Radiation Requirements for

Uranium Mining Projects

Jim Hondros

Vienna

June 2014

Content

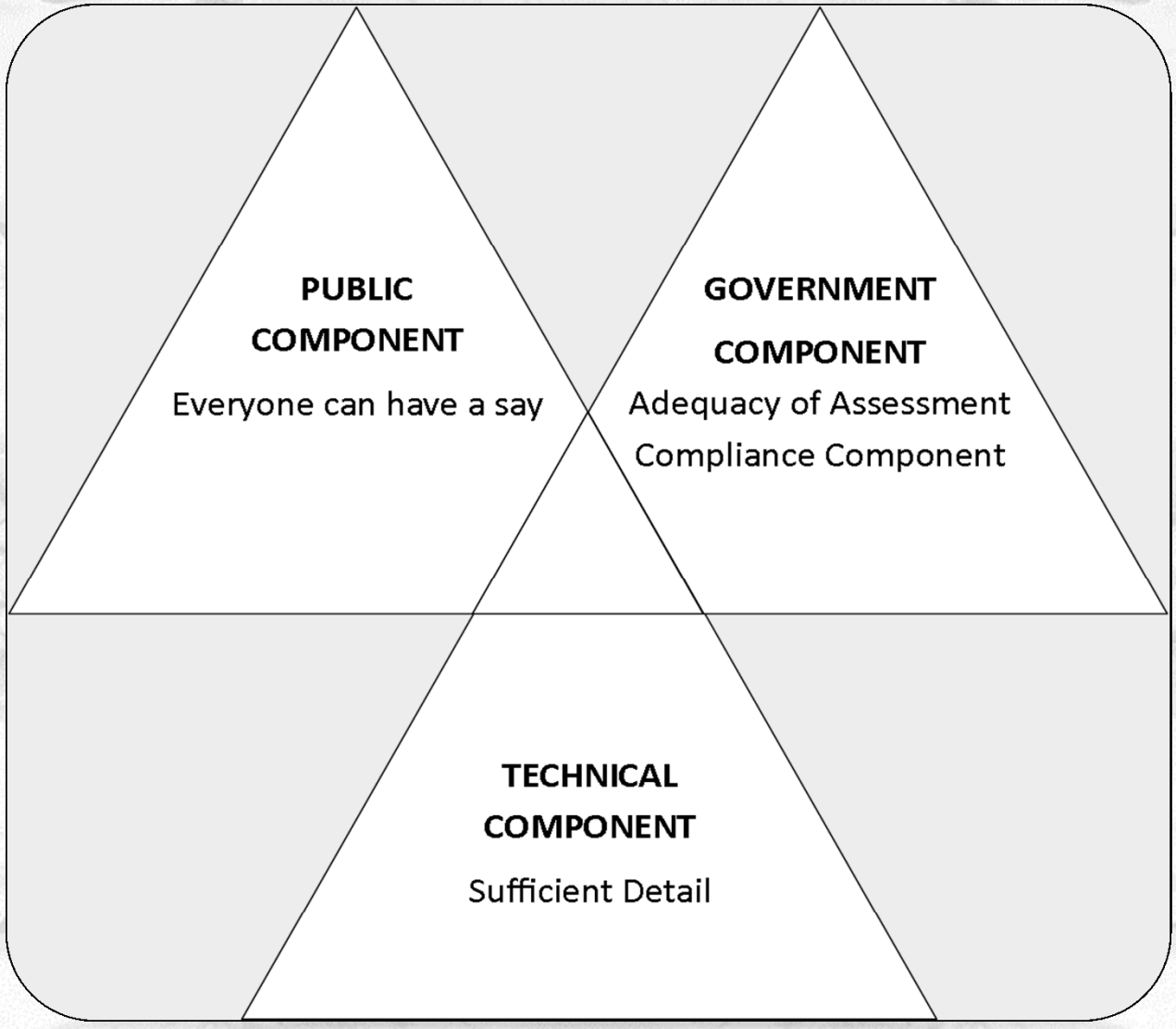
Describe approval process

Outline approach for radiation impact assessments

Observations and conclusions

Approvals Process

- External approvals are one part of the project development;
  - Interim project scope
  - Primary environmental approval
  - Followed by internal company approvals
- Subsequent licensing, authorisation or secondary approvals involve more detail
- Primary approval based on impact assessment based on an agreed ***terms of reference***
- Focus on environment, the public and workers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Everyone can have a say
GOVERNMENT
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Adequacy of Assessment
Compliance Component
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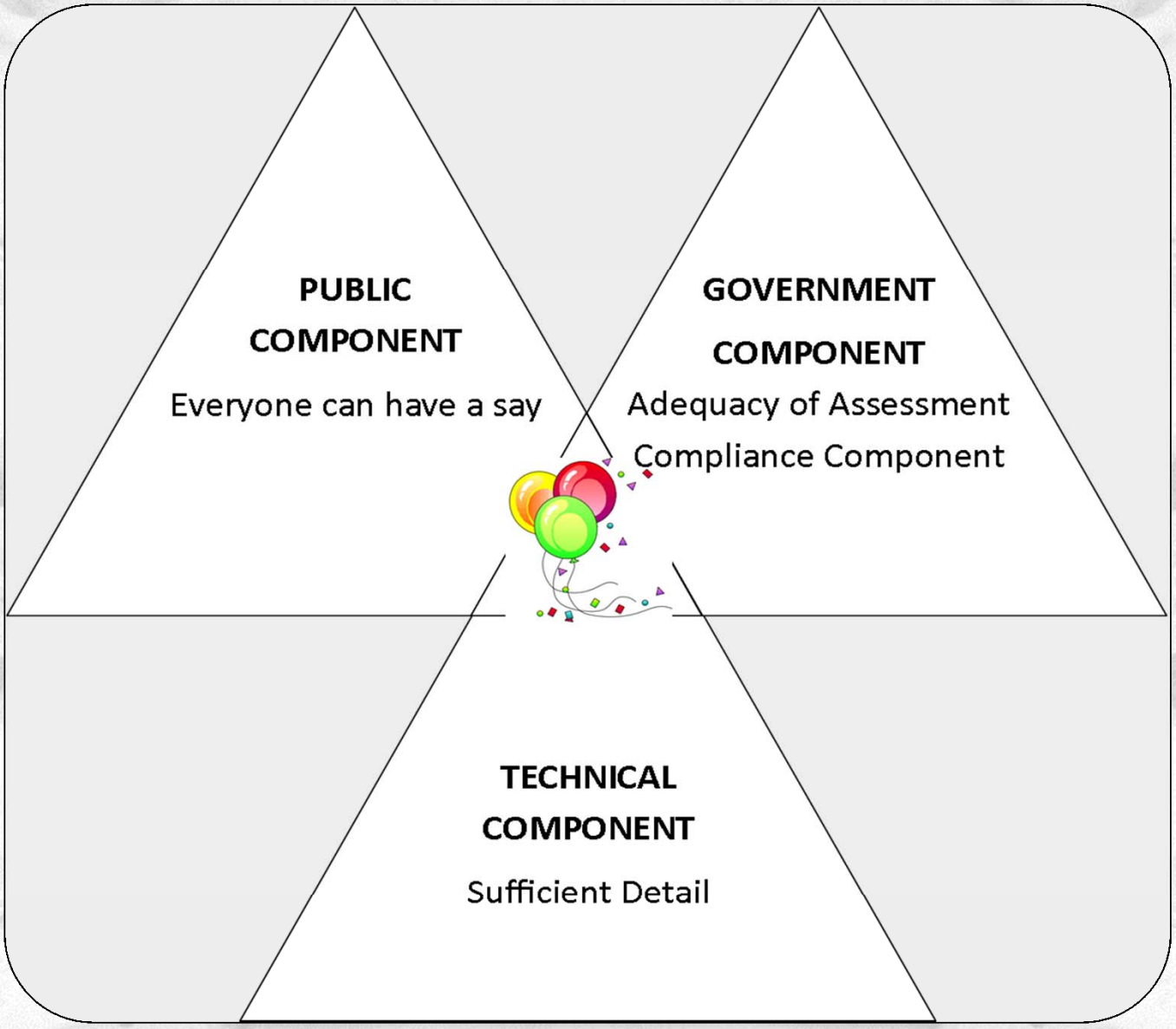
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Radiation

- Complex concepts that need to be understood and communicated
- Uncertainty and precautionary
- Requirements can be confusing (ALARA)
- Perceptions of risk
- Communicate risk and respond to perception
- Demonstrated competence and confidence

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How do we do this ?

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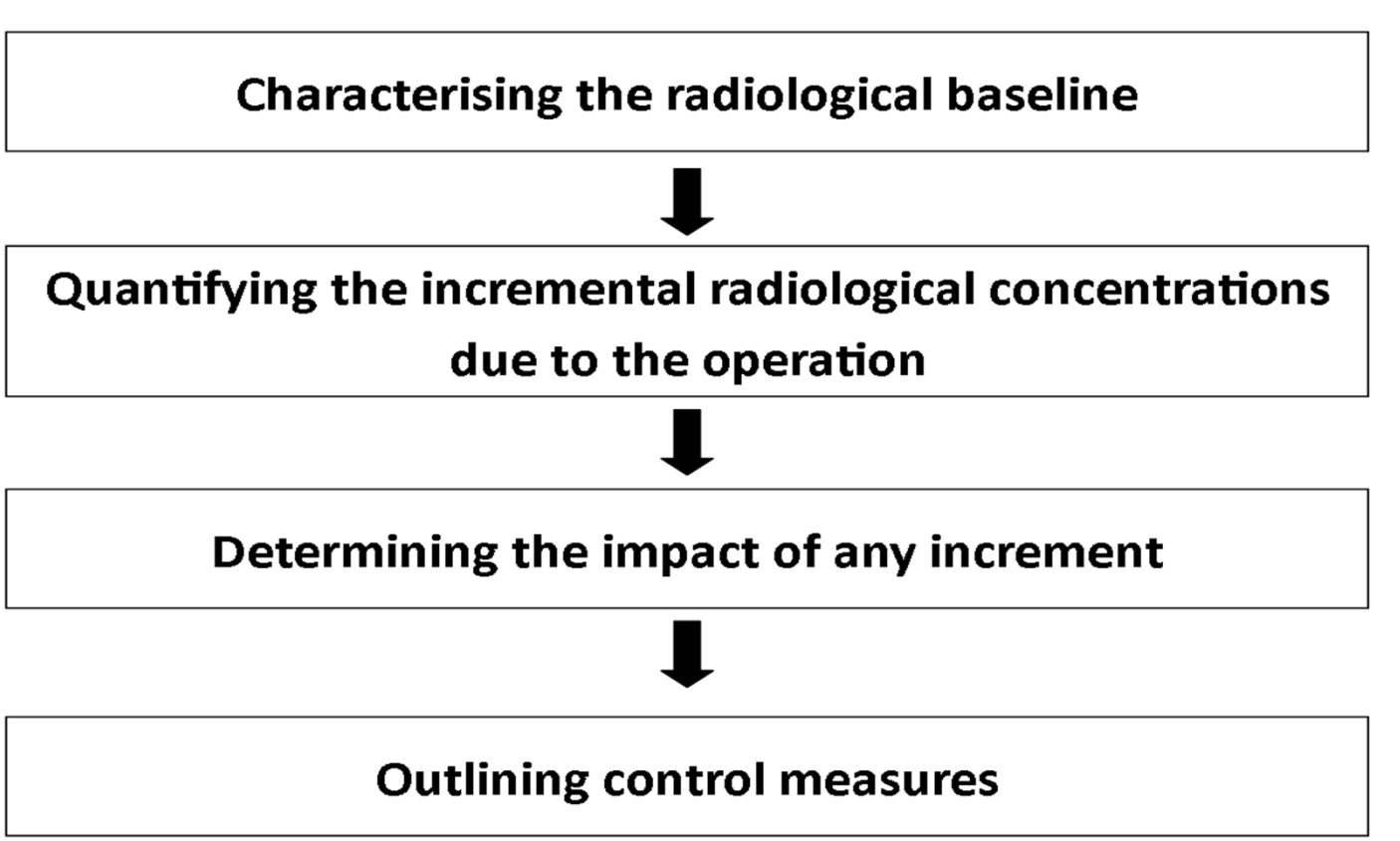
Radiation Impact Assessment



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1. Radiological Baseline

- Need to know what is there because;
  - Provides confidence to regulator and public that company understands
  - Shows the natural levels and variation
  - Provides information for company for rehabilitation and closure
- Present data in understandable manner
- Usually done quite poorly (eg; gamma results in cps)
- Need to start early – aim for 1 to 2 years of monitoring

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Baseline Monitoring Considerations

- Usually remote or inaccessible, therefore power a problem – consider passive devices

- Identify credible service providers
  - Analytical laboratories
  - Equipment providers
  - Monitoring technicians

- Have someone in control of monitoring program who gets it

- Avoid outsourcing everything

- Need to understand the numbers mean

Baseline Monitoring Considerations

- Establishment of sampling stations (Environmental Monitoring Locations (EML's))

- Think about the locations
  - Natural features
  - Wind direction
  - Access to power
  - Current and future infrastructure
  - Security
- Places look much closer on a map
- Piggyback with other sampling that might be occurring
- EMLs for background monitoring, but also useful to measure impact through operations

Baseline Monitoring Considerations

- Passive;
  - TLD's
  - Radon/thoron detectors
  - Dust deposition gauges
- Real time;
  - Gamma surveys
  - Grab samples for dust and RnDP
  - Water, soil, fauna and vegetation sampling
- Active long term
  - Real time Rn or RnDP monitors
  - High volume samplers
- RN Analysis
  - Mass spec for U and Th
  - Gamma and alpha spec

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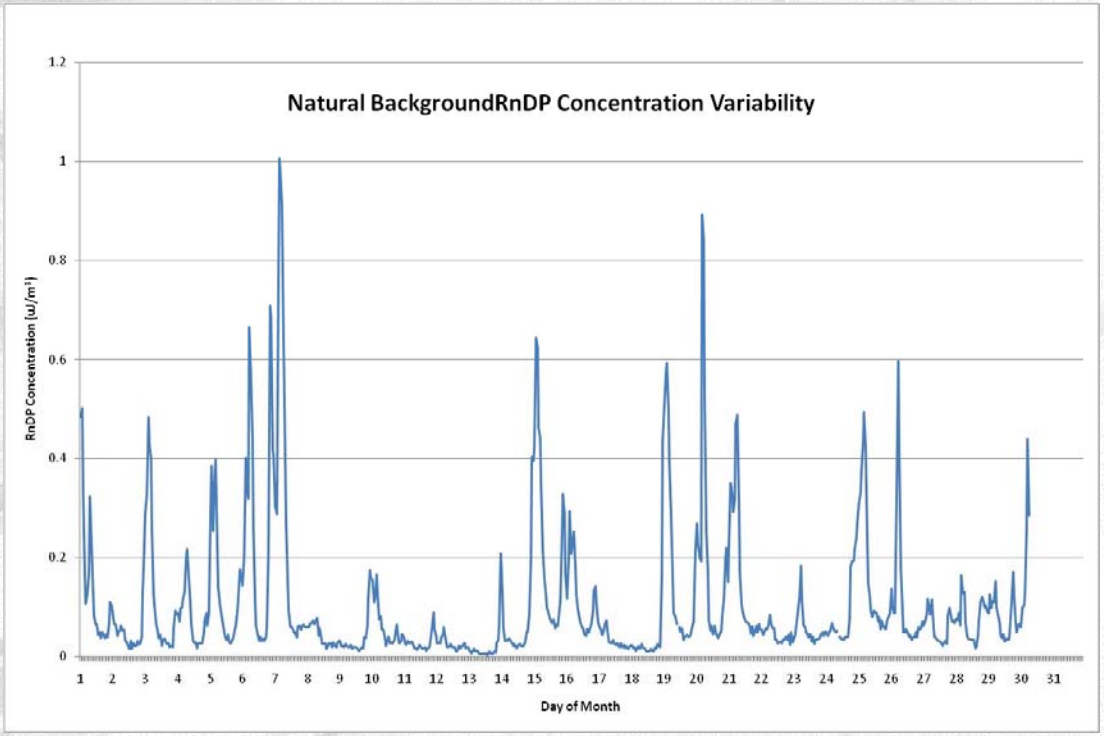
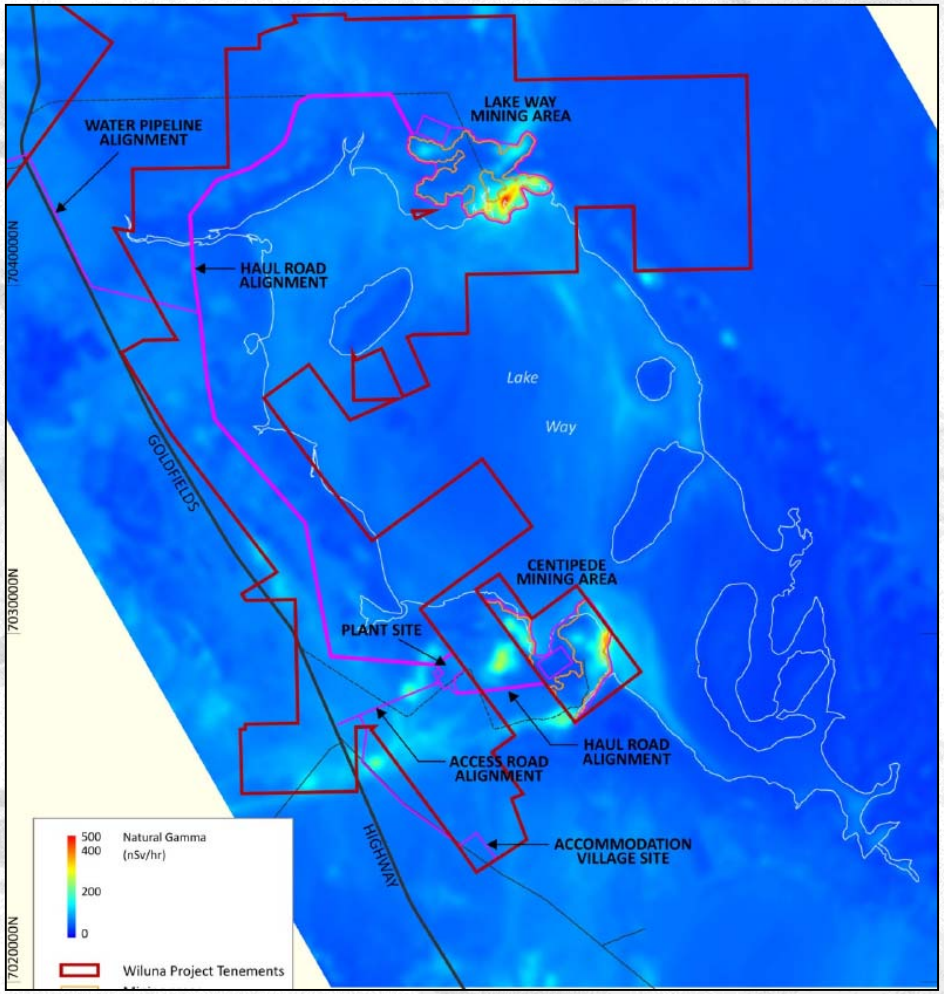
Baseline Monitoring Example



Shows that natural variation occurs

Shows regulator and public that you know what is going on

Baseline Monitoring Example



Visual representation of regional gamma radiation levels from aerial gamma survey

Shows localised areas of higher gamma radiation

From: Toro Energy ERMP Appendix 4 page 12

But....

This is going to cost so much ……

Well ….

- Not really.... can be quite cost effective
- Need to balance;
  - Cost of monitoring
  - Credibility
  - Information for closure
  - Requests for more info that might delay approval
  - Types of monitoring
- In the end it is about demonstrating competence.
- Get it right in the first place

2. Determine Project Increment

- **Good** understanding of the actual project and the potential variations
- What does the company want to do ?
- What are the sources of radiation ?
- Where do radionuclides accumulate in the process?
- What control features are considered in design ?
- Other difficult questions....

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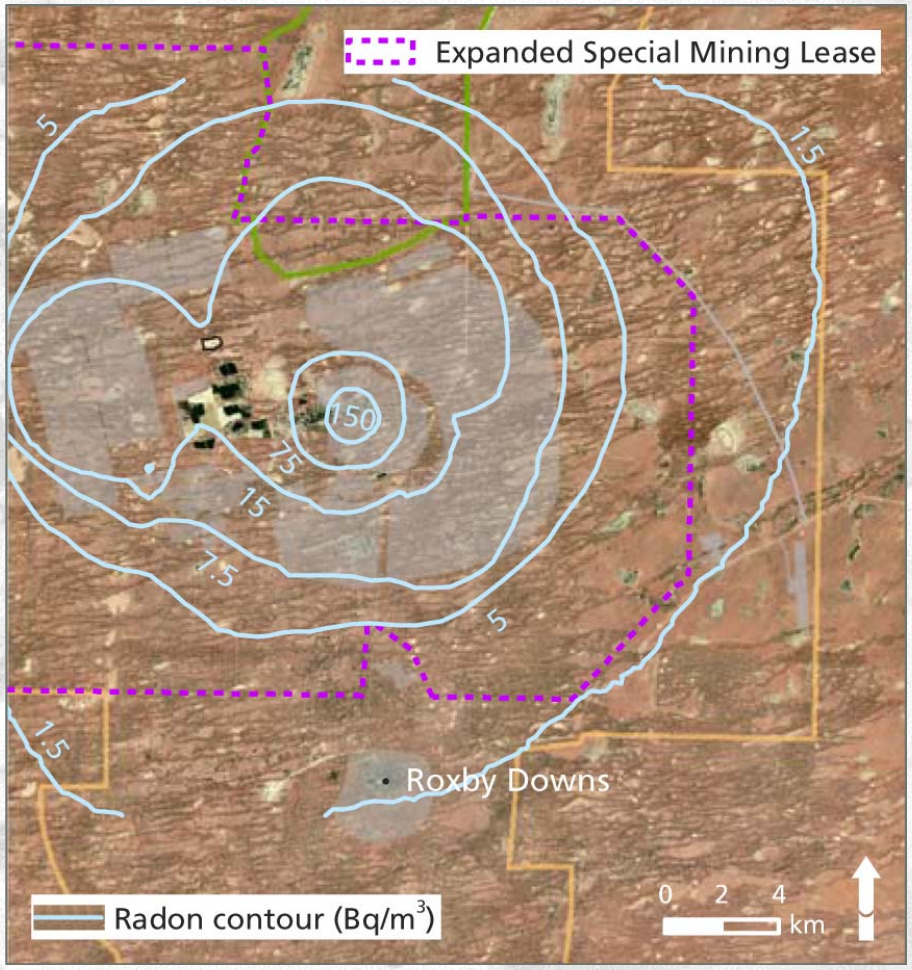
Determine Project Increment

- The potential increment above baseline through;
  - Modelling
  - Consideration of other similar operations
  - First principles/”rules of thumb”
- Examples of increment assessment include;
  - Contaminant and fate modelling
  - Air quality modelling for dust deposition and dust concentrations
  - Using first principles for determining gamma radiation levels
- Be cautiously conservative when making assumptions

Modelling Example



Shows air quality impacts (in Bq/m^3)

Can be used to assess annual potential dose

From BHP Billiton Olympic Dam SEIS – Appendix M1

3. Radiation Impact

- Assess *impact* from project emissions
  - Dose estimates to workers
  - Dose estimates for the public (sensitive receptors – including transport)
  - Doses to non human biota
  - Changes to existing levels
- Justify any assumptions in impact assessment
- Tell the “story”

Worker Doses

- Actual doses from similar operations/activities
- “Rules of thumb” – established relationships (eg; uSv/h per %U)
- Estimated dose rates by occupancy time
- Consideration of factors;
  - Exposure geometry
  - Characteristics (solubility, particle size, equilibrium factors)
  - Control systems (ventilation, shotcrete)
- Identify most exposed and conduct more detailed assessment

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Public Doses

- Gamma
  - usually negligible from operation (but check)
- Inhalation dose (dust and RnDP)
  - from air quality modelling
  - use realistic/conservative factors
- Ingestion
  - estimates based on deposition modelling or seepage modelling

Non Human Biota Doses

- Use air quality modelling dust deposition
- Determine radionuclides deposition at different distances
- Identify the species in the region
- Conduct ERICA assessment
- Undertake tier 1, 2, or 3 assessment, (if still a problem look at species abundance)

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4. Management Controls

- Describe the company approach/philosophy
- Describe the specific management measures
- Identify how ALARA would be implemented in design and in operations
- Describe the radiation management plan and the radioactive waste management plan
- Identify commitments for controls

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Observations

- Assessment process requires good understanding of project
- Radiation assessment covers whole of project (resources to designs)
- Where radiological impact might be higher, opportunity for design improvements
- Work with project personnel to understand and provide input (ALARA)
- Presenting balance between data and information (this is not just a technical process)

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Conclusions

- Radiation impact can be complex and confusing
- Aim to be credible and competent
- Process can be straightforward;
  - Baseline monitoring
  - Project emissions
  - Impact of emission
  - Management measures
- “Tell the story” (what does it all mean)

Jim Hondros - Principal
www.jrhc.com.au

Thankyou for listening !

Jim Hondros - Principal
www.jrhc.com.au