

# Assessment of Radiologically Contaminated Land

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# Contents

- Health Physics
- Radiological Contamination Assessment Criteria
- Computer Modelling
- Radiation Sources: NORM
- Radiation Sources: Anthropogenic
- Survey Meters
- Field Sampling & Laboratory Analysis
- Examples of Mineral Sand Contaminated Sites
- Conclusion

# Health Physics

"Health physics" is the profession devoted to protecting people and their environment from potential radiation hazards, while making it possible to enjoy the benefits of the peaceful use of the atom.

*<http://www.hps.org/>*

## HEALTH PHYSICS PROFESSIONS

- Regulatory
- Medical
- Reactor / Nuclear
- Environmental
  - Dose assessments
  - Contaminated land
  - Environmental monitoring/surveillance
  - Environmental modelling – transport & impact
  - Decontamination & Decommissioning

# Radiological Contamination Assessment Criteria

## *Dose Based*

**NEPM:** *National Environment Protection (Assessment of Site Contamination) Amendment Measure 2013 (No. 1).*

The purpose of the Measure is to establish a nationally consistent approach to the assessment of site contamination to ensure sound environmental management practices by the community which includes regulators, site assessors, environmental auditors, land owners, developers and industry. The desired environmental outcome for this Measure is to provide adequate protection of human health and the environment, where site contamination has occurred, through the development of an efficient and effective national approach to the assessment of site contamination.

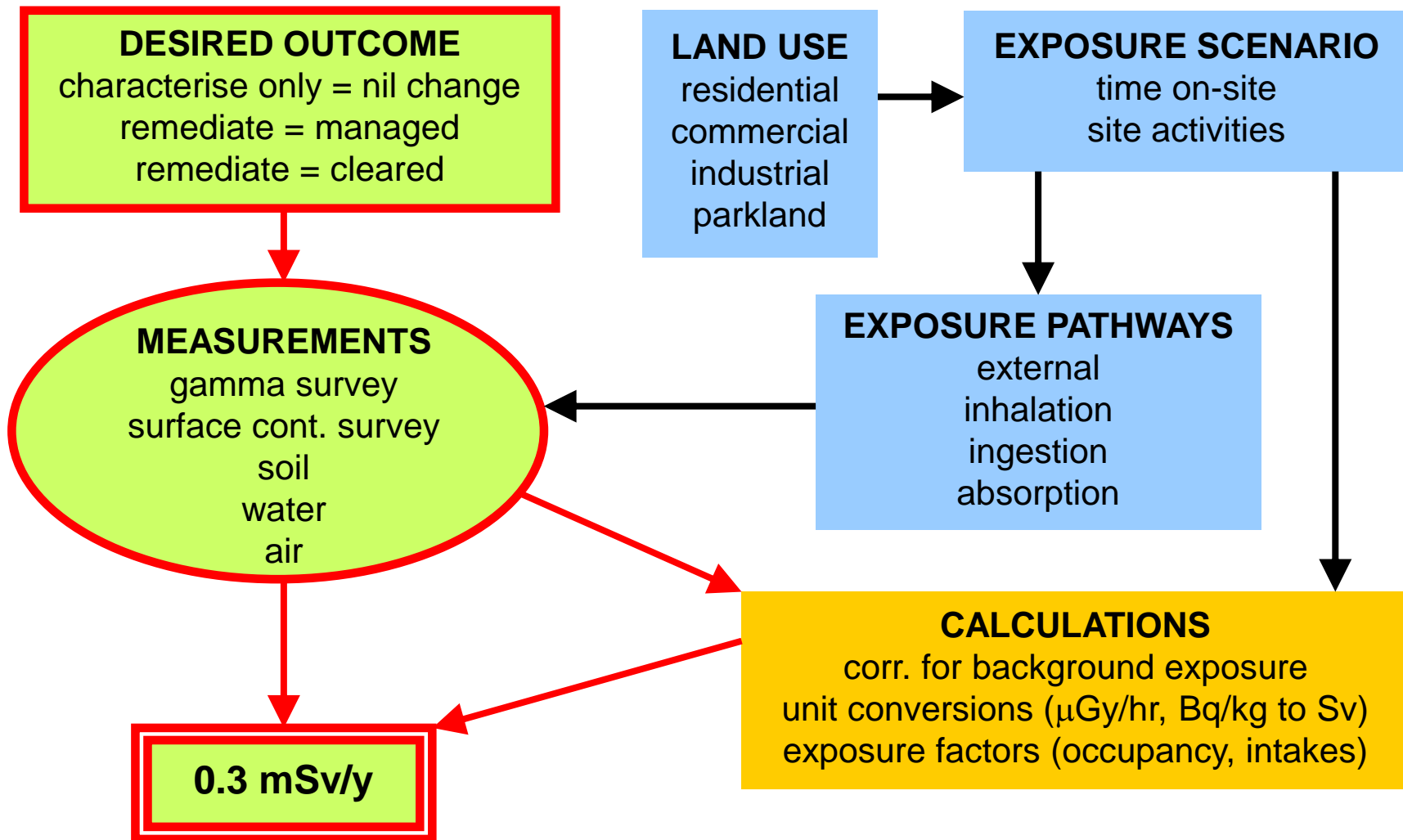
**Queensland 0.3 mSv/y**

**MARSSIM:** *Multi-Agency Radiation Surveys and Site Investigation Manual*

Provides detailed guidance for planning, implementing, and evaluating environmental and facility radiological surveys conducted to demonstrate compliance with a **dose- or risk-based regulation**. MARSSIM focuses on the demonstration of compliance during the final status survey following scoping, characterization, and any necessary remedial actions. <http://www.marssim.com/>

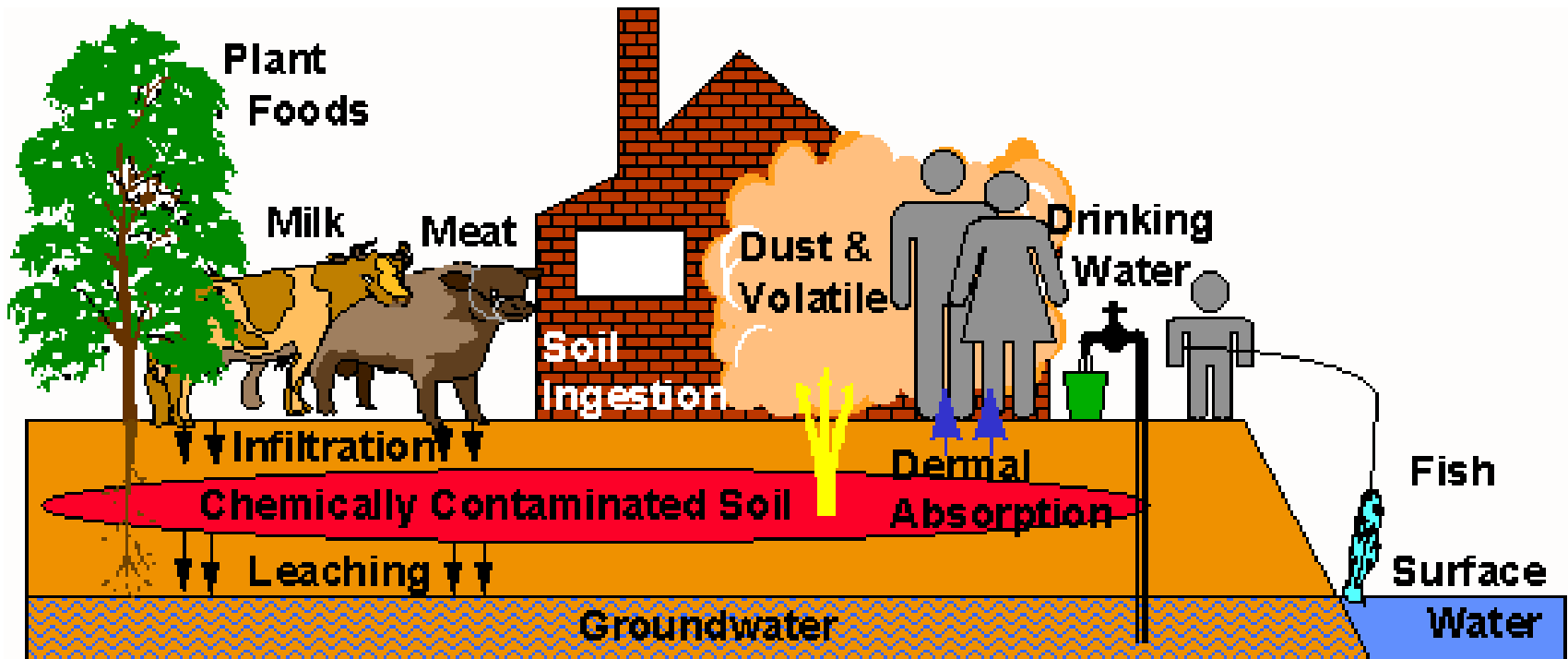
# Radiological Contamination Assessment Criteria

## *Dose Based*



# Computer Modelling

**RESRAD** is a computer model designed to estimate radiation doses and risks from RESidual RADioactive materials. <https://web.evs.anl.gov/resrad/>



**ERICA-tool** is a software system that has a tiered approach to assessing the radiological risk to terrestrial, freshwater and marine biota. <http://erica-tool.com/>



# Radiation Sources

## Naturally Occurring Radioactive Material (NORM)

NORM is present within the earth's crust and can be extracted and concentrated such as during mining activities, the processing or use of minerals. And may appear in by-products and waste streams.

### INDUSTRIES

- Uranium
- Mineral sands
- Coal seam / natural gas
- Phosphate fertilizers
- Rare earths

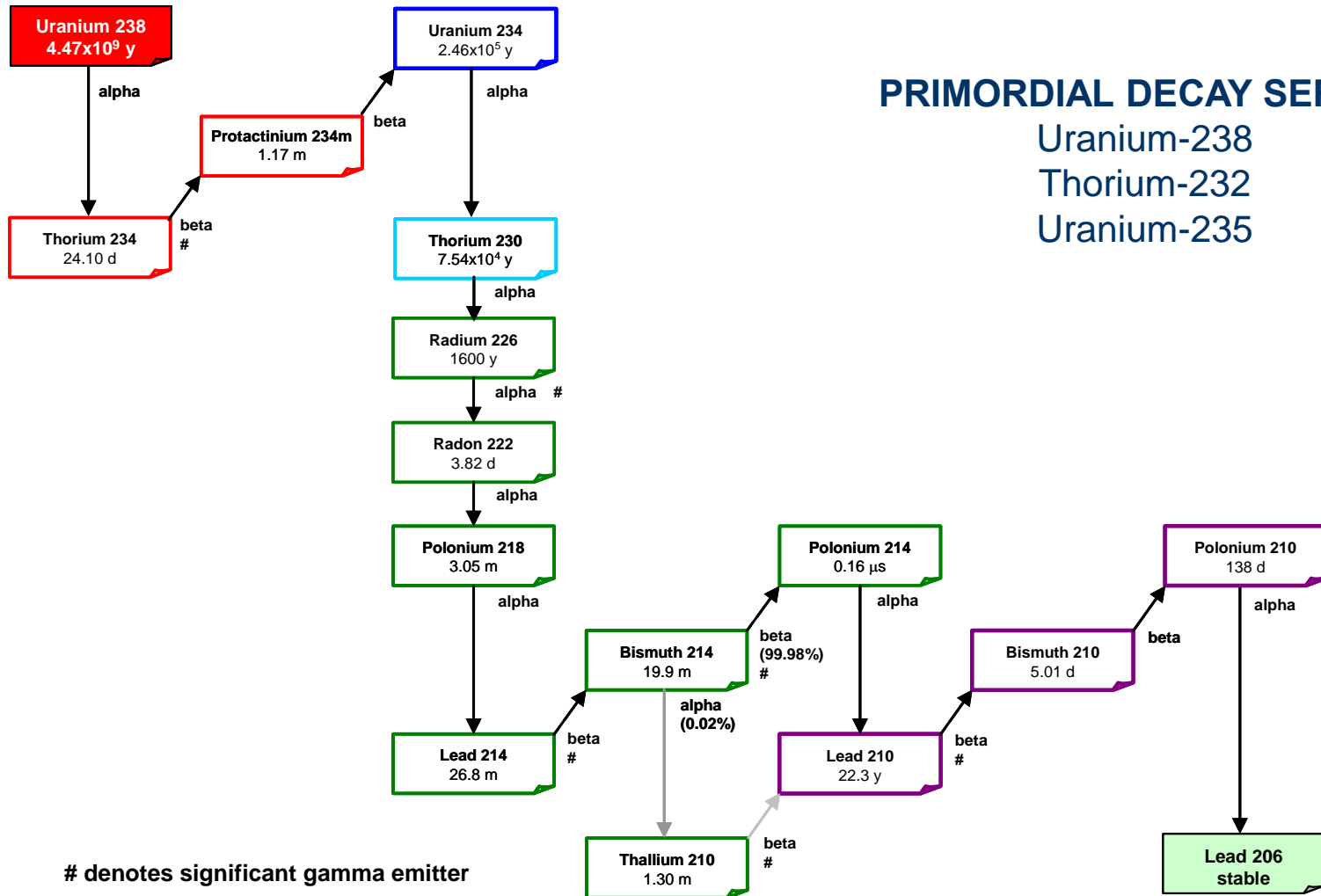
### PRODUCTS

- Metal alloys
- Ceramics
- Tile glazes
- Gas lantern mantles
- Welding rods



# Radiation Sources

## Naturally Occurring Radioactive Material (NORM)



### PRIMORDIAL DECAY SERIES'

Uranium-238  
Thorium-232  
Uranium-235



# Radiation Sources

## Anthropogenic



### INDUSTRIAL

- Level / density gauges (Cs137, Co60)
- Radiography (Ir192, Co60)

### MEDICAL

- diagnostic & treatment radiopharmaceuticals (Tc99m, F18, Ga67, I131, I123, In111)

### RESEARCH

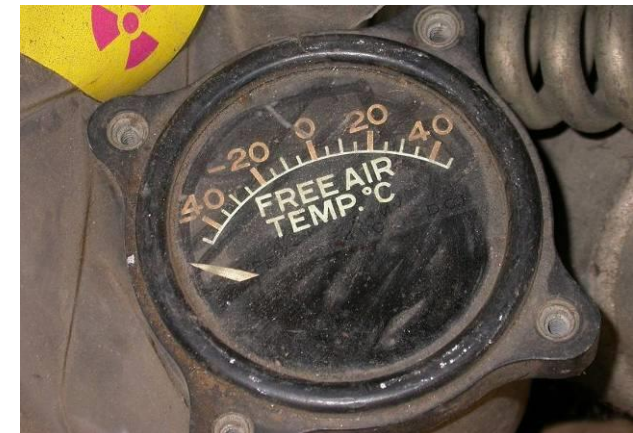
- Radiolabelling (Cr51, H3, C14)
- Gas Chromatograph Mass Spectrometry (Ni63, H3)

### SELF POWERED LIGHT SOURCES

- Exit signs, watches, compasses (Ra226, Pm147, H3)

### OTHER

- Smoke detectors (Am241)
- Electricity meters



# Gamma Survey Meters

## PROTECTION LEVEL

- Small detector volume
- Rapid response time
- Wide measurement range
- Low cost



## ENVIRONMENTAL LEVEL

- Large detector volume
- High accuracy at low doses
- Radionuclide identification
- High cost



- Audible / visual adjustable alarms
- Data storage / downloadable
- Ruggedised



# Field Sampling

Sampling for radiological assessment is comparable to sampling for other contaminants.

Target areas & materials of interest based on observation, history, field surveys, etc.

In-situ monitoring equipment for real-time or grab sample results.



# Laboratory Analysis

Lab assessment of samples provides low detection limits and high accuracy, but take longer.

## ALPHA SPECTROMETRY

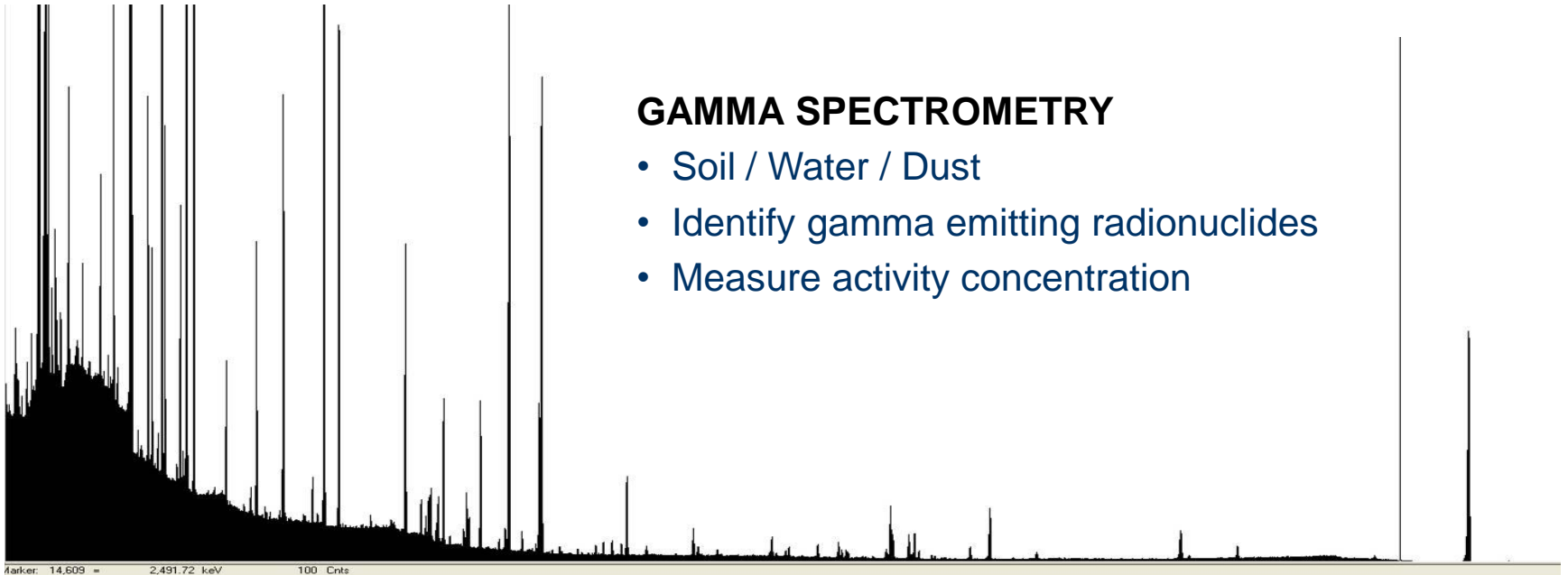
- Water / Soil / Dust
- Alpha emitting radionuclides
- Intensive sample prep = high cost

## LIQUID SCINTILLATION COUNTING

- Water / TCLP solutions
- Alpha/Beta emitting radionuclides
- Gross alpha/beta activity
- Activity concentration (Ra226, Pb210)

## GAMMA SPECTROMETRY

- Soil / Water / Dust
- Identify gamma emitting radionuclides
- Measure activity concentration





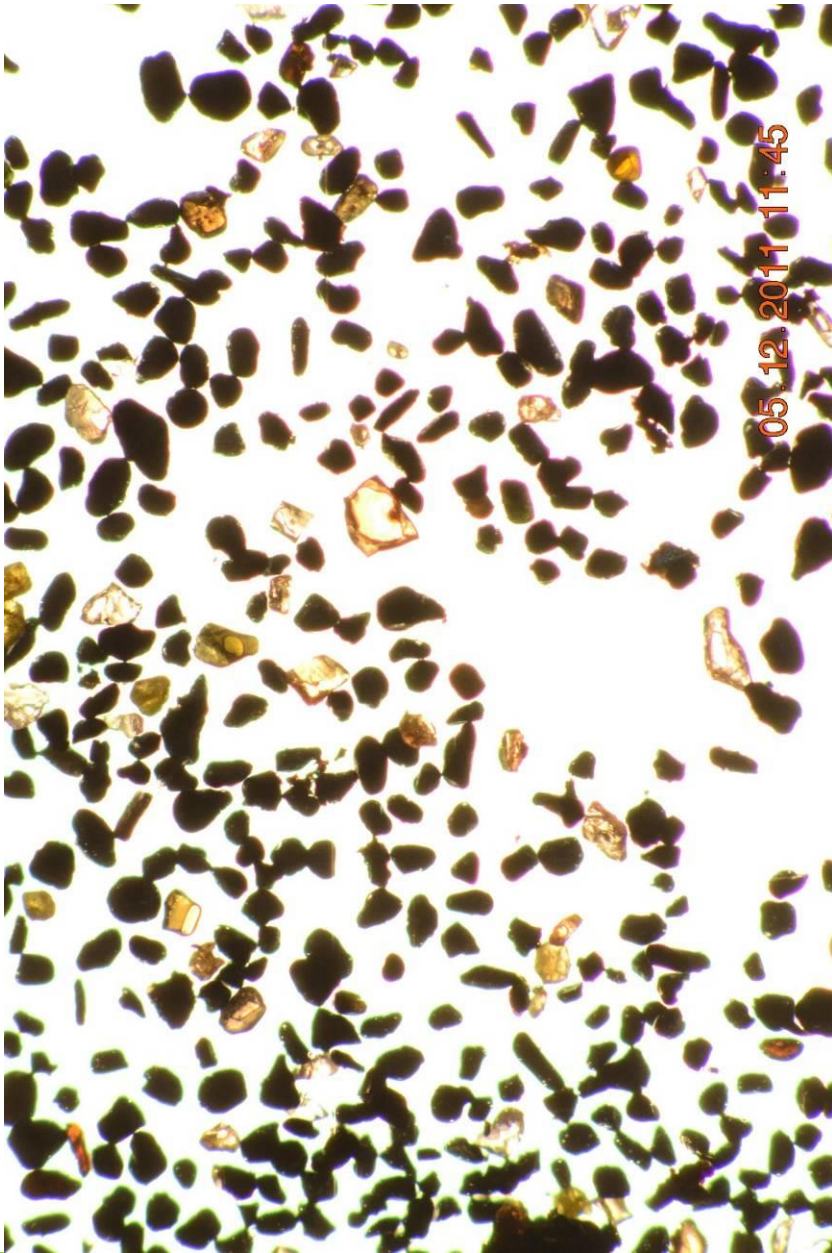
# Mineral Sands

## COMMON SITE ACTIVITIES

- Abrasive blasting
- Processing & storage
- Foundry
- Fill

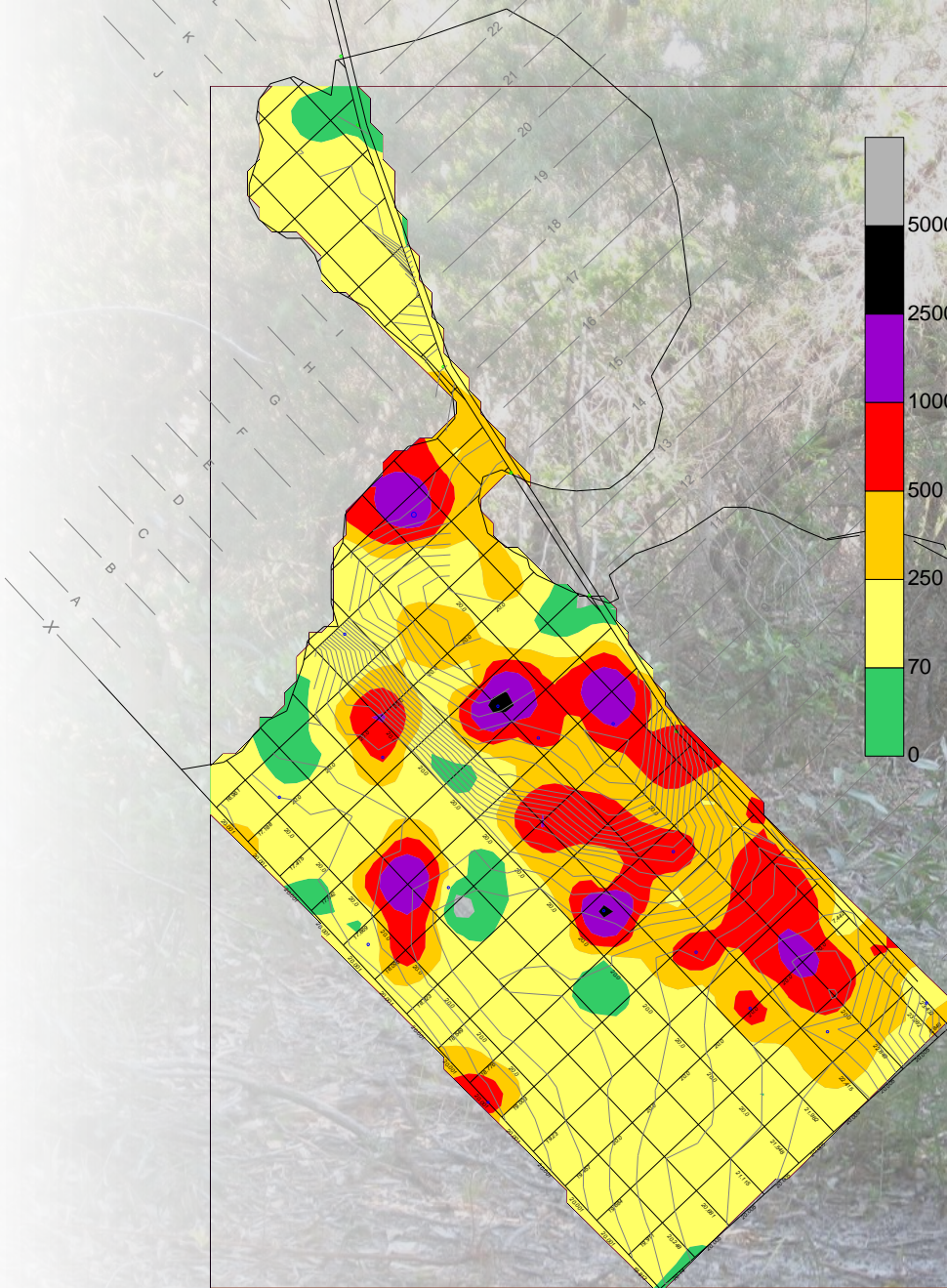
**abrasive blasting site**





**ilmenite under microscope**





**surface gamma radiation survey map of mineral sands processing site**





surface gamma radiation survey map of industrial site – abrasive blasting / fill

# Conclusion

The type of radioactive material/s and how they present at a site can be simple or complex.

How to measure the contaminant depends upon characteristics of the radionuclides and exposure scenarios.

Assessments usually involve a combination of measurements (eg. gamma survey, gamma spectrometry).

Comparison of site radiological properties with dose based compliance criteria can be complex and subjective.

A team effort between the Environmental Consultant and Health Physicist provides the best outcome for radiologically contaminated land assessments.



# THANK YOU

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