

**ALLIGATOR RIVERS REGION TECHNICAL COMMITTEE  
MEETING 20  
8 – 10 OCTOBER 2007  
MEETING OUTCOMES**

**ATTENDANCE**

**MEMBERS**

Mr Ray Evans - Independent Scientific Member (Chair)  
Dr Carl Grant - Independent Scientific Member  
Prof Peter Johnston – Independent Scientific Member  
Dr Simon Barry – Independent Scientific Member  
Dr Terry Hillman - Independent Scientific Member  
Dr Jenny Stauber - Independent Scientific Member  
Dr Tony Milnes – Energy Resources of Australia Ltd  
Mr Mike Delosa – NT Department of Primary Industries, Fisheries and Mines  
Mr Mike Ellsmore – Hanson Pty Ltd  
Mr Mark Foy - Northern Land Council  
Mr Alan Hughes – Supervising Scientist

**APOLOGIES**

Prof Jon Nott - Independent Scientific Member  
Ms Anne-Marie Delahunt – Parks Australia North

**PRESENTERS/OBSERVERS**

Dr David Klessa - EWL Sciences Pty Ltd  
Dr Mark Gardener – EWL Sciences Pty Ltd  
Mr Alan Puhlovich – EWL Sciences Pty Ltd  
Dr Jeff Turner - CSIRO  
Mr Geoff Kyle - Gundjei'mi Aboriginal Corporation  
Mr Howard Smith - Northern Land Council  
Mr Suresh Rajapakse – ERA Pty Ltd  
Ms Philippa Varris – ERA Pty Ltd  
Dr David Jones - Environmental Research Institute of the Supervising Scientist  
Dr Andreas Bollhoefer - Environmental Research Institute of the Supervising Scientist  
Dr Chris Humphrey - Environmental Research Institute of the Supervising Scientist  
Dr Ken Evans - Environmental Research Institute of the Supervising Scientist  
Dr Peter Bayliss - Environmental Research Institute of the Supervising Scientist  
Dr Rick van Dam - Environmental Research Institute of the Supervising Scientist  
Dr Renee Bartolo – Environmental Research Institute of the Supervising Scientist  
Mr Bruce Ryan - Environmental Research Institute of the Supervising Scientist  
Mr Robert Thorn - Environmental Research Institute of the Supervising Scientist  
Ms Wendy Murray - Environmental Research Institute of the Supervising Scientist  
Ms Kate Turner - Environmental Research Institute of the Supervising Scientist  
Mr Mike Saynor - Environmental Research Institute of the Supervising Scientist  
Ms Suzanne Davis-Hall - Office of the Supervising Scientist  
Ms Shelly Illes - Office of the Supervising Scientist  
Ms Michelle Bush - Office of the Supervising Scientist  
Mr Greg Balding - Parks Australia North  
Other *eriss* staff  
Mr Scott Parker – Office of the Supervising Scientist (Secretary)

## 1 Introductory Session

### 1.1 Welcome and Overview

- 1.1.1 The Chair welcomed members to the 20<sup>th</sup> meeting of ARRTC and introduced Dr Simon Barry who has been recently appointed to replace Dr Keith Hayes as the independent scientific member with ecological risk assessment expertise. Dr Barry provided a brief overview of his background and expectations as a member of ARRTC. Members noted that Dr Barry was already getting up to speed on the work of ARRTC and it was agreed that the ARRTC Secretariat would provide Dr Barry with relevant background information and any other assistance as necessary.

#### **ARRTC20 Action/Outcome 1A**

**ARRTC agreed the Secretariat would provide Dr Barry with background information on ARRTC and any other assistance as necessary.**

- 1.1.2 Mr Evans proposed that the Order of Business be amended to allow the ERA stakeholder presentation by Dr Jeff Turner to be brought forward to Day 1 and the Hanson stakeholder report by Mr Mike Ellsmore to be moved back to Day 3. This was agreed.

### 1.2 Apologies and Observers

- 1.2.1 Mr Evans noted apologies for the meeting had been received from Prof Jon Nott and Ms Delahunt. Mr Evans also noted the presence of observers from relevant stakeholder organisations. Mr Evans advised members that Mr Ellsmore would be attending the meeting on Day 3.

### 1.3 Correspondence

- 1.3.1 Mr Evans advised that there was some uncertainty as to whether his letter to Assistant Minister Cobb dated 28 May 2007 had been sent. Mr Parker advised that the Minister's office had no record of having received the letter. He advised that he had provided the Minister's office with a copy which had been subsequently referred to the Department for response. Mr Evans advised members that he had received a letter from Assistant Minister Cobb dated 20 September 2007 advising Dr Barry's appointment to ARRTC.

### 1.4 Declarations of any conflicts of interest with Agenda items

- 1.4.1 There were no conflicts of interest declared.

## 2 Draft Summary Record of 19th Meeting

### 2.1 Draft Summary Record

- 2.1.1 Mr Evans noted that the draft meeting outcomes from ARRTC19 were still to be approved and asked if members had any comments or required changes.
- 2.1.2 Mr Foy asked that the wording of Action/Outcome 2F be amended as follows: "*Mr Kyle to provide further information on the proposed meeting between ARRTC and the GAC under his report later in the meeting*".
- 2.1.3 Dr Stauber asked whether a list of outstanding meeting actions was being maintained as previously agreed by ARRTC. She noted the report on sediments work by Ranger was still outstanding. Dr Klessa advised that a report on the sediment work should be available by the end of the year.
- 2.1.4 Dr Stauber requested that the wording under KKN 5.2.11 on page 9 be amended as follows:
- "She indicated that the first stage would be to see what billabong exposure data are, and whether measured concentrations could potentially cause effects on freshwater benthic biota, with the next stage possibly being the development of a freshwater benthic biota test. She suggested that if sediments turn out to be a major issue, this would require a major effort and long term commitment"***.
- 2.1.5 Dr Stauber also suggested that the word "tight" used to describe the state of Ranger sediments in para 6.1.18 be replaced with 'compact' or 'fine'.
- 2.1.6 The ARRTC19 meeting outcomes were approved with the above changes.

#### **ARRTC20 Action/Outcome 2A**

**ARRTC approved the draft minutes as being a true and fair record of the ARRTC19 meeting with a number of minor changes.**

### 2.2 Business Arising

- 2.2.1 Mr Evans noted that all Actions/Outcomes from ARRTC19 had been completed except for the following items:

**2H - ARRTC agreed to take account of various members' views regarding risk assessment techniques when reviewing the KKNs, specifically in relation to the use of BPT as a decision making process;**

**2J - ARRTC agreed to advise ERA that it considers the trial vegetation project to be of high priority and recommend that it should proceed as soon as possible. Chair to write to ERA with this advice; and**

**6B - Dr Grant indicated he would like the opportunity to comment on the experimental design document for the demonstration area and to visit the landform revegetation site at some point in the future.**

2.2.2 It was agreed to address item **2H** after the discussion on the KKN review later in the meeting, item **2J** following the presentation by Dr Gardener and item **6B** after Dr Grant had arrived.

## **3 Current Operations**

### **3.1 Contextual statements by stakeholders**

#### **Energy Resources of Australia (Ranger & Jabiluka)**

3.1.1 Dr Milnes provided a presentation on behalf of ERA covering production, safety performance, recovery from the extreme rainfall event, key operational projects, applications to MTC since last meeting, a Feasibility Study for Pit#3 extension and Ranger expansion studies.

#### *Production*

3.1.2 Prof Johnston asked why the sulfuric acid plant at Ranger was being replaced. Dr Milnes indicated that it was simply more economic and safer to transport acid in than make onsite.

#### *Operational performance*

3.1.3 Mr Evans asked why the production figures were shown on a calendar year basis versus financial year. Dr Milnes advised that ERA operates its financial year on a calendar year basis and the table compares production between the year affected by the extreme rainfall event and a normal year.

#### *Safety performance*

3.1.4 Dr Milnes advised that safety performance at Ranger had improved over last few years. He advised that ERA is implementing a major program to improve safety cultures onsite. He noted however that contractor safety was looking better than employee safety performance which was of concern to the company, since it is a reversal of the situation in previous years, and is currently being addressed.

#### *Recovery*

3.1.5 Dr Milnes provided a comparison between the last two wet seasons in terms of their effects on Ranger operations and water inventory. He noted the key difference was that in Oct/Nov 2006 the Pit was empty but in early 2007 there was a much larger volume of water than at the same time in 2006. He outlined some of the water management strategies being implemented by ERA to deal with the increased water inventory, including expanded irrigation, water treatment and evaporation of pond water.

3.1.6 Dr Milnes advised that the primary strategy for dealing with process water was the proposed raise of the Tailings Dam to RL +51m with a continued focus on solving the current problems with process water treatment. Mr Evans asked whether ERA will increase the level of monitoring to complement the increased use of land application. Dr Klessa advised that some baseline work on this had been carried out including an ecological survey and a number of heritage surveys undertaken in collaboration with GAC. In relation to monitoring, Dr Klessa advised that a number of GW bores would be installed along the gradient of the Land Application Areas in addition to two surface monitoring sites (including one control site).

3.1.7 Mr Evans asked about ERA's knowledge of solute balances in Magela Creek and whether ERA believes that sufficient monitoring is being done. Dr Milnes advised that work would soon commence on comparing old and newer irrigation areas in terms of contaminants and dose models. He advised work on the rehabilitation strategy would also be commencing after the meeting and that ERA was required to present a report on this work to ARRTC by 2009.

3.1.8 Dr Hillman indicated he was aware that benchmarking was being done and there is now a need for ERA to audit the water disposal processes. Dr Milnes advised the land application process needed to finish by 2009 by statutory requirement and that, after this, disposal would be through the Water Treatment Plant. Dr Klessa advised that following the extreme rainfall event, stakeholders had agreed to the use of the Jabiru East LAA and the new Corridor Creek LAA. He noted stakeholders had only approved use of these new areas until 2009, and that at this stage it is anticipated that only treated water will be land applied from 2009 onwards.

3.1.9 Mr Evans suggested that there are several questions arising from the MTC minutes regarding the technical information used to support decisions on water disposal options. Dr Milnes noted that the final applications were available for scrutiny if required. Mr Evans expressed concern in relation to the level of ARRTC involvement in MTC decisions regarding land irrigation. Mr Delosa advised that he could table copies of relevant applications if ARRTC was interested in seeing these. Dr Milnes advised that Dr Klessa undertakes an annual review of land irrigation practices but acknowledged that further work on whole-of-site disposal is required. Mr Evans suggested

that the role and fate of land application areas will be key issues in terms of the final landform and terrestrial ecology of the rehabilitated site. Dr Milnes advised that ERA would be meeting with **eriss** in due course to identify key issues and concerns.

- 3.1.10 Dr Milnes advised that the current level of Pit water is continuing to decline and is currently at RL -91 down from RL -70. Dr Jones asked what ERA's plans were for rehabilitation of the evaporation basins constructed on top of the waste rock stockpiles. Dr Milnes advised that the evaporation basins would be scraped out.

#### *Exploration - Applications to MTC*

- 3.1.11 Prof Johnston asked why construction workers had been housed in Jabiru East. Dr Milnes advised that there was no room to accommodate the 50 man camp onsite. Prof Johnston asked whether the application to the MTC for optimisation of radiation and atmospheric monitoring was the same as discussed at ARRTC19. Dr Milnes indicated he wasn't sure. Mr Hughes advised he thought this was the same project that was discussed previously.

#### *Feasibility study Shell 50 footprint*

- 3.1.12 Dr Milnes advised that the Shell 50 will require additional rock stockpiles (with 1s to the North and 2's and 3's to the South) which would extend to margins of the wetland and access road.

#### *Ranger expansion*

- 3.1.13 Dr Milnes advised that further resource evaluation is currently underway as part of the pre-feasibility study for Ranger expansion including examination of different processing technologies and potentially new processing facilities. Mr Kyle asked what is meant by 'post Ranger plant'. Dr Milnes advised that this referred to plant that was not part of the original project design. Dr Grant asked what attempts were made by ERA during exploration drilling to minimise impacts. Dr Milnes advised that most access roads and drill pads are rehabilitated following use.

- 3.1.14 Dr Grant expressed concern that rehabilitation of these areas should include efforts to manage impacts to minimise the total area needed to be rehabilitated and address threats such as weeds and fire. Dr Klessa advised that this is why efforts are being made to ensure such impacts are minimised. Dr Grant noted it is standard practice to minimise impacts when undertaking exploration activity because it is not known if the area will be subsequently disturbed by mining or not. Dr Milnes advised the impact footprint would be substantially larger if the mine was to be expanded. However, he advised that if underground mining was shown to be more profitable and ended up proceeding, a number of impacts associated with the current open cut mining operations would be reduced.

- 3.1.15 Dr Milnes outlined an estimated time frame for closure of Ranger assuming no further expansion beyond that currently approved by the ERA Board. Mr Evans asked when under the current plan do tailings have to be put into Pit#3. Dr Milnes advised the current plan would see tailings going into Pit#3 by 2012. Dr Milnes outlined various milestones for current operations with an expanded Pit#3. Mr Kyle noted that Mr Rajapakse had advised a different timescale at the last Ranger MTC of 2030. Dr Milnes advised that this date took account of the required monitoring period following cessation of rehabilitation. Dr Grant advised he thought four years was an optimistic timeframe for rehabilitation. Dr Jones asked about the timeframe for closing out Pit#1. Dr Milnes advised this was part of the current planning process. Mr Evans noted that current timeframes assumed various steps were able to be completed on time.

- 3.1.16 Dr Grant asked how key stakeholders would view the period of time taken to get the Water Treatment Plant working as designed. Dr Klessa advised that ERA has developed a strategy for when the Water Treatment Plant has to be commissioned and has developed a range of contingencies to deal with various future scenarios. Dr Grant asked what contingencies have been developed. Dr Milnes advised that there are a number of unknowns associated with the potential expansion of the mine that would need to be addressed and that water management was one of them. It was noted that water management issues would be raised later in the meeting. Dr Grant asked whether the ERA presentations to the meeting regarding water management could be made available to ARRTC members. Dr Milnes advised that he would check whether it would be possible to provide members copies of the ERA presentations but indicated that as the presentations remained commercial-in-confidence, they would not be able to be put on the ARRTC website.

#### **ARRTC20 Action/Outcome 3A**

***Dr Milnes agreed to confirm whether ERA presentations can be made available to ARRTC members and under what terms.***

#### **Hanson Australia (Nabarlek)**

- 3.1.17 Mr Ellsmore provided members with a report on Hanson's activities at Nabarlek. He advised that the earth bund around the diesel tank would hopefully be removed next year with the involvement of the local community. He advised that plant and equipment for revegetation works including spraying equipment had been purchased and delivered to site. Mr Ellsmore advised that weed control on the site was ongoing and that the nursery at Oenpelli currently has approximately 2000 plants in stock. He advised that the perimeter fence would be removed with the assistance of the local community hopefully by the end of the year and, if not, by next dry season. Mr Ellsmore advised there was some erosion control work to do onsite and that Hanson would spend about \$60,000 to \$70,000 on works on the site this year.

### *Rehabilitation Workshop*

- 3.1.18 Dr Grant advised members that a rehabilitation workshop was to be held following ARRTC20 involving a number of ARRTC members and staff from ERA, *eriss* and the NLC. He advised that the workshop would be considering a range of issues including the outcomes from the ecosystem establishment workshop in December 2005 and the proposed rehabilitation trial at Ranger.
- 3.1.19 Mr Evans asked whether members had any concerns regarding the proposed size of the rehabilitation trial plot at Ranger. Dr Hillman advised that, while he wasn't fully aware of the difficulties involved, he believed the proposed trial offers the opportunity to do some experimental work but was concerned the area may not be big enough. He asked whether similar trials could be established at other locations within the mine area. Dr Klessa noted that this would be interesting theoretically but would also be very expensive. Dr Jones noted that one factor in the current location of the trial site was that ERA wanted to use the area as a readily accessible demonstration site. However he could see no technical reasons why other larger trial areas couldn't be established elsewhere onsite. Dr Klessa agreed that additional areas could be established if this was required.
- 3.1.20 Mr Evans advised he was generally happy with progress to date on the rehabilitation trial given the scale of the investment and the operational difficulties involved. However, from a scientific point of view, he suggested that it would be valuable for ARRTC to place on the record its views on the optimal design requirements for the rehabilitation trial. Dr Klessa highlighted the need to understand what the current knowledge gaps are so these can be looked at as part of the rehabilitation trial and, if necessary, to then establish additional trials to examine these issues in more detail. Dr Jones suggested that it will take at least five years to get a basic understanding of the various interrelationships between vegetation and landform. Dr Klessa suggested that the Nabarlek site may be one area where this can be done as an analogue. Dr Grant agreed that it would be good to have larger area but he didn't want this to jeopardise the current proposal.
- 3.1.21 Dr Hillman suggested that some design issues for the trial could be tweaked, but it was important to look at design parameters to minimise possible confounding issues. Dr Grant noted that the original proposal was for a four to five hectare site which was much larger than the current proposed trial site size of 1.8 hectares. Dr Barry suggested the parameters of the trial site should be based on what needs to be known and the associated timeframe. Dr Jones noted that ERA originally proposed to directly revegetate waste rock on closure, based on the findings from previous rehabilitation research which was largely focused on planting in waste rock. However, it is now proposed to use a cover comprising waste rock mixed with laterite which is obviously quite a different medium to waste rock alone. He suggested this could have substantial ramifications for development of vegetation on the rehabilitated landform. Prof Johnston suggested that ARRTC wait to see what comes out of the rehabilitation workshop scheduled for Oct 11.
- 3.1.22 Dr Grant noted a number of ARRTC members had expressed interest in overseeing the rehabilitation trial process. Dr Klessa acknowledged a number of processes needed to come together. Mr Evans proposed that if there was a shared view within ARRTC that the Ranger trial site should be larger, then ARRTC should formally record this. He suggested that ARRTC consider putting forward a view that, while five hectares would have been better, it strongly supports getting the best outcomes from what ERA has proposed.
- 3.1.23 Mr Smith suggested that a key issue was the small number of treatments currently proposed and whether these would be sufficient to draw scientifically reliable conclusions. He suggested that if the area is too small then it may be difficult to extrapolate any results to a landscape scale. Dr Grant noted the last rehabilitation work at Ranger was undertaken in around 2000 and thought the current proposal was a step in the right direction. He expressed hope that the demonstration area will work at the scale proposed and that this would be one of a number of demonstration areas.
- 3.1.24 Mr Evans noted that ARRTC members would be interested in seeing the outcomes from the rehabilitation workshop to be held following ARRTC20. It was noted that Dr Bayliss and Dr Gardener would be preparing a report on the outcomes from the workshop and agreed that ARRTC would consider this report at its next meeting.
- 3.1.25 Dr Jones asked whether all aspects of the rehabilitation demonstration site at Ranger, including physical design and construction, would be considered by the workshop. Dr Grant indicated that broad aspects of the Ranger rehabilitation trial would be looked at but the focus of the workshop was on ecosystem establishment.

#### **ARRTC20 Action/Outcome 3B**

**ARRTC agreed to consider a report by Dr Bayliss and Dr Gardener on the outcomes from the Rehabilitation Workshop at its next meeting.**

#### **Department of Primary Industry, Fisheries & Mines**

- 3.1.26 Mr Delosa outlined recent NT Government changes in the administration of safety and environmental regulatory issues. Safety issues are now handled by a single regulatory authority (NT Worksafe) and some aspects of environmental regulation are handled by the NT Environment Protection Authority in NRETA.
- 3.1.27 Mr Delosa advised that a large number of companies (approximately 100) are currently looking for uranium in the Northern Territory and a number of these are working in the Alligator Rivers Region. In relation to Koongarra, Mr Hughes noted that the current moratorium on mining was still under consideration by TOs. Mr Foy advised that he believed a decision was very close.

- 3.1.28 Mr Delosa advised there are a number of current mining applications covering old mining leases and a number of applications for exploration, including one under ALRA. Mr Foy advised that when initial work was done on Koongarra there wasn't a good estimation of reserves but that by the second year of drilling, the ore reserves were about ten percent higher. Dr Grant indicated he thought TOs had been reluctant to give approval to exploration because they thought that would mean that mining would proceed. Mr Hughes advised his understanding was that the veto under the Act only applies once and that once this had run its course, the miner can proceed. Mr Delosa confirmed this was the case but noted that environmental and other processes would come into effect and would also need to be met.
- 3.1.29 Mr Foy advised that there was another ore body much deeper and of much lower grade at Koongarra which would be near impossible to open pit mine without disturbing the adjacent escarpments. Mr Delosa advised that audits had been carried out at Koongarra as part of MTC activities.

#### **Northern Land Council**

- 3.1.30 Mr Foy suggested that the NLC report be deferred until Mr Smith was present. Mr Smith subsequently advised that most of the NLC activities in the period since the last ARRTC meeting have been related to water management issues at Ranger. He advised that the NLC was also involved in consideration of a range of other mine related activities.

#### **Supervising Scientist Division (including Monitoring)**

- 3.1.31 Mr Hughes noted that SSD had previously provided a report on Ranger monitoring under this agenda item but as this was already covered in SSD's report to ARRAC (which had been tabled) he wouldn't cover this issue in detail. He advised that SSD has continued with the development of continuous monitoring equipment and in-situ biological monitoring at Ranger, although this process had been affected by the extreme rainfall event which caused damage to the equipment. In relation to monitoring at Jabiluka, Mr Hughes advised that as previously discussed, there have been problems with obtaining suitable upstream water quality reference locations owing to the different geologies of the upstream catchments - it is not as clearcut as the upstream reference and downstream monitoring locations in Magela Creek. Mr Hughes indicated that, based on comparison of upstream and downstream data over many years, the upstream monitoring site is not considered to provide the most suitable baseline condition for the catchments downstream of the Jabiluka project area. He advised that, as a consequence, the MTC had been informed that SSD would discontinue monitoring upstream at Swift Creek starting with the 07/08 wet season. However, monitoring will be maintained at the downstream site which, in the absence of any activity on the project area, will provide an ongoing before impact reference record.
- 3.1.32 Mr Evans asked why SSD believes the upstream monitoring site is not a good reference location. Mr Hughes advised that the site has a different chemistry to the other branches of Swift Creek and hence does not provide an integrated picture of upstream water quality. Any significant future impact from the Jabiluka project area would be detected at the downstream site by comparing the measured water quality data with the long term water quality record for this site. Mr Evans noted that this assumes that any time response in the system following initial disturbance and subsequent initiation of the long term care and maintenance regime has already occurred. Dr Jones agreed. Dr Klessa advised that a long history of data indicates that the upstream site is not scientifically useful as a true upstream reference. Mr Evans noted this but expressed concern on the basis that groundwater systems can take longer than eight years to respond – viz a delayed groundwater impact from the original site disturbance. Dr Klessa advised that if there was any indication of potential for impacts based on time series results from ongoing groundwater monitoring, then this would trigger further monitoring. Mr Hughes advised that if there was any indication of impact at the downstream site, upstream monitoring could be recommenced immediately. Mr Evans noted this strategy assumed that the system relaxes quickly. Dr Klessa acknowledged there may be value in maintaining the upstream site in order to monitor the Mg/Ca ratio.
- 3.1.33 Mr Evans sought assurance that SSD retained capacity to grab sample upstream if needed. Dr Grant asked why the upstream monitoring site was not useful as a control site. Mr Hughes agreed that the upstream site would have value as a control for comparative purposes but suggested that as the downstream site was providing a long term record prior to any significant future disturbance of the site, then closure of the upstream site would not compromise any future ability to detect impacts in the event that the Jabiluka project was reactivated. Mr Hughes also noted that historical values for U detected at both the upstream and downstream monitoring sites were very low. Dr Klessa agreed that the data showed very low concentrations of U and Mg, and that the difference between the control and the downstream site was very low.

- 3.1.34 ARRTC supported the decision to discontinue monitoring the upstream site at this time.

#### ***ARRTC20 Action/Outcome 3C***

***ARRTC agreed to the decision to discontinue monitoring the Swift Creek sites upstream of Jabiluka at this time.***

#### **Parks Australia North (South Alligator Valley)**

- 3.1.35 Mr Balding provided members with an update on progress on the Gunlom Land Trust Area rehabilitation project. He advised that planning and design work for a containment facility for radiologically contaminated materials is progressing well and that a risk assessment workshop had been held in September to help make decisions about the project. He advised that surveying has been completed at the El Sherana Airstrip to establish drainage

patterns and monitoring bore relative heights. Sampling at the Rockhole Mine residues area had been undertaken to assist in calculating the volume of tailings material to be moved to the new containment. He advised that Werenbun Aboriginal Corporation has removed old cores, trays, racks and other infrastructure from the old El Sherana Camp area in preparation for building demolition, installed a security fence around the new weather station at El Sherana Airstrip and demolished derelict buildings at Sleisbeck. Asbestos and derelict buildings have been removed from El Sherana Mining Camp. The El Sherana core shed and an old accommodation building have been preserved for their heritage value, and have been structurally assessed. Mr Balding advised that seed collection by Werenbun Aboriginal Corporation for rehabilitation of the sites is progressing well, and some of the seed will be used to revegetate areas after the earthworks and to revegetate the Rockhole residues area, and both the old and new containment sites, in 2009. Earthworks associated with the rehabilitation of non-radiologically contaminated areas has commenced and will be followed by backfilling and capping Sleisbeck Pit and cleaning up of rubbish scatters at Sleisbeck Camp, remediating terraced areas on Guratba, returning old core material stored at the El; Sherana Camp to the Guratba Pit, and minor works at El Sherana and Koolpin Pit. Mr Balding advised this part of the project should be completed by early November.

- 1.3.36 Mr Hughes asked how the material that was taken out of the El Sherana core shed will be stored. Mr Balding advised that the material will be moved and put into the pit at Guratba consistent with the wishes of the Traditional Owners. Mr Evans asked what follow up activity will occur after this phase. Mr Balding advised a containment would be built during the dry season in 2009. Mr Evans asked whether members would like an update on the project at a later stage and it was agreed that ARRTC would consider a update report at its second meeting in 2008.

**ARRTC20 Action/Outcome 3D**

**ARRTC agreed to consider a report on progress in the South Alligator Valley rehabilitation project at its second meeting in 2008.**

**Minesite Technical Committee (MTC) informed regulatory decisions (DPIFM)**

- 1.3.37 Mr Delosa provided a presentation on informed regulatory decisions by DPIFM in the period since the last ARRTC meeting. He referred members to copies of MTC minutes in the meeting papers.

*Ranger MTC*

- 3.1.38 Mr Delosa advised there had been two changes to the Ranger authorisation in the past 6 months associated with raising the level of the TSF (Approval to raise MOL of TSF to 45.5m RL - 6 March 2007; Approval to raise MOL of TSF to 46.5m RL - 3 April 2007). He advised that the MTC had also considered a number of applications including the Ranger Mining Management and Rehabilitation Plans, applications for extension of existing and new land application areas (extra 150 Ha), construction of evaporation basins and a construction camp, and construction of new laterite and radiometric sorting plants.
- 3.1.39 Mr Evans asked if he could see the underlying documentation for the application to expand the land application areas at Ranger. Dr Hillman also expressed interest in seeing these documents. Mr Delosa undertook to provide copies of the relevant documentation to the ARRTC Secretariat for interested members.

**ARRTC20 Action/Outcome 3E**

**Mr Delosa agreed to provide (through the ARRTC Secretariat) the underlying documentation for the MTC application/s dealing with the expansion of land application areas at Ranger to Dr Hillman and Mr Evans.**

- 3.1.40 Mr Evans asked about the issues to do with the pooling of water at the tailings dam at Ranger. Dr Milnes advised that this issue would be covered in a presentation on Day 2. Mr Evans asked if there was a need to rerun the solute model work by Franz Kalf. Dr Klessa advised that Franz is further refining his initial modelling work to predict post closure solute loads to Magela Creek from closed out Pit#1 and that ERA is also working on understanding the groundwater input and mechanism of transport of groundwater into Pit#3 and trying to predict how much groundwater would come into the pit from Magela Creek. Mr Evans asked if Shell 12 is as close to Magela Creek as Shell 50 is. Dr Klessa indicated that regardless of distance in both cases there will be a potential issue of backflow from Magela Creek. Mr Evans asked whether the MTC decision on this was still pending. Dr Milnes indicated that he didn't think there is a need to adjust the groundwater models for Shell 50, but, for a larger extension, there would need to be a range of additional groundwater and other investigations. Mr Evans asked if groundwater was still coming in at depth. Dr Milnes confirmed this was the case.
- 3.1.41 Mr Evans noted mention in the MTC minutes of differences between DPIFM and ERA pH and EC data. Mr Delosa noted this issue had also been raised at ARRAC and advised there will be a project looking at how consistent the relevant data are. Mr Hughes indicated that he thought there are some base level shifts in surface and particularly groundwater data which could be due to issues with QA or calibration. Dr Klessa noted there is a difference but queried whether the same types of data, ie lab vs field data, are being compared.
- 3.1.42 Prof Johnston asked about the radium reporting by the Technical Expert Group. Mr Hughes indicated that he understood the issue relates mainly to the time taken to get results out to stakeholders. He noted the Radium reports were lagging by six to twelve months. Dr Klessa advised that the Radium data were not ready by the time the wet season reports were prepared. Mr Kyle advised that a number of ways of speeding up reporting were being examined in discussion with *eriss* and ERA.

#### *Jabiluka MTC*

3.1.43 Mr Delosa advised that there had been one variation to the Jabiluka authorisation changing timing of monitoring from weekly to monthly. He advised that consideration was currently being given to access to the vent raise and to Mine Valley for sampling of groundwater and for the capping of old exploration bores. He advised that DPIFM was currently engaging DITR for feedback on what should go into the mining management plan for Jabiluka. Mr Evans noted that previous MTC minutes stated that GAC/NLC would refer their report on the bore rehabilitation issue to ARRTC. Mr Kyle advised members that he and Mr Smith had been doing some work looking at potential use of selected groundwater bores at Jabiluka for monitoring and they had identified a number of bores that may be worth monitoring. He advised that the MTC had decided that it wanted to consider the matter further before raising with ARRTC. Mr Evans noted that a report on this work would be provided to ARRTC in due course.

#### *Narvalek MTC*

3.1.44 Mr Delosa advised that there were no approved changes to the Nabarlek authorisation and a number of applications had been and were being considered by the MTC. Prof Johnston asked if there is any use of the site by Traditional Owners. Mr Hughes advised that only use of site by TOs is for hunting and lighting fires. He noted that one problem was that the fence was hampering fire management of the area.

### **PRESENTATIONS**

3.1.45 As was previously agreed, the presentation by Dr Jeff Turner was brought forward. Dr Klessa also agreed to do a presentation on water management at Ranger.

#### ***Presentation: Dr Jeff Turner (CSIRO) - Environmental tracers in modelling groundwater recharge/discharge at Ranger***

3.1.46 Dr Turner provided an overview of the water balance models being used in his work at Ranger. He advised that data are being collected using both grab and continuous methods and is at the 80 day mark in the annual drying cycle for Georgetown Billabong (GTB). He advised a range of groundwater parameters were also being measured to assist in refining the groundwater model for Ranger. He noted this approach allows for systematic water balance and groundwater-surface water interactions, scenario testing, case identification and field experimental design. He advised that data collection would continue during 2007-08 and that a Doppler logger would be installed to measure dynamics of GTB filling and whether there are oscillations, and the recession process.

3.1.47 Dr Jones asked if this work will inform the modelling by Dr Kalf. Mr Puhlovich advised the work will be used to test the current conceptualisation of groundwater systems at Ranger and associated interactions. Dr Jones asked if Dr Kalf's more recent work has refined the initially identified issue of potential salinisation at the ground surface downstream of Pit 1. Mr Evans noted the CFC data suggest some mixing was occurring and asked if Dr Turner would be trying to quantize this in the next phase of work. Dr Turner advised that he would like to look at mixing ratios and corrected C14 ages in the next phase of work. Mr Evans noted that the data suggest that the groundwater system was one-dimensional - operating just up and down. Dr Turner advised that further work was required to understand stratification in the groundwater systems. Mr Evans asked if ERA would include piezometric data from north of Pit#3. Mr Puhlovich advised it was difficult as that zone was currently subject to dewatering by mining and hence groundwater levels do not reflect natural seasonal fluctuations.

#### ***Presentation: Dr David Klessa - Integrated water management principles***

3.1.48 Dr Klessa provided members with a presentation on integrated water management principles being applied by ERA at Ranger over the short and medium terms.

3.1.49 Dr Stauber asked whether any of the current water management issues at Ranger would change if the expansion of Pit#3 proceeded. Dr Klessa advised he thought this would be the case as the current water management strategies are based on Shell 12. Mr Evans asked how tailings would be removed from TSF to Pit#3. Dr Milnes advised that truck load and haul had been successfully used at the Woodcutters mine but there are difficulties in the case of Ranger due to the consistency of tailings. Dr Klessa advised ERA have a number of options under consideration but need to look at this issue further. Mr Hughes noted that the current rehabilitation plan specified trucking as option.

3.1.50 Dr Stauber asked what 'active management' means. Dr Klessa advised active management in this context means using pumping versus using gravity fed systems. Dr Hillman asked if ERA has a good idea of the possible flow regime so that mass transport systems could be modelled. Dr Klessa advised that as electrical conductivity is very low in the treated water there would be a need to ensure the system wasn't being overloaded. Mr Evans noted that the sensitivity of the models used needs to be considered in terms of understanding the extent to which the strategies could deal with extreme events (i.e. if based on annual water balance). Dr Stauber noted that assuming rainfall patterns may be changing this could be an issue. Dr Klessa advised that optimisation of the water balance model would be required working back from the statutory restrictions on storage of process water in Pit1 and the TSF.

3.1.51 Dr Jones asked how stockpile runoff would be dealt with by the OPSIM model. Dr Klessa agreed that the model needed to take account of this but advised the process wasn't currently at a level of sophistication that would allow for this to be considered. Members discussed various issues relating to the use of LAAs and the assumptions used in developing the water management strategy. It was noted that the strategies assumed the

availability of a Water Treatment Plant functioning to design performance specifications. There was also discussion on rehabilitation approaches for Land Application Areas.

3.1.52 Mr Evans noted a number of members would like a copy of Dr Klessa's presentation if this was possible. Dr Klessa advised that the presentation was commercial-in-confidence and was not able to be put on the ARRTC website. However, Dr Klessa agreed to provide the presentation to interested members on request on the condition that the document would be appropriately protected.

**ARRTC20 Action/Outcome 3F**

***Dr Klessa agreed to provide the ARRTC Secretariat with a copy of his presentation on water management to be made available to interested members on request (but not through the ARRTC website).***

## 4 Research Activities & Key Knowledge Needs

### 4.1 Supervising Scientist Division - Summary of *eriss* research on ARRTC Key Knowledge Needs 2006–07

- 4.1.1 Dr Jones provided a strategic overview of the *eriss* 2006-07 research report and introduced key presenters. Dr Jones stated *eriss* was seeking to provide ARRTC with an introduction to the various streams of research and current status. Mr Hughes suggested that another outcome is to ensure that ARRTC members are more informed on progress against KKNs. Dr Jones advised this would be the final report on *eriss* research activity against the previous KKNs.
- 4.1.2 Dr Jones advised that Cyclone Monica in April 2006 provided a good opportunity to observe how extreme events impact on landscape. The flood at the end of February 2007 resulted in an increased water inventory at Ranger, several land slips from weathered dolerite intrusion in the upper Magela landscape with implications for baseline fine sediment delivery in the catchment, and extensive damage to SSD monitoring equipment. Dr Grant asked if the opportunity to track natural successional recovery of vegetation on the landslip areas had been considered since it provided a possible natural analogue for the revegetation on the final Ranger landform, given that the cover system will comprise a mix of waste rock and weathered (laterite) material. Dr Jones advised it hadn't been considered as a research topic at this time but agreed that vegetation establishment following a landslip in the natural environment was an interesting research idea.
- 4.1.3 Mr Evans asked what percentage of the fine weathered material from landslips was in the sediment load in Magela Creek. Dr Jones indicated that whilst it was not possible to answer this owing to loss of autosampling equipment during the flood, there was a significant pulse of suspended material detected by the continuous turbidity measuring equipment at MCUS uostream of the minesite. Further work on composition of the fine suspended sediment load in Magela Creek will be conducted during the 07/08 wet season.
- 4.1.4 Dr Stauber asked if the characterisation was just radiological or included chemical and biological parameters. Dr Jones indicated that measuring physical, chemical and radiological parameters of the suspended sediment was the primary focus. The effect of fine suspended sediment on aquatic biota will be the subject of a specific program of reaserch to be started in Q4 and continue through the 08/09 FY.
- 4.1.5 Prof Johnston asked if the main *eriss* data assets lost in the flood were load or concentrations related. Dr Jones indicated that the type of data assets lost varied between locations. Prof Johnston asked to what extent the extreme event dominated erosion (eg in the case of Maralinga where dust was a major issue). Dr Evans advised that information on suspended sediment loads would be presented later. Dr Jones advised that most data from Magela Creek had been preserved, both upstream and downstream.
- 4.1.6 Mr Evans asked whether a conceptual model of linearity processes had been developed to determine what happened during the extreme event. Dr Evans advised that *eriss* does some reconstruction between historical and current records. He advised that in Gulungul Creek the sediment pulse normally moves ahead of the hydrograph, so that information was available. He indicated that historical records can also assist understanding system dynamics. Dr Jones advised that reconstruction of flow events was also able to be achieved. Dr Evans advised that information on this had not been included in the *eriss* research report (as it is very recent work) but he would include in his presentation.

#### **Presentation – Dr Rick van Dam – Ecotoxicology**

##### *KKN 1.2.4 - Project 1 – U toxicity of larval Mogurnda mogurnda*

- 4.1.7 Dr van Dam provided a presentation on his work on the U toxicity of larval *Mogurnda mogurnda* (purple spotted gudgeon). He advised the species showed an eighty percent survival rate over twenty eight days and was therefore very good for a chronic toxicity test. He indicated that there was not much difference between the 8-day and 28-day endpoint results for this species. Hence there would be no significant difference to the NOEC value for U derived using this new data set, compared to the previous value for the U limit which had been derived using the results from the shorter duration test.
- 4.1.8 Dr Grant asked where the various concentration levels used in the study were derived from. Dr van Dam advised that the concentration levels were derived from data on feeding trials and that the toxicity values that go into the trigger values are based on the No-Observed-Effect-Concentration (NOEC). Dr Stauber noted the seven day NOEC was generally more sensitive.
- 4.1.9 Dr Hillman queried whether there was a risk that the species tested may not be representative of the real world. Dr van Dam noted an argument against toxicity testing is that you are raising and then testing species in the laboratory and there is some risk associated with this. Dr Stauber asked if seven day survival data were available. Dr van Dam advised some data were available. Dr Stauber asked what the difference in sensitivity was between the two fish species tested. Dr van Dam advised that chequered rainbow fish was about half as sensitive as the other species tested.

##### *KKN 1.2.4 - Project 2 – toxicity of pond water*

- 4.1.10 Dr van Dam advised that synthetic pond water was too clean to support the survival of the filter feeders tested and that the low DOC was also a limiting factor. He advised that the different toxicity responses for natural versus artificial pond waters was probably due to lack of food and that it appeared that U concentration in artificial pond water was more toxic than the real RP2 water.
- 4.1.11 Dr Evans asked why U appeared to be more toxic in artificial water. Dr van Dam suggested that species are more stressed in artificial pond water due to the low nutrient conditions, as well as there being less dissolved organic carbon to bind metals. Dr Klessa asked whether the chemical composition of the water was also a factor (ie. pH). Dr van Dam advised that there was no difference in pH between the two types of water used. Dr Hillman noted that the big difference in toxicity between the two types of water indicates that there may be other factors at work. Dr Stauber suggested that differences in organic carbon alone couldn't explain the difference. Dr van Dam responded that the controls showed that there were negligible losses of U to the container walls.
- 4.1.12 Prof Johnston asked why there is such a big difference and whether this was just related to DOC. Dr van Dam advised that it was just related to DOC because the synthetic water was designed to mimic Magela Creek water. Dr van Dam suggested that the result was not surprising but probably the key factor is nutrient deficiency. Dr Grant asked whether the test species could be placed in Magela Creek water and then into artificial water to determine what is causing the stress. Members agreed that results appear to be confounded. Dr van Dam suggested that the results were still relevant because the test species don't do well in mine permeate. Dr van Dam suggested that it may be useful to look at potential for U to be toxic in treated pond water. He advised that a project in July 2007 using a mobile pond water treatment unit looking at the toxic effect on *M. macleayi* showed the same results as a study conducted in Dec 2005.

*KKN 1.2.4 - Project 3 – toxicity of Mg to local spp – deriving a site specific trigger value*

- 4.1.13 Dr van Dam advised that Ca was shown to reduce Mg toxicity but not to the same level for all species. Based on the testwork a 99% species protection trigger values of: 1.1mg/l Mg would apply to high Mg/Ca ratio waters and 4.6 mg/l Mg, for waters with a Mg:Ca ratio of less than 9:1. For the 9:1 ratio the following management trigger values were proposed: limit of 4.6mg/l, action=3.5mg/l and focus=2mg/l. Dr van Dam advised that the weekly water quality record for 009 shows there had been no exceedences of the limit value in last two years. However the continuous monitoring record contained 0.1% exceedance based on the total number of data points. He advised that levels tended to be elevated over shorter transient exposures rather than over periods of several days – and that such short duration exposures at the limit value which is itself a conservative NOEC might not be significant. He suggested that further work could be undertaken to investigate in more detail the effect of exposure duration around the limit value. It was further suggested that a moving average (eg daily) of the continuous monitoring data be used for comparison with the guideline value. This would still provide better time resolution than weekly grab sampling.
- 4.1.14 Dr Hillman suggested that outlier Mg concentrations in the data record be used to better define the relationship between Mg and EC that is used to infer Mg concentrations from the continuous turbidity record. Dr van Dam agreed that Mg needs to be looked at further and commented that at the present time there are not many concurrent higher EC and high measured Mg data points. He indicated he was hopeful that some more higher end data pairs will be able to be acquired during the 07/08 wet season. Mr Evans asked if the data included the February extreme rainfall event. Dr van Dam confirmed this was the case. Mr Evans asked which ion (Mg or sulphate) was producing the observed toxicity. Dr van Dam confirmed it was Mg.

**Presentation - Dr Chris Humphrey - Ranger stream monitoring program - KKN 1.3.1**

- 4.1.15 Mr Evans asked whether there is an inverse relationship between flow and EC. Kate Turner advised there was only one incidence where the EC peak was not related to flow. Dr Klessa asked why the relationship between EC and Mg couldn't be derived theoretically (ie. derive EC from ionic strength) rather than using the derived correlation between measured EC and measured Mg. Dr Klessa indicated that the dominant cations in the system were Na/Mg and dominant anions were sulfate (downstream of the mine) and carbonate. Mr Evans asked if the intent of the work was to partition between catchment and mine site flow. Dr Jones confirmed this and indicated the work will also assist in determining the mass loading of solutes from the minesite through a wet season. Mr Evans asked if any estimate of Mg load resident in system had been done. Dr Jones advised that this had been done previously by Dr Klessa using weekly water quality data, with its notable timestep problems. The current work is focused on refining the solute budget using the continuous monitoring data being produced on the minesite by ERA and in Magela Creek by *eriss*. Mr Evans suggested looking at wet season loads per unit area of catchment across different rainfall events might be a better way of deriving solute flux from the mine site.

*Early detection toxicity monitoring – creekside monitoring*

- 4.1.16 Dr Humphrey advised that currently two approaches to toxicity testing are being used – creek side and in-situ. He advised the in-situ method had proven its worth and was readily redeployed after the Feb-March 2007 flood when creek side infrastructure was severely damaged. He suggested there is potential for a robust, inexpensive, readily-transportable toxicity monitoring method if comparative testing with the long running creekside methodology proved successful after another wet season. Dr Humphrey advised that successful deployment of the in-situ snail test in the future could lead to more frequent (weekly) testing. He advised the less sensitive and problematic fish larvae test will be discontinued.
- 4.1.17 Dr Grant asked about the trends shown in the data. Dr Humphrey indicated the observed trends appeared to be linked to long term decadal cycles in river flow. Mr Evans asked how flow velocity was controlled in the in situ test and whether high flows in the creek could cause problems with the test. Dr Humphrey noted that because the

snails are contained in perforated capsules the effect of high flow would be considerably dampened and the snails would not be as affected as if they were directly exposed to the higher flow velocity.

#### *Bioaccumulation*

- 4.1.18 Dr Humphrey advised that primary reporting is for U and Ra in mussels, and U in forked tail catfish flesh. For 2006 and 2007, Ra and U concentrations data in mussels were similar to previous years (Ra was consistently higher in Mudginberri compared with Sandy (control) Billabong). He advised that the recommendations from the bioaccumulation review workshop held in late 2006 have largely been implemented: the bioaccumulation sampling program had been streamlined; analytes for measurement had been re-evaluated after on-site waterbody investigation; filter-feeder-relevant <63µm sediment fraction are now being measured for metal and radionuclide content; and a sampling of mussels along Magela Creek from upstream to downstream of the mine had been carried out to establish suitability of control sites for inferring extent of minesite impact.
- 4.1.19 Prof Johnston asked if the data were indicating that take up of U in mussels isn't related to sediments but rather U in solution. Mr Evans asked how U moves into the system and if it's linked to sediments. Dr Jones advised that U is linked to sediments and that's why there is a need to differentiate between fines and sands in active systems. Dr Klessa advised that U concentration in Georgetown Billabong ranged from 1.0 to 20mg/kg in 2005. Dr Jones noted that there are no mussels in upper reaches of Georgetown Billabong. Dr Humphrey noted that mussels became extinct in that system in 1983 due to changes in the surrounding catchment.
- 4.1.20 Mr Evans asked how did billabongs respond to the extreme rainfall event and was there any structural change observed that could account for the difference between Georgetown Billabong and the other billabongs. Dr Humphrey advised that no structural change had been observed. Dr Humphrey advised that if major habitat change was evident then you could expect to see some impacts.
- 4.1.21 Mr Evans noted that reporting of upstream and downstream water quality data for Ra used median values. Ms Illes noted this only applied to Radium. Dr Klessa indicated he has studied upstream/downstream statistical distribution of data for the major ion solutes and U but not for metals apart from U as they are not that important for assessing the impact of the mine. Dr Klessa advised Radium reporting was linked to risk assessment for human health. Mr Evans noted that reported chemical results based on median can be problematic. Dr Bollhoefer advised that there is no statistical difference between median values over years in Magela Creek.
- 4.1.22 Prof Johnston indicated he was concerned about small spikes in the continuous monitoring data and queried their significance. Dr Jones agreed that these can be taken out of context so it's prudent to use caution in interpreting these data. Dr Barry asked if there is a logical scientific reason to show that transient spikes don't have any impact on biota. Dr Jones suggested transient spikes were fine provided the spike doesn't go over a survival threshold. Dr Stauber advised that her work based on one species and one metal suggested that continuous (chronic) exposure was more important. Prof Johnston asked if these spikes are significant in terms of regulatory requirements. Dr Jones suggested that perhaps rolling average could be used instead. Dr Hillman indicated he wasn't sure about the value of doing this if you don't have knowledge of impacts as a function of concentration and duration.
- 4.1.23 Dr van Dam suggested that ultimately it depends on to what extent the science can provide the assurance demanded by the community. Dr Jones agreed that it depends on how the general public see it. Dr Barry asked if this issue requires further investigation. Dr Jones suggested that the implications of this work needs to be discussed in the MTC forum. Mr Hughes suggested that the actual issue needs to be defined in more detail so that the appropriate course of action can be followed. Dr Jones stated the approach would need to be technically defensible. Mr Evans suggested that the regulatory limits could be based on a rolling average over three days but that there was a need to assess risk associated with interpretation. Dr Jones noted that in the case of snails, continuous monitoring can be supported by lab work involving testing various concentration-duration exposure scenarios.
- 4.1.24 Mr Evans noted that any limits will always have error bars. Prof Johnston expressed concern that the graph showing spikes above trigger levels would be seen by lay person as instances of exceedences or regulatory breaches. Dr Klessa suggested that samples of water need to be collected when EC spikes are being recorded by the continuous monitoring equipment. Dr Jones advised that **eriss** was looking to set up auto samplers that would trigger at higher EC values.
- 4.1.25 Dr Grant suggested that more work was required looking at U toxicity in low dissolved organic carbon permeate water from the Water Treatment Plant.

#### **ARRTC20 Action/Outcome 4A**

***Dr Grant requested that further work be undertaken to examine the importance of dissolved organic matter in modifying response in whole effluent toxicity testing, particularly in the context of testing permeate.***

- 4.1.26 Dr Hillman asked whether growth rings and elemental composition of mussel shells could be analysed using electron microprobe to look at event history. Dr Humphrey noted that mussels are relatively young (up to ten years old) in the channel. It was noted that it would be useful to examine archived mussel shells from pre mining days to compare with the current situation. Mr Evans acknowledged the potential scientific value of looking at mussel shells but noted that **eriss** is probably too busy to undertake such work at this time.

#### **Presentation - Dr Andreas Bollhoefer - KKN1.3.1**

- 4.1.27 Dr Bollhoefer outlined results of three projects under KKN 1.3.1: Radiological surface water monitoring (226Ra) in the vicinity of Ranger and Jabiluka; Bioaccumulation of radium and metals in mussels and fish; and Atmospheric radiological monitoring in the vicinity of Ranger and Jabiluka.
- 4.1.28 Mr Evans asked what drives the intra annual variability in mussel size. Dr Bollhoefer advised that he wasn't sure of the reasons for variability in mussel size but this could be related to where mussels were collected. He noted however that no statistically significant difference in mussel size has been observed between different locations. Dr Klessa noted another interesting factor was size changes due to the age of mussels. Dr Evans suggested sediment could be a factor. Dr Humphrey suggested that possible movement of mussels from areas upstream could be responsible for the observed size variation.
- 4.1.29 Ms Davis-Hall asked how the 2kg ingestion level for mussel flesh used in human dose calculations was derived. Dr Bollhoefer advised this was based on an estimate included in the 1986 diet proposed by *Johnston et al* which assumed an annual intake for various food items. He advised that as the TOs suggested annual food intake of 4 kg for mussels or adults, it was assumed that a reasonable intake for a child was around half this. Prof Johnston noted that this figure was similar to the estimated ingestion levels for children used in other studies.
- 4.1.30 Prof Johnston noted the radon dose figures are very low as are the total annual dose figures quoted for dust monitoring. He suggested that Dr Bollhoefer include a pie chart showing average exposure for Jabiru as it is quite different to world average exposure levels. He acknowledged however it was difficult to explain the differences between mine derived and background exposure.

#### **ARRTC20 Action/Outcome 4B**

***Prof Johnston suggested that Dr Bollhoefer prepare a pie chart showing components of the natural background radon exposure for Jabiru.***

#### **Presentation - Dr Peter Bayliss KKN 1.2 and KKN 5.0**

- 4.1.31 Dr Bayliss provided a presentation on KKN 1.2 ongoing operational issues. He advised that conceptual model for surface water had been completed and that conceptual models for other key pathways and contaminants were currently being finalised with *eriss* staff (to be finalised by June 2008).
- 4.1.32 Dr Grant suggested that the risk table used by Dr Bayliss include a note highlighting that minesite related risks shown are only related to surface water pathways and that other factors and pathways may show a different picture.

#### **ARRTC20 Action/Outcome 4C**

***Dr Grant suggested that the risk table used by Dr Bayliss include a note highlighting that minesite related risks shown are only related to surface water pathways and that other factors and pathways may show a different picture.***

- 4.1.33 Mr Evans asked what proportion of *eriss* work is using students to participate in components of the risk assessment work. Dr Jones indicated this varies but noted it is getting more difficult to get students. Dr Stauber asked whether additional work would add to the existing level of understanding of ecological risks. Dr Bayliss noted there is already a significant amount of information that should be integrated into decision support frameworks. Dr Grant suggested that the work is more about a test case involving running data through various techniques and using results to guide the next step which is rehabilitation. Dr Bayliss agreed the work was related to the context of rehabilitation. Mr Evans asked at what point are the results of the work reported back to ISP. Dr Jones indicated there was no direct requirement to report back to the ISP and noted the ISP focus was more related to Jabiluka issues. Dr Grant suggested that presenting the results at conferences and getting into the literature will assist in raising awareness.
- 4.1.34 Dr Grant asked whether ERA has considered assisting in management of surrounding Kakadu area. Ms Varris advised that this was one of the various issues that ERA would be looking at as part of a forthcoming workshop on biodiversity management on the mining lease and within the broader Kakadu environment. She noted that the risk assessment work fits well with the approach ERA intends taking which would be focused on mine-related impacts. Ms Varris advised that ERA would welcome ARRTC support and advice on where resources should be focused. Dr Grant suggested there is even more of a basic issue – for example if para grass isn't dealt with then it will be big problem for the floodplain. He suggested that if resources were an issue for Parks then ERA should look to assist with management work beyond the mine lease. Ms Varris noted that biodiversity action planning needs involvement of other stakeholders. Dr Grant noted if resources were the only limitation then there is an opportunity for mutual activity.

#### ***KKN 5 – communication of Magela Ecological Risk Assessment***

- 4.1.35 Dr Bayliss provided an outline of the proposed strategy for communicating the results of the Magela Floodplain Ecological Risk Assessment work which would include presenting the results at a number of workshops and symposiums. Dr Bayliss indicated that using decadal analysis of climate, flow and ecosystems to determine predictable links between trends in global climate systems (e.g. ENSO & PDO) to changes in local rainfall and

flow events is one of the objectives of his work. He suggested this could assist reduce current uncertainties in water resource management, especially on tropical mine sites with a 20+ year life. He suggested it may also reduce uncertainties in predicting and mitigating future long-term impacts of climate change on ecosystems, communities and infrastructure. He suggested the influence of global climate systems is probably the main factor forcing coherent cyclic trends in rainfall, flow and animal population dynamics.

4.1.36 Dr Stauber suggested that the results of this Magela floodplain risk assessment project could be presented at the Society for Environmental Toxicology and Chemistry Conference in 2008.

4.1.37 Mr Evans asked whether potential impacts of climate change on streamflows have been looked at. Dr Bayliss advised some work has been done looking at rising sea level and possible increased flows. Mr Evans indicated that he would be interested in possible mine site effects in terms of sediment transport and streamflow. Dr Klessa suggested this work may have relevance to tailings storage in the longer term and there is a need to ensure climate change is factored into rehabilitation planning. Prof Johnston noted this is just part of the variability affecting the dataset that needs to be considered. Mr Evans asked about the potential relevance of current datasets to possible decadal changes. Dr Bayliss highlighted the need to differentiate between decadal trends and climate change. Mr Evans suggested this needs to be factored into modelling as current inter-decadal variability effects are likely to be bigger than any currently measurable climate change effects. Dr Klessa noted the work was scientifically interesting and that decadal rainfall sequence data could be put into the OPSIM model. Mr Evans noted the work was currently just based on historical rainfall data and there is a need to start looking at possible changes in the future related to both decadal and climate change.

#### *Spatial based risk assessment - Dr Renée Bartolo - Tropical Rivers Inventory and Assessment Project*

4.1.38 Dr Barry noted that the Australian Greenhouse Office is currently developing a new Digital Elevation Model. Dr Humphrey noted that the risk assessment conducted by *Johnston et al* may have used a possibly flawed U sediment toxicity value. Dr van Dam mentioned a recent PhD study looking at *Chironomids* that suggested a much higher sensitivity to sediment U than earlier work done by Dr Klessa. Dr van Dam noted whole issue of U toxicity was captured in the revised KKNs.

4.1.39 Mr Evans suggested there could be value in better understanding load data and mass balance beyond the minesite (ie. does it stay there or keep going out). Dr Klessa noted work by *eriss* and others (*Wasson et al*) which provided background information for the development of a radiation impact assessment which then fed back into setting load limits for U and radionuclides for particulate matter and soluble transport. Dr Jones noted that ANSTO did studies using tracer and radionuclide releases on the floodplain

#### **Presentation - Dr Ken Evans – Landform Design**

*Assess impact of extreme rainfall events on ranger rehabilitated landform stability using CAESAR landform evolution model*

4.1.40 Dr Grant asked about the underlying assumptions used in the model. Dr Evans advised that he starts the model with no vegetation with the same erosional potential as waste rock then adds vegetation. Mr Ray Evans noted stability came back into system after 4-8 years and asked if that would be expected based on observations. Dr Ken Evans indicated that the time period for initial conditioning is not known but based on observations at analogue sites it could be as long as 50 yrs.

#### **KKN 2.5 Monitoring – Dr Ken Evans**

*Monitoring of sediment movements in Gulungul Creek*

4.1.41 Dr Evans advocated the need to look at event rather than instantaneous measurements when assessing sediment movement from the point of view of deriving suspended sediment trigger guidelines and closure criteria. He outlined two techniques – spatial and temporal. Dr Evans advised that hydrology affects the amount of sediment moved and this aspect is best addressed by using a whole of event load analysis approach. He presented an analysis of the Feb/Mar 2007 flood, and the relationship between turbidity and suspended sediment (mud) concentration. Dr Evans identified the differences in turbidity measurements between the east and west channels of Magela Ck and commented on this aspect in the context of deriving event turbidity loads in the creek.

4.1.42 Prof Johnston asked what are the current uncertainties regarding mud loads. Dr Evans advised there is variation in mud concentration through the water column and that there are a range of size fractions present. Prof Johnston noted that uncertainties aren't usually quantified. Dr Evans advised there is no relationship between flow volume and sediment. Dr Grant suggested that the high R<sup>2</sup> value for the correlation between predicted and observed event loads for the event-based methodology implied that the uncertainty was not that great.

#### **KKN2.2.1 Closure and rehabilitation – Dr Chris Humphrey**

4.1.43 Dr Klessa noted that 2006 was a potentially difficult year for aquatic organisms in Georgetown Billabong as it followed on from a drought (Georgetown Billabong virtually dried up) and asked to what extent this may have affected the macroinvertebrate data. Dr Humphrey agreed this was a good point but noted that other (control) waterbodies would also have been affected. Dr Jones noted samples were taken from the edge of the billabong which is usually subject to drying out.

4.1.44 Dr Stauber suggested that there are other good examples where there are several lines of evidence therefore it would have been good to have had a whole sediment toxicity test available to determine which benthic macro fauna would be best indicator species (Chironomid or other organisms eg. Oligochaete). Dr Jones suggested that RP1 would perhaps be better to test this hypothesis as it has a higher U concentration. Dr Klessa agreed but

noted RP1 has changed in water chemistry following inputs of higher loading of magnesium sulfate from the adjacent land application area. Dr Jones noted that RP1 has changed over time due to sulphate loads. Dr Hillman suggested it might be useful to look for mouth part deformities in the macroinvertebrates. Dr Humphrey agreed this would be useful to look at but additional samples would be required to do this. Dr Klessa suggested that reasons for lower abundance of benthic macroinvertebrates in Georgetown Billabong may not be U related. Dr Stauber indicated it was good to see what the bioaccumulation and sediments data show and that this information would provide the field information required for developing and interpreting a sediment test.

#### **KKN2.2.2 Vegetation Analogues – Dr Chris Humphrey**

4.1.45 Dr Humphrey outlined the key issues arising out of work on vegetation analogues undertaken jointly by eriss and EWLS including the key knowledge gaps and modelling outcomes. He advised that these issues would be further addressed in the rehabilitation workshop following the ARRTC meeting.

4.1.46 Dr Grant recommended that vegetation be trialed on mixed waste rock and laterite to see if this will produce a similar outcome to the species characteristics measured in the vegetation analog study. He suggested there is a need to look at the practicalities involved in how selected species will be put back into rehabilitated areas to address the environmental requirements. Dr Grant also suggested doing some leaching column work to look at the solute generating capacity of the cover material, and that this should be run in parallel to provide sufficient basis for comparison. He suggested that on-site trials would also be important.

#### **Enrad - Closure and Rehabilitation - Dr Andreas Bollhoefer**

##### *KKN 2.2.4 radiation exposure pathways assoc with ecosystem establishment*

4.1.47 Dr Bollhoefer provided an outline of his work undertaken on radiation exposure pathways associated with ecosystem establishment. He advised that a questionnaire was being used to identify key components of Aboriginal diet and noted the relevance of the information from Mr Dave Lindner on meat consumption at various communities. He advised that information on the diet profile was being validated through discussions with relevant Aboriginal communities and that the updated diet profile would be incorporated into dose models. He advised that work on Ra-226 passiflora was almost complete and a report on this work would be provided at the next ARRTC meeting.

4.1.48 Prof Johnston noted the proposed protein component of diet around 300kg of meat per person and suggested that this be contextualised in terms of the total diet. Mr Kyle suggested that, based on his experience, care needs to be applied to the credibility of field reports because Aboriginal people are often ashamed that their traditional diet has changed and therefore may not be providing accurate information. Dr Bollhoefer noted this and indicated that's why *eriss* is sending back diet information to the respondents for validation. Prof Johnston suggested this may not be a problem as the proposed levels of ingestion to be used are likely to be overestimated anyway.

#### **2 Ranger Rehab – Dr Peter Bayliss**

4.1.49 Dr Bayliss provided a presentation covering work on projects under KKN 2.2.2 Characterisation of terrestrial and aquatic ecosystem types at analogue sites, KKN 2.2.3 Establishment and sustainability of ecosystems on mine landform, KKN 2.5.1 Monitoring of the rehabilitated landform, KKN 4.1.1 Revegetation assessment and KKN 4.1.2 Development of revegetation monitoring methods.

#### **4.2 Supervising Scientist – other reports**

4.2.1 There were no other reports or presentations.

#### **ARRTC20 Action/Outcome 4D**

**ARRTC thanked eriss staff for their high quality work over the past six months and supported the collaborative approach adopted by eriss in dealing with other stakeholders.**

#### **4.3 ERA research**

##### **ERA research presentations**

##### **Dr Mark Gardener: Overview of recent work on biodiversity, fire management, weed management and status of the demonstration landform**

4.3.1 Dr Gardener provided a presentation on recent biodiversity, fire and weed management work at Ranger and the status of the demonstration landform. He advised that the ERA planning would feed into the Rio Tinto Biodiversity Action Plan which IUCN has been asked to validate. In relation to weed management, he advised that there has been a total decrease in area affected by weeds down from 92ha to 45ha, and increase in work effort from 400 hrs in 2005-06 to over 800 in 2006-07. He advised there has been significant reduction in weeds on the Land Application Areas due to a mixture of factors including doubled person hrs and dedicated staff/contractors, use of all terrain vehicles, dry season spraying, weather, having an inspired weed management team and access to greater resources.

4.3.2 In relation to fire management, Dr Gardener advised that work has focussed on operational areas involving construction of fire breaks, fuel reduction and fire exclusion which has resulted in a high degree of infrastructure protection. He advised that fire management by TOs was moving from adhoc traditional fire management to a more strategic approach. He advised that fire management by PAN was based on good monitoring systems and

district based burning programmes. Dr Gardener advised that satellite technology and mapping had enabled a comparison of the results of fire management on the ERA lease with the surrounding KNP area. He indicated there is a difference between early and late dry season fires; on the Ranger and Jabiluka leases there is much less frequent fires in the late dry season compared to surrounding areas, where in the case of the Ranger non-operational area, there is a higher frequency of fires compared to surrounding areas. Dr Gardener advised that a five year integrated fire management plan will be a chapter in the KNP fire management plan. The pilot on traditional fire management has worked well and has potential to expand subject to ongoing support and championing from the Mirarr. He also mentioned a draft land access agreement to allow TO access to non operational areas of Ranger lease was being developed. Mr Kyle advised that the agreement was expected to be signed shortly.

- 4.3.3 Ms Davis-Hall asked why the frequency of fires in the late dry season was much lower in the lease area compared to surrounding areas. Dr Gardener indicated that this was probably due to the limited fire breaks within the area. Dr Barry asked how habitat ranking based on biodiversity value was done in the Rio Tinto policy. Dr Gardener indicated the methodology was set out in the report. Dr Jones indicated he assumed that the reference to net positive impact on species of conservation significance referred to the post rehabilitation state. Dr Gardener confirmed this and indicated that taking account of benefits and impacts overall has to be positive.

#### **Demonstrated Landform trial**

- 4.3.4 Dr Gardener indicated that the key secondary objectives of the trial were understanding plant-water relationships, erosion rate, natural diversity accumulation. He indicated this would feed into the design of trial location and specifications. He suggested that the thickness of the substrate was important to provide a sustainable medium for plant growth. He indicated that there would be two types of covers and two different planting types.
- 4.3.5 Dr Grant asked if the mix of cover to be used was based on the species inventory. Dr Gardener advised that the mix of cover was based on issues such as plant available water. Dr Grant queried whether a thick cover of mixed waste rock and laterite was realistic and if there was sufficient laterite available for rehabilitating the site. Dr Jones suggested another issue related to the amount of fines that would be required. Mr Evans asked if work on plant available water has been done on the analogue sites. Dr Gardener advised that work had been done and that some of the findings were interesting, for example species like *Melalucecca* were establishing on top of waste rock pile. Dr Gardener advised that plumes were being installed, that weather stations and soil probes had been purchased and that ERA was currently going through land disturbance clearances.
- 4.3.6 Ms Davis-Hall asked how the cover will be mixed. Dr Gardener advised that the material will probably be ripped and mixed onsite. Dr Grant advised that Alcoa has developed a ripping tyne for mixing gypsum into soil and suggested that there could be value in collaborating regarding the mixing technique for Ranger.
- 4.3.7 Dr Grant asked how the top of the landform was to be maintained. Dr Gardener advised that this wasn't known at this stage. Mr Evans suggested that the different capping will have different hydrology and the constructed landform will require sub drainage drainage as water already pools at this site. Mr Evans indicated he assumed the landform will be free draining. Dr Barry suggested the site may be confounded with respect to aspect. Dr Hillman agreed that this was probably the case.
- 4.3.8 Dr Evans asked if there would be bunding around the sides of the trial site to stop water flowing over sides. Mr Rajapakse advised that there will be channels around the site but not bunding. Mr Evans asked if the design was an initial design. Dr Gardener advised the design was preliminary and subject to further refinement. Mr Evans asked what the timetable for construction of the trial site was. Dr Klessa indicated the first step was to get the design back from SKM and then show to stakeholders.
- 4.3.9 Mr Evans noted that the design of the rehabilitation demonstration site was a matter of interest to ARRTC. Dr Jones noted that a number of workshops had been held to look at issues associated with the rehabilitation trial such as numbers of cover treatment and establishment strategies (direct seeding or planting of tube stock). Dr Klessa noted ARRTC's interest in the project and asked if members would be interested in seeing the initial design once it came back from SKM. Mr Evans suggested this would be useful and proposed that the design be circulated out of session. It was agreed that Mr Evans, Dr Grant, Dr Barry and Prof Nott would review the initial design on behalf of ARRTC (in three days) and provide advice to ERA. Mr Delosa noted that regulatory approval would be required before the rehabilitation demonstration project could proceed.
- 4.3.10 Dr Grant indicated that while he considered the current design was not optimal, he believed it provided a useful starting point for further discussion and that ARRTC should commend ERA on its efforts in actually getting something going on the rehabilitation project. Dr Gardener advised that the next demonstration area will likely be Pit#1 in several year's time.

#### **ARRTC20 Action/Outcome 4E**

**ARRTC agreed to consider and comment on the initial design on the Ranger landform rehabilitation demonstration area to be provided by ERA. Mr Evans, Dr Grant, Dr Barry and Prof Nott to review the initial design in three days and provide advice to ERA.**

- 4.3.11 Dr Gardener advised that it was proposed to use a mass seeding of kerosene grass for initial surface stabilisation and erosion control. Dr Grant noted the need to stabilise the surface in the first year but queried the suitability of kerosene grass for this purpose. He suggested that coming up to wet season the emphasis should be not be on relying on vegetation stabilisation but rather engineered solutions. Dr Grant suggested the vegetation could be established at whatever rate but this would not be effective in terms of erosion control. Prof Johnston asked if the landform substrate would contain much organic matter. Dr Gardener advised that the initial landform will not have any added organic material. Dr Gardener advised a key issue was to prevent weed infestation so therefore just want good initial native grass cover which will die and add organics to soil. Dr Grant advised he agreed with Dr Gardener that the ultimate aim will be to get cover with appropriate species or framework species.
- 4.3.12 Dr Jones asked what arrangements are required for **eriss** and ERA to work together on the rehabilitation trial given the short timeframe for construction prior to the start of the 07/08 wet season. Dr Gardener noted this was a key issue to be determined as part of the workshop following the ARRTC meeting. Mr Evans suggested that ARRTC agree this is a positive move by ERA even if it has taken longer than first expected, and that ARRTC support the ongoing collaboration between **eriss** and ERA on the project. Dr Grant noted that significant progress has been made with fire and weed management issues and that the level of ERA collaboration with relevant stakeholders on some of these issues appears to have increased. He noted the work is not just at the theoretical research stage but moving into actual management practice.

**Mr Alan Puhlovich: Status of closure planning and geotechnical investigations around Pit #3**

- 4.3.13 Mr Puhlovich advised he was able to report back on the Action/Outcome 21 from ARRTC19. He also advised that he has been appointed as the closure manager for Ranger so now has a broader brief than just groundwater related matters. He advised the closure model would have to meet Rio Tinto and statutory requirements. Mr Puhlovich outlined the process to date in the evolution of the closure model and advised that the model was continuously being reviewed and updated in light of changes in operational status. He indicated that the cost model was being rerun following each change to the closure model. He indicated that OPSIM was being used to examine water management implications of various aspects of the closure model and to support the refinement of the closure vision and objectives. He advised that the next phase until early 2008 would focus on stakeholder consultation.
- 4.3.14 Mr Puhlovich noted that there hasn't been a defined process for stakeholder engagement on closure issues over past 18 months. Dr Klessa said that one reason for this was that ERA needed to develop its own technical understanding before engaging stakeholders. Mr Evans noted that determining the most appropriate time to engage stakeholders in closure processes was a key issue. Dr Klessa noted this required ERA to also understand its responsibilities and obligations fully before engaging. Dr Grant acknowledged this but suggested it depends on how this is communicated to stakeholders (ie. Don't go out with blank paper – which ERA has done). Dr Klessa stressed the need to adopt a flexible approach which provides for addressing stakeholder input otherwise process may be perceived as being a rubber stamping process.
- 4.3.15 Dr Stauber noted the wording of the ERA mission statement for closure and asked if the use of words “new and healthy environment” had been chosen to reflect that the mine area will not be returned to the pre mining state. Dr Grant noted that the Ranger Environmental Requirements make it clear that the rehabilitated site won't be same as pre mining. Dr Grant suggested that one of the primary closure criteria should be integration of the rehabilitated area into Kakadu National Park (ie. it should be a self-sustaining site with no active management different to that employed in the Park required post rehabilitation). It was noted that the ERA mission statement included reference to rehabilitation being “..completed by 2026”. Dr Grant noted this but suggested the key point is that the rehabilitated landform needs to be able to stand alone and potentially be reincorporated into KNP.
- 4.3.16 Mr Puhlovich outlined various criteria and targets for surface water, groundwater, radiation, flora, fauna, soil contamination, landform stability and erosion as part of the closure process. Mr Evans suggested that soil moisture may be more important than ground water in initial stages of rehabilitation of the final landform. Dr Stauber asked if, in terms of site water bodies, there will be site criteria for sediment. Dr Klessa advised there would be criteria dealing with sediment quality in RP1 and that all creeks that carry water off minesite will need to be surveyed. It was already stated in the closure plan that the footprint of the RP1 wetland would be rehabilitated. He indicated that Djalkmarra Billabong and Coonjimba Creek would also probably need to be reinstated. Dr Grant indicated he thought wetlands and sediment traps would be used to capture metals in runoff and seepage so onsite management measures would have to include sentinel wetlands.
- 4.3.17 Mr Puhlovich discussed closure strategies. Mr Evans asked if “closure” meant a rehabilitated site or reinstatement of all of the groundwater systems. Dr Klessa advised that rehabilitation was required to be completed by 2026. Mr Evans noted this but could envisage situations where the site would require further management past this point. Dr Grant suggested that decommissioning is part of rehabilitation and getting sign off on closure comes after that. Mr Puhlovich outlined the closure schedule including the option of bringing forward closure of Pit #1, installation of laterite plant and radiometric sorter. Dr Jones suggested the pond water inventory could also blow out. Dr Jones also suggested that closure of Pit#1 could potentially be delayed longer than currently planned if to was to be used for additional storage of tailings.
- 4.3.18 Dr Klessa advised ERA has developed a range of contingencies in case of additional wet years, and that there is substantial capacity in existing storages – including Pit 3 as a last resort. Mr Puhlovich advised the treatment of the groundwater mound has to be brought forward and that the current closure plan allows for contingency

storage. Mr Evans asked when revegetation of Pit #1 would be commenced. Mr Puhlovich advised from 2012. Mr Puhlovich indicated closure of Pit#1 would provide a test landform which would inform the rest of the closure process.

- 4.3.19 Mr Puhlovich advised the final landform construction plan has been prepared. Prof Johnston suggested the need to give thought to what kind of final landform monitoring techniques will be required (eg. height markers to measure landform surface movement). He suggested that, consistent with this, the draft monitoring plan needs to exist prior to commencement of closure planning.

#### **Water management**

- 4.3.20 Mr Puhlovich outlined various water management strategies being considered by ERA including using OPSIM to model various scenarios to minimise the water inventory including restoring catchments, use of rock lined channels and evaporation basins. He also discussed options for sediment and erosion management and radiation management.

- 4.3.21 Prof Johnston asked if there is going to be enough volume in the Pits to store the potentially significant volumes of contaminated soil to be disposed of as part of the rehabilitation process. Mr Delosa advised that, from an engineering perspective, ERA may have to address at closure at least ten million cubic metres of material, and that issues such as soil contamination will mean that a lot more material may have to be moved and stored. Mr Puhlovich advised that large scale scraping was not proposed at this stage. Mr Evans queried whether, given the volume to be put into Pit#3, a few more million cubic metres would make any difference to the plan. Mr Puhlovich advised that most rock will be left on surface. Dr Klessa advised that a strategy for dealing with contaminated material and associated constraints will have to be developed at some stage. He noted that some 2's material would be left over from the radiometric sorting process. Mr Puhlovich indicated this wasn't considered to be a big issue at this stage as there will be significant materials available, but acknowledged that availability of clean laterite for incorporation into the cover could be an issue.

#### **Action arising from ARRTC19**

- 4.3.22 Mr Puhlovich provided members with the information as requested under Action/Outcome 2I from ARRTC19 regarding the outcomes of Pit#3 geotechnical investigations. He advised that there are two issues that have been identified as a result of the investigations: leakage from RP2 and presence of unfavourable structures; and overflow from the spillway from RP2 causing damage to the Pit 3 walls and ramp. Mr Puhlovich advised that, following advice from the consultant, ERA was planning to undertake further geotechnical investigation on Pit#3 walls in early 2008. He advised that the spillway had been assessed as being suboptimal so ERA was arranging sufficient pumping capacity in RP2 to facilitate transfer of water to Pit 3, rather than allow passive spillway discharge to Pit 3. He made it clear that use of the spillway would be restricted to wet periods that were considered to pose an "emergency condition".

#### **4.4 Other stakeholder research activities**

- 4.4.1 There were no other reports on other stakeholder research activities.

#### **ARRTC20 Action/Outcome 4F**

**ARRTC thanked ERA staff for their high quality presentations and contribution to the work of the Committee.**

## 5 Strategic Planning – KKN Review

### 5.1 Gaps

#### Model validation

- 5.1.1 Dr Klessa highlighted the need to agree on datasets to be used in modelling, especially for long term processes such as climatic variability, and that this could be addressed under a model validation KKN. It was noted that this may also apply to a number of other KKNs that involved modelling of exposure pathways. It was agreed to develop a new KKN dealing with model validation.

#### **ARRTC20 Action/Outcome 5A**

**ARRTC agreed to develop a new KKN dealing with model validation to address the need for near and far term datasets for validation of scenarios and model outputs?**

#### Commonality

- 5.1.2 Members noted that commonality was also required in datasets and approaches. Prof Johnston suggested that the need for commonality didn't just apply to datasets and that agreement was required for ranges of parameters to be input into models in both the near and longer term. Dr Stauber raised concerns about water management issues on-site and differences in limits applied to different water bodies over past wet seasons (eg. there are currently specific limits for N in RP1 and RP2). Dr Stauber suggested that, in light of the presentation by Dr Klessa on the ERA integrated water management approach, there is a need for a whole of site assessment of load limits, especially in relation to nutrients.
- 5.1.3 Dr Klessa suggested the key issue was that the Ranger authorisation hasn't kept up with the way that the mine has evolved in terms of water management. He advised that going back 20 years, the policy was that ERA was allowed to release RP2 water to Magela Creek and, at that time, limits were set at 009 and load limits were set based on a combination of RP1, RP2 and Djalkmarra billabong releases. Dr Klessa advised this approach worked well at the time, but since then, there has been changes in water management requirements and ERA has committed to not release RP2 water (unless in an emergency). He advised that load limits have since been updated to reflect the relevant NWQMS guidelines and these were developed by *eriss* in 1980's along with some other load limits (eg for Nitrates). Dr Klessa advised that he had tried to find the source material and rationale for how these limits were determined and set without success. Dr Klessa suggested that the current load limits are ridiculously low (ie. 5t of Nitrate). He noted however that increasing reliance on water treatment rather than land application will bring direct benefits in terms of managing discharge loads.
- 5.1.4 Mr Evans asked whether Dr Klessa supported the view put forward by Dr Stauber. Dr Klessa stated that he wasn't supporting any particular view but made the point that the current authorisation is out of date. Dr Jones raised the issue of terrestrial nitrogen. Dr Klessa stated that if all of N was converted to nitrate then ERA would breach its current load conditions. Dr Klessa also noted that the authorisation doesn't deal with permeate from the water treatment plant.
- 5.1.5 Dr Grant asked where the gaps in current knowledge are. Mr Evans suggested there was a need for solute mass balances for the site. Dr Stauber agreed there is a need to understand how the current nutrient limits set in the authorisation were derived. Dr Hillman suggested this requires a very good understanding of how the system operates which would be best achieved by developing appropriately detailed conceptual models. Mr Evans suggested conceptual models for this could be married with OPSIM for water inventory management.
- 5.1.6 Dr Grant suggested that ARRTC needed to define what is the knowledge gap, which KKN it falls under and who should look at it. Dr Stauber suggested that her comments under KKN 1.2.4 defined what she saw as the knowledge gap. Dr Klessa suggested that the wording in the NWQMS guidelines was also problematic, especially for N and Nitrate and ecotox limits. Dr van Dam advised he thought the nitrate value in the nutrient section of the NWQMS guidelines had been shown to be erroneous and that a new figure had been proposed. Dr Klessa noted this was the case in relation to the concentration and load limits for N only and that work has been done on other key parameters. Mr Evans suggested that this could be addressed under a new KKN looking at load limits and how they have been derived, and that ERA and *eriss* could look at this issue as part of their respective workplans. This was agreed.

#### **ARRTC20 Action/Outcome 5B**

**ARRTC agreed to develop a new KKN under KKN 1.2.1 looking at whole of site load limits and how they have been derived, with *eriss* looking at mass balance and EWLS looking at whether authorisation limits are still appropriate.**

## **KKN 1.2.2**

5.1.7 Dr Grant suggested there is a need to look at the management of rehabilitation of Ranger. Prof Johnston asked what work is being undertaken in relation to determining the rehabilitation implications of a request for expansion of the Land Application Areas. Dr Klessa advised that ERA undertakes a risk assessment to understand the potential impacts of a proposed change in management on the rehabilitation of LAAs, especially looking at vegetation issues including weeds, and the need for mass budgets.

## **KKN1.2.5 /1.2.6**

5.1.8 Prof Johnston suggested that another key knowledge gap related to whether the monitoring programs for radiation exposure pathways for Ranger worker exposure are currently optimised. He asked what was required in order to meet international best practice benchmarks. Dr Grant indicated he was uncertain why this issue should be considered by ARRTC which does not have a role in reviewing or validating ERA radiation protection measures and performance standards. Mr Evans noted that current KKNs reflected the views of those existing and previous ARRTC members who had been involved in their development. Prof Johnston indicated that he understood Dr Grant's concerns but suggested ARRTC needed to consider these issues in the broader political context.

5.1.9 Dr Grant suggested this was more of a regulatory issue and not something that ARRTC should address. Dr Klessa suggested that it comes back to whether the regulator feels it has the right tools to assess the performance of the company in terms of radiation protection. He noted that what Prof Johnston was referring to were the tools required to do this form of assessment. He agreed with Dr Grant that this was essentially an issue for the regulator and fell outside ARRTC's remit.

5.1.10 Mr Hughes noted the various concerns being raised and suggested ARRTC focus on the original statement of the KKN and determine whether the KKN has been progressed. Dr Hillman indicated he was also concerned about drifting into areas that are not the responsibility of ARRTC, but highlighted the need to take advantage of Prof Johnston's expertise in this area. Mr Evans indicated he believed that radiation protection should stay in the KKNs as this is analogous to ARRTC's interest in nutrient loads (ie seeking to understand the science underpinning the defined limits but not looking at the company's compliance with these limits). Mr Evans suggested it was within ARRTC's remit to look at the science supporting the regulator in assessing compliance.

5.1.11 Mr Delosa noted that the proposed national dose register should provide the opportunity to compare what is happening at Ranger to other sites. Prof Johnston agreed that the proposed dose register will provide useful information but advised data used in dose registers often suffer from uncertainty because they are indirectly measured. Dr Grant noted that the discussion was about humans as receptors of various environmental impacts and radiation is just one of a number of such impacts.

5.1.12 Mr Evans asked if members wanted to remove the KKNs dealing with radiation protection. Dr Klessa noted that the radiation protection KKNs had been included by Dr Arthur Johnston because they were proposed to be used to optimise the radiation protection plan which was being developed at that time. Dr Stauber noted there was a good reason to include the KKNs at the time but suggested that they are no longer needed. Mr Ellsmore suggested that if ARRTC wanted to have KKNs dealing with radiation protection there could be a similar case for having KKNs dealing with chemical exposures.

5.1.13 Prof Johnston noted the views of various members about ARRTC dealing with radiation protection issues but indicated he thought ARRTC should comment on these issues. Mr Hughes suggested that the issue could be addressed by ARRTC separately from the KKNs. Dr Hillman suggested perhaps replacing the current KKNs with a general KKN dealing with radiation on-site. Dr Grant suggested that radiation issues should be being captured under the rehabilitation section of the KKNs. Mr Evans suggested that KKN 1.2.6 dealing with radiation protection be removed.

5.1.14 Prof Johnston argued the need to compare the standard of radiation protection at Ranger to the standard of practice elsewhere in the world. He also suggested that further work is required to understand dose relationships. Prof Johnston acknowledged that the standard of Occupational Health and Safety at Ranger is a matter for the company and Worksafe NT. Dr Klessa noted that radiation protection standards and dose relationships are national knowledge needs. Mr Hughes suggested that he would follow up these issues with the relevant external authorities. Prof Johnston noted there have been concerns raised previously about radiation protection at Ranger and that is why it is included in the KKNs.

### **ARRTC20 Action/Outcome 5C**

**ARRTC agreed to delete KKN 1.2.6 on the basis that it deals with regulatory rather than research matters and is already being addressed by other competent responsible authorities in the NT (eg NT Worksafe).**

## **KKN 2.1.1**

5.1.15 Dr Grant suggested there is a need to include greater emphasis on current and proposed trial landforms at Ranger.

## **KKN 1.2.1**

- 5.1.16 Dr Hillman noted that the deletion of the previous text has created a gap. Dr Stauber suggested that if the deleted text isn't replaced then the KKN only deals with work that has been completed.
- 5.1.17 It was noted that Dr Hayes had previously raised concerns regarding risk assessment in relation to Best Practicable Technology (BPT) and there was discussion on whether risk assessment should be covered under a broad KKN. Dr Stauber noted that Dr Hayes had contributed to the revision of a number of KKNs.
- 5.1.18 Dr Klessa sought clarification on what the risk assessment KKNs are trying to achieve. He advised that there are standard approaches to risk assessment across the mining industry. Dr Klessa advised that ERA was required to use BPT under the Ranger Environmental Requirements despite knowing that it has flaws and perhaps it could be done better, but questioned whether it was ARRTC's role to look at the issue. Mr Evans advised that he could see no reason why ARRTC couldn't identify an issue that ends up with change in the authorisation. Dr Klessa indicated he thought this was fine on a R&D level, but noted that all applications ERA puts to the regulator for approval need to be supported by a BPT assessment.

#### **KKN 5.1.1 Risk Assessment**

- 5.1.19 Mr Evans asked whether members have a view on the scale of the ecological risk assessment work undertaken by *eriss*. Dr Klessa suggested it is important to retain a good understanding of the broader risks to the environment of the Alligator Rivers Region, and that that this work is useful in putting potential threats associated with Ranger into context. Dr Grant asked if the risk assessment work was now complete. Mr Smith noted that the obvious landscape scale issue missing is climate change which will affect the mine in some way. Dr Jones asked if there is a KKN dealing with climate change. Dr Barry noted that the implications of climate change on the operations and rehabilitation of the mine is an obvious question.
- 5.1.20 Dr Klessa suggested that this should form part of regular environmental reporting because a lot of people are interested in knowing the relative effect of the mine on the landscape. Mr Evans asked if members believed that KKN 5.1.1 has been completed as evidenced by the presentation by Dr Bayliss. Mr Hughes suggested that the original scope of the risk assessment work (ie quantification and comparison of mining and non-mining impacts on the Magela Floodplain) has been completed. Dr Grant noted that it was agreed that the framework should be re-run for the likely different mix of risk factors in the rehabilitation phase, so given this, a risk assessment KKN was still required in his view.
- 5.1.21 Mr Evans asked if there are other issues other than impacts of climate change on modelling that should be addressed under a new KKN 2.6.1. Dr Jones noted there are a number of factors that need to be considered like the potential impacts of extreme climatic effects on the rehabilitated landform. Mr Hughes noted that extreme events were already being factored in such as the 2006-07 extreme rainfall event and that climate change is unlikely to result in any greater magnitude of event. Mr Hughes suggested that reference to climate change was perhaps too nebulous and that the focus should be on sea level change and other more specific factors such as analysis of extreme event probability and magnitude. Mr Hughes noted that the risk assessment work had been competed for the Magela floodplains and the KKN currently points to this work being undertaken for the rest of the ARR reflecting other work that is being undertaken for Parks Australia. Mr Hughes suggested that ARRTC consider whether this broader risk assessment work falls with its responsibilities. Mr Evans queried the priority of this work. Dr van Dam noted the risk assessment work would also have benefits in assisting Parks Australia in managing the reintegration of the post mining areas back into the KNP. Dr Grant queried whether the work would be undertaken if not included under KKN2.6.1.
- 5.1.22 ARRTC agreed to delete KKN 5.1.1 on the basis that this work had been completed. It was also agreed to include words under KKN 2.6.1 to include reference to the need to include issues related to climate change and broader scale in so far as they had potential to impact on the mine site rehabilitation risk profile (through decommissioning and afterwards).

#### **ARRTC20 Action/Outcome 5D**

**ARRTC agreed to delete KKN 5.1.1 as this work has been completed and to add new text to KKN 2.6.1 to include reference to the need to include issues related to climate change and broader scale in so far as they had potential to impact on the mine site rehabilitation risk profile (through decommissioning and afterwards).**

#### **KKN 6.1.1**

- 5.1.23 Following discussion, ARRTC agreed to delete KKN 6.1.1 on the basis that the conceptual models have already been developed. Mr Evans noted that as mine closure gets closer there will need to be additional KKNs developed addressing knowledge gaps dealing with risks associated with rehabilitation of the mine site and the reintegration of the area into the KNP.

#### **ARRTC20 Action/Outcome 5E**

**ARRTC agreed to delete KKN 6.1.1 on the basis that it is not required as conceptual models are already developed.**

#### **KKN 2.2.4**

5.1.24 Prof Johnston expressed concern that the new KKN 2.2.4 proposed by Dr Grant did not include the words “*and expected land use by indigenous people*”. Dr Grant suggested that this was covered by the new first sentence. Dr Klessa noted that the Environmental Requirements set out expectations in terms of the use of the rehabilitated landform, and that the new wording focuses on pathways. Mr Evans noted that the proposed KKN 2.2.4 was more focused on terrestrial pathways. Prof Johnston suggested the expectations of the Traditional Owners, in terms of what land use the rehabilitated landform should support, were important. He also noted that some of this issue may be limited to radioactivity of plants and animals, but suggested there are other factors that should also be considered as part of closure criteria.

5.1.25 Dr Klessa noted the importance of defining landuse expectations when seeking to understand what pathways need to be looked at. Mr Hughes noted the only problem with this is that landuse could change over time so therefore you would have to plan for all potential landuses. Dr Klessa suggested adding a reference to other exposure pathways. Prof Johnston noted the KKN was focused on busk tucker pathways. ARRTC agreed to amend KKN 2.2.4 with words that allow for other landuses to be considered as they are identified.

**ARRTC20 Action/Outcome 5F**

**ARRTC agreed to amend KKN 2.2.4 by including words that allow for consideration of other landuses as they identified.**

**Stewardship**

5.1.26 Prof Johnston suggested that post rehabilitation stewardship of mine sites is an important issue that should be considered and provided members with background on the stewardship arrangements that applied to the rehabilitation of the Maralinga nuclear test site. Prof Johnston advised that issues that should be considered under Stewardship include the management of land post-closure, periods of institutional control required, how long land use could be restricted and management mechanisms.

5.1.27 ARRTC agreed to a new KKN dealing with the development of a Stewardship plan for Ranger, noting at this stage it is intended that the rehabilitated mine site should be able to be integrated into KNP.

**ARRTC20 Action/Outcome 5G**

**ARRTC agreed to develop a new KKN dealing with the development of a Stewardship plan for Ranger.**

**Process for finalising KKN review**

5.1.28 ARRTC noted the need to finalise the KKN review out-of-session and agreed that DPIFM would provide advice on questions raised by Mike Ellsmore under KKN 4.2, and Dr Grant would review questions in light of this advice and the outcomes from the Rehabilitation Workshop on Oct 11, and then in discussion with Mr Ellsmore, provide a revised set of KKNs for Nabarlek. ARRTC also agreed that Mr Hughes would arrange for the KKNs to be updated consistent with the outcomes from this meeting and circulated to members for approval out of session.

5.1.29 ARRTC agreed to the KKN prioritisation table being reviewed, updated and circulated prior to the next meeting. It was also agreed to populate the table with hyperlinks to relevant *eriss* project titles and provided as part of meeting papers before the next meeting. ARRTC also requested Dr Klessa to provide presentations on OPSIM and its calibration and use, and ERA work on sediments and metals to the next meeting.

5.1.30 ARRTC thanked all SSD staff for their support and contributions to the meeting.

**ARRTC20 Action/Outcome 5H**

**ARRTC agreed that DPIFM (through Mr Delosa) would provide advice on questions raised by Mike Ellsmore under KKN 4.2.**

**ARRTC20 Action/Outcome 5I**

**ARRTC agreed that on the basis of advice from DPIFM under ARRTC20-5H and in light of the outcomes from the Rehabilitation Workshop, Dr Grant, in discussion with Mr Ellsmore, would develop a revised set of KKNs for Nabarlek.**

**ARRTC20 Action/Outcome 5J**

**ARRTC agreed that Mr Hughes would work with relevant *eriss* staff and the ARRTC Secretariat to update the revised KKNs in light of outcomes from ARRTC20 and, subject to agreement of the Chair, circulate to ARRTC members for out-of-session final approval.**

**ARRTC20 Action/Outcome 5K**

**ARRTC agreed that the KKN prioritisation table would be reviewed, updated and circulated prior to the next meeting.**

**ARRTC20 Action/Outcome 5L**

**ARRTC agreed that the KKN table would be populated with hyperlinks to relevant *eriss* project titles and included in the meeting papers for the next meeting.**

**ARRTC20 Action/Outcome 5M**

**ARRTC agreed that Dr Klessa would arrange for a presentation on OPSIM, its calibration and use at Ranger for the next ARRTC meeting.**

**ARRTC20 Action/Outcome 5N**

**ARRTC agreed that Dr Klessa would provide a report on ERA/EWLS metals and sediment work to next ARRTC meeting.**

**ARRTC20 Action/Outcome 5O**

**ARRTC thanked the ARRTC Secretariat and all SSD staff for their contribution to the arrangements and presentations for this meeting of ARRTC.**

## **6 Other Business**

6.1.1 There was no other business raised.

## **7 Next Meeting**

7.1.1 Mr Evans suggested the next ARRTC meeting be held during wet season in late Feb or early March 08, and that members may wish to visit the Ranger mine and inspect the rehabilitation demonstration project at this time. Members agreed to hold the next ARRTC meeting on 6<sup>th</sup> and 7<sup>th</sup> of March 2008 in Darwin and to fly to Ranger on the 5<sup>th</sup>. Members also agreed to include a fly over Nabarlek enroute.

**ARRTC20 Action/Outcome 6A**

**ARRTC agreed that the next meeting will be held at Darwin on 6<sup>th</sup> and 7<sup>th</sup> of March 2008, to be preceded by a site visit to Ranger mine to inspect the Ranger rehabilitation demonstration site on the 5<sup>th</sup> - with a flyover of Nabarlek.**

ARRTC20 Draft Actions/Outcomes

No.	Action/Outcomes	Responsibility
ARRTC20-1A	ARRTC agreed the Secretariat would provide Dr Barry with background information on ARRTC and any other assistance as necessary.	ARRTC Secretariat
ARRTC20-2A	ARRTC approved the draft minutes as being a true and fair record of the ARRTC19 meeting with a number of minor changes.	Done
ARRTC20-3A	Dr Milnes agreed to confirm whether ERA presentations can be made available to ARRTC members and under what terms.	Dr Milnes
ARRTC20-3B	ARRTC agreed to consider a report by Dr Bayliss and Dr Gardener on outcomes from the Rehabilitation Workshop at its next meeting.	Dr Bayliss, Dr Gardener
ARRTC20-3C	ARRTC agreed to the decision to discontinue monitoring the Swift Creek sites upstream of Jabiluka at this time	
ARRTC20-3D	ARRTC agreed to consider a report on progress in the South Alligator Valley rehabilitation project at its second meeting in 2008.	ARRTC Secretariat, Mr Balding
ARRTC20-3E	Mr Delosa agreed to provide (through the ARRTC Secretariat) the underlying documentation for the MTC application/s dealing with the expansion of land application areas at Ranger to Dr Hillman and Mr Evans.	Mr Delosa
ARRTC20-3F	Dr Klessa agreed to provide the ARRTC Secretariat with a copy of his presentation on water management to be made available to interested members on request (but not through the ARRTC website).	Dr Klessa, ARRTC Secretariat
ARRTC20-4A	Dr Grant requested that further work be undertaken to examine the importance of dissolved organic matter in modifying response in whole effluent toxicity testing, particularly in the context of testing permeate.	Dr Van Dam
ARRTC20-4B	Prof Johnston suggested that Dr Bollhoefer prepare a pie chart showing components of the natural background radon exposure for Jabiru.	Dr Bollhoefer
ARRTC20-4C	Dr Grant suggested that the risk table used by Dr Bayliss include a note highlighting that minesite related risks shown are only related to surface water pathways and that other factors and pathways may show a different picture.	Dr Bayliss
ARRTC20-4D	ARRTC thanked eriss staff for their high quality work over the past six months and supported the collaborative approach adopted by eriss in dealing with other stakeholders.	Done
ARRTC20-4E	ARRTC agreed to consider and comment on the initial design on the Ranger landform rehabilitation demonstration area to be provided by ERA. Mr Evans, Dr Grant, Dr Barry and Prof Nott to review the initial design in three days and provide advice to ERA.	Dr Milnes, Dr Klessa, Mr Evans, Dr Grant, Dr Barry and Prof Nott
ARRTC20-4F	ARRTC thanked ERA staff for their high quality presentations and contribution to the work of the Committee.	Done
ARRTC20-5A	ARRTC agreed to develop a new KKN dealing with model validation to address the need for near and far term datasets for validation of scenarios and model outputs.	ARRTC
ARRTC20-5B	ARRTC agreed to develop a new KKN under KKN 1.2.1 looking at whole of site load limits and how they have been derived, with eriss looking at mass balance and EWLS looking at whether authorisation limits are still appropriate.	ARRTC, Dr Jones et al, Dr Milnes et al
ARRTC20-5C	ARRTC agreed to delete KKN 1.2.6 on the basis that it deals with regulatory rather than research matters and is already being addressed by other competent responsible authorities in the NT (eg NT Worksafe)	ARRTC

ARRTC20-5D	ARRTC agreed to delete KKN 5.1.1 as this work has been completed and to add new text to KKN 2.6.1 to include reference to the need to include issues related to climate change and broader scale in so far as they had potential to impact on the mine site rehabilitation risk profile (through decommissioning and afterwards).	ARRTC
ARRTC20-5E	ARRTC agreed to delete KKN 6.1.1 on the basis that it is not required as conceptual models are already developed.	ARRTC
ARRTC20-5F	ARRTC agreed to amend KKN 2.2.4 by including words that allow for consideration of other landuses as they identified.	ARRTC
ARRTC20-5G	ARRTC agreed to develop a new KKN dealing with the development of a Stewardship plan for Ranger.	ARRTC
ARRTC20-5H	ARRTC agreed that DPIFM (through Mr Delosa) would provide advice on questions raised by Mike Ellsmore under KKN 4.2.	Mr Delosa
ARRTC20-5I	ARRTC agreed that on the basis of advice from DPIFM under ARRTC20-5H and in light of the outcomes from the Rehabilitation Workshop, Dr Grant, in discussion with Mr Ellsmore, would develop a revised set of KKNs for Nabarlek.	Dr Grant, Mr Ellsmore
ARRTC20-5J	ARRTC agreed that Mr Hughes would work with relevant eriss staff and the Secretariat to update the revised KKNs in light of outcomes from ARRTC20 and, subject to agreement of Chair, circulate to ARRTC members for out-of-session final approval.	Mr Hughes, relevant eriss staff, ARRTC Secretariat
ARRTC20-5K	ARRTC agreed that the KKN prioritisation table would be reviewed, updated and circulated prior to the next meeting.	ARRTC Secretariat
ARRTC20-5L	ARRTC agreed that the KKN table would be populated with hyperlinks to relevant eriss project titles and included in the meeting papers for the next meeting.	ARRTC Secretariat
ARRTC20-5M	ARRTC agreed that Dr Klessa would arrange for a presentation on OPSIM, its calibration and use at Ranger for the next ARRTC meeting.	Dr Klessa
ARRTC20-5N	ARRTC agreed that Dr Klessa would provide a report on ERA metals and sediment work to next ARRTC meeting.	Dr Klessa
ARRTC20-5O	ARRTC thanked the ARRTC Secretariat and all SSD staff for their contribution to the arrangements and presentations for this meeting of ARRTC.	Done
ARRTC20-6A	ARRTC agreed that the next meeting will be held at Darwin on 6 <sup>th</sup> and 7 <sup>th</sup> of March 2008, to be preceded by a site visit to Ranger mine to inspect the Ranger rehabilitation demonstration site on the 5 <sup>th</sup> - with a flyover of Nabarlek.	ARRTC Secretariat