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South Alligator Valley abandoned uranium mines – hazard reduction program: Triennial radiation survey – October 2002

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Summary

As part of the ongoing program of monitoring of previous hazard reduction works and rehabilitation for the abandoned uranium mines in the South Alligator Valley a radiation survey was conducted by Peter Waggitt (OSS) with the assistance of Lassmyn Shiosaki from the SSD Jabiru Field Station. The triennial survey was carried out from 28 to 30 October 2002 and adopted the methodology used previously. The previous survey was completed in August 1999.

All containment sites were found to be performing satisfactorily from an erosion aspect. Although some of the individual radiation readings were higher than background, the limited occupancy of the sites meant that no site was deemed to be giving rise to a dose in excess of 1mSv per year. This resulted in the decision that no further intervention was required at this time. Revegetation at the sites was variable but generally satisfactory.

In the course of the survey the opportunity was taken to inspect the state of the remedial works at the Gunlom Road tailings site and the waste storage facility. All was found to be satisfactory.

The annual inspection regime will resume, as usual, in the dry season and a full radiation survey will be undertaken in 2005. However, a further check survey will be made at the bund and weighbridge sites in 2003 as a check on the results of the present survey and to establish that there has been no deterioration of the sites.

1 Introduction

In 1992 the Commonwealth Government undertook a program to reduce physical and radiological hazards at abandoned uranium mines in the South Alligator Valley of Kakadu National Park. As part of the program it was agreed that the sites where radiologically contaminated materials had been contained would be checked on a regular basis by OSS staff. The monitoring program comprises annual inspections for erosion damage, general radiation conditions and site integrity. In addition a triennial program of complete radiation surveys is undertaken at each of the containment sites in the valley.

The hazard reduction work program was completed in 1992 and the first 'radiological survey' was undertaken in July 1995. The present survey was carried out, from 28–30 October 2002, by Peter Waggitt of OSS, with the assistance of Lassmyn Shiosaki from the Jabiru Field Station staff.

In the course of the previous survey, in 1999, a quantity of previously buried tailings was found to have been exposed in the course of road works. Following the report from the OSS survey team an additional survey and risk assessment was undertaken to look specifically at this issue. The outcome of the survey was published as SSD Internal Report 332 (Tims S, Ryan B & Waggitt PW 2000. γ Radiation survey of exposed tailings in the area around Rockhole mine. Internal Report 332, Supervising Scientist, Darwin. Unpublished paper).

The recommendations made in this report formed the basis of a program of remedial actions undertaken by Parks Australia North (PAN). The program collected up all the loose tailings and contaminated soil, which were then placed in a custom built above ground containment facility adjacent to the borrow pit containment area. The remaining tailings were left in-situ and stabilised with a layer of rock armouring to prevent any further dispersal until a permanent solution could be put in place. Drainage improvements were undertaken in the vicinity of the works to improve the erosion control situation and reduce the risks of any further dispersal.

The storage facility comprises two shipping containers on a concrete base within a security fence. The OSS maintains a watching brief over the storage facility and the associated works in conjunction with PAN staff from the Mary River Ranger Station (MRRS). During the radiation survey a routine inspection of the storage facility, the rock armouring works and the drainage was undertaken. All components were found to be in satisfactory condition.

Another item which was inspected during the survey was the remedial erosion control works that had been undertaken at the site of the El Sherana containment. Over the previous few wet seasons an erosion gulley had been developing which would eventually have threatened the integrity of the containment. A program of remedial works was undertaken by contractors, on behalf of PAN, under the supervision of PAN's consultant. The program repaired the erosion damage and reinstated surface drains to prevent recurrence of the problem. At the time of the inspection all was found to be satisfactory. A further check will be carried out at the start of the 2003 dry season, in the course of the routine monitoring program.

2 Methodology

The 2002 work program was carried out in essentially the same manner as the previous surveys for ease of comparison of results. The instruments used were the same, and the grid spacing was based on previous surveys. At each site a grid was set out as close as possible to the grid used for the original check survey in 1995. Instruments were then set up at each grid point to measure gamma radiation at a height of 1 metre above ground level. The counting period was 100 seconds. Results were recorded and then assessed after conversion to dose rates. The intervention level was set at twice the measured average regional background level of 0.15 μ Gy/hr, i.e. if readings showed gamma dose rates above background of higher than 0.15 μ Gy/hr then the need for intervention is considered, including remediation options. However, the average value for a site was also taken into consideration when making the intervention decision.

The detailed layout of each site inspected is given in the attached figures. The containment sites inspected were:

Saddle Ridge; Battery/Bund; El Sherana; Weighbridge; South Alligator Township and Borrow Pit

At each site apart from the radiological survey observations were recorded concerning the state of vegetation regrowth and erosion. These have been appended to the individual site reports.

3 Individual site surveys

In the following sections the results from each site are presented and discussed separately.

The readings shown are dose rates of gamma radiation in μ G/hr above background values. Where the reading from a location was at or below the background for the area the value is shown as B/G. The representation of the survey grid is not to scale and the shaded cells show

the approximate position of the containment boundaries. The survey areas were all located within the containment boundaries. Background levels of radiation were measured close to each site at locations chosen to be typical of the natural vicinity in terms of vegetation and drainage etc

The reference point for each survey is listed on the site description and the co-ordinates for each site, as determined by a Magellan hand-held Meridian Platinum Geographic Positioning System, are also shown. Coordinates are given as latitude and longitude using the WGS 84 datum.

3.1 Saddle Ridge site

The site was little changed from the previous inspection, well covered with trees and grass, mainly Acacia species and few Eucalyptus seedlings. There was no evidence of surface erosion nor was there any significant subsidence.

Saddle Ridge Containment

Date of Survey: 29 October 2002	Surveyors: PWW / LS		
Grid spacing : 10 m X 7 m	Rows Direction: 300° mag		

↓ 300° Magnetic
Background readings: 0.180±0.0058 µGyh-1

13.33.106 S 132.33.830 E				13.33.117 S 132.33.82 E
	B/G	B/G	B/G	Reference point tree X
	B/G	B/G	B/G	
	B/G	B/G	B/G	
	B/G	B/G	B/G	
	B/G	B/G	B/G	
13.33.92 S				13.33.097 S
132.33.81 E1				132.33.802 E

The whole site is at below background levels. The local background may be elevated slightly due to the former use of some of the vicinity as an ore haul road and dumping ground. Despite elevation the gamma readings are well below any level at which intervention might be considered.

- 1. Dose rates are taken at 1 metre above ground level
- 2. Units are μ Gy/hr above Background
- 3. B/G indicates reading was at or below background of 0.15 μ Gy/hr

3.2 Battery/Bund site

The site was less well vegetated than previously. Although the grass cover remained over the whole site the Acacia growth had died off in places with few volunteer replacements. As previously observed Eucalyptus species are gradually establishing themselves on the site, although few were seen that were more than 1.5 m tall. The area previously noted for tree deaths was little changed although the grass cover appeared healthy. It was noted that the dominant grass at some points was not the local spear grass but another lower habit grass, which was also seen elsewhere in the vicinity. There was evidence of a past fire, which may have been in part responsible for the present state of the vegetation, as it appeared to have been quite severe. There was no evidence of surface erosion or any significant subsidence on the site.

Bund Containment



Reference point for top left corner = gate post at Boom Gate

13.31.261 S					13.31.272 S
132.31.454 E					132.31.465 E
	0.203	0.108	0.182	0.037	
	0.183	0.026	0.066	0.103	
	0.047	0.014	0.075	0.045	
	0.034	0.039	0.026	0.069	
	0.044	0.146	0.016	0.106	
	0.044	0.076	B/G	0.123	
		0.034			
13.31.289 S					13.31.300 S
132.31.419 E					132.31.435 E

 \downarrow 60° Magnetic Background readings 0.16 ±0.0053 µGyh⁻¹

Overall average for the site 0.073 $\pm 0.0053~\mu Gyh^{-1}$

- 1. Dose rates are taken at 1 metre above ground level
- 2. Units are μ Gy/hr above Background
- 3. B/G indicates reading was at or below background of 0.15 μ Gy/hr

3.3 Weighbridge site

The site had been affected by fire as in previous years. There were few trees remaining from the previous substantial growth. There was little remaining grass cover. It was noted that the soil cover placed over the 'hot spot' to the south of the main containment had continued to erode which is resulting in higher dose rates being maintained in that vicinity. Whilst it is recommended that appropriate remedial work be undertaken during the overall rehabilitation program, the site will continue to be monitored to ensure that the situation does not deteriorate to a point where more rapid intervention is required. The present inhospitable and unattractive nature of the site coupled with the relatively low dose rate lead the team to conclude that there is no significant hazard to human or environmental health. However, in the longer term the issue of what intervention is required for the 'hot spot' must be resolved. The recommendation is that the possibility of further excavation of the site be investigated with the objective of bringing the gamma dose rate down to a level similar to that found over the remainder of the site.

ate of Survey: 29 October 2002		2 Surveyors: PWV			
<u>Critererie</u>	5 V 10	Calar			
Grid spacing :	5 m X 10 m	Colum	Column Direction: 12° mag		
Desta		0.162.10	0052 Cali 1		
Васке	round readings	0.162 ± 0.000	$10053 \mu \text{Gyn}^{-1}$		
K	eference point =	weighbi	ridge hut		
13.30.747 S			12 20 751 S		
1323.30.713 E			13.30.751 S 132.30.719 E		
	0.151	0.105			
	0 131	0 329			
	0.131	0.32)			
	0.047	0.014			
0.261	0.020	0 144	Reference point Shed		
0.201	0.020	0.144	$55 \text{ m} \rightarrow$		
0.246	0.044	0.146			
↑Hot spot	0.037	0.011			
	0.089	0.032			
13.30.783 S			13.30.784 S		
132.30.712 E			132.30.717 E		

Weighbridge Containment

- 1. Dose rates are taken at 1 metre above ground level
- 2. Units are μ G/hr above Background
- 3. B/G indicates reading was at or below background of $0.15 \,\mu$ Gy/hr

3.4 El Sherana site

The containment was thickly revegetated with a wide variety of tree, shrub and grass species although still dominated by Acacia species. The site has no new erosion features but it was noted that that the previously observed sink holes had grown marginally in size. Also a gulley is developing to the northern edge of the containment at the mid point. This will be monitored in future inspections. Surveys of the depressions and sinkholes had previously shown no increase in radon emanations or gamma radiation relative to the surrounding area.

El Sherana Containment

Date of Survey: 29 October 2002	Surveyors: PWW / LS
Grid spacing : 8m X 10 m	Column Direction: 45° mag

Reference point for top left corner = Tree near road

Background readings $0.162 \pm 0.0053 \,\mu\text{Gyh}^{-1}$

0.075			12 20 5105
0.075	B/G	B/G	13.30.5198 132.30.881 E
0.083	B/G	B/G	
0.016	B/G	B/G	
0.011	B/G	0.017	13.30.531 S 132.30.873 E
B/G	B/G	0.041	
B/G	0.015	0.034	
0.005	0.038	B/G	
B/G	0.004	0.004	
B/G	0.034		
	13.30 132.30	.556 S).844 E	13.30.560 S 132.30.850 E
	0.083 0.016 0.011 B/G B/G 0.005 B/G B/G	0.083 B/G 0.016 B/G 0.011 B/G B/G B/G B/G 0.015 0.005 0.038 B/G 0.004 B/G 0.034	0.083 B/G B/G 0.016 B/G B/G 0.011 B/G 0.017 B/G B/G 0.041 B/G 0.015 0.034 0.005 0.038 B/G B/G 0.0041 0.0041 B/G 0.015 0.034 B/G 0.038 B/G B/G 0.0044 0.0041 B/G 0.038 B/G B/G 0.038 B/G B/G 0.0344 0.0044

 \downarrow 45 ° Magnetic

Average for whole site 0.014±0.0053 µGyh-1

- 1. Dose rates are taken at 1 metre above ground level
- 2. Units are μ Gy/hr above Background
- 3. B/G indicates reading was at or below background of 0.15 μ Gy/hr

3.5 South Alligator Valley borrow pit site (near township site)

The borrow pit site is the location of the materials recovered from the Airstrip anomaly site. The only area of vegetation in the borrow pit was the area of the containment, which had a sparse grass cover and two or three small Acacia trees. There was no evidence of surface erosion or subsidence.

South Alligator Village – Borrow Pit Containment

GPS Location: Centre of site 12.24.298 S 130.52.636 E

Date of	of Survey: 28 October 2002	Surveyors: PWW / LS		
	Grid spacing : 3 m X 3 m	Column Direction: 40° mag		

Reference point was the vegetation of the containment, the rest of the borrow pit being bare ground.

 \downarrow 40 ° Magnetic Background readings 0.13±0.0043 µGyh⁻¹



Average for site 0.015±0.0048 µGyh-1

The radiation level is barely above background

- 1. Dose rates are taken at 1 metre above ground level
- 2. Units are μ Gy/hr above background level
- 3. B/G indicates reading was at or below background of 0.15 μ Gy/hr

3.6 South Alligator Valley township site

The main township containment was well grassed and there were also a few small shrubs and trees across the site, including some small *Eucalyptus spp* as well as *Acacia* spp. There had been a fire across the site but regrowth was apparent. The failure of good tree cover to establish is almost certainly the consequence of annual fires. There was no evidence of erosion or subsidence.

South Alligator Valley Township Containment

Date of Survey: 28 October 2002	Surveyors: PWW / LS

Grid spacing : 10 m in rows X 5 m between columns Column Direction: 102° mag

Reference point is sole tree at side of containment $\uparrow 102 \circ$ Magnetic

Background readings $0.16 \pm 0.0053 \,\mu\text{Gyh}^{-1}$

				1
13.28.903 S				13.28.911 S
132.28.153 E				132.28.151 E
	B/G	B/G	B/G	
	0.008	B/G	B/G	
	0.008	B/C	B/C	
	0.008	D/U	D/O	
	0.000	0.00 -	7.4	
	0.008	0.005	B/G	
	0.014	0.006	0.008	
	0.006	0.009	0.018	$\mathbf{X} = reference$
	0.000	0.009	0.010	tree
				ucc
	B/C	B/C	B/C	
	D/O	D/U	D/U	
	0.004	0.04	B/G	
13 28 003 8				13 28 010 \$
13.20.903 5				13.20.910.5
132.28.11/E				132.28.110 E

Average for whole site 0.005 $\pm 0.0053~\mu Gyh^{-1}$

- 1. Dose rates are taken at 1 metre above ground level
- 2. Units are μ Gy/hr above background level
- 3. B/G indicates reading was at or below background of $0.15 \,\mu$ Gy/hr

3.7 Former South Alligator mill area

This site had previously been managed in the course of the intervention works to remove and contain tailings. The inspection was limited to a check of the state of vegetation, road drains and erosion control works. The main site was found to be in a satisfactory condition. The rock armouring has been extended over the whole roadside embankment and the area is acquiring a cover of creeping vegetation with a few shrubs. There was no evidence of any erosion damage or weak points developing. The roadside drain needed some minor works in the form of cleaning out and final finishing. This recommendation was reported to MRRS staff who undertook to ensure the task would be completed before the wet season. A final pre-wet season inspection of the tailings storage facility by OSS in mid-December confirmed that these tasks had been completed satisfactorily.

4 Conclusions

The prime outcomes from the survey are that the containments are continuing to achieve their objective and that there is no significant radiological risk to human health or the environment in the areas managed by the hazard reduction program. In reaching this conclusion it has been assumed that the sites would not be occupied for more than 10% of the time. This was previously established as a reasonable decision after consultation with the park managers and Traditional Owners. On this basis the annual radiation dose, above natural background, arising from gamma sources would range from 0 (e.g. Borrow Pit at South Alligator Township) up to approximately 200 μ Sv (Battery Site; weighbridge 'hot spot'). This figure is well within the 1mSv limit set by the legislation.

The additional dose due to radon and dust inhalation/ingestion as a consequence of the materials within the containments is expected to be a small proportion of the gamma dose. This is because the materials are not exposed at the surface and the areas of the containments are small.

Background radiation levels throughout the area were found to be generally elevated. The higher readings were not necessarily associated with the containments. It was not possible to be certain if this phenomenon was due to a regional characteristic related to natural mineralisation or a consequence of historical mining and milling activities. A regional background value of 0.15 μ G/hr at 1 metre above ground level was used for most of the survey, a conservative value in that some background levels were in fact greater than this. However, the local value was checked at each site and has been recorded in the notes.

The outcome of the radiation survey and the associated inspections is that all the containments continue to perform satisfactorily with no serious erosion or radiation hazards being observed or identified.

5 Recommendations

- 1. The existing periodic surveillance program should be maintained covering all containments at the previously agreed frequency. OSS staff will re-inspect the area in the early dry season of 2003.
- 2. The weighbridge and battery sites will be re-checked in 2003 to ensure that the situation has not deteriorated. No intervention is recommended at this stage but surveillance will be maintained at an increased level in the short term.
- 3. Monuments should be placed at containment sites as a permanent warning as soon as possible. This work will be investigated in the dry season of 2003.