Radiological Hazards/Risks and Regulatory Capacity Constraints

Pertaining to Radioactive Waste: Uranium Mining

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Mining Area

Witwatersrand Goldfields:

- **Kosh Basin**
- **Free State Goldfields**
- **Far West Rand**
- **West Rand**
- **Central Rand**
- **Eastern Rand**

Key Issues

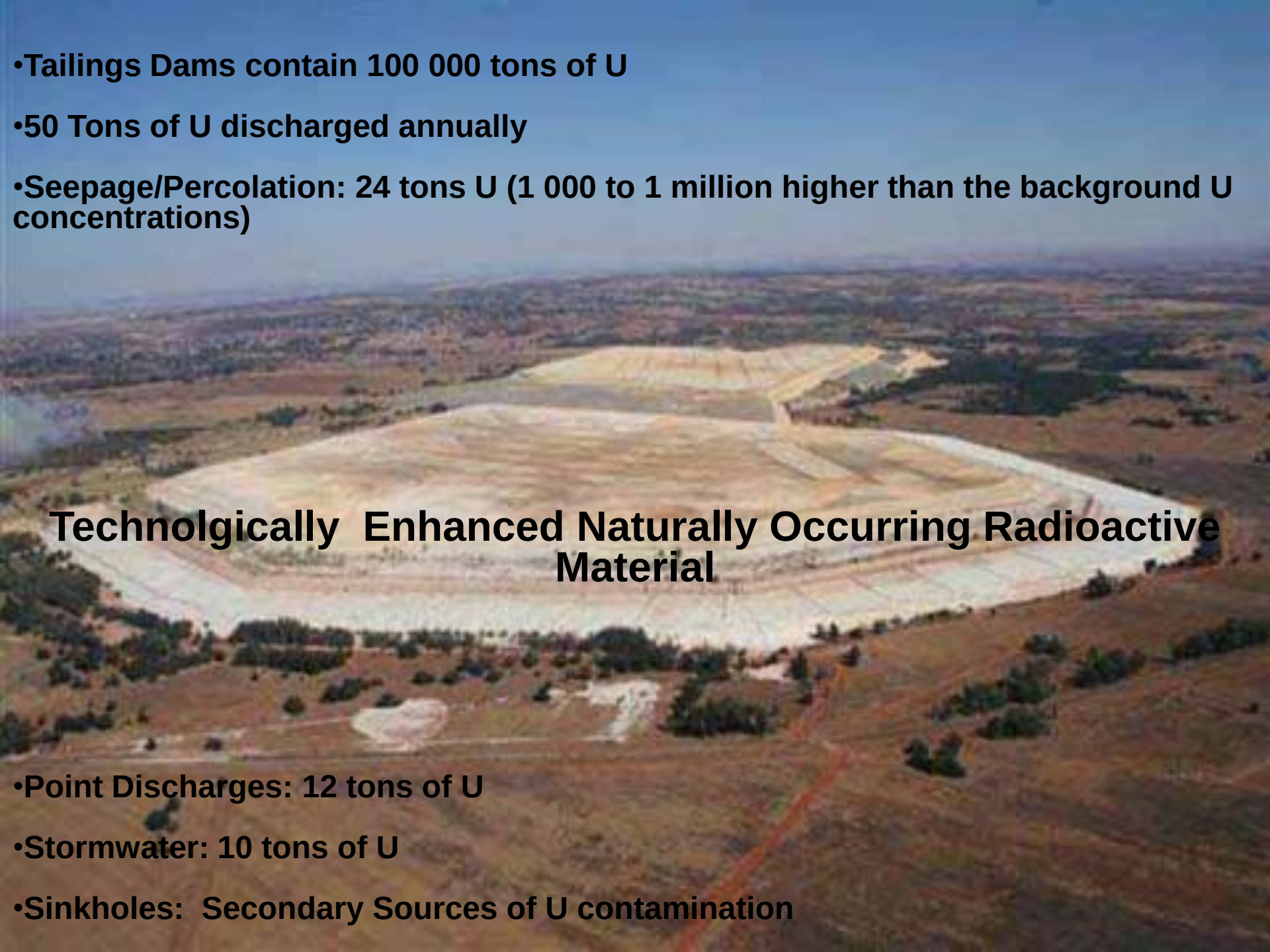
- **Interconnection of mining basins**
- **Acid Rock Drainage and Mine Drainage**
- **Large Salt Loads**
- **Decanting of Flooded Mines**
- **Physical Instability**
- **Dust Pollution**
- **Land Use Conflicts with Growing Urban Centres**
- **Radioactivity (Contamination) and Uranium**

WITWATERSRAND MINING BASIN*

- The Witwatersrand has been mined for more than a century.
- It is the world's largest gold and uranium mining basin with the extraction,
- from more than 120 mines,
- of 43 500 tons of gold in one century and
- 73 000 tons of uranium between 1953 and 1995.
- The basin covers an area of 1600 km^2, and
- led to a legacy of some 400 km^2 of mine tailings dams and
- 6 billion tons of pyrite tailings containing low-grade uranium.

* The Witwatersrand Mining Basin is composed of the Far East Basin, Central Rand Basin, Western Basin, Far Western Basin, KOSH and the Free State gold mines.

A Remote-Sensing and GIS-Based Integrated Approach for Risk Based Prioritization of Gold Tailings Facilities – Witwatersrand, South Africa – S. Chevrel et al



- Tailings Dams contain 100 000 tons of U
- 50 Tons of U discharged annually
- Seepage/Percolation: 24 tons U (1 000 to 1 million higher than the background U concentrations)

Technolgically Enhanced Naturally Occurring Radioactive Material

- Point Discharges: 12 tons of U
- Stormwater: 10 tons of U
- Sinkholes: Secondary Sources of U contamination

Air Pollution

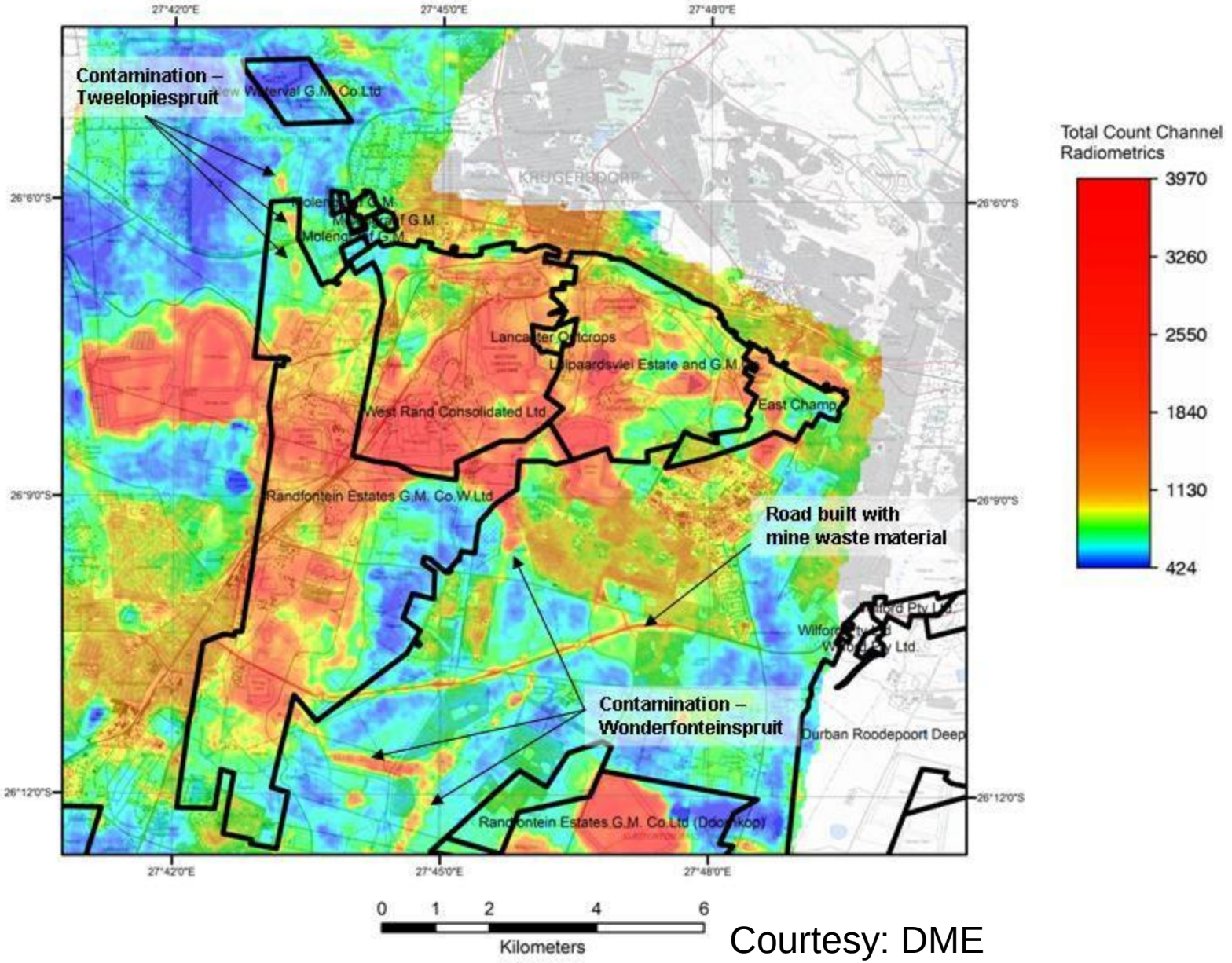
The health effects of uranium particles inhaled:

- **Small particles** are carried by the inhaled air stream all the way into the alveoli. Here the particles can remain for periods from **weeks up to years** depending on their solubility.

- Highly insoluble uranium compounds may remain in the alveoli, whereas soluble uranium compounds may dissolve and pass across the alveolar membranes into the bloodstream, where they may exert **systemic toxic effects**.

- In some cases, insoluble particles are absorbed into the body from the alveoli by **phagocytosis into the associated lymph nodes**.

- "**Insoluble" particles may reside in the lungs for years**, causing chronic radiotoxicity to be expressed in the alveoli.



Courtesy: DME

Draft Regional Closure Strategy For The Far West Rand Goldfield

•An airborne radiometric survey of the WR and FWR was done for DWAF

•Interpretation of the data show many of the residential areas (Carletonville, Westonarea, Khutsong, Kagiso, Randfontein) fall within areas of high risk of **radioactivity contamination.**

NATIONAL STRATEGY UNDERTAKEN BY:

the dme
Department:
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REPUBLIC OF SOUTH AFRICA

IN COOPERATION WITH:

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Specialists in mineral and metallurgical technology

“The most important lesson learnt from the studies in the Wonderfonteinspruit is that no short-cuts exist which would allow certain pathways to be ignored in a study of radioactive contamination within these mining areas.”.

"The mean values for the Wonderfonteinspruit samples were found to exceed not only natural background concentrations, but also levels of regulatory concern for cobalt, zinc, arsenic, cadmium and uranium, with uranium and cadmium exhibiting the highest risk coefficients.
"At present the U and other heavy metals, such as cadmium, copper, zinc, arsenic and cobalt are adsorbed in the sediment. Plausible environmental conditions such:

- Acid mine drainage

Can cause the remobilisation and solubilization of heavy metals including uranium into the water column.

Reference: WRC Report No 1214/1/06