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# Remediation and Liability Cost Estimating

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# Subtitle: Unravelling a tangle of string

- **Consultant:** **We found contamination.**
- **Site Owner/Operator:** **What will it cost to clean up?**
- **Consultant:** **How long is a piece of string?**

Aztecvideo.co.uk

# CONTENTS

# Uncertainty In & Causes of Cost Estimate Over-Runs

# Uncertainty In & Causes of Cost Over-Runs

- Phase 1 ESA not done or incomplete, APECs and/or COPCs missed
- Contamination poorly delineated, poor soil volume estimates
- Insufficient boreholes and/or test pits
- Poor sampling methodology
- Vertical delineation not achieved
- Conceptual Site Model more complicated than realized
- Data not fully or properly analysed
- Fractured till or bedrock, LNAPL transport through fractures
- Perched water tables, fluctuating water tables
- Sporadic contaminant distribution (“jelly bean” maps)

# Uncertainty & Causes cont'd

- Tier 2 approaches misunderstood
- Basis of estimate not well defined
- Insufficient remedial engineering system design and pilot testing, particularly with innovative technology & complicated CSMs
- Conceptual engineering design taken as detailed
- Proponent expectations & communication e.g. not allowing for uncertainty in estimates, consultant scope creep
- Weather conditions (particularly northern sites)

# Uncertainty & Causes cont'd

➢ Other

- Key staff changes, property owner/operator changes
- Compressed schedules
- Changes in remediation criteria
- Unexpected remedial process optimization required
- Inadequate confirmatory sampling

# Cost Over-Runs: Soil Volume Estimates

- What do horizontal and vertical distribution of contamination look like?
- Were there limitations to the sampling method? Logging?
- Where are the APECs, how was contaminant released?
- Are there cross-sections? What controlled fate and transport? Is this consistent with apparent distribution?
- If there are inferred “jelly beans”, are they real?
- Was full delineation achieved? Is correlation with other parameters consistent? For LNAPL sites, did holes go to water or permafrost?
- Do excavation estimates account for side slopes and precision of equipment?

# Uses of Cost Estimates

# Uses of Remediation and Liability Cost Estimates

- **Regulatory Compliance**
- Regulatory directives, regulated facilities, remediation and reclamation certificates
- Alberta AER requirements for liability assessments

- **Financial Liability Reporting Requirements**
- Publically-traded private companies (Canadian Securities Administrators)

- Government organizations (Public Sector Accounting Board)

- **Asset Management**
- Baseline studies, site management, liability reduction/closure
- Infrastructure management/protection

# Uses cont'd

- **Asset Purchase/Sale**
  - Real estate transactions, purchase price discounts
  - Corporate mergers & acquisitions
  - Brownfields redevelopment

- **Infrastructure Pre-Design and Design Studies**
  - Alternatives screening
  - Construction cost estimates
  - Materials compatibility with contamination

- **Cost-Cap Insurance Underwriting**

# Financial Liabilities

- Accounting Equation

  Assets = **Liabilities** + Equity

- IFRS Framework and IASB definition (paraphrased)
  - present obligations arising from past events expected to arise in outflow of resources (payment)
- Public Sector Accounting Handbook (Section 3200.05)
  - present obligations arising from past transactions or events expected to result in future sacrifice of economic benefits

# Financial Liabilities cont'd

What if we're not sure what the liability is?

- Provision
  - Liability of uncertain timing or amount
  - Payment is probable and can be estimated reliably
  - Environmental cleanups measured at most likely amount under Canadian guidelines
- Contingent Liability
  - Possible obligation depending on whether some future event occurs, or
  - Payment not probable or amount cannot be measured reliably

Deloitte (2010) International Accounting Standard 37

# The Cost Estimating Toolbox

# Fundamental Characteristics of Cost Estimates (AACE International)

- Primary Characteristic
- Maturity level of project definition and end use of the estimate e.g. alternatives screening, conceptual design, detailed design, bid/tender
- Secondary Characteristics
- Basis of estimate i.e. SWAG, parametric and/or deterministic
- Type of estimate e.g. simple range, engineering estimate, probabilistic range
- Effort/cost to prepare the estimate relative to project risk

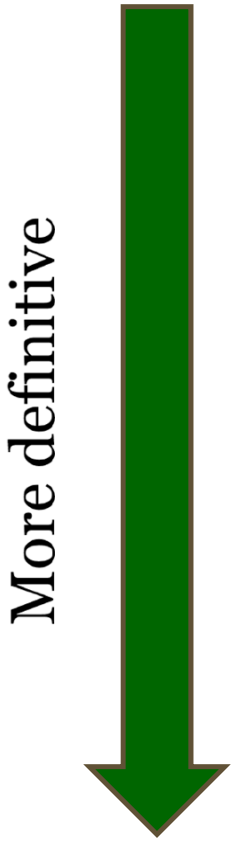
Modified from AACEI (2011) Cost Estimate Classification System

# AACE International Classification System

| | *Primary Characteristic* | *Secondary Characteristic* | | | |
|---|---|---|---|---|---|
| **ESTIMATE CLASS** | **MATURITY LEVEL OF PROJECT DEFINITION DELIVERABLES** Expressed as % of complete definition | **END USAGE** Typical purpose of estimate | **METHODOLOGY** Typical estimating method | **EXPECTED ACCURACY RANGE** Typical +/- range relative to index of 1 (i.e. Class 1 estimate) [a] | **PREPARATION EFFORT** Typical degree of effort relative to least cost index of 1 [b] |
| **Class 5** | 0% to 2% | Screening or feasibility | Stochastic (factors and/or models) or judgment | 4 to 20 | 1 |
| **Class 4** | 1% to 15% | Concept study or feasibility | Primarily stochastic | 3 to 12 | 2 to 4 |
| **Class 3** | 10% to 40% | Budget authorization or control | Mixed but primarily stochastic | 2 to 6 | 3 to 10 |
| **Class 2** | 30% to 75% | Control or bid/tender | Primarily deterministic | 1 to 3 | 5 to 20 |
| **Class 1** | 65% to 100% | Check estimate or bid/tender | Deterministic | 1 | 10 to 100 |

Notes: [a] If the range index value of "1" represents +10/-5%, then an index value of 10 represents +100/-50%.
[b] If the cost index value of "1" represents 0.005% of project costs, then an index value of 100 represents 0.5%.

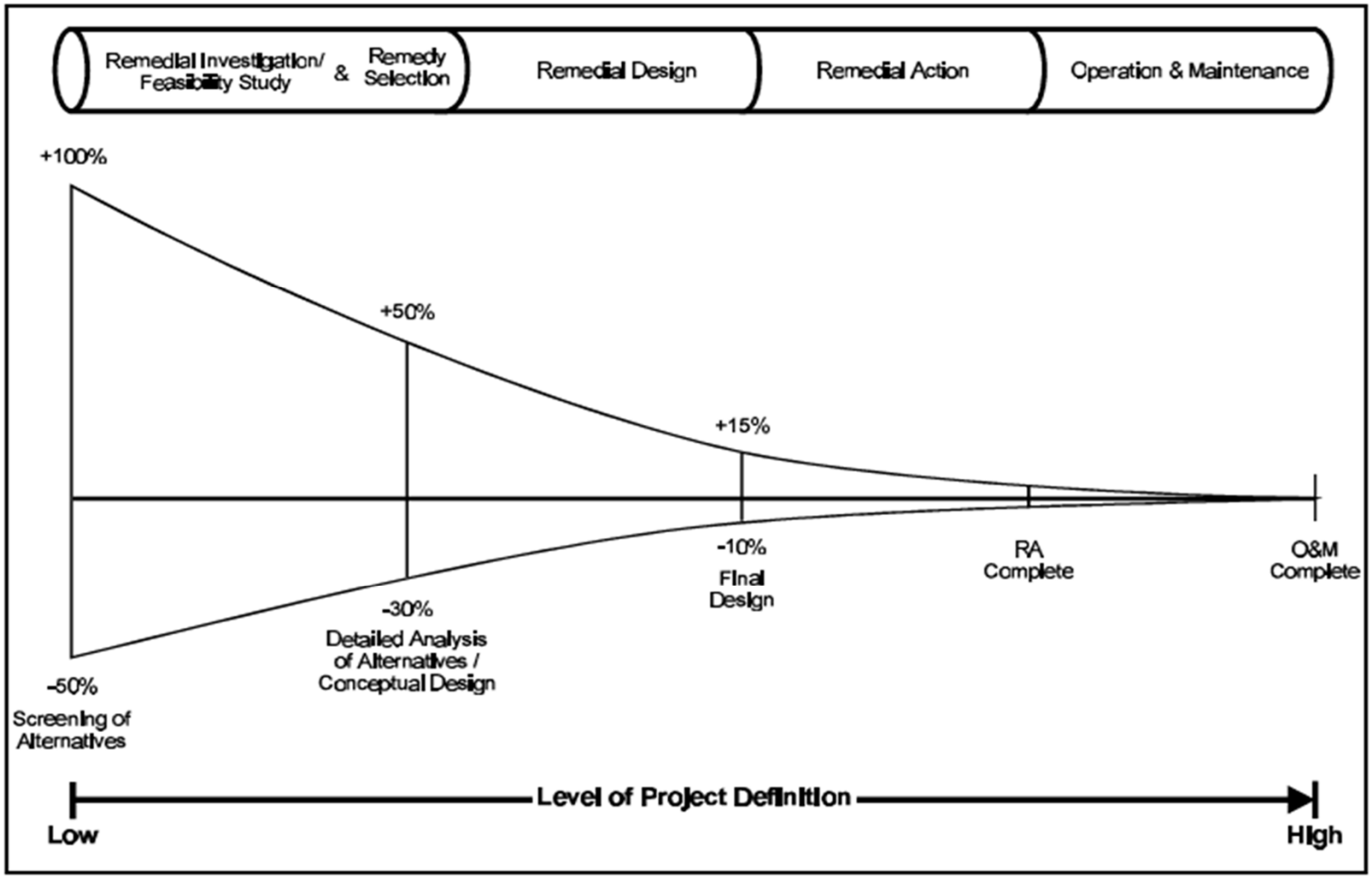
# Example Classification Systems




| AACE Int'l | ANSI Z94.0 | Treasury Board, CEBC | WorleyParsons |
|---|---|---|---|
| 5 | Order of Magnitude | D | 1 |
| 4<br>3 | Budget Estimate | C | 2 |
| 2 | Definitive Estimate | B | 3 |
| 1 | | A | 4 |

Bronsro (2012)

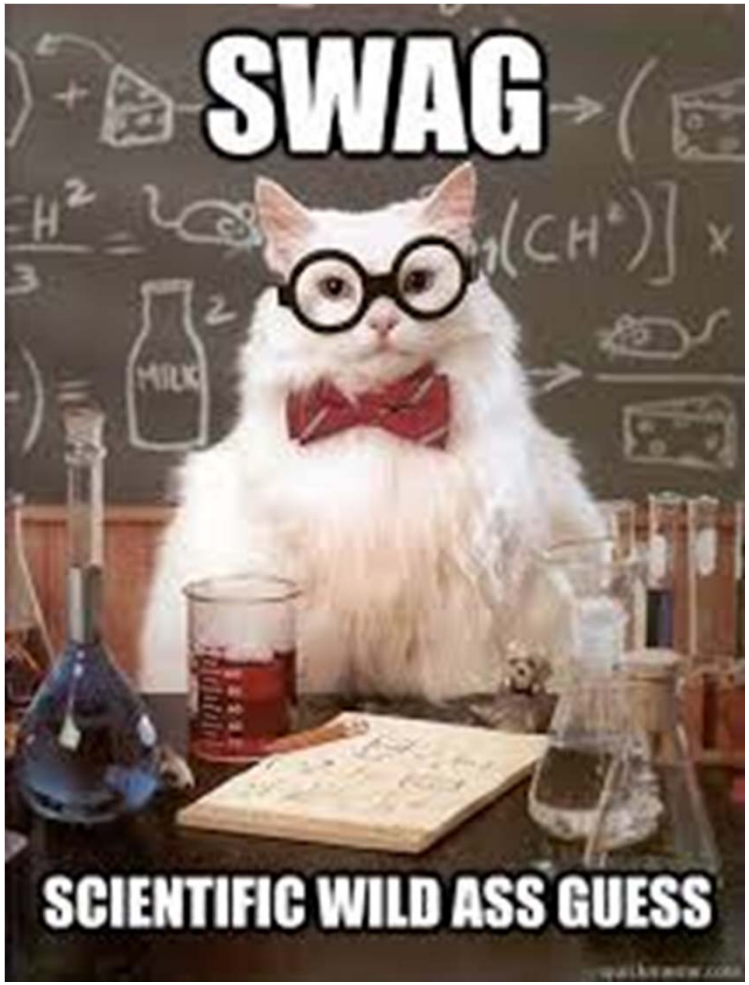
# USEPA Superfund Cost Classification System




USEPA & USACE (2000)

A Guide to Developing and Documenting Cost Estimates During the Feasibility Study

# Basis of Estimate - SWAG




www.quickmeme.com

# Basis of Estimate

- Parametric - cost rates used for estimate are indirectly related to project, such as professional experience and judgment, and scaling factors (called “stochastic” by AACE International)
- Deterministic - cost estimates are directly related to project such as contractor estimates and bids, consultant proposals

Useful Website:
Federal Remediation Technologies Roundtable
http://www.frtr.gov/


RS Means Cost Estimating Guide (Rast & Rast 2003)

# Type of Estimate

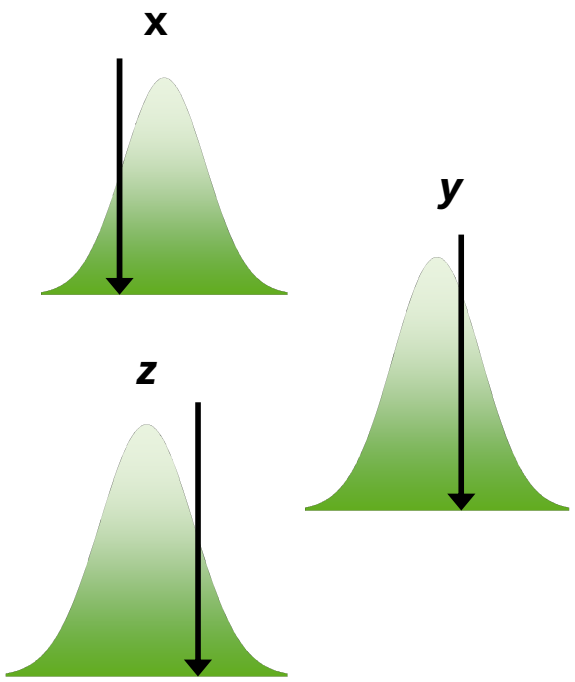
- Simple range

- Single-point engineering estimate
  - typically with a +/- depending on project stage
  - Most likely scenario

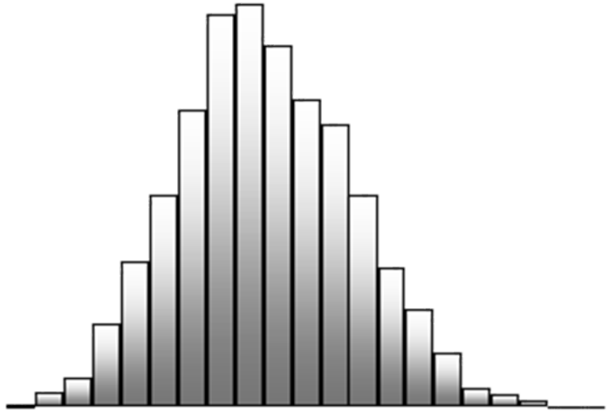
- Probabilistic estimates
  - Probability-weighted average
  - Monte carlo distributions

# Probabilistic Monte Carlo Simulations

**Input Variables** ⇨ **Model Equation** ⇨ **Results Distribution**




$$F(x_i, y_i, z_i) = R_i$$



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# Concluding Thoughts

# Where Engineering Approaches Work and Where They Need to be Modified

➢ **Where engineering approaches work**

- Definitions/considerations of the primary and secondary characteristics of estimates
- Emphasis on describing basis of estimate and uncertainty

➢ **Where engineering approaches need to be modified**

- Recognition of much greater uncertainty in remediation and liability cost estimating
- Consideration of more types of estimate values at early stages of ESA and remediation process

# And Finally….

- **Pick a tool appropriate to the:**
  - Project stage
  - End use of the estimate
  - Effort/cost to prepare the estimate relative to project size, complexity and risk

- **Carefully think about and describe the basis of design and uncertainty in the estimate**

- **Communicate regarding what you are doing and why and get key stakeholder feedback**

# Thank you!

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