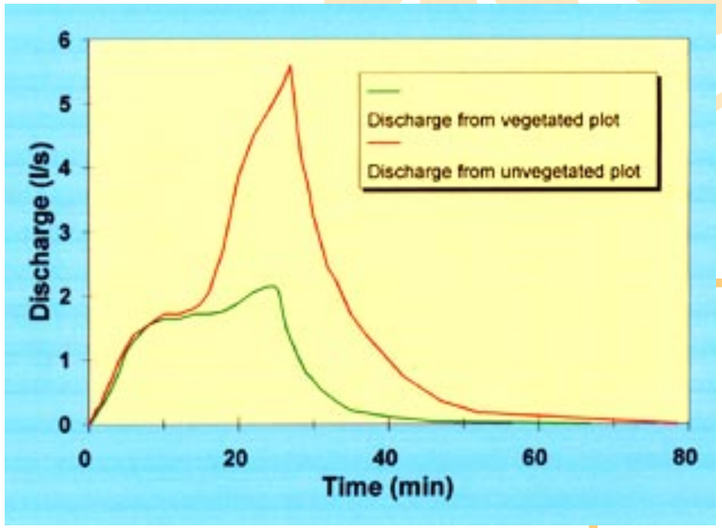
Research progress

Work is nearing completion on the assessment of the effects of vegetation and ripping on landform development. Rainfall simulation experiments on the waste rock dump have shown that the presence of vegetation greatly reduces the amount of runoff water from a site. The diagram shows that runoff from a vegetated surface is almost half the runoff from an unvegetated surface.



Runoff from a vegetated surface and runoff from an unvegetated surface under rainfall simulation. Vegetation has considerable control on runoff and the resulting erosion.

Analysis of the change in landform characteristics over time is well underway. The results are important as this will allow the predictions of erosion to be changed in line with ecosystem development. This will improve the accuracy of modelling.

Confirming the accuracy of SIBERIA model predictions requires monitoring of previously rehabilitated mine sites and undisturbed areas. *eriss* is presently establishing a research site at Scinto 6, an abandoned mine site in the South Alligator River Valley. The site is being established in cooperation with Parks Australia and the Jawoyn Association representing the traditional Aboriginal owners of the land. Studies at this site will provide an opportunity for comparing model predictions of erosion and landform development to what has actually happened on this 40 year old site.

Completion of these projects will reinforce confidence in predictions of long term erosion of rehabilitated mine sites.

eriss carries out scientific research for the protection of people and the environment in places that are highly valued by the Australian community.

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eriss notes

EROSION

Protection of a world heritage area through erosion research

The Environmental Research Institute of the Supervising Scientist (*eriss*) is located at Jabiru in Kakadu National Park in Australia's Northern Territory and conducts research into environmental issues relating to mining and wetland management.

The ERA Ranger mine, at which uranium is mined and processed, is located near the town of Jabiru and is surrounded by Kakadu National Park, a World Heritage Area.

The area receives high-intensity storms and rain depressions between October and April (wet season) with little rainfall during the remainder of the year (dry season). The average annual rainfall is approximately 1500 mm. When mining is finished, the mined area will be rehabilitated—that is, it will be returned to a condition where stable ecosystems can develop and the land can be used by future land users. After the uranium is mined, the remaining landform will comprise tailings storage sites, a dump where waste rock has been deposited, and large mined-out pits. Tailings are a slurry of ground-up rock and other waste that remains after uranium is removed.

The post-mining landform at Ranger will cover more than 3 square kilometres, reach approximately 17 m above the local ground surface and cover the tailings. The tailings will contain low levels of radioactivity. The site must be left so that, over the next 1000 years, the risk that this radioactive material will be released to the environment through erosion or weathering will be very small.

The East Alligator River, a pristine river system bordering Arnhem Land, adjacent to Kakadu National Park. The Ranger uranium mine is located in the catchment of Magela Creek, a major tributary of the river.

To design the landform so that erosion rates meet community, industry and government standards, the stability of the land surface left after mining needs to be predicted. Techniques of erosion modelling are applied to predict the stability of the mined land over a very long time.

What is erosion modelling?

Erosion modelling is the use of mathematics, based on measured physical properties, to predict the soil loss from land areas caused by flow of surface water or, in some cases, wind. Erosion models have been used in agriculture for many years to predict soil loss, and recently some models have been used in the mining industry. More recently erosion modelling has been extended to landform evolution modelling, which enables the effect of erosion on landform development to be studied.

Predicting soil loss

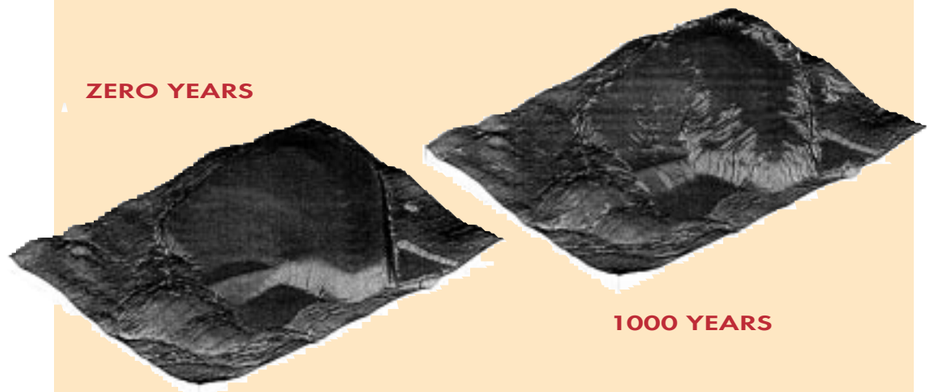
Erosion models can be used to predict soil loss from an area during a single rainfall storm, or on an annual basis. To predict soil loss from rehabilitated areas, we need information about the land surface, such as land slope, vegetation and rock cover, and soil conservation practices (eg. soil ripping, where deep furrows are produced to reduce water runoff). However, some characteristics, such as the resistance that soil has to erosion (known as erodibility) cannot be measured directly. Erodibility is usually calculated from measurements of rainfall runoff and soil loss.

Predicting landform changes

Landform evolution models can predict how a landform will change through time. These models estimate the depth, length and location of gullies. *eriss*, in cooperation with the University of Newcastle, has been using such a model called SIBERIA. SIBERIA, run on a high-powered computer, can be used by agencies to assess rehabilitation designs of a landform. Alternatively, industry designers can test their landform designs using SIBERIA. The results are used to specify hill-slope length and angle and/or drainage structures to control water flow in unstable areas.

How does SIBERIA work?

SIBERIA can predict thousands of years of change in the shape of a landform. Information about present day erosion and hydrology of a landform is required to run the model. Data are required for both vegetated and unvegetated areas, and on areas where soil conservation practices such as ripping have been applied. The model uses a three-dimensional representation of the landform and calculates the changes in height, through time, at various points.



Three dimensional representation of one option for the rehabilitated landform of the waste rock dump at the Ranger mine. The stability of this landform has been modelled using SIBERIA. The diagram on the right shows where erosion valleys may form over a period of 1000 years .

Erosion research at eriss

Erosion and hydrology research at *eriss* has focused on the application of SIBERIA in the design of rehabilitated waste rock dumps. In addition to collection of the information required to run the model, three other aspects of the modelling have been addressed. These are:

1 The effect of land management on landform development. For example, vegetation cover and soil ripping affect erosion rates.

2 Assessment of the effect on the model of environmental changes over time. For example, ecosystem development and climatic change may affect erosion rate and hydrology.

3 The accuracy of SIBERIA predictions must be confirmed.

How is erosion and hydrology information collected?

Erosion and hydrology information is collected from runoff plots which have been set up on the waste rock dump at Ranger. These plots are monitored during natural storm events during the wet season and the technique of rainfall simulation is applied during the dry season.

Each plot is approximately 600 square metres and has surrounding borders which ensure that only run-off from the plot is measured. Water samples are also collected and analysed for the amount of sediment present. Sediment particles which are too heavy to be carried by the water are deposited in a trap at the outlet of the plots and collected at the completion of a rainfall event. The amounts of heavy sediment and light sediment are added together to give a total sediment loss.

Monitoring of natural storm events ensures that information is collected for a variety of storm types. Erosion and runoff characteristics determined for a site using the collected information are then used in the SIBERIA model to make predictions of landform change.

A large scale rainfall simulator being used at the Ranger mine by eriss researchers to collect sediment loss and runoff data for use in the SIBERIA model.