Groundwater contamination assessment of Rum Jungle using EM techniques
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Contents

1.0 Introduction
2.0 Geology
3.0 Instrumentation and techniques
4.0 Results
5.0 Conclusions and recommendations
1.0 Introduction

Rum Jungle is located 75 kilometres south of Darwin near Batchelor in the Northern Territory. The minesite layout and location, within the Northern Territory, is illustrated in figure 1.

During the field season of 1991 Rum Jungle was surveyed using geophysical techniques to assess groundwater contamination in the vicinity of Whites overburden heap for Water Resources Division, Power and Water Authority.

This involved a total field period of 3 days during which 423 observations of em34-3 and 346 of em31 were completed.
2.0 Geology

Geology in the survey region is documented in "Groundwater investigations at Rum Jungle" by S. Appleyard, Water Division, Department of Transport and Works, 1983.
3.0 Instrumentation and Techniques

Electromagnetic instruments used on the present survey comprised the Geonics em34-3 and em31. These are commercial inductive terrain conductivity meters.

The em34-3 employs a dual coil system in either horizontal or vertical coplanar mode with three coil separation combinations. These operating parameters have been chosen to ensure the systems operation at low induction numbers where an apparent ground conductivity is definable from the quadrature response. Apparent conductivities in the range 0 - 3 to 300 millimhos/meter are read directly from the meter.

The em31 operates similarly to the em34-3 in either horizontal or vertical mode with a fixed spacing of 3.66m and a frequency of 9.8kHz. Apparent conductivities are measured directly from the meter in the ranges 0 - 3 to 1000 millimhos/meter.

Anomalous zones found around Whites Heap were gridded and surveyed using a compass and tape. Otherwise a hip chain was used.

Traverse locations are illustrated in figure 2.
Rum Jungle Geophysical Survey, 1991

Scale 1 : 6 000
4.0 Results

Results for lines 1 through 3 are discussed briefly below since further conductivity/depth interpretation is complicated by infill and associated earthworks between Whites open cut and overburden heap.

Line 1, figures 4 through 6, nearest Whites heap; em31 data resembles EM34 10m Vertical coil data; two zones of increased conductivity, at 245 mE and 410 mE; conductivity is similar at all depths; considerable increase in conductivity near Sweet Water Dam.

Line 2, figures 4 through 6; similar conductivities at all depths; slight increase in conductivities relative to line 1; considerable increase in conductivities near Sweet Water Dam.

Line 3, figures 4 through 6, nearest the open cut; em34/3 10m Vertical coil reflects EM31 data very closely; considerable increase in conductivity after 120 mE; sweet Water Dam entrance, into the old open cut, is well defined by 20m data; large increase in conductivity east of 470 mE indicates a change in lithology; significant high, increasing with depth, in conductivity at 140 mE and 200 mE.

Line 4, completed around the base of Whites heap, isolated three anomalous zones which imply, possible, preferential flow paths. Further investigation was carried out near two of these anomalies, as depicted in figure 2. The third, due east of the heap, is clearly depicted along line 4 between 550m and 1000m. This flows directly into the Sweet water dam and may reflect regional flow.

Lines 5,6 and 7, illustrated in figure 7, show the anomalous zone found on line 4, adjacent to drain F. The high in conductivity, shown in figure 3, is on a bearing of 47°.

Lines 8,9 and 10, illustrated in figure 8, show the anomalous zone depicted on line 4, in the proximity of RN25164. The conductivity high is in the proximity of another drain, drain G. The high in conductivity, as shown in figure 3, is mapped well from line 8 through 11 on a bearing of 50°.

The bearing of Giants Reef Fault is in the order of 50° which implies the conductivity highs, as mapped in figure 2, are more than likely associated with this fault structure. The source of contaminate may be associated with, or a combination of, either drains F and G or the heap itself.
Rum Jungle, EM31, 12th November 1991

Conductivity contour interval: 20 mmho/m
Station spacing: 10 m
Figure 4.
Graphs showing conductivity over different lines at Rum Jungle, EM34/3 20m, 7th October 1991.

- **Line 3**: Conductivity (mmho/m) against station (m).
- **Line 2**: Conductivity (mmho/m) against station (m).
- **Line 1**: Conductivity (mmho/m) against station (m).

Legend:
- Horizontal coil
- Vertical coil

**Figure 5.**
Rum Jungle, EM31, 7th October 1991

Line 3

Conductivity (mmho/m)

Station (m)

Line 2

Conductivity (mmho/m)

Station (m)

Line 1

Conductivity (mmho/m)

Station (m)

Figure 6.
Rum Jungle, EM31, 12th November 1991

Line 5

Line 6

Line 7

Figure 7.
Rum Jungle EM31, 12th November 1991

Figure 8.
Rum Jungle EM31, around Whites overburden heap
5.0 Conclusion and recommendations

Infill and associated earthworks around the mine site, resulting in topographic and lithologic changes between Whites open cut and overburden heap, complicate the interpretation of EM.

Line 3 shows considerable conductivity increase with depth. This implies a mixing zone between the dam and surrounding rock types. This is more likely due to a possible negative groundwater gradient existing between the heap and open cut.

Other than a general increase in conductivities, towards the open cut, there appears to be little connection between the open cut and heap. There appears to be no correlation of significant features between traverses one through three.

Line 5 through 11 show significant conductivity high's associated with a regional structure. Further geophysics is required to better define the fault/fracture system southwest and northeast of Whites overburden heap.