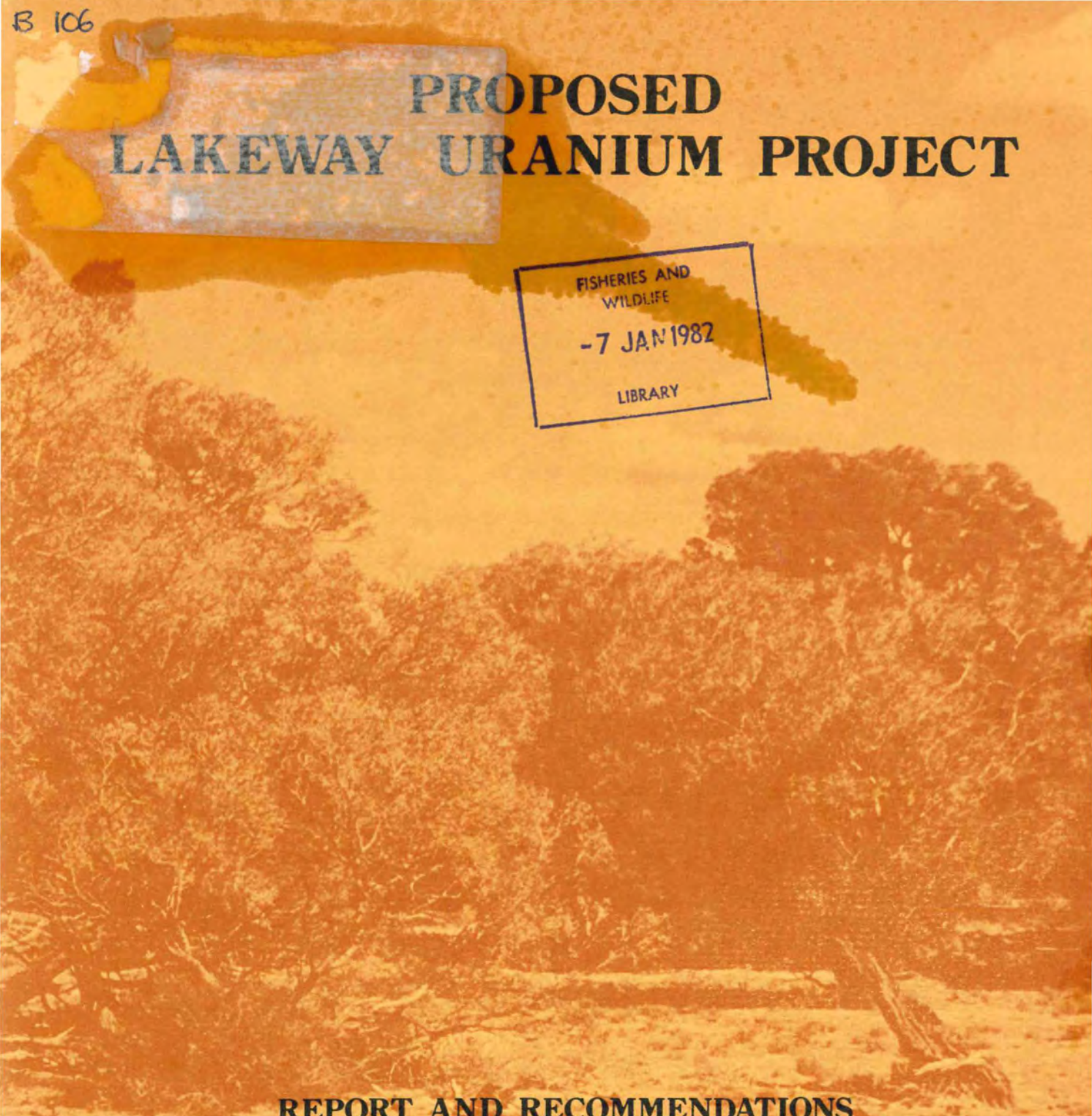
PROPOSED LAKEWAY URANIUM PROJECT



REPORT AND RECOMMENDATIONS BY THE ENVIRONMENTAL PROTECTION AUTHORITY

Department of Conservation & Environment
Perth Western Australia

BULLETIN 106
AUGUST 1981

ENVIRONMENTAL PROTECTION AUTHORITY
BP HOUSE,
1 MOUNT STREET, PERTH, WESTERN AUSTRALIA 6000
Telephone 322 2477

HON MINISTER FOR CONSERVATION
AND THE ENVIRONMENT

Your Ref.
Our Ref.

My Dear Minister

The Environmental Review and Management Programme prepared by the Lake Way Joint Venturers for the Lake Way uranium development has been considered by the Environmental Protection Authority following submissions by the public and Government departments.

Please find attached the Authority's report and recommendations (Bulletin 106) as requested by you on 25 March 1981. The Authority believes that the recommendations (except those that apply exclusively to the State) in the above report be made conditions of any approval to the Joint Venturers to proceed with the development. The Authority would appreciate being advised of those recommendations which will not be applied as conditions of the project proceeding.

I would appreciate if you would refer the attached report and recommendations and the above advice to the Hon Minister for Resources Development. I also seek your concurrence and that of the Hon Minister for the publication of the above document.

Yours sincerely

P R ADAMS
CHAIRMAN

13 August 1981

053539

LAKE WAY URANIUM PROPOSAL

by

DELHI INTERNATIONAL OIL CORP AND

VAM LTD JOINT VENTURE

REPORT AND RECOMMENDATIONS

by the

ENVIRONMENTAL PROTECTION AUTHORITY

August 1981

DEPARTMENT OF

CONSERVATION & ENVIRONMENT

Western Australia

Bulletin No. 106

FOREWORD

As in the case of the environmental assessment of the Yeelirrie uranium development, the Authority is aware of the wider issues of the nuclear fuel cycle but feels that such issues have been appraised by elaborate and detailed investigations by the Fox Inquiry and therefore need not be addressed by the Authority.

The Authority has assessed the impact of the proposed Lake Way uranium project, as described in the ERMP/Draft EIS, on the local environment. During the assessment the Authority was aware that an Agreement Act has not as yet been drawn up and therefore the Authority has specified, in some instances, the submission of detailed proposals which may normally have been required by an Agreement Act. In the event of the Joint Venturers being required to enter into an Agreement, consideration should be given to the inclusion of many of the Authority's recommendations therein.

P.R. ADAMS
CHAIRMAN

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1. INTRODUCTION

1.1 The Project

The Lake Way uranium deposit occurs at shallow depth in a salt water aquifer. The Joint Venturers, Delhi International Oil Corporation and Vam Ltd., propose to extract from this deposit between 3500 and 4000 tonnes of uranium oxide (U_3O_8) over a period of 7 to 8 years. This yield is based on a reject ore grade of 0.02 kilograms U_3O_8 per tonne of ore.

The Joint Venturers favour mining the deposit at an accelerated rate over a period of 4-5 years. Under this scheme milling and processing of stockpiled ore would continue for a further 2.5 to 3.5 years beyond the completion of mining.

The project will essentially consist of mining pits, treatment plant for milling and processing ore to produce yellow cake (U_3O_8), a tailings disposal area and a single man's camp accommodating 140 persons. A workforce of up to approximately 250 persons may be required during the construction and operational phases of the project.

1.2 Location

The development will be situated on the Millbillillie pastoral property at the northern end of Lake Way (refer figure 1) which is approximately 750 kilometres north-east of Perth. The nearest town is Wiluna (15 km distance) to the north-west and Meekatharra, the regional centre for the East Murchison pastoral region is 170 km to the west.

The proposed Yeelirrie uranium project lies approximately 70 kilometres to the south.

1.3 ERMP/Draft EIS

In accordance with the Commonwealth Environment Protection (Impact of Proposals) Act 1974 and Western Australian Government requirements, an ERMP/Draft EIS for the project was prepared by the Joint Venturers.

The ERMP/Draft EIS was made available for public review on 25 April 1981 and persons were invited to make written submissions to the Department of Conservation and Environment and the Department of Home Affairs and Environment on or before 20 June 1981.

1.4 The Proponent

The Lake Way deposit is owned jointly by Delhi International Oil Corporation (53.5%) and Vam Ltd. (46.5%). The project, to date, has been run as a joint venture with Delhi acting as managers and operators.

2. EXISTING ENVIRONMENT

2.1 Regional Setting

The development will take place within the Wiluna sub-region of the East Murchison region which is typically arid country with large areas of flat to undulating terrain, sandplains and salt lake systems. Vegetation in the region is dominated by spinifex, mulga and other acacia species, and halophytic associations in the vicinity of salt lakes. The only trees of the region of any size, are river gums and coolabahs along creeks and river drainage systems.

2.2 Climate and Meteorology

The climate in the Lake Way area is arid with average annual rainfall and evaporation of approximately 250 mm and 2500 mm respectively. Rainfall is variable with most occurring in the December to May period, generally as a result of thunderstorms and cyclonic activity elsewhere. Dry periods of between 6 and 9 months occur in most years.

Summers are hot with the maximum temperatures for the months of December, January and February averaging 37°C. In winter frosts are common and the days are generally mild.

The wind pattern is largely dominated by the movement of the sub-tropical anticyclonic belt. In winter this system moves north maintaining easterly winds over the area. Between winter and summer the system moves south again maintaining south-easterly to easterly winds. In summer a monsoonal depression forms over the northern centre of the State causing the system to move further south and the combined circulation maintains easterlies in the Wiluna area. Consequently for 41% of the year winds prevail from the south-easterly and easterly sectors.

In the winter months calm, clear conditions often occur at night leading to the formation of nocturnal inversions with ceiling heights ranging from 20 to 200 m (above ground level) on 90 to 100 days of the year.

2.3 Landforms, Geology and Soils

In the vicinity of the development two landforms "Cunyu" and "Carnegie" have been identified. The mine and mill sites are principally located on the "Cunyu" landform which consists of calcreted valley fills and alluvial plains. The Carnegie landform (Lake Way) immediately south of the mining area, consists of floors of highly saline sediments surrounded by saline soils which support samphire and halophytic vegetation.

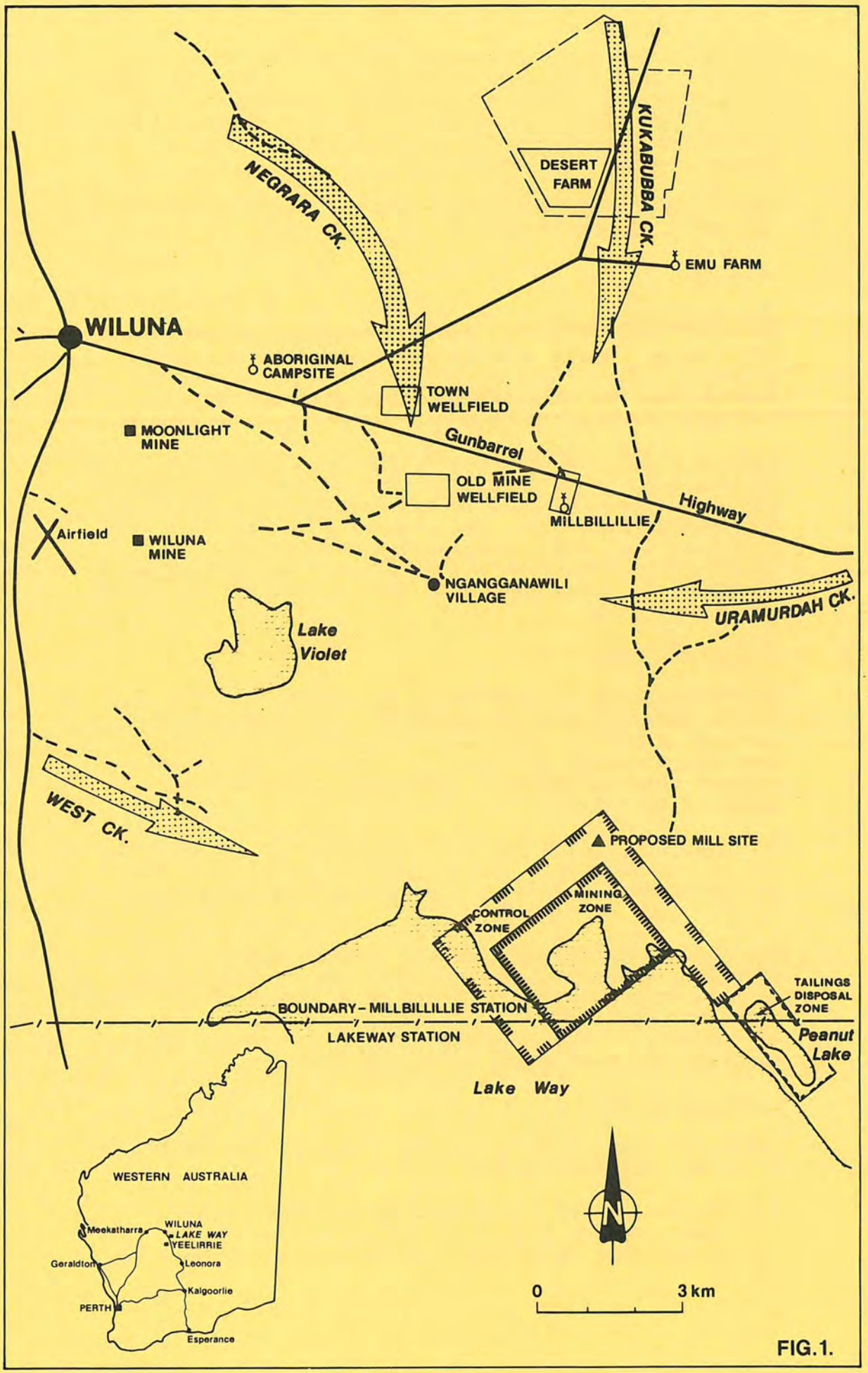
NEGRARA CK.
KUKABUBBA CK.
DESERT FARM
EMU FARM
WILUNA
ABORIGINAL CAMPSITE
TOWN WELLFIELD
MOONLIGHT MINE
Gunbarrel Highway
OLD MINE WELLFIELD
MILLBILLILLIE
Airfield
WILUNA MINE
NGANGGANAWILI VILLAGE
URAMURDAH CK.
Lake Violet
WEST CK.
PROPOSED MILL SITE
MINING ZONE
CONTROL ZONE
TAILINGS DISPOSAL ZONE
BOUNDARY - MILLBILLILLIE STATION
LAKEWAY STATION
Peanut Lake
Lake Way
WESTERN AUSTRALIA
Meekatharra
WILUNA
LAKE WAY
YEELIRRIE
Geraldton
Leonora
Kalgoorlie
PERTH
Esperance
N
0
3 km

FIG.1.

Uranium mineralization occurs over a wide area in the vicinity of Lake Way. Within this region are four areas where ore-grade material can be located. The uranium occurs as the mineral carnotite deposited from groundwater on slickensides, fractures, voids and coarse grained material.

The soils are predominantly coarse-grained earths and sands of low fertility.

2.4 Land Use

The development will take place on the Millbillillie pastoral lease which at present carries approximately 2500 sheep. Apart from gold mining which occurred from the early 1900's to the late 1940's, grazing constitutes the only other significant land use in the Lake Way region.

Between 5 and 6 kilometres to the north of Millbillillie station are two agricultural enterprises "Desert Farm" and "Emu Farm" operated in conjunction with the local aboriginal community. The "Desert Farm" is an irrigated citrus orchard and market garden enterprise. The objective of "Emu Farm" is to produce marketable emu products, in particular high quality leather for shoes and accessories.

2.5 Flora and Fauna

The development is located in the Wiluna sub-district of the Austin Botanical District. A total of 148 species of plants were identified in the mining, tailings disposal and control zones and additional species were recorded on traverses throughout the proposed bore-field.

A number of species collected are rare or restricted. One of these species, an undescribed Melaleuca, has to the present only been recorded at two other sites.

The natural environment of the region appears to be seriously degraded and the population of indigenous animals depressed, most likely as a result of grazing by stock and hunting by feral animals. There are very few animals in the area that can be considered narrow endemics and none whose status is critical.

2.6 Groundwater

There are four major groundwater systems (refer figure 2) in the Wiluna/Lake Way area :

1. Paroo aquifer - some 100 km in length rises near Diamond Well Station (approximately 110 km north-west of Wiluna) and terminates in Lake Way.

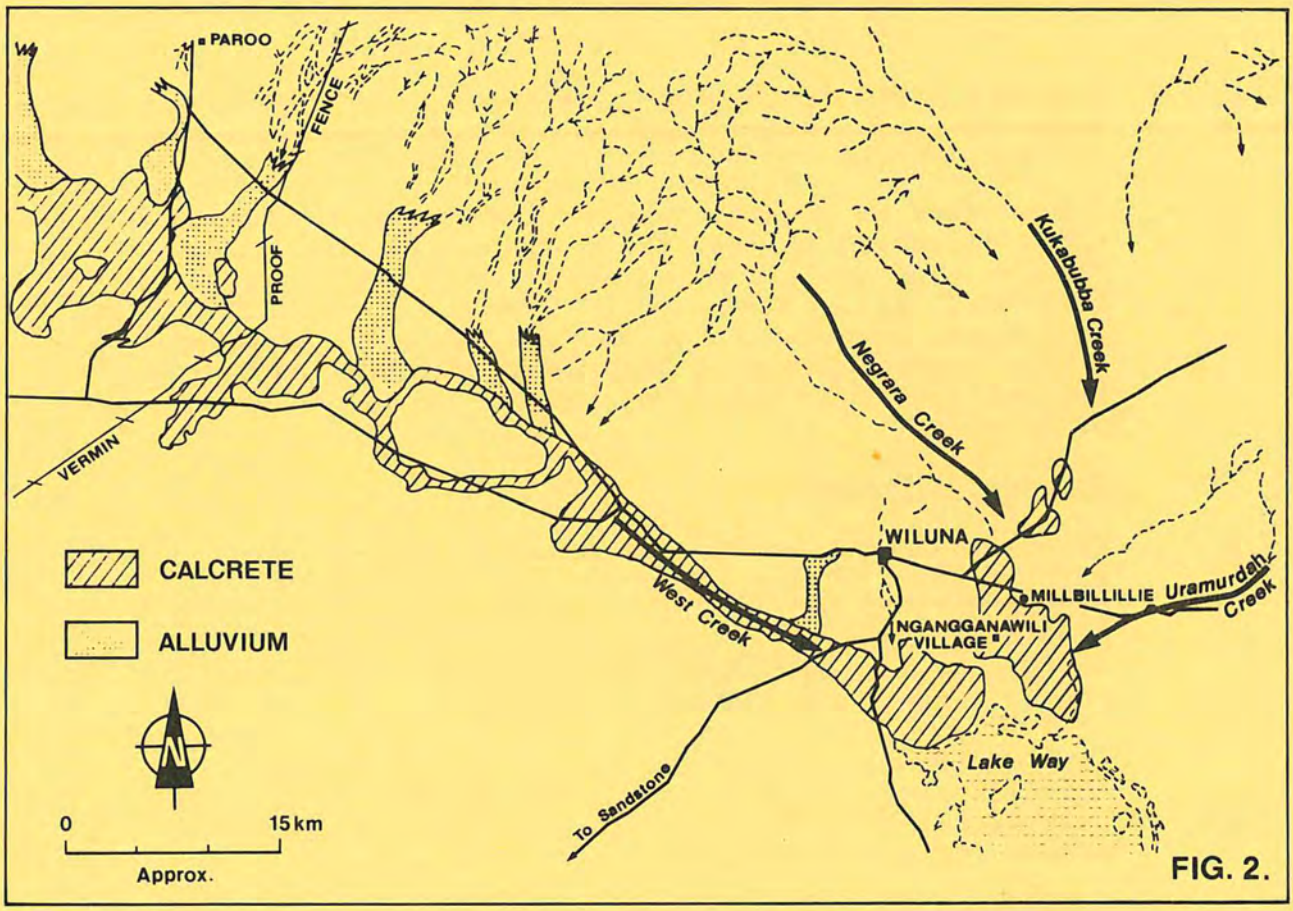
PAROO
FENCE
PROOF
VERMIN
Kukabubba Creek
Negrara Creek
WILUNA
MILLBILLILLIE
Uramurdah Creek
NGANGGANAWILI VILLAGE
West Creek
Lake Way
To Sandstone
CALCRETE
ALLUVIUM
N
0
15 km
Approx.

FIG. 2.

2. Negrara Creek aquifer - rises 25 kilometres to the north west of Wiluna and coalesces with the Kukabubba Creek aquifer approximately 3-4 km north of Millbillillie Homestead. These groundwaters then flow to Lake Way.

3. Kukabubba Creek aquifer - rises approximately 60 kilometres north of Wiluna and joins the Negrara Creek system.

4. Uramurdah Creek aquifer - rises to the west of Millbillillie Homestead and coalesces with the combined Negrara Creek/Kukabubba Creek system just south of the homestead.

The area where the Negrara Creek, Kukabubba Creek and Uramurdah Creek systems combine and flow to Lake Way, is sometimes called the east Wiluna aquifer.

Groundwater of potable quality (less than 1000 ppm total dissolved solids) is found near Millbillillie Station, but quality deteriorates as it approaches Lake Way. At Uramurdah Well, 5 km south of Millbillillie Homestead, groundwater is only suitable for stock and in the mineralized zone (approximately 9 km south of the Station) salinity levels can be up to three times that of seawater.

2.7 Human Environment

The closest town to the development, Wiluna, has a population of 27 and serves as the administrative centre for the Wiluna Shire. Approximately 600 aboriginal people live in the Wiluna area with the majority being located at the Ngangganawili Community Village and a campsite along the Gunbarrel Highway.

Most of the aboriginees at Wiluna are Putitjarra, Mantjiltjarra, Kiyatjarra and Kurtutjarra people who have migrated to the area from the north and east desert regions since 1940.

The Wiluna aborigines have a strong commitment to traditional religious beliefs and ritual. Wiluna itself is an important ritual centre for the local and more distant aboriginal communities.

One aboriginal sacred site was identified by the Western Australian Museum, within the Joint Venture's claims and has been declared as a protected place under the Aboriginal Heritage Act.

2.8 Radiological Levels

In the mineralized zone existing radon daughter levels are below 0.001 WL* under windy atmospheric conditions. Under calm conditions levels up to 0.1 WL can be expected. Under extremely calm conditions, i.e. in the presence of strong nocturnal inversions, levels as high as 0.6 WL are possible.

Levels of radon daughters found in the mineralized area can be expected to occur at any site up to 6 km away.

Groundwater near the mineralized zone has high radium 226 and moderate uranium concentrations, but these abnormal concentrations do not extend far from the mineralized zone. Groundwater at the Millbillillie Homestead and Ngangganawili Community are well within potable water standards.

*WL - A unit of radon daughter concentration; a value of 0.33 WL is set as the maximum allowable in the work place over a 40 hr week.

3. THE PROPOSAL

The development can be categorized into four phases; construction, operation, decommissioning and rehabilitation, with the latter two phases substantially overlapping. The life of operational aspects of the project is expected to be between 6 and 7 years, and construction will take approximately 2 years.

During the construction phase the single man's camp, road system, flood diversion system, process bore-field and some mining pits will be established.

The Joint Venturers favour the project proceeding at an accelerated mining and milling rate, because of economic considerations.

3.1 Mining Operation

An open cut system will be employed using standard earth moving equipment. There is no need for blasting.

The material removed from the pits will be divided into four broad categories :

- Overburden - unmineralized material more than 0.3 m above the water table (10,848,400 tonnes).
- Waste - unmineralized material less than 0.3 m above the water table (8,978,800 tonnes).
- Sub-ore - mineralized material containing less than 450 ppm but more than 250 ppm of uranium (1,150,500 tonnes).
- Ore - mineralized material containing more than 450 ppm of uranium (5,761,400 tonnes).

The top 0.3 m of overburden (topsoil) will be removed and stockpiled separately and then returned following the backfilling of the mining pits.

The ore will be subdivided into three categories :

- Ore with uranium content greater than 900 ppm.
- Ore with uranium content between 701 and 900 ppm.
- Ore with uranium content between 451 and 700 ppm.

In the initial phases of the project mineralized material with higher uranium content will be milled preferentially. This is apparent from the proposed milling programme which shows that under an accelerated milling rate the two highest grades of ore will be processed within 2 years.

As the ore body is below the water table continuous dewatering of the mine pits will be necessary. Initially the dewatering rate is expected to be as high as 3500 kL per day, but after two years will reduce to 2000 kL per day. The waters are very saline (between 20,000 and 90,000 ppm total dissolved solids) and will be discharged to the surface of Lake Way.

3.2 Stockpiles

The amount of ore, overburden and waste in stockpiles will be highly dependent on the mining and milling rate. At the accelerated mining rate the amount of ore in stockpiles could be as much as 3 million tonnes after 4 years and cover an area of 31 hectares. Under this scheme the amount of sub-ore in stockpiles would reach a maximum of 1 million tonnes at the same time and occupy 15.5 hectares.

Ore stockpiles will be located adjacent to the mill whereas sub-ore stockpiles will be situated in the mining area.

Stockpiles will be kept wet and there is a possibility that the watering system will also serve to wash chlorides from the ore.

3.3 Ore Processing

Basically, an alkaline process combined with ion exchange will be used to extract uranium from the ore.

The processing of ore can be split into 7 basic steps :

- Chloride Washing - Chlorides will be removed from the feedstock ore either by irrigating the ore in stockpiles or by a counter current decantation process. Wash waters would be disposed of in the mining pits or Lake Way.

- Crushing and Grinding - The washed ore is milled to produce a maximum particle size of 600 microns and slurried. The ore will be handled wet throughout this process.

- Leaching - The ore slurry will be treated with a 0.2 molar solution of sodium carbonate at 95°C for 16 hours. During this step uranium goes into solution.

- Sand/Slime Separation - The sand fraction of the reaction mixture will be separated and disposed of in the mining pits leaving a slime slurry which will be processed further.

- Ion Exchange - The slimes slurry will be processed through an ion exchange system to extract the uranium that is in solution. The resin is then separated from the slimes (pulp) which is combined with waste process water and pumped to the disposal area.

- Uranium Recovery - The uranium will then be stripped from the resin and precipitated from solution, (in the form of a peroxy complex) by the addition of hydrogen peroxide.

- Product Preparation - The uranium peroxy complex slurry will be dewatered and then calcined at 500°C. The product, yellow cake, (U_3O_8) will be packaged into drums for later shipment by road to Geraldton, Esperance or Fremantle.

3.4 Tailings Disposal

The tailings effluent from the ore processing plant will be separated into two streams. One stream will contain the sand tailings and will be conveyed back to mining pits for disposal. These pits will be filled with sand tailings up to the water table level and backfilled with 2 m of overburden.

The other stream, slime tailings, will be pumped with process reject waters as a 20% slurry to an existing clay pan (known as Peanut Lake) on the eastern side of Lake Way. This separation of the tailings streams is considered to be necessary because of the difficulties that would be encountered in settling and consolidating the slimes fraction in mining pits that are inundated with groundwater.

The clay pan is 1.25 km^2 in area and is surrounded by stable cemented sand - gypsum dunes. The floor of the clay pan consists of layers of consolidated clay-gypsum sediments which are expected to be of low permeability. The permeability of the clay pan is expected to be reduced further by consolidation of clays which constitute a high percentage of the slimes.

The Joint Venturers intend to utilize almost all of the clay pan area for evaporation of waste liquors and at the end of the project the area will contain at least 1.5 m of consolidated tailings which will be covered with sediments from Lake Way.

3.5 Flood Diversion

During the early construction phase of the project a diversion drain and bund will be constructed across Uramurdah Creek from the 494 m contour to Lake Way, to divert run-off from the Uramurdah Catchment away from the mining pits.

Waters coming down the Kukabubba and Negrara Creeks drain into Lake Way to the west of the mining area through West Creek and are not expected to flood into the mining area. However the Joint Venturers intend to construct a bund across the entrance of the clay pan adjoining Lake Way, which drains into this drainage system, to prevent possible flooding of some mining operations.

3.6 Water Supplies

Initially water will be obtained from the calcrete aquifer (east Wiluna aquifer) north of the mining area near Millbillillie Homestead. The project will require a maximum total of 7000 kL per day of process water with a quality better than 3000 ppm of total dissolved solids. Approximately 3% of this demand is required to be of potable quality (less than 1000 ppm of total dissolved solids).

If it is found that chlorides can be washed from the ore in stockpiles then the water requirements for the project could be substantially reduced.

As the supply of water to the project could interfere with the supply of water to existing users in the region, the Joint Venturers have undertaken to provide potable water to the township of Wiluna, Ngangganawili Community and Millbillillie Station until such time as the aquifers have recovered and normal supplies can be resumed.

3.7 Camp

A single man's camp will be built in the proximity of the mining and mill sites. It will be designed to accommodate approximately 160 people. The intention is for the camp to be self-contained with its power and water supplies. The camp will be sewered and the effluent treated in an oxidation pond.

3.8 Roads and Transportation

The road system will be built for heavy use and surfaced with unmineralized calcrete from the mined areas. Discussions have taken place between the Wiluna Shire and the Joint Venturers with a view to providing road access to the mill, mining and camp sites from the Kalgoorlie road.

Supplies for the mining and milling operations will be transported by road. Consultation will occur on the preferred trucking routes and requirement for upgrading.

Packaged yellow cake will be despatched by road to an export port (Fremantle, Esperance, Geraldton).

3.9 Decommissioning

When all mining and milling operations have been completed the Joint Venturers intend to undertake the following :

- All process equipment and buildings will be decontaminated and dismantled and where possible shipped off site for re-use.
- Water will continue to be supplied to appropriate users in the area until they can return to their own supplies.
- The camp will be shipped off site.
- Flood diversion system will be removed and the area recontoured back to its original condition and revegetated.
- Plant site will be recontoured and revegetated.
- Mine pits will be progressively filled and revegetated during the mining operation and this is expected to be completed by the time that milling ceases.
- Slime tailings disposal area will be covered with lake sediments.

4. ENVIRONMENTAL ASSESSMENT

In assessing the environmental impact of the Lake Way Uranium Project the Authority took into consideration public and Government Department submissions. The Department of Conservation and Environment held discussions with appropriate Commonwealth Government officers and the Joint Venturers on various aspects of the projects and the results of these discussions have been taken into account by the Authority.

4.1 Adequacy of ERMP/Draft EIS

The Authority considered that although the ERMP/Draft EIS document had some omissions and shortcomings, it contained sufficient information for the public and other government authorities to make an assessment of the proposal.

The report contains many significant commitments, for example the section dealing with Environmental Management, but because the report has not been organised in a coherent manner many of the commitments are hard to determine in total, because the topics to which they apply are found in several sections of the report in a fragmented way.

The report was deficient in some aspects of the estimation of radiation hazards and also lacked detailed plans of operations such as mining and milling. The Authority, however, recognises that such documentation would in any case have been subjected to continuous amendment during the final planning stages of the project.

The report was only marginally acceptable from an editorial viewpoint. For example the report, when it was formally submitted, contained numerous spelling and typographical errors as well as transposition of clauses. A major shortcoming was the use of mixed metric (both SI and non SI) and imperial units throughout and particularly in Appendix 7 and the report lacked a glossary to explain the radiological units and geological terms. The Joint Venturers cooperated by correcting many errors and adding a glossary prior to the report being made available to the public, but Appendix 7 was not significantly improved.

The Authority considers that although the Joint Venturers have responded to the public submissions as required by assessment procedures, their responses have been in most cases at best the minimum that was required.

4.2 Tailings Disposal

The disposal of wastes (tailings) from the processing of uranium ore is one of the most critical environmental aspects of any conventional uranium mining and processing project. The disposal of tailings should be conducted in such a manner that it does not present an unacceptable risk, either now or in the future.

To illustrate these points the following is an extract from the Code of Practice "Management of Wastes from the Mining and Milling of Uranium and Thorium Ores", published by the International Atomic Energy Agency, Vienna, 1976 with which the Yeelirrie Uranium Project is required to comply under the Uranium (Yeelirrie) Agreement Act 1978.

> "Tailings. The goal in management of tailings is their disposal in such a manner that continuing surveillance (over thousands of years) would be reduced to a minimum, if not made unnecessary. This goal has not yet been achieved, but in view of its feasibility in some cases, it should be striven for when planning each new project. However, there are alternatives for managing tailings in a safe manner.
>
> If the hydrogeological, engineering, radiological protection, environmental and economic aspects are favourable, disposal to mined-out areas is preferred. However, at least for underground workings, it is rarely possible to arrange for all the tailings material to be so disposed, and a surface waste retention system for the remaining fine material is still needed.
>
> The more usual solution involves the construction of a waste retention system to retain the tailings material in such a manner that it does not present an unacceptable risk, either now or in the future, to man and the environment beyond the immediate area of the deposit, with due account being taken of wind and water erosion and radon emanation.
>
> The characteristics of the tailings, including factors affecting long-term stability, should be assessed in relation to the site characteristics before selecting the waste retention system to be adopted and the water management programme which is a part of it.
>
> The site assessment should involve field measurements of the permeability of the base of the waste retention system and of the material to be used in the construction of the embankment. Unstable material should not be used in the embankment. Geological fault zones should be identified and avoided where indications of

instability exist. Consideration should be given to reducing their permeabilities by grouting or other means, where necessary, and to locating test bores in aquifers and fault zones as a check on the estimates for seepage loss.

The design and construction of the embankment system should meet the safety criteria of engineering codes with respect to long-term stability, particularly against internal and external erosion and seismically induced acceleration fields. Consideration should be given to operating systems as well as requirements for decommissioning.

The embankment design should provide adequate free board at all times, means for preventing wave erosion of the upstream face and physical protection of surfaces that is consistent with the long-term objectives of stabilization."

Alternative tailings disposal options considered by the Joint Venturers were :

Option 1 - Disposal of all tailings into mining pits.

Option 2 - Disposal of all tailings in a conventional above ground tailings dam.

Option 3 - Disposal and burial of slimes in Peanut Lake and sand tailings in mine pits. (Option preferred by Joint Venturers).

Option 4 - Disposal below grade in an excavation created specifically for tailings disposal.

The Authority believes that Options 2 and 4 are either impractical or environmentally less desirable than Options 1 and 3.

The Authority sees the following environmental advantages and disadvantages for Options 1 and 3.

	Advantages	Disadvantages
Option 1	- less interference with existing landscape. - reduced release of radon to atmosphere. - long stability is guaranteed if disposal is below grade. - long-term surveillance is reduced to a minimum, very little monitoring after completion of the project is necessary. - mined area will be stabilized and revegetated.	- disposing into groundwater. - insufficient volume available in mining pits in the ore zone for slimes. - consolidation problems. - drying of slimes may be necessary, potentially creating further short-term environmental problems.

	Advantages	Disadvantages
Option 3	- natural depression with what appears to be long-term stability. - disposal will be above the water table. - permeabilities of underlying sediments are expected to be low.	- a greater amount of the environment will be affected. - as disposal of tailings will occur over a large area there will be an increased risk of contamination of the environment in the future. - final covering over tailings will not be revegetated. - monitoring of groundwater will be required long after project is completed.

Overall the Authority considers that the most environmentally desirable option would appear to be the disposal of all tailings into the mining pits. However the Joint Venturers are of the opinion that there are some difficulties associated with the disposal of slime tailings into the pits at Lake Way.

The Authority believes that further detail is required for assessment of the ability of Peanut Lake to fulfil all the requirements for a long term disposal site. Also further detail is required on the engineering and other problems associated with the disposal of slimes into mining pits and the subsequent rehabilitation of these areas.

The Authority believes that both options (Options 1 and 3) will be within acceptable environmental limits, but feels that the more environmentally acceptable option (taking into account potential long-term hazards) should be adopted, if practicable.

The Authority feels, that as insufficient detail is available on the two most environmentally acceptable options (Options 1 and 3), the choice of the best option should be left to be finalised by the State following the submission of a detailed proposal for tailings disposal. This proposal should also contain a monitoring programme.

The Authority believes that should the disposal of slimes into Peanut Lake ultimately prove to be the only practicable option, then the final surface of this disposal area should be revegetated and stabilised in accordance with the objectives of the rehabilitation programme.

The Authority therefore recommends that :

Recommendation 1

A detailed tailings disposal proposal should be prepared and submitted to the State for evaluation at least 18 months prior to the commencement of mining.

The Joint Venturers should consult closely with the State on the preparation of the proposal which should examine in detail the two options -

(1) Slimes into Peanut Lake.

(2) Slimes into mining pits.

The proposal should include details of a monitoring programme.

The proposal should also be included in an overall Environmental Management Programme.

4.3 Mining and Stockpiles

From a financial point of view the Joint Venturers would prefer to mine at an accelerated rate over a period of 4-5 years. This would mean that the amounts of ore in stockpiles and the number of open mining pits would be greater than would result from the slower rate of 7 to 8 years. The accelerated mining rate would lead to greater emissions of radon to atmosphere over the life of the project and environmental problems would be greater in the event of a premature shut down.

Therefore from an environmental perspective a mining rate equivalent to the milling rate is preferable. However under either scheme the annual average concentrations of radon in the atmosphere will be well below acceptable limits.

The Authority believes that the environmental problems that face the State in the case of a premature termination or suspension of the project, should be minimized. To accomplish this objective the Authority feels that the accelerated mining rate would be acceptable only if it was ensured that all mineralized ores are processed or returned to the pits and the area rehabilitated in the event of premature termination or suspension.

The information provided on mining is of a generalized nature and does not give any detail on sequence and schedule of mining activities.

The Authority believes that a detailed mining plan is required so that an assessment can be made of proposals to minimize environmental impacts.

The Authority therefore recommends that :

Recommendation 2

A final detailed mining plan be prepared and submitted to the State at least 21 months prior to commencement of mining operations. The final mining plan should indicate proposals to ameliorate or minimize environmental impacts and these proposals should be addressed in the Environmental Management Programme.

Environmental impacts of stockpiles have not been fully considered in the ERMP. Several stockpiles will be present in the area. It is anticipated that overburden and topsoil stockpiles will be produced adjacent to the pit areas and that ore stockpiles will be constructed near to the mill. Topsoil from proposed ore stockpile areas will also be saved. The Joint Venturers have indicated that dust will be suppressed on the ore stockpiles by irrigation of the top surface. They anticipate that stockpile sides will also be kept adequately moist by this technique. The Joint Venturers have no plans for the treatment of topsoil or overburden stockpiles and non-radioactive dust from these would be likely to be dispersed.

The Authority therefore recommends that :

Recommendation 3

Overburden and topsoil stockpiles should be treated to minimise dust nuisance.

Recommendation 4

A bond be required from the proponent which is sufficient to cover the estimated cost of replacing stockpiled ore in the pits, rehabilitation of the site and disposal of the plant in the event of premature termination or suspension of the project. The adequacy of the bond should be reviewed periodically and modified to accommodate changes in or completion of part of the rehabilitation programme.

4.4 Decommissioning

In the ERMP/Draft EIS a brief description of commitments during the decommissioning phase of the project is given. Discussions with the Joint Venturers have indicated that a preliminary decommissioning plan or programme will be developed and co-ordinated with the final project design programmes.

The Authority believes that all building structures and items of plant should be decontaminated and safely disposed of. The mine and mill sites should be restored to as natural state as possible.

The Authority therefore recommends that :

Recommendation 5

A detailed decommissioning plan or programme should be drawn up with the following objectives and submitted to the State for evaluation at least 15 months prior to the commencement of mining :

- *aim to minimize the area of land on which future uses are restricted.*
- *nominate the areas which will be subject to a covenant restricting future use of the land.*
- *indicate the levels of radioactivity below which plant, equipment and structural equipment will be decontaminated.*
- *include detailed plans for decontaminating the site, the disposal of plant and materials and restoration of the area affected by the project.*

4.5 Radiological Impacts

There are basically three routes by which the body can be affected by radiation :

- direct external irradiation (gamma rays).
- inhalation.
- ingestion.

The major demonstrated health hazard associated with uranium mining results from the inhalation of radioactive material and in particular radon daughters. External radiation (gamma rays) can still be a significant hazard to miners and plant operators but radiation doses can be kept below acceptable limits by adoption of some safety precautions. Ingestion of radioactive substances can be significant but improvements to radiation hygiene have reduced this problem substantially.

4.5.1 External Gamma Radiation

Exposure to gamma radiation will be greatest for mine pit workers and mill operators in ore leaching and ion exchange areas of the plant. The level of exposure 0.02 Sv*(calculated on the basis of 40hr/week) will still be well below the recommended level of 0.05 Sv in the "Code of Practice on Radiation Protection in the Mining and Milling of Radioactive Ore", 1980.

The Joint Venturers intend to rotate employees between various mine site job locations and to monitor employee exposure to ensure that worker exposure is held well below Code of Practice limits. Diligence in these practices should prevent any employee receiving doses in excess of the above standards.

4.5.2 Ingestion

Potable water will be supplied to users in the Wiluna area from the underground storage at the northern end of the east Wiluna aquifer, and will not be subject to additional contamination from activities associated with the development. Storage tanks in the mine-mill complex will be small and enclosed to limit contamination by airborne dust. Ingestion of radioactive substances from meat will be minimized by ensuring the sheep on Millbillillie Station will not be used for meat or sold for meat. The Joint Venturers also intend to monitor the level of radioactive substances in kangaroo meat over the life of the project.

The contamination of produce at the Desert farms by fallout of dust containing radioactive substances is not expected to be significant.

4.5.3 Inhalation

The ERMP/Draft EIS indicates that under the worst case of an accelerated mining rate the radon release rate from the project reaches a maximum of 2.28 M Bq.S^{-1}* during the fifth year of operation (which is 2.5 times the rate of radon emission over the mineralized area). The dispersion of radon emissions has been modelled and radon daughter concentrations estimated for the following locations (appropriate acceptable concentration limit is also shown).

	Estimated Level (WL+1 X 1000)	Acceptable Level (WL X 1000)
Wiluna Township	0.024	10++
Ngangganawili Community	0.053	10++
Mining Pits	0.17	330+++

* Sievert - a unit of gamma radiation exposure.

* M Bq S^{-1} - Megabecquerel per second, rate of release of radioactivity.

\+ WL - Unit of radon daughter concentration.

++ Based on 168 hr/week exposure.

+++ Based on 170 hr/month exposure.

The ERMP/Draft EIS has not provided an estimate of the annual dose equivalents for the working and general population.

The Department of Health has advised, and the Authority agrees, that the ERMP has not established the existence or otherwise of a critical group who may be exposed to the greatest radiation doses. Further studies, including the identification of foodchains which may contribute most to the radiation exposure of persons, should be carried out.

Appendix 4 (prepared by the Australian Atomic Energy Commission Research Establishment) indicates that existing radon daughter concentrations in the central mining area could, under conditions of extreme atmospheric stability, reach 0.6 WL. The authors also indicate that it is possible that similar values could be observed at any site within a distance of 6 km.

The Authority believes that it will be essential to monitor levels of radon daughters continuously particularly during periods of calm atmospheric inversion. In addition to this monitoring it is also essential that meaningful meteorological measurements be made under these conditions.

The Authority therefore recommends that :

Recommendation 6

Further studies be carried out to establish the existence or otherwise of a critical group.

Recommendation 7

Levels of radon be monitored continuously in the mining pits and in addition the Joint Venturers institute a study of radiation levels inside and outside the project area under circumstances of calm atmospheric conditions. This study should include the gathering of meteorological data suitable for use in air dispersion models.

Recommendation 8

The Joint Venturers should liaise with the Departments of Conservation and Environment and Health and Medical Services during the preparation of proposals for the above studies.

4.6 Water Supply and Management

The Joint Venturers have investigated in detail the characteristics of the east Wiluna aquifer. The ERMP/Draft EIS indicates that the project will require up to a maximum of 7000 kL per day from this aquifer of groundwater with total dissolved solids of less than 3000 mg/L. From discussions with the Joint Venturers there appears to be scope for substantial reductions in process water requirements, if a larger proportion of the water used is of good quality and if washing of the ore stockpiles is successful. Also alternative sources of groundwater in the region could be utilized for the project.

There are possible future problems relating to the supply of water to future developments in the area. At present a company proposes to treat tailings and this will require large amounts of water. There is also the probability that Desert Farm will expand its operations and require additional water supplies.

Given the possibility of competition for groundwater resources in the area the Authority believes the State needs to construct an inventory of quantities and capacities of groundwater resources in the area. The State would also need to have reliable information on recharge rates, safe yield and quality of groundwater in the various aquifers in the region. Such actions would provide a basis for a rational and maximum use of the limited resource.

The State would ultimately benefit from such actions, as it could maximise safe usage without unnecessarily precluding new or expanded developments which are of benefit to the State.

The Authority therefore recommends that :

Recommendation 9

The State through the Public Works Department institutes a comprehensive study of the characteristics, capacities and qualities of all groundwater resources in the Wiluna/ Lake Way region. The results of this study would then be used to plan the rational use of the limited water resource to maximize safe usage for developments.

The ERMP/Draft EIS provides estimates of the reduction in the levels of groundwater that will result from the extra water required by the project. The Joint Venturers claim these estimates are based on conservative assumptions including no recharge. Reduction of water table levels (drawdown) are to be 2-3 metres at Emu Farm, 8-9 metres at Millbillillie Homestead, 5-6 metres at the town wellfield and 1 metre at Desert Farm.

As these drawdowns may interfere with local water supplies the Joint Venturers have undertaken to supply the Wiluna Township, Millbillillie Station and the Ngangganawili Community with potable water. The same undertaking should be extended to include the Emu Farm operation. The Joint Venturers do not intend to supply Desert Farm, but if this operation is adversely affected, the Joint Venturers have undertaken to reduce their rate of groundwater abstraction to a level which will not adversely affect Desert Farm.

The Authority notes that the estimates of drawdown are based on conservative assumptions but it still believes that the Joint Venturers ought to be required to reduce their water consumption as far as practicable. Also alternative groundwater sources should be exploited where possible to relieve any short term pressure on groundwater resources. The use of alternative sources should be consistent with any State plan for the rational use of the regional groundwater resources (as indicated in previous recommendations).

A Conceptual Water Management Scheme has been drawn up by the Joint Venturers and is described in the ERMP/ Draft EIS. The Public Works Department has reviewed this Scheme and found that it requires revision to allow for peak rates and anticipated growth in water demands. The Authority believes the requirements of the Public Works Department should be complied with on this matter.

The Joint Venturers provide no indication of how long it will take the aquifers to recover after cessation of the operations. Undertakings have been given by the Joint Venturers that the existing users will be supplied by the Joint Venturers until such time as they are able to return to using their original groundwater supplies. It is probable that water will have to be supplied to existing users for some time beyond the life of the project.

The Authority feels that a satisfactory means of ensuring supply to the existing users beyond the life of the project or following the premature shut down of the project must be devised. The Public Works Department has suggested that a sizeable bond be lodged for this purpose.

The Authority therefore recommends that :

Recommendation 10

The Joint Venturers undertake to supply the water requirement of the Emu Farm.

Recommendation 11

The Joint Venturers reduce water consumption as far as practicable.

Recommendation 12

The Joint Venturers be requested to use alternative groundwater resources, provided that such use is consistent with an overall State plan for rational use of the resource.

Recommendation 13

The Conceptual Water Management Scheme be revised to satisfy the requirements of the Public Works Department.

Recommendation 14

The long-term supply of potable groundwater to Emu Farm, Ngnangganawili Community, Millbillillie Station, and the Wiluna Township should be assured in the case of premature shut down and beyond the life of the project by the provision of a bond by the Joint Venturers.

4.7 Camp and Workforce

The peak construction workforce is expected to be up to 250 persons. At the accelerated mining rate the operational workforce is expected to reach 140 persons. The camp is designed to cater for a total of 160 (140 workforce plus 20 spare) which seems to fall well short of the accommodation required by a peak workforce of 250 during construction. The ERMP/Draft EIS does not make it clear whether the camp will accommodate the construction workforce or just the operational workforce. Additional information provided by the Joint Venturers indicates that during the construction phase the number of workers accommodated per room will be increased to cope with peak workforce levels.

A conceptualized plan of the camp has been provided and additional information supplied by the Joint Venturers indicates that all essential services will be provided. Sewage will be treated by the oxidation pond method and garbage will be disposed of in a sanitary landfill site in one of the abandoned mines in the area.

According to recent discussions with the Joint Venturers there are numerous alternative camp sites available so access to the camp could be made available from the Kalgoorlie road to minimize vehicular traffic through areas of habitation.

The Joint Venturers intend restricting all operating staff to the camp and private vehicles and personal visitors will be prohibited from all areas controlled by the Joint Venturers. Employees will be rostered on a 19 day on 9 day off rotation, with all recreation days spent in either Geraldton or Perth. The Joint Venturers are intending to make these restrictions to minimize social impacts on the local aboriginal populations. Anyone working on the Joint Venture would have to observe this working pattern and this would include local aborigines if any are employed on the project.

The Authority therefore recommends that :

Recommendation 15

Access to the camp should be exclusively from the Kalgoorlie road and the Joint Venturers should submit to the State for its evaluation a detailed proposal on the camp and its location.

Recommendation 16

Plans for treatment of effluent, disposal of garbage, and details of any clearing and revegetation associated with these activities should be included in the Environmental Management Programme.

4.8 Transportation

4.8.1 Employees and Consumables

Employees will travel to and from Perth by air. The mine-mill complex will use up to 150 tonnes per day of fuel, chemicals and supplies which will be taken to the site by road. This will result in an increase in traffic density of ten trucks per day (assuming a load of 15 tonnes). Dust, noise and degradation of the road surfaces will be increased and will continue for the entire period of construction and operation. The Joint Venturers have recognised that consultation with the relevant State authorities to determine road requirements will be necessary.

Spillage of fuel and chemicals may result from traffic accidents. Hazardous materials will be transported with the same precautions as required in other parts of Western Australia.

4.8.2 Yellowcake

Transportation and packaging of the uranium product will comply with IAEA regulations or the relevant Australian codes. The Joint Venturers have stated that the yellowcake will be contained in sealed drums that will be properly blocked and braced before leaving the plant. Approximately ten tonnes per week of yellowcake will be shipped from the site by road and taken to Esperance, Geraldton or Fremantle for shipment.

The Authority therefore recommends that :

Recommendation 17

In order to reduce the risk of yellowcake drums accidentally being disloged from vehicles travelling on unsealed roads and as an additional safeguard in the event of an accident, the Joint Venturers adopt the practice used elsewhere in Australia, of sealing yellowcake drums into shipping containers at the mine site.

4.9 Aboriginal Sites and Community

The Joint Venturers engaged the Museum to carry out a survey of aboriginal sites in the area of the development. One site was identified within the area of the Joint Venturers' claims which is remote from the mineralized areas. No disruption of this site is expected and the Joint Venturers have given an assurance that access to the site by local and itinerant aborigines will not be restricted. The Authority is satisfied that the steps taken by the Joint Venturers in this regard are reasonable.

The Museum survey was carried out before the flood diversion dam was proposed for Uramurdah Creek. As many sites of significance occur on the banks of this creek no development should take place in that area until further discussions have been held with the aboriginal community.

Some concern has been expressed as to the possible social effects the project may have on the local aboriginal community. The Joint Venturers intend minimizing this impact by restricting all mine/mill employees to the project area and requiring that all leave be taken in Perth or Geraldton. No indication is given in the ERMP of whether similar restrictions will be applied to sub-contractors/employees during all phases of the project.

From discussions with the Joint Venturers it appears that road access to mill, mine and camp sites will be altered in order to minimize traffic on roads used by the community. The Authority believes a commitment should be sought from the Joint Venturers in this regard.

The relationship between the aboriginal community and the Joint Venturers throughout the project's life will be very sensitive to the ability of Joint Venturers to develop an appreciation and understanding of aboriginal society. The Authority suggests that to minimize antagonism and suspicion the Joint Venturers acquaint themselves adequately with the local aboriginal culture and traditions and institute an orientation programme to foster understanding and tolerance for its and sub-contractors employees. The on-site environmental officer should also, if possible, be knowledgeable in

liaising with aboriginal communities in order that effective communications can be established with the community and the Joint Venturers.

The Joint Venturers intend erecting signs warning of radiation hazards on fences enclosing their operations. A high proportion of the local and itinerant aboriginal community are illiterate. Consequently the Authority believes that the Joint Venturers will have to clearly explain to the local community the meaning of signs posted and hazards associated with the Joint Venturers activities.

The Authority therefore recommends :

Recommendation 18

That no development should take place on the banks of Uramurdah Creek, including construction of the diversion dam, until further discussions have taken place between the Joint Venturers, the W.A. Museum and the Aboriginal Community.

Recommendation 19

The Joint Venturers undertake a programme to clearly explain to the local aboriginal communities the meanings of warning signs and hazards associated with the project.

Recommendation 20

Warning signs should cover the accidental consumption of contaminated meat from around the mill site.

Recommendation 21

The site environmental officer's responsibilities should include liaising with the local aboriginal communities.

Recommendation 22

The Joint Venturers should institute (in consultation with the appropriate authorities), an educational programme for their own and sub-contractors' employees, to foster an appreciation and understanding of local aboriginal customs and culture.

4.10 Environmental Management

The overall environmental objectives expressed in the ERMP/Draft EIS are reasonable. The Authority agrees that by planning, early identification of potential environmental problems is possible and furthermore enables such problems to be more readily avoided, ameliorated or overcome.

The Authority believes that the preparation of an Environmental Management Programme (EMP), at an early stage, is essential. This Programme should be comprehensive and consider all environmental aspects including monitoring, rehabilitation, waste disposal (including tailings), dust suppression, decommissioning and proposed amelioration of environmental impacts from any other activities associated with the project.

The appointment of on-site radiation and environmental officers is welcomed. The Authority would suggest that the environmental officer should be familiar with aboriginal culture and also have the responsibility of regular liaison with the local aboriginal community.

In reply to public comment the Joint Venturers have indicated that it is impracticable to hold a company to a maintenance and restoration commitment long after all its operational activities on the mining sites have terminated. The Authority feels that, as the project involves a relatively short operational life, resolution of financial arrangement is needed (possibly by a bond) to cover costs of rehabilitation and monitoring in the long-term or in the event of premature shut down or suspension of the project.

The Authority therefore recommends that :

Recommendation 23

An Environmental Management Programme (EMP) should be prepared and submitted to the State for evaluation at least 15 months prior to the commencement of mining operations. Guidelines and criteria for this document should be drawn up in conjunction with the State.

Recommendation 24

Reports on the results, effectiveness and progress of management programmes, monitoring and studies should be submitted to the State at least annually. A detailed reporting timetable should be drawn in conjunction with the State following the submission of the EMP.

Separate detailed proposals for some aspects of the Environmental Management Programme may, if necessary, be prepared and submitted separately at the appropriate time.

Recommendation 25

The EMP may be amended and revised (provided the amendments meet with State approval) as is necessary or required by the State.

Recommendation 26

A bond should be required from the Joint Venturers which is sufficient to cover the costs of rehabilitation, monitoring and any other appropriate aspects of environmental management in the event of premature shut down or suspension of the project.

Recommendation 27

Financial arrangements should also be made to cover the costs of long-term rehabilitation and monitoring of areas affected by the project.

4.10.1 Rehabilitation/Restoration

The ERMP/Draft EIS provides a framework and objectives for a rehabilitation programme. The Authority considers this framework is a sound approach and should constitute a useful basis for the construction of a detailed rehabilitation/restoration programme. The Authority recognises that revegetation of the area will be difficult and any rehabilitation programme should recognise that the techniques and methods of rehabilitation will evolve with time.

In addition to the areas proposed for rehabilitation the Authority feels that the diversion channel and bund should be given a stable vegetative cover. This area could be used to conduct trials of methods of rehabilitation in advance of the commencement of mining.

Although the Joint Venturers have undertaken to remove the diversion channel and bund and recontour this area, on cessation of mining operations, the Authority believes that there is merit in this channel and bund remaining for a period so that flooding over the filled mining pits area will be prevented and rehabilitation thus enhanced.

The Authority therefore recommends that :

Recommendation 28

As part of the Environmental Management Programme, the Joint Venturers draw up and submit to the State for evaluation a detailed rehabilitation/restoration programme including details of the establishment of stable vegetative cover for the flood diversion channel and bund. The programme should emphasise the need for planning in order to minimize impact and thereby minimize the amount of rehabilitation required.

Recommendation 29

The diversion channel and bund on Uramurdah Creek be left for a period to be determined, as temporary protection for the rehabilitated mining pits area.

4.10.2 Monitoring Programme

4.10.2.1 Radiation Monitoring

The ERMP/Draft EIS indicates that monitoring will be carried out in accordance with requirements of the Code of Practice and the Western Australian Radiological Council. Some indications are also given of the places and frequency at which parameters will be measured inside and outside the mining and milling area. Radiation monitoring will be carried out by a Radiation Safety Officer.

The Authority agrees with the Health Department that the monitoring programme as stated is insufficient to judge whether proper surveillance of the operation will be maintained. The Authority believes that the Joint Venturers should submit to the State a detailed radiation monitoring programme for evaluation.

The Authority therefore recommends that :

Recommendation 30

A detailed radiation monitoring programme (including a programme to monitor levels in food and water) be drawn up and submitted to the State for evaluation. The Joint Venturers should draw up this programme in close consultation with the State and the date for submission should be negotiated with the State.

Recommendation 31

In order to ensure that satisfactory radiation safety procedures are being observed, all records maintained by the Radiation Safety Officer (as required under the Commonwealth Code of Practice) must be made available to the appropriate State Authority.

Recommendation 32

The special provision of the Code of Practice in relation to medical surveillance be strictly observed and that employee medical records be made available for Public Health Department scrutiny.

Recommendation 33

The employee's medical record should be made fully available to him/her at any time and also such records should be lodged with the appropriate authority.

4.10.2.2 Groundwater Monitoring

The Joint Venturers intend to monitor the effects of their groundwater extraction on groundwater quality and levels. Undertakings are given that the Public Works Department will be kept informed of the results of the monitoring programme and consulted on any corrective measures that are necessary.

The Authority feels that the Joint Venturers commitments in this area are reasonable, but a detailed monitoring programme to determine the effects of groundwater extraction and discharge of effluents should be produced.

The Authority therefore recommends that :

Recommendation 34

The Joint Venturers should submit to the State for evaluation, a detailed monitoring programme to determine the effects of groundwater extraction and the discharge of effluents, upon groundwater quality and levels and vegetation. This programme could be incorporated and submitted with the Environmental Management Programme.

Recommendation 35

The Joint Venturers should provide the raw data as well as results of the monitoring programme to the Public Works Department for independent assessment.

4.11 Vegetation

Vegetation covering the orebody will be destroyed by the direct effects of mining. If Peanut Lake is used for the disposal of tailings the lacustrine and allied halophytic association within this lake will also be destroyed.

The most significant impact of this project on vegetation will be the threat to vulnerable or rare species. In particular, stands of an undescribed species of Melaleuca (considered to be rare) and an associated parasitic plant (an undescribed Amyema species - also considered rare) are threatened both by the direct effects of mining and the lowering of the water table. Fortunately most of the Melaleuca stands will not be affected directly by mining activities.

The undescribed Melaleuca was recognized as a distinct species in the Yeelirrie EIS/ERMP but no reference was made in this document to its restricted occurrence. However the document does state that "as a number of plants collected from this area are as yet undescribed, it is not possible to determine whether or not they are rare or threatened species, i.e. their distribution is not at present understood" (p. 53, Appendix 4).

The Yeelirrie Study does point out that the Melaleuca, along with Eucalyptus trivalvis, E. clelandii and Casuarina crista, are phreatophytic, i.e. tap saturated soil at the water table with their roots. Populations of the species may, therefore, be detrimentally affected by a lowered water table.

In the flora report of the Lake Way Venture (Appendix 3) the fringing Melaleuca at the northern end of Lake Way is identified as the undescribed species found at Yeelirrie. It is described as a rare and poorly known species known only from Lake Way, Yeelirrie and Lake Darlot. The Lake Way population is the largest of the three known populations.

It must be said that because the botany of inland Western Australia is not thoroughly known, it is possible that other populations are to be found in fringing communities near salt lakes. Any such discoveries are yet to be documented.

The Authority recognises the rarity of some species in the Lake Way area and is concerned that the relatively large population at Lake Way may be at risk, not so much through the direct effects of mining as through lowering of the water table.

The Authority therefore recommends that :

Recommendation 36

The Joint Venturers monitor closely the status of vulnerable or rare species in areas which may be affected by the lowering of the water table and mining activities.

Recommendation 37

The Joint Venturers institute studies in conjunction with the State to assess whether there is wider distribution of rare or vulnerable species than is presently known.

Recommendation 38

Proposals for the studies described in recommendations 36 and 37 should be drawn up in conjunction with appropriate authorities and submitted to the State for evaluation. The emphasis of this monitoring programme should be on the synthesis of all field studies into an ecological appraisal of the area to enable relationships between stress and resilience to be continuously monitored.

5. CONCLUSION

The Lake Way ERMP/Draft EIS, following some editorial amendments, was marginally acceptable as a document for public review. While it is recognised that the Joint Venturers have made commendable efforts in describing most aspects of the existing environment, the Authority feels that insufficient detail was available on some aspects of the proposal including tailings disposal, mining activities, stockpile management and decommissioning.

Tailings disposal is regarded as one of the major environmental concerns associated with the project. As in the case of the Authority's assessment of the Yeelirrie uranium development, the Authority believes that disposal of all tailings into mining pits is the most satisfactory long term solution.

The Authority does recognise that both options (disposal of all tailings into the mining pits or disposal of slimes into Peanut Lake) are unlikely to give rise to levels of radioactive substances, in the short term, above limits described in the "Code of Practice on Radiation Protection in the Mining and Milling of Radioactive Ores", 1980. However insufficient information is available in the ERMP/ Draft EIS to satisfy the Authority that Peanut Lake meets all requirements from a long term perspective and that disposal of slimes into mining pits is impracticable.

The use of groundwater has also arisen as a prominent issue. The Authority believes the State has a responsibility to ensure sufficient knowledge is gathered on the groundwater systems in the region. Such information is vital as a basis for the rational allocation of the limited groundwater resource. Adopting a comprehensive and system approach to groundwater management would ensure maximum use of the resource and would not unnecessarily preclude developments which are of benefit to Western Australia.

The development will take place in the vicinity of a large aboriginal community. The Authority believes the Joint Venturers will have to exercise great sensitivity in relations with this community over the life of the project. The Authority believes that potential adverse impacts upon the community can be minimized also by gaining an appreciation of aboriginal customs and culture.

The Authority has noted that at this stage no Agreement Act exists for this development. In view of this the Authority has given more consideration to many aspects of the proposal and presents more detailed recommendations on the submission of detailed proposals (including mining plans and tailing disposal plans) and environmental management.

Overall the Authority has no objection to the project proceeding provided a satisfactory Environmental Management Programme is prepared, submitted and approved by the State and the recommendations provided in this report are made conditions of any approval given to the Joint Venturers to proceed.

6. LIST OF RECOMMENDATIONS

Recommendation 1

A detailed tailings disposal proposal should be prepared and submitted to the State for evaluation at least 18 months prior to the commencement of mining.

The Joint Venturers should consult closely with the State on the preparation of the proposal which should examine in detail the two options -

(1) Slimes into Peanut Lake.

(2) Slimes into mining pits.

The proposal should include details of a monitoring programme.

The proposal should also be included in an overall Environmental Management Programme.

Recommendation 2

A final detailed mining plan be prepared and submitted to the State at least 21 months prior to commencement of mining operations. The final mining plan should indicate proposals to ameliorate or minimize environmental impacts and these proposals should be addressed in the Environmental Management Programme.

Recommendation 3

Overburden and topsoil stockpiles should be treated to minimise dust nuisance.

Recommendation 4

A bond be required from the proponent which is sufficient to cover the estimated cost of replacing stockpiled ore in the pits, rehabilitation of the site and disposal of the plant in the event of premature termination or suspension of the project. The adequacy of the bond should be reviewed periodically and modified to accommodate changes in or completion of part of the rehabilitation programme.

Recommendation 5

A detailed decommissioning plan or programme should be drawn up with the following objectives and submitted to the State for evaluation at least 15 months prior to the commencement of mining :

- *aim to minimise the area of land on which future uses are restricted.*

- *nominate the areas which will be subject to a covenant restricting future use of the land.*

- *indicate the levels of radioactivity below which plant, equipment and structural equipment will be decontaminated.*

- *include detailed plans for decontaminating the site, the disposal of plant and materials and restoration of the area affected by the project.*

Recommendation 6

Further studies be carried out to establish the existence or otherwise of a critical group.

Recommendation 7

Levels of radon be monitored continuously in the mining pits and in addition the Joint Venturers institute a study of radiation levels inside and outside the project area under circumstances of calm atmospheric conditions. This study should include the gathering of meteorological data suitable for use in air dispersion models.

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The Joint Venturers should liaise with the Departments of Conservation and Environment and Health and Medical Services during the preparation of proposals for the above studies.

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The State through the Public Works Department institutes a comprehensive study of the characteristics, capacities and qualities of all groundwater resources in the Wiluna/ Lake Way region. The results of this study would then be used to plan the rational use of the limited water resource to maximize safe usage for developments.

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The Joint Venturers undertake to supply the water requirement of the Emu Farm.

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The Joint Venturers reduce water consumption as far as practicable.

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The Joint Venturers be requested to use alternative groundwater resources, provided that such use is consistent with an overall State plan for rational use of the resource.

Recommendation 13

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Recommendation 23

An Environmental Management Programme (EMP) should be prepared and submitted to the State for evaluation at least 15 months prior to the commencement of mining operations. Guidelines and criteria for this document should be drawn up in conjunction with the State.

Recommendation 24

Reports on the results, effectiveness and progress of management programmes, monitoring and studies should be submitted to the State at least annually. A detailed reporting timetable should be drawn in conjunction with the State following the submission of the EMP.

Separate detailed proposals for some aspects of the Environmental Management Programme may, if necessary, be prepared and submitted separately at the appropriate time.

Recommendation 25

The EMP may be amended and revised (provided the amendments meet with State approval) as is necessary or required by the State.

Recommendation 26

A bond should be required from the Joint Venturers which is sufficient to cover the costs of rehabilitation, monitoring and any other appropriate aspects of environmental management in the event of premature shut down or suspension of the project.

Recommendation 27

Financial arrangements should also be made to cover the costs of long-term rehabilitation and monitoring of areas affected by the project.

Recommendation 28

As part of the Environmental Management Programme, the Joint Venturers draw up and submit to the State for evaluation a detailed rehabilitation/restoration programme including details of the establishment of stable vegetative cover for the flood diversion channel and bund. The programme should emphasise the need for planning in order to minimize impact and thereby minimize the amount of rehabilitation required.

Recommendation 29

The diversion channel and bund on Uramurdah Creek be left for a period to be determined, as temporary protection for the rehabilitated mining pits area.

Recommendation 30

A detailed radiation monitoring programme (including a programme to monitor levels in food and water) be drawn up and submitted to the State for evaluation. The Joint Venturers should draw up this programme in close consultation with the State and the date for submission should be negotiated with the State.

Recommendation 31

In order to ensure that satisfactory radiation safety procedures are being observed, all records maintained by the Radiation Safety Officer (as required under the Commonwealth Code of Practice) must be made available to the appropriate State Authority.

Recommendation 32

The special provision of the Code of Practice in relation to medical surveillance be strictly observed and that employee medical records be made available for Public Health Department scrutiny.

Recommendation 33

The employee's medical record should be made fully available to him/her at any time and also such records should be lodged with the appropriate authority.

Recommendation 34

The Joint Venturers should submit to the State for evaluation, a detailed monitoring programme to determine the effects of groundwater extraction and the discharge of effluents, upon groundwater quality and levels and vegetation. This programme could be incorporated and submitted with the Environmental Management Programme.

Recommendation 35

The Joint Venturers should provide the raw data as well as results of the monitoring programme to the Public Works Department for independent assessment.

Recommendation 36

The Joint Venturers monitor closely the status of vulnerable or rare species in areas which may be affected by the lowering of the water table and mining activities.

Recommendation 37

The Joint Venturers institute studies in conjunction with the State to assess whether there is wider distribution of rare or vulnerable species than is presently known.

Recommendation 38

Proposals for the studies described in recommendations 36 and 37 should be drawn up in conjunction with appropriate authorities and submitted to the State for evaluation. The emphasis of this monitoring programme should be on the synthesis of all field studies into an ecological appraisal of the area to enable relationships between stress and resilience to be continuously monitored.

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APPENDIX I

REVIEW OF PUBLIC SUBMISSIONS

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A total of 5 public submissions were received by the State and Commonwealth Departments and transmitted to the Joint Venturers for formal reply to issues raised in the submissions. The Authority has considered all submissions in its evaluation of the ERMP/Draft EIS.

The public submissions highlighted a number of areas of environmental concern. These are discussed in detail below and are also summarized in Table 1.

1. Radiological Hazards and Contamination

   Three of the public submissions indicated some concern in relation to radiological hazards and contamination as a result of mining, milling and tailings disposal operations. In particular some areas of concern were :

   - concentration of radon daughters under periods of extreme atmospheric stability.
   - contamination of local agricultural produce with radionuclides.
   - contamination of food chain and food sources by radionuclides.

2. Nuisance (Dust, Noise and Traffic)

   Concerns were expressed relating to the effectiveness of dust suppression techniques on stockpiles and roads. The dangers of increased traffic and resultant noise on nearby aboriginal communities were highlighted.

3. Groundwater Quality and Supply

   The prospect of the Joint Venturers affecting existing or future plans for the expansion of an agricultural enterprise by the extraction of large amounts of groundwater gave cause for concern. Also this groundwater extraction could affect the survival of native vegetation upon which another enterprise is dependent.

   Lack of detail provided on the characteristics of the local groundwater systems was also highlighted.

4. Tailings Disposal

   The proposed method of disposal of tailings was queried. Concern as to lack of detail and the potential for short or long term contamination of the environment by radioactive substances was expressed. The possibility of premature drying of the tailings surface and the final covering contributing significantly to final background radiation was raised.

5. Aboriginal Sites and Community

Concern was expressed as to the possibility of areas of special significance being disturbed by the sudden influx of people and mining activities. This large influx of people is also feared because of the detrimental effects it may have on the aboriginal community's social structure.

Further liaison with aboriginal communities was stressed.

6. Monitoring

It was felt that inadequate monitoring has been carried out to give a meaningful picture of existing levels of contaminants. The possibility of radioactive substances entering the foodchain was raised and hence ought to be considered when drawing up a monitoring programme.

Concern was expressed as to the lack of detail on personnel monitoring. The lack of indication of responses (contingency plans) if exposure limits were exceeded was criticized.

7. Rehabilitation

The outline of a rehabilitation programme found some support in some of the public submissions. However, some concern was expressed as to who determines whether rehabilitation is complete and how this is determined.

It was thought that firm guarantees should be sought from the Joint Venturers to mine out, mill and stabilize waste products in the event of premature shut down of the project. Concern was also expressed as to the likelihood of the lack of acceptance of the Joint Venturers of responsibility for the long term care of the tailings disposal area.

8. Yellowcake

Contingency plans and procedures for accidents or spillages involving yellowcake were queried. Education of drivers on these aspects was emphasized.

9. Deficiencies of the ERMP/Draft EIS

Several criticisms were made of the ERMP/Draft EIS concerning the lack of detail and structural defects. The glossary of terms and mixture of units in the Appendices and the main report were considered to be inadequate. The treatment of alternatives in the Draft ERMP/EIS was also considered unsatisfactory. Inadequate referencing was another criticism of the main report.

TABLE 1

ENVIRONMENTAL CONCERNS	SUBMISSION NUMBER 1	2	3	4	5
Radiological Hazards and Contamination	X		X	X	
Nuisance (Dust, Noise and Traffic)	X		X		
Groundwater Supplies and Quality	X		X		
Tailings Disposal			X	X	
Aboriginal Sites and Community	X				
Quality of ERMP/Draft EIS			X		
Monitoring	X		X	X	
Rehabilitation	X		X		
Yellowcake			X		
Nuclear Fuel Cycle - wider issues		X			
Need for the Project		X			

Unqualified support for project.

APPENDIX II

SUMMARY OF FORMAL GOVERNMENT SUBMISSIONS

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1. WA DEPARTMENT OF MINES

Overall, the document, although using sometimes scant data from an early stage of the mining exercise, projects an impression of environmental responsibility on the part of the Joint Venturers. At such an early stage, some assumptions have had to be made, and these appear to be reasonable extrapolations from similar mining situations elsewhere (in South Australia, Canada and the USA, for example).

It is suggested that the Joint Venturers be asked to provide more details in the areas of Rehabilitation, Mining Method, Tailings Disposal and Stockpile Protection.

1.1 Rehabilitation

The rehabilitation programme is clearly only in outline form at this stage, but should provide a workable basis for a detailed programme. The detailed programme should be submitted to Government as soon as practicable, and progress closely monitored.

Detail should be provided on the length of time that topsoil will be held in stockpile, the areas of ground that will be exposed ahead of mining and total areas to be exposed by mining before rehabilitation can be commenced. In addition, the plan should suggest alternative methods of dust suppression on dumps, either rehabilitated or otherwise, other than the spreading of rock fragments, eg, the use of bituminous emulsions.

A large number of mining projects have no commitment to the Government for the Company to outlay any more finance once a mining project becomes uneconomical or mineral reserves are depleted. An endeavour should be made to have a clause in the agreement that the Joint Venturers continue to control the area for an indefinite period following the completion of mining so that all disturbed areas are restored to the satisfaction of the controlling authorities. The suggestion to remove all domestic stock from Millbillillie Station for a period of 10 years to allow the land time to regenerate seems to be a sensible move.

On page 5-18, paragraph 5.5.3, reference is made to recontouring embankments back to the original landform - this would allow Uramurdah Creek to cross four of the mine sites.

Control of water in the creeks, eg, Uramurdah, will have to be redirected in such a manner that rehabilitated areas are not disturbed.

Two other points need to be answered. Page 5-17, paragraph 5.5.1, how will the buildings be 'decontaminated'? Page 5-19, second paragraph B, the term 'fresh' needs to be defined precisely.

1.2 Mining Method

It appears, at this stage, that no decision has been made on the method of mining, on whether mining and milling will be at the same rate, or whether mined material will be stockpiled before milling commences. The less damaging mining method would be to mine and mill at the same rate, as the method of stockpiling ore ahead of milling would involve the damage of an additional 31 hectares of land and increased radon emission over the stockpile area. It is presumed that the economics of the venture will dictate the final decision. The Venturers should be asked to decide on their method so that it can be seen at a glance just what area is going to be affected, and comment made accordingly.

1.3 Tailings Disposal

More experimentation and detail should be carried out on the method of slimes tailings disposal.

The area set aside for tailings disposal - Peanut Lake - is very close to Lake Way, and before this is used as the disposal site, every effort should be made to guarantee that there will be no contamination of Lake Way via possible porous layers in the walls holding the slimes. Sections of the holding walls and plans showing the precautions that will be needed in case of flash floods need to be provided.

The reference to montmorillonite on page 5-16 requires quantifying. What percentage of the clay mineral occurs in the ore body, and what percentage will there be in the tailings?

1.4 Stockpile Protection

Plans and grades for the dumps for stockpiled overburden and low grade ore, showing the precautions taken to prevent runoff, caused by seasonal rains, should be provided

1.5 Other Points

Considerable confusion is generated in Appendix 7 by the unnecessary mixing of imperial and metric units, such as feet, yards and metres in one set of calculations. All figures should be in S.I. (metric) units.

Page 5-17, paragraph 5.4.5, is the third sentence correct? One would expect an east-west facing building to have its long side facing north and therefore in the latitude of the site be liable to have maximum heat gain on that side.

2. WA DEPARTMENT FOR COMMUNITY WELFARE

Procedures detailed in the report include:

a) Social isolation of the mining community to prevent the existing social fabric being disrupted.

b) Utilization of local services and businesses to support the project where desirable. The report suggests that local businesses, including the Aboriginal enterprises, will benefit economically during the mine's life.

c) Re-establishment of the environment at the completion of the mining operation.

d) Monitoring of mining operations to ensure safety standards are maintained and pollution minimised. Monitoring will include measuring uranium and radium levels in kangaroos grazing in the mill area. The Joint Venturers have made an undertaking that if these levels exceed acceptable quantities, alternative supplies of meat will be provided at no cost to the aboriginal people who are normally consumers of such meat.

e) Consideration will be given to the water supply. The Joint Venturers have stated that groundwater use will not exceed a level where irrigation would be disrupted. Stock levels on Millbillillie Station will be adjusted to the available water supply, and this meat will not be available for consumption. Drinking water will be supplied for the people in the Wiluna area, drawn from sources not subject to contamination. This supply will continue until existing supplies are again available for use.

Issues for which further clarification is required are Desert Farms Produce, Aboriginal Sites, Radiation Warning Signs and Impact on Lake Way Station.

2.1 Desert Farms Produce

The report indicates that Desert Farms fruit and vegetables may be subjected to dustfall from the mine mill complex and states that 'conservative estimates indicate that consumption of fruit and vegetables exclusively from this source during the mining life will increase the ingestion of radionuclides by less than 1% of the normal intake' (p 7-13).

The significance of this is not clear as regards the health of consumers of Desert Farms produce.

2.2 Aboriginal Sites

A significant aboriginal sacred site has been identified on the joint venture area and this will be protected under the Aboriginal Heritage Act. The Aboriginal Elders have been assured that sacred sites will not be disrupted; however, there is no indication that there will be continued safe access to the site for Aboriginal communities. It may also be a significant site for itinerant aboriginals from other areas.

2.3 Radiation Warning Signs

Radiation warning signs will be posted on fences surrounding all accessible areas of the mill site, mine facilities and tailings disposal area. It will be necessary to educate the local community, and those from other communities who consider the Wiluna area as an important ritual centre, as to the meaning of such warnings because of the problems of illiteracy. The possibility of accidental consumption of contaminated kangaroo from around the mill site by transient Aboriginals also needs consideration.

2.4 Impact on Lake Way Station

The intended tailings disposal site, Peanut Lake, lies on the border of Lake Way Station. Stock from this station could become contaminated and dangerous to consume, and this possibility has not been examined in the report.

3. WA MUSEUM

In 1978, the Western Australian Museum undertook a survey of the Lake Way area. Their submission addresses the areas of Aboriginal Sites and Fauna.

3.1 Aboriginal Sites

The Museum is satisfied that the Joint Venturers are, for the most part, implementing the recommendations contained in the report on the area. The Joint Venturers will avoid the sacred site *Yurawarri* and in addition is assisting with the collection of archaeological material from areas within the planned development.

At the time that the survey was carried out, the Museum did not know that a flood water diversion drain would be constructed on Uramurdah Creek and, as many sites of significance occur on the banks of this creek, no development should take place in that area until further discussions have been held with the Aboriginal Community.

The Company did instigate discussions with Aboriginal elders as recommended by the Museum; however, the Museum envisaged that this liaison would be ongoing and believes that the Company should hold further meetings with the Aboriginal elders and Museum representatives to clarify issues such as possible 'dangerous' effects of windborne dust, contamination of groundwater, and the possible negative social effects that the establishment of a European workforce may have on the community.

The Museum recommended that the Company institute an orientation programme for its employees to foster understanding and tolerance for the extant customs and traditions amongst the local Aboriginals. The Company has undertaken to do this when a more permanent workforce is established and will produce a booklet, for distribution to its employees, covering important aspects of Aboriginal customs and traditions.

3.2 Fauna Survey

The vertebrate fauna of the Lake Way area has been thoroughly documented and, judged by the Museum's own surveys in the Goldfields region, the data are in general comprehensive, the conclusions are valid and the recommendations pertinent.

There is lack of documentation of the fauna from specific sites within and adjacent to areas likely to be mined. Although the survey provides comprehensive lists of vertebrates in specific habitats, it does not provide the baseline data for specific sites which would be the foundation of any long-term monitoring programme or later comparative studies.

The habitats recognised in the Fauna Survey would have benefitted in description by cross reference to the Flora and Vegetation Survey.

4. WA PUBLIC WORKS DEPARTMENT

The Draft Environmental Review and Management Programme dated March 1981, covering the proposal provided by the Joint Venturers, has been examined and the sections of interest to the Public Works Department relate to Water Resources, Water Supply, Water Pollution and Flood Diversion.

4.1 Water Resources

The project requires 6650 m^3/d of brackish water with a salinity less than 3000 mg/L TDS plus 200 m^3/d of potable water over the life of the development, expected to be 6-8 years.

The only available water in the Wiluna-Lake Way area is underground water. If the required amount of water is drawn from the area, it will grossly exceed the average annual recharge. The Joint Venturers therefore propose to mine the underground water over the period of their operation, thus depleting the quantity of water stored in the aquifer. After the project has closed down, the aquifer will gradually refill ultimately returning to its present status.

Whether there is sufficient extractable water present to supply the proposed development, and existing consumers over the life of the project is questionable, but if an extended drought occurs during the project period, the capacity of the source can only, at best, be classified as marginally sufficient.

The underground water consultants have gone to some lengths to model the performance of the aquifer. They have been conservative in that they have assumed little recharge during the project period, but have quite consciously underestimated drawdowns near pumping bores. The modelling suggests that there should be just sufficient water available to supply existing consumers and the project, but because of the complexity of the modelling in this instance, this result can only be classed as a 'best estimate'.

The problem of the adequacy of water resources is further exacerbated by the possibility of additional demands by other developments in the region.

It follows that the Lake Way Uranium Project can only proceed if the water resources required by it are positively allocated to it, and this will mean that other major developments will need to be excluded from this water source.

4.2 Water Supplies

A number of existing users will be seriously affected by the depression of water levels in the aquifers that will

result from mining of the underground water resource by the Joint Venture. The extent of this effect will vary over the area and will depend on how much rainfall occurs during the mining period. Depression of water levels in bores can be expected to increase progressively during the life of the mine. The underground water consultants have attempted to model this effect and predict likely maximum drawdowns, but the values obtained suffer the shortcomings mentioned earlier.

Comments on the various supplies affected are as follows:

4.2.1 Wiluna Water Supply

It is expected that water levels in the Town wellfield will fall progressively during the project, to the extent that the existing wells will eventually prove to be inadequate. The Joint Venturers have given an undertaking to make up any shortfall from sources developed by them. This is a very serious commitment, but provided it is honoured, Wiluna water supply should not be affected unduly.

4.2.2 Nangganawili Village

The water supply to the Nangganawili Aboriginal community will be similarly affected. The Joint Venturers have undertaken to supply them with water, as in the case of Wiluna Town, and if honoured, this should be satisfactory.

4.2.3 Millbillillie Station

Stock and homestead supplies will both be seriously affected, but as the Joint Venturers now own this station, any resultant problem are really their own. They propose to pipe water to the homestead and to adjust stock numbers to the amount of water available.

4.2.4 Desert Farms

Desert Farms is an irrigation development operated by Aborigines. The underground water consultants have calculated that water levels at Desert Farms could be depressed by as much as one metre. This should not inconvenience the project unduly. However, the Joint Venturers have stated in the ERMP document that 'if a competent authority such as the Western Australian Public Works Department finds that the mine/mill water supply scheme will adversely affect the operation of the Desert Farm irrigation system, the rate of water extraction by the Joint Venture will be reduced to a level which will ensure an adequate water supply for the orchard'.

4.2.5 Emu Farm

This is an Aboriginal project using underground water to irrigate lucerne. The consultants have calculated that water levels here could be lowered by up to 2.4 metres which could result in some inconvenience.

In this case, the Joint Venturers have not given an undertaking to ensure that an adequate water supply is maintained and a similar assurance to that given for Desert Farms should be required.

4.2.6 Recommendations (2.4.1 and 2.4.2)

It is recommended that the water resources and water supplies sections of the document be accepted subject to:

a) a satisfactory Conceptual Water Management Scheme being supplied.

b) the Government being prepared to commit all of the uncommitted water resources within 15 km of the proposed mill site to this project.

(Such a decision could be enforced under the groundwater licensing provisions of the Rights in Water and Irrigation Act.)

4.3 Conceptual Water Management Scheme

To show that it is in fact feasible to honour the undertakings to make up the shortfalls of potable water to Wiluna water supply and the Ngangganawili village, the Joint Venturers employed consultants to prepare a Conceptual Water Management Scheme. Both the scheme to supply process water and the scheme to supply potable water had to be included in this concept although it is really only the latter that requires close scrutiny.

Unfortunately, it seems that the consultants are not used to designing water supplies, and it appears that they may have designed their schemes on average annual rates rather than peak demands and not allowed for growth. This means that although the process water scheme concept appears satisfactory, the potable water scheme is underdesigned, for example, the supply allowed for Wiluna water supply is 135 m^3/d, whereas a satisfactory design allowing for expansion, would need to cater for peaks in the order of 700 m^3/d. The potable water section of the conceptual scheme requires revision to allow for peak rates and anticipated growth. It appears that although the design as submitted is inadequate, the resource is is such that it should be possible to design a satisfactory potable water scheme.

4.3.1 Recommendations

The Joint Venturers plan to closely monitor the performance of the aquifer and to adjust water management if necessary. Their proposed monitoring appears to be satisfactory, however, experience may indicate that this monitoring should be revised from time to time.

4.4 Groundwater Monitoring

Since the water resource will be exploited to near its limit, it will be necessary to closely monitor the performance of the aquifer and adjust water management if necessary. The Joint Venturers plan to do this, and their proposed monitoring programme appears to be satisfactory.

Experience may reveal that this monitoring needs to be revised from time to time, but this should be readily achieved.

4.5 Decommissioning

At the end of the mine life, the water levels in the aquifers will have been lowered and they will not recover for some time. As a result, it may prove necessary to supply other users, such as Wiluna Town, from the Joint Venturers' potable scheme for a period after the mine closes.

The Joint Venturers have made an undertaking that supply will continue beyond the life of the mine until local water supplies return to their pre-mining levels. It is most important that this undertaking be honoured.

The Joint Venturers may not have appreciated the extent of this commitment, and they should be required to have their underground water consultants estimate the length of time taken for local water supplies to return to their pre-mining levels. This could then be the basis for the calculation of some form of bond to ensure that satisfactory supplies are maintained after the mine closes.

4.6 Water Pollution

Pollution of water supplies could occur from three activities, namely: Pit Dewatering, Sand Tailings Disposal and Slimes Tailings Disposal.

4.6.1 Pit Dewatering

Saline water will have to be removed from the pits as the excavation proceeds, and this will be disposed of by pumping it into Lake Way, normally a dry salt lake, and allowing it to evaporate. This is considered to be a satisfactory means of disposal.

If a radiation problem is found to exist in the dried residues, then alternative disposal of mine water into infiltration pits adjacent to Lake Way is possible and this is considered to be satisfactory.

4.6.2 Sand Tailings Disposal

Sand tailings are to be returned to the mine pits which will be underlain by, or contain saline water. As the soluble radioactive components will be less than in the original ore body, percolation through the sand tailings down to the saline groundwater is not expected to produce a pollution problem.

4.6.3 Slimes Tailings Disposal

No problems are expected to arise in this area. Slimes tailings are to be deposited in Peanut Lake, seepage out of the slimes tailings to the underlying groundwater is not expected to be great, and in any case the Joint Venturers have given an undertaking to monitor the groundwater in the vicinity of Peanut Lake and to pump back any polluted groundwater to the surface of the tailings impoundment for evaporation.

4.6.4 Recommendation

It is recommended that the sections of the report dealing with underground water pollution be accepted.

4.7 Flood Diversion

The Joint Venturers propose to divert the last two kilometres of Uramurdah Creek around their workings directly into Lake Way, to prevent it from flooding the mine pits. The workings will additionally be protected by a levee to be constructed on the downstream side of the diversion channel. This diversion should not cause problems and can readily be accepted.

5. WA DEPARTMENT OF HEALTH AND MEDICAL SERVICES

The document has been examined and the comments here relate solely to the implication of the project for imposing and increasing radiation dose to workers and the general public in the area.

No comments are considered to be necessary at this stage on aspects of air pollution. An application to construct this plant, as required under Section 34 of the Clean Air Act, will need to be submitted to the Air Pollution Control Council prior to construction of the plant.

5.1 Radon Daughter and Dust Contaminants

The ERMP has identified sources of radon from the mining operation and has studied the radioactive dust dispersal from the area. Radon daughter and dust concentrations have been calculated but have not been carried through to give total dose commitment to the operators at the mine, the mill or to the general public. From the concentration given it is fairly evident that the dose will be well below the maximum permissable dose for workers or the dose limits for the general public.

5.2 Critical Group

The ERMP does not establish the existence or non-existence of a critical group who may be exposed to the greatest radiation doses from the mining operation. This should be done by identifying the food chains in the area which may contribute most to the radiation exposure of persons. This may require further study of the living and eating patterns of the surrounding communities and the proposed arrangement for the operators near the mine site.

5.3 Monitoring

The monitoring programme as stated is insufficient to judge whether proper surveillance of the operation will be maintained. A suitably detailed monitoring programme will have to be submitted. This should be along the lines of the U.S. Nuclear Regulatory Commission monitoring programme for uranium mines and mills but should identify any special provision of a site specific nature which should be deleted from or added to the U.S. monitoring programme.

5.4 Slimes Tailings Disposal

The use of Peanut Lake as a disposal site is not favoured unless further investigations can demonstrate beyond doubt its suitability. The possibility of tailings being released to Lake Way is a major concern. Insufficient evidence has been given for the suitability of the dune system surrounding the Lake and tests of its ability to retain effluent have not been carried out.

In general it is considered undesirable to store tailings above grade as this may lead to erosion of the barrier and release of the tailings. We do not favour the storage of tailings in the manner described and would seek more suitable alternative disposal methods.

5.5 Mine Plan

A detailed mine plan will have to be produced indicating areas to be mined in successive years, estimating sizes of stockpiles, amount of waste being produced and giving estimates of radiation levels in the mined areas.

5.6 General

The Public Health Department would wish to comment as more details of the project become available. This is particularly relevant in the areas of design of uranium concentrate handling and packaging areas and in the design of the monitoring programme.

It will be necessary for the Joint Venture to apply for a licence for mining and milling of radioactive ores or to request transfer of the existing licence to the Joint Venture and to apply for that licence to be extended to incorporate mining and milling of radioactive ores.

6. COMMONWEALTH DEPARTMENT OF SCIENCE AND TECHNOLOGY - BUREAU OF METEOROLOGY

The sections dealing with the general and mesoscale climate in both the ERMP/Draft EIS report and Appendix 1 present data which are in general agreement with the records and experience of this Office.

Measurements of the thermal structure of the lower levels of the atmosphere would be essential if it was necessary to improve the confidence attached to the estimates of ground level concentrations presented. Specific comments are below.

6.1 Rainfall and Evaporation

In Section 3.5 the quoted annual evaporation rate of 2500 mm should specify the method of measurement. The Class A pan evaporation at Meekatharra is approximately 4000 mm per annum and the value for the Wiluna area is expected to be similar. An annual measurement of about 2900 mm has been made at Wiluna but in an unsatisfactory siting.

In Table 1 deciles of monthly rainfall would have given far more useful information about the rainfall at this location.

6.2 Section 3.5.2. of ERMP

The term "inversion height" has been used in this report when referring to surface based nocturnal inversions. It would have been less confusing if a term such as "thickness of surface based inversion" had been used.

The last two sentences in this section cannot be substantiated without detailed long term measurements. The normal process of nocturnal surface inversion formation starts near sunset under light wind conditions so that a surface based inversion would be well established before 10.00 p.m. on many occasions. Figure 6.6 shows restricted mixing heights occurring after 6.00 p.m. in the average situation. The "inversion heights" mentioned in this paragraph are at variance with those quoted in Appendix 1 page 4 section 2 para. 5 which in turn differ from Appendix 1 page 38 para. 6.5.

6.3 Section 5.2.3. of ERMP

This section mentions that the drain to be constructed will cope with the runoff from the maximum probable precipitation, however no mention is made of the adequacy of the slimes pond embankments to resist the wind wave action which might occur in a flood situation or whether in a flood situation these banks might be over topped.

6.4 Appendix 1 Table 4.2 Page 17

Column 3 should be headed "Extreme Maximum" and column 4 "Extreme Minimum". Some maximum daily rainfalls in the last column of this table differ from those available for Wiluna, e.g. in July 30 mm should be replaced by 73 mm.

7. WA DEPARTMENT OF LANDS AND SURVEYS

Comments are provided on the Millbillillie Pastoral Lease, Rehabilitation and Development.

7.1 Millbillillie Pastoral Lease

The Joint Venture partners effectively control this lease and they intend to monitor water levels and adjust stock levels accordingly.

The Station is considered to be a non-viable pastoral unit under present economic conditions. There are usable portions suitable for inclusion within adjoining leases, consequently it is desirable that all improvements be maintained in an operational manner to facilitate any subdivisional programme that may be planned in the future.

7.2 Rehabilitation

Adequate consideration needs to be given to this phase. The present limit specified is one year and yet vegetation in this area grows very slowly.

7.3 Development Facilities

It is not made clear in the ERMP/Draft EIS whether the areas to be affected by mining and housing facilities are to be established under the Land Act or Mining Act. The former would involve surrender of portion of the Pastoral Lease and issue of a Special Lease which is the procedure to be implemented with the Yeelirrie project.

8. WA MAIN ROADS DEPARTMENT

The ERMP/Draft EIS describes the roads between Meekatharra and Wiluna and those linking Wiluna to Leonora and Wiluna to Yeelirrie as 'formed gravel surface roads'. This is not entirely correct as the roads mentioned are of variable standard, and are not gravelled throughout. They could, however, be described as being adequate for current traffic needs.

The existing road system may not be adequate for the transportation task associated with this project. It will be essential that the Main Roads Department be involved, at planning stage, in discussions with Company personnel to agree to a satisfactory road network and to determine requirements for any road improvements, including financial arrangements.

9. COMMONWEALTH DEPARTMENT OF TRANSPORT

The transport system, be it road, rail or sea, is used to handling yellowcake and there are adequate regulations covering it.

10. TOWN PLANNING DEPARTMENT OF WA

No objection is raised to the project itself from the information made available. It is suggested that any Agreement between the Government and the Company would provide for :

a) direct involvement of the Public Health Department in the monitoring of radiation levels in the locality of the mine site during and after mining operations.

b) a procedure for the long term supply of potable water to all the residents of the Wiluna area if water supplies are affected beyond the life of the mine.

11. WA DEPARTMENT OF FISHERIES AND WILDLIFE

The ERMP appears to be well prepared and clear. It appears that the project will not have a major effect on the flora or fauna.