



Department of Resources, Energy and Tourism (DRET)

PROPOSED COMMONWEALTH
RADIOACTIVE WASTE MANAGEMENT
FACILITY, NORTHERN TERRITORY

**CH2M HILL Review of Site
Characteristics Report
– PB Response**

CH2M HILL Review of Site Characterisation Reports

PB Response

13 March 2009

Department of Resources, Energy and Tourism (DRET)



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Signed:

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Signed:

Date: 13 March 2009

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13 March 2009

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PREVIOUS
ENGINEERING
EXCELLENCE
AWARD WINNER
2006, 2005, 2004,
2003, 2002, 2001

Dear Stephen

CH2M HILL Review of Site Characterisation Reports – PB Response

Parsons Brinckerhoff (PB) and Kellogg Brown & Root (KBR) are grateful for the opportunity to comment on the CH2M Hill Draft Review commissioned by Department of Resources, Energy and Tourism (DRET). We have examined each of the comments and suggestions and have responded accordingly. In short, we believe that our Brief was clear and that we have fulfilled its requirements without having to limit our work due to budget or time factors.

We believe that the work presented in our reports provides DRET with sufficient information to move to the next phase of the Commonwealth Radioactive Waste Management Facility Project (CRWMF), and we freely acknowledge that additional studies will be required for the facility to gain necessary approvals. Importantly, we discovered no critical issues at any of the sites that would remove one or more from further consideration. Our preliminary analyses and costings also indicate that the Concept Design can be accommodated at any of the sites with relatively minor engineering and cost modifications.

Attached are our responses to the issues raised by the CH2M HILL Review. If you have any further questions or requires any further clarification, please do not hesitate to call me on 0412 186 393 or David Howard on 0417 080 660.

Yours faithfully

Julieanne Goode
Principal Environmental Scientist/Planner
Parsons Brinckerhoff Australia Pty Limited

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1. Introduction

1.1 Preamble

Parsons Brinckerhoff (PB) and Kellogg Brown & Root (KBR) were commissioned by the then Department for Education, Science and Training (DEST) to undertake a project to characterise four nominated sites in terms of their suitability for hosting a Commonwealth Radioactive Waste Management Facility (CRWMF).

The work resulted in seven Draft Technical Reports and a Draft Synthesis Report. These were submitted to the Department of Energy, Resources and Tourism (DRET) which has assumed responsibility for the project.

DRET commissioned CH2M Hill to review the Draft reports.

CH2M Hill submitted a Draft Review letter to DRET. The stated aims of the review were to:

- assess and validate the methodologies and findings used to characterize four potential sites in the Northern Territory for the proposed radioactive waste disposal facility
- examine the content (of the PB/KBR reports) against relevant criteria detailed in International and National siting guidelines (CH2M Hill Dec. 2008).

DRET has asked PB/KBR to comment on the Draft Review.

This short report is in eleven sections:

- Introduction (preamble and discussion)
- Synthesis Report
- Geology and Geotechnical Investigation Report
- Hydrogeology and Hydrology Report
- Biological Environment Report
- Mineral Prospectivity Report
- Meteorological Analysis Report
- Land Use and Demographic Analysis Report
- Transport Assessment Report
- Other issues

1.2 Discussion

The review by CH2M Hill reaches the following principal conclusions:

- Synthesis Report – suitable preliminary overview, however, requires further reconciliation with details of the technical reports.
- Geology and Geotechnical Investigation Report – suitable preliminary investigation.
- Hydrogeology and Hydrology Report – suitable preliminary investigation.
- Biological Environment Report – requires further data collection and analysis.
- Mineral Prospectivity Report – suitable preliminary investigation.
- Meteorological Analysis Report – suitable preliminary investigation some additional information required to fully address criteria.
- Land Use and Demographic Analysis Report – requires further information.
- Transport Assessment Report – suitable preliminary investigation.

If the words ‘...suitable preliminary investigation’ can be taken as endorsement of the reports thus designated (i.e. that they meet the requirements of the scope for this project), then here we make comment only on those not so designated.

1.2.1 Synthesis Report

CH2M Hill considers that the Synthesis ‘...report requires further reconciliation with the details of the Technical Reports’.

The Synthesis Report was not designed to merely summarise the Technical Reports, it arose principally out of a series of Workshops, not as a simple result of summarising Technical Reports, although key aspects of those reports were used in the Synthesis Report.

We do not consider that further reconciliation is required for the purposes of the site characterisation project.

1.2.2 Biological Environment Report

CH2M Hill considers that the Biological Environment Report ‘...needs further data collection and analysis’.

Later, the review makes comment about the seeming lack of information about seasonal variability at the sites.

We consider that the literature and database reviews conducted for each site, together with an assessment of the presence (or absence) of habitat suitable to support specific species listed as possibly present in the defined areas is sufficient at this level of investigation, without the need for seasonal survey data.

It must also be remembered that the potential footprint of the CRWMF and associated infrastructure (roads, water management ponds, buffer zones etc.) is tiny in comparison with the bioregions that surround the sites. Thus it is extremely unlikely that the facility would adversely impact species or their habitat at an area or regional scale. Similarly, the ‘target zones’ within each parcel of land are sufficiently large to

enable the facility and its infrastructure to be located by optimisation once a site is selected for further investigations.

We recognise that more detailed data collection and analysis will be required at the site chosen to go forward to a full Environmental Impact Assessment (EIA), but we do not agree that the information as presented in the Technical Report is deficient.

1.2.3 Meteorological Report

CH2M Hill considers that the Meteorological Report is a ‘...suitable preliminary investigation some additional information required to fully address criteria’.

The specific area identified by CH2M Hill is in regard to ‘extreme events’.

The Meteorological Report canvassed extreme:

- rainfall
- temperature
- humidity
- wind
- bushfires
- tropical cyclones, and
- lightening.

In terms of ranking extreme events, only the fact that Fishers Ridge is located within the cyclonic belt of northern Australia makes it stand out. For the other sites, the risk of extreme events is very similar.

We do not consider the report to be deficient in its preliminary assessment of extreme weather events.

1.2.4 Land Use and Demographic Analysis Report

CH2M Hill considers that the Land Use and Demographic Report ‘...requires further information’.

The reviewer focuses on data above and beyond that which was accessed for the report, i.e. data gathered in the field.

Stakeholder and Community consultation was not a part of the PB/KBR scope for this project, indeed it was specifically excluded, since all stakeholder and community consultation activities during the site characterisation studies were undertaken by DRET. Similarly, an analysis of potential exposure of members of the public or CRWMF staff to radiation from the facility was specifically excluded from the scope.

Once a site is chosen, full stakeholder and community consultation will be integral to the EIA process.

We do not consider that the preliminary report is deficient in this regard.

2. Synthesis Report

2.1 Review text

The following is a copy of the reviewer's text:

The Synthesis Report provides an overview of the background to the project, scope of the investigation and exclusions, details considerations, summarises the methodologies and findings from the technical reports, and discusses the process undertaken with testing the concept design against the characteristics of each site. Although detailed, the Synthesis Report is, in parts, inconsistent with some details contained within the technical reports.

It is acknowledged that the scope of this work was of a preliminary nature. The methodology was generally consistent in assessing each site against the themes outlined in the international and national Guidelines. Although investigative techniques were reflective of the broad objectives yet limited, the subsequent accuracy of the findings were also inhibited. Therefore there is reduced confidence surrounding the full identification of constraints in the:

- Hydrology and Hydrogeology Report (interpretation of results)
- Biological Environment Report (methodology of data collection and field monitoring)
- Mineral Prospectivity (scope of this investigation)
- Meteorological Analysis Report (methodology for extreme events)
- Land Use and Demographic Analysis Report (methodology of data collection and analysis)
- Transport Assessment Report (methodology of data sources).

The site suitability assessment provides a comprehensive reconciliation and comparison of site characteristics against factors derived from the Guideline themes. This is a fair and reasonable indication of the sites' natural and enhanced abilities to provide an effective isolation barrier to the biosphere. The criteria in the matrix is derived from the Guidelines, however, the scoring used is not a direct translation from the technical reports, but rather an interpretation of potential risk derived from information presented in the technical reports. Having also considered the types of wastes requiring disposal and the most appropriate disposal facility type, the assessment is detailed and provides a good framework/model for addressing the interaction between the natural and engineered environments. As noted, further investigations are required to clarify outstanding unknowns, confirm assumptions and validate data interpretation, and any such changes to the site factors will need to be reflected in this model.

2.2 Response

On the one hand the reviewer endorses the methodology used to derive the matrices used in the Synthesis Report, but on the other there is acknowledgement that additional information is needed to fully characterise a site or sites against National and International Guidelines.

We wholly agree that additional studies are necessary, and these will be undertaken as part of the next phase of the CRWMF Project, i.e. the EIA. We do not agree that the preliminary studies reported in the Technical Reports, or the Synthesis Report are unable to characterise the sites to a sufficient degree to enable the Commonwealth to select a site (or sites) for the EIA phase.

There is also a concern that the ranking methodology may not reflect the technical information in the Technical Reports.

The reason for designating the report 'Synthesis' instead of 'Executive Summary' was because it was not a simple summary of the technical findings.

The sequence of events was as follows:

- individual technical studies commissioned (using the DEST Brief and with reference to National and International Guidelines, Standard method etc.)
- desk-top review of extant information in each technical category
- preliminary (rapid) assessment of potentially suitable areas within nominated sites
- design of field programmes
- conduct of field programmes
- documentation of Technical Reports
- workshops to assess each site and each technical issue against Guidelines
- workshops to address potential modifications to Concept Design at each site
- documentation of the Synthesis Report.

The way that the Workshops were conducted was to use the formal structure of an 'ENVID', by seeding the matrices with themes from the Guidelines, then asking technical participants to think across technical disciplines to identify aspects. Each site was then rated in terms of its relative 'suitability' against the themes.

This is not unlike the way that an EIA is conducted. Technical Reports (or Appendices) state the factual findings from surveys, models, literature surveys etc., then a small team analyses these findings and documents the Main Report, which usually includes a form of risk identification, ranking and mitigation measures.

3. Geology and Geotechnical Report

3.1 Review text

The following is a copy of the reviewer's text:

The Geology and Geotechnical Report provides a satisfactory level of assessment for a preliminary overview of the sub-surface conditions at each site. The methodology used to conduct a preliminary investigation of the four potential sites is considered to be suitable for an initial site characterisation. The approach was consistent with accepted industry practices and addresses criteria outlined in international and national Guidelines for the siting of radioactive waste facilities.

Data collection and analysis comprised both a desktop study followed by site and regional investigations. The desktop review identified existing information and gaps to be investigated, whilst on-site drilling and excavations were undertaken to obtain more site specific information on the sub-surface conditions for each location nominated. The methods used to gain information, the data collected, the various analyses conducted and assumptions made, are appropriate and in accordance with standard practices. The process and results have been comprehensively documented and provide a suitable level of confidence for the sub-surface characteristics at each site.

Factual conclusions and summaries have been appropriately derived from the investigation results. Whilst the report is comprehensive with respect to the geological and geotechnical content, confirmation of site specific conditions would require further localised investigations, a detailed safety assessment, and modelling of the final facility design, to ensure complete addressing of all criteria outlined in the guidelines.

The report addresses all important and relevant geological considerations including geological and topographical descriptions, geotechnical properties of rocks and soils, stability, tectonic and seismic environment, groundwater conditions, chemical compositions, and suitability for construction (bearing capacities, excavatability, suitability and availability), and other general hazards (landslide, liquefaction, flooding and erosion risks). No particular issues or constraints exist, however, engineering design and construction methods can be adapted according to the local conditions. Further clarification may address 'collapsing soils' and 'air expulsion' noted in the report, and the behaviour of conditions over a long design life of 300 yrs proposed for the facility.

Although the ground conditions at individual sites appear to be relatively uniform, sampling density is reasonably sparse (~200m to >1000m separation). Depending upon the specific layout of the proposed disposal facility, greater density of geological investigation may be warranted to gain further information, and determine the presence or otherwise, of any localised geological variability that may present an additional site specific risk.

3.2 Response

PB/KBR agrees with the conclusions of CH2M Hill that the report provided a suitable preliminary investigation report and that all areas requiring further work were outside of our scope and will be addressed in following works associated with selected site(s).

4. Hydrogeology and Hydrology Report

4.1 Review text

The following is a copy of the reviewer's text:

The Hydrology and Hydrogeology document addresses the identification of local and regional surface and groundwater resources in proximity to the investigation sites. The investigations undertaken are an appropriate means of determining depth of groundwater, flow rates/hydraulic conductivity and direction of flow, permeability, hydrogeochemistry and catchment sizes and influences.

Although CH2M HILL was not addressing grammar or typos, Table H4.6 has two apparent typos in the "Above ground with future development, Effective Area" column – the first two rows are believed to be intended to read 14100 and 11670 respectively. Additionally, page 4 of the document has been shifted to be between pages 9 and 10.

Seasonal fluctuations in groundwater level were not able to be defined for the Muckaty site, however, expected fluctuation range was identified.

H6.1.2 indicates the installation of data loggers to understand longer term fluctuations and two months data from these loggers are presented in table H6.2. The value of these results needs to be placed in context of the stated objective of the data loggers, i.e. while the loggers have been installed for long term trends initial short term results have been reviewed and these may not be reflective of longer term trends.

The assessment of groundwater characteristics and hydrogeochemistry is appropriate for identifying the potential for interactions between waters and host rock, however, the summary and discussion section do not highlight the outcomes of the geochemical assessment with respect to the solubility and sorption of radionuclides.

The utilization of the Langelier Saturation Index (LSI) calculations is questioned. The LSI does give somewhat of an indication of the potential for calcite scale formation but it is the undersaturation of calcium carbonate that is used to estimate the potential for corrosivity (the higher the sodium relative to the calcium carbonate saturation the more potential for corrosivity). PHREEQC and other thermodynamic equilibrium models are much more effective and accurate at estimating calcium-carbonate saturation than LSI because they take the entire major ion chemistry into account - that includes calcium complexing with

sulfate and chloride and therefore unavailable for saturation considerations but ignored by the LSI calculation so the LSI calculation result over estimates calcium carbonate saturation (over estimates potential for scale formation) and underestimates the potential for corrosivity.

The LSI may typically be calculate it if specifically requested to compare it with historical LSI results but it is not considered to be usable for consideration about materials. The geochemical models are far more accurate and effective. The differences between the LSI and geochemical models are far more than theoretical, they are based on current scientific principles of aqueous geochemistry.

There is no consideration of the interaction of the results of this report with the results of other reports, i.e. surface and groundwater dependencies by local townships, flora or fauna and implications for the loss or contamination of these water sources given their local and regional dependencies and sensitivities. This aspect also seems to be absent from the synthesis report. Information on actual major water uses including abstraction rates and land use requirements could be expanded upon in order to identify any relative sensitivities of groundwater resources – i.e. human, agricultural, and/or stock dependencies. Additionally, regional flooding events are only lightly touched upon in the text with no apparent historic event referencing, and no consistency of consideration across the sites.

The potential for natural events such as subsidence, sub-surface movements, faulting or fracture or volcanic activity and the potential effects on regional hydrology and hydrogeological systems has not been addressed in the document. Similarly, consideration of the potential impacts associated with climate change to hydrology and hydrogeology have not been considered in this document.

It is noted that the Synthesis Report documents groundwater use and the migration of nuclides and flooding in Table 10.1 and attributes a score against these for each site. The source for this scoring is not readily identifiable in the Hydrology and Hydrogeology document text or summary as would be expected.

4.2 Response

4.2.1 Typographical errors

The figures in the 'Above ground with future development, Effective Area' should agree with those in Table 4.2 of Appendix A, i.e. they should read 14105 and 11670. We appreciate these errors being identified in the review.

4.2.2 Short-term vs. long-term data from loggers

We appreciate the comment. If the document is revised, a statement will be included to this effect.

4.2.3 Solubility and sorption of radionuclides

This is outside the scope of works that were requested. It is our understanding that this level of technical evaluation would occur if/when a final site has been chosen. For

this report, the scope was limited to a detailed consideration of contaminant migration pathways.

4.2.4 Use of Langelier Saturation Index

PB concurs that the best way to appreciate thermodynamic stability of calcite is through geochemical modelling using PhreeqC or another modelling package, as opposed to the use of Langelier Saturation Indices.

It is for the reasons outlined in the peer review that PB extensively modelled thermodynamic characteristics of the groundwater system (in particular saturation indices of minerals including calcite) using PhreeqC. PB's approach is thoroughly documented in section H8.4. In the report, PB stated that the use of LSI is not as 'comprehensive' as geochemical modelling techniques, and that LSI is provided as a comparison to previous investigations that may (or may not) comprise LSI data and interpretation. This is documented in the text below which has been extracted from section H8.4.7.

4.2.5 H8.4.7 Langelier saturation indices

PB considered Langelier Saturation Index (LSI) calculations an appropriate tool to assess the likelihood of CaCO₃ scale formation and/or CaCO₃ corrosivity of the water samples in:

- the present groundwater setting (although this is already done by the more comprehensive saturation indices calculated in the geochemical models), and
- future uses of groundwater (for instance interactions with building materials, etc).

Appendix E-6 lists the LSI values derived, and the likelihood of scale formation associated with each water sample. Although the saturation indices calculated by PhreeqC are more 'comprehensive' than the LSI calculation, and there are theoretical limitations associated with the LSI calculations, they represent a traditional approach to modelling.

Consequently, PB does not plan to modify the text.

4.2.6 Interaction of results with results of other reports, i.e. surface and ground water dependencies

The report includes estimates of travel times to possible groundwater discharge areas and groundwater users.

The Fishers Ridge site is identified as being in a region of substantial groundwater use. The other sites are not identified as being within regions of substantial groundwater use. This is reflected in the relatively short travel time estimates for the Fishers Ridge sites.

While the implications of the loss or contamination of water resources to local townships and/or ecosystems is considered to be outside the scope of works that were requested, we appreciate this comment. If the document is revised, we would likely include an additional line in the comparison table within the executive summary,

the purpose of which would be to compare the groundwater beneficial use (to people and ecosystems) in the different areas.

4.2.7 Geological events and climate change

The potential for such natural events is discussed in the geology and geotechnical report. The risk of such events was identified as very low in that report. Due to the very low likelihood of such events, the consequences of such events on regional hydrology and hydrogeology are not considered in the hydrogeology and hydrology report.

With respect to climate change, we recommend that the potential impact of climate change is considered in any further investigation/consideration of any of these sites. We consider it to be beyond the scope of the current study.

5. Biological Environment Report

5.1 Review text

The following is a copy of the reviewer's text:

The Biological Environment Report provides a constrained summary assessment of the biological characteristics of the four potential sites. The investigation undertaken provides a limited understanding of the flora and fauna across each site, and limits confidence for decision-making. The methodology associated with flora and fauna data collection was restricted to one season per site and conducted within short time frames of relatively similar climatic and environmental setting. The data is not representative of year round (or longer term) conditions and comparative analysis is restricted. Such investigation limitations have not been outlined in the corresponding section of the Synthesis Report.

The flora and fauna surveys were undertaken over consecutive days that were of similar conditions. It is preferable that fauna investigations be undertaken in various conditions, where time is otherwise available, to provide a more representative sampling of the range of potential communities present based on seasonal responses (i.e. after the commencement of the wet season or during breeding seasons). This would enhance the ability for species to be confirmed as opposed to relying on hypotheses about the presence of a particular species. In turn, it will then be possible to provide more definite conclusions on the significance of each of the sites.

The Fishers Ridge site, the site considered to have the greatest biodiversity, had undergone a fuel reduction burn 6 weeks prior to the field investigation. This is expected to have had an impact on the diversity and abundance of species encountered at the time of data collection, given species of both flora and fauna may not have adequately re-colonised the area following the recent fire.

It is recommended that additional flora and fauna surveys be undertaken across the range of seasonal conditions to provide an indication of the species present at both times of year as it is likely that they will be considerably different. This is emphasised for all four sites in order to enable a better defined assessment of relative sensitivities between sites.

The species of flora and fauna at many sites were predicted to occur on the basis of suitability of habitat or the presence of co-indicative species. It is difficult to conclude that the species predicted to occur at any particular site is of any particular conservation status.

The assumed lists of species present have been compiled on what is typical of each bio-region, however more detailed biological assessments of the region would be required to determine if this conclusion was correct on a site specific basis. Additionally, broader assessment during a range of climatic conditions would verify the status of species assumed to be encountered.

5.2 Response

It is noted that the review provides similar comments and conclusions to those established in the report in relation to the relative abundance of species in relation to environmental variables and the seasonal variation for some aspects of the flora and fauna at each site. It is our opinion that sufficient information has been compiled from the literature and the field assessment to characterise each site for this component of the project. Certainly sufficient information and data have been accessed and assessed to define the relative biological sensitivities of each site (which was our Brief).

The lists of species compiled for each bio-region are those recorded for the region by various authorities. Whether or not a species is present is actually not that important, unless it is a species of particular conservation significance. It is extremely difficult and costly to undertake an assessment to determine all species present in an area. The key ecological issue is the presence of habitat for a species. The report indicates if habitat for such species is present or absent.

Additional surveys to assess the seasonal variation complement for each site are desirable, but they are not required at this stage. Once a final decision about a preferred site is made, then additional information can be gathered and the hypotheses erected can be tested.

It must also be noted that the actual area of impact of the proposal is very small and this is an important consideration in any assessment of impact on the biological environment.

6. Mineral Prospectivity Report

6.1 Review text

The following is a copy of the reviewer's text:

Overall the Mineral Prospectivity Report is reliable, given the scope of the study was restricted to a desktop review and samples taken from drilling undertaken for geological purposes. Some minerals of interest were identified in the surrounding areas of each site as well as identifying existing mineral licences/leases. Further quantitative investigation into the economic value of a potential mineral deposit vs. extraction cost (approx. 200 m overburden), may be required to confirm if the use of the sites as a radioactive waste management facility would unreasonably sterilize the resource. This consideration would need to utilize reasonable forecast minerals pricing and consider various options for extraction.

The conclusions drawn based on the desktop investigation on mineral prospectivity around the four proposed sites are reasonable. General statements about the extraction of potential mineral deposits at the four sites being sub-economical due to the thickness of overlying material are sound, given the desktop constraint on the study. Although there is sufficient detail on the regional prospectivity analysis, there is little information about the methodology used to analyse the local prospectivity. The Synthesis Report outlines that samples for analysis of commercial minerals were collected from drilling and test pitting program, however, there is only limited description of this in the Mineral Prospectivity technical report.

Given the restricted nature of the analysis, the suggested depth of minerals, and the limited information on potential deposits beneath the nominated sites, it is difficult to conclude that 'there are no known mineral deposits', and confidently allocate the site for the purposes of a radioactive waste management facility. Further investigation into available data, or deep drilling would be required to be fully satisfied as to the economic potential of any minerals present.

6.2 Response

PB/KBR agrees with the conclusions of CH2M Hill that the report provided a suitable preliminary investigation report and that all areas requiring further work were outside the scope, and will be addressed in following works associated with selected site(s). Full reference to the sampling program is included in the Geology and Geotechnical Investigation Report.

7. Meteorology Report

7.1 Review text

The following is a copy of the reviewer's text:

The Meteorological Report provides a satisfactory overview of weather and climatic conditions across each of the four potential waste facility sites. The report documents findings from a desktop review which addressed much of the primary requirements outlined in the international and national siting Guidelines. The review was preliminary and included the collection and analysis of comprehensive weather data (precipitation, wind speed and direction) from numerous weather stations located around each of the sites as well as discussion of extreme events (including cyclones and lightning ground flash intensity) and general air quality and the impacts on the individual sites.

To fully assess the sites against criteria listed in the Guidelines, further analysis would be required into extreme events which may pose significant risk and impact on the facility. The collection of data from BOM is adequate, however, the analysis of the results for extreme events has not been completed for all sites as recommended in the Guidelines where "the one extreme event for the year should be identified and tabulated for each year in order to perform the calculation of extreme statistics." There has only been one such assessment undertaken, at Fishers Ridge in relation to cyclones. Discussion surrounding the effects of rainfall and subsequent flooding has been partially identified within the Hydrology and Hydrogeological Report.

Further requirements as listed in the Guidelines that could be addressed during the next stage of the site assessment process include:

- extreme wind/precipitation conditions from cyclone events included on a regional map
- discussion of the potential (if any) of sandstorms occurring in the area and the implications on the design of the facility
- transport of airborne releases to be evaluated via modelling of atmospheric dispersion of any radioactive material from the proposed waste management facility
- discussion of the impact of meteorological conditions (including flooding) on repository design to be included in more detailed design once the site has been selected

- address the potential effects of climate change on meteorological conditions for the sites and the implications on design of the facility
- discussion on atmospheric stability parameters (e.g. Pasquill atmospheric stability classes) and prolonged inversions (including comment on absence)
- once final site has been selected, onsite weather station to be installed with data (minimum 12 months) to be compared with regional weather for correlation.

7.2 Response

The project team agrees with the meteorological aspects identified by CH2M Hill that could be addressed during the next stage of the site assessment. While we note that these aspects were not included in the scope for the investigations in this site characterisation phase the following discussions have been provided.

7.2.1 Extreme wind/precipitation

For each of the four nominated sites, the extreme weather condition characteristics investigated were floods, drought and bushfire. Due to the location of the Fishers Ridges site, tropical cyclone events were also investigated for this location.

For all sites, the use of BOM weather data as the basis of the report has resulted in precipitation and wind conditions associated with cyclone events being indirectly included in the meteorological component of the site characterisation review.

7.2.2 Sandstorms

Sand/dust storms are a result of strong dry wind blowing over the desert/uncleared areas that raise and carry along clouds of sand/dust. The wind is usually the result of convection currents created by intense heating of the ground.

The (often) local nature of these events will require further site specific climate data and investigation during the next phase of the project (i.e. for the site(s) identified for further environmental impact assessment investigations).

It should also be noted that the ability to incorporate engineering modifications to the facility design means that sand/dust storm events are not considered to be a differentiating factor between the four sites for the purposes of this site characterisation phase of the project.

7.2.3 Other investigations

As outlined above, the project team agrees with the aspects raised by CH2M HILL that could be included in the investigations associated with the next phase of the project.

On reviewing these points, the project team considers that issues associated with:

- transport of airborne releases
- impact of meteorological conditions (including flooding) on repository design
- potential effects of climate change on meteorological conditions for the sites and the implications on design of the facility, and
- atmospheric stability parameters (e.g. Pasquill atmospheric stability classes) and prolonged inversions (including comment on absence)

are issues that are common to all sites and for this reason are not considered to be a differentiating factor between the four sites for the purposes of this site characterisation phase of the project. It should also be remembered that the facility is not intended to emit contaminants to the atmosphere, thus consideration of stability classes (which are used in dispersion modelling) and inversion frequency or depth (which indicate trapping layers and control dispersion) are not particularly high priority issues at this preliminary stage.

7.2.4 On site weather station

During the completion of the investigations associated with the site characterisation project, consideration was given to the installing on site weather stations at each of the sites.

Given the limited data that would have been collected during the project period, and the nature of data required for site characterisation purposes, it was considered (in discussions with DRET) that installation of on site weather stations was more appropriate (for the identified site(s)) or the next phase of the project.

8. Land Use and Demographics Analysis Report

8.1 Review text

The following is a copy of the reviewer's text:

The Land Use and Demographics Analysis Report provided an adequate preliminary desktop assessment of each of the four sites and surrounding areas. The selection of land-use issues and demographics topics used to conduct the preliminary investigation of the four potential sites is considered to be adequate and suitable for an initial site characterization. The investigation mostly satisfies the criteria outlined in the Guidelines to confirm buffering from populated areas and indigenous and non-indigenous cultural or heritage sensitivities.

Each of the four site sections use data collected from a reliable source to portray the social profile and land-uses of the site. No site specific data was collected and final discussions were drawn from literature information and Census data generated in 2006 and earlier. Verification in the field would lead to greater confidence in the data presented as rapid demographic changes can be experienced in these communities following economic and climatic (i.e. drought) fluctuations.

The majority of the criteria outlined in the Guidelines have been considered in the technical report, however, aspects that have not been addressed and require further investigation and analysis to identify constraints include:

- The potential hazards of the waste facility on human health and the current population has not been identified, particularly with respect to emergency response requirements. A hazard assessment should be undertaken, at least at a preliminary level for the purposes of site characterisation.
- More details are required for water characterisation; each site needs to have an outline of where their potable water is sourced from for each of the surrounding communities.

- Identification of cultural centres for all four sites that are not necessarily listed on any heritage database but may create 'a sense of place' for local residents should be considered.
- Identification of the acceptance by local residents of the facility
- Identification of requisite utility resources - water, electricity, site access, accommodation, health and medical, education, etc
- Consideration should be given to sensitive land uses such as schools, hospitals and prisons and the location of these facilities in relation to the four sites.
- Outline of required buffer zones around the facility and whether this will impact on current communities and/or land uses located around the four sites.
- Discussion should be provided regarding the availability of potable water and other utility services and infrastructure that would be required to be brought onto the site for the purpose of building a facility and the implication on local resources.
- The consideration of the local employment rates and status, including potential for workers in constructing and operating the facility and the potential impacts on community resources (e.g. hospitals, accommodation, schools).
- Identification of the applicable legislation, regulations and approvals for each site given the Commonwealth status of the project.

Some details presented in the Synthesis Report regarding land use and demographics, although relevant have not been duplicated from the technical report.

8.2 Response

The project team agrees with the CH2M HILL observation that "the selection of land-use issues and demographics topics used to conduct the preliminary investigation of the four potential sites is considered to be adequate and suitable for an initial site characterization".

Further discussion addressing the specific issues raised by CH2M HILL is provided below.

8.2.1 Facility hazards, human health, hazard assessment

The project team acknowledges that the potential hazards of the waste facility on human health have not been identified. Assessment of these types of hazards are most appropriately undertaken using radionuclide pathway analyses and exposure scenarios which were not included in the scope of the investigations for the site characterisation.

Given the nature of the information collected as part of the site characterisation, it is considered that any preliminary hazard assessment undertaken at this stage of the project may not have provided specific site differentiation data. The project team does

not consider that the site characterisation investigations are deficient due to a lack of any preliminary hazard assessment.

Emergency response elements associated with the operations of the facility require consideration for both the site as well as transport of waste. Provision of additional training, equipment both on the site and potentially at regional emergency services stations will be required for all sites. It is for this reason that for the purposes of site characterisation, emergency services requirements were not considered to be a differentiating element.

8.2.2 Potable water supply

It is acknowledged that the identification of the potable water supply for the communities surrounding each of the sites has not been included in the report. The Hydrogeological and Hydrology Report does however include details of the nearest surface and groundwater interaction points associated with each of the sites.

If the document is revised, we would include additional details, the purpose of which would be to identify the potable water supply of the communities surrounding the sites.

8.2.3 Cultural centres

The project team acknowledges that there may be local cultural centres associated with the sites (that may not be listed on available data bases) but may create 'a sense of place' for local residents.

The collection of this information requires specific on ground and community engagement/interaction activities (e.g. interviews) which were specifically excluded from the scope of the site characterisation project.

At this stage of the project, the exclusion of this information is not considered to pose a significant data gap for site characterisation purposes.

8.2.4 Acceptance by local residents of the facility

As outlined above, specific on ground and community engagement/interaction activities were specifically excluded from the PB/KBR scope of the site characterisation project. Community and stakeholder engagement during the site characterisation activities were undertaken by DRET.

8.2.5 Utilities location

The only site with current access to the electricity network is Mt Everard. All other sites will require either connection to the grid or on-site generators. On-site generators are almost certainly going to be required even if mains power is available, for emergency back-up.

All sites would require access to potable water, which is currently not readily available at Fishers Ridge.

Because the provision of utilities is similar for every site, a full analysis was not undertaken since it would have provided no additional point of differentiation.

8.2.6 Sensitive land uses

For each site, land use, zoning, nearest population centres and demographics were considered. It is acknowledged that within these discussions, no identification of sensitive land uses has been identified.

For the purposes of the site characterisation investigations, the consideration of the nearest general population centre (which in itself may contain more or less sensitive land uses) is considered appropriate.

8.2.7 Facility bufferzones

Details of the buffer zones required for the facility were provided by ANSTO and outlined on Figures 2.3 – 2.9 of the Synthesis Report.

Consideration of facility requirements (including buffer zones) were included in the identification of investigation zones within each of the sites, specifically those at Harts Range and Mt Everard where Defence related activities are undertaken on site.

8.2.8 Construction requirements

Whilst it is acknowledged that some sites may be closer to construction resources than others, construction resource requirements are not considered to be unique to any one site and for this reason did factor majorly in the site characterisation assessment.

8.2.9 Local employment

This is a matter for future phases of the project. It should be noted that only the construction phase would require significant manpower. The facility is likely to be operated by a very small crew between disposal/storage campaigns and is therefore unlikely to provide significant local employment opportunities.

8.2.10 Legislative requirements

The legislative requirements for the approval and operation of the Commonwealth Radioactive Waste Management Facility are common for of the identified sites. As a result, legislative requirements were not considered to be a contributing factor to the site characterisation investigations.

8.2.11 General

The following is a copy of the reviewer's text:

Some details presented in the Synthesis Report regarding land use and demographics, although relevant have not been duplicated from the technical report.

As outlined above, the reason for designating the report 'Synthesis' instead of 'Executive Summary' was because it was not a simple summary of the technical findings.

9. Transport Assessment Report

9.1 Review text

The following is a copy of the reviewer's text:

Overall the Transport Assessment Report provides an outline of transport infrastructure, condition and the various logistics options (and cost) available for transporting the radioactive materials. The report provides a preliminary assessment of the regional transport network and suggestions on the relocation of radioactive waste. The report focuses entirely on operation of the facility with little detail regarding potential construction issues associated with transportation, perhaps with the exception of potential upgrades to infrastructure. Whilst the scope appears to have addressed key considerations through data collection and site visits, the methodology is not clearly stated. There are some aspects within the report that require clarification and detail, particularly around the collection of data, for example traffic data details, truck breakdown information, and rail transport speed.

Whilst some of this investigation involves operational planning, due consideration of relevant legislation must be undertaken, i.e. National Environmental Protection Measures (NEPM) requirements (Movement of Controlled Wastes between States and Territories). Aspects related to handling and human exposure levels requires some discussion to satisfactorily address the relevant guideline criteria. Overall the report meets the requirements of the various guidelines, with further clarification required in some areas.

An additional transport-related criteria in the Guidelines refers to potential air crashes. An investigation and discussion into this aspect is required to consider the likelihood, consequence and risk associated with air flight routes on such a facility for the given four sites.

9.2 Response

9.2.1 Road construction issues

The report presents recommendations as to the types of access road upgrades required. Further detail is not warranted at this stage. Engineering details will be developed during the EIA process for the selected site(s).

9.2.2 Costing methodology

The transport report provides a detailed summary of site access, of logistics strategies, travel times, and costs, commensurate with this comparative exercise. Much of the logistics information was provided at no cost by TOLL and Linfox – detailed cost breakdowns are not reported for reasons of confidentiality as noted in the report.

The overall objective was to consider the range of issues pertinent to each site and to identify any significant differences in impacts. To this end, it is considered that the focus of the assessment is appropriate.

9.2.3 Additional data

The detailed data identified by C2HM Hill are not required at this stage to make relative judgements about the four sites. Again, these data will be addressed in the EIA.

9.2.4 NEPM, handling and human exposures

These issues are common to all four sites and any analyses would provide no differentiation between sites. Such analyses are therefore not of value to this site characterisation phase.

9.2.5 Aircraft crashes

Information pertaining to the authorised routes of commercial aircraft was obtained from Airservices Australia. It is our understanding that over-flights can be expected at all four sites, however aircraft movements would likely be at altitudes of between 20,000 and 30,000 feet.

The possible exception to this is at Fishers Ridge, where the presence of Tindal airbase may increase aircraft activity in the region, although we are also led to understand that the Fishers Ridge site is not directly on an approach or climb-out path to Tindal.

The concept design of the CRWMF did not include specific provision for protection against aircraft crashes, and we do not believe such protection is necessary, however a full 'Safety Case' will be required for the next phase of the investigations. No doubt this will require additional risk evaluations.

10. Other issues

10.1 Other issues review text

The following is a copy of the reviewer's text:

The technical reports primarily address siting characteristics and criteria outlined in the Guidelines. The ancillary function of the current technical documents is to facilitate the integration of the siting of the facility with the natural environment and engineering requirements, operations, and long-term performance of a radioactive waste management facility. The technical documents need to demonstrate a consideration of how their respective content will, and can, be relied upon for the following:

- results of the Senate inquiry
- design life of facility
- types of radiation, human dosage levels (public and occupational)
- types (classification and list) of wastes, conditioning/treatment/packaging & disposal requirements (during both operational and post-closure periods)
- long-term behaviour of wastes (both solids and liquids)
- environmental impact assessment
- safety assessment
- approvals, licences and permits (Australian Radiation Protection and Nuclear Safety Agency)
- public and community and stakeholder considerations and acceptability
- decommissioning and closure planning
- engineering and design requirements, construction requirements, availability of materials, building materials, structural stability, standards, and techniques
- impact of construction on determined site characteristics
- operational and disposal plan
- institutional requirements
- record management
- emergency response
- maintenance requirements
- contingency planning
- monitoring requirements and benchmark conditions
- auditing and reporting requirements
- security.

10.2 Response

The DEST (now DRET) brief was entirely concerned with site characterisation. The bulleted list provided by the reviewer lists many issues which are the same for any site chosen (even sites other than the four nominated sites) and can not therefore contribute to the site characterisation brief, or provide significant points of difference that would require re-consideration of the concept design.

The list of issues is beyond the current phase of the work, i.e. site characterisation.

10.3 Conclusions text

The following is a copy of the reviewer's text:

The preliminary investigation for the initial characterization and subsequent technical reports provide DRET with a reasonable overview of constraints, characteristics and conditions of the nominated sites in the Northern Territory for the proposed radioactive waste management facility.

This review process has identified areas for improvement in:

- methodology, i.e. desktop study, field investigations
- data collection, i.e. level of representative data obtained from each of the sites
- analyses, i.e. to determine impacts and risks to adequately characterize sites and address Guideline criteria
- information translation, i.e. from the technical reports to summary and assessment report (Synthesis Report).

The scope of work involved conducting investigations across four potential sites, in accordance with international and national siting Guidelines. Although the reports address and fulfil the majority of the scope outlined, there are some further investigations required to increase the certainty of sensitivities, constraints and localised conditions that will facilitate an informed decision making process. Additional works, excluded from the scope of this investigation, also need to be undertaken to integrate the nature of the facility with the characteristic findings to better determine the probable performance of the sites. This will enable DRET to exercise comprehensive judgements for site selection as well as providing additional details required for approval purposes.

To build capacity of the preliminary investigation and adequately address siting criteria in the Guidelines, as well as consider the engineered facility design, there are steps for the subsequent stages of work, including:

- conducting a gap analysis of further preliminary information required across the four sites to confirm characteristics or assumptions before proceeding on a decision of a particular site(s)
- reconciling against assumptions and initial findings
- refining multi-criteria analysis model to reflect any changes in characteristics
- confirming any changes to concept facility design and identify subsequent impacts on design requirements and constructability
- refining cost analysis to gain understanding of overall costs

- identifying specific information required for approval purposes and stakeholders to be engaged
- conducting detailed site-specific investigation of preferred site(s).

It is acknowledged that there may be some constraints (time and budget) to confirming site conditions, however, some additional effort should be made to confirm assumptions that have implications for site sensitivity or site interaction with sensitivities and therefore have implications in the siting assessment.

10.4 Response

The first section of the Conclusions suggests that the site characterisation project undertaken by PB/KBR could benefit from further investigations to ‘...increase the certainty of sensitivities, constraints and localised conditions that will facilitate an informed decision making process’.

We do not agree with this conclusion and believe the information presented in the reports both fulfils the scope of the commission and provides DRET with sufficient information for it to take the next step, i.e. the process of nominating one or more sites for full investigations during the EIA process (followed by Licensing processes).

The reviewer is not very specific in suggesting that additional information or data are required.

The remainder of the conclusions have little to do with the work presented in the PB/KBR reports, and cannot therefore be true ‘conclusions’. They relate to the next stages in this project (i.e. beyond initial site characterisation and concept design).

PB/KBR is well aware of the details of the next stages, having previously been commissioned by DEST to undertake a full EIS for the National Radioactive Waste Repository and a study into the siting of the then proposed ‘Store’.

We do not consider that either time or budgetary constraints limited our ability to fulfil our obligations under the contract.