Economic Implications of ET Covers

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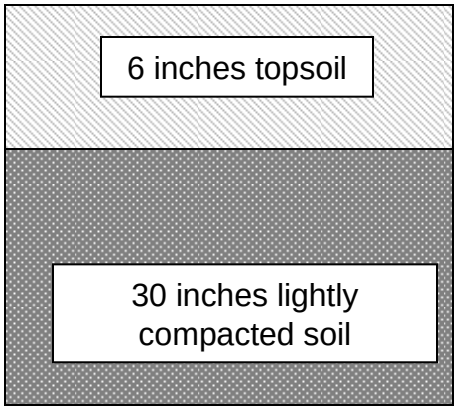
April 22, 2005

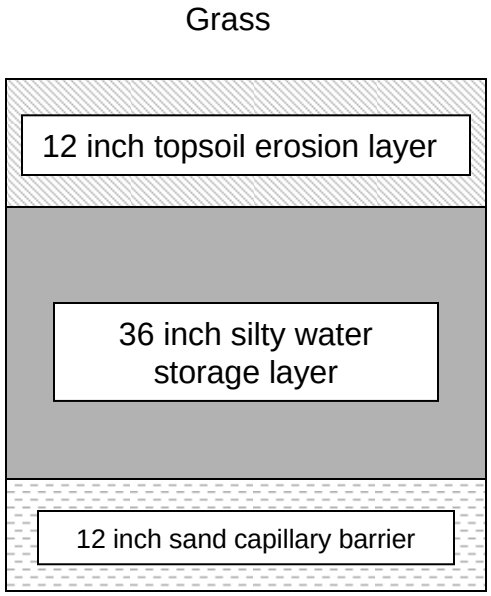
WASTE MANAGEMENT

ET Final Cover Types

Arid

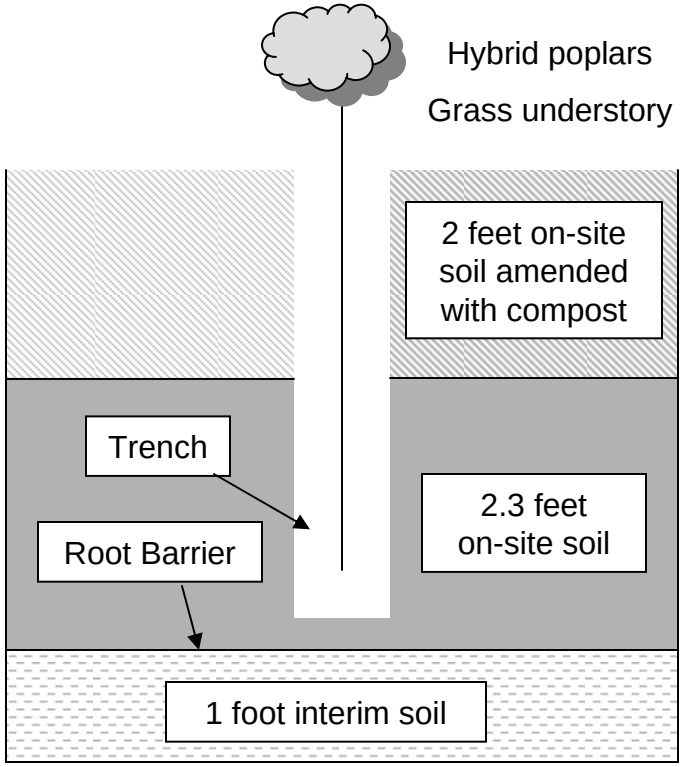


Semi-Arid



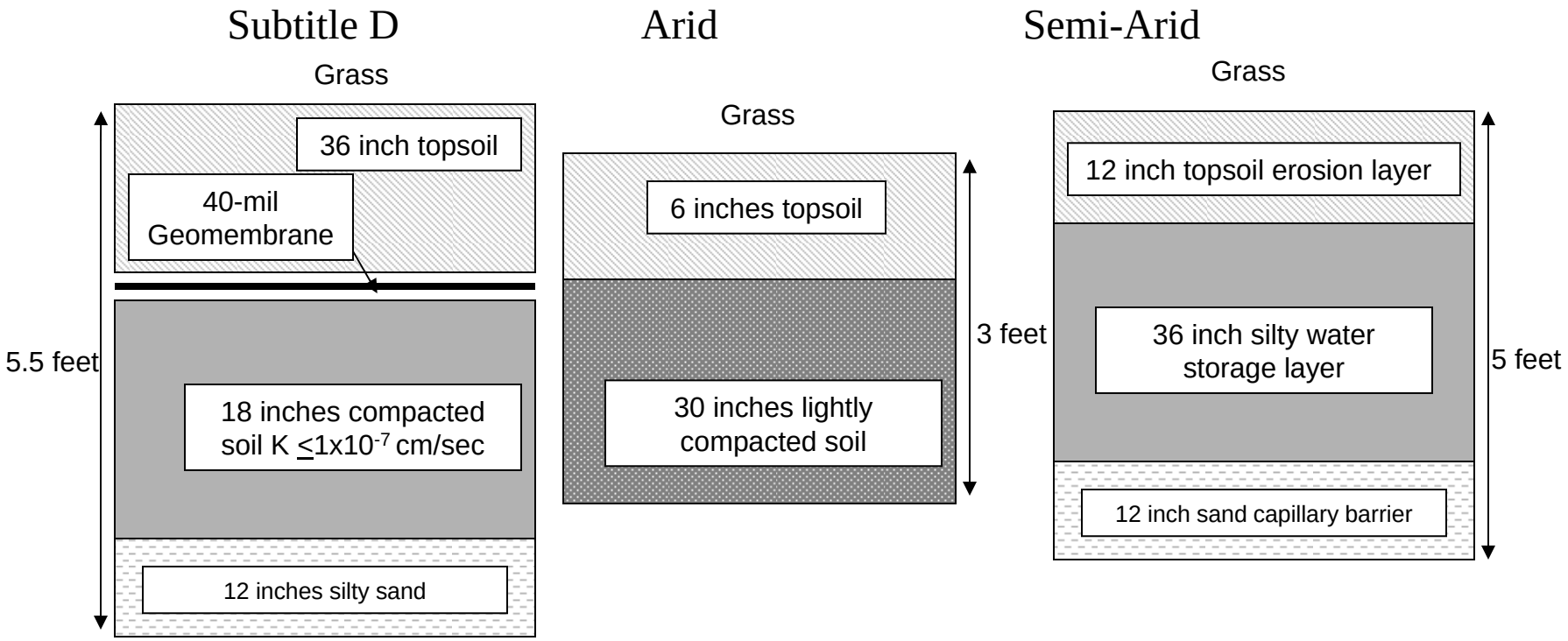
Future (Humid Climates)

Mixed Species Evapotranspiration-type Alternative Cover



Per Acre Unit Costs

(@ $3/cy Earthmoving Cost)



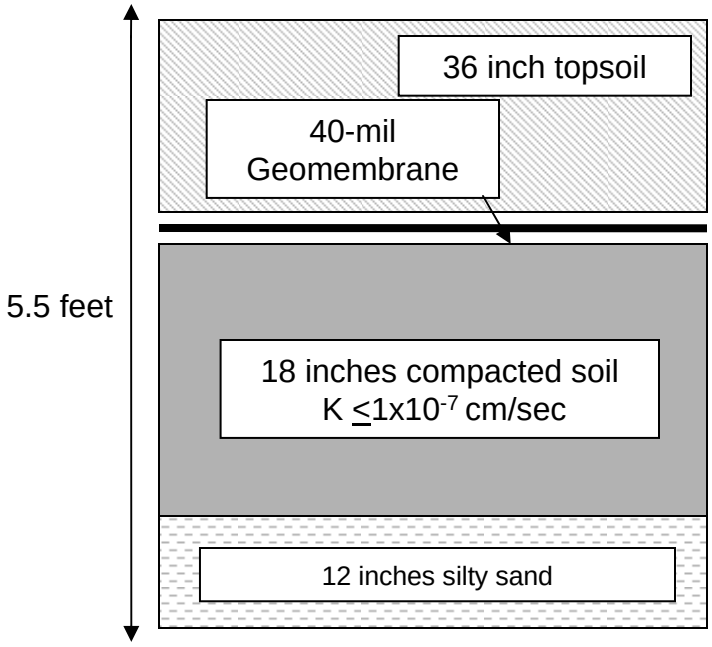
Topsoil/Vegetation	**$16,700**	**$ 6,000**	**$ 4,800**
Geosynthetic	**21,580**	**0**	**0**
Soil Layer	**12,000**	**17,600**	**23,800**
Capillary Barrier	**0**	**0**	**8,100**
Per Acre Unit Costs	**$50,280**	**$23,600**	**$36,700**

Present Value of Design Change for 100 Acre Final Cover

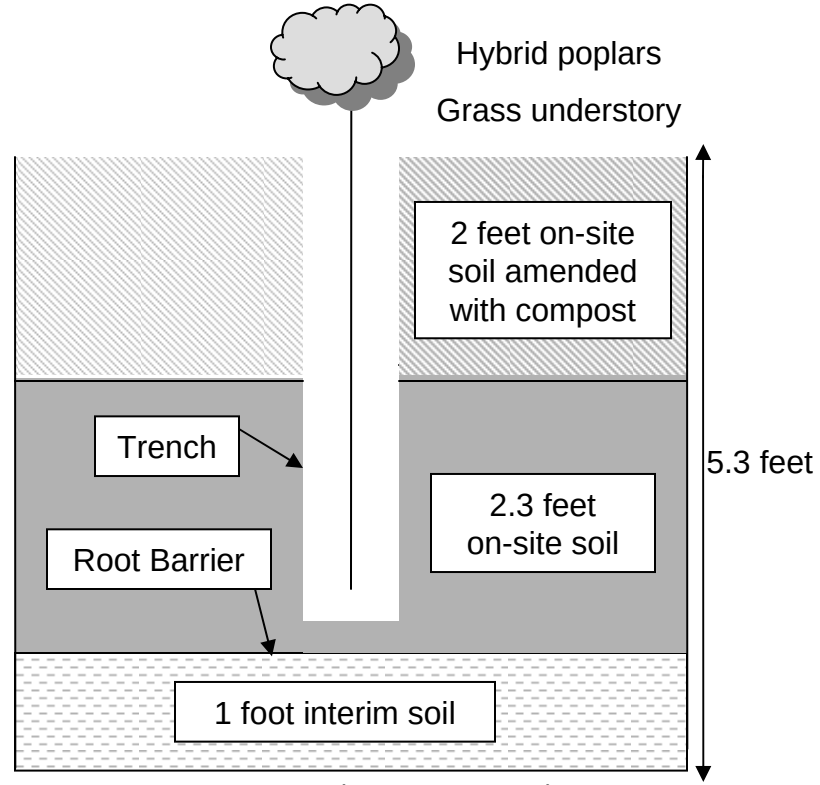
		To Be Built:		
	△ Per Acre Unit Cost	Now	In 2015	In 2035
Sub-Title D ***($50.3K/AC)***	**- 0 -**	**- 0 -**	**- 0 -**	**- 0 -**
Arid Design ***($23.6K/AC)***	**$26,700**	**$2,670,000**	**$1,459,000**	**$433,000**
Semi-Arid Design ***($36.7K/AC)***	**$13,600**	**$1,360,000**	**$ 743,000**	**$220,800**

(Using 6.25% Discount Rate)

Comparison of ET Final Cover Design in Humid Climates



Mixed Species Evapotranspiration-type Alternative Cover



Topsoil/Vegetation	**$16,700**	**$11,700 + $15,000 (trees)**
Geosynthetic	**21,580**	**0**
Soil Layer	**12,000**	**18,000**
Capillary Barrier	**0**	**0**
Per Acre Unit Costs	**$50,280**	**$44,700**

△ = $5.65K/AC

Present Value of Design Change for 100 Acre Final Cover

		To Be Built:		
	△ Per Acre Unit Cost	Now	In 2015	In 2035
Sub-Title D ***($50.3K/AC)***	**- 0 -**	**- 0 -**	**- 0 -**	**- 0 -**
Humid Climate Design ***($44.7K/AC)***	**$5,600**	**$560,000**	**$306,000**	**$90,900**

Recent Landfill Emissions Research

- **T. Abichou, D Powelson, J.P. Chanton, S. Escoriaza, and J. Stern, Characterization of Methane Flux and Oxidation at a Solid Waste Landfill submitted to ASCE Journal of Environmental Engineering, Fall 2004**

- **M. A. Barlaz, R.B. Green, J.P. Chanton,C.D. Goldsmith, and G.R. Hater, Evaluation of a Biologically Active Cover for Mitigation of Landfill Gas Emissions, Environ. Sci. Technol, 2004 38,4891-4899**

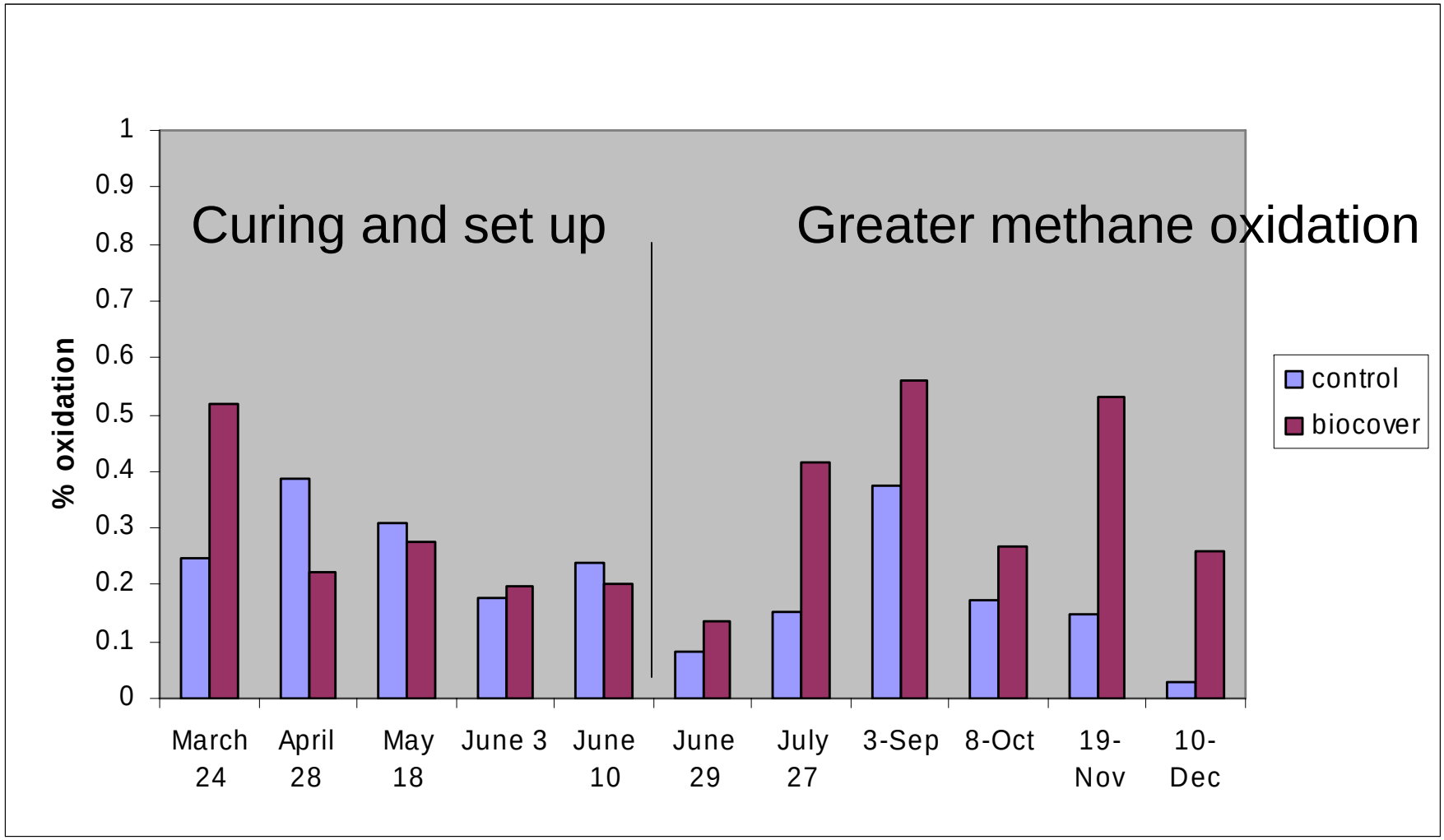
- **T. Abichou, J. Chanton, Characterization of Methane Flux, Oxidation,and Bioreactive Cover Systems at the Leon County Landfill, Annual Report- Florida Center for Solid and Hazardous Waste Management. August 2003 to August 2004**

3 Critical Findings

1) **Emissions can be 100% controlled with soil cover and active gas extraction systems (current AP-42 acknowledges 60% - 85%).**

2) **Soil oxidation rate (previously assumed @ ≤ 10% of gas production) is much higher (20% w/soil, higher w/organically enhanced designs).**

3) **Final cover on side slopes (>15%) perform better than final cover on flat slopes, most likely due to greater lateral stress condition in soil layer.**

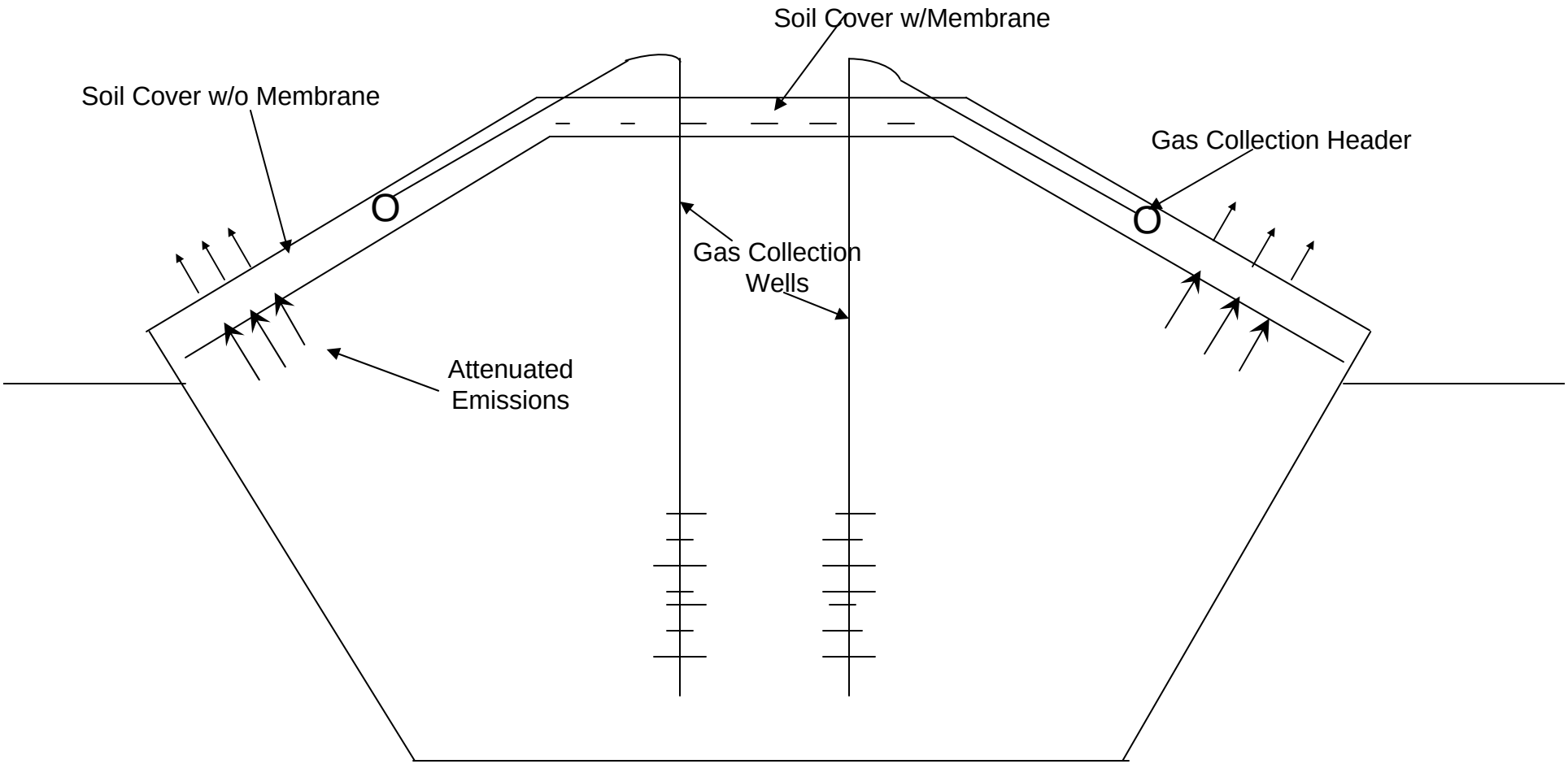


Biocover installed 3/24/04. Since mid June, the biocover has shown significantly greater methane oxidation than control sites.

Statistics – Since Mid June

- **% Oxidation significantly greater at the biocover sites @ 99.9% confidence.**
- **Mean Biocover % oxidation = 36.5% ± 3.0**
- **Mean Control % oxidation = 17.5% ± 4.7**

Landfill Cross Section with Hybrid Final Cover (Beanie Cap)



- **Decreased Maintenance of Gas System & Cover**
- **Allows Soil Attenuation of Some Emissions**

Implications for ET Final Cover Designs

1) **ET final covers can control emissions.**

2) **ET covers can incorporate significant emissions control features (not currently recognized in AP-42).**

3) **Higher level of performance of soil cover on side slopes promotes consideration of hybrid designs (i.e., Beanie Caps).**

Effect of Decreased Maintenance & Flare Operation

(For 30-Year Post-Closure Period)

	Period Beginning:		
	Now	**In 10 Years**	**In 30 Years**
Decreased Maintenance	**$268,000**	**$146,000**	**$43,500**
Shorter Flare Operational Period	**$141,000**	**$77,000**	**$22,900**
	$409,000	**$223,000**	**$66,400**

Present Value of Design Change for 100 Acre Final Cover

		To Be Built:		
	△ Per Acre Unit Cost	Now	In 2015	In 2035
Sub-Title D ***($50.3K/AC)***	**- 0 -**	**- 0 -**	**- 0 -**	**- 0 -**
Humid Climate Design ***($44.7K/AC)***	**$5,600**	**$560,000**	**$306,000**	**$90,900**
Humid Climate Design w/Less Maintenance in Post Closure	**N/A**	**$409,000**	**$223,000**	**$66,400**
		$969,000	**$529,000**	**$157,300**

Environmental Benefits

Greenhouse Gas Emission Reduction Credits

At 20% oxidation (per Florida State studies) and $1.75 per ton of CO_2 equivalents, typical 100-acre landfill could accumulate value of over $2,500,000 over its active life

	10 Years	30 Years
Present Value	**$1,832,000**	**$1,126,000**

Present Value of ET Design Change for 100 Acre Final Cover in Humid Climates

	Built Now	Built In 10 Years	Built In 30 Years
Construction	**$560,000**	**$306,000**	**$90,900**
Post-Closure Maintenance Improvement	**$409,000**	**$223,000**	**$66,400**
Environmental Benefits	**- - -**	**$1,832,000**	**$1,126,000**
Total	**$969,000**	**$2,361,000**	**$1,283,300**

POLICY CHANGES NEEDED

- **Recognition of superior performance of soil covers on side slopes → hybrid final cover designs.**

- **Modification of USEPA standard emissions calculations (AP-42) to allow credit for soil oxidation of emissions.**

- **Establishment of GHG credit markets (e.g., CCX) that recognize soil attenuation.**

Summary

- **ET cover designs in arid and semi-arid climates have adequate financial benefits to support technology.**
- **ET cover designs in humid climates need recognition of long-term and environmental benefits to provide enough value to support technology.**
- **We need to recognize benefits of soil attenuation of emission in USEPA standards (AP-42) to adequately value all design options.**