COTTON PRODUCTION & PROCESSING RESEARCH UNIT

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Inherent PM_{10} and $PM_{2.5}$ Stack Sampling Errors Due to the Interaction of Particle Size and Sampler Performance Characteristics

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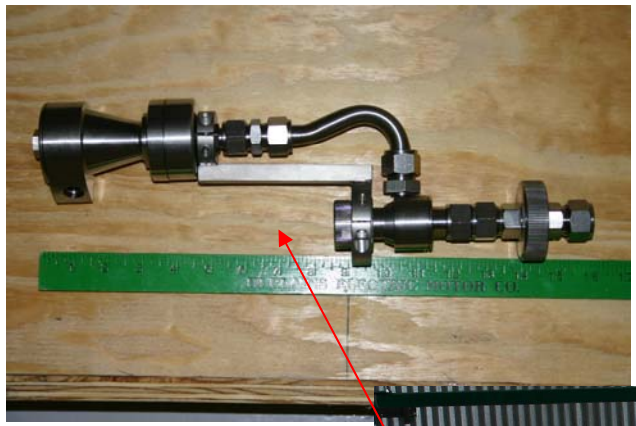
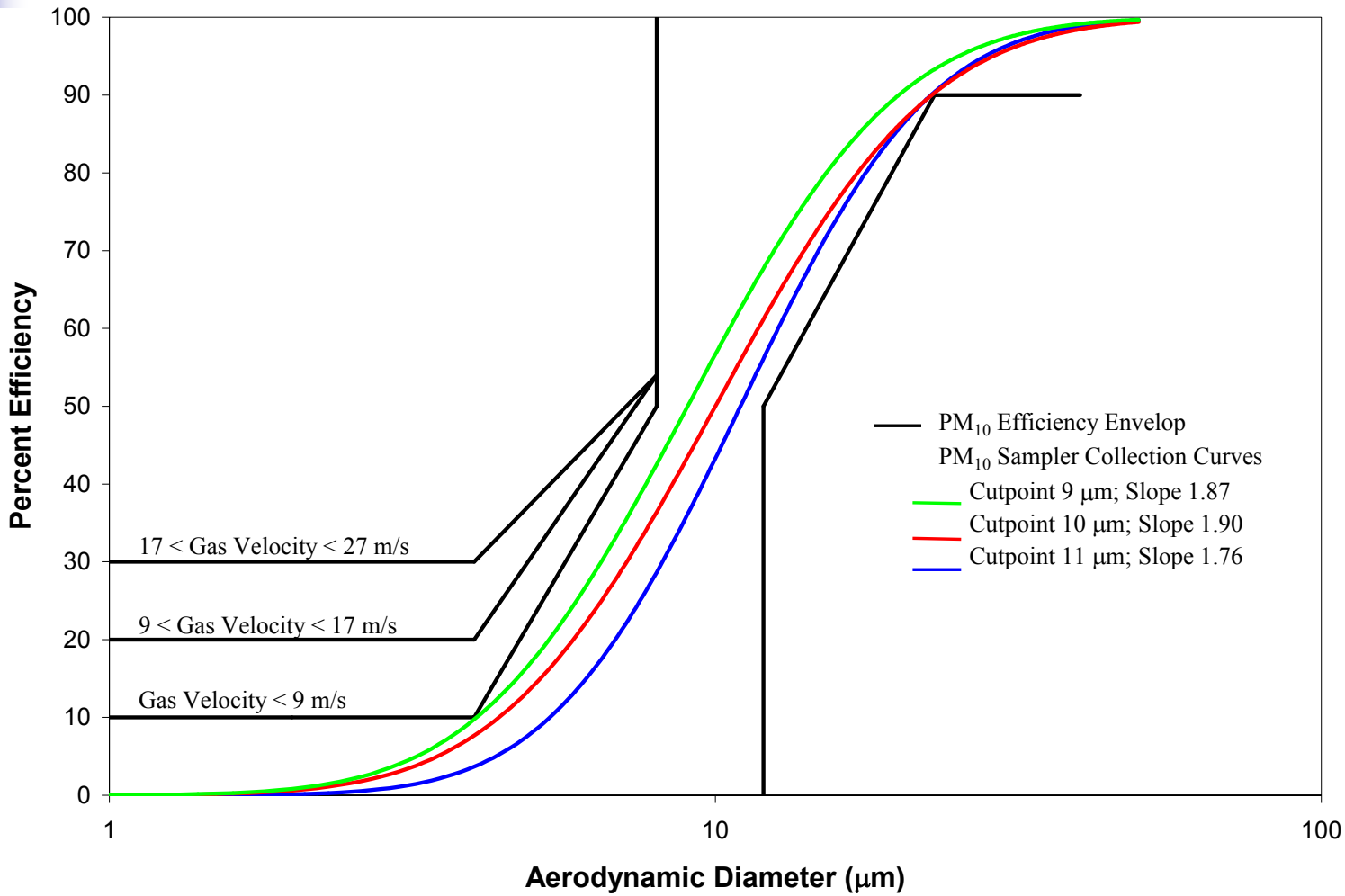
Research Focus



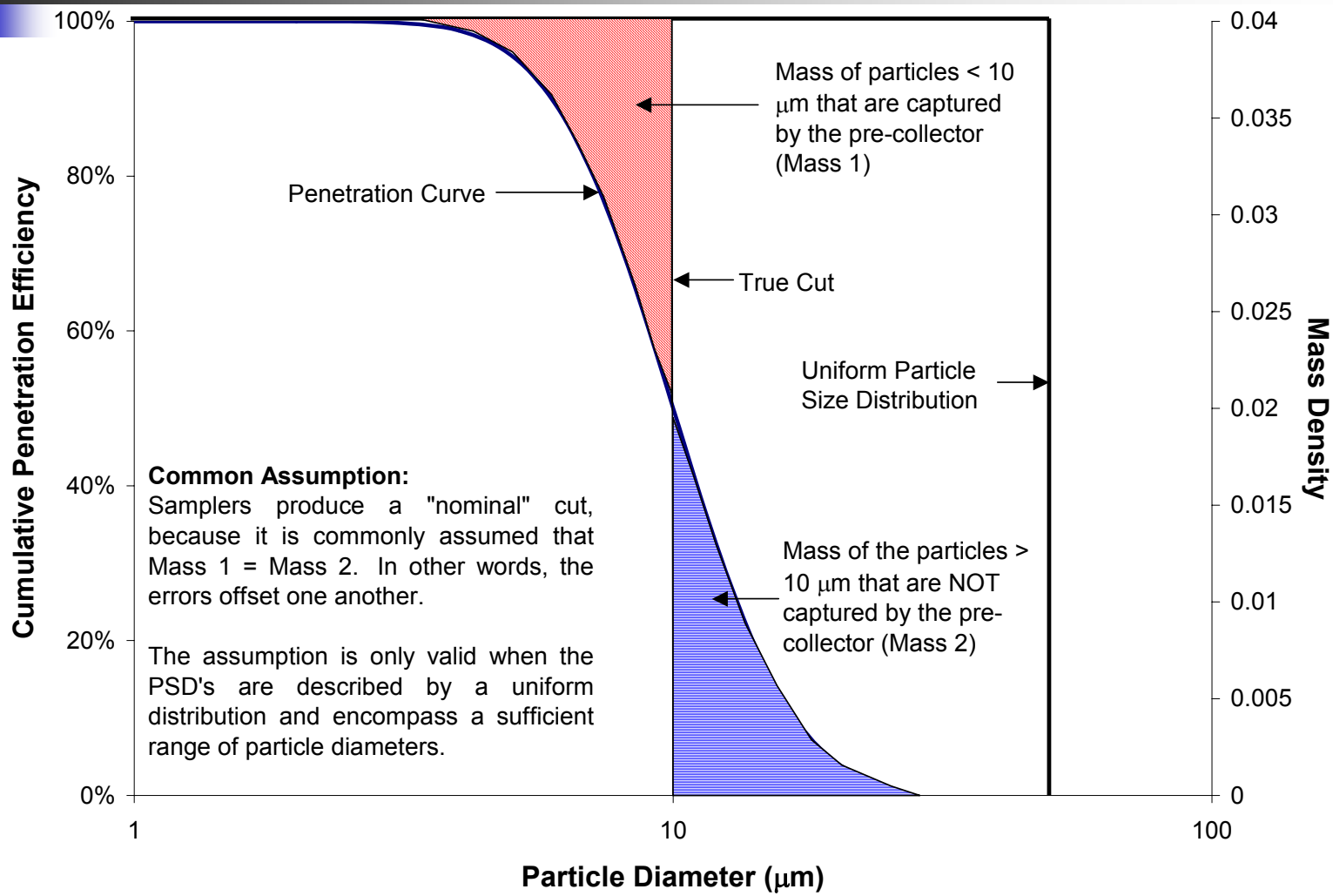
Research Objectives

- Theoretical errors of PM_{10} and $PM_{2.5}$ stack samplers when operating within EPA's performance criteria.
- Theoretical errors of PM_{10} and $PM_{2.5}$ stack samplers when operating outside of EPA's performance criteria.
- Experimentally determine sampler errors
  - Sampler concentrations versus true concentrations
  - Stack sampler performance characteristics
- Compare theoretical to experimental sampler errors.

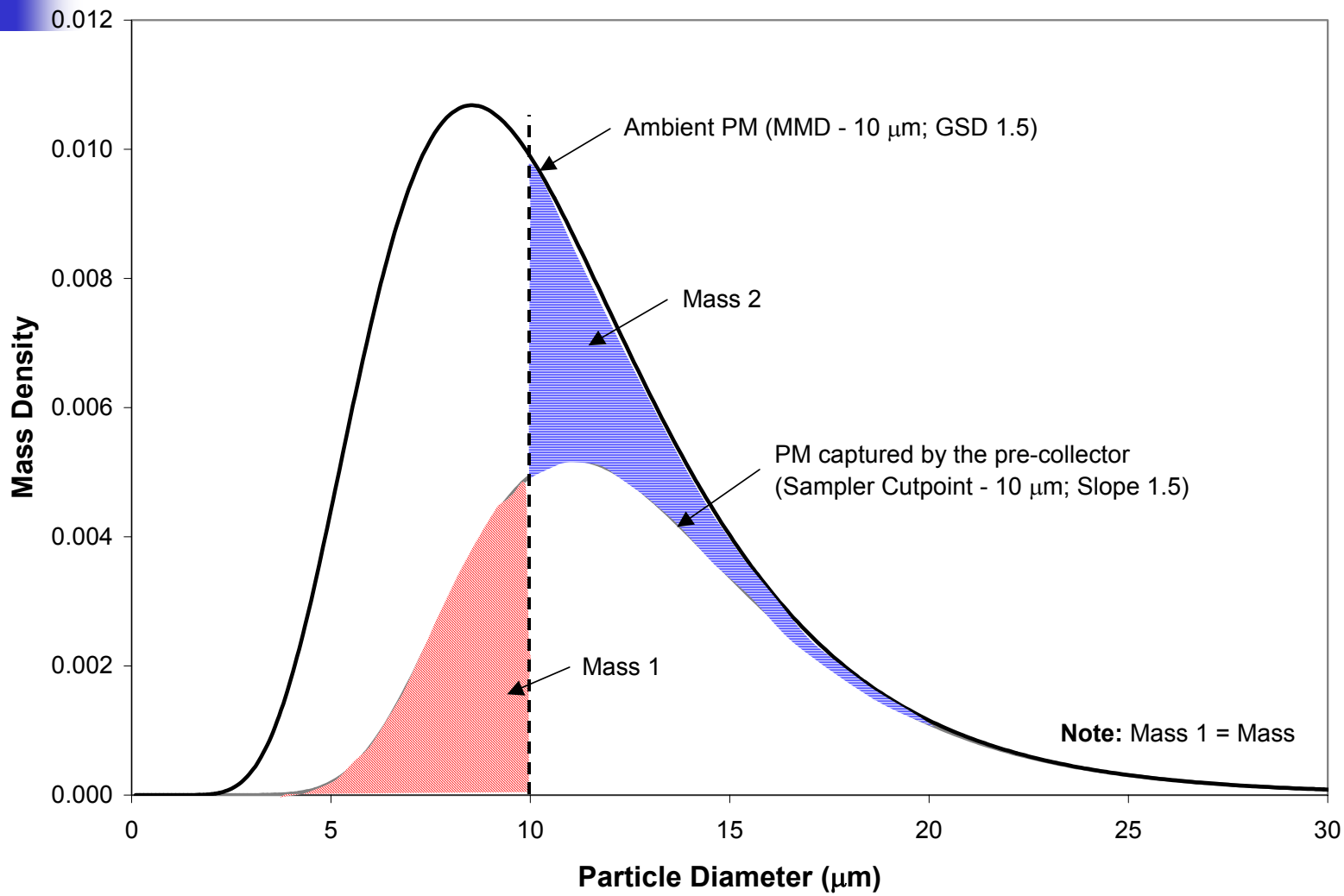
PM_{10} Stack Sampler Performance Criteria



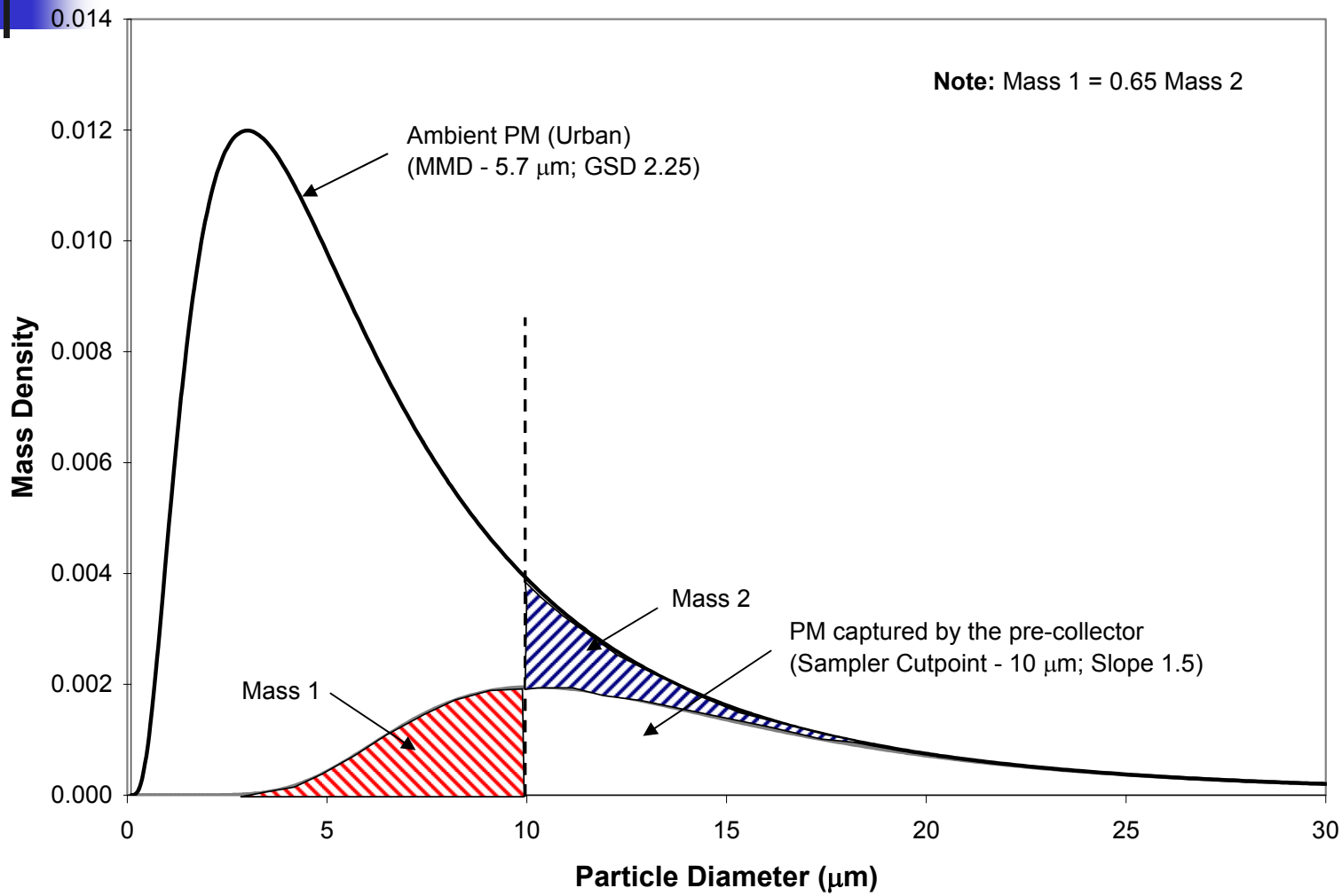
Sampler Nominal Cuts



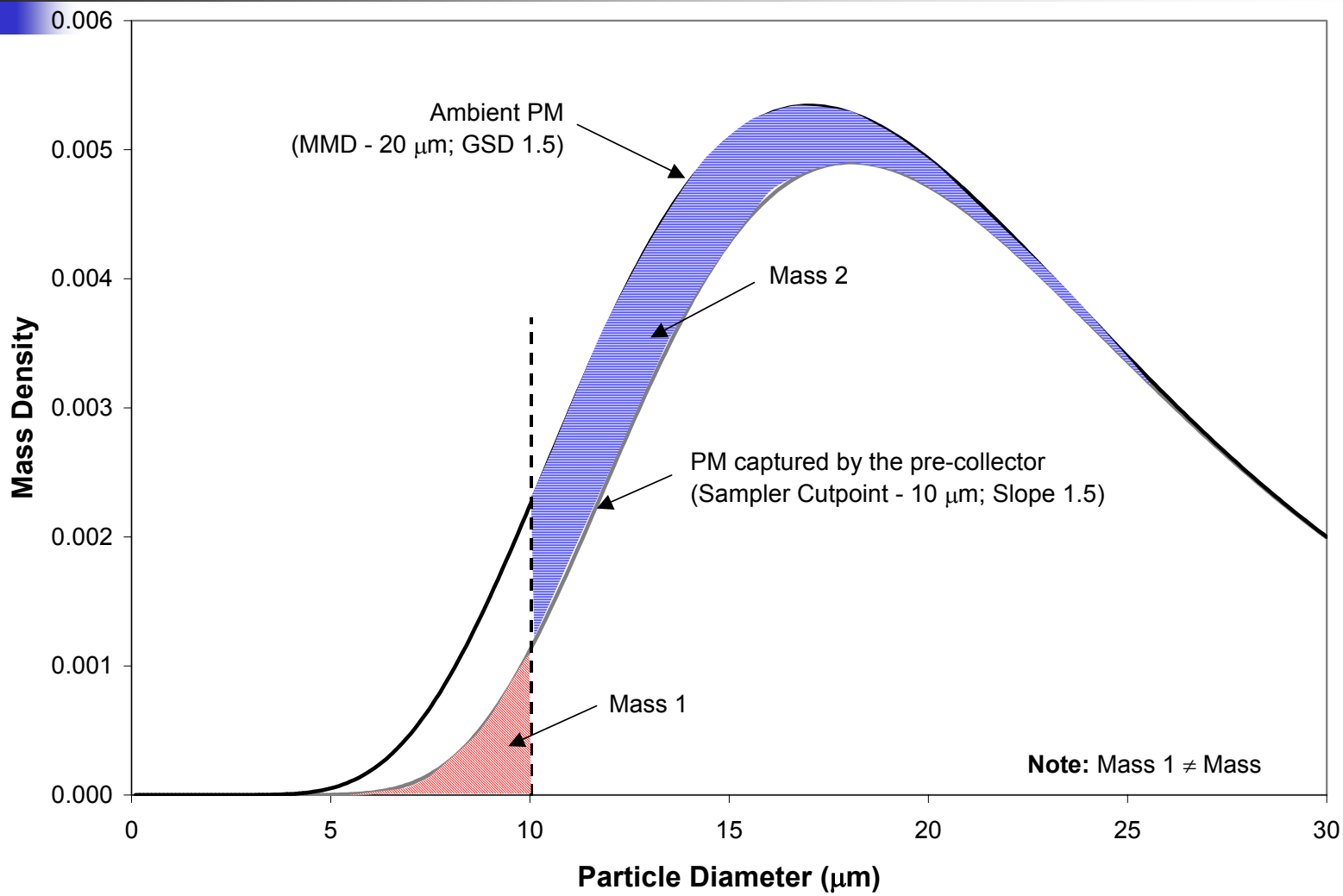
Sampler Nominal Cuts



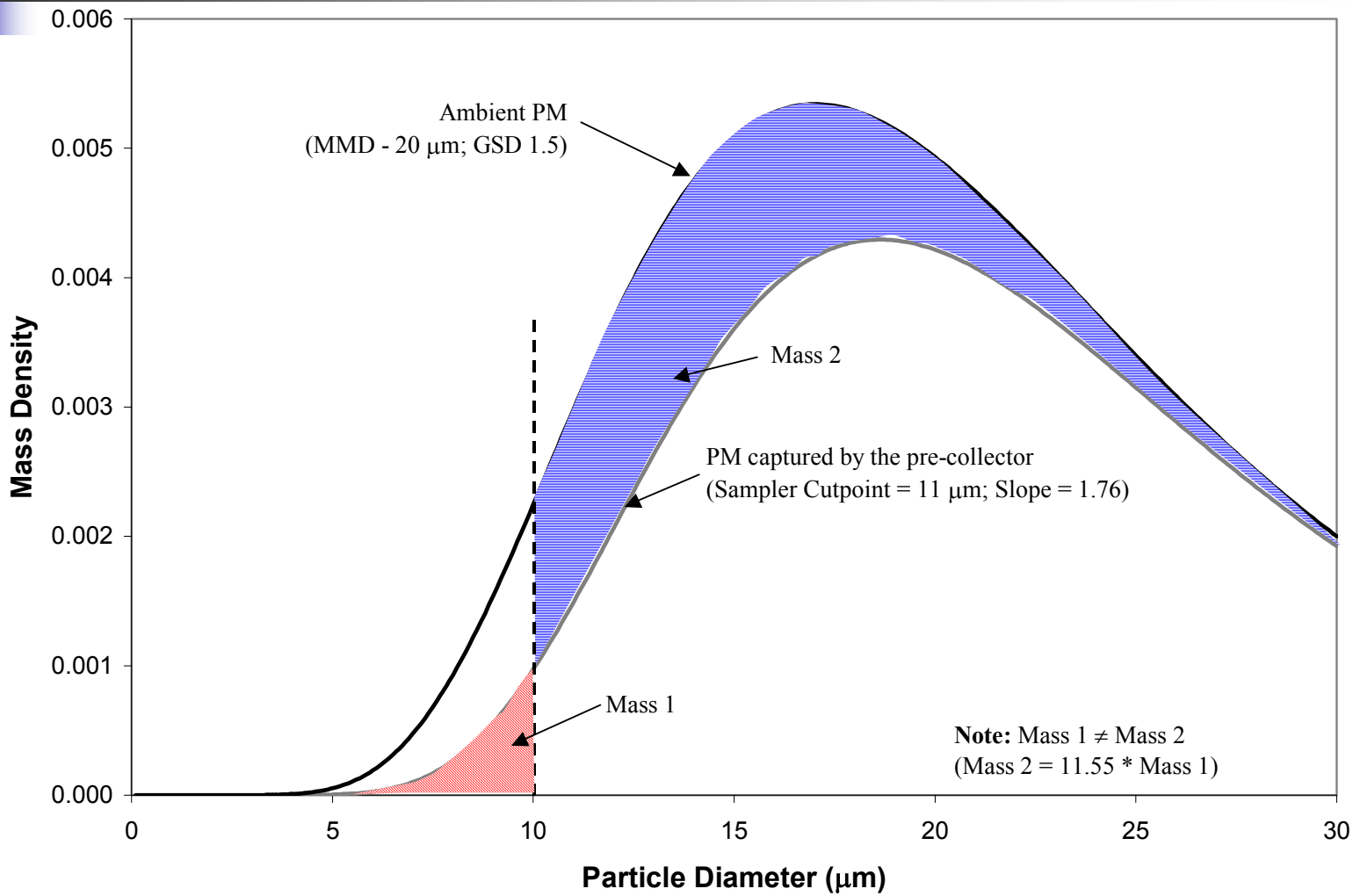
Sampler Nominal Cuts



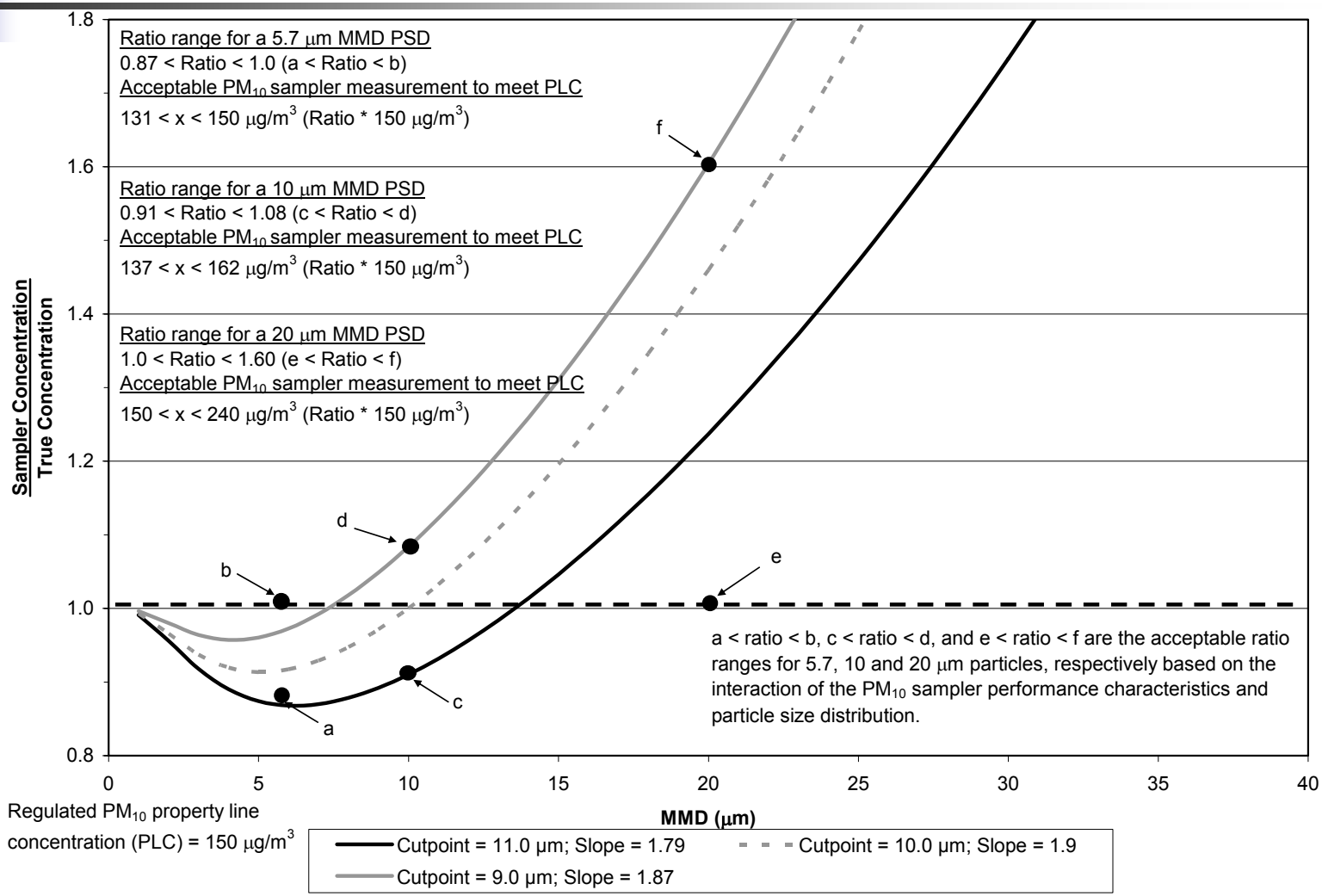
Sampler Nominal Cuts



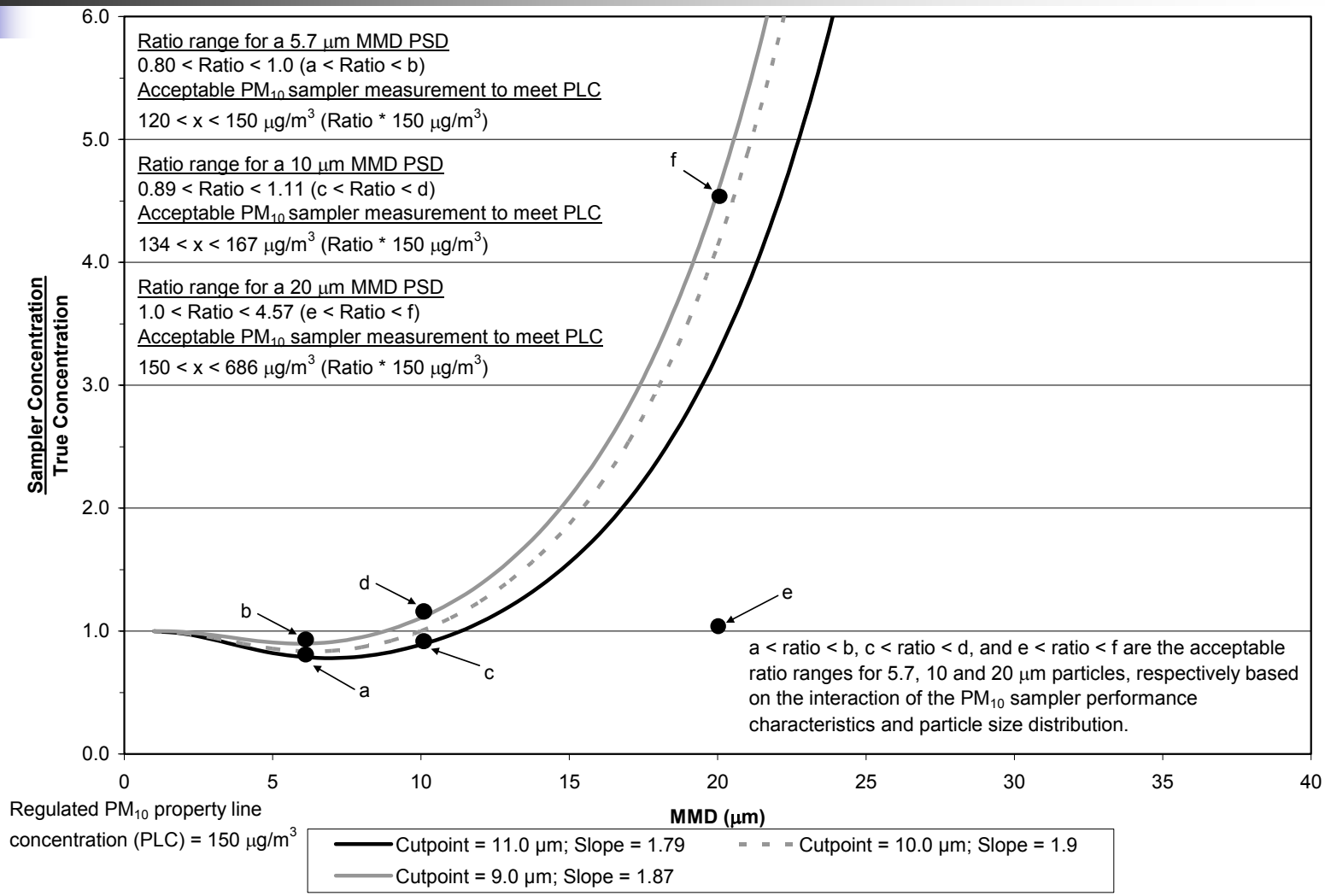
PM_{10} Cyclone Nominal Cut



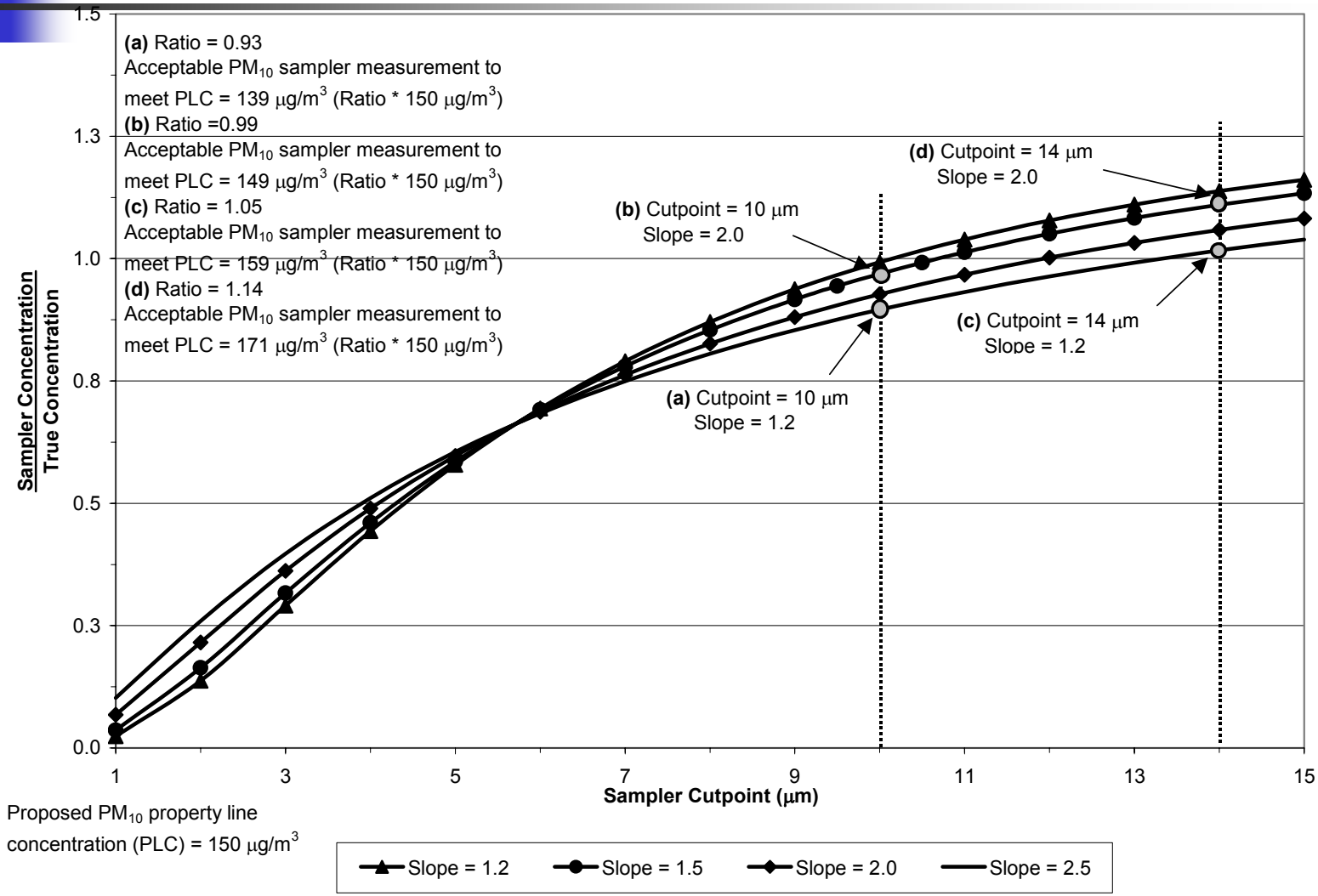
Theoretical Ratios of PM_{10} Sampler to True Concentrations (PSD – GSD = 2.0)



Theoretical Ratios of PM_{10} Sampler to True Concentrations (PSD – GSD = 1.5)

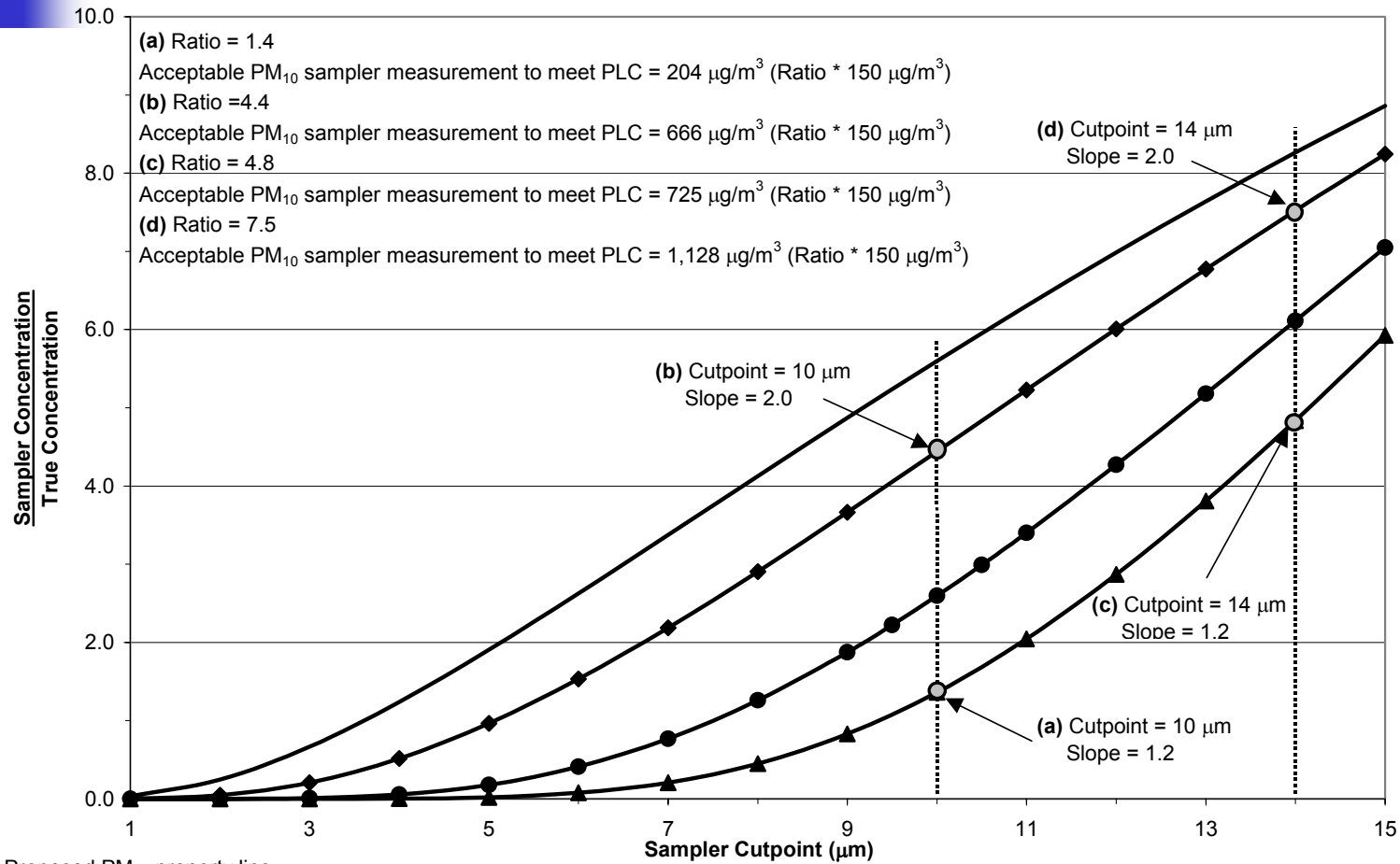


Effects of Varying PM_{10} SPC (PSD: MMD = 5.7 μm; GSD = 2.25)



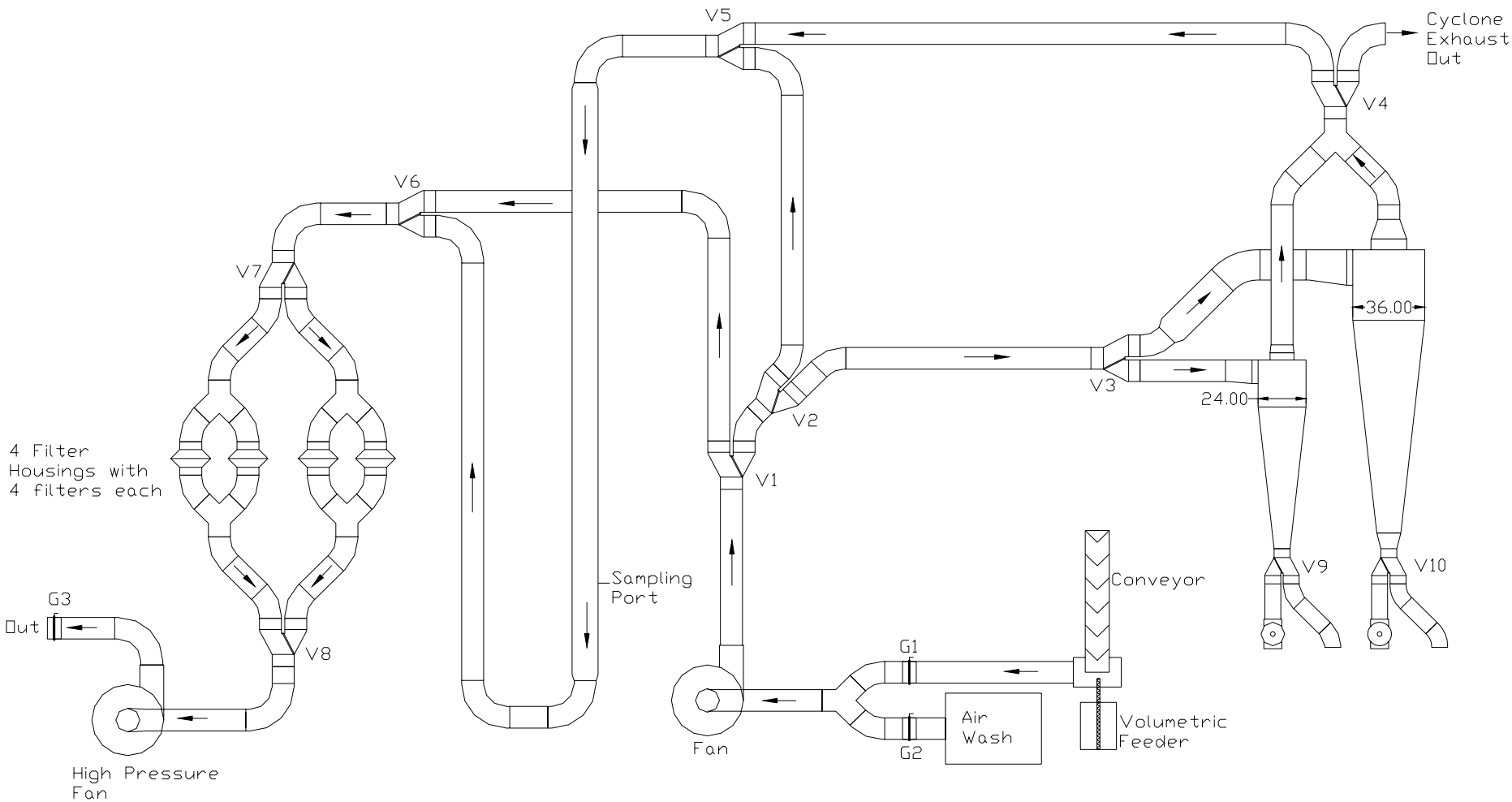
Proposed PM_{10} property line concentration (PLC) = 150 μg/m^3

Effects of Varying PM_{10} SPC (PSD: MMD = 20 μm; GSD =1.5)



Proposed PM_{10} property line concentration (PLC) = 150 μg/m³

Evaluation System



Evaluation System

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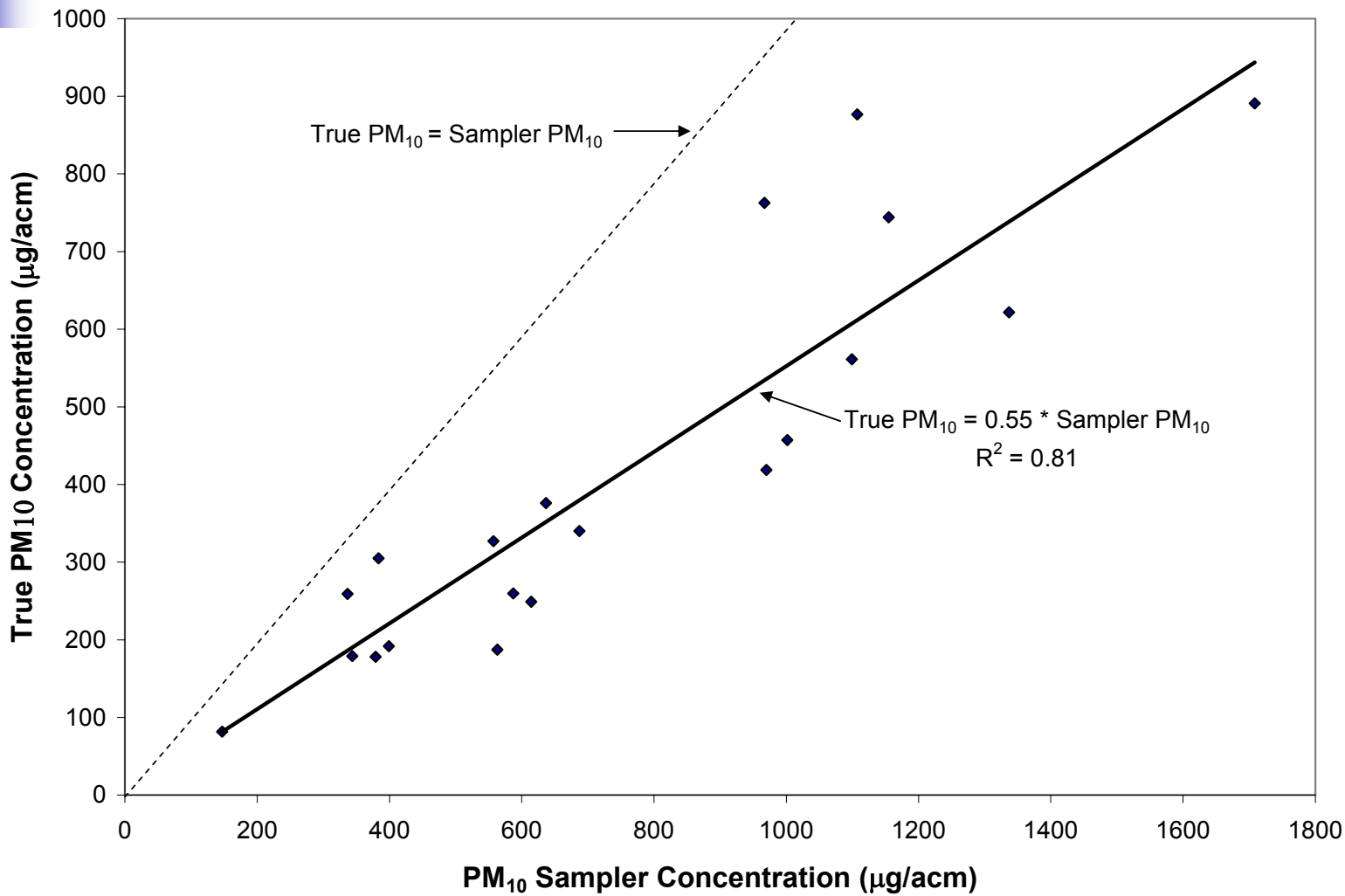
Harvest	Source Sampling			Coulter Counter Analysis (True)			
	TSP*	PM_{10}*	PM_{10}/TSP Ratio	PM_{10}*	$PM_{2.5}$*	PM_{10}/TSP Ratio	$PM_{2.5}$/TSP Ratio
1st Pick	0.1889	0.1192	63.1 %	0.0771	4.3 e^{-4}	40.8 %	0.22 %
2nd Pick	0.1595	0.0898	56.1 %	0.0582	2.7 e^{-4}	35.9 %	0.16 %

* Emission factors reported in lb/bale

PM_{10} Sampler to True PM_{10} Comparison Preview



Example

- Assumptions
  - Method 201a is used to determine the emission concentrations emitted from two sources.
    - Cutpoint = 11 μm; Slope = 1.76.
  - Source 1 – emitting PM with a MMD of 5 μm and a GSD of 1.5 (power plant).
  - Source 2 – emitting PM with a MMD of 20 μm and a GSD of 1.5 (agricultural operation).
  - Both sources are emitting 100 $\mu g/m^3$ true PM_{10}.

Example

- The Method 201a sampler at the power plant would measure 91 $\mu g/m^3$.
  - Under estimation of 9%.
- The Method 201a sampler at the agricultural operation would measure 446 $\mu g/m^3$.
  - Over estimation of 346%.
- Therefore, the current method of regulating PM_{10} is inappropriate when applied to sources emitting large particulate matter.

Conclusions

- From a scientific stand-point, **ALL** institutions conducting air quality research on particulate matter should account for these substantial errors when determining emission factors for specific operations.

Conclusions

- From a regulatory stand-point, **ALL INDUSTRIES and STATE AIR POLLUTION REGULATORY AGENCIES** should be concerned with the errors associated with these site specific regulations.

Air Quality Research at the Cotton Production and Processing Research Unit Lubbock, TX