11th Annual British Columbia ML/ARD Workshop

Panel Discussion

December 2, 2004

BGC ENGINEERING INC.
AN APPLIED EARTH SCIENCES COMPANY

Questions: For a 50 ha dump with 5 km of ditch and a cover set to limit infiltration to 80%..

What triggers should be used to initiate repairs or replace the soil cover? *Or what do you need to look at to know the cover is broken?*

How often and extensive do you predict these repairs to be? Or*?* *how often do you have to fix it and how much will it cost?*

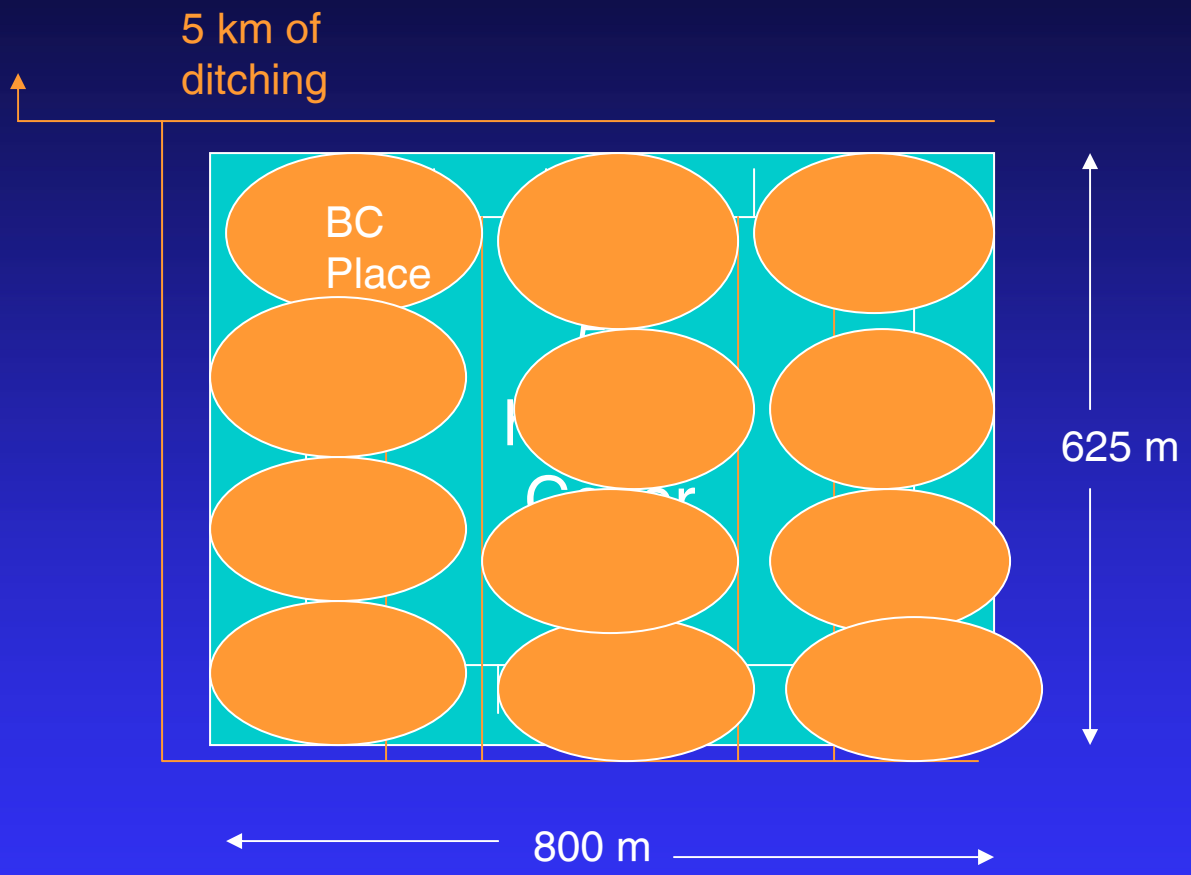
Regulators need to establish a fair bond??

42?

It depends….

BGC ENGINEERING INC.
AN APPLIED EARTH SCIENCES COMPANY

Given the following:



- limit infiltration to 80%

BGC ENGINEERING INC.
AN APPLIED EARTH SCIENCES COMPANY

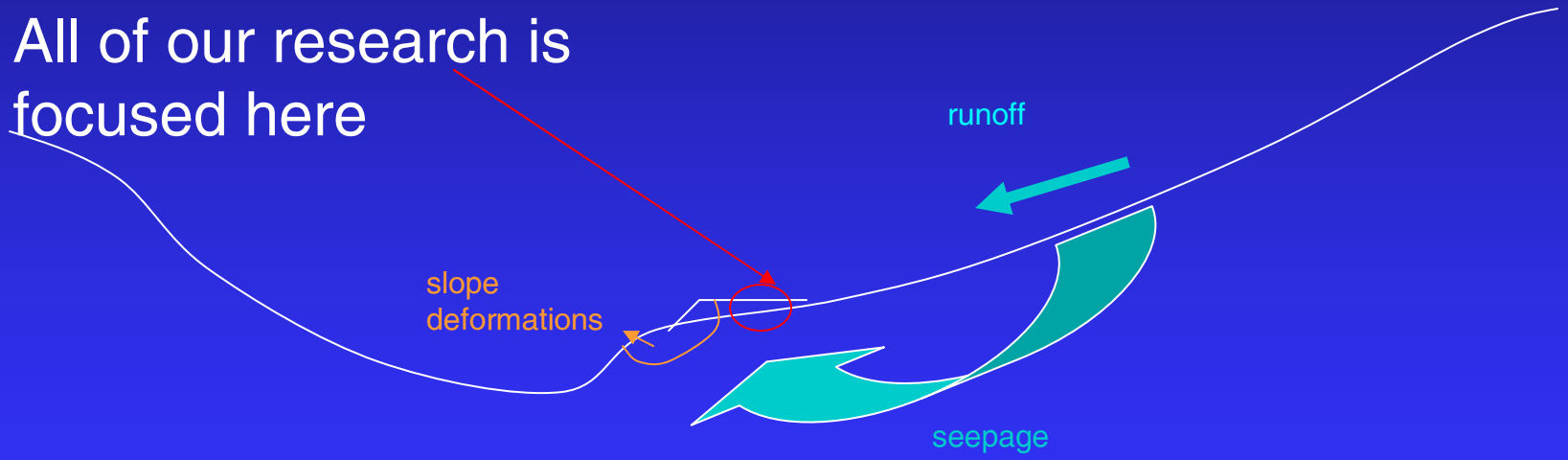
Cover is 1 to 2 m thick

What makes us think we'll have a good cover in the first place?

BGC ENGINEERING INC.
AN APPLIED EARTH SCIENCES COMPANY

Need to look at the big picture, we need to see the system…

All of our research is focused here



BGC ENGINEERING INC.
AN APPLIED EARTH SCIENCES COMPANY

Is it flat area on tailings or a steep waste dump susceptible to erosion?

BGC ENGINEERING INC.
AN APPLIED EARTH SCIENCES COMPANY

Where have you built this dump cover?

How forgiving is the environment and have you selected the right type of cover system?

BGC ENGINEERING INC.
AN APPLIED EARTH SCIENCES COMPANY

So what do we use to define if its broken?

We want to reduce water infiltration by 80%? 80% of of each year or 80% over life of structure?? 80% of the 200 year storm?What really is the target? Reduce infiltration or reduce exit loadings. 80% with or without maintenance?

Performance based may be ok because just have to treat ??

K.I.S.S.

BGC ENGINEERING INC.
AN APPLIED EARTH SCIENCES COMPANY

Can you monitor quantity and quality on large scale? Catch it at the dump toe or is it too late then?

BGC ENGINEERING INC.
AN APPLIED EARTH SCIENCES COMPANY

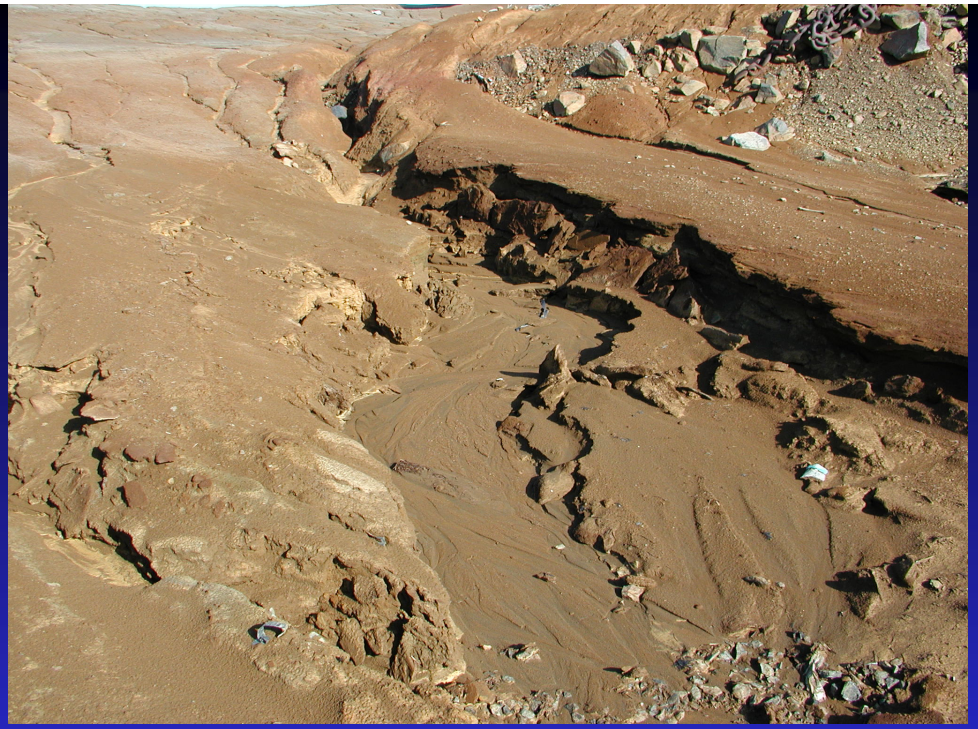
What triggers should be used to initiate repairs or replace the soil cover?

BGC ENGINEERING INC.
AN APPLIED EARTH SCIENCES COMPANY

Will an annual inspection work?

BGC ENGINEERING INC.
AN APPLIED EARTH SCIENCES COMPANY

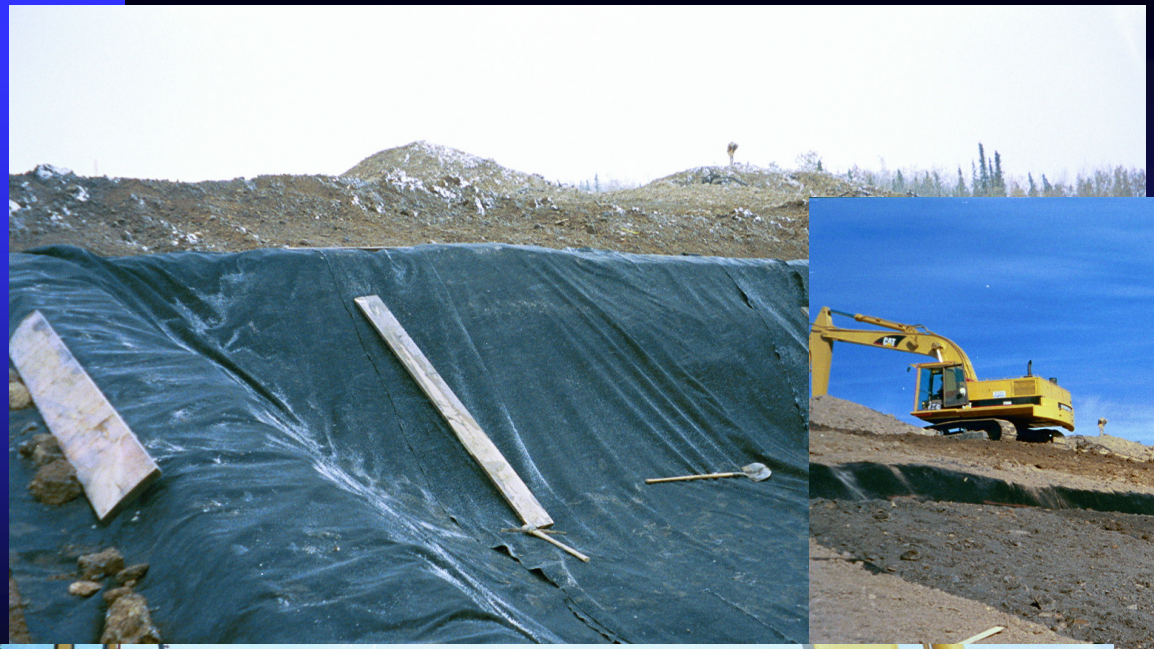
Can you recognize and quantify erosion?



Can you monitor for vegetation issues with time? Sacramento covers didn't show any differences…

Can you recognize long term cover deteriorations from animals like Rum Jungle and mitigate against them?

BGC ENGINEERING INC.
AN APPLIED EARTH SCIENCES COMPANY

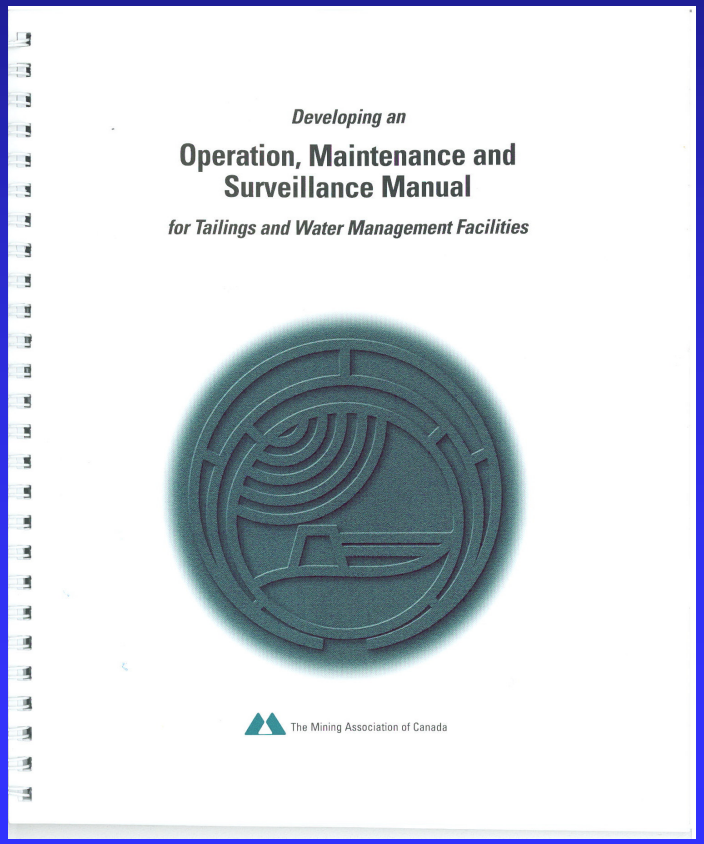


Can you monitor for seepage rates? Can you build a Lysimeter and assess suitability in a timely manner?

BGC ENGINEERING INC.
AN APPLIED EARTH SCIENCES COMPANY

Instrumentation can help.. But can't put them in just for the sake of installing it.

A Surveillance Manual will help to formalize the system and identify targets. Need a predicted performance for comparison.



CAUTION!! Instruments can be misleading

MAC Guide to OMS is a good place to start

BGC ENGINEERING INC.
AN APPLIED EARTH SCIENCES COMPANY

Each system will be different and a risk assessment is recommended for each system.

Step 1, is define the likelihood of failure.

Consequences	Likelihood of Occurrence				
	Very High	**High**	**Moderate**	**Low**	**Negligible**
Very High	Highest Risk VH/VH	VH/H	VH/M	VH/L	Low Risk VH/N
High	H/VH	High Risk H/H	H/M	H/L	H/N
Moderate	High Risk M/VH	M/H	Moderate Risk M/M	M/L	M/N
Low	L/VH	L/H	L/M	Low Risk L/L	L/N
Very Low	Low Risk VL/VH	VL/H	VL/M	VL/L	Negligible Risk VL/N

High Risk Classification - More Work is Required to Define Concepts for Feasibility Level

Moderately High Risk - More Work Required for Final Design Unless the Degree of Confidence Surrounding the Likelihood is Low or Medium in Which Case, More Work is Required to Define Concepts for Feasibility Level

Moderate Risk - More Work is Required for Final Design

Low Risk - No Significant Additional Work Required

BGC ENGINEERING INC.
AN APPLIED EARTH SCIENCES COMPANY

Identify Failure Modes

- soil erosion
- vegetation failure
- weathering
- global instability
- frost activity
- snow and ice buildup
- membrane failure

BGC ENGINEERING INC.
AN APPLIED EARTH SCIENCES COMPANY

So assessing the likelihood of failure?

How well was the cover designed?

Was it designed as a filter taking into account the grain sizes of the materials?

Was it designed based on permeabilities that were estimated from grain sizes?

Were there enough samples to give you confidence in the answer?

BGC ENGINEERING INC.
AN APPLIED EARTH SCIENCES COMPANY

How well was it built? What were the conditions like during construction?

BGC ENGINEERING INC.
AN APPLIED EARTH SCIENCES COMPANY

And defining the failure modes allows you to develop a Mitigative Strategy and a cost..

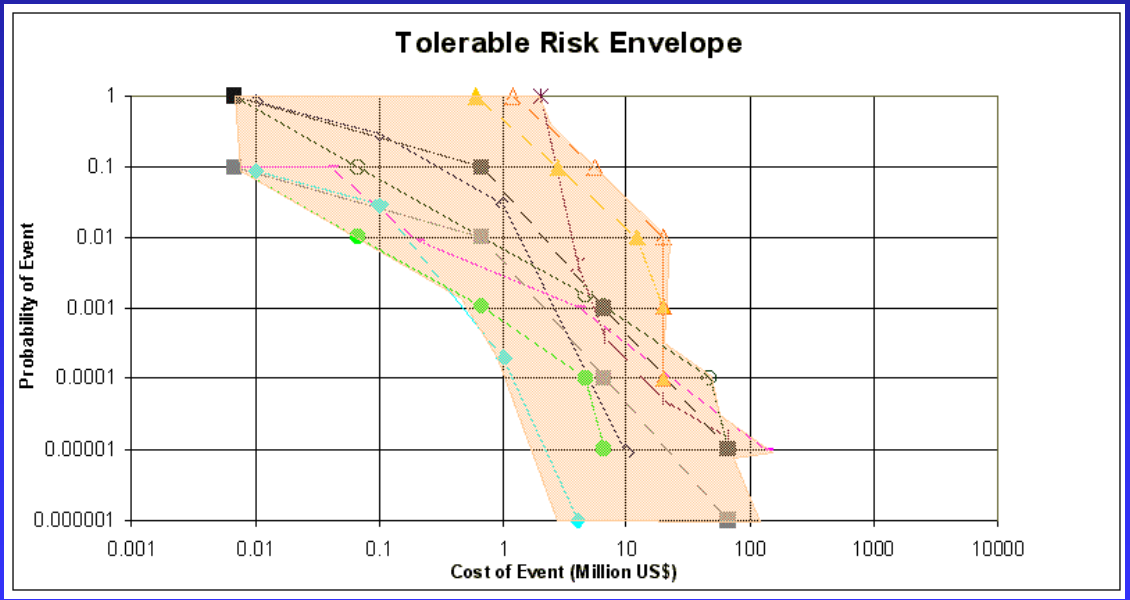
What happens if…

BGC ENGINEERING INC.
AN APPLIED EARTH SCIENCES COMPANY

Need to define Consequences..

What are consequences of various levels of failure for each likelihood?

Is that acceptable? Do you need to ‘fix’ it??



BGC ENGINEERING INC.
AN APPLIED EARTH SCIENCES COMPANY

Sorry Bill, No easy answers…

But whatever you do it has to be effective, robust, simple, inexpensive,

and work for perpetuity…

BGC ENGINEERING INC.
AN APPLIED EARTH SCIENCES COMPANY