

**ALLIGATOR RIVERS REGION TECHNICAL COMMITTEE
MEETING 19, 8 – 9 MARCH 2007, DARWIN NT
MEETING SUMMARY**

MEMBERS

Mr Ray Evans - Independent Scientific Member (Chair)

Dr Carl Grant - Independent Scientific Member

Prof Peter Johnston – Independent Scientific Member

Dr Keith Hayes – Independent Scientific Member

Dr Terry Hillman - Independent Scientific Member

Prof Jon Nott - Independent Scientific Member

Dr Jenny Stauber - Independent Scientific Member

Mr Alan Hughes – Supervising Scientist

Dr Tony Milnes – Energy Resources of Australia Ltd

Mr Mike Delosa – NT Department of Primary Industries, Fisheries and Mines

APOLOGIES

Mr Mark Foy – Northern Land Council (represented by Mr Smith)

Mr Shane Maraldo – Hanson Pty Ltd

ADVISERS AND OBSERVERS (PRESENT FOR ALL OR PART OF THE MEETING)

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

Mr Bruce Ryan - Environmental Research Institute of the Supervising Scientist

Dr Mark Gardener – EWL Sciences Pty Ltd

Mr Alan Puhlovich – EWL Sciences Pty Ltd

Mr Ian Hollingsworth – EWL Sciences Pty Ltd

Mr Howard Smith - Northern Land Council (proxy for Mr Mark Foy, NLC)

Mr Geoff Kyle - Gundjei'mi Aboriginal Corporation

Mr Greg Balding - Parks Australia North

Mr Richard McAllister - Office of the Supervising Scientist

Ms Ann Web - Office of the Supervising Scientist

Ms Carolyn Lord - Office of the Supervising Scientist

Ms Suzanne Davis-Hall - Office of the Supervising Scientist

Ms Wendy Murray - Office of the Supervising Scientist

Mr Scott Parker – Office of the Supervising Scientist (Secretary)

Other *eriss* staff

1. INTRODUCTION

1.1 Welcome and Overview

1.1.1 Mr Hughes provided members with a fire safety briefing. Mr Evans welcomed members and observers to the 19th meeting of the ARRTC and noted that the current Committee has now been in existence longer than the original Committee it replaced.

1.2 Apologies and Observers

1.2.1 Apologies were received from Mr Mark Foy (represented at this meeting by Mr Howard Smith) and Mr Shane Maraldo.

1.3 Conflict of interest declarations

1.3.1 No conflict of interest declarations were tabled.

1.4 Order of Business

1.4.1 Mr Evans suggested that discussions on the MTC reports be brought forward and addressed between Agenda Items 2 and 3 to provide context to the Committee's deliberations. He also suggested that the MTC reports be left as a standing agenda item for future meetings. This was agreed.

1.4.2 Mr Evans noted the recent extreme weather event had posed significant implications for the operations of the Ranger Mine and surrounding region. He noted members may be interested in hearing about the range of responses taken by ERA to deal with the event. Dr Milnes agreed to cover these matters in his presentation under Agenda Item 4.

Action/Outcome 1A

ARRTC agreed the MTC reports would be a standing agenda item for future meetings.

2. ARRTC18 MEETING SUMMARY AND ACTIONS ARISING

2.1 Draft ARRTC18 – Summary of Meeting Outcomes/Actions

2.1.1 Members reviewed the draft ARRTC18 meeting summary. Mr Evans raised his concerns regarding the timing of circulation of agenda, meeting outcomes and actions following each meeting. Members agreed that ARRTC meeting papers should be circulated as soon as possible after each meeting, especially any actions arising.

2.1.2 Mr Evans noted the need to be more definitive when summarising the outcomes and actions arising from discussion on each agenda item. He advised Mr Parker would assist him in the future to ensure that all decisions and actions agreed by the Committee are properly and concisely recorded.

2.1.3 Mr Evans suggested that future meeting outcomes and actions should be finalised within 8 weeks of the meeting. Dr Grant noted that many actions arising are administrative in nature and suggested that only substantive actions should be recorded. Dr Grant suggested that the longer it takes for the minutes to come out the less recollection members have and the more difficult it is for members to support and follow through.

2.1.4 Dr Hayes agreed and suggested that meeting outcomes and actions could be displayed as they are recorded during the meeting. Mr Hughes noted that this approach was already being used successfully in MTC meetings and supported the timeframe proposed by Mr Evans. Mr Evans noted the proposed timeframe will also place greater onus on members to review the information and to provide their comments back to the Secretariat in a timely way. Prof Johnston agreed and suggested that actions arising be reviewed the following day.

2.1.5 Mr Evans supported the idea of doing the minutes electronically consistent with his preference for ARRTC to move towards a paperless approach to its business. Dr Grant supported Prof Johnston's suggestion that the actions arising be reviewed and agreed the day following. Mr Hughes noted that ARRTC's decision to agree the outcomes/actions arising after each agenda item would also assist this.

Action/Outcome 2A

ARRTC agreed to the following timetable for minutes and actions arising:

- minutes and actions arising should be finalised within 8 weeks of the meeting;
- list of draft actions to be circulated to members within 1 week of meeting;
- draft minutes to be circulated 4 weeks after the meeting;
- members have 2 weeks to review and advise any changes; and
- final draft minutes to be posted to website within 8 weeks of meeting.

- 2.1.6 Mr Evans advised members that Dr Hayes was intending to resign from ARTCC and this would be his last meeting. Dr Hayes advised that he was not able to continue on ARRTC due to personal commitments. He advised he would continue to collaborate with eriss research staff on projects relating to risk assessment and felt this would be a better use of his time. Mr Evans expressed his disappointment that Dr Hayes was resigning and believed he would be difficult to replace. Mr Evans formally thanked Dr Hayes for his contribution to ARRTC.

Draft ARRTC19 Outcomes

- 2.1.7 Dr Stauber queried the meaning of the wording of the second sentence in paragraph 4.1.38. Dr Jones noted the reference was to the binary nature of billabong condition between wet and dry seasons. After further discussion members agreed to delete the second sentence and replace it with words to be provided by Dr Hillman.
- Dr Hillman subsequently provided the following words to replace section 4.1.38 of the ARRTC18 meeting outcomes, "*Billabongs are highly heterogeneous components of the landscape and the composition of their macro-invertebrates communities may naturally differ substantially at any point in time – though over time most taxa will be represented in most billabongs in a similar ecological condition. This needs to be borne in mind when ascribing causes to observed differences in macro-invertebrate communities*".

Action/Outcome 2B

ARRTC agreed to delete sentence in paragraph 4.1.38 of the draft ARRTC18 meeting outcomes and replace with words to be provided by Dr Hillman.

- 2.1.8 Mr Evans expressed concern regarding the potential implications of changing the wording of the draft minutes at this stage. Members agreed it was vital to ensure the draft minutes are an accurate and fair record of the Committee's deliberations.
- 2.1.9 Prof Johnston queried the wording of Action/Outcome 2B which states he was to "continue to acquaint himself with Ranger Radiation Management System". He requested the words "continue to" be deleted. This was agreed.

Action/Outcome 2C

ARRTC agreed to amend the wording of ARRTC18 Action/Outcome 2B, by removing the words "continue to".

Action/Outcome 2D

ARRTC agreed to amend the draft ARRTC18 minutes to reflect the above changes and place on the ARRTC public website.

2.2 ARRTC18 - Actions Arising

- 2.2.1 Action/Outcome 2B - Prof Johnston advised that he didn't have a copy of the ERA Ranger Radiation Management System. Dr Milnes undertook to provide a copy to Prof Johnston.

Action/Outcome 2E

Dr Milnes to provide copy of ERA Ranger Radiation Management System to Prof Johnston.

- 2.2.2 Action/Outcome 2C - Mr Kyle advised he would update members on the proposed meeting between ARRTC and the GAC in his report later in the meeting.

Action/Outcome 2F

Mr Kyle to provide further information on the proposed meeting between ARRTC and the GAC under his report later in the meeting.

- 2.2.3 Mr Evans advised that the words in Action/Outcome 2D regarding the issue of environment NGO representation agreed at ARRTC18 were included in his last letter to Parliamentary Secretary Hunt, to which he has not yet received a response.
- Mr Evans subsequently advised members that he had received a response to his letter from Minister Turnbull and that the Minister had "noted ARRTC's advice regarding NGO representation and that no further action was required at this stage".
- 2.2.4 Mr Hughes advised members that it was still not clear whether ARRTC would be reporting directly to Minister Turnbull or to Assistant Minister Cobb. He suggested that, until reporting arrangements have been confirmed, Mr Evans should address his report on the outcomes from ARRTC19 to Minister Turnbull.
- 2.2.5 Dr Grant queried whether ARRTC is in a position to request a response to Mr Evans' reports. Ms Webb advised members that the Secretariat had been requested by the Minister's office to prepare a draft response to Mr Evans, which had been forwarded two weeks ago. She suggested the response might have been delayed due to other

priorities associated with the Minister assuming his new portfolio responsibilities. Mr Hughes advised there was no need to specifically request a response to Mr Evans's report.

- 2.2.6 Prof Johnston suggested that incoming/outgoing correspondence be included as a standing agenda item for future meetings so that all members could be informed. Dr Grant suggested that this agenda item could also cover matters such as changes in key personnel in relevant government and stakeholder organisations.

Action/Outcome 2G

ARRTC agreed that:

- *the Secretariat will advise members of ministerial reporting arrangements once these have been confirmed; and*
- *incoming/outgoing correspondence and key personnel changes will be included as a standing agenda item for future ARRTC meetings.*

2.2.7 Mr Kyle advised that, in relation to stakeholder comments on the Ranger Closure Model addressed under Action/Outcome 2F, he would provide feedback on the TO consultation held in November 2006 in his report later in the meeting. Members were unsure whether ARRTC members had seen the TO comments on the last closure model. Dr Milnes advised that a new revision of the closure model would be available in mid 2007.

2.2.8 Dr Grant indicated his disappointment that there had been no feedback on *eriss's* comments on the previous closure model. Dr Milnes advised that all stakeholders were waiting for the next iteration of the model. Mr Hughes suggested that no further action was required on this agenda item as there have been no revisions since the last meeting and ERA has advised there would be further iterations of the closure model.

2.2.9 In relation to Action/Outcome 3A, Mr Evans noted Dr Hayes had raised the issue of risk assessment techniques at the last meeting and ARRTC had agreed to consider as a key strategic issue as part of the gap analysis but not as a Key Knowledge Need. Dr Jones noted the action arose from a discussion of the Best Practical Technology assessment methodology at the last meeting.

2.2.10 Dr Hayes made the point that the BPT framework was not a formal risk assessment process but essentially a point based decisions approach. Mr Evans noted the issue was of interest to ARRTC and suggested that it be considered in the context of ARRTC's review of the KKNs. Dr Hayes noted these are essentially operational matters for ERA to deal with in the context of their legislative requirements but suggested that BPT is not considered to be stringent enough to be used for risk assessment purposes, particularly when dealing with high degrees of uncertainty.

Action/Outcome 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.

2.2.11 In relation to Action/Outcome 3B, Dr Milnes advised that a geotechnical inspection of RP2 and Pit 3 walls had been carried out following the recent severe weather event and he was currently awaiting a report from the consultant. He advised that there was no indication at this stage of any problems with the integrity of either structure. Members requested further information on the key findings in the consultant report when available.

Action/Outcome 2I

ARRTC agreed Dr Milnes would provide a report on the outcomes of the geotechnical consultant's report on Pit 3 and RP2 to the next meeting.

2.2.12 In relation to Action/Outcome 3C, Mr Balding indicated he would provide an update on the South Alligator Valley rehabilitation project in the Parks Australia North report later in the meeting.

2.2.13 In relation to Action/Outcome 4A, Dr Milnes advised that information on ERA's vegetation demonstration plot project would be included in his report later in the meeting. Dr Grant expressed concern that this was inconsistent with ARRTC's original request for a detailed presentation on the issue, and thought it would be appropriate for ARRTC to have some input into the experimental design parameters of the project. Dr Jones advised that there had been a meeting between *eriss* and ERA staff to discuss and agree on the overall objectives of the vegetation project, but this did not specifically address experimental design issues. Dr Grant expressed concern that due to the delay in getting the project running, there was now limited time between this meeting and the project commencement for ARRTC members to provide input. Mr Evans agreed and asked Dr Milnes whether it would be possible for ARRTC members to be provided with further information on the project as part of the ERA reports later in the meeting. Dr Milnes indicated he would see whether this was possible.

2.2.14 Dr Hillman indicated his support for this approach and suggested that ARRTC may be able to assist ERA in relation to aspects of the project design. Dr Jones suggested that this was a matter for ERA to determine. Mr Evans noted this but suggested that there was a clear opportunity for collaboration between ARRTC members and ERA on this issue. Mr Evans suggested that the organisational divides between SSD and EWLS were sufficiently transparent for this to occur. Dr Milnes advised that the main reason for delay in the project was that he was waiting for ERA to commit the necessary resources to the project. Dr Milnes advised that the project was a

major investment so resources could not be organised quickly. Dr Grant advised that he was involved initially in project design and expressed concern that very little has happened since then. Mr Evans suggested that, given some members' concerns, ARRTC advise ERA that it considers the vegetation project to be of high priority and recommend that it should proceed as soon as possible. Members agreed to this approach and also agreed that ERA be requested to provide detailed advice on vegetation projects at the next ARRTC meeting.

Action/Outcome 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.

Action/Outcome 2K

ARRTC agreed that ERA should be requested to provide advice on progress of the trial vegetation projects at the next meeting.

2.2.15 In relation to Action/Outcome 4B, Dr Milnes advised that there was nothing additional to report on the uranium in sediments work since the last meeting.

2.2.16 Dr Stauber expressed concern that a number of action items from the last meeting had not been completed and were at risk of "falling off" the agenda. Dr Stauber indicated that she would like the information on the uranium in sediments work to be presented to ARRTC as originally requested.

2.2.17 Dr Milnes advised that all actions arising were on the official record of the meeting so there was no way for these to remain unactioned, unless ARRTC decided that the actions were no longer required or relevant to its business. Mr Evans suggested that, in future, all action items not finalised be deferred to the following meeting and that the Secretariat list unactioned items under a standing agenda item until completed. Members agreed to this approach.

Action/Outcome 2L

ARRTC agreed that, in future, all action items not finalised will be deferred to the following meeting and that the Secretariat will list unactioned items under a specific agenda item until resolved.

2.2.18 Mr Evans suggested that not all actions arising from previous meetings have been reflected in the minutes of those meetings. Prof Nott asked whether the Parks Australia Landscapes Group meeting scheduled for March 6-7 had occurred as planned. Mr Hughes advised that the meeting had been postponed until mid April 2007 owing to road closures for the recent heavy rain.

2.2.19 In relation to Action/Outcome 6B dealing with the proposed meeting between the ARRTC Chair and the GAC, Mr Kyle advised that a suitable opportunity had not arisen to date for such a meeting. Mr Kyle suggested the meeting was originally going to be informal rather than business related. He advised that the matter had been raised with the GAC but hadn't been progressed. He suggested the meeting could be arranged if ARRTC members were still interested.

2.2.20 Mr Evans recalled the original purpose of the meeting was to establish lines of communication between ARRTC and the GAC and advised he would be happy to meet with the GAC or selected members in whatever way was considered appropriate. Mr Kyle noted finding a suitable time would be difficult but suggested that the meeting be arranged around the next ARRTC meeting when members were expected to be at Jabiru. Mr Hughes advised that the next ARRTC visit to Jabiru was supposed to be during the wet season. Mr Evans recalled that ARRTC had agreed that all members should have the opportunity to visit the Ranger site every 2 years. Members noted this would mean the meeting probably wouldn't be able to be arranged for another 12 months.

Action/Outcome 2M

ARRTC confirmed its continuing interest in arranging a meeting with the GAC should an appropriate opportunity arise in the future.

3. MINESITE TECHNICAL COMMITTEE (MTC) - INFORMED REGULATORY DECISIONS

As agreed earlier in the meeting, this agenda item was brought forward. Mr Delosa provided members with an update on the key outcomes of recent meetings of the Ranger, Jabiluka and Narbalek Minesite Technical Committees and reported on key DPIFM activities.

3.1 Nabarlek

3.1.1 Mr Delosa advised that the mine operator has submitted a mine closure plan for Nabarlek to DPIFM for approval.

3.2 Jabiluka

3.2.1 Mr Delosa advised that the environmental conditions of the Jabiluka EIS and PER were still being considered by the Australian Government Department of Industry, Tourism and Resources (DITR). DITR is expected to report to the next Jabiluka MTC on how to progress this issue.

3.3 Ranger

- 3.3.1 Mr Delosa advised that the operations of the RP2 spillway had required the MOL to be lowered and then raised. He indicated that the lift of the tailings dam was completed before the commencement of the wet season, and that an application to raise the MOL to 45.5m is currently with the NT Minister for approval. Mr Delosa advised that the annual amended plan of rehabilitation for Ranger has been submitted to the Federal Minister for approval. He also advised of stakeholder consultation on the ERA water management plan. Mr Delosa advised that the draft plan for deposition of tailings into Pit 3 is still being reviewed by stakeholders. Mr Evans asked when the plan was to be approved and Dr Milnes indicated the plan should be approved at the next MTC meeting.
- 3.3.2 Mr Evans asked whether the Pit 3 solute transport model had been updated to take account of more hydrological data. Dr Milnes advised that the solute transport model was not formally linked to the closure planning process. Mr Evans thought there was a reference to the solute transport model in the application and asked whether OSS has independently reviewed the solute transport model. Dr Milnes advised that a number of workshops have been held looking at modelling of Pit 3 and this work had included consideration of solute transport issues. Dr Milnes noted that stakeholders were asking questions on closure provisions for Pit 3 but advised that Pit 1 closure work has a higher priority at the moment but will inform the development of the Pit 3 closure model.
- 3.3.3 Mr Evans asked whether ERA was making application to cover impacts of tailings deposition up to 2014. Dr Milnes advised that ERA was looking at addressing tailings deposition up to 2020. Mr Evans indicated this wasn't his understanding. Mr Hughes indicated he thought it was only up to 2014. Mr Evans indicated that his interest in the issue was based on his concern that a range of operational decisions were in the process of being made which could limit the range of available options for closure of the Pit. He was therefore concerned to understand how these decisions were being made if not on the best available scientific information. Dr Jones indicated that it would be necessary to update the water management plan, including treatment scheduling, given the extension in processing from 2014 to 2020.

4. KEY KNOWLEDGE NEEDS - GAP ANALYSIS

4.1 Gap Analysis

- 4.1.1 Mr Evans thanked Ms Webb for her work on the spreadsheet to support the KKN gap analysis. Mr Evans recalled that when the KKNs were originally drafted it was decided to put proposed projects under each KKN that would inform budget and work priorities. He suggested that any research work proposed should demonstrably be both *necessary* and *sufficient* to achieve each KKN. He suggested work may be required for some KKNs which isn't currently on *eriss's* or ERA's work programs. Mr Evans expressed concern that the process had gone on too long and that some of the KKNs may now be redundant or no longer appropriate. Members agreed to review the work undertaken to date including the KKN gap analysis prepared by the Secretariat.
- 4.1.2 Dr Grant suggested a number of the KKNs may have been achieved since they were first identified and some may need to be changed or removed given recent extensions to mine life. He also suggested that the document should be tightened up to remove unnecessary detail and repetition, and to focus on the key priorities. Mr Evans agreed and asked members whether they believed the KKNs should be reviewed.
- 4.1.3 Prof Johnston suggested that reviewing the KKNs at this stage might be premature given the closure timeline has been extended and ERA is now focusing on the next stage of operational activity. Dr Grant indicated he thought it was previously agreed that the KKNs would always be kept under review and amended in response to changes in the operating environment. Dr Milnes suggested that he provide an outline of ERA's corporate priorities, which drive and direct ERA's research work. Mr Evans agreed this would be useful but noted a process for reviewing the KKNs is required. Prof Johnston suggested that if the ERA corporate objectives were going to affect the focus of the KKNs then it was important that this be done first.
- 4.1.4 Dr Hayes suggested that the priorities and timeline document supporting the KKNs should be updated as not all of the issues raised in the body of the KKNs are reflected in the identified priorities and timeline. Dr Jones recalled it was previously agreed that the KKN priorities should represent ARRTC's view taking into account advice from ERA and *eriss* on their respective research priorities. He noted that a number of these priorities had recently changed. Mr Evans noted there was general consensus that the KKNs should be reviewed and updated.
- 4.1.5 Mr Kyle suggested that best practice would require that all closure criteria be agreed with key stakeholders. However, he acknowledged that this would be subject to commercial pressures and thus may not always be possible. He suggested that it would be pointless to agree a final set of KKNs as these would always be changing. Dr Grant agreed but suggested that best practice also means that criteria are likely to be reviewed and changed over time.
- 4.1.6 Dr Stauber supported reviewing the KKNs, but she was concerned that KKNs had been pushed to the back of previous ARRTC meetings and members had run out of time. She suggested that it would be useful to go through each KKN sequentially.
- 4.1.7 Mr Evans asked members if they wanted to change any of the KKN headings. Dr Jones suggested that some of the headings are now redundant. Dr Milnes believed some of the headings are too detailed and should be broadened and made more strategic. He also noted that there was currently no way of telling whether any of the

work will be signed off. Dr Jones suggested that a number of specific subheadings for each type of closure criteria was required. Dr Grant agreed that there are a number of structures that could be used to do this but suggested that the current structure be retained. He agreed however that the document contained a lot of background information that many of the stakeholders already knew and that this could be removed to make the document more focused.

- 4.1.8 Mr Smith agreed that the document should be reviewed and asked whether it would be possible and useful to link the KKNs to the ERs (he noted that it probably would be easier to do this for Ranger than Narbalek). Mr Evans agreed with Dr Grant that ARRTC shouldn't revisit the structure of the document at this stage. He suggested the measure of the document should be how useful it is to guide research by *eriss* and ERA. He expressed concern however that there was currently no way of determining the extent of completion for each of the KKNs. Dr Hayes agreed and suggested that a table be developed showing status of each project. Mr Evans noted that the spreadsheet compilation of projects goes someway towards this.
- 4.1.9 Dr Hillman suggested that the document is a three-layered hierarchal structure comprising: a) a top unit – of broad statements of KKN assumptions and goal posts; b) a middle layer – made up of the KKNs; and c) a foundation layer – which is essentially the spreadsheet. He suggested that the document should be treated as a knowledge management process. Dr Grant indicated that he believed that a gap analysis of sorts was occurring at each ARRTC meeting and suggested the spreadsheet was probably better used as a check back to work underway. Mr Evans expressed concern that ARRTC is not always aware of the work that isn't being undertaken. Dr Hayes suggested that the spreadsheet be further refined and that some metadata be developed. Mr Hughes agreed the spreadsheet should be used to inform ARRTC's review of the KKNs.
- 4.1.10 Dr Hayes stressed the need to keep track of what work has been done. Mr Hughes suggested this has already been done through developing the spreadsheet and *eriss*'s review and annotation of the KKNs. He indicated that the focus was on capturing knowledge and suggested that members should review the spreadsheet and *eriss*'s annotations on the KKNs. Dr Hillman noted that this was only useful if members are aware of what is in the spreadsheet. Prof Nott agreed there is a need to review the KKN document and identify what needs to change or be removed. Dr Hayes suggested the key issue is how this work can lead into and support future work priorities. Mr Hughes agreed that reviewing the KKNs was a good idea and was appropriate given the recent changes in the operating environment. He expressed concern however that this could be very resource and time intensive so ARRTC should be careful not to "reinvent the wheel".
- 4.1.11 Mr Evans noted members' support for reviewing the KKNs taking account of the gap analysis (spreadsheet) and *eriss*'s annotations on the document. Mr Hughes suggested that members also revisit some of the underlying assumptions as part of the review. Dr Grant suggested that ARRTC break into smaller groups to do the review. Dr Milnes suggested there wasn't sufficient *eriss* and ERA staff present to ensure appropriate representation on each sub-group.
- 4.1.12 Mr Evans advised he initially thought about using breakout groups but he considered doing it as a single group would be a better approach. Dr Hillman suggested that ARRTC at this stage focus on the level that *eriss* has commented on in the KKN document.
- 4.1.13 Dr Hayes noted *eriss*'s comments on the KKN were valuable and should be incorporated into the document and the spreadsheet. Mr Evans asked whether the document would benefit from having ERA comments as well. Dr Milnes advised that he could live with the document as is but there would be a need to sit down with *eriss* at some stage. Dr Grant suggested that ERA's comments are important but shouldn't drive the process as ERA's priorities are not sufficiently focussed on the KKNs. Dr Milnes noted while the KKNs do not drive ERA's priorities, ERA takes ARRTC's views into account as part of its corporate priorities. Dr Jones indicated that there was dialogue between ERA and *eriss* in relation to the KKNs.
- 4.1.14 Dr Stauber advised she was looking for the following three key outcomes from the review process: are the KKNs still appropriate; has sufficient work been done to achieve the KKNs; and what else needs to be done to address key knowledge gaps?

Action/Outcome 4A

ARRTC agreed that a small group of members would look at the KKN document over lunch

5. KEY KNOWLEDGE NEEDS REVIEW

5.1 Process

5.1.1 The Committee agreed to work through the KKNs sequentially.

5.2 Review of each KKN

KKN 1.1.1 Surface water transport of radionuclides

5.2.1 It was noted that this work is ongoing and further work will be required post decommissioning.

KKN 1.1.2 Atmospheric transport of radionuclides

5.2.2 It was noted that this work is ongoing. Prof Johnston noted that ARRTC had previously requested a copy of the paper going to the IAEA Conference and this had not been received. Dr Bollhoefer offered to provide Prof Johnston with a copy of the Conference paper.

Action/Outcome 5A

Dr Bollhoefer to provide Prof Johnston with copy of paper to IAEA conference for review.

5.2.3 Prof Johnston noted that the sulphur pathway was relatively well understood and that acid rain had been ruled out as an issue. Dr Jones noted that the level of knowledge for this KKN was not quite at the level of that for KKN 1.1.1. Prof Johnston agreed to review the work done to date and discuss with Dr Bollhoefer.

Action/Outcome 5B

Prof Johnston to review work done so far under KKN 1.1.2 and discuss with Dr Bollhoefer.

KKN 1.2.1 Ecological risks via the surface water pathway

5.2.4 Dr Stauber thought this KKN was fine. Dr Hayes suggested that the project would benefit from some formal risk/hazard analysis to identify the relationship between sources and receptors. Dr Jones suggested this process should also be applied to the transition from the operational stage to the decommissioning stage. Dr Hayes agreed. Mr Hughes asked whether the current wording was still appropriate. Dr Hayes suggested that some formal reference to pathways would be useful. Dr Stauber suggested that reference could be made to some of the biological work that has been done and presented in this area. It was agreed that Dr Jones, Dr Stauber and Dr Hillman would review the wording of KKN 1.2.1 and amend as needed.

Action/Outcome 5C

Dr Jones, Dr Stauber and Dr Hillman to review wording of KKN 1.2.1 and amend as needed.

5.2.5 Mr Evans noted the nature of KKN 1.2.1 changes priority closer to the mine rehabilitation phase. Dr Hayes suggested that some distinction between operational and decommissioning priorities be made in the back of the KKN document. Dr Hillman queried whether pigs and geese were considered safe for consumption given the current wording. Dr Jones advised that given the number of geese that visit the site is small compared to the total pool of geese on the floodplain, there is a very low probability of eating one that potentially contains some low levels of input from the mine site. He suggested there may be a greater risk posed by ingestion of pigs or geese after decommissioning.

KKN 1.2.2 Land Irrigation

5.2.6 It was noted that this work is still current and no change was required. Prof Johnston noted that *eriss* had commented on the need to link the water quality model to ecological effects. Dr Grant recalled previous ARRTC discussion regarding the need to rehabilitate the irrigation areas, as these areas may be sufficiently contaminated to warrant this. Dr Jones advised recent work had been done by Ian Hollingsworth from EWLS looking at soil depth profiles of metals and radionuclides. Prof Johnston noted that there are known areas where soils have very high levels of radioactivity. Dr Van Dam advised that there was considerable background information available on this issue. Mr Evans suggested that the current KKN wording covered this and that the last sentence could be deleted. This was agreed.

Action/Outcome 5D

ARRTC agreed to delete last sentence from KKN 1.2.2 "water quality will be linked to knowledge of ecological effects".

KKN 1.2.3 Wetland Filters

5.2.7 Dr Milnes advised that the results of work by CSIRO relating to potential for NH₃ removal in the Corridor Creek wetlands should be available in a few months. Mr Evans noted that the issue of solute mass balance keeps coming up. Dr Milnes advised the CSIRO work includes this. Dr Jones suggested it would be useful to have a historical knowledge of loads. Dr Milnes noted that RP1 wetland filter performance had been substantially affected by the death of vegetation. Dr Jones noted the wetland filter hadn't failed and had still managed to remove 85% of uranium. Mr Evans asked whether there were any specific changes required to the wording of the KKN. Dr Grant suggested the need to record that a major change in the vegetation in the wetland filter in 2006 impacted on its effectiveness and efficiency. Dr Jones agreed that this is supported by the current scientific knowledge. Dr Hayes suggested that this get linked to the KKN in the spreadsheet.

5.2.8 Dr Jones asked whether the KKN had been achieved and suggested, as there hasn't been a review, the KKN hadn't been addressed fully. Dr Hayes noted that most of the information to determine this would be in the spreadsheet, which highlighted the need to extract useful metadata from the spreadsheet. Mr Hughes suggested that it wasn't appropriate to expect that one report would answer all of the questions. Prof Johnston suggested that this shouldn't prevent the Supervising Scientist issuing a determination that the KKN has been addressed. Mr Hughes noted this is why ARRTC is doing the gap analysis but suggested the spreadsheet is only a first step and shouldn't be seen as a definitive statement of current knowledge.

5.2.9 Mr Evans noted that the report done by Milnes and Johnston provides a good overview of research up to 2002. Dr Hayes suggested that ARRTC could assist in extracting metadata from the spreadsheet. Mr Hughes noted ARRTC members have limited ability to work on this out-of-session so some prioritisation of tasks is required. Dr Hayes suggested there is a role for ARRTC members in providing advice and suggested that this should be a working item. It was agreed to consider this further on the second day of the meeting.

Action/Outcome 5E

ARRTC agreed to consider how to link KKNs to the gap analysis spreadsheet on the 2nd day of ARRTC19 meeting.

5.2.10 Mr Evans suggested one KKN could be extracted and used as a pilot to see how difficult this would be to do.

KKN 1.2.4 Ecotoxicology

5.2.11 Dr Stauber suggested KKN 1.2.4 be redrafted. 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.

5.2.12 Dr Milnes advised that *Klessa et al* had reported high sediment U concentration data for the RP1 wetland (which is the most contaminated) in 1997 and 2006. Dr Jones noted this was less of an issue during the operational phase but would be an issue during the decommissioning phase.

5.2.13 Dr Hillman asked whether all exposure pathways are being measured as part of testing. He suggested the form of exposure (ie. how the uranium is being presented to organisms) may affect the variability of data (eg. Mussels selectively feed on fine organic particles and are more likely to ingest uranium if it is attached to them rather than in solution or associated with inorganic particles). Dr Hayes agreed that this is a good point, which highlights need for development of conceptual exposure models – he wasn't sure if this is clearly understood by stakeholders. Dr Jones advised the science is moving towards this and agreed that the KKN needs updating. Dr Stauber advised that the differences between laboratory and field ecotoxicology testing results are academically interesting but she wasn't sure this needed to be tested as a KKN under Ranger operations.

Action/Outcome 5F

ARRTC agreed Dr Stauber, Dr Van Dam and Dr Hillman would review wording of KKN 1.2.4 and amend as needed.

KKN 1.2.5 Assurance Program for radionuclide surface water

5.2.14 Prof Johnston suggested that this KKN overlaps with KKN 1.1.1 and 1.3.1 and could be deleted. Mr Smith advised that NLC requested such an assurance program for the MLAA held during the wet season last year. It was agreed that this KKN is addressed under KKN 1.2.2 and should be deleted.

Action/Outcome 5G

ARRTC agreed to delete KKN 1.2.5 (as it is covered under 1.1.1, 1.3.1 and 1.2.2).

KKN 1.2.6 Radiation exposure of workers

5.2.15 Mr Evans noted the need to better understand the relationship between the roles of the respective regulators and ARRTC on issues related to radiation exposure of workers. Dr Milnes suggested the role of ARRTC is essentially a protective one to ensure that the appropriate data are collected and assessed - he suggested that this issue was already being picked up under KKN 1.2.2. Prof Johnston disagreed and noted KKN 1.2.2 was dealing with the issue of environmental exposure whereas this KKN deals specifically with human exposure.

5.2.16 Mr Hughes suggested that radiation exposure of workers really is an issue for the mining company and the regulators to deal with. Prof Johnston noted that the methodology used is fairly indirect and questioned whether there are better techniques for measuring worker exposure. Dr Grant queried whether the issue of worker exposure fell within ARRTC's terms of reference. Prof Johnston suggested that if the issue doesn't fall within ARRTC's remit, the KKN should be deleted.

5.2.17 Members agreed to revisit the issue on the 2nd day of the meeting when continuing the KKN review. Dr Milnes advised that he would try to include a slide on worker health as part of his presentation.

Action/Outcome 5H

ARRTC agreed that Prof Johnston would update himself on radiation management at the Ranger mine and speak to Peter Burns from ARPANSA to determine the appropriate wording of KKN 1.2.6.

5.2.18 Members agreed to continue the KKN review after the activity reports had been presented.

6. ACTIVITY REPORTS

6.1 Energy Resources of Australia (Ranger and Jabiluka)

- 6.1.1 Dr Milnes provided a presentation on ERA operations, production and sales in the period since the last ARRTC meeting in October 2006. Key points included a 28% improvement in safety performance in 2006, recertification for ISO14001, a successful surveillance audit against AS4801, 2006 production of 4,748t U₃O₈ and record sales of 5,760t. Total reserves increased by 11,100t U₃O₈ which will be processed between 2014 and 2020. ERA completed a pre-feasibility study for limited expansion of Pit 3 ('Shell 50') which would target an additional 6,100t U₃O₈ and could extend mining from 2008-2011.
- 6.1.2 Dr Milnes advised the current life of mine timeframe would see mining in Pit 3 end in 2008, milling of stockpiled ore end in 2020, decommissioning and rehabilitation end in 2026 with a final completion date of 2030. Dr Milnes also advised that exploration drilling would continue through 2007. He identified the key projects for 2007 as being water treatment and disposal, exploration and resource evaluation, an update of the life of mine plan, planning for early closeout and rehabilitation of Pit 1, and a feasibility study for potential Pit 3 extension. In relation to the Pit 3 feasibility study, he advised that the extension would provide an additional 47M t of mined material, including 1.7M t of low-grade ore and 2M t of high-grade ore. Dr Milnes advised the feasibility study would look at waste rock stockpiles, water and tailings management, hydrogeology, geological modeling, geotechnical issues and other issues related to equipment, staffing and financial costs. An external consultant will be engaged to manage the study and associated technical investigations, which should be completed by October 2007.
- 6.1.3 Dr Grant asked whether ERA has applied for release of water to cover the current extreme event. Dr Milnes responded that it was unlikely that sufficient water could be released via this route to make a significant difference. Dr Jones indicated the large dilution factor would be working in their favour and that *eriss* could run some toxicity tests to determine the dilution required.
- 6.1.4 Mr Evans asked about linkages between tailings management and use of Pit 3. Mr Delosa asked about other mining approaches such as moving to underground mining. Dr Milnes indicated that these issues would be addressed as part of the feasibility study.

ERA Presentation: Vegetation types and environmental trends in Ranger analogue areas – Ian Hollingsworth

- 6.1.5 Mr Hollingsworth provided a presentation on vegetation types in the Ranger analogue areas. Members noted that KKN 2.2.2 Vegetation Criteria for Closure combines work being done by ERA and *eriss*. Members also noted that a presentation was provided to ARRTC14 on analogue selection, and that ARRTC recommendations had been forwarded to EWLS. Mr Hollingsworth advised that three main classes of vegetation had been identified from a broad range of analogue sites.
- 6.1.6 Dr Grant noted the presentation suggests that ERA has a good idea of the factors influencing keystone species presence/absence. He asked how this knowledge would inform final landform design. Dr Grant commended the ERA work to date but noted further work may be required given the uncertainty regarding effects of predation and environmental gradients. Dr Grant expressed interest in looking at the report on vegetation criteria.

Action/Outcome 6A

Dr Grant requested copy of vegetation criteria report (Hollingsworth et al 2007) from ERA.

ERA Presentation: Ranger landscape design and reconstruction – Ian Hollingsworth

- 6.1.7 Mr Hollingsworth provided a presentation on Ranger landscape design and reconstruction. Members noted this work relates to KKN 2.1.2 Landscape Design. Mr Evans asked how the 3D depth to water table model was generated. Mr Hollingsworth advised that the WEC-C model doesn't deal with deep groundwater issues in any detail, mainly only 5-10m interval in the waste. Mr Evans expressed interest in seeing the report. Dr Grant noted the model has been used elsewhere but required extensive validation (eg Alcoa). He suggested caution in using for Ranger where there are insufficient data on how the final landform is going to behave. Mr Hollingsworth agreed but suggested that some form of modelling was required and this was an initial approach at this stage. Members noted a catchment model of the saturated zone was required.
- 6.1.8 Dr Grant supported the proposed approach subject to further work being done on input/output parameters. Mr Evans expressed concern about using current data to calibrate model if you are seeking to use it to predict behaviour. Dr Jones agreed the model would need to be trained. Mr Hollingsworth advised that a 10-year active management period would be required following landscape rehabilitation with perhaps some water treatment. Mr Evans asked whether the pathway between surface and groundwater is integrated. Mr Hollingsworth advised that surface and near surface hydrology was closely connected with Magela Creek probably dealing with 90% of load.
- 6.1.9 Prof Nott asked why a one in twenty year event was being used. Mr Hollingsworth advised that the design was for a 1 in 20 storm intensity. Dr Jones suggested that given the design timeframe he would expect that this should be higher. Dr Grant indicated that if water management structures were designed for a greater ARI then this would require significantly more engineered structures that would reduce the area available for rehabilitation. Mr

Hollingsworth advised that the aim is for non-engineered control structures being required long term (ie shouldn't be over-designed). Dr Grant suggested that ERA should look at 10, 20, 50 and 100-year events to allow contingency otherwise there would be greater reliance on using engineering solutions. Dr Jones suggested that this was especially important in the interim stage of design. Mr Hollingsworth advised that a MODFLOW model was being developed looking at seepage hydrology.

6.1.10 Dr Jones asked for ERA's view on the timeline for Pit 1 closure. Dr Milnes advised he didn't have a final view at this stage as they were just starting work. However, he noted that it was desirable from a process water management perspective to excise Pit 1 from the process water circuit as soon as possible. Dr Jones suggested that the vegetation issues were critical in the interim closure stage and therefore priority on vegetation trials work for Pit 1 was important.

6.1.11 Mr Evans asked whether there would be further work done on solute transport in the in the vicinity of Pit 1 (specifically dealing with the outputs from the Kalf model of the Pit) in the future. Mr Hollingsworth advised that the model has capability to parameterise salinity. Dr Grant suggested that solute transport could be modelled - just need to understand pathways. Mr Hollingsworth suggested that he could look at stream TDS but they haven't looked at metals. Mr Evans also asked about salinity tolerance of vegetation. Mr Puhlovich advised if the model shows this to be an issue then it will be looked at. Mr Evans asked how the model would cope if soil salinity is low and vegetation has low salinity tolerance. Mr Hollingsworth advised the primary solute at Ranger is $MgSO_4$, not NaCl, and this has a much lower impact on plants. Dr Jones suggested that nutrient loading (for example, nitrate from residues) would also be important. Mr Evans noted that the KKN also has geochemistry in it so should look at this as well. Mr Hollingsworth advised he would speak to *eriss* further about this.

6.1.12 Mr Hollingsworth advised that future work would focus on water balance, landform, improved hydrology model of post mine, better description of cover material, specific advice on risks and design reinstated water bodies.

ERA Presentation: Update on land management Projects at Ranger – Dr Mark Gardener

6.1.13 Dr Gardener provided members with a presentation on land management projects at Ranger. Dr Gardener advised that a draft issues paper on ecosystem closure criteria dealing with interpretation of ERs 2.1 and 2.2a was being developed by ERA for internal use only initially. He also advised that weed closure criteria were not specifically mentioned in the ERs and noted that weeds are a serious issue in the Ranger lease area – 71 weed species (compared to 90 in surrounding KNP).

6.1.14 Dr Hayes suggested a paper by *Calv* from ANU might be of relevance to the vegetation work. Dr Gardener advised that weed monitoring and mapping had been carried out since 2003 to provide a baseline for comparison with data from KNP and to develop methods for monitoring landform rehabilitation. He noted that the highest weed diversity occurred in more disturbed areas.

6.1.15 Dr Gardener advised that historical rehabilitation work on weeds on waste rock areas was characterised by established trees with an understorey of weeds. He advised that a total of 11 Ha had been planted for the trials. He advised 1500 Ha would need to be planted as part of the mine closure process. Dr Grant expressed interest in commenting on the experimental design for the proposed vegetation demonstration project and in visiting the site at some stage.

Action/Outcome 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.

6.1.16 Dr Stauber asked whether the proposed planting timeframe of Jan 08 was realistic, given that the trial areas might not be constructed until late this year. Dr Gardener indicated the timeframe was considered appropriate.

ERA Presentation: site wide hydrological characterisation at Ranger Mine – Dr Alan Puhlovich

6.1.17 Dr Puhlovich provided a presentation on the hydrology and hydrogeology of the Ranger mine area. Key findings from the work to date include:

- the current whole of site groundwater model builds on that originally developed by Salama and Foley;
- there is high transmissivity in surrounding groundwater systems to the NE of Pit 3 where there is significant dewatering occurring and lower transmissivity to the W of Pit 3;
- there is high permeability in the surrounding region
- the post closure landform will closely follow pre mining topography;
- work is continuing on fate and transport of solute plumes by revisions to model;
- there is low recharge to deeper rocks at Ranger and the groundwater is very old;
- work is underway with CSIRO using environmental tracers to better understand recharge and discharge dynamics;
- a new finding that substantial groundwater recharge may be occurring in Georgetown Billabong; and
- mass balance work suggests that there is both inflow and outflows occurring under billabongs which could be a key process.

6.1.18 Mr Evans noted that Magela Creek has low solute levels that may mean there is a throttle somewhere in the system (ie. basal sediments are reasonably coarse so should leak). Dr Puhlovich advised that evidence from elsewhere in Ranger indicates that the sediments are very fine.

- 6.1.19 Mr Evans noted a late wet season spike in some constituents was observed previously, and ascribed to groundwater baseflow from the deeper fractured rock, yet the model now suggests that the contribution from that source is relatively small. Mr Evans suggested the spike would have to come from the minesite because it is absent upstream. Dr Puhlovich suggested that it is coming from irrigation zones but warned against extrapolation as it is not physically possible for there to be connection between deep groundwater and Magela Creek.
- 6.1.20 Mr Evans suggested there might be benefit in understanding the hydrology further downstream to get a better appreciation of groundwater discharge. Dr Puhlovich suggested that a better understanding of groundwater flow paths was a possible issue for the decommissioning phase. He suggested the groundwater probably swings around and heads towards Mudginberri. Dr Milnes asked whether information could be gleaned from airborne data. Dr Puhlovich indicated that this could tell you where the pathways might be but not where they are.

6.2 Supervising Scientist Division

- 6.2.1 Dr Jones provided presentations on the status of *eriss* 2006-07 research programs and proposed research projects for 2007-08.

Recent Extreme Event

- 6.2.2 Dr Jones advised the recent extreme event provided an all time monthly rainfall record of 800mm in 3 days and that the year to date total rainfall figure was 2000mm versus 2100mm total for last year. Rainfall intensity had been measured at up to 70mm/hr. The extreme weather event had resulted in all gauging stations being lost in Magela Creek, flooding of the JE Land application area and loss of *eriss* equipment in the Magela and Gulungul Creeks.

Monitoring (1)

- 6.2.3 Dr Jones advised that based on work to date, *eriss* has a high degree of confidence in the merit of using snails as biological monitors to detect change. Dr Grant asked how the data were analysed. Dr Humphries responded that there are 3 treatments looking for differences between values. Dr Jones advised that the difference between upstream and downstream is the key issue for monitoring. Dr Grant asked what signal would indicate potential impact. Dr Humphries advised the occurrence of outlier data would trigger greater scrutiny. Dr Jones advised that, due to flood damage to the monitoring stations, the upstream creekside station may not be running again this year although the downstream creekside station could be up within a few weeks.

Conductivity

- 6.2.4 Dr Jones advised that 2007 is an atypical year in terms of Mg concentrations in the early part of the wet season—peak concentration was 2.2 mg/l. Dr Jones advised that Ca protects against the toxic effects of Mg and at the concentration of Ca currently present the Mg guideline value would be 4.5 mg/l. He indicated the Mg/Ca ratio in runoff may rise following closure and this needs to be assessed in the context of whole of site solute modelling being conducted as part of the landform design process.

Monitoring (2)

- 6.2.5 Dr Jones advised that monitoring in Magela and Gulungul Creeks was ongoing and that RP1 discharge in early February 2007 had shown higher concentrations of salts with dilution in Magela Creek. Dr Milnes noted there was nothing coming out of Georgetown Billabong. Dr Humphries indicated that salinity levels had now dropped to background levels typical of upstream due to the very large flooding events with flows of approximately 1500 cumecs (which are an order of magnitude higher than normal flooding events).
- 6.2.6 Dr Milnes asked what factors may be causing the peakiness in data. Dr Jones indicated that the peaks were due to complex interactions between discharge from RP1 and flows in Magela Creek. Mr Hughes suggested that whether the hydrograph is rising or falling may also be a factor. Mr Evans suggested rainfall on the minesite could be another factor. Mr Hughes suggested that the peaks evident in the graph are probably due to local rainfall events that occur at times of lower flow in Magela Creek. Mr Smith asked whether the monitoring structures could be made more robust given the potential for similar or more intense extreme events in the future. Dr Jones advised that there are problems with mounting monitoring stations adjacent to trees and there may be a need to look at design of more appropriate methods.

Monitoring (3)

- 6.2.7 Dr Jones advised that monitoring of turbidity in Gulungul and Magela Creeks was ongoing and that auto samplers had been installed for the first time in Magela Creek at the start of the 06/07 wet season. Current work is seeking to define the relationship between turbidity and TSS and by calculating individual events/annual loads, to estimate the total load of uranium and radium in suspended sediments within the Magela Creek system.

Bushtucker

- 6.2.8 Dr Jones suggested there is a need to better understand the biological availability of U, P and Ra in soils and plant tissue so that the diet profile of TOs can be updated on an ongoing basis.
- 6.2.9 Dr Stauber asked whether the Ra comes from water or soil. Dr Bollhoefer advised that most Ra comes from the water fraction/extracts of the soil. Mr Evans asked whether the ^{226}Ra : ^{228}Ra ratio in plants was being looked at and Dr Bollhoefer indicated it was. Mr Evans also asked whether there was a change in ratio in plants and Dr Bollhoefer advised that no change had been observed. Prof Johnston asked what the ratio is. Dr Bollhoefer

advised that work to date has shown that the concentration factor of Ra present in food species is much higher than the IAEA default values (which are based on tomatoes and potatoes).

6.2.10 Dr Milnes advised that in relation to the importance of soils, one would need to map the Ra and Th concentrations in soils to understand the plant concentration samples. Mr Evans suggested soil moisture content would also need to be measured in order to understand the dynamics. Mr Smith asked whether there has been any investigation into the water/soil fractions to determine mobilisation pathways. Dr Jones advised this has been looked at but there is a need to better understand soil leaching potential to assess potential for remobilisation. Prof Johnston asked whether a dose assessment had already been done. Dr Jones advised that the dose assessment work was more focused on the mine rehabilitation phase. Dr Jones advised there are large ranges in current values for radionuclide concentration factors and more samples will need to be collected.

Hydrogeology

6.2.11 Dr Jones advised that the characterisation of water quality reporting to the Magela Creek alluvial sediments using EM31 geophysical survey had been compromised due to instrument malfunction.

6.2.12 Mr Evans suggested that just using geophysics could be problematic if the distribution of the channel (ie. Alluvial versus fractured rock) is not known. He suggested that an independent identification of alluvial location could be carried out then followed by EM measurement. Dr Jones advised there was evidence of salts in the Magela Creek adjacent to the Magela Land Application Area based on EC values measured in pools towards the end of the 2006 dry season. Mr Evans suggested that the early time component of the aerial geophysics signal was needed to investigate the near-surface groundwater and that Tim Mundy from CSIRO in Perth has done work on early time data for NAP salinity program. Mr Evans noted there could be storage of salts in the alluvial sands, which may mean that flux and dynamics of remobilisation would need to be looked at. Dr Jones advised that *eriss* is looking to have closer cooperation with EWLS for groundwater work in 07/08.

Landform evolution (erosion)

6.2.13 Dr Jones advised that Prof Gary Willgoose from Newcastle University has been contracted to upgrade the Siberia model to provide modelling capability for extreme events. He advised *eriss* was currently also collaborating with Dr Greg Hancock from the University of Newcastle in evaluating the "CAESAR" model from the UK which complements the Siberia model.

6.2.14 Prof Nott advised that based on modelled erosion rates there seems to be a consistent phenomenon of extremely slow erosion rates in the ARR craton but there also appears to be an anomaly between measured short term and long-term erosion rates. The short term rates measured over the last two decades are much higher than the long term (over geologic time) rate. Dr Jones asked if Prof Nott was saying the erosion rates being used are not right. Prof Nott suggested there is a need to examine the data in more detail. For example, using the current measured erosion rates over the long term, the Tin Camp Creek area should have eroded to sea level by now.

6.2.15 Dr Jones asked whether the same phenomenon was observed in other areas. Prof Nott suggested that there might be climate effects involved. Mr Evans suggested linearity may also be an issue, as one shouldn't assume erosion rates are constant through time (eg. have to assume there are also periods of deposition).

6.2.16 Dr Milnes expressed concern that perhaps the correct process isn't being monitored. Dr Jones suggested the real question is whether contemporary erosion rates are correct given ERA needs current erosion rate information to provide the basis for erosion rate closure criteria for the mine landform. He suggested some indication of the expected stability of the final landform was required. Dr Hayes suggested that expectations and timelines are both key issues that need to be addressed.

6.2.17 Dr Milnes asked whether there are some parts of the landscape that erode so slowly they don't noticeably change. Prof Nott suggested in that case you would see relief change. Prof Johnston asked whether the discrepancy might be due to human disturbance. Dr Milnes agreed it would be useful to determine what is going on. Dr Jones noted it could be related to a range of factors, in particular the possibility of changes in the pH of rainfall through time. The current pH at the start of the wet season in the ARR can be as low as 3.5, which is quite an aggressive regime. Mr Evans noted the focus is on vertical erosion rates rather than lateral.

Cyclone Monica Effects

6.2.18 Dr Jones advised that work on vegetation impacts from Cyclone Monica was looking at the ratio of fallen to standing trees, extent of disturbance to soil profiles by uplift of the root balls of the fallen trees and other parameters. Comparisons were being made between different soil unit types in the Gulungul Creek catchment with areas of trial rehabilitation on the Ranger waste rock dumps. He advised that work was also done at Nabarlek, which had suffered much more damage. Dr Milnes advised that the latest image on Google Earth was of high resolution and clearly shows the damage caused by the cyclone.

Environment Risk Assessment of Magela Floodplains

6.2.19 Dr Jones advised the results of this project would be presented to the AusIMM Conference in May this year. It was noted that further work would be undertaken with the involvement of Dr Hayes including advising PAN on Para grass management and stakeholder communication.

6.2.20 Dr Jones provided an overview of the *eriss* project proposals for 2007-08.

South Alligator Valley Rehabilitation

6.2.21 Dr Jones advised that *eriss* is currently assisting PAN with the tender process for the Part B (radiologically significant sites) and finalising characterisation of the extent of radiological issues at Sleisbeck. He highlighted the need to determine whether there has been significant weathering over last 40 years that might have leached radionuclides from the waste material into the underlying soli profile and to identify specific "hot spot" areas. He advised that the results from the soil profile measurements showed that most activity was contained within the top 5 cm, indicating very little vertical movement. Prof Johnston asked whether a scraper could be employed as part of the rehabilitation. Dr Jones indicated this could be difficult due to TO concerns with the use of heavy equipment in the area and access restrictions.

Ecotoxicology (1)

6.2.22 Dr Jones advised that a PhD project is looking at the effects of dissolved organics on modifying metal toxicity, which could be particularly important for billabongs that receive organic matter from vegetation, and which are therefore likely to contain much higher concentrations of dissolved organics than Magela Creek. Dr Hillman asked whether the study was looking at particulate or dissolved metals. Dr Van Dam advised the study would be looking at attached organic matter. Dr Stauber suggested that if the study will be looking at natural organic matter it might be useful to consider the use of "Swanee River" fulvic acid – an international reference material that is used for this type of work. Dr Van Dam advised that he expects that DOM would generally reduce the toxicity of dissolved metals.

6.2.23 Dr Stauber advised that pH has been shown to be a key factor in modulating the toxicity of metals in the presence of dissolved organic matter (eg the effect of Swanee River fulvic acid on Cu toxicity). Dr Hillman suggested that there might be bacterial mediation effects as well.

6.2.24 Dr Jones advised that KKN 1.2.4 indicates that the effects of fine suspended sediment should also be investigated as a physical "toxicant". Dr Hayes suggested that work at Jim Jim Falls had shown that there is a turbidity threshold for effect of suspended sediment. Dr Van Dam advised that *eriss* work has shown a negative relationship between turbidity and biological production in Gungulug Creek.

6.2.25 Dr Stauber asked whether clean sediments would be used for the first stage of the work to investigate the effects of suspended sediments. Dr Van Dam advised that there is a logical progression involved (from use of clean sediment to investigate physical effects alone to use of sediment with adsorbed metals) and the next step would be to look at redesigning the project based on conceptual models. Dr Hillman advised that one of the major effects coming out of the literature regarding suspended sediments is the impact on macro-invertebrate production. He suggested this was probably due to impacts on biofilm layers. Dr Jones noted that many mines have turbidity as a primary impact factor and there are not many good data on the effects of this on downstream aquatic systems.

Ecotoxicology (2)

6.2.26 Dr Jones advised this project would involve field validation of laboratory derived NOEC trigger values for uranium in Magela Creek. Dr Stauber thought the project was interesting though she was unsure what the final outcome would be. Dr Stauber queried whether the results would be too site specific and suggested that the outcomes for Magela Creek might not be directly related to the KKNs. Dr Van Dam agreed that the issue may not be directly related to the KKNs but it was certainly a knowledge need in the broader ecotoxicological context .

6.2.27 Dr Stauber wasn't sure how this work fits with the KKN, but noted the important biological line of evidence it would provide. Mr Evans asked what kind of conceptual framework would be required to understand how this work relates to the KKN. Dr Stauber indicated she wasn't sure but perhaps a high level conceptual overview would be useful.

6.2.28 Dr Van Dam acknowledged the work is site specific but highlighted the need to identify these relationships for systems across Northern Australia. Dr Stauber advised that the approach had been used overseas but wasn't able to provide the biological prediction due to other confounding factors. She suggested the work was "a test of guidelines" rather than an ecotox predictor but she supported the project.

6.2.29 Mr Evans suggested this discussion highlights the need for ARRTC to be clear about the research needs under each KKN (ie how does work support the KKN) and he suggested that this was hampered by not having a defined research strategy. Dr Hillman agreed the project was important work that should be supported. Dr Hayes suggested that the work could be positioned as supporting the KKN by providing/addressing a key knowledge gap.

Links with ARC funded PhD project at RMIT (Rockhole Creek).

6.2.29 Dr Stauber raised concerns regarding the comparison of acute and chronic response data. She advised she hasn't seen the results of this work done in Antarctica. Dr Jones noted there could be broader applicability of this work to other uranium mines in the NT, and indeed to mines in general as a rapid screening tool in the absence of location specific chronic toxicity tests for a suite of 5-6 organisms. Dr Stauber suggested that one way to overcome the issues associated with acute versus chronic comparison would be to use the same species in both studies. Dr Jones advised that the proposed approach needed to be cleared with PAN since it would involve the controlled injection of a solution of uranium into Rockhole Creek. However, this injection would occur upstream of

an existing input of elevated concentrations of uranium and other metals from the Rockhole mine adit. Mr Kyle suggested that the TOs might have a problem with this work and that it would need to be carefully considered.

Landform Evolution (1)

6.2.30 Prof Johnston raised the issue of dust generation and exposure of TOs in the dry season and asked if this had been properly thought through. Dr Jones advised that the dust issue was one that still had to be looked at. Dr Milnes advised that previous studies on mine dust have shown that dust and fine particulate material tend to decrease over a very short time period following rehabilitation. Prof Johnston indicated that work in desert environments has shown that the activities of TOs living in the area were one of the key dust generation factors. Dr Milnes advised the issue of dust is being looked at in terms of the post mining landform access restrictions.

Landform Evolution (2)

6.2.31 Dr Jones noted a key problem in determining a pre-mining analogue for Ranger was the lack of suitable data. Mr Evans suggested that the data required could be held by Geoscience Australia as part of the national database of air photos.

General discussion

6.2.32 Dr Grant proposed that a species list be developed so that research and rehabilitation design priorities could be species based. He suggested there is a need to better understand species and linkages with revegetation plans to final landform/ecosystem, which would be useful in structuring research priorities.

6.2.33 Dr Jones agreed with this approach in principle. Prof Johnston asked how the conceptual closure criteria for land use would be determined. Dr Grant noted the ERs are specific in terms of general characteristics of the revegetated final landform. Dr Jones advised that the final landform is being determined from an ecological point of view as well as from a human health viewpoint. Mr Hughes noted this is a topic that arises at various fora and it is generally agreed that the final landform should be able to support all anticipated uses by TOs. Prof Johnston noted that this is a key knowledge need that is not currently represented in the KKNs.

6.3 Hanson Australia (Nabarlek)

6.3.1 No report was provided on Nabarlek activities as Mr Maraldo was not present.

6.4 NT Department of Primary Industry, Fisheries and Mines

6.4.1 Covered under report on MTC by Mr Delosa at Agenda Item 3.

6.5 Northern Land Council (NLC)

6.5.1 Mr Smith tabled a report on NLC activities since the last ARRTC meeting. Key activities included development of a conceptual plan for closure of Nabarlek mine site in conjunction with TOs and Hanson Australia Pty Ltd, and undertaking a survey of drill and boreholes located within the eastern part of Mine Valley adjacent to Jabiluka and continuing work on development of a Cultural Health Index, both in conjunction with Gundjei'mi Aboriginal Corporation.

6.6 Parks Australia North (PAN)

6.6.1 Mr Balding provided the PAN report on the South Alligator Uranium mine rehabilitation project in place of Mr Winderlich who was busy at Jabiru dealing with the impacts of the recent extreme weather events. Mr Balding apologised to those ARRTC members who had planned to attend the PAN Landscape Symposium at Jabiru, which had been postponed to 17-18 April 2007. Mr Balding advised PAN had received the heritage report by Guse and Wolfe in December 2006. The report identified some buildings in the area with potential early mining heritage value. However, PAN considers none of these are of high heritage significance.

6.6.2 Mr Balding advised PAN also received a report from EWLS on previous scientific knowledge about the sites and has contracted ECOZ environmental services Pty Ltd to provide an ecological management plan and draft referral under the EPBC Act. A decision is due by 16 March 2007. He advised PAN is looking to contract services as soon as possible for Part A works and that tenders for Part B (radiologically significant sites) works close on 12 March 2007. A site visit was held on 28 Feb 2007 and 13 potential tenderers were identified. Access to the sites has been difficult due to the recent extreme weather events and a small tornado that went through Mary River.

6.6.3 Mr Evans asked whether members wanted another report on the project next meeting. Dr Jones noted the Part A works should be well progressed by the next ARRTC meeting. Mr Evans suggested that ARRTC request another presentation in 12 months time.

7. Other Business

7.1.1 There was no other business raised.

8. NEXT MEETING

8.1.1 Mr Evans asked members to nominate suitable dates for the next meeting. Members agreed it was important that the KKNs be finalised prior to the next meeting. The travel requirements of various members were noted and it was agreed to hold the next meeting over three days, starting lunchtime on the first day.

8.1.2 Following some discussion members agreed the next meeting would be held 15-17 October 2007. It was noted however that these dates potentially clash with the International Mine Closure Conference which a number of ARRTC members may be attending.

Action/Outcome 8A

ARRTC agreed that the next meeting would be held over three days from 15 – 17 October 2007, commencing at lunchtime on the first day.

8.1.3 Dr Stauber asked about arrangements for replacing Dr Hayes on ARRTC. Mr Evans noted that Dr Hayes was appointed to ARRTC in recognition of his expertise in risk assessment and suggested his replacement should have a similar technical background. It was noted that there is a predefined process by which the Minister would appoint a replacement for Dr Hayes and this would be achieved via FASTS. Informally, the Chair may correspond with Dr Hayes to provide the names of suitable replacements. It was also noted that Dr Hayes needs to formally advise the Minister in writing of his resignation.

Action/Outcome 8B

ARRTC agreed that Dr Hayes's replacement should have expertise in environmental risk assessment and this will be provided as advice to the Minister.

Action/Outcome 8C

Dr Hayes to send a formal letter of resignation to Minister Turnbull.

Action/Outcome 8D

ARRTC Secretary to send Dr Hayes an email reminding him of Action 8C.

9. KKN REVIEW

ARRTC recommenced its review of the KKNs.

9.1 KKN 1.2.6 Radiation exposure of workers

9.1.1 Mr Smith tabled the 2006 AIATSIS Research Discussion Paper (No 20) by *Tatz et al, Aborigines and Uranium: Monitoring the Health Hazards* and requested that ARRTC formally consider the report and its implications. Mr Smith advised members that he did not necessarily agree with the claims made in the report or support the scientific basis for these claims, but believed it was important that ARRTC consider the report and form a view. Mr Kyle noted the TOs don't want ARRTC to review the report but would like ARRTC to advise the governments that the types of epidemiological data referred to in the report need to be collected.

9.1.2 Prof Johnston advised that the report had been submitted to, and considered as part of, the Uranium Mining, Processing and Nuclear Energy Review (UMPNER) and was considered by the Committee to be scientifically unsound and a cause of unnecessary concern for many TOs. Dr Jones advised that *eriss* does comprehensive radiological assessments and believes that there are no problems for the TOs due to radiological exposure.

9.1.3 Following considerable discussion, members noted the matters addressed by the report fall outside of ARRTC's Terms of Reference and are the responsibility of relevant NT Government authorities.

9.3 KKN 1.3.1 Surface water, groundwater, chemical, biological, sediment, radiological monitoring

Action/Outcome 9A

ARRTC agreed:

- to delete the second sentence "*there is also...monitoring program*" and insert the words from KKN 1.2.5;
- Prof Johnston would provide advice on the wording in KKN 1.3.1;
- to delete "*more specifically*" and "*new*" in last sentence; and
- Mr Hughes would review and amend wording as needed.

9.3 KKN 2.1.1 Development and agreement of closure criteria from the landform perspective.

Action/Outcome 9B

ARRTC agreed to roll together KKN 2.1.2, KKN 2.1.7 and KKN 2.1.8 into a new KKN called "Landform Design"

10. REPORT ON MULA2 MEETING – MR KYLE

10.1.1 ARRTC agreed to receive a report from Mr Kyle on recent TO consultation meetings. Mr Kyle advised key outcomes from the MULA2 meeting held in November 2006 included:

- first iteration of the Range closure model;
- comments taken by ERA and rolled into 2nd iteration of the closure plan (due later 2007);
- large volume of high quality information exchanged;
- agreement process is working - only real impediment is the economic reality that ERA has expanded its Pit and changed the mine life – TOs don't have to like it but they understand the commercial reality. Key issues to address concerns and perceptions;

- agreement in principle on TO preferences in terms of final landform design to enable access to various sites of cultural and spiritual significance; and
- recognition that ERA is making effort to address TO concerns.

10.1.2 Mr Evans asked whether there were any views expressed in terms of the TO reaction to first iteration of the mine closure plan. Mr Kyle advised that TOs would provide comments on the second iteration of the Ranger closure plan later in 2007. Mr Evans agreed it is important to bed down the proposed closure approach.

11. PRESENTATION: THE UMPNER REVIEW - PROFESSOR JOHNSTON

11.1.1 Prof Johnston provided a presentation on the work and key findings of the Uranium Mining, Processing and Nuclear Energy Review in which he was involved. Copies of the UMNPER report are available on the web at <http://www.dpmc.gov.au/umpner/reports.cfm> A copy of Prof Johnston's presentation is also available on the ARRTC members' web site.

12. Process for finalising review KKNs

12.1.1 Following further discussion, ARRTC agreed the KKN review should be finalised out of session. Members also agreed to nominate ARRTC members to teams to work on various KKNs.

Action/Outcome 12A

ARRTC agreed to continue to review the KKNs out of session and finalise prior to the next meeting in October 2007.

Action/Outcome 12B

ARRTC agreed to nominate the following members to "champion" the review and amendment of the KKNs under the headings of:

KKN 1.0	Dr Stauber with Dr Hillman
KKN1.2	Dr Hillman with Dr Stauber
KKN 2.1	Dr Jones with Prof Nott
KKN 2.2	Dr Grant
KKN 2.3	Mr Evans
KKN 2.4	Dr Milnes with Dr Jones
KKN 2.5	Mr Hughes with Dr Jones
KKN 3.0	no change
KKN 4.1	Dr Grant with Dr Bayliss
KKN 4.2	SSD/eriss
KKN 5.0	Mr Hughes with Dr Bayliss
KKN 6.0	Mr Hughes with Dr Bayliss

12.1.2 ARRTC also discussed the process to be used for reviewing the KKNs out of session. Dr Grant suggested using a proforma with the existing words with space for the revised words and related explanatory notes. Members agreed the Secretariat would develop and circulate a suitable table to members.

Action/Outcome 12C

ARRTC agreed that the Secretariat would develop a proforma for the review of the KKNs and circulate this to members out of session.

12.1.3 ARRTC noted the KKN review will require meeting papers to be available much sooner than for previous meetings.

12.1.4 Mr Evans thanked Dr Hayes for his contribution to the work of the committee and wished him well in his future endeavours. Dr Hayes indicated that he would continue to follow the work of ARRTC with interest.

Action/Outcome 12D

Mr Evans formally thanked Dr Hayes for his contribution to the work of the Committee.

12.1.5 Mr Evans advised members that he thought the meeting had been very successful and asked Mr Hughes to pass on his thanks to all SSD staff involved in organising and supporting the meeting.

Action/Outcome 12E

Mr Evans formally thanked all SSD staff involved in organising and supporting the ARRTC meeting.

13. CLOSE

13.1.1 Meeting closed at 5.28pm.

ARRTC19 - Actions and Outcomes Summary

No.	Action/Outcome	Responsibility
1A	<i>ARRTC agreed the MTC reports would be a standing agenda item for future meetings</i>	<i>Secretariat</i>
2A	<i>ARRTC agreed to the following timetable for minutes and actions arising:</i> <ul style="list-style-type: none"> - <i>minutes and actions arising should be finalised within 8 weeks of the meeting;</i> - <i>list of draft actions to be circulated to members within 1 week of meeting;</i> - <i>draft minutes to be circulated 4 weeks after the meeting;</i> - <i>members have 2 weeks to review and advise any changes; and</i> - <i>final draft minutes to be posted to website within 8 weeks of meeting.</i> 	<i>Secretariat</i>
2B	<i>ARRTC agreed to delete second sentence in paragraph 4.1.38 of the draft ARRTC18 meeting outcomes and replace with words to be provided by Dr Hillman.</i>	<i>Dr Hillman</i>
2C	<i>ARRTC agreed to amend the wording of ARRTC18 Action/Outcome 2B by removing "continue to".</i>	<i>Members</i>
2D	<i>ARRTC agreed to amend the draft ARRTC18 minutes to reflect the above changes and place on the ARRTC public website</i>	<i>Secretariat</i>
2E	<i>Dr Milnes to provide copy of ERA Ranger Radiation Management System to Prof Johnston.</i>	<i>Dr Milnes</i>
2F	<i>Mr Kyle to provide further information on the proposed meeting between ARRTC and the GAC under his report later in the meeting.</i>	<i>Mr Kyle</i>
2G	<i>ARRTC agreed that:</i> <ul style="list-style-type: none"> - <i>the Secretariat will advise members of ministerial reporting arrangements once these have been confirmed; and</i> - <i>incoming/outgoing correspondence and key personnel changes will be included as a standing agenda item for future ARRTC meetings.</i> 	<i>Secretariat</i>
2H	<i>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.</i>	<i>Members</i>
2I	<i>ARRTC agreed Dr Milnes would provide a report on the outcomes of the geotechnical consultant's report on Pit 3 and RP2 to the next meeting.</i>	<i>Dr Milnes</i>
2J	<i>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.</i>	<i>Chair; Secretariat</i>
2K	<i>ARRTC agreed that ERA should be requested to provide advice on progress of key vegetation projects at the next meeting.</i>	<i>Secretariat; Dr Milnes</i>
2L	<i>ARRTC agreed that, in future, all action items not finalised will be deferred to the following meeting and that the Secretariat would list unactioned items under a specific agenda item until resolved.</i>	<i>Secretariat</i>
2M	<i>ARRTC confirmed its continuing interest in arranging a meeting with the GAC should an appropriate opportunity arise in the future.</i>	<i>Mr Kyle</i>
4A	<i>ARRTC agreed that a small group of members would look at the KKN document over lunch</i>	<i>Members</i>
5A	<i>Dr Bollhoefer to provide Prof Johnston with copy of paper to IAEA conference for review.</i>	<i>Dr Bollhoefer</i>
5B	<i>Prof Johnston to review work done so far under KKN 1.1.2 and discuss with Dr Bollhoefer.</i>	<i>Professor Johnston; Dr Bollhoefer</i>
5C	<i>Dr Jones, Dr Stauber and Dr Hillman to review wording of KKN 1.2.1 and amend as needed.</i>	<i>Dr Jones; Dr Stauber; Dr Hillman</i>

5D	<i>ARRTC agreed to delete last sentence from KNN 1.2.2 “water quality will be linked to knowledge of ecological effects”.</i>	<i>Secretariat</i>
5E	<i>ARRTC agreed to consider how to link KKNs to the gap analysis spreadsheet on the 2nd day of ARRTC19 meeting.</i>	<i>Members</i>
5F	<i>ARRTC agreed Dr Stauber, Dr Van Dam and Dr Hillman would review wording of KKN 1.2.4 and amend as needed.</i>	<i>Dr Stauber; Dr Van Dam; Dr Hillman</i>
5G	<i>ARRTC agreed to delete KKN 1.2.5 (as it is covered under 1.1.1, 1.3.1 and 1.2.2).</i>	<i>Secretariat</i>
5H	<i>ARRTC agreed that Prof Johnston would update himself on radiation management at the Ranger mine and speak to Peter Burns from ARPANSA to determine the appropriate wording of KKN 1.2.6.</i>	<i>Prof Johnston</i>
6A	<i>Dr Grant requested copy of vegetation criteria report (Hollingsworth et al 2007) from ERA</i>	<i>Dr Grant; Dr Milnes</i>
6B	<i>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.</i>	<i>Dr Grant</i>
8A	<i>ARRTC agreed that the next meeting would be held over three days from 15 – 17 October 2007, commencing at lunchtime on the first day.</i>	<i>Members</i>
8B	<i>ARRTC agreed that Dr Hayes’s replacement should have expertise in environmental risk assessment and this will be provided as advice to the Minister.</i>	<i>Members</i>
8C	<i>Dr Hayes to send a formal letter of resignation to Minister Turnbull.</i>	<i>Dr Hayes</i>
8D	<i>ARRTC Secretary to send Dr Hayes an email reminding him of Action 8C.</i>	<i>Secretariat</i>
9A	<i>ARRTC agreed:</i> <ul style="list-style-type: none"> - <i>to delete the second sentence in KKN 1.3.1 “there is also...monitoring program“ and insert the words from KKN 1.2.5.</i> - <i>Prof Johnston would provide advice on the wording in KKN 1.3.1;</i> - <i>to delete “more specifically” and “new” in the last sentence; and</i> - <i>Mr Hughes would review and amend wording as needed.</i> 	<i>Prof Johnston; Mr Hughes</i>
9B	<i>ARRTC agreed to roll together KKN 2.1.2, KKN 2.1.7 and KKN 2.1.8 into a new KKN called “Landform Design”</i>	<i>Members</i>
12A	<i>ARRTC agreed to continue to review the KKNs out of session and finalise prior to the next meeting in October 2007.</i>	<i>Members</i>
12B	<i>ARRTC agreed to nominate the following members to “champion” the review and amendment of the KKNs under the headings of:</i> <i>KKN 1.0 Dr Stauber with Dr Hillman</i> <i>KKN1.2 Dr Hillman with Dr Stauber</i> <i>KKN 2.1 Dr Jones with Prof Nott</i> <i>KKN 2.2 Dr Grant</i> <i>KKN 2.3 Mr Evans</i> <i>KKN 2.4 Dr Milnes with Dr Jones</i> <i>KKN 2.5 Mr Hughes with Dr Jones</i> <i>KKN 3.0 no change</i> <i>KKN 4.1 Dr Grant with Dr Bayliss</i> <i>KKN 4.2 SSD/eriss</i> <i>KKN 5.0 Mr Hughes with Dr Bayliss</i> <i>KKN 6.0 Mr Hughes with Dr Bayliss</i>	<i>Dr Stauber; Dr Hillman; Dr Jones; Prof Nott; Dr Grant; Mr Evans; Dr Milnes; Mr Hughes; Dr Bayliss</i>
12C	<i>ARRTC agreed that the Secretariat would develop a proforma for the review of KKNs and circulate this to members out of session.</i>	<i>Secretariat</i>
12D	<i>Mr Evans formally thanked Dr Hayes for his contribution to the work of the Committee.</i>	<i>Mr Evans</i>
12E	<i>Mr Evans formally thanked all SSD staff involved in organising and supporting the ARRTC meeting.</i>	<i>Mr Evans</i>

