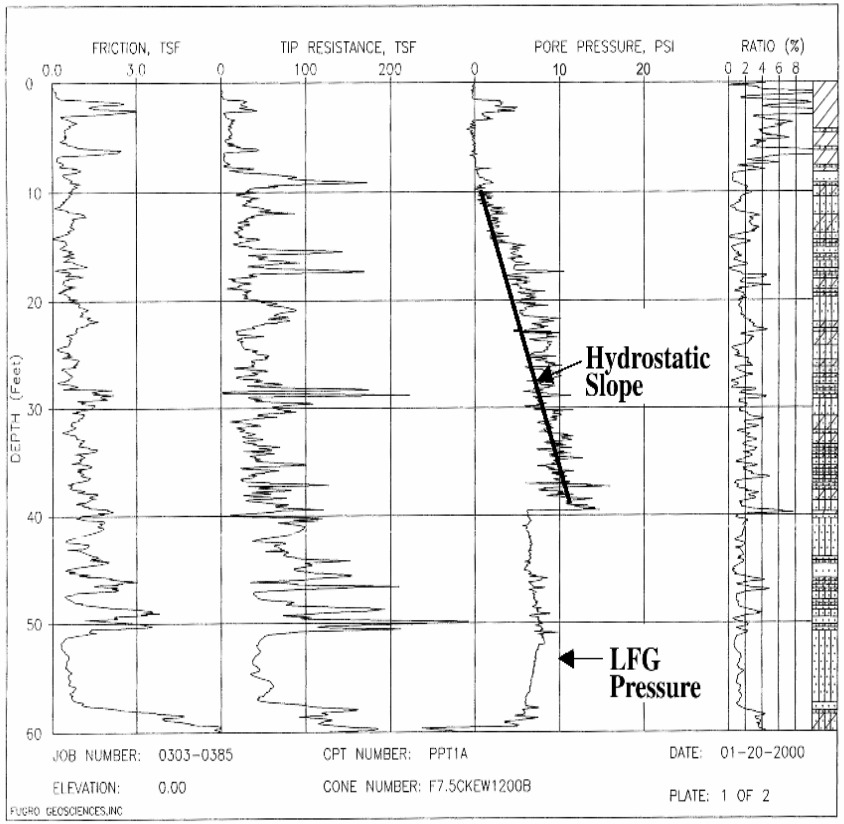
TYPICAL PPT LOG

- Column 1-Depth, ft.
- Column 2-Friction, tsf
- Column 3-Tip Resist., tsf
- Column 4-Pore Pres., psi
- Column 5-Friction Ratio %
- Column 6-Lithology



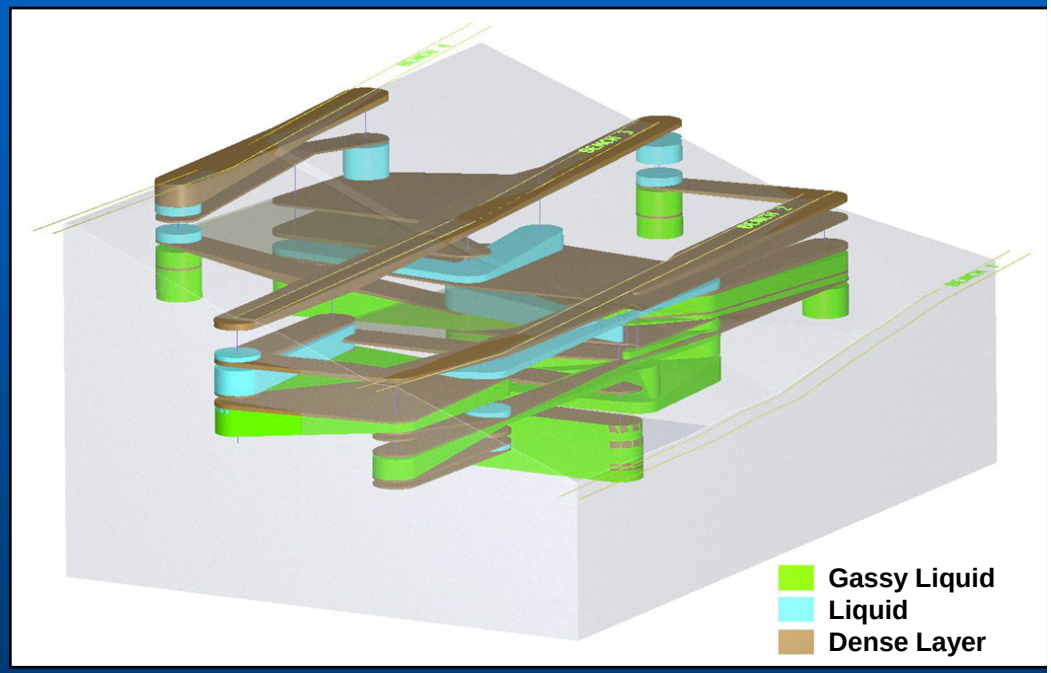
HYDROSTATIC PRESSURE SLOPE

- PPT Indicates Hydrostatic Liquid Pressure
- Interim Cover Layer at 40-ft Depth Causing Perched Water
- LFG Pressure Indicated Below Water Column



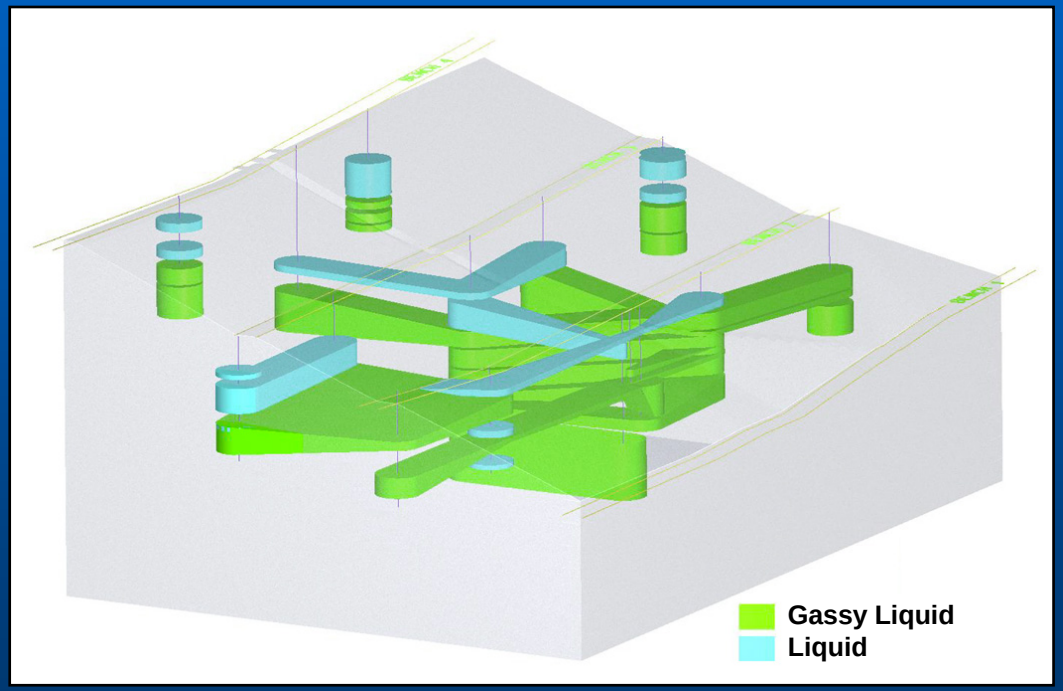
Building 3-D Profiles in Stages

- Liquids Trapped on Dense Layers
- Gassy Liquids Generally Trapped Between Dense Layers
- Continuity Between Liquid Layers Encountered Below Bench Roads

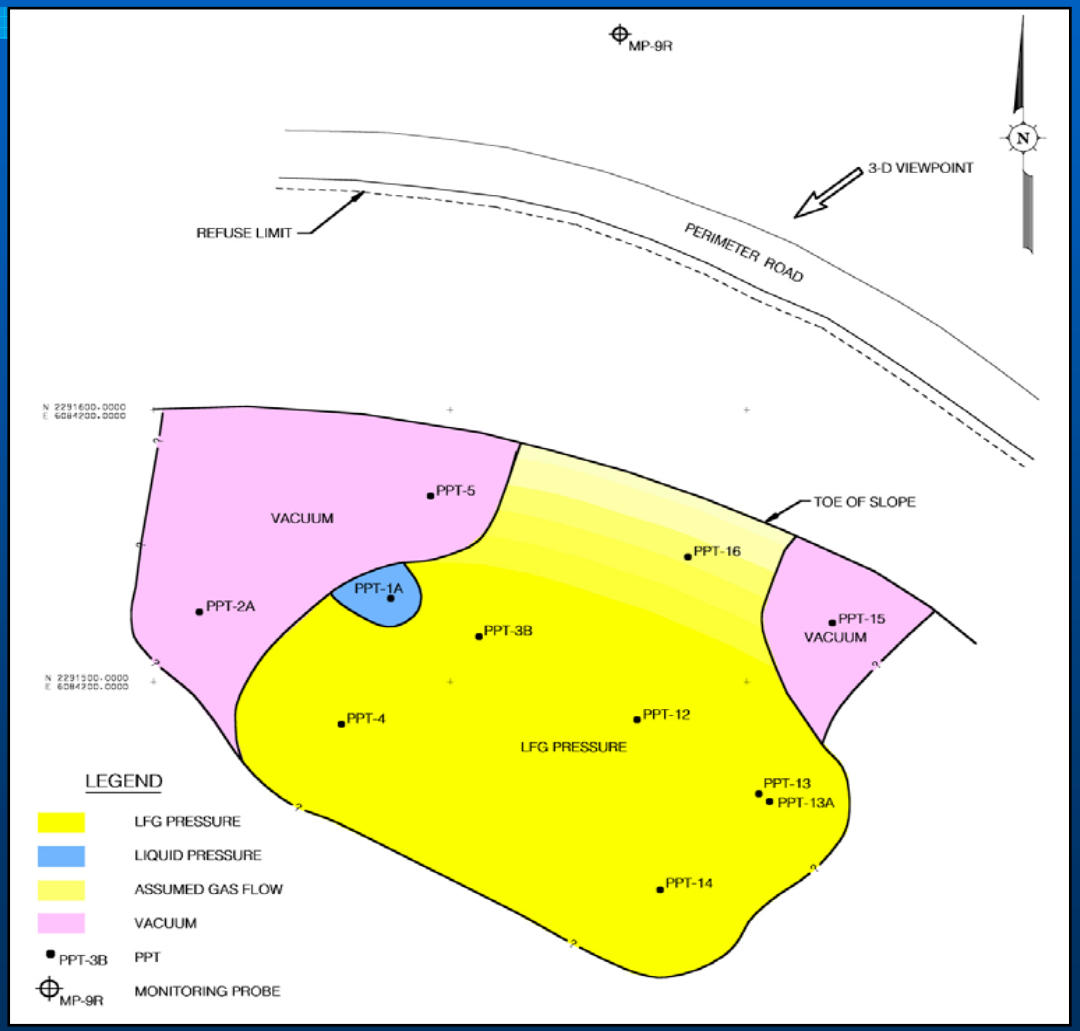


3-D Profile Enhances Understanding of Conditions

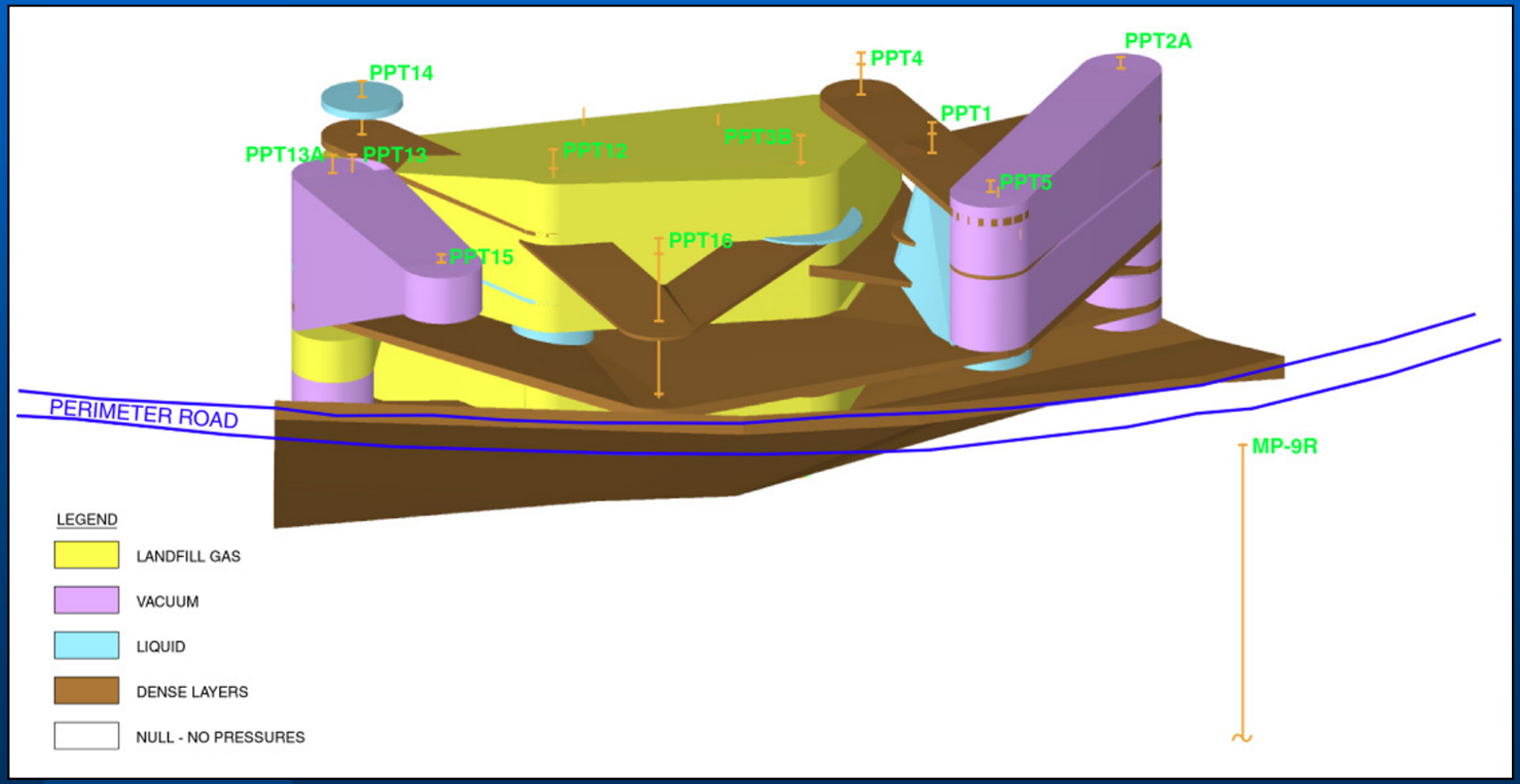
- Continuity of Liquid or Gassy Liquid Between and Along Bench Roads
- Liquids Above Gassy Liquids Indicates Water Intrusion



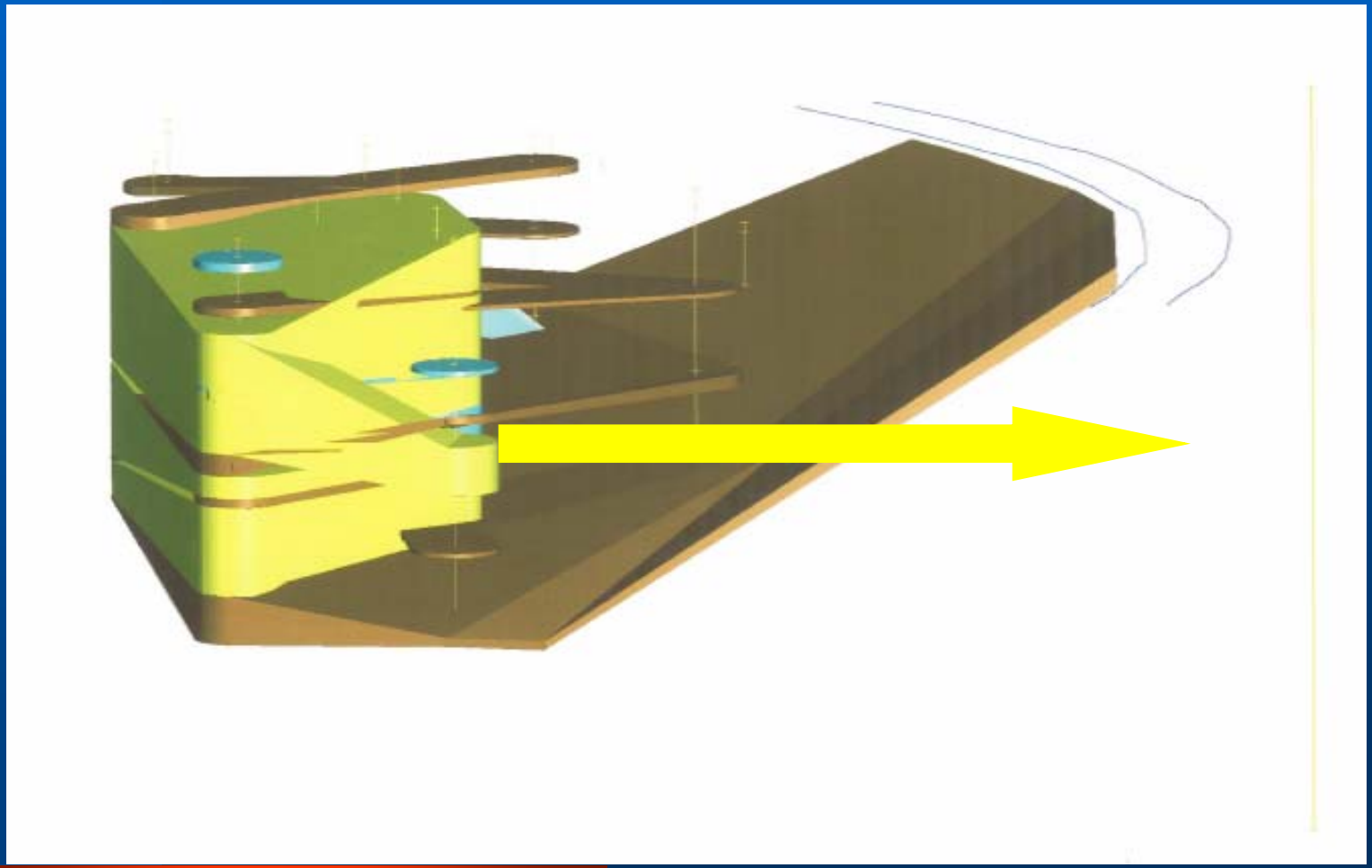
Landfill PPT Profiling Plan View



Landfill PPT Profiling
3-D Profile

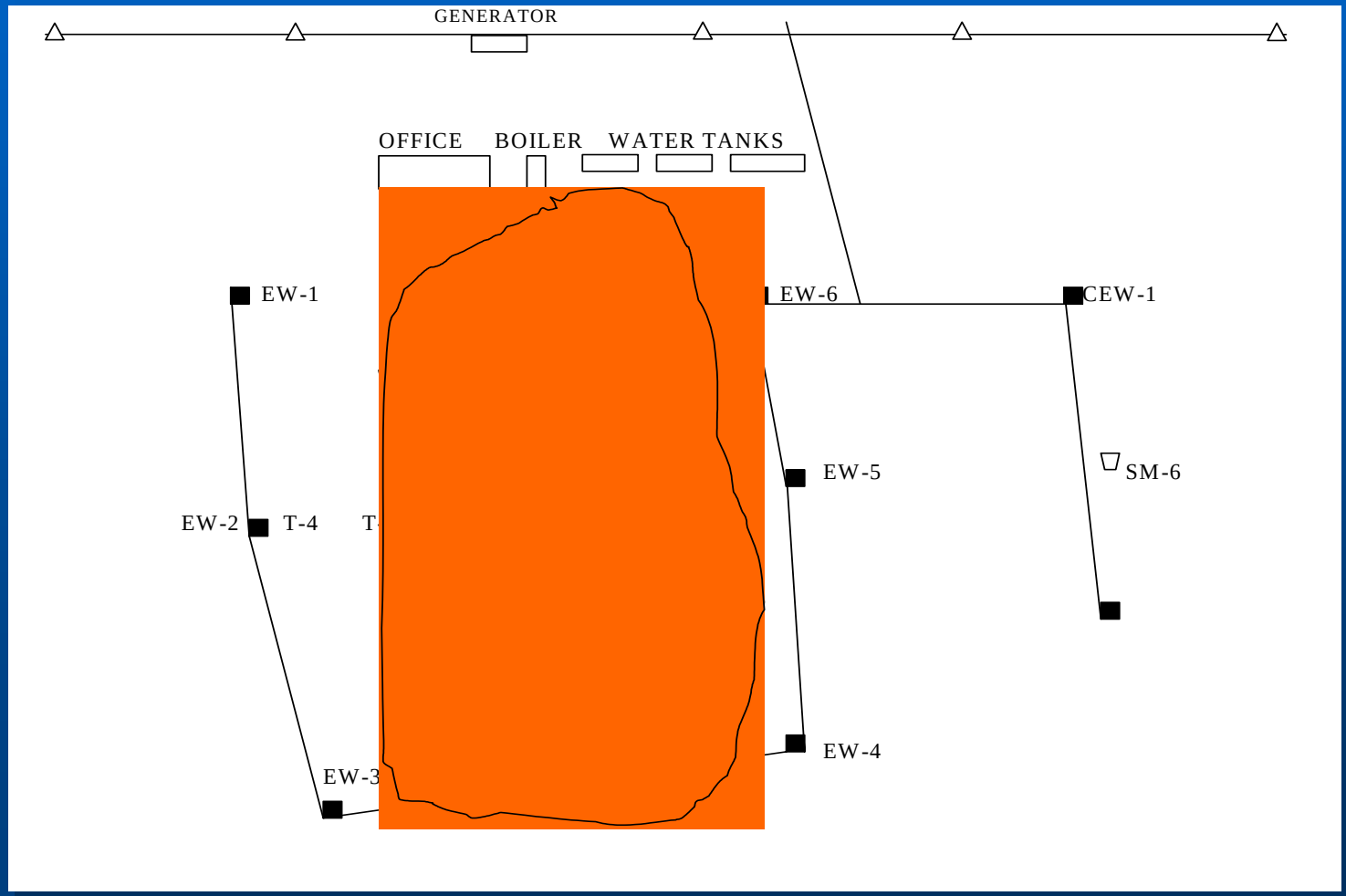


Landfill PPT Profiling
Side View



Steam Injection Bioreactors
Miramar Landfill Pilot Study

Site Layout Map



LFG Collector System

Steam Injector

Four GPM Boiler

Landfill Settlement

Miramar Landfill Pilot Study Objectives

- Determine If The Steam Migration Can Be Controlled By The LFG Collectors
- Determine If The Steam Can Heat Up & Moisten The Waste
- Determine If The Steam Increases Quality & Quantity Of Methane Gas
- Determine If Steam Injection Can Recover Airspace
- Determine If Leachate and Condensate Can Be Used In The Steam Process

Miramar Landfill Pilot Study
All Objectives Were Achieved

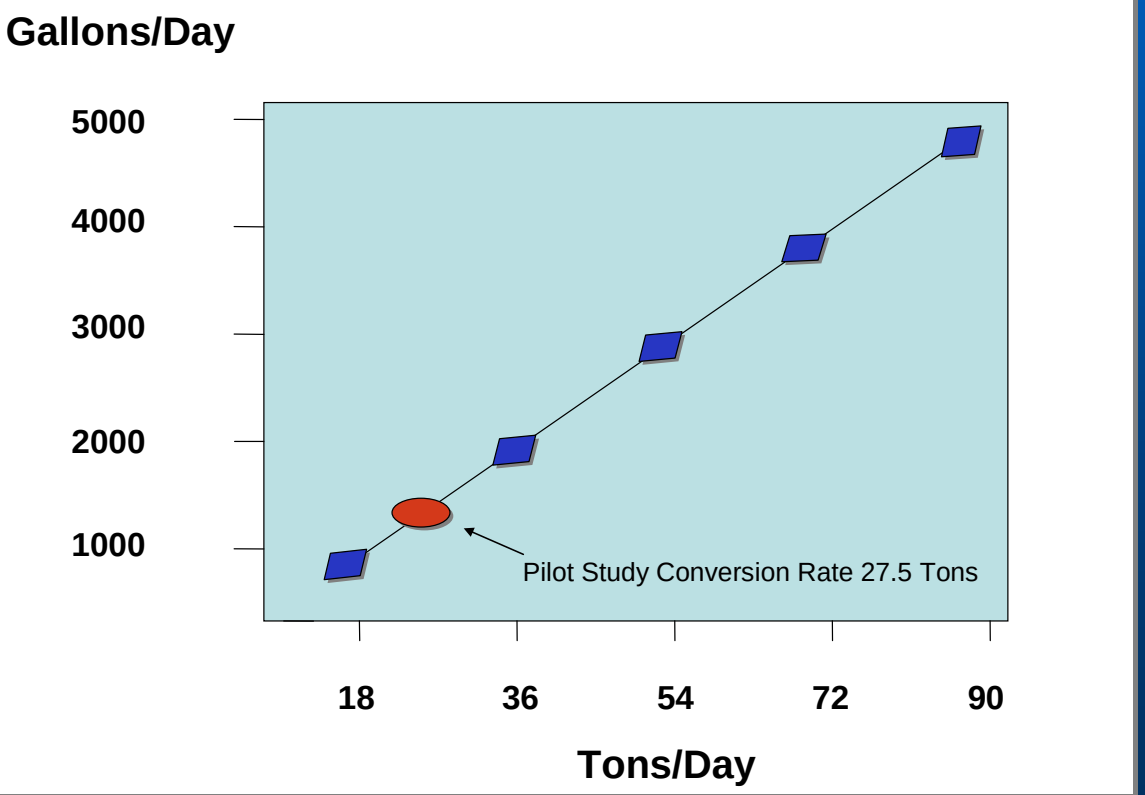
- By Increasing The Vacuum At The Collectors Steam Migration Was Indicated By The Thermocouples
- Thermocouples Indicated Increased Waste Temperature And Moisture
- Methane Started At 54% Increased To 66%
- Test Cell Settled 26 Inches Near Injector # 2, In 7 Months
- Leachate and Condensate Was Used In The Steam Process

Study Gas Production

- 1,500 Gallons/Steam Per Day
- Average 229 scfm Of LFG
- 229 x 1440 Minutes = 329,760 Cu. Ft. / Day
- 329,760 / 12,000 = 27.5 Organic Tons Converted/Day
- 25,212 / 27.5 = 917 / 365 = 2.5 Years

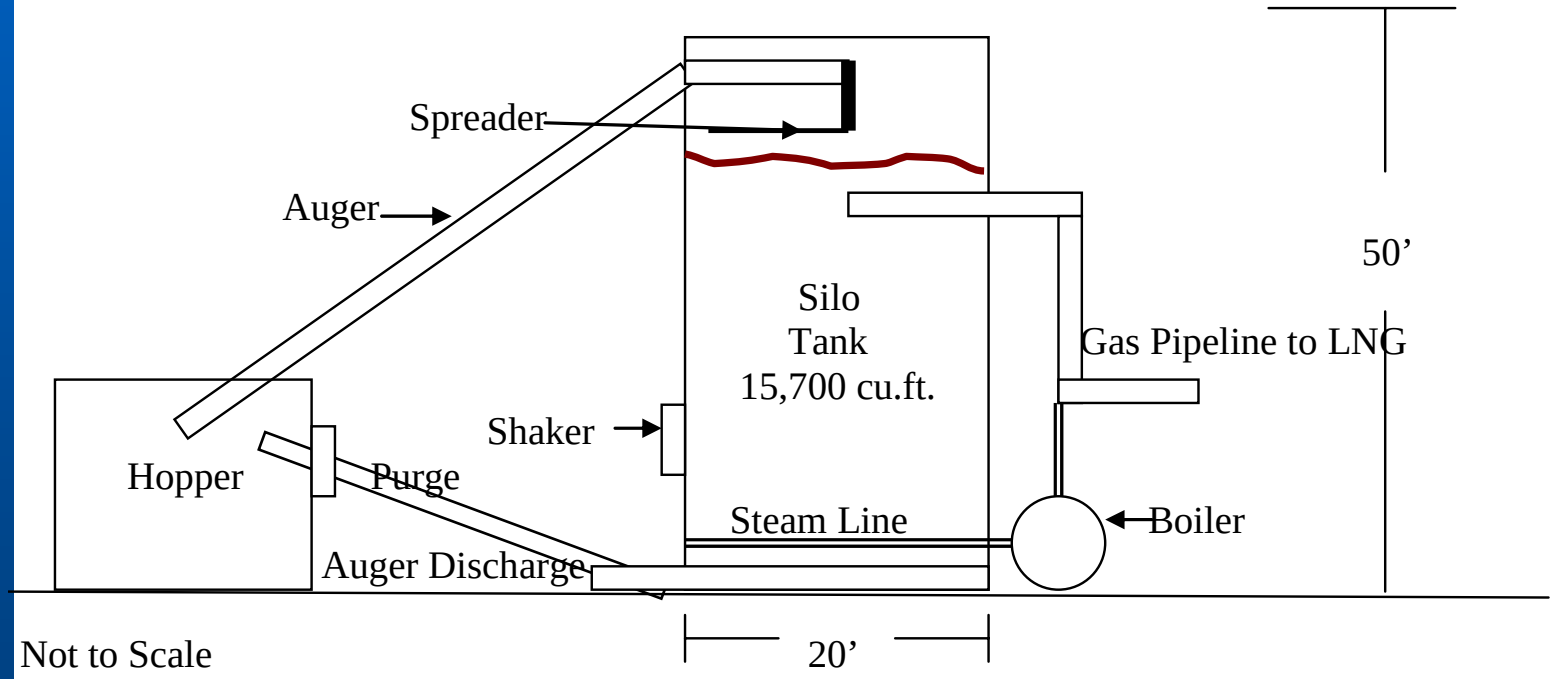
- If 5,000 Gallons/Steam Per Day
- 5,000 / 7.5 x1,600 = 1,066,666 Cu.Ft. Steam
- 1:1 Conversion Ratio = 1,066,666 Cu.Ft. LFG
- 1,066,666 / 12,000 = 89 Organic Tons Converted/Day
- 25,212 / 89 = 283 / 365 = 9 Months

Conversion Rate



Conventional Biomass Reactor
Chino California
500 Ton/1.2 Million Gallons

Steam Biomass Reactor
500 Ton



QUESTIONS?

- **Answer All Questions If Time Allows Today And/Or**
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