Salinity and Metals' Impacts of Solid Waste Management Practice in Mining and Minerals Processing

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Environmental Impact of Solid Waste

- The environmental impact of solid waste management in mining and minerals processing is due to the leaching of salts and metals, and their subsequent migration into the environment
- Resultant elevated environmental concentrations of metals and salts may lead to eco-toxicity and human toxicity effects due to contamination of surface and ground water
- The long-term potential environmental impact is often not questioned and rarely quantified

Solid Waste Impacts in LCA

- In Life Cycle Assessment there is a discrepancy between actual solid waste impacts and LCA-predicted impacts as:

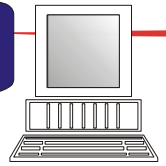
- Time-dependent nature of solid waste impacts is not incorporated
- Spatial-dependency of impact is lacking
- Current impact assessment approaches are not entirely applicable to metals and salts
- Aggregation and the functional unit concept introduce additional problems

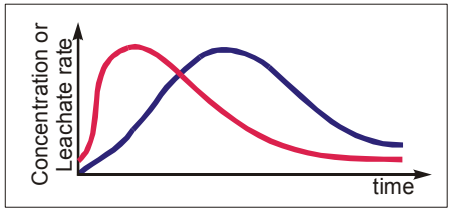
An Alternative Approach

- Consideration of the spatial- and time- dependent nature is essential for accurate assessment
- Focus is on exposure assessment: leachate generation processes and the spread of the resulting pollution plume
- This results in a potentially contaminated land mass termed an "Impacted Land Mass" or "Impacted Land Volume"
- The Impacted land mass varies both spatially and temporally and is a function of the contaminants of concern
- "Mid-point" impact indicator

Approach Overview

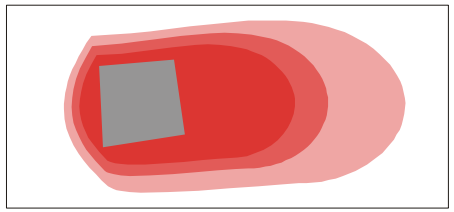
Detailed, Waste-specific Leachate Generation Model





Time-dependent Leachate Composition and Generation Rate

Three-dimensional, Generic Groundwater Flow and Mass Transport Model

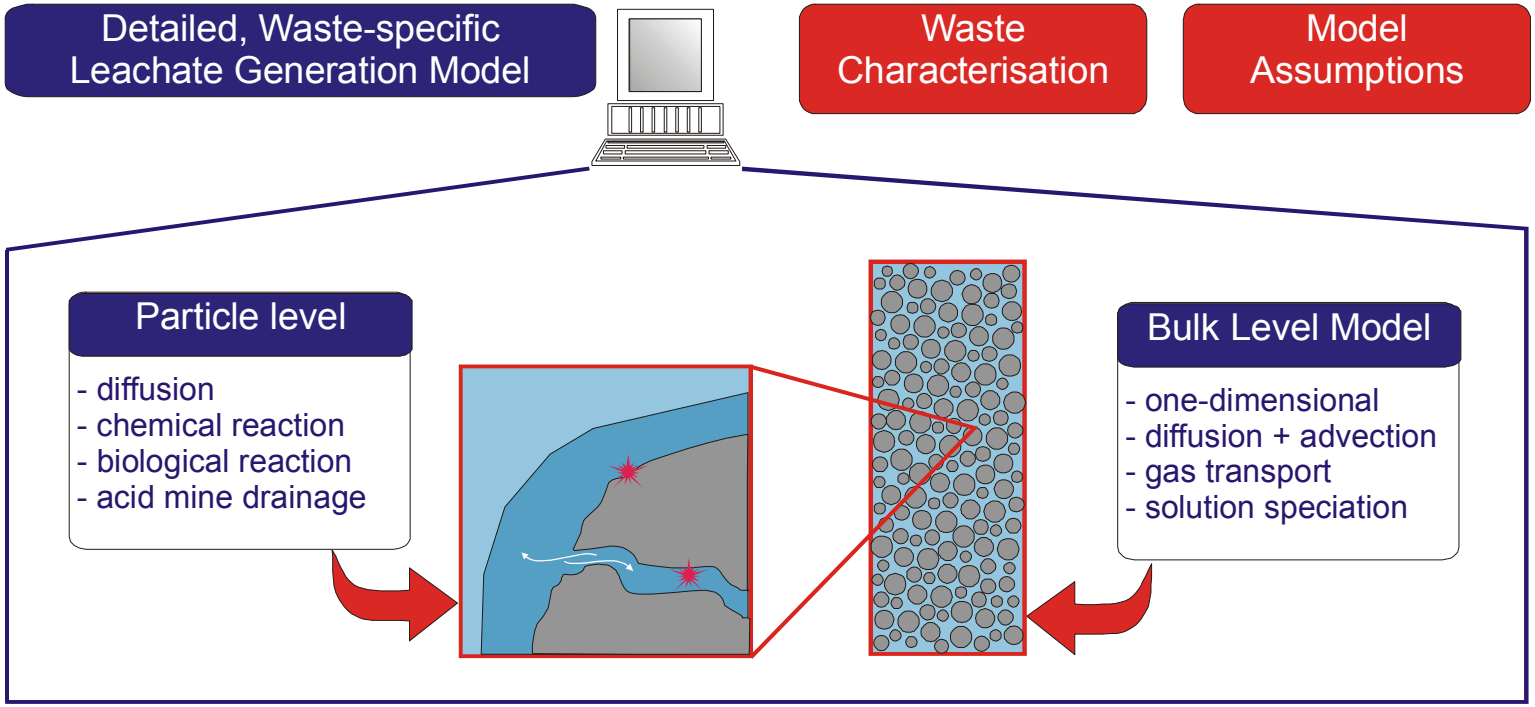


Spatial and Temporal Distribution of Contaminants in the Subsurface Environment

Impacted Land Mass based on Acceptable Risk Level

Leachate Generation Modelling

- Developed specifically for abiotic mining and minerals processing wastes as well as combustion residues



The Impacted Land Mass

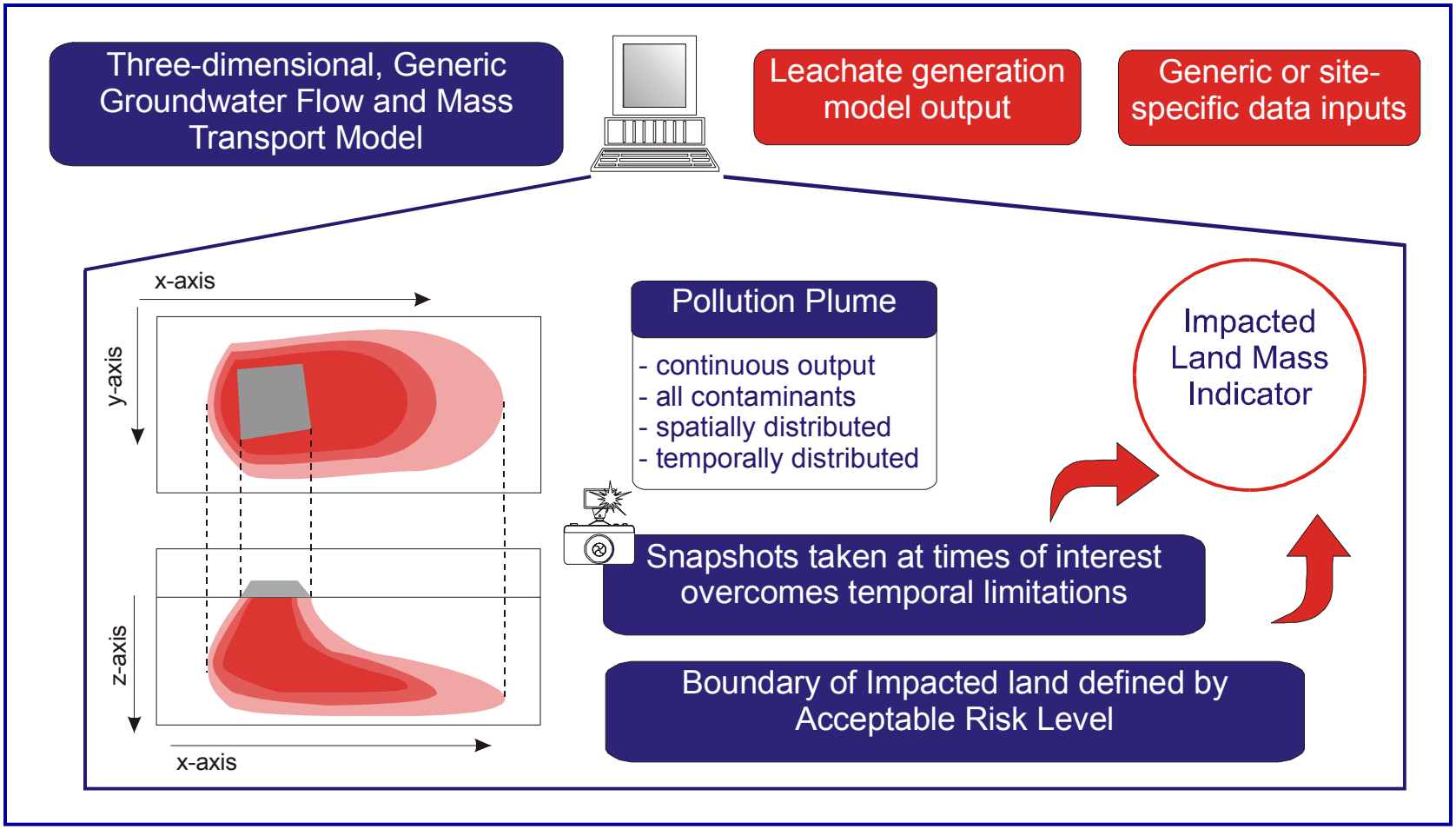
SALINITY

- Salinity is a significant environmental problem
- Modelling the land affected by salinity is a useful indicator of environmental risk
- Impacted land mass is based on ionic strength
- Acceptable Risk level denoted by legislative limit for Total Dissolved Salts (TDS)
- An indication of the total extent of salinity impact may be found by considering most mobile salt species (i.e. Chloride)

METALS

- Trace metals pose a serious environmental threat
- Impractical to model every trace element
- A strategic metal tracer or tracers should be chosen based on its environmental significance in terms of presence in the waste, mobility and impact on the surrounding environment
- Impacted land mass determined by water quality guidelines set for this metal

Calculating the Impacted Land Mass



Conclusions and Significance

- Life Cycle Assessments of primary industries are of limited benefit without a consideration of impacts arising from solid waste management
- The Impacted Land metric provides a first-order indicator of the impact of solid waste deposits and extends the current ability of LCA to address site-specific, time dependent impacts associated with leachate generation and mobility
- As a concept this approach is a significant improvement over current LCA approaches