TORO ENERGY LIMITED

WILUNA URANIUM PROJECT

RADIOACTIVE WASTE MANAGEMENT PLAN

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1 INTRODUCTION

This Radiation Waste Management Plan (RWMP) describes the management systems that would be implemented during the construction and operational phases of the Wiluna Uranium Project (the Project). This document provides an overview of the key management strategies and systems based on the discussions provided in the PER. A more detailed plan would be submitted for approval to the appropriate authority, prior to operations commencing.

Transport of the final product is covered in the Transport Management Plan

This RWMP describes how Toro would –

- Comply with relevant legislation and standards for radioactive waste management;
- Identify potential direct and indirect environmental impacts from radioactive waste;
- Provide environmental indicators, objectives and targets; and
- Implement management measures, methods and reporting, auditing and review.

This RWMP is part of a suite of plans that deal with impacts and aspects of the Project. It is designed to assist Toro employees and contractors to manage radioactive waste in a manner that is compliant with relevant legislation, safe and environmentally responsible. All management strategies would be periodically reviewed as part of Toro's commitment to continuous improvement, and for their continued application to the Project, particularly during the operational phase.

1.1 Project Overview

The Wiluna Project is in the Murchison region of Western Australia, approximately 960km north-east of Perth. It is based on mining four deposits: Centipede, Millipede, Lake Maitland and Lake Way. The Centipede and Millipede deposits are approximately 30km south of the town of Wiluna, and the Lake Way deposit is approximately 15km south of Wiluna. The Lake Maitland deposit is some 90km to the south east at another salt lake, Lake Maitland.

The principal activities planned for the Project include:

- Development and operation of a uranium mine encompassing the Centipede, Millipede, Lake Maitland and Lake Way deposits;
- Construction and operation of a uranium ore processing, packing and handling facility at Centipede/Millipede;
- Development of the Lake Maitland and West Creek borefields to supply water to the Project;
- Support facilities including an accommodation village, mine administration buildings and workshops, haul roads, power generation and transmission facilities, communications systems and water and waste management;
- Transport of uranium product within Australia for export; and
- Rehabilitation and closure of the mine and other areas disturbed by the Project.

The proposed total area of disturbance required for the development of the Project over the planned 20-year-life-span is approximately 3120 hectares (ha) including infrastructure.

Across the four deposits the grade of the ore remains relatively consistent with the Centipede, Lake Maitland and Lake Way deposits having average grades of between 545 to 566 parts per million (ppm). The Millipede deposit is the lowest grade deposit, with an average grade of 486 ppm. Table 1-1 shows how the grades of the deposits compare to the tonnes of ore in each deposit and the pounds of uranium metal available from each deposit.

Table 1-1: Comparison of Deposits in the Wiluna Uranium Project

	Total		
	Ore	Grade	Metal
	Mt	PPM	Mlb's
Centipede	10.4	566	13.0
Lake Way	10.3	545	12.3
Millipede	6.4	486	6.9
Lake Maitland	19.9	555	24.3

2 SCOPE

This RWMP provides a reference for monitoring, reporting and auditing as necessary to minimise identified and potential environmental impacts of the Project.

This RWMP is being submitted to the Environmental Protection Authority (EPA) with the Public Environmental Review (PER) as part of the environmental assessment and approvals process for the Project.

This RWMP has been prepared based on:

- Toro's Environment Policy;
- Toro's Indigenous Relations Policy;
- Toro's Occupational Health and Safety Policy;
- Relevant Commonwealth and Western Australian legislation;
- Other legal obligations;
- Identified potential direct and indirect environmental impacts from risk assessments;
- Consultants' reports;
- Relevant permits and standards; and
- Toro's commitment to continuous improvement.

This RWMP has been developed to:

- Outline the existing information available in relation to radioactive waste relevant to the Project;
- Identify and assess potential impacts of the creation of radioactive waste during Project activities;
- Describe the proposed management and monitoring strategies;
- Demonstrate reporting, auditing and review mechanisms;
- Outline procedures for consultation and complaints; and
- Guide the development of other site specific plans and procedures relevant to the Project

This RWMP covers the following phases of the Project:

- Construction at and mining of the Centipede, Millipede, Lake Maitland and Lake Way deposits;
- Construction and operation of a processing, packing and handling facility;
- Development of the Lake Maitland Borefield and refurbishment of the West Creek borefield; and
- General infrastructure including an accommodation village, mine administration buildings and workshops, haul roads, power generation and transmission facilities, communications systems and water and waste management.

The wastes relevant to this RWMP that would be generated during operation of the Project are as follows:

Liquid Waste Streams

- Tailings liquor;
- Stormwater;
- Waste from routine operations (e.g. shower and wash water from ablutions and equipment cleaning water);
- Seepage from operations;

- Unplanned releases of liquids; and
- Runoff from the delineated mining areas.

Solid Wastes

- Tailings and waste rock;
- Sediment runoff from stockpiles during rainfall events;
- Contaminated equipment such as pumps and valves;
- Contaminated clothing such as overalls, gloves and boots; and
- Soil contaminated by spilled radioactive materials.

Airborne Wastes

- Radon gas (and radon decay products);
- Radioactive dust;
- Process evaporation; and
- Power and steam generation off-gas

3 LEGISLATIVE REQUIREMENTS

Toro would comply with all relevant Commonwealth and State legislation and regulations that apply to the radioactive waste management aspects of the construction and operational phases of the project. In relation to radioactive waste management, the following legislation and regulations are applicable:

3.1 Commonwealth Legislation and Standards

- *Environment Protection and Biodiversity Conservation Act 1999*;
- Australian Radiation Protection and Nuclear Safety Agency (ARPANSA), 2005. *Code of Practice and Safety Guide for Radiation Protection and Radioactive Waste Management in Mining and Mineral Processing*;

3.2 Western Australian Legislation

- *Mining Act 1978;*
- *Mines, Safety and Inspection Act 1994 (and Regulations 1995);*
- *Nuclear Waste Storage (Prohibitions) Act 1999;*
- *Occupational Health, Safety and Welfare Act 1984 (amended 1995 and Regulations 1988);*
- *Radiation Safety Act 1975*;
- *Radiation Safety (General Regulations) 1983*;
- Department of Mines and Petroleum (DMP), 2010. *Managing naturally occurring radioactive material (NORM) in mining and mineral processing*; and

Toro would construct and operate the Project facilities utilising best practicable technology, as defined by Part 16 of the DMP's *Mine Safety and Inspection Regulations 1995.*

4 OVERVIEW OF POTENTIAL IMPACTS

4.1 Radiological Dose Assessment

The overall radiological impacts of the Project are related directly to workers, members of the public and the environment.

The human radiation exposure pathways that have been identified for the construction and operational phases of the Project are:

- Irradiation by gamma radiation;
- Inhalation of decay products of radon;
- Inhalation of radionuclides in airborne dust; and
- Ingestion of radionuclides.

Occupational exposure to radiation would be assessed by determining doses to the different work groups (miners, plant workers, transport workers and final product handlers). For the public, critical groups have been identified as people living in the following locations:

- Wiluna Township;
- Bondini Reserve;
- Nganganawili Community;
- Millbillillie Station;
- Lake Way Station;
- Toro Camp; and
- Barwidgee Station.

4.2 Radiation Doses to Workers

4.2.1 Radionuclides in Airborne Dust

There are a number of radiological dust sources that result from the mining and processing of uranium ores.

The following sources of dust from the mining operations have been identified:

- Dust from mining of ore; and
- Dust from ore stockpiles, ore transfer processes, crushing, road haulage and conveyor systems.

Processing of ore generates dust from the following sources:

- Fugitive dust from tailings deposits;
- Transport systems in mill area (conveyors etc.); and
- Uranium oxide drier and packaging area.

Mining would generate low levels of dust, because the mined material would generally be damp, and dust suppression would be used when necessary to keep dust levels low. Dust levels in the processing plant would be low due to the process material being mainly wet or damp and the operational and engineering controls put in place.

The impacts from radionuclides in dusts have been calculated from air quality modelling and experiences at other operating uranium mines and shown to be low due to design controls and management practices. An annual dust dose of 0.32 mSv/y may be expected for mine workers, and the average dust dose for process plant workers is estimated to be 0.64 mSv/y.

4.2.2 Decay Products of Radon (RnDP)

The RnDP impact is determined directly from the radon impact modelling. RnDP doses have been determined by modelling the mine as an open pit and estimating the release rate of radon into the mine. The ventilation rate of the open pit is then predicted by atmospheric modelling.

Radon sources include:

- Mining of ore;
- Stockpiles;
- Ore processing; and
- Tailings management and disposal.

The impacts from radon arise from the decay products, which are generally directly proportional to the radon concentrations. Modelling has shown that the incremental radon concentrations at the closest permanently occupied communities to the Project would be low. Based on conservative modelling assumptions, the estimated average RDP dose for a miner would be 3.8mSv/y, and for workers in the processing plant the calculated occupational RDP dose is expected to be 0.05mSv/y.

4.2.3 Gamma Radiation

The main sources of gamma radiation from the Project are:

- Stockpiles;
- Tailings;
- Uranium; and
- Process materials.

All materials would be contained within the Project area. Accordingly, gamma radiation from the
Project is not expected to be detectable beyond the Project boundary.

Estimates of gamma radiation exposure have been based on two sources; information from other operational uranium mines and estimates from first principles. For a full work year the theoretical maximum exposure would be 3.9mSv/y. However, this figure does not take into account the shielding afforded by the mining equipment. Based on gamma radiation levels observed in other open-cut uranium mines, it is estimated that miners would on average receive 1mSv/y from gamma radiation.

4.2.4 Radionuclides in Soil

The radionuclide concentrations in soils may change through spillages or through long term dust deposition.

Spills have not been considered in the assessment of environmental impact, as operational procedures would ensure that all spillages would be immediately cleaned up and therefore would not contribute to long term changes in soil concentrations.

Over time, dust deposited from emissions from the Project would accumulate in the local soil, leading to increases in the pre-existing radionuclide concentrations. The impact of long term dust deposition from the Project on soils was estimated from the air quality modelling and showed that changes in natural levels would be approximately 3% after 15 years.

4.2.5 Waterborne Emissions

Radionuclides in water can lead to radiation exposure to the environment or to humans when consumed.

The regional groundwater is unsuitable for human or stock consumption due to its relatively high salinity and therefore human and animal exposure to radionuclides in the groundwater is highly unlikely.

Additional radionuclides may enter the groundwater from various sources including seepage from tailings storage facilities, seepage from the pit and water infiltration through the stockpiles into groundwater.

Groundwater modelling shows that movement of groundwater from the mine area is limited. During mining there would be an induced and natural groundwater flow towards the mine as a result of active dewatering. Groundwater would also tend to flow back towards the lake systems, thereby preventing groundwater to flow away from the mining areas.

Test work has shown that the radionuclides have low solubility and do not migrate with seepage.

Overall, the limited spread of seepage, the direction of groundwater flow, the low solubility of the radionuclides and the limited exposure pathways from groundwater indicate that the impacts would be low.

4.2.6 Emissions during Transport of Uranium Oxide Concentrate

The transport of UOC is a closely regulated activity with strict requirements for packaging, labelling, emergency response and management. Airborne emissions from the routine transport of the material are non-existent although low levels of gamma radiation would be detected close to the containers. The gamma levels are reported externally on all containers. Finished product would be trucked interstate for export either through the Port of Adelaide or Darwin Port. Truck drivers would be exposed to low levels of gamma radiation for the duration of the trip.

Final product uranium would be trucked interstate for export either through the Port of Adelaide or Darwin. Truck drivers would be exposed to low levels of gamma radiation for the duration of the trip. Gamma radiation measurements in truck cabins transporting uranium oxide would be on average, 1µSv/h. For a 36 hour trip between Wiluna and Port Adelaide, this equates to 36µSv. A driver may make up to 12 of these trips per year giving a total dose of approximately 0.5mSv/y.

4.2.7 Radiation Doses to the Public

The most exposed public group are residents of the Toro accommodation camp. People living full time at this location could be exposed to up to 0.033 mSv/a. Residents of Wiluna are expected to receive less than 0.022 mSv/a when mining is occurring at Lake Way, the nearest deposit to the town.

4.3 Summary of Radiological Impacts

Radiation doses to both workers and members of the public from the operation are expected to be well below internationally accepted limits, as shown in Table 4-1.

Table 4-1: Summary of Radiological Impact

	Expected Impact	Limit/Standard
Workers Doses	5 mSv/a	20 mSv/a
Member of Public Doses	<0.1 mSv/a	1 mSv/a

Toro has prepared a Radiation Management Plan (RMP) which is Appendix 6 to the PER. The Radiation Management Plan discusses:

- Objectives, Targets and Indicators;
- Management Strategies and Actions;
- Operational and administrative controls: and
- Monitoring and management.

The RMP will manage radiological impacts of Toro's operations on humans, non-human biota and the environment. The remainder of this RWMP sets out how Toro would manage the radioactive waste generated during the operation of the Wiluna Uranium Project.

5 RADIOACTIVE WASTE MANAGEMENT

5.1 Environmental Objectives, Targets and Indicators

The objectives of the RWMP and the assessment criteria are described in Table 5-1.

Table 5-1: Objectives and assessment criteria

Component	Objective	Assessment Criteria	Applicable Waste Stream
Radioactive Process Material Spillage	No adverse impacts to health of the public from exposure to radiation from spillages during finished product transport	Radiation doses to members of the public less than 1 mSv/y above natural background	• Unplanned release of liquors • Soil contaminated by spills of radioactive material
Radioactive Emissions	No adverse impacts to health of members of the public from exposure to radiation from Wiluna Project from emissions during operation	Radiation doses to members of the public less than 1 mSv/y above natural background	• Radon gas • Radioactive dust
Containment of tailings and mine rock	Maintain structural integrity of the mine rock stockpiles and tailings facility	No unplanned structural failures to the stockpiles or tailings facility	• Tailings liquor • Tailings and waste rock
Major storage seepage	No significant adverse impacts to ecological communities as a result of seepage from the stockpiles or tailings facility	No loss of native vegetation outside bunded Tailings Storage Facility as a result of seepage	• Seepage from operations
Radioactive Waste	No adverse impacts to health of members of the public from exposure to radiation from the Project	Radiation doses to members of the public less than 1 mSv/y above natural background	• Waste from routine operations • Contaminated equipment • Contaminated clothing
Stormwater	No adverse impacts to health of members of the public from exposure to radiation from the Project	No unplanned release of water from the mine or processing area	• Run off from the mining area • Sediment run off • Stormwater

5.2 Management Strategies and Actions

The aim of the waste management system is to ensure that the objectives are met through either specific design controls or management measures. The effectiveness of the controls would be determined through the ongoing monitoring program. Where the objectives were not being achieved, appropriate measures would be implemented.

In addition to outlining controls for the identified radiological impacts, this RWMP also outlines mitigation measures for unforeseen events (termed as key risks in this document). Each of the design features adopted has utilised best practicable technology (BPT) as defined in Part 16 of the DMP *Mine Safety and Inspection Regulations 1995.* BPT has been determined by referring to the DMP NORM guidelines for recommended controls and incorporating leading practice design from other operations where possible.

5.2.1 Stormwater Management

All rainfall landing within the plant area would be collected and directed to a sediment sump, one of the ponds or left to evaporate.

5.2.2 Seepage Management

Seepage from the tailings and waste rock stockpiles has been modelled and shown to be low.

5.2.3 Spillages and waste water

The process has been designed with bunds, liners and slopes such that all wash down water or spillages would be captured and directed to the sediment sump or one of the ponds.

5.2.4 Tailings residue

Tailings would be placed into the mined out voids at the Millipede and Centipede deposits. After they have dried out sufficiently they would be covered with a layer of waste rock and rehabilitated. Seepage from the tailings is expected to be low due to the settling and drying of the tailings and the positive flow of water into the tailings. Modelling shows that there would be limited spread of minerals from the stored tailings.

Seepage from the residue has been assumed to be minimal due to both the mineralogy of the ore and the carbonate leaching system utilised.

5.2.5 Waste Rock

The mining cut off for the deposits currently sits at levels dictated by economic grades. This means that not all the waste rock excavated by the Project is uranium free or radiation free. There will be some level of mineralisation associated with waste rock.

Waste rock would be stockpiled at the deposits and used to backfill pits and construct the radon emanation layer over the TSF. Excess waste rock is expected to be generated at Centipede and Millipede where pit void space has been filled with tailings. Waste rock from these deposits would be returned to either Lake Way or Lake Maitland to enable this pits to be backfilled as much as possible.

5.2.6 General Solid Wastes

The general solid wastes would be cleaned, checked for radioactive contamination and if clean, disposed of either by recycling off site or in a general landfill.

Items that cannot be cleaned of radioactive contamination to below 0.4 $Bqcm^2$ would be temporarily stored in 205 L drums in a dedicated location that was clearly sign posted. Items that cannot be placed into 205L drums would be placed on an appropriate impervious material to prevent soil contamination. This facility would be bunded to prevent rainfall runoff.

Final disposal of all items with radioactive contamination would be in the mined out pit or purpose built landfill site.

Table 5-2: Design controls, management controls and monitoring

Component	Design Controls	Management Controls	Monitoring
Radioactive Process Material Spillage	• Plant designed to best practice • Plant design to incorporate bunding (with sumps) and adequate hose points to contain spillages • Plant design for ease of access for small earthmoving equipment for ease of clean-up	• Minimise dry cleaning of spillages to prevent dust • Spills control kits available in readily accessible areas • Spills response procedure • Operator training • Supervisor training • Approved disposal procedure for contaminated soil (eg; disposal in tailings facility or reprocessing)	• All spills reported and investigated to prevent recurrence
Radioactive Emissions	• Design standards to minimise dust generation (to include dust extraction of transfer points, covered conveyors, scrubbing systems) • Subaqueous tailings disposal to minimize radon and dust emission • Stockpiles to remain damp to minimize dusting	• Standard operating procedures (e.g. access to the tailings surface during drying will be minimized to prevent dusting) • Regular supervisor inspection of all dust controls • Immediate clean-up of all spillages	• Dust and radon monitoring at key environmental locations • Operator dust monitoring • Maintenance schedule for all extraction systems

Component	Design Controls	Management Controls	Monitoring
Containment of tailings and mine rock	• Approved design standards for both tailings disposal and waste rock stockpiles • Tailings to be disposed in- pit then covered • The tailings pipeline would be within a protected corridor that ran for the entire length of the pipeline, with leak detection	• Standard operating procedures (e.g. placement of tailings and waste rock as per schedule, placement recorded, volume and waste type recorded) • Regular inspection of facilities • Regular daily inspection of tailings pipeline flow via the process control system • Procedure for release of tailings from pipeline (includes quick clean-up and reporting)	• Long-term monitoring – including volume of tailings disposed, volume of liquid disposed • Maintenance of water balance • Quality assurance procedures during construction • Maintenance or register of other material disposed in tailings facility • Monitor radionuclides content of mine water used for dust suppression • Monitor tailings pore pressures monthly • Monitor rate of rise of tailings in each TSF
Major storage seepage	• Installation of groundwater curtain to reduce groundwater flow during operations • Design standard for tailings facility to minimise seepage • Installation of prepared base and clay perimeter walls for tailings facility • Prepared compacted base for stockpiles	• Maintaining a water balance • Minimize any free standing liquor prior to the base having a consolidated layer of tailings	• Quality assurance checks during construction • Monitor groundwater level (to identify seepage) • Monitor groundwater quality (to identify seepage) • Maintenance of tailings water balance

Component	Design Controls	Management Controls	Monitoring
Radioactive Waste	• Establishment of dedicated low level radioactive waste disposal area within mine lease • Accumulated low level waste to be disposed in tailings facility at end of mine life • Installation of self-contained decontamination facility • Installation of wheel and undercarriage wash for vehicles installation of onsite change rooms and laundry for workers clothers	• Policy to decontaminate where practicable rather than disposal • Establishment of an identification process to determine waste material suitable for decontamination • Contaminated soils to be treated or disposed in tailings facility • Radiation check on all material leaving the site • Low level radioactive waste (e.g. laboratory waste and used personal protective equipment from workers in the uranium packing area) securely stored and then disposed of to the tailings facility	• Establish a register of all low level radioactive waste • Annual review of procedures
Stormwater	• Processing facility designed to contain a 1 in 100 year annual rainfall event with stormwater contained and directed to settling ponds and sediment traps • Establishment of diversion bunds so that natural surface water flows diverted around operations	• Maintenance of stormwater control facilities	• Monitor natural water flows

6 Risk Management

For this RWMP risk events are those events that are not predicted and therefore are probabilistic in nature – that is, there is only a chance that they may occur. Table 6-1 provides an outline of the key risks and mitigation measures.

Table 6-1: Key risks and mitigation measures

Potential Risk	Likelihood	Cause	Mitigation measures
Unplanned release of material from tailings system (either; accidental release / spill, overflow, wall failure))	Low	Design, construction and ongoing operation does not incorporate adequate controls for: • Wall or line failure • Underdrain collection system failure • Failure of base system • Unexpectedly high seepage rate • Excessive rainfall • Geotechnical failure	• Clear sustainability design outcomes • Continuous check and verification processes during design, construction and operation phases of the project to ensure sustainable design outcomes are achieved
Excessive seepage from tailings	Low	Failure of clay liner during operations or clay liner dries and cracks prior to tailings placement	• Monitoring of groundwater during tailings deposition • Quality assurance during clay liner construction
Excessive dusting from stockpiles	Low	Poor rock placement during operations, excessive handling of material, material too dry	• Monitor dust levels • Ensure stockpiles are moist (use of water sprays if necessary) • Ensure highest levels of controls on mineralised ore stockpiles
Failure to successfully rehabilitate tailings at closure resulting in exposed tailings	Low	Design does not incorporate adequate controls for: • soil erosion • water infiltration	• Robust geotechnical design • Correct execution of design requirements • Quality assurance system during closure

7 Closure and Rehabilitation

A conceptual Mine Closure Plan has been developed for the PER and is included as Appendix 3. The aim at mine closure is to return the disturbed areas as close as practicable to pre-mining conditions. The general methods to achieve this aim are outlined below.

7.1 Contaminated Plant and Equipment

All plant and equipment would be tested and cleaned to remove contamination. Where the radiation contamination of equipment is returned to approved radiation levels, this equipment would be disposed of offsite. Items that cannot satisfactorily be cleaned would be disposed of in pit voids or in approved purpose built landform.

7.2 Tailings

The tailings would be allowed to dry sufficiently then covered with a radon capping layer at least 2m thick, before being covered with topsoil and revegetated. The closure of the TSF would be an ongoing procedure across the life of the operation and refining of the closure technique would occur over time as lessons are learnt.

Landform stability and erosion modelling has occurred to assess the stability of the cover over time. The modelling found that no erosion or landform evolution would occur and that the TSF structure below ground was stable. Modelling to assess the impacts of seepage from the TSF has indicated that the natural lake sediments that surround the TSF would trap and immobilise uranium leaching from the facility. Further modelling is planned prior to construction to further demonstrate this.

7.3 Mineralised Waste

All mineralised was would be buried within pit voids across the project which would then be revegetated. Rehabilitated pit voids would be returned to as close as practicable to pre mining baseline radiation levels.

7.4 Monitoring

The site would be monitored after rehabilitation and post-closure for a period long enough to ensure that the agreed closure completion criteria are achieved to the satisfaction of regulators.