PORT PIRIE

FORMER URANIUM & RARE EARTH TREATMENT PLANT

RADIATION AND ENVIRONMENT MANAGEMENT PLAN

December 2016

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Executive Summary

This Radiation and Environment Management Plan (REMP) has been prepared to define the obligations of the Department of State Development (DSD) to manage and monitor the radiological and environmental risks identified at the site of the former Port Pirie Uranium and Rare Earth Treatment Plant.

The management of all of the radioactive materials located at the site is subject to requirements under the Radiation Protection and Control Act 1982 (RPC Act) to ensure the ongoing protection of people and the environment from the harmful effects of ionizing radiation. The DSD holds Facilities Licence (LF4: Radioactive Substances Resulting from Past Practices) under the RPC Act for the low level radioactive waste remaining at the Port Pirie site.

The Port Pirie Uranium Treatment Plant operated from 1955 until 1962 and processed ore from the Radium Hill mine. The extracted uranium was separated from the crushed ore using an acid leach process, after which spent ore was mixed with waste liquid and pumped to adjacent tailings dams. There are six uranium process tailings dams on site covering around 22ha and constructed on tidal mudflats. Only four dams contain uranium tails. At the time of closure of the uranium treatment plant in 1962, the total dry weight of material in the dams was estimated at approximately 200,000 tonnes. The other dams contain waste sludge, minor laboratory wastes, and excess rainwater run-off.

A solvent extraction plant was also constructed on the site by AMDEL during the period 1960-62. This plant produced primarily scandium with some yttrium oxide and rare earth oxides.

The closed plant was sold in 1968 and the Rare Earth Corporation (REC) began chemical processing, manufacturing and marketing of rare earths in 1969. REC utilised parts of the former uranium treatment plant, and also installed new equipment to process rare earth elements from a total of around 1500T of monazite before closing in 1972. Approximately 1.2Ha of new tailings dams were built to the east of the uranium treatment plant to contain the REC wastes.

The REMP outlines the site history including a summary of the previous rehabilitation works undertaken. More recent investigations including site characterization work and risk assessment processes are described. In summary, the likely human and ecological risks arising from radiological and chemical exposures arising from the site in its current state are considered to be Low.

The investigations indicate that, in the long term (beyond the year 2100), potential climate change risks may affect the geotechnical and hydrological stability of the tailings dam impoundments if unmanaged.

A radiation and environmental monitoring program is established to ensure the identified risks are minimized and managed.

1. Port Pirie Site Summary

1.1 Introduction

The Department for State Development (DSD) has engaged in an extensive 3 Phase investigative project to arrive at a long-term management and remediation plan for the radioactive wastes remaining at the site of the former Port Pirie Uranium and Rare Earth Treatment Plant (Pt Pirie site). This Radiation Management Plan represents a key component of the 3rd and final Phase of that project.

The management of radioactive materials located at the site is subject to requirements under the Radiation Protection and Control Act 1982 (RPC Act) to ensure the ongoing protection of people and the environment from the harmful effects of ionizing radiation.

1.2 RPC Act License & Conditions

Initial Registration of the Site: RPC Act

The Port Pirie site was initially registered in 2003 by South Australian Environmental Protection Authority under the RPC Act, for a period expiring on November 2006. The certificate of registration described the site as a Type C waste disposal site for unsealed radioactive sources located on allotments 1 and 2, plan 11452, Port Pirie West Hundred of Port Pirie. Registration was granted with conditions requiring a preliminary investigation of the site including history, nature of the wastes present, and other data that might characterize the site.

Licensing of the Site: RPC Act

DSD was later granted a Facilities Licence (LF4: Radioactive Substances Resulting from Past Practices) under the RPC Act for the Port Pirie site. This Licence with conditions is renewed annually and can be accessed in the link below:

http://www.minerals.statedevelopment.sa.gov.au/mining/former_mines/port_pirie_treatment_plant

1.3 Licensing under the EP Act

As the site contains a variety of non-radioactive contaminants, provisions of the EP Act apply with regard to management and rehabilitation to ensure compliance with relevant regulations and policies (e.g. obligations under the National Environment Protection Measure (NEPM) for Site Contamination).

1.4 Location & Site Map

Description of Site

The physical location of the former Port Pirie is described as:

- Allotments 1 & 2 Plan 11452, Pt Pirie West,
- Hundred of Port Pirie
- PORT PIRIE SA 5540

Figure 1 Port Pirie area – Landsat image (PIRSA)

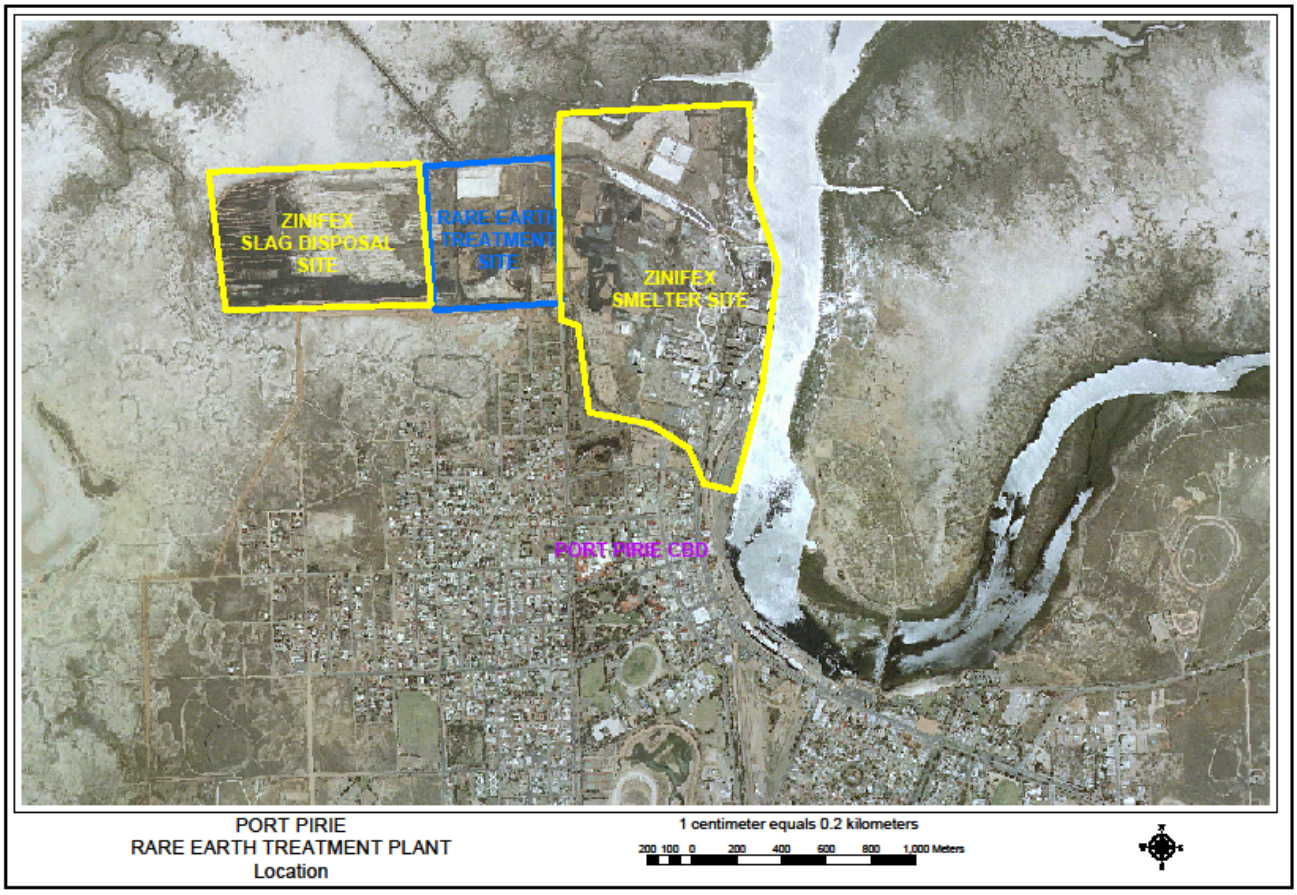

Figure 2 Port Pirie Site Map

Main features

The former Port Pirie site is located immediately north of the city of Port Pirie, adjacent to the Nyrstar Smelter complex. The Port Pirie site is surrounded, particularly to the north, by supratidal samphire mudflat. Spencer Gulf is located 2.5 km to the northwest and the Port Pirie River is 1 km to the east. The Site is located amidst an industrialised area of the city of Port Pirie. The majority of the Site is disturbed and in various stages of recovery. Much of the Site has been covered with soil and slag (from the nearby smelter), and has, in part, been revegetated. Nystar has placed a large stockpile of smelter slag to the west of the tailings dams.

The land immediately to the south of the Port Pirie site was once partially occupied but is now cleared of housing.

The area to the east of the Site is an active industrial facility (the Nystar smelter) and the area to the south grades from mudflats into slightly higher "upland" soils where residential development occurs. The Port Pirie "river" is located east of the smelter. This former tidal channel is maintained as a shipping channel. Except for groundwater seepage, the channel is not affected by the site, and any site-related groundwater seepage would have to flow under the smelter before reaching the river.

The effluent canal, which originates from the smelter settling ponds, traverses the northern boundary of the site and provides a rapid conduit for discharged smelter effluent to 1st Creek and thence, to the open Gulf. The canal is operated and maintained by the smelter, and there are currently no discharges directly from the site to the canal.

The areas north and northwest are remainders of the original salt marsh habitat bordering Spencer Gulf in this region.

Figure 3 the operating Port Pirie plant in the 1950s

Site entry points

The site perimeter is entirely fenced but has several controlled access points. Entry can be gained via the original Port Pirie locked gates in the SE corner of the site, or via a locked gate in the SW corner, which provides access to the tailings dams area.

Nyrstar has access via an internal road directly from its site, over the covered Dam 2, for the purpose of developing the slag stockpile to the west of the Port Pirie site. These access points are gated and controlled by Nyrstar security.

1.5 Summary of Radioactive Wastes Remaining

The main features of the existing Port Pirie site are shown in Figure 4 below and are described in McLeary 2004a.

Figure 4 The Port Pirie plant and tailings dams in 2003 prior to rehabilitation work

1.5.1 Treatment Plant Area

The existing radioactive wastes remaining in the former treatment plant area consist of the following:

- Contaminated rubber lined steel tanks and concrete from the former plant area,
- Contaminated structural steel from the former processing plant buildings.
- Contaminated concrete foundations of the processing building.

In addition, there are chemical contaminants remaining on the site from previous operations.

Figure 5 Steel from the former processing plant building

1.5.2 Tailings Dams Area

The radioactive waste materials remaining in the tailings dams area consist of the following:

- Approximately 200,000T of uranium tailings held in dams 2, 3, 4 and part of 5 to the west of the former plant,
- A smaller but unspecified quantity of contaminated residues (sludges) held in evaporation dams 1, 5 and 6. (These dams are uncovered and seasonally contain excess rainwater run-off from the other uranium tailings dams).
- 1500T of thorium wastes from the former REC operations held in two dams to the NE of the uranium tailings dams,
- Contaminated soil and other solid wastes from the former laboratory buildings buried in the eastern end of dams 5 and 6.

The risks to human health and the broader environment arising from the radioactive wastes (and non-radioactive wastes), are discussed below in Section 5.

Figure 6 Tailing Dam 1 covered in Smelter Slag in background with evaporation pond in foreground

Figure 7 Easterly view of uncovered portion of dam 6

2. Plant Site History

2.1 Operational History

1949 – 52: The South Australian Department of Mines identified a worthwhile uranium deposit at Radium Hill, and work began on establishing an underground mine and ore concentration plant. The operation was commissioned and operated by the South Australian Government to satisfy a contract signed by the Commonwealth and state government with the UK–USA Combined Development Agency for delivery of uranium over a seven-year period.

The proposed development of the Radium Hill uranium mine in 1952 required the development of a suitable processing plant. A site was chosen at Port Pirie.

1955 – 1962: The Uranium Treatment Plant was completed in 1955. The operations comprised processing and waste storage areas, administrative and support buildings, and other infrastructure. The extraction and leaching area included extraction and leaching plant buildings, and other associated equipment.

Ore was railed some 280km from the Radium Hill mine to Port Pirie where the leaching of uranium concentrate was conducted as a batch process and utilised 98% sulphuric acid in the digesters. The extracted uranium was separated from solids within a thickener tank, after which spent ore was mixed with waste liquid and pumped to the tailings dams. Uranium was then recovered by precipitation of uranium salt, which was heat dried (McLeary, 2004).

The 6 uranium tailings dams cover the majority of the site (approximately 22 ha), and were constructed on tidal mudflats. The uranium tailings dams are reported to consist of clay-cored levee banks on a clay base, and the banks were capped with limestone gravel to allow access to the dams. The residues in the tailings dams were pumped in as wet material, and remained damp during the life of the mine.

Dams 2, 3 and 4 contain only uranium tailings. Dam 5 held some tailings and sludges, and Dams 1 and 6 contained mainly waste sludges and excess rainwater run-off.

1960 – 62: A solvent extraction plant was also constructed on the site by AMDEL during the period 1960-62. This plant produced primarily scandium with some yttrium oxide and rare earth oxides.

1962: At the time of closure of the uranium treatment plant in 1962, the total dry weight of material in the dams was estimated at approximately 200,000 tonnes.

1968: The plant, which had remained idle since closure in 1962, was sold in 1968 to the Rare Earth Corporation (REC).

1969 – 72: The REC began chemical processing, manufacturing and marketing of rare earths in 1969. REC utilised parts of the former uranium treatment plant, and also installed new equipment to process rare earth elements. A number of new tailings dams (~ 1.2Ha) were built to the east of the uranium treatment

plant, and approximately 1500T of monazite are believed to have been processed.

During REC operation of the site, it is believed that monazite concentrates were sourced from the mining of beach sands throughout Australia, and residues from the treatment process were placed into the new REC dams and some wastes went into the former treatment plant tailings dams.

1979 – 80s A metals recovery business operated on the then derelict site from approximately 1979 to the mid1980s. Lead was recovered from batteries and copper from electric cables.

1986: Under a licence issued in 1986 for a 'Solid Waste Landfill Depot', asbestos was buried in a portion of dam 1 before being covered with granulated slag.

1988–91: SX Holdings Ltd proposed establishing a rare earths plant on site. There was an initial cleanup of the plant site in preparation for this project and by 1990, most of the construction work associated with stage 1 of the project, in addition to most of the process design of stage 2, had been completed. However, the project did not eventuate and the site remained unoccupied until 1997.

1997 – 99: During the period 1997–99, Ecofab Australia Ltd used a large shed remaining on site (the Pentad Hanger) to construct fibreglass canopies for railway wagons. Later, Zinifex stored paragoethite (hydrated iron oxide) in the Pentad Hanger for ongoing operations in the smelter until the early 2000s.

1980s – 2016: From the late 1980s the smelter operators had access to the site to place slag over the tailings dams and currently use the site to gain access for the purpose of slag dumping across an area to the west of tailings dams.

2006: A number of buildings remained at the site until 2006, at which time they were demolished. Foundations relating to these operations remain, but much of the area is now covered by granulated slag.

2.3 Site Clean-up and Remediation activities

During the period 1976 – 79, the tailings dam area was fenced with six-foot cyclone mesh and warning signs added. Slag from the adjacent smelter was also placed over a number of areas around the uranium and REC tailings dams where elevated gamma levels were recorded, to reduce the surface radiation dose rate to 10 µSv/hr or less. The necessity of providing increased protection for the site became clear in 1981 when severe weather conditions and peak tides caused seawater to over-top one of the REC dam walls. As the tide receded, seawater that had originally flowed over the top of the dams, began to drain back to the tidal flats creating a 0.3 m deep channel cut into the top of the north wall of dam 3A.

There was no evidence of scouring of the tailings material in dams 3 or 3A (McLeary, 2004).

In the mid to late 1980's, PIRSA (then DME) commenced a program of rehabilitation of the tailings impoundment by covering the area with approximately 2m of granular slag supplied by the adjacent Nyrstar Smelter (then BHAS); this was overlain by 150–300 mm of topsoil to encourage vegetation growth.

The slag covered all of dams 2, 3, 4 and the REC dams, approximately one half of dam 1, and around one-third to one-half of dams 5 and 6.

Figure 8 Tailings dam covered by Smelter slag with soil and vegetation cover

Prior to the deposition of the slag cover, piping was installed to ensure rainfall seeping to the base of the slag cover on dams 2, 3 and 4, was directed to dams 1 and 5 for evaporation.

Gamma and alpha surface contamination measurements were conducted across various infrastructure and buildings prior to a major clean-up of the site at the time of the proposed SX Holdings operations in the late 1990s. Small quantities of potentially contaminated materials from the former laboratory and other structures were removed and buried in the eastern edges of dams 5 & 6.

PIRSA in conjunction with the EPA conducted a contamination survey of the remaining buildings on site prior to their demolition in 2006.

Lightly contaminated steel process tanks, concrete foundations and structural steel remain on site as there is currently no agreed disposal pathway for these materials.

Figure 9 Scrap steel partially covered with Smelter Slag

2.4 Current site activities

Access to the site is restricted. The site boundaries are fenced, gates at access points are kept locked, and radiation hazard warning signs have been placed along the external fence.

Figure 10 Warning Sign located at front gate

Routine twice yearly site surveillance is conducted by DSD officers, and only Nyrstar maintains routine access for slag movement along a road constructed across the covered Dam 2, for the construction of stockpiles to the west of the site.

3. Roles & Responsibilities

3.1 Government departments/agencies

The Department of State Development (DSD) manages the Port Pirie site on behalf of the South Australian Government.

DSD will appoint a Radiation Safety Officer to manage the licence and associated conditions including site access, monitoring and reporting.

The Environment Protection Authority (EPA) is responsible for the administration of the Radiation Protection and Control Act (1982) in South Australia and oversight of the site licence LF4.

The EPA is also responsible for administering the Environment Protection Act 1993 (EP Act) and provides advice and guidance to ensure that site contamination is managed in accordance with relevant regulations and policies under the EP Act.

3.2 Other Stakeholders

Other stakeholders include:

Port Pirie Regional Council – whose interest is in the security of the site and any off-site impacts.

Operators of the Nyrstar Smelter – Nyrstar continue to use access to the site for stockpiling granulated slag to the west of the tailings dams.

South Australian Environmental Protection Authority (SA EPA) - who licence the site under *Radiation Protection and Control Act 1982*.

Other indigenous and local groups.

4. Site Evaluation & Risk Assessment

DSD has conducted a site evaluation and risk assessment project to arrive at a long-term management and remediation plan for the radioactive wastes remaining at the site of the former Port Pirie Uranium and Rare Earth Treatment Plant (Port Pirie).

This Radiation and Environment Management Plan (REMP) represents a key component of the 3rd and final Phase of that project and is based on the outcomes of that investigative project.

The following is an overview of Phases 1 and 2, a summary of risks, and the basis for the proposed REMP.

4.1 Phase 1: Preliminary Site Evaluation Work

Following registration of the site in 2003, PIRSA prepared a comprehensive report (McLeary, 2004a) completing Phase 1 of a longer-term management plan. The report addressed conditions applied to the initial registration under the RPC Act and provided a preliminary characterisation and conceptual model of the site. This included:

- consolidation of a considerable amount of site-related information

- background data and an assessment of the potential radiological exposure to humans and the environment
- a preliminary 'risk assessment' based on selected scenarios relative to the radiological environment of the site
- identification of data deficiencies and gaps and recommendations for further information and data required in order to progress to Phase 2 of the management plan
- provision of initial recommendations on existing management strategies and initiatives.

4.2 Phase 2: Risk Assessment & Control Scoping Program 2006/9

The second phase of work involved a more detailed site characterisation incorporating additional and specific studies and investigations to enable effective decision making on the future management of the site.

A Contaminated Site Risk Assessment and Remediation Control Scoping Assessment was conducted. This was a multi stage exercise, which included the following major tasks:

Task 1: Data Review and Gap Identification

Task 2: Conceptual Site Model and Workplan Development

Task 3: Human Health and Ecological Risk Assessment

Task 4: Control Scoping

The overall objectives of the multi-stage Risk Assessment and Control Scoping Assessment were to:

- Identify human health and ecological risks associated with current and potential future exposure to contaminants (chemical and radiological) present at, or that have migrated from, the sites, and
- focus remediation efforts to those areas and media which exceed acceptable risk levels.

The reports by AECOM on each major Task were subject to independent peer review. All reports have been provided to the Radiation Protection Branch of the SA EPA.

4.3 Summary of Phase 2 Findings & Recommendations

4.3.1 Data Review and Gap Identification

The results of the data review and gap identification were reported in AECOM 2009a. While a number of data gaps were identified, it was considered the majority of these information gaps could be addressed by the adoption of more conservative assumptions in the analysis of the site. A conservative approach is likely to overestimate actual risks at the sites. The results of any risk assessment can indicate where further data collection is necessary to fully characterize risks associated with the site.

4.3.2 Conceptual Site Model

A conceptual site model was created to determine human health and ecological risks arising from current and potential future exposure to contaminants (both chemical and radiological) present at, or that have migrated from, the former plant at Port Pirie (AECOM 2009c and AECOM 2009h).

Supporting reports relating to potential risks associated with Climate Change, Geotechnical, Hydrological and issues have also been prepared (AECOM, 2010a. AECOM, 2010b. & AECOM, 2010c).

The model considered impacted, or potentially impacted media, within and adjacent to the site (soil/sediments, groundwater, surface water).

Contaminant transport pathways were identified by which contaminants have the potential to have been transported within, and in the vicinity of the Pt Pirie site. These included the following:

- Wind erosion of surface soil resulting in dispersion in air and/or deposition to land surface.
- Water/storm erosion of surface soil/tailings and deposition to surrounding low-lying areas (mudflats sediment and/or surface water).
- Leaching of soil contaminants to groundwater.
- Migration of contaminants in groundwater to surface water/sediment in mudflat areas.
- Radon emissions.

Less significant transport pathways at the site are considered to be the following:

- Uptake of surface soil contaminants by vegetation
- Uptake of surface soil contaminants by terrestrial animals
- Uptake of sediment or surface water contaminants by aquatic biota
- Transport of volatile contaminants in soil and/or groundwater to air via the vapour migration pathway. (It was noted that potentially volatile petroleum hydrocarbons and some semi-volatile PAHs have been reported as present in isolated soil and groundwater samples).

Considering the primary impacted media and potentially significant contaminant transport pathways described above, the primary exposure points/media via which receptors at the site may be exposed to site-related contaminants are the following:

- Direct gamma radiation exposure
- Inhalation of airborne dust
- Inhalation of radon
- Surface soil/sediment 1
- Subsurface soil
- Surface water (primarily nearby mudflats)

Other less significant exposure points/media via which receptors may be exposed to site-derived contaminants include the following:

- Vegetation (not considered likely to be significant as it is considered unlikely vegetation in the area would be ingested).
- Terrestrial animals (stock is not kept on or near the site, and ingestion of other edible animals, e.g., rabbits, is considered unlikely and/or insignificant given the proximity to commercial food sources).
- Vapours in air (soil or groundwater derived vapours).
- Groundwater (not currently extracted, and not considered suitable for extractive uses based on high salinity).

4.3.3 Future Site Use & Human Receptors

The risk assessments undertaken for the Pt Pirie site considered a range of potential future land uses based on consideration of development and zoning classifications applicable to the site and other characteristics of the site which affect likely future land use scenarios (e.g., proximity to population centres or developed areas, climate, etc.). The following land use scenarios and human receptors were considered in the risk assessments:

- The current or potential future peri-urban land use, where human receptors may contact site contamination are considered to be:
    - Nyrstar workers (adult only)
    - Trespassers (adult or child)
    - Maintenance/Monitoring Personnel, primarily DSD employees or contractors (adult only)
    - Recreational users (adult or child)
- A potential future industrial land use scenario (e.g., industrial warehousing) where human receptors who may contact site contamination are considered to be:
    - Office based industrial workers or workers temporarily accessing the site
    - Maintenance/ monitoring workers accessing the site on a short term basis (adult)
- A potential future recreational/public open space land use scenario, where human receptors who may contact site contamination are considered to be:
    - Recreational users (adult or child)
    - Maintenance workers accessing the site on a short-term basis (adult).

Based on the above potential exposure pathways, human receptors, and site surveys, it is possible to estimate potential human health and ecological risks from radiological and chemical contaminants remaining on site.

4.3.4 Human Health Radiological Risks

Potential risks to human health associated with radiological contamination at the Port Pirie site were assessed and detailed in AECOM (2009h). The model used (RESRAD) was complex and incorporated a range of parameters including soil radionuclide content, gamma dose rate surveys, radon concentrations, assumed exposure times and frequencies for different receptors and dietary assumptions.

The radiation exposure scenarios were based on site average exposure rates and also average exposure rates across three sub areas, and exposure rates associated with five areas of increased gamma gamma dose rates noted in previous gamma surveys of the site (see Fig 11).

Radiation doses estimated in the risk assessment were compared with the effective dose limit of 1mSv/y for a member of the public, and average occupational effective dose limit for workers is 20mSv/year. (RPC 2015). It was noted that radon had minimal impact on the total radiological levels.

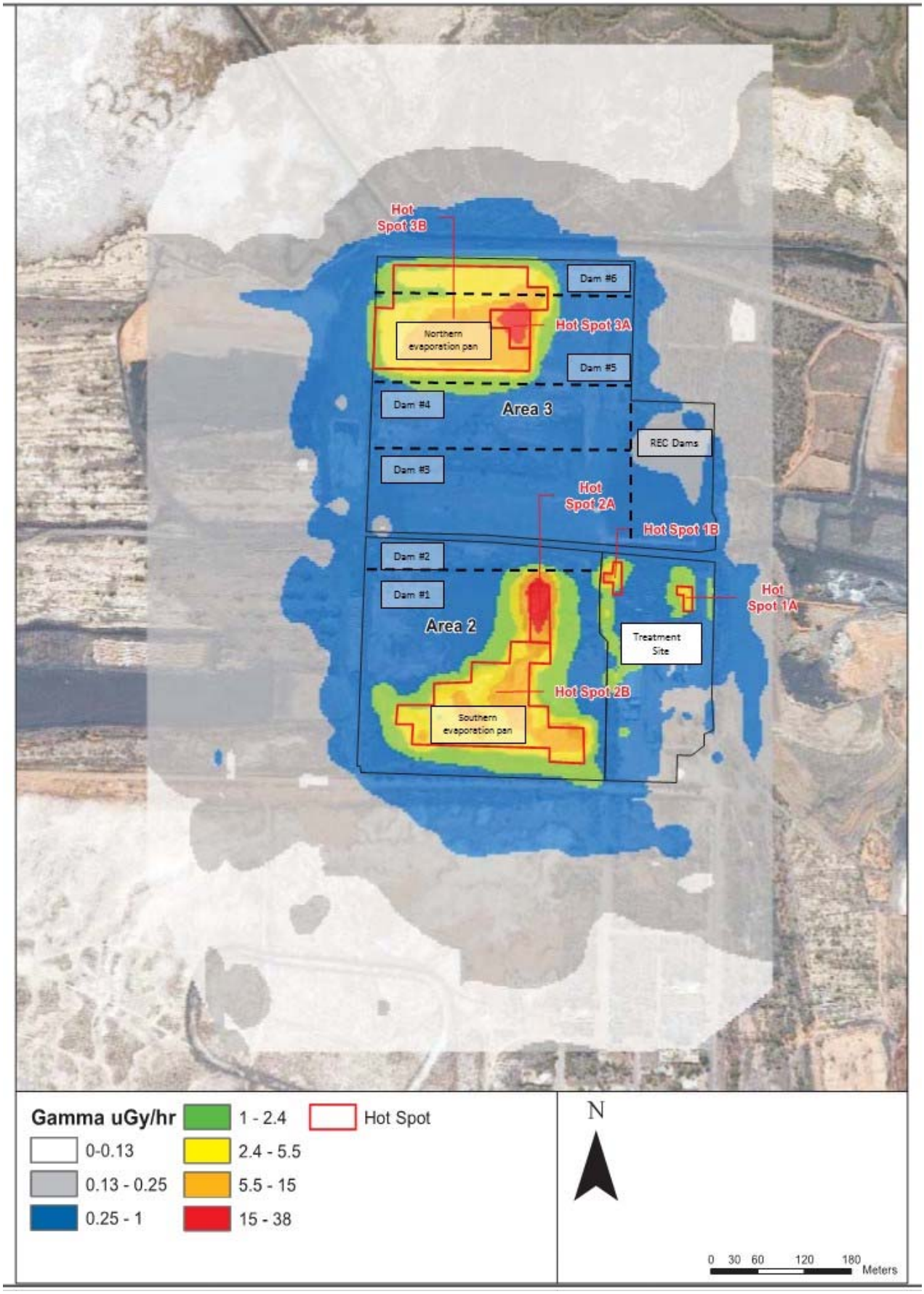

Figure 11 Tailings Dams 1 - 6 & REC Dams, and locations of increased gamma dose rates

The conclusions of the radiological risk assessment for the PP site were as follows:

- Estimated exposures to site-wide average levels of radiological contamination were below the public dose limit (1 mSv/year) for all receptors other than the industrial worker (1.45 mSv/year).
- Estimated average area doses were below the limit (1 mSv/year) for all receptors in areas 1 and 3. In area 2 average dose levels exceeded the limit for the Adult on-site recreational user (1.21 mSv/year), the Nyrstar Worker (1.04 mSv/year) and the Industrial Worker (2.22 mSv/year).

- Estimated doses within each of the elevated gamma areas (Figure 5) exceeded the adopted exposure limit of 1mSv/year for all receptors, except Maintenance/Monitoring Personnel (where the limits were exceeded in all areas except location 1B, 0.59 mSv/year) and the Intrusive Maintenance Worker (where exposure levels were below the limit in all areas except location 2a (2.77 mSv/year) and location 3A (1.37 mSv/year).

- Receptor doses at location 2A ranged from 2.77 mSv/year (Industrial Maintenance Worker) to 48.57 mSv/year (Industrial Worker); up to twice the occupational exposure limit of 20 mSv/year for workers

- Estimated exposures to site-wide average levels of radiological contamination were below the public dose limit for both Nystar Workers (0.68mSv/y) and Maintenance/ Monitoring Workers (0.14 mSv/year).

- Estimated area average doses for sub areas of the site were below the public annual dose limit (1 mSv/year) for all receptors in areas 1 and 3. In area 2 average exposure levels for the Nyrstar Worker (1.04 mSv/year) just exceeded the public dose limit.

- Estimated exposures within each of the elevated gamma dose rate areas exceeded the dose limit of 1mSv/year for Nystar Workers and Maintenance/ Monitoring Workers.

- Radon exposure levels estimated by RESRAD were considered to be negligible.

- A separate estimate was made of potential doses arising from ingestion of fish caught in the Port River. The conservative scenarios indicated a maximum potential dose to adults of around 5% of the 1mSv/y annual dose limit for members of the public.

4.3.5 Human Health Chemical (Non-Radiological) Risks

Potential risks to human health from chemical contaminants were assessed and detailed in AECOM (2009g).

Chemicals of potential concern (CoPC) for which health risks were quantified on-site (within the site boundary) were identified as those chemicals which consistently exceeded adopted media-specific health-based investigation levels.

The selected CoPC on-site consisted of a wide range of both metals and rare earth elements in soils and surface waters are presented in the below table.

Table 1: Chemicals of potential concern

Domain	Type of CoPC	CoPC identified
Soil	**Metals**	Arsenic, Cadmium, Chromium, Copper, Lead, Thorium, Uranium, Vanadium, Zinc
Soil	**Rare earth elements**	Cerium, Dysprosium, Erbium, Europium, Gadolinium, Holmium, lanthanum, Lutetium, Neodymium, Praseodymium, Samarium, Scandium, Terbium, Thulium, Ytterbium, Yttrium
Surface Water	**Metals**	Aluminium, Antimony, Arsenic, Boron, Cadmium, Chromium (total), Cobalt, Copper, Iron, Lead, Manganese, Mercury, Nickel, Selenium, Silver, Thallium, Thorium, Uranium, Vanadium, Zinc
Surface Water	**Rare earth elements**	Cerium, Dysprosium, Erbium, Europium, Gadolinium, Holmium, Lanthanum, Lutetium, Neodymium, Praseodymium, Samarium, Scandium, Terbium, Thulium, Ytterbium, Yttrium

Off Site (outside the site boundary)

The CoPC in off-site areas were selected as those chemicals which are likely to have been associated with historic site activities, but excluded chemicals considered to be present at or near the site as a result of regional contamination or activities associated with the nearby Nyrstar smelter. The selected and much more limited set of CoPC in off-site areas comprised the following:

Metals: Boron, Thorium, Uranium, Vanadium

Rare earth elements: Cerium, Scandium, Yttrium.

The assessment concluded:

- Exposure levels are expected to be within acceptable levels for most receptors provided that receptors are not repeatedly exposed to the most contaminated areas of the site, and that significant contact with environmental media (soil and surface water) in the tailings dam areas are avoided.

- Swimming and other activities involving direct contact with surface water in the tailings dam should be prevented due to both chemical contaminants and low pH in tailings dam surface water.

- Human health risks associated with exposure to site-related contaminants in off-site areas by recreational users are expected to be within acceptable levels, and not significantly higher than background risks.

- Should the plant area of the site be developed or used in the future, potential health

and aesthetic risks associated with isolated discrete petroleum hydrocarbon contamination may need to be managed

The most sensitive (i.e. highly exposed) receptors considered in the risk assessment were child recreational users. In the case of uncontrolled public open space/recreational use of the Site, the possibility of these receptors spending a significant amount of time at the site, including in areas of elevated gamma dose rates, is considered possible, as is the potential for adverse site-related health risks to these receptors.

Therefore, as part of the control scoping process, a more detailed analysis of specific chemicals and soil sample locations contributing to potentially unacceptable risks to child recreational users was undertaken.

Lead and chromium concentrations are significant anywhere on the site. It should however be noted that a significant level of risk is also associated with background areas which is assumed to be related to regional contamination.

It was noted that the highest concentrations of lead at the Site were identified in tailings; lead concentrations in tailings were generally five to ten times higher than those in non-tailings samples (on average). The report noted that while elevated lead concentrations at the Site may be associated with regional sources of contamination (i.e. the smelter adjacent the Site), the reported concentrations in tailings suggest that the ore may have contained traces of lead.

The reported average chromium concentration in tailings samples was approximately three times higher than average concentrations in non-tailings samples. This reported distribution is also suggestive of a Site-related, rather than regional, source of chromium.

As detailed in Appendix C of AECOM (2009 g), and summarised in Table T1 to Table T4 (in the Tables section at the rear of this report), hazard quotients greater than 1 (per chemical) were associated with the reported maximum concentrations of chromium and lead in site soils, and these metals accounted for over 90% of the total hazard index estimated for continuous exposure to maximum soil concentrations.

It was noted that the risk estimates for chromium and lead due to direct contact with soil are considered likely to be associated with a relatively high degree of uncertainty and to be overestimated due to conservative assumptions used in the modelling. However, the risk assessment and above analysis indicate that risks to human health are possible given the widespread lead and chromium exceedances across the site.

4.3.6 Ecological Risks

Potential ecological risks associated with radiological and chemical contamination at the PP site were assessed and detailed in AECOM (2009 i). In summary:

- Risks to aquatic ecological receptors were considered to be low. Radionuclides and rare earth elements are not considered to be a risk to aquatic and riparian receptors.
- Risks to terrestrial receptors (higher trophic level and community level) were considered to be low overall. The majority of the risk to higher level terrestrial receptors was from lead and copper which is widely distributed across the site.
- There was a marginal risk to terrestrial receptors in the plant and tailings dam areas due to exposure to radionuclides and rare earths.
- Conventional metals exceeded screening concentrations for community-level

effects in all areas. Many of the locations where screening levels were exceeded were in areas where terrestrial vegetation was absent, discontinuous and/or generally sparse. Potential adverse effects to plant communities appeared to be associated with general physical disturbance of the area.

- Low or marginal exceedances in groundwater and sediment radionuclide levels, when considered in conjunction with dilution and mixing with tidal water and overall stability and productivity of the aquatic communities in 1st Creek, are not considered to be a risk to aquatic and riparian receptors.

4.3.7 Climate Change, Geotechnical & Hydrological Risks

Risks identified in these reviews are summarised below.

(a) Climate Change Assessment

The Climate Change Assessment (AECOM, 2010a) noted the following risks:

- Increased extreme wind speed and reduction in soil moisture content may increase the risk of soil/fill movement in areas exposed to high winds.
- Reduced stability of the dams due to decreased soil moisture content leading to increased soil movement and cracking.
- Compromise of dam embankments and walls due to increased temperatures and winds, and decreased soil moisture.
- Increased rainfall runoff as a result of decreased soil moisture content and increased soil baking.

This report noted that identified climate change risks primarily relate to a range of issues associated with decreased soil moisture content and/or increased temperatures and wind erosion. The key conclusion relevant to potential for contaminant migration at the site was that increased temperature, solar radiation, extreme wind speed, and decreased soil moisture content, should be considered in the future studies and development undertaken at the site.

The AECOM assessment considered the impact of sea level rise during the 21st Century. While there are uncertainties in projecting future sea level rise due to climate change impacts, there is medium confidence that the rise will not exceed several tenths of a metre during the 21st Century (IPCC 2013).

A long term rise in sea level may eventually impact on groundwater levels and the structural integrity of the base and walls of the dams. In addition, sea level rise in combination flooding, spring tides or storm surges may also represent a risk.

Figure 12 North road embankment looking east separates the tidal mudflats from the dams.

(b) Geotechnical Assessment

The Geotechnical Assessment (AECOM, 2010b) noted the following risks:

- Susceptibility to erosion from surface water run-off.
- Risk of structural failure of the embankments was assessed as very low.
- Risk of structural failure due to internal instability was considered possible (but unlikely).
- Potential for overtopping of dam embankments from a build-up of water or from tidal actions from the seaward side, breaching the embankment (Figure 12).

(c) Hydrological Assessment

The Hydrological Assessment (AECOM, 2010c) noted the following risks:

- Ponding and overflow from uncapped dams during extended periods of wet weather causing discharge of contaminants.
- Seepage of ponded water through the tailings dams causing mobilisation of contaminants (derived from tailings or low level radioactive waste) as a result of seepage through dam embankments.
- Failure of the dam embankments as a result of overtopping in a major storm, and associated erosion and scour of the embankments, or catastrophic failure.
- External flooding of the site either from tidal inundation during storm surges under both existing condition and potentially increase risks associated with future increases in sea levels; and
- Flooding of the site from the Port Pirie River inundating the site of affecting the

stability of the dam embankments

In summary, the risk issues and uncertainties identified in the geotechnical and hydrological assessments above relate to the potential for contaminant mobilisation due to structural failure, erosion/scour or seepage within the tailings/waste dams, while the issues and uncertainties identified in the climate change assessment relate to potential for reduced dam stability (and associated contaminant migration) due to decreased soil moisture content and/or increased temperatures and wind erosion, or rising groundwater levels.

The risk issues summarised above, and potential control measures to address these issues, are further discussed in Section 6.

5. Current Status of Site (2016)

5.1 Site Use

Nyrstar continues to use the access road across the site for slag movements from the smelter to the stockpile to the west of the tailings dams.

Figure 13 Nyrstar's haul route facing west

DSD officers conduct bi-annual inspections of the site. Gamma dose rates are measured at key points across the site (e.g. the identified elevated gamma dose rate areas) and around the site perimeter. Groundwater levels are measured at fixed monitoring points, vegetation growth checked and security fencing, signage, outer boundaries, tailings containment, and other stored waste materials inspected.

5.2 Site Condition

No changes have been made to the tailings slag cover, dam walls, or to the large quantity of lightly contaminated steel and concrete from the demolished processing tanks stored on site.

The site remains in a state unchanged from the Phase 2 investigations conducted up to 2010.

5.3 Site Security

Routine checks are made of the security fence and radiation warning signs. The perimeter fence and locked gates remain in good repair.

6. Radiation & Environment: Risks, Controls & Monitoring

The following outlines a program of radiation monitoring of the Port Pirie site (including monitoring of structural integrity, chemical risks and potential environmental impacts.

The proposed monitoring program is based on the routine site monitoring currently done by DSD to ensure site integrity, and also includes measurable parameters relevant to the risks identified in the Phase 2 Control Scoping studies (AECOM 2010d). That is, where possible, measurable components of the suggested control options have been incorporated into the monitoring program.

The Control Scoping study notes that the geotechnical, hydrological and climate change issues are closely linked. For this reason, potential climate change-related variations in soil moisture, wind speed and temperature should be incorporated in future modelling and/or assessment efforts to further assess geotechnical and hydrological risk issues identified based on the current situation.

The essential components of the monitoring program are described below and summarised in Appendix B.

6.1 Dose Limits

The applicable annual radiation doses limits for a member of the public and for a radiation worker are specified in Division 2 of the Regulations under the RPC Act (RPC 2015).

The annual effective dose limit for workers is 20mSv/year,

The annual effective dose limit for a member of the public is 1mSv/year,

6.2 Human Health: Radiological Impacts

Receptors

For the purposes of this REMP, the following are considered to be potential receptors for radiological exposure for the site remaining in its current state:

- DSD officers and contractors (monitoring and maintenance/intrusive workers),
- Nyrstar transport workers,
- Unauthorized entry, for short periods, by children or adults.

While the Control Scoping review (AECOM 2010d) also considered other potential receptors for radiological exposure (such as industrial workers and uncontrolled recreational users, accessing the site on a daily basis), these are not considered likely in the future.

Risks

In estimating the risks to intrusive workers, it was assumed that maintenance workers may be exposed to site contaminants for 8 hours a day, up to 12 days (96 hours) per year for 5 years. If it is assumed that workers are located entirely in the elevated gamma dose rate areas, their doses only marginally exceeded the long-term exposure limit of 1 mSv/year (estimated exposures for increased gamma dose rate areas 2a and 3a were 2.8 and 1.4

respectively). This is an unlikely scenario and the overall potential for risk to intrusive maintenance workers at the site is therefore expected to be Low.

Nyrstar transport workers spend only a very limited time transporting slag across the site under existing conditions. This is generally done inside heavy vehicles that provide a degree of shielding from direct gammas. (The haul road runs near elevated gamma areas 1A, 1B and 2A). The dose estimated for Nyrstar workers in area 2 was 1.04mSv/y.

It can also be expected that the risk to trespassers during short term unauthorized entry to the site would be Low and doses would not exceed 1mSv/y.

The Control Scoping review notes that elevated radiological exposure could occur if existing soil and/or slag cover material is removed from the site in areas where radiologically contaminated material is present. As it is not possible to predict the levels of gamma or radon exposure which may occur in the event that significant quantities of cover are removed, future management controls and/or remediation scoping should consider the potential for changes to the currently measured radiological exposure levels over time.

Controls

Increased covering/shielding over known areas of increased gamma dose rate.

Routine inspections and gamma monitoring, and maintenance of fencing and warning signs.

Radiation Monitoring

The radiological monitoring program incorporates the above risks and suggested controls. The program includes systematic routine gamma surveys to detect any long-term site changes (e.g. around and across the tailings dams and plant area), and particularly changes in cover effectiveness at identified areas of elevated gamma dose rates.

Structural integrity, any erosion points, and fencing and warning signs will be regularly checked along with signs of unauthorized entry to the site.

Personnel Gamma Dose Monitoring:

Government staff, their contractors and Nyrstar drivers are the only persons receiving regular radiation exposures at all locations across this site, and may be considered to be radiation workers with an annual dose limit of 20mSv. All other visitors will be considered to be members of the public (1mSv/y dose limit). If site visits increase in frequency, or duration, consideration should be given to the provision of personal gamma monitors (dosimeters).

6.3 Human Health – Chemical Impacts

Receptors

The receptors are as for radiological exposures.

Risks

There is the potential for exposure to chromium and lead in soils (tailings and/or other fill material. In addition, there is the potential for exposure to chromium, manganese and zinc in surface water of dams 5 and 6, and also the possibility of immediate physical risks (e.g. acid burns) resulting from dam surface water contact, due to the low pH of these waters.

Exposure levels are expected to be within acceptable levels for most receptors provided that receptors are not repeatedly exposed to the most contaminated areas of the site, and that

significant contact with environmental media (soil and surface water) in the tailings dam areas are avoided.

Swimming and other activities involving direct contact with surface water in the tailings dam should be prevented.

Human health risks associated with exposure to site-related contaminants in off-site areas by recreational users are expected to be within acceptable levels, and not significantly higher than background risks.

Controls

- Fencing and warning signs
- Covering known areas of elevated metals in soil.

Monitoring

Monitoring will consist of routine visual inspections and maintenance of fencing and warning signs and routine inspections of slag cover over areas of elevated metals in soil.

6.4 Ecological Impacts – Radiological & Chemical

Receptors

The exposure units of concern at the Port Pirie site were the:

- Plant/Treatment area – 3.2ha
- Tailings Dams area – 22ha
- Surrounding area – 50ha immediately to the south and west
- Mudflats area – 700ha between 1st Creek and 2nd Creek to the north and northwest of the Port Pirie site.

For all defined exposure areas the receptors quantitatively evaluated include:

- Terrestrial vegetation community
- Soil invertebrate community
- Terrestrial herbivorous birds (gibberbird [Ashbyia lovensis])
- Terrestrial omnivorous birds (inland dotterel [Peltohyas (Charadrius) australis])
- Terrestrial carnivorous birds (spotted harrier [Circus assimilis])
- Terrestrial herbivorous mammal (European rabbit [Oryctolagus cuniculus]);
- Terrestrial omnivorous mammals (Bolam's mouse [Pseudomys bolami]); and.
- Terrestrial carnivorous mammals (red fox [Vulpes vulpes]).
- Aquatic receptors present in the lower intertidal and subtidal zones of the salt marsh were also considered, although qualitatively as little data are available to evaluate these receptors in this zone of the marsh. Potential aquatic receptors include invertebrates, plants, fish, birds and mammals.

Risks

The Remediation Control Scoping review notes the overall ecological risk is considered to be low and controls are not considered to necessarily be required unless the site is to be used as recreational/public open space and will contain landscaped areas. This is not proposed as the site will remain under care and maintenance for the foreseeable future.

- Radionuclides and rare earth elements are not considered to be a risk to aquatic and riparian receptors.
- Low or marginal exceedences in groundwater and sediment radionuclide levels, are

not considered to be a risk to aquatic and riparian receptors when considered in conjunction with dilution and mixing with tidal water and overall stability and productivity of the aquatic communities in 1st Creek.
- There was a marginal risk to terrestrial receptors in the plant and tailings dam areas due to exposure to radionuclides and rare earths.

- Risks to terrestrial receptors (higher trophic level and community level) were considered to be Low overall. The majority of the risk to higher level terrestrial receptors was from lead and copper which is widely distributed across the site.
- Conventional metals exceeded screening concentrations for community-level effects in all areas. Many of the locations where screening levels were exceeded were in areas where terrestrial vegetation was absent, discontinuous and/or generally sparse. Potential adverse effects to plant communities appeared to be associated with general physical disturbance of the area.
- Risks to aquatic ecological receptors were considered to be Low.

Controls

Potential options to control the identified risk were only considered likely to be warranted in the event that the site is further developed for recreation and/or public open space purposes, and some areas of the site are to be landscaped. This will not be the case if the site is maintained in its current state.

Monitoring

No specific monitoring is suggested for this type of exposure.

6.5 Dam Structural Failure, Erosion/Scour or Seepage

Risks

The Hydrological and Geotechnical Assessments undertaken for the site (AECOM, 2010b and 2010c) identified a range of risks relating to the potential for contaminant mobilisation due to structural failure, erosion/scour or seepage within the tailings dam area.

The Remediation Control Scoping study (AECOM, 2010d) notes that the likelihood of contaminant migration from tailings dam is considered to range from possible to almost certain (depending on severity), while the consequences of these risks range from minor (e.g., minor dispersal of tailings material due to scouring or erosion of the dam walls or surface) to major (e.g., complete structural failure of the dams). The overall risk associated with this issue has therefore been assessed as ranging from Medium to Extreme.

It was emphasised that extreme risks are considered primarily relevant to the long term, rather than to the current situation.

In addition, there is a relatively high level of uncertainty associated with the assessment of these risks, based on the lack of available data for:

- Geotechnical characteristics of tailings and soil cover, and underlying materials.
- Strength of the slag material
- Compaction density and water content of embankment materials
- Subsurface information to calibrate the results of the CPT testing
- Water balance modelling to assess maximum ponding levels in the dams.

It was recommended that additional investigation (e.g., water balance modelling and/or

geotechnical investigation) should be undertaken in order to further assess the potential for contaminant migration risks due to geotechnical and hydrological factors, and the need for further management, engineering and/or remediation controls to address risks should be reassessed based on the results of these investigations.

If risks are still considered to be unacceptable after additional data collection and assessment efforts, additional management and remediation control options may need to be considered within the context of DSD's overall risk management approach for the site.

Controls

Ongoing inspections and maintenance to prevent and/or reduce consequence of mobilisation as a result of minor erosion and scouring.

Additional data collection (geotechnical investigations and water balance modelling) to provide information relevant to maintenance and future remediation work may be considered in the context of planning for any remedial works onsite

Monitoring

Undertake biannual visual inspections of the tailings impoundment to assess condition of site and need for maintenance.

6.6 Reduced Dam Stability Due to Climate Change Effects

Risks

Changes in Soil Moisture and Temperature:

The Climate Change Risk Assessment undertaken for the site (AECOM, 2010a) identified a range of climate change variables which have the potential to affect dam stability (and associated contaminant migration), primarily decreased soil moisture content and/or increased temperatures and wind erosion.

A number of the potential climate change related risks are closely linked to identified geotechnical and hydrological risk issues, as variations in soil moisture, wind speed and temperature will affect the geotechnical and hydrological stability of the tailings dam area.

The Remediation Control Scoping study (AECOM, 2010d) notes that the likelihood of climate change variables resulting in contaminant migration from tailings dam is considered to range from moderate to likely (depending on severity), while the consequences of these risks range from minor (e.g., minor dispersal of tailings material due to scouring or erosion of the dam walls or surface) to major (e.g., complete structural failure of the dams).

The overall risk associated with this issue has therefore been assessed as ranging from Medium to Extreme. It was emphasised that extreme risks are considered primarily relevant to the long term (beyond the year 2100), assuming no active remediation of the site, rather than to the current situation where there is ongoing surveillance and maintenance.

It should also be emphasised that there is a relatively high level of uncertainty associated with the assessment of these risks, as long term effects of identified climate change variables on overall dam stability are difficult to predict.

Sea Level Rise and/or Storm Surge Effects:

The climate change assessment also identified that future modelling is required to determine the impact of global average sea level rise and storm surge on dam stability and

potential for overtopping at the Port Pirie site in the long term (i.e. beyond the year 2100).

A relatively high level of uncertainty is associated with the assessment of these risks, as modelling of sea level and storm surge effects over the long term is associated with a high degree of uncertainty.

Controls

It was recommended that climate change predictions (e.g. soil moisture decrease) be incorporated within geotechnical and hydrological models and investigations to assist the design of physical controls for the existing site and for possible long term closure.

Further modelling was recommended to assess impact of global sea level rise, storm surge and spring tides on dam stability over the long term

Regular inspection should be conducted to monitor the effect to which climate effects may impact the dam walls and surface, and implementation of maintenance where necessary.

Monitoring

Undertake biannual visual inspections of the site and tailings dam walls and surface to assess condition of site and need for maintenance.

Maintain groundwater level monitoring in and around site over long term.

6.7 Site Clearance Checks

Contamination is defined in the ARPANSA Code of Practice on Safe Transport of Radioactive Material (2014) as the presence of radioactive substance on a surface in excess of 0.4 Bq/cm^2 for beta and gamma emitters and low toxicity alpha emitters, or 0.04 Bq/cm^2 for all other alpha emitters.

Occupational exposure due to contact with contaminated surfaces or contaminated work clothing is considered to be a negligible exposure pathway if normal hygiene procedures are followed.

Ingestion of contaminated soils is possible although very unlikely. Accidental ingestion of radioactive materials may occur where exposure was due to unauthorized entry to the site by persons not familiar with the site hazards.

It is proposed that plant and equipment that has had significant contact with contaminated soils or sludges and is to leave the site, will be monitored for surface alpha and beta contamination.

A "clearance limit" of 0.4 Bq/cm^2 will apply to all such plant and equipment.

Vehicles or equipment working in areas of the plant or tailings dams where there has been contact with uncovered contaminated soils or sludges, should be subject to site clearance procedures. Prior to leaving the site, all such vehicles and equipment should be washed down where necessary to remove visible contamination and then checked with a surface contamination meter to confirm alpha and beta levels are below the "clearance limit" of 0.4 Bq/cm^2.

6.8 Radiation Safety Officer

A Radiation Safety Officer will be appointed to advise DSD on complying with licence requirements, including the radiological aspects of the site and monitoring program.

Details of the qualifications and experience of the RSO will be provided to the EPA as required per Regulation 15 of the Radiation Protection and Control (Ionising Radiation) Regulations, 2014 (RPC 2014).

6.9 Radiation & Environment Monitoring

Site radiation monitoring will be undertaken by the RSO or, a competent person appropriately trained as necessary by an independent third party trainer.

Calibration of all radiation survey instruments and samplers will only be conducted by a recognised facility, including the EPA Laboratory if available, and records held by DSD.

All site and environmental monitoring data will be stored within a dedicated database and will be retained permanently by DSD for review by the EPA. Should personal dose monitoring be required for Nystar or DSD officers, the personal dose records will also be retained by DSD. The RSO will review the dose recording system annually.

The Monitoring Program is outlined in detail in Appendix B.

7. Site Access & Visitor Controls

7.1 OH&S considerations

The site in its existing state contains a number of radiological, physical and chemical hazards.

Basic PPE is required for anyone entering the site. This will include steel capped boots, safety glasses and gloves if handling material.

If any contaminated material is handled (e.g. during a sampling program), a dust mask should be used wherever there is potential or visible dust. Hands and face should be washed prior to all meals and at the completion of daily work on site.

All visitors should be aware that Nyrstar operate vehicles and heavy machinery across the centre of the site. Access to the roadway is via a locked and signposted gate.

Time spent on uncovered dams should be minimized to reduce gamma radiation exposure. Exposure to radiation will be monitored in accordance with the standard methods (ARPANSA, 2011)

Appendix B outlines the hazards associated with specific areas within the site.

7.2 Management of workers/visitors

A site safety induction will be undertaken for all DSD employees and contractors to ensure they have a thorough understanding of the environmental and safety management requirements, and their OHS responsibilities. The safety induction will describe the potential radiological, physical and chemical hazards associated with the site

The Safety Induction will include:

- personal hygiene;
- personal protective equipment;
- rules involving eating, drinking and smoking;
- cleaning procedures;
- incident response and reporting procedures (e.g. in the event of observed containment defects; and
- emergency response procedures (e.g. in the event of an accident or medical emergency).

The site induction material is part of the Standard Operating Procedure to be followed by all site visitors (Appendix A).

DSD will keep a record of all authorized site visits and activities performed, to confirm radiation exposure scenarios remain valid.

7.3 Incidents, Accidents and Emergencies

Acute exposure to ionizing radiation routine site visits by DSD officers is unlikely to occur given the relatively low dose rates observed around the site, the limited time spent on site, and limited access to contained tailings and other radioactive materials.

A contingency plan will be developed to address the accidental contact or ingestion of contaminated liquids and solids. In addition, the plan will include contingencies for accidental

and uncontrolled releases of radioactive (+other chemical/physical) materials from site to environment.

Contingency plans will also include response to non-radiological factors (for example physical injury, contact with acidic sludge, etc.) as these are generally given priority over potential radiological risks at this site.

8. Record Keeping & Reporting

8.1 Periodic Reporting

Under the conditions of licence (LF_3), the DSD is required to provide an annual licence report EPA addressing requirements under licence conditions.

An Annual Radiation Report will be provided to EPA summarising the site annual radiation monitoring results, including exposure to workers and members of the public, status of containment structures, materials held on site, and the surrounding environment.

The report will also assess proposed changes to the future monitoring program for the next twelve months.

8.2 Periodic review and updating of site information

The effectiveness of the REMP will be reviewed annually by the RSO at the time of providing the Annual Licence Report to the EPA. The REMP will be formally reviewed every three years against the approved requirements and will include:

- Compliance against authorisations and commitments in the REMP
- Appropriateness of monitoring frequencies, techniques and locations,
- Review of assessed employee effective doses (if such dose assessment is required),
- Estimates of effective dose to the most exposed member of the public (should that be required).
- Review of administrative procedures for managing radiation exposures.
- Site changes will be incorporated into the REMP.

An REMP update can be provided to the EPA if necessary.

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Appendix A: Site Access Control - Standard Operating Procedure

The Standard Operating Procedure for controlling access to the site aims to monitor, control and keep records on any person (Government employees and visitors) entering the site. The SOP outlines the process in place that controls the access to the site and provides direction on what minimum procedures should be followed.

All persons accessing the site must be accompanied and escorted by the Responsible Officer and/ or delegated Government officer at all times.

For Entering

1. Visitors should contact the Government representative in order to approve and schedule the site visit

   Responsible Officer:
   Catherine Fullston
   Project Manager Mine Completion
   Tel. (08) 8463 3083
   Catherine.fullston@sa.gov.au

2. The Contact Officer will keep record of all persons accessing the site in the Entry log book. The following details are to be registered and signed by the visitor:
   - Visitor Name, Company Name, Date / Time of visit, Responsible Officer, Reason for the visit, Exiting time.

3. Upon arrival, the Responsible Officer will conduct a WHS Induction that will include:
   - site security measures
   - nature of site hazards and locations
   - personal hygiene;
   - personal protective equipment;
   - rules involving eating, drinking and smoking;
   - cleaning procedures;
   - incident response and reporting procedures (e.g. in the event of observed containment defects; and
   - emergency response procedures (e.g. in the event of an accident or medical emergency).

4. All persons must wear their corresponding PPE and visitor badges.
5. The Responsible Officer will provide with Radiation and Radon gas monitoring during the visit.

Upon Exiting

6. When exiting the visitor or person leaving the site must return all PPE and badges if provided.
7. The log book must be signed indicating the date and time at which they are leaving.

Appendix B: Radiation Monitoring Program - Outline

Site Area	Risk	Measured Parameter	Method used	Monitoring Frequency
Identified areas of increased gamma dose rates	Change in Gamma dose rate due to material spreading or cover thinning.	Gamma dose rate	Point Survey	Annual
Routine inspections of entire site	Unauthorised entry	Maintenance of fencing & warning signs	Visual inspection	Bi-annual
Routine inspections of entire site	Reduction of slag cover over areas of elevated metals in soil, scrap or contaminated materials in Plant area,	Maintenance of cover materials	Visual inspection	Annual
Routine inspections of entire site	Loss of contaminated scrap metal from Plant area.		Visual inspection	Annual
Tailings dams surface and walls	Loss of structural integrity through erosion or scouring	Erosion monitoring points.	Visual inspection and change measurement	On an as needs basis
Site Clearance checks	Unrecognised removal of contaminated vehicles, equipment or scrap materials	Alpha/beta surface contamination level	Surface contamination monitor.	As required
Site and surrounds	Long-term groundwater depth changes	Groundwater depth	Dipping	Bi-annual
Site Area	Groundwater contamination	Groundwater quality (radionuclides)	Groundwater sampling	5 years (next 2017-18)
Site Area	Radon	Radon exhalation	Gas Monitoring	5 years (next 2017-18)
Site and surrounds	Dust fall out	Radionuclides in Dust	Dust deposition gauges, high vol.	Initially 5 years

Appendix C: Communication Plan

Government of South Australia
Department of State Development

PORT PIRIE

FORMER URANIUM & RARE EARTH TREATMENT PLANT

Communication Plan

December 2016

Table of contents

1 Introduction

The Department of State development (DSD) is responsible for the management of radioactive material located at the former Port Pirie Uranium and Rare Earth Treatment Plant (Pt Pirie site) under the requirements of the Radiation Protection and Control Act 1982 (RPC Act).

DSD's responsibility is to provide effective management of radiation hazards associated to the Port Pirie site. Site activities comprise the identification and management of potential risks associated with the site that can impact adversely on the environment and/ or jeopardise public safety.

The Department is undertaking a long-term management and remediation plan for the radioactive wastes remaining at the site and has developed a Radiation and Environment Management Plan (REMP) for the site in order to ensure the protection of public safety and the environment.

This communication plan sets the framework for engagement and communication protocols with all Stakeholders and relevant parties that would be affected by the activities formulated in the REMP for Port Pirie site.

2 Objectives

The objective of the communication plan is to monitor stakeholder engagement and communication protocols in relation with the implementation of the program and recommendations in the REMP.

3 Context

3.1 Background

The Port Pirie site is a registered premise under the Radiation Protection and Control Act 1982, a certificate of registration has been issued for the site by the EPA, which includes a number of conditions. These conditions are aimed towards the development of an appropriate overall long term management plan. DSD manages the site on behalf of the South Australian Government.

The Port Pirie Uranium Treatment Plant operated from 1955 until 1962 and processed ore from the Radium Hill mine. The Rare Earth Corporation undertook chemical processing, manufacturing and marketing of rare earths between 1969 and 1972. There are six tailings dams onsite from these activities.

The site requires long-term management considerations due to the long half-life of the naturally occurring radionuclides in the waste; there is also the possibility of other contaminants exceeding guidelines being present.

Recognising that there was a need for better long-term management of radioactive material at the site, a decision was made to formally investigate the sites and develop a comprehensive management strategy to effectively deal with issues relevant to the site now and into the future.

Following a formal desktop study, the first phase of the management strategy was completed in 2004 with extensive 'Preliminary Investigation' reports being produced for each site; these are available publicly.

The second phase included data gap analysis of the previously completed surveys of the site, and where necessary further characterisation and testing were conducted.

The third phase in 2009 involved a major risk assessment that included human health and ecological risk assessments. This phase determined suitable controls to treat those risks identified.

The current phase entails the development of management plans for the site to potentially undertake and manage remediation activities in order to treat the risks identified.

The site is inspected bi-annually (as a minimum) and includes surveys of fencing, signage and environmental monitoring as required.

3.2 EPA licence for Port Pirie site

The Department of State Development holds a Facilities Licence (LF4: Radioactive Substances Resulting from Past Practices) under the RPC Act for the Port Pirie site.

The conditions of the licence require DSD to provide an annual report to the Director of the Radiation Protection Branch on the progress of the program and detailed reports as required.

3.3 Radiation and Environment Management Plan

The Department has developed a Radiation and Environmental Management Plan for the site. This plan will detail the types of radiation sources onsite and the radiation health and safety risks they present. The Plan also includes site access procedure, monitoring, inspection program.

4 Communication Protocols

4.1 Key Representatives for the site

DSD representative is the primary contact for all communication matters in relation with the Port Pirie former Uranium and Rare Earth Treatment Plant.

All communication issues will escalate to the Manager Mine Completion / Former Mines.

DSD's representative

Name: Catherine Fullston
Position: Project Manager Mine Completion
Address: Level 3 101 Grenfell St Adelaide 5000
Telephone: 08 8643 3428
e-mail: catherine.fullston@sa.gov.au

EPA Licence Coordinator (EPA to confirm)

Name: David Kruss
Position: Senior Environment Protection Officer/Senior Scientist
Address: 250 Victoria Square Adelaide 5001
Telephone: 08 xxxxx
e-mail: xxxx @epa.sa.gov.au

4.2 Key Stakeholders

A review on previous reports and meetings has identified the stakeholders listed below:

Stakeholder	Representative
Government of South Australia	Members of Parliament
Port Pirie Regional Council	Mayor
Port Pirie Regional Council	Chief Executive Officer
Port Pirie Regional Health Service Incorporated	Regional Director of Community Health & Primary Health Care
Environment Protection Agency (EPA) South Australia	EPA Licence Coordinator
Department Of Environment, Water and Natural Resources - DEWNR	Crown Land Heritage Council
Nyrstar Port Pirie Smelter	Environment Superintendent
Port Pirie Citizens	Community Representative
Southern Flinders Ranges Development Board	Economic Development Officer
Environmental Health Centre	Director
DSD – Office of Minerals & Energy Resources	Executive Director Mineral Resources
DSD – Mining Regulation	Director mining Regulation
Local Indigenous Group	Representative / Elder

4.3 Communication records

Communication will be registered and recorded including subject, matter, date, names and contact details.

Where confidential or sensitive information is communicated, DSD will register the communication flow, including who this has been sent to, when and in what format. The stakeholder receiving the confidential information must inform on who will access the information (see confidentiality below).

4.4 Stakeholder engagement

As required, DSD will discuss the performance and outcomes of the REMP with stakeholders. Where relevant, DSD will seek participation of other Government agencies in the stakeholder engagement process.

Stakeholders will receive regular updates on the progress of the program and the works carried out at the site.

DSD will provide to the EPA an annual report on the progress and outcomes of the REMP and will publish it following EPA's review.

DSD expects comments and feedback from Stakeholders on these reports.

See below a communication matrix.

Communication	Description	Delivery Method	Frequency	Owner	Audience
Updates	Communicate program status, issues and activities	By e-mail Newsletter	Quarterly	DSD representative	All stakeholders
Activities on site	Communicate on site activities that could impact stakeholders	By e-mail Mail post	As required	DSD representative	All stakeholders
Inspections	Coordination for site inspections	By e-mail	As required	DSD representative	Relevant stakeholders
Request for Information	Enquiries on matters about the site.	Ministerial letter	As required	DSD representative	Designated stakeholder
Program report	A consolidated report on the progress and status of the REMP.	Report Published in DSD website (for public access)	Annual	Manager Mine Completion / Former Mines	EPA

5 Communication Tools

5.1 Meetings

As required, DSD will conduct regular meetings with key stakeholders.

These meetings will include attendance of DSD's Manager Mine Completion / Former Mines, DSD representative, the EPA License Coordinator and relevant liaison officers. Other Government representatives and stakeholders could participate as required.

DSD will record minutes and follow-up action lists from these meetings.

5.2 Email

DSD will update by e-mail on matters relevant to the REMP to the relevant stakeholders.

Communication about activities and/ or incidents at the site that can potentially affect public safety and/ or the environment.

5.3 Web

Details and reports related to the Port Pirie site are available to the community and public via the DSD website.

The link to the Port Pirie site is:
http://minerals.statedevelopment.sa.gov.au/mining/former_mines/port_pirie_treatment_plant

5.4 Written

In accordance with the REMP and license conditions for the site, DSD will provide an annual report to the EPA and publish it.

Written communication will include newsletters and reports as per communication matrix.

6 Confidentiality

DSD will identify information of a confidential nature and will follow confidentiality protocols before their release.

DSD will maintain a registry of all released confidential information.