Representative Subsampling at the Laboratory: New Guidance From USEPA

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Washington Group International
Integrated Engineering, Construction, and Management Solutions

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10,000 TONS
OF
HAZARDOUS (?)
WASTE

SAMPLE

1 QUART

INSTRUMENT

1 GRAM
(ANALYZED)

WHAT DO WE
REALLY KNOW?

John Wiley & Sons 1997

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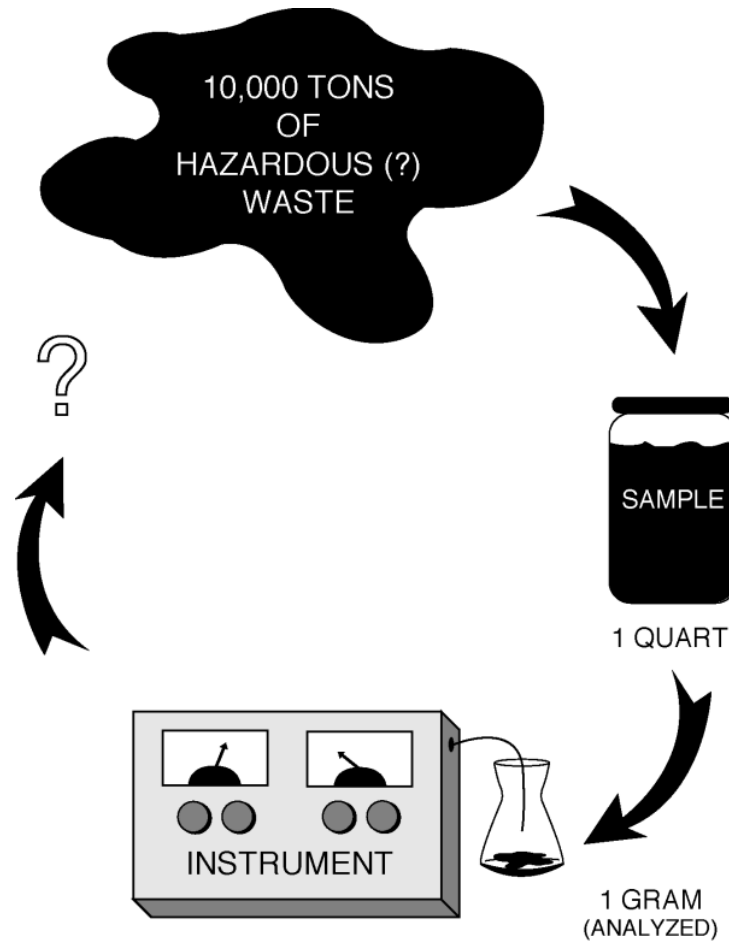
THE SEVEN "DEADLY" SAMPLING ERRORS

GROUPING & SEGREGATION ERROR GE

LONG-RANGE FLUCTUATION ERROR CE2

PERIODIC FLUCTUATION ERROR CE3

FUNDAMENTAL ERROR FE

INCREMENT DELIMITATION ERROR DE

INCREMENT EXTRACTION ERROR EE

PREPARATION ERROR PE

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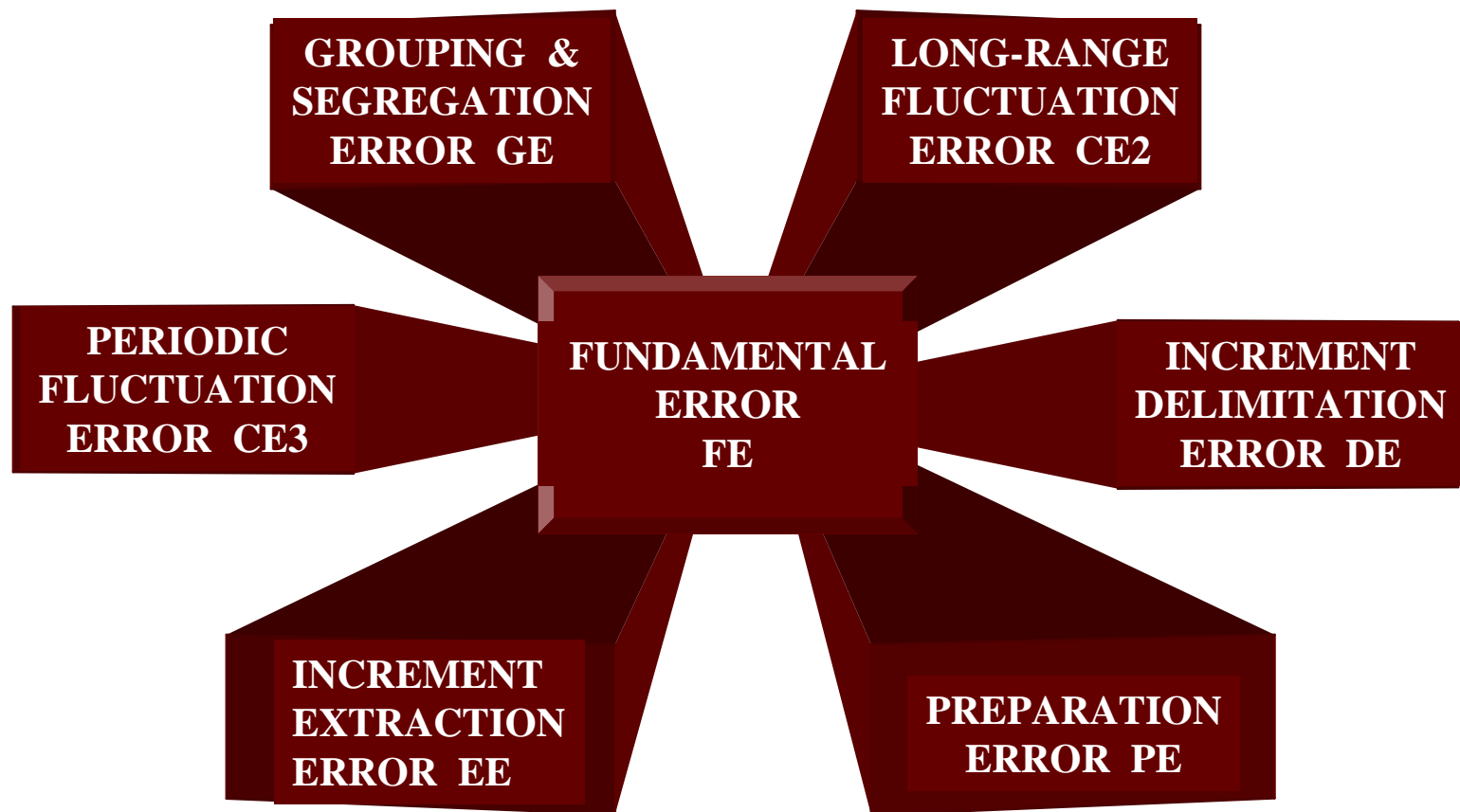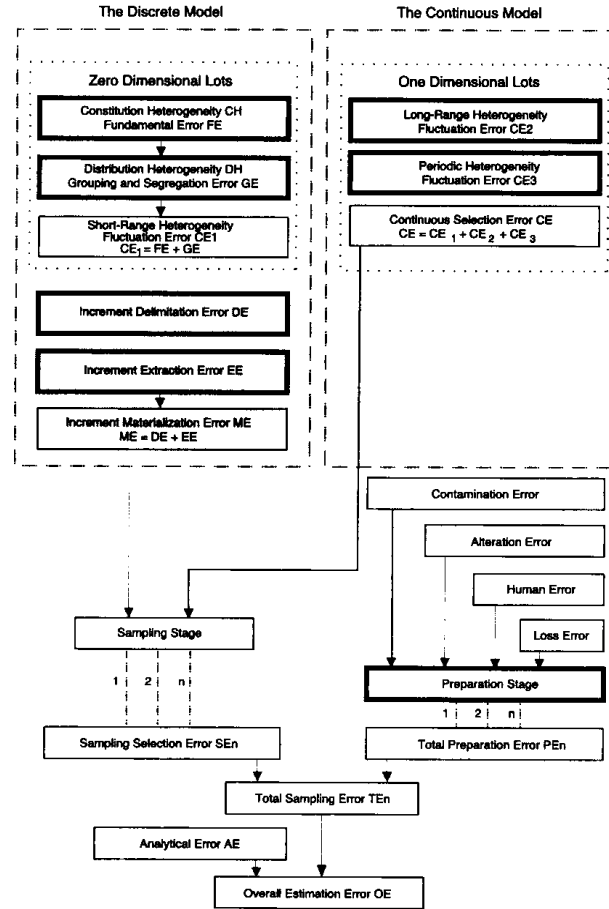
The Seven Basic Sampling Errors

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FORMS OF HETEROGENEITY

COMPOSITIONAL CH

DISTRIBUTIONAL DH

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ZERO DIMENSIONAL LOT

DEFINITION OF CH

DEFINITION OF DH

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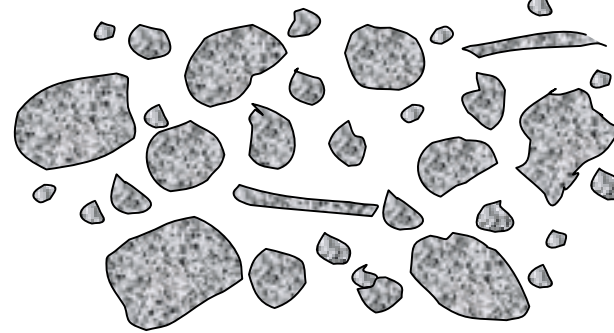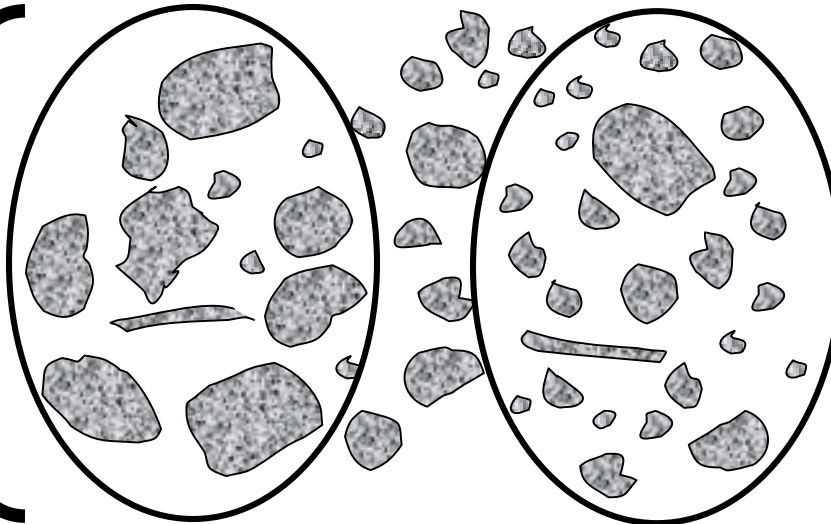
THE TRIAD APPROACH FROM EPA

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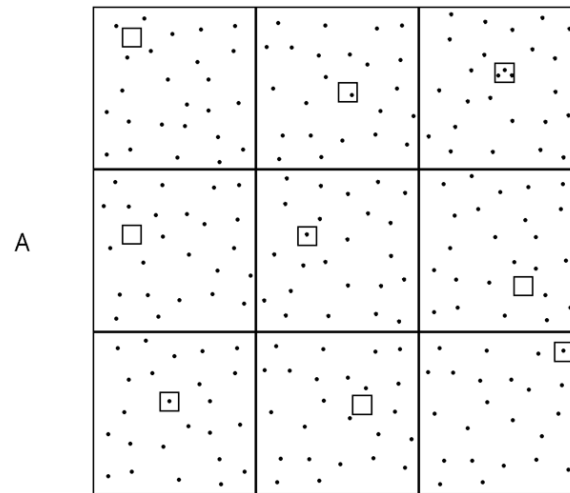
Uncertainties add as vectors ($a^2 + b^2 = c^2$)

Total Uncertainty
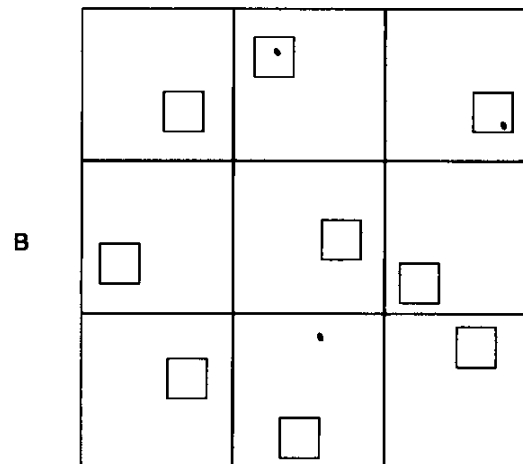
Analytical Uncertainty

A

Sampling Uncertainty

3 X

B

C

1/3 X

A

C

B

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Analytical = 5%

Sampling = 95%

331 On-site
286 Lab

500 On-site
416 Lab

39,800 On-site
41,400 Lab

164 On-site
136 Lab

27,800 On-site
42,800 Lab

24,400 On-site
27,700 Lab

1,280 On-site
1,220 Lab

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A

B

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Poisson Distributions with Mean = ⊙

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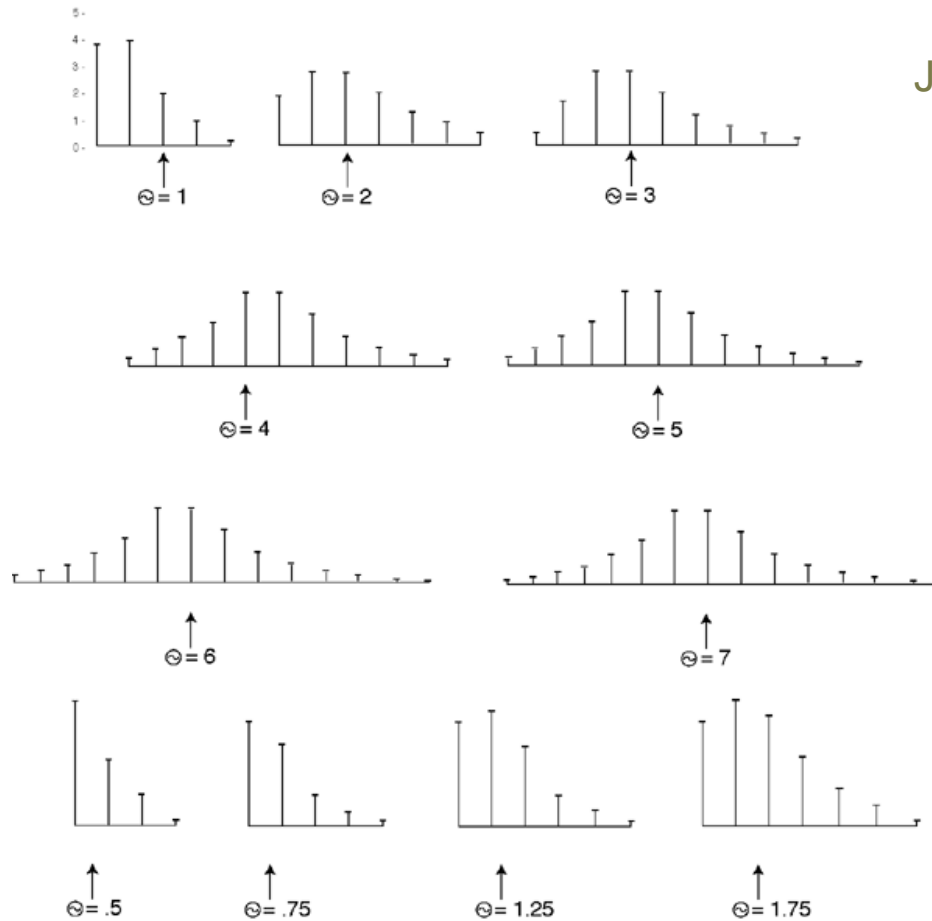
$$FE^2 = \frac{(22.5)(D^3)}{MASS}$$

- FE = FUNDAMENTAL ERROR
- D = DIAMETER OF LARGEST PARTICLE
- MASS = MASS OF ANALYZED PORTION

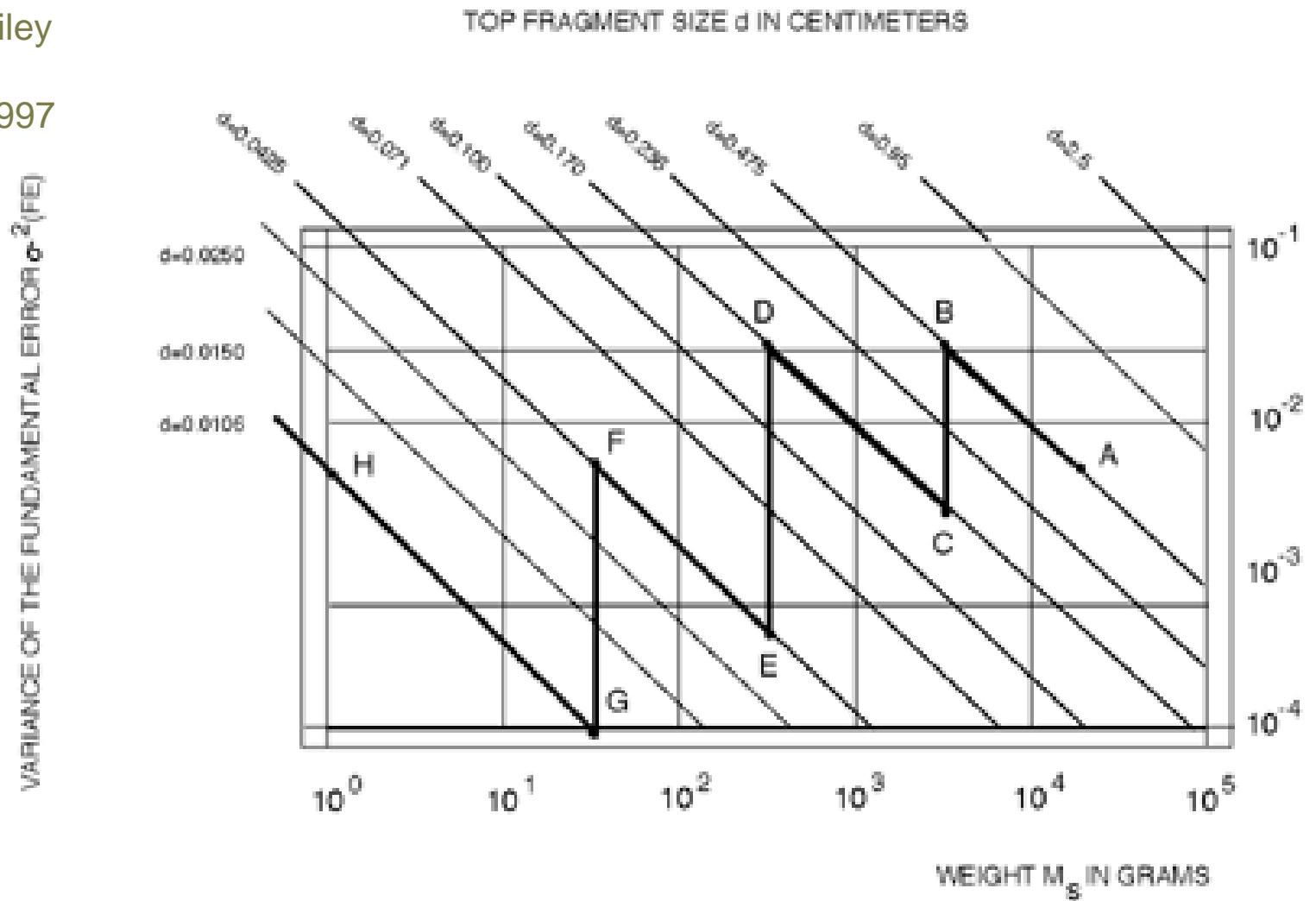**Washington Group International**

RELATIVE FUNDAMENTAL ERROR: PARTICLE SIZE REPRESENTATION
(RAMSEY 1990)

SAMPLE MASS	APPROX. ERROR
1 gm	40%
2 gm	30%
5 gm	20%
10 gm	15%
20 gm	10%

PARTICLE SIZE = 2mm

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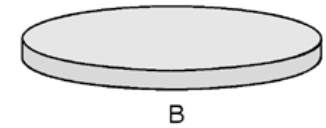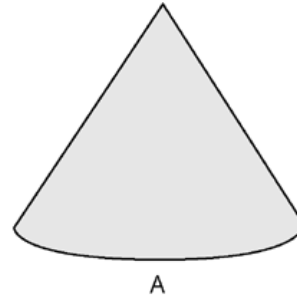**Washington Group International**
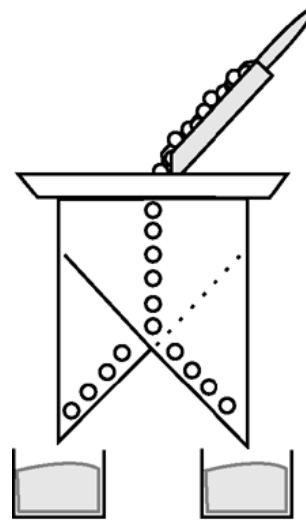
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SUBSAMPLING METHODS
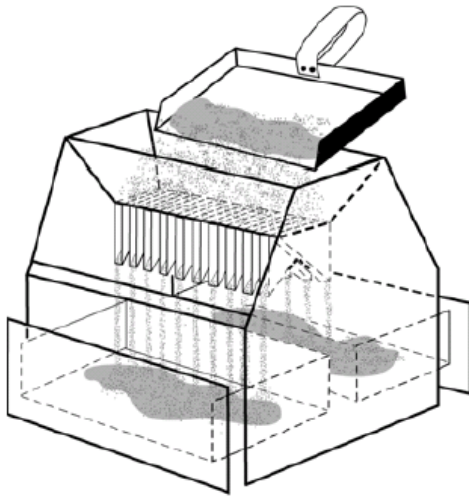
- **CONING & QUARTERING**
- **ALTERNATE SHOVELING**
- **FRACTIONAL SHOVELING**
- **RIFFLE SPLITTERS**
  - CHUTE
  - ROTARY

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CONING & QUARTERING

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RIFFLE SPLITTERS

A

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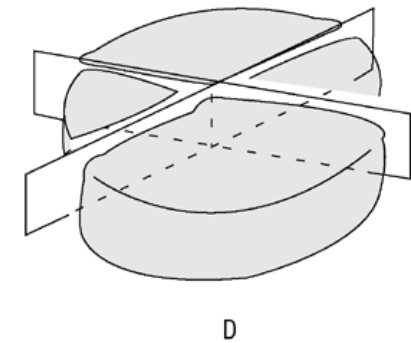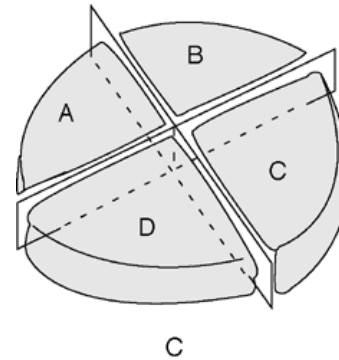
CORRECT AND INCORRECT SAMPLING DEVICES

Incorrect Design

Correct Design

Spatula

Flat without edges: material segregates when falling off each side
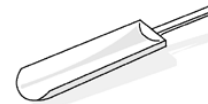
Spatula

Square edges prevent material from falling off each side

Scoop

Round shape: material at the top of a flattened sample has more chance to be part of an increment than the material at the bottom
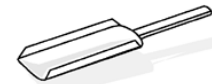
Scoop

Square shape: all material has the same chance to be part of the increment

Shovel

Round shape: material at the top of a flattened sample has more chance to be part of an increment than the material at the bottom

Shovel
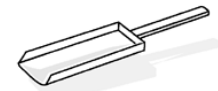
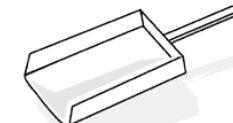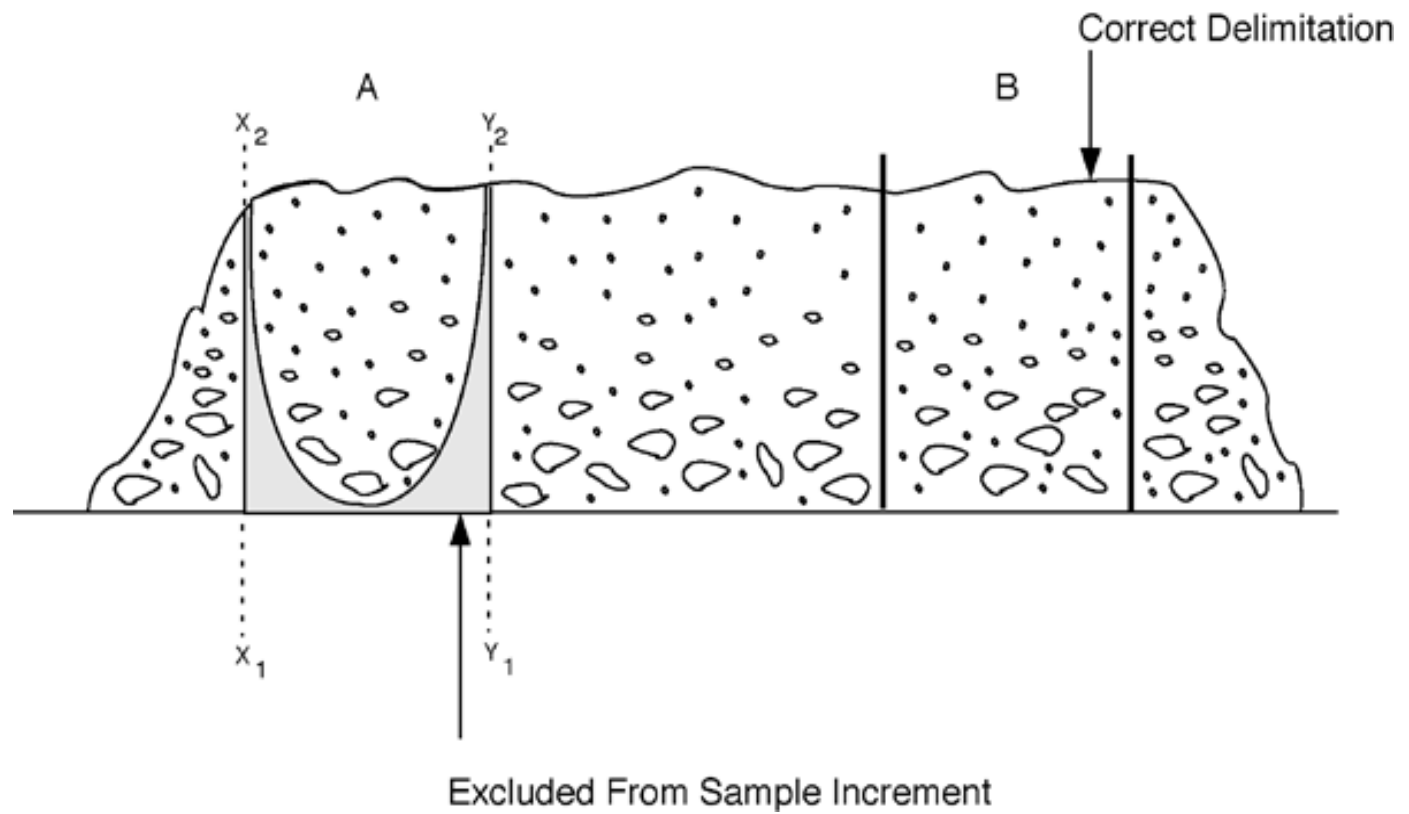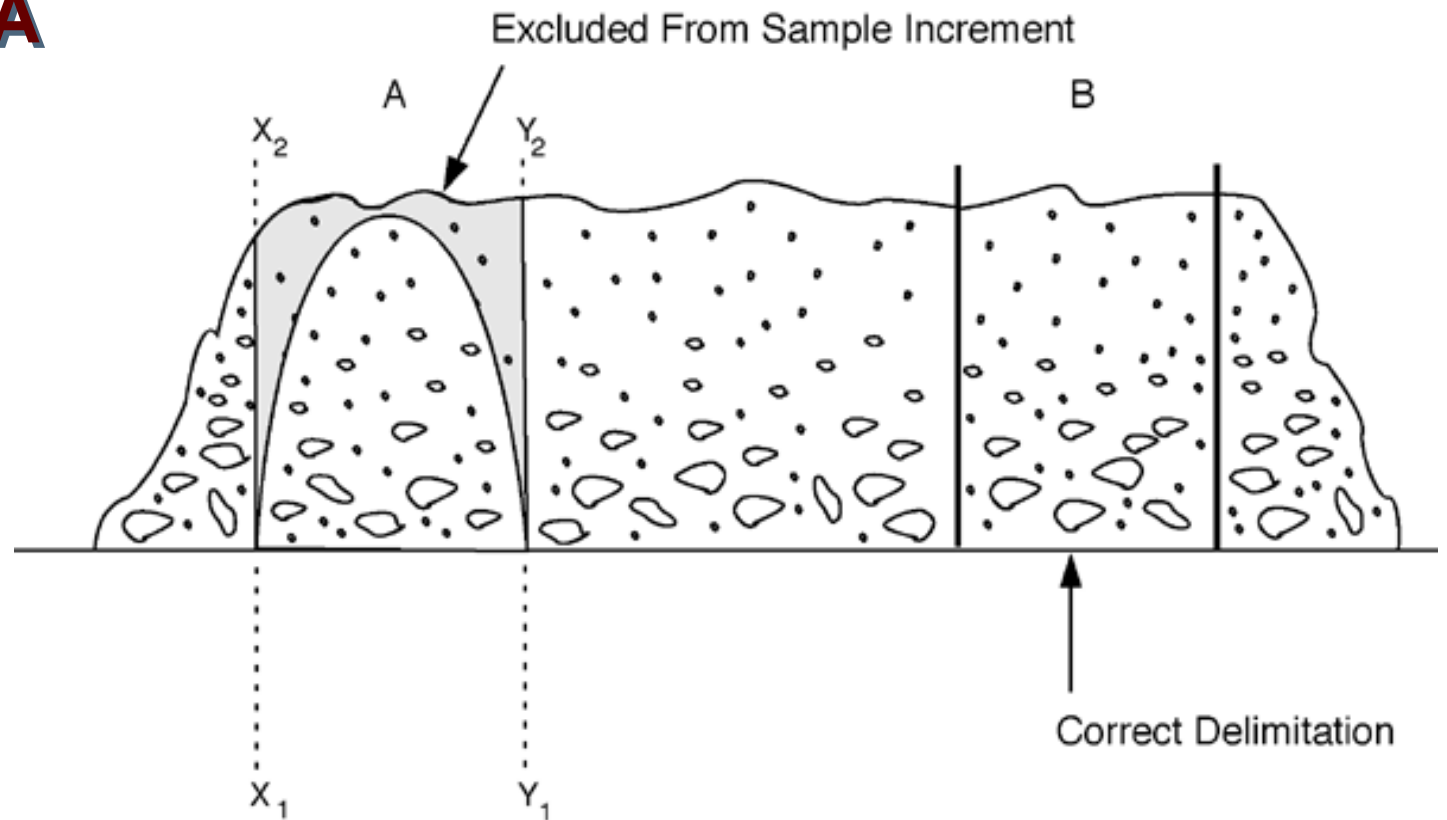Square shape: all material has the same chance to be part of the increment

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SCOOP

Correct Delimitation

Excluded From Sample Increment

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SPATULA

Excluded From Sample Increment

Correct Delimitation

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JAPANESE SLAB CAKE

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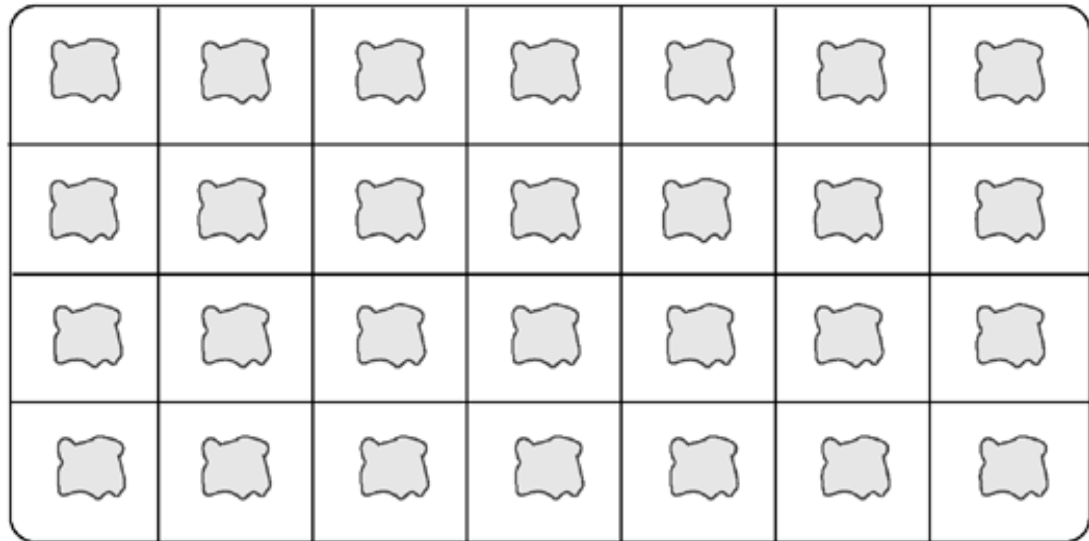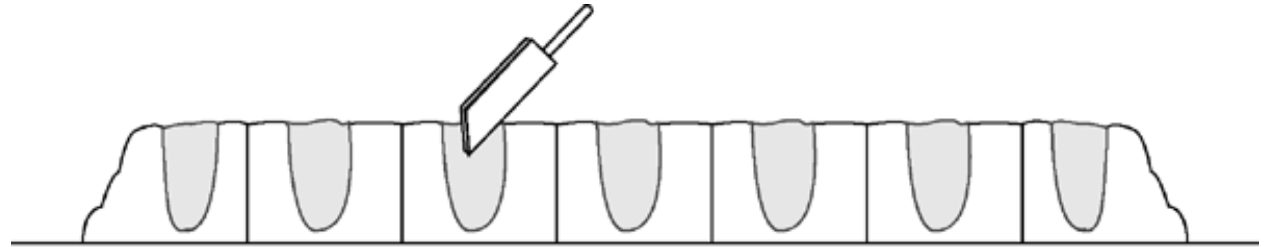
CORRECT DELIMITATION WITH JAPANESE SLAB CAKES

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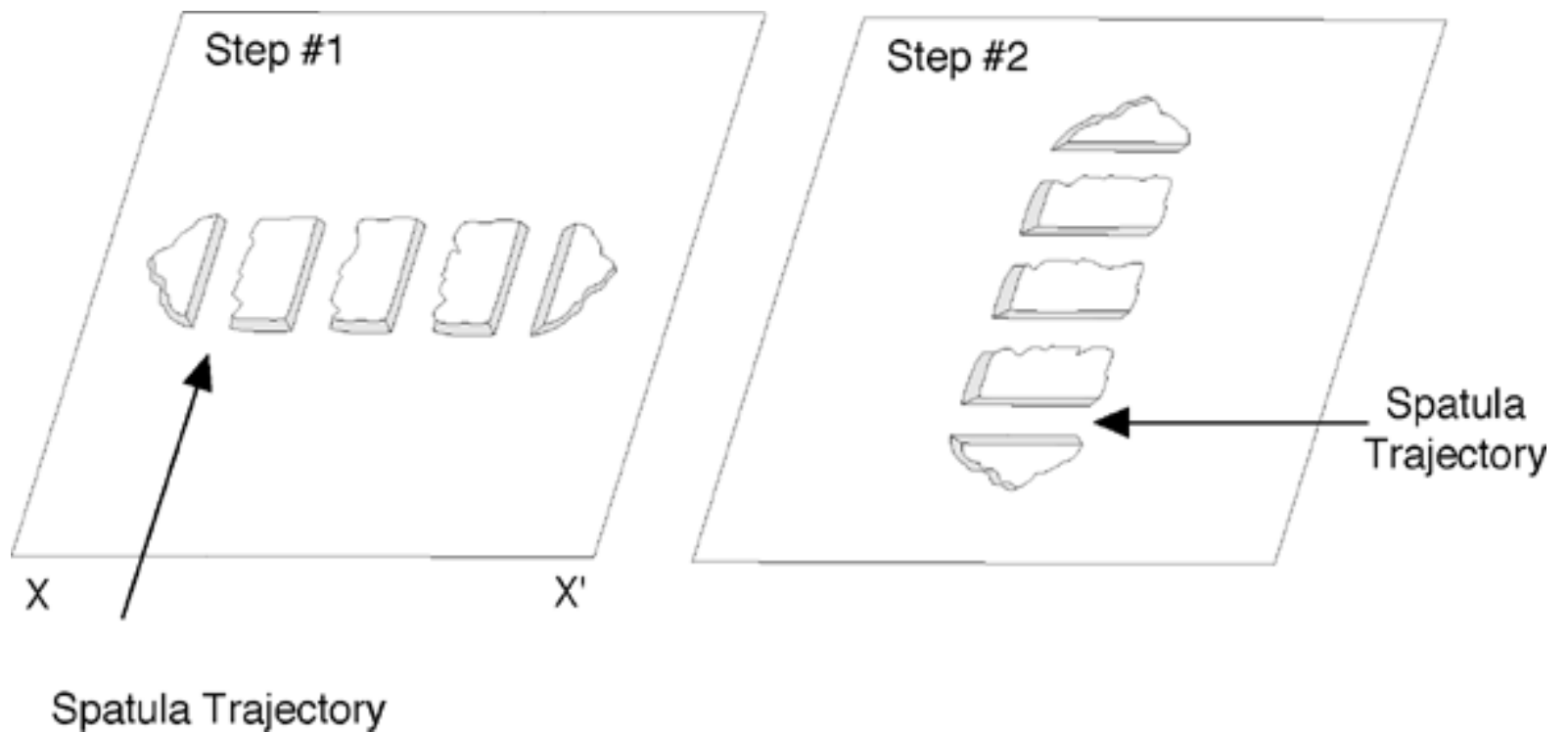
SUMMARY

- PIERRE GY'S SAMPLING THEORY
- EPA/600/R-03/027

- http://cluin.org/publications/db/db_search.cgi?new=1&title=1&submit_search=1

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