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<td>Angela Uranium Project</td>
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<td>Report Title</td>
<td>Annual Report for period 3 October 2010 to 3 October 2011</td>
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<tr>
<td>Personal Authors</td>
<td>Katrina James, James Thom &amp; Ian Loftus</td>
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CONTENTS

1 SUMMARY .................................................................................................................................................. 3
2 INTRODUCTION ........................................................................................................................................... 3
   Location .................................................................................................................................................. 3
   Tenure ................................................................................................................................................... 4
3 GEOLOGICAL SETTING ............................................................................................................................. 5
   Regional Geology ................................................................................................................................. 5
   Project Geology .................................................................................................................................... 5
4 PREVIOUS EXPLORATION ......................................................................................................................... 6
5 2011 EXPLORATION PROGRAM ............................................................................................................... 7
6 OVERVIEW OF ROTARY MUD TRIAL ..................................................................................................... 9
   Outline of drilling and sample collection practice ............................................................................... 9
   Penetration Rates ................................................................................................................................... 10
   Environmental Management ................................................................................................................. 11
7 RESOURCE ESTIMATION .......................................................................................................................... 11
8 REHABILITATION ..................................................................................................................................... 12
9 ENVIRONMENTAL MONITORING ........................................................................................................... 12
   Water Monitoring ................................................................................................................................ 12
   Ongoing Water Monitoring Program ...................................................................................................... 16
   Air (Dust) and Radiation ......................................................................................................................... 16
   Meteorology ......................................................................................................................................... 18
   Flora and Fauna .................................................................................................................................... 19
   Heritage ................................................................................................................................................ 19
10 COMMUNITY RELATIONS ....................................................................................................................... 19
11 EXPENDITURE .......................................................................................................................................... 19
12 2011 - 2012 PROPOSED WORK PROGRAM AND BUDGET .................................................................... 19
   MMI Survey .......................................................................................................................................... 20
   Rehabilitation Monitoring ....................................................................................................................... 20
   Water Monitoring ................................................................................................................................ 20
   Proposed Expenditure ............................................................................................................................ 20
REFERENCES ................................................................................................................................................ 20
1 SUMMARY

The Angela Uranium Project is located about 25km south of the central business district of Alice Springs and consists of a single Exploration Licence (EL25758) encompassing the Angela and Pamela uranium deposits.

Exploration Licence 25758 was granted to the Cameco Australia Pty Ltd/Paladin NT Pty Ltd Joint Venture on 3 October 2008, for a period of six years.

Cameco Australia Pty Ltd operated and managed the project from 3 October 2010 until 19 August 2011, and Paladin Energy Ltd managed the project from then until 2 October 2010.

Because of the NT Government’s announcement on 28 September 2010 that it would not support the development of a mine at Angela, a substantially reduced program was undertaken during the reporting period.

The reduced program consisted of three (3) rotary mud drill holes for a total of 690m during the reporting period, together with ongoing environmental monitoring.

As foreshadowed previously, an Australian JORC (2004) and Canadian NI31-101 compliant Mineral Resource estimate was prepared and released publicly on 20 July 2011.

Eligible expenditure on the Angela Uranium Project for the reporting period was $306,920.

A program of $138,000 is proposed for the period 3 October 2011 to 2 October 2012.

2 INTRODUCTION

The Angela Uranium Project (the Project) comprises both the Angela and Pamela uranium deposits located around 25 km south of Alice Springs in the Northern Territory.

Cameco Australia Pty Ltd (Cameco) and Paladin NT Pty Ltd (Paladin), the “Angela Project Joint Venture” (“the JV”) as 50:50 partners in the Angela-Pamela Project on EL 25758, which was granted on 3 October 2008.

Exploration drilling commenced in 2009 and continued through into 2010 with the Project being operated and managed by Cameco under the Cameco/Paladin Joint Venture agreement.

Paladin Energy Ltd assumed the role of operator and manager in August 2011.

Location

EL25758 is located approximately 25km south of the central business district of Alice Springs, and straddles the Old South Road, the historic Ghan Railway Line, the Old Telegraph Line and the Central Australian Railway (see map at Figure 1 and Appendix 1).

The historic Ghan railway line is not currently operational. The Central Australian Railway passes through the tenement on the western extremity. This railway line is in operation and passes the Brewer Industrial Estate just north of the licence.

Apart from these, the only existing infrastructure is a minor gravel road passing through the centre of the licence in a northeast-southwest direction that extends south to the No.3 Dam. This road crosses a subsidiary track running in an east-west direction that comes off the Old South Road and continues west to the Stuart Highway.
Tenure

Uranerz Australia Ltd worked extensively on the Angela deposit between 1972 and 1983. In 1990 the company requested the ground be Reserved from Occupation (RO) pending an improvement in the uranium price.

Following a review of all ROs in the Northern Territory, the intent to revoke the RO for the Angela-Pamela area was publically announced and subsequently enacted.
Cameco and Paladin subsequently submitted an Exploration Licence application covering the Angela and Pamela uranium prospects south of Alice Springs for a total of 37.67 km². On 3 October 2008, Exploration Licence 25758 was granted to the Cameco Australia Pty. Ltd (50%) / Paladin Energy Minerals NL (50%) Joint Venture for a period of six years (expiring on 2 October 2014).

Cameco Australia Pty Ltd operated and managed the project from 3 October 2010 until 19 August 2011, with Paladin Energy Ltd assuming the role of operator and manager from then until 2 October 2011.

3 GEOLOGICAL SETTING

Regional Geology

The Angela and Pamela deposits are hosted within the Undandita Sandstone Member of the late-Devonian to early-Carboniferous Brewer Conglomerate. The Brewer Conglomerate is the youngest geological unit within the Amadeus Basin and was deposited as a wedge-shaped, molasse deposit in a foreland basin setting in response to southwards thrusting of the Arunta Block (to the north) over the Amadeus Basin.

Continued deformation during the latter stages of the Alice Springs Orogeny subsequently deformed the Brewer Conglomerate, producing a series of broad, east-west trending, doubly-plunging synclines within the Amadeus Basin.

Uplift occurred along the northern margin of the Amadeus Basin and progressed from west to east through the later stages of the Alice Springs Orogeny. The lower part of the Undandita Sandstone Member was derived from Upper Proterozoic to Lower Palaeozoic sediments of the basin. With increasing uplift in the Alice Springs Orogeny, the Lower Proterozoic granitic and gneissic Arunta Complex to the north became exposed and contributed increasingly to the upper parts of the Undandita Sandstone Member, providing an intrastratal source for uranium.

The Brewer Conglomerate was deposited as a series of coalescing alluvial fans developed on the southern flanks of the proto-MacDonnell Ranges by southwards draining, braided fluvial channels fed into a large-scale, generally east-west trending, longitudinal drainage system. Depositional environments are interpreted to environments included braided fluvial channel, abandoned channel, to overbank and possibly lacustrine settings.

Stream gradient decreased away from the ranges (southwards) and the Brewer Conglomerate inter-fingers with, and passes laterally into, the finer-grained, more distal Undandita Sandstone Member. The Brewer Conglomerate reaches a maximum thickness of 3000 m within the Missionary Syncline, 15 km southeast of Alice Springs where the largely oxidised Undandita Sandstone Member contains a wedge of reduced sediment between regionally planar upper and lower redox boundaries. Uranium mineralisation and anomalous gamma is concentrated at these redox boundaries.

The regional geology is further described in Appendix 2.

Project Geology

Uranium mineralisation at the Angela and Pamela deposits is hosted within the Undandita Sandstone Member which ranges from fine- to coarse-grained lithic arenite, and from medium- to coarse-grained lithic arkose, intermixed with subordinate conglomerate and pebbly sandstone horizons, and thin, poorly developed limestone and mudstone units deposited under waning flow conditions and within abandoned channels. Most of the
mineralisation is hosted by medium to coarse grained feldspathic lithic arenites, which although finer, are better sorted.

Mineralisation is considered to have been emplaced during the early-Carboniferous (during diagenesis) and has been preserved by extensive calcite cementation of the host rock. Structural deformation during the Alice Springs Orogeny has subsequently folded and exposed the mineralisation at surface. The main Angela I mineralisation crops out near the eastern margin of the licence, close to the Old South Road, and dips ~9° to the west. Mineralisation is known to extend westwards for at least 5km to depths of ~900m.

The target in the area is sandstone hosted uranium mineralisation formed at geochemical (redox) boundaries by deposition of uranium from groundwater. Redox boundaries in the upper part of this reduced zone typically show uranium accumulations. The major accumulations are located in irregularities or steps, mainly on the upper regional redox boundary in the Missionary Syncline. These accumulations were previously identified in the Angela area (Borshoff & Faris, 1990).

4 PREVIOUS EXPLORATION

Uranerz explored the Alice Springs Project (which extended across the current EL25758) for over 10 years from 1972 to 1983 and the tenements were held until 1990. The following summary is adapted from Uranerz reports as detailed in the Bibliography.

A detailed airborne radiometric survey over the tenements was carried out in 1973 and airborne spectrometry located three anomalies. Trenching and drilling of these anomalies in 1973-1974 led to the recognition of the Angela and Pamela prospects. In 1974, shallow vacuum drilling on a regional grid, together with reconnaissance mapping indicated that these prospects were regionally located along the boundary between oxidised and reduced sandstones.

From 1974 onwards exploration was divided into two broad phases; the first involved diamond/percussion drilling of the known mineralised bodies to test size, grade and establish mineralisation controls; the second involved regional exploration along the reduced zone and its margins. Detailed drilling at the Angela and Pamela prospects in 1974-1975 defined the main outline of the mineralisation. Ore resources for the part of the Angela I deposit that was drilled amounted to about 1500t U₃O₈. From 1975 to 1977 percussion drilling was carried out along strike of the upper or northern margin of the reduced zone to test the potential of mineralisation at depth in the zone between the Pamela and Angela prospects. The redox boundary was tested by holes drilled approximately 500m apart to a maximum depth of 150m. Drilling was continued southwest from the Angela I deposit.

In 1978 recalulation of ore resources based on results of the latest investigations confirmed a resource of 1,500t U₃O₈ using a cut-off of 500 ppm over 2m for the Angela I deposit, and it was also concluded that considerable resources could occur further down-dip and in separate zones immediately north and south of the Angela I deposit. Detailed drilling of the Angela I deposit in 1979 indicated a 30-40m change in the stratigraphic level of the redox boundary with which the mineralisation is associated. This “step” marks a complex zone of stacked oxidised and reduced lobes and tongues. In plan, this multi-lobed zone plots as a distinct east-west trend.

Drilling between the Angela I deposit and the Pamela prospect delineated a group of spatially and genetically related step zones containing inter-digitated mineralisation. These are referred to as Angela II, Angela III and IV prospects. Close-spaced drilling at 10 m intervals
on the 800W section over the Angela I deposit provided detailed lithology but hole-to-hole lithological correlations could not be demonstrated.

In 1980, the eighth year of project operations, the Angela I deposit was confirmed over a 4,900m strike length and remained open to the west at depth. Infill percussion and diamond drilling upgraded the integrity of defined resources. Angela II-IV satellite prospects were defined as thinner ore zones with similarities to the Angela I deposit. The Angela V satellite prospect was delineated as a new ore zone south of Angela I, similar to the Angela II and III prospects.

All prospects have good potential down-dip to the west. Exploration in 1981 concentrated on establishing the style, continuity and potential of the Angela prospects, flanking the Angela I deposit. A data review was carried out, which included recalculation of all gamma log eU₃O₈ values using the high-resolution deconvolution methodology. Regional sedimentological studies established a sedimentary history for the basin, which led to improved genetic concepts for redox processes and allowed a better evaluation of prospectivity.

Investigations in 1982 were confined to re-logging drill core and data studies of prospects in the East Missionary Syncline. Detailed re-logging allowed more meaningful sedimentological profiles to be constructed. Correlation of sedimentary features was achieved using downhole resistivity logs. Ore distribution profiles from deconvolved down-hole gamma logging were compiled.

Data studies showed individual lenses of ore are related to a regionally continuous 30m stratigraphic sandstone package with a prominent coarse-grained basal unit.

In 1983, Uranerz completed a pre-feasibility study that indicated the Alice Springs Project, comprising the Angela and Pamela deposits, would not be economically viable at the prevailing and predicted short to mid-term uranium price and the project was placed on care and maintenance. In 1990, Uranerz, applied to the Northern Territory Government to have the project area converted to a Reservation from Occupation (RO) to protect the resource.

5 2011 EXPLORATION PROGRAM

Drilling Program

As noted in the Executive Summary, the program conducted between October 2010 and October 2011 was substantially less than in previous years. Between 10 April 2011 and 18 April 2011 Thompson Drilling of Adelaide was contracted by the Joint Venture to test the suitability of the mud rotary drilling technique at the project.

Three drill holes (APM163, APM164 and APM165) were drilled for a total of 690m. The location of these holes in relation to earlier drilling is shown at Appendix 3. The holes were drilled using a Borne 1000 rotary drilling rig (see photograph at Figure 2) and a shovel sample was collected every 2m allowing geological logging.

Logging practice recorded colour, grain size, redox state and the presence of pyrite, organic matter, limonite, hematite and calcite.
Each shovel sample was read with a handheld scintillometer. For the duration of the program a ThermoScientific RadEye scintillometer was used to take measurements from drill samples. A portion of the shovel sample was taken, sieved and stored in a chip tray for future reference. At the completion of the drilling program the chip trays were returned to the Joint Venture's warehouse in Alice Springs for storage.

At the completion of each drill hole, invariably when the drill hole passed the targeted redox interface, the hole was radiometrically and electrically logged (see photograph at Figure 3) once the drill rods were pulled from the hole. Logging used a Gamma probe, a SPPR electric probe, and an EAL Resistivity probe (multitool). The gamma logging information was deconvolved to produce down-hole $\text{eU}_3\text{O}_8$ values.

No down-hole deviation surveys were taken over the course of the drilling program.
A drill collar pickup was completed by Auserv Pty Ltd using a DGPS after the drilling was completed.

Drill hole data is attached as **Appendices 4A to 4J**.

Note that samples of very poor quality were returned from depths >160m in APM0164, thus no geological logging information below this depth is reported.

Due to the other problems associated with APM0164 there are also no wireline logs reported for this drill hole.

### 6 OVERVIEW OF ROTARY MUD TRIAL

Prior to the mud rotary trial exploration drilling utilised a combination of RC and diamond drilling. The combination did produce results, although it had some limitations.

During previous drilling programmes, dust generation was an issue that stakeholders expressed concerns about. Whilst all expected mineralised intercepts were previously diamond cored, eliminating the likelihood of generating radioactive dust; it is seen as an advantage to use a wet drilling technique for the entire drill hole.

Mud rotary drilling is expected to have a cost advantage for two reasons. The first being the per metre cost is expected to be somewhere in the vicinity of the costs of RC drilling and the "rig work time" component of costs will be at a minimum as two drill rigs don’t have to be used for one drill hole.

The mud rotary trial sought to determine whether adequate penetration rates, sample quality and environmental management could be achieved with mud rotary drilling. Below is an outline of how a typical mud rotary hole was drilled at Angela during the trial.

**Outline of drilling and sample collection practice**

**Surface Casing**
The first 6m of the drill hole was drilled and then the first rod was pulled from the hole and 1m of 6 inch PVC pipe pushed into the ground as casing. The casing did not require cementing.

**Drill Bits and hole diameter**

<table>
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<th>Depth</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>0-50m</td>
<td>“blade bits” (5 ½ inch) used until refusal and were eventually destroyed. One set of blades costs around $220.</td>
</tr>
<tr>
<td>50m-54m</td>
<td>(around 9 rods in the ground) used a “tricone” bit (5 5/8 inch) which cleaned the hole any debris left over by the destroyed blade bits, and widening the hole by 1/8 of an inch.</td>
</tr>
<tr>
<td>54m-EOH</td>
<td>PCD (polycrystalline diamond compact) bit (5 ½ inch) used. The bit used was chosen based on our knowledge of the expected facies. Tiny from Thompson drilling informed us that there are many, many different PDC bits developed for specific formations. Given that they are specialist drilling equipment, they have the price tag to match- some $14,000 per drill bit.</td>
</tr>
</tbody>
</table>

**Sample Size**

Samples were taken every two metres by scooping a shovel of cuttings out of the mud bath at the end of drilling a 2m interval. The samples were placed in piles straight off the shovel, on the ground next to the drill rig. The drill crew did not wash the samples to rid them of mud, and stated that it was not common practice for them to do so.

**Mud Change**

The finer grained material in the Brewer Conglomerate caused the mud to become too thick and it was necessary to change the drilling mud at least once during a 200m- odd hole. To do this the mud was dumped into the sump next to the mud bath and a new mud was mixed with water and mud products. The mud change is not a time intensive exercise. The mud used was “standard” polymer from AMC and a thickener (again standard and from AMC) was the only additive required to the complete the mud mix.

**End of hole mud circulation**

Once the target depth was reached the driller circulated mud through the drill hole to ensure that as much residual sample as possible was flushed out of the drill hole. This is standard practice and increases the chances of acquiring a wireline log to total depth.

**Penetration Rates**

In hindsight the first two drill holes were used to work out how best to drill the Brewer Conglomerate with the mud rotary method. Due to the experimental nature of the first two drill holes it is best to use the drilling rate of the final drill hole as an expectation of minimum penetration rates. On 15 April 2011 the first 6m of APM0165 was drilled late in the day.

On 16 April 2011 a depth of 180m was reached by 4:30pm, meaning 174m was drilled in a shift, nudging the target penetration rate of 20m/hr. On the 17 April 2011 the target depth of 240m was reached by 11am, 60m in 3 hours- again 20m/hr.

Overall, the penetration rate achieved in three holes was deemed acceptable.
Environmental Management

The contractor was very diligent and ensured that all drilling fluids and excess sample was deposited in the sumps provided at the drill site during drilling and right through to emptying the mud bath at the end of the hole. There was probably as much “mess” around the drill hole as would be expected from a diamond drill rig site with conventional excavated sumps. As long as the pits used for excess sample and mud changes are made to suit the expected depth of the hole (larger sumps for deeper holes), it is unlikely there will be a problem with spread of drilling fluids.

Water use at the Angela project is of particular concern for the people of Alice Springs. Although mud rotary drilling can be very water intense it proved not to be during the mud rotary trial. Based on Paladin’s estimates, a drill hole of 200m depth would require less than 8000L of water, which was the equivalent of one tank of water during the trial.

7 RESOURCE ESTIMATION

A Mineral Resource estimate conforming to the Australian JORC (2004) and Canadian NI 43-101 guidelines was completed in June 2011 for the Angela-Pamela uranium deposits. This followed an extensive compilation and validation of historic data and a drilling program of 172 drill-holes for 32,810m completed by the Joint Venture. This is shown at Table 1.

The estimate was publicly released in Paladin’s quarterly activities report to the Australian Securities Exchange on 20 July 2011.

The Mineral Resource estimate is based on 794 holes totalling 180,468m and covers the Angela (1 to 5) and Pamela deposits. The mineralisation plunges shallowly, approximately 9°, to the west and the larger of the deposits, Angela 1, has been defined up to 4.3km to the west at depths up to 600m and remains open. The mineralisation is contained within nine individual stratigraphic sequences with mineralised thicknesses of up to 10.4m. The cut-off for the Mineral Resource is a combination of grade greater than or equal to 300ppm U₃O₈ and thickness greater than 0.5m. In addition, areas of low grade probability were removed from the model.

Table 1 - Resource estimation (Figures in the table above may not add due to rounding)

<table>
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<th></th>
<th>Mt</th>
<th>Grade ppm U₃O₈</th>
<th>t U₃O₈</th>
<th>Mlb U₃O₈</th>
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</thead>
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<tr>
<td>Inferred Mineral Resource</td>
<td>10.7</td>
<td>1,309</td>
<td>13,978</td>
<td>30.9</td>
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The Mineral Resource estimation was completed using a two dimensional conditional simulation. The dataset was derived predominantly from recent and historic downhole radiometric logging. The radiometric grades have been extensively validated against laboratory assays.

The Mineral Resource is currently classified as Inferred, primarily due to drill spacing and the large volume of historic drilling data within the dataset. A higher confidence classification is expected as additional drilling is completed. This updated resource estimate improves on the historic resources previously announced providing a 10% increase in both grade and tonnage U₃O₈.
8 REHABILITATION

The three drill holes that were completed during the reporting period, utilising rotary mud drilling, were rehabilitated immediately following completion of the program in April 2011. Photographs of these drill sites taken before disturbance and after rehabilitation are provided in Appendix 5.

As reported in the previous annual report, all holes from the 2009 and 2010 drilling programme have been rehabilitated, with the exception of six holes. These six holes, from the 2009 drilling programme (AP091-AP096), were not rehabilitated to allow Geoscience Australia to carry out downhole probing.

These holes will be rehabilitated in the coming year if they are no longer required.

Rehabilitation of the historical (Uranerz) drillholes continued with 19 holes completed during the reporting period. Approximately a further 60 historical holes have been identified and it is believe these have been rehabilitated, however no formal records exist to confirm this and further confirmation will be undertaken in the coming year.

Rehabilitation continues to be conducted in accordance with the guidelines contained in the relevant advisory notes (AA7-008 and AA7-027) issued by the Department of Resources.

9 ENVIRONMENTAL MONITORING

The license conditions as stipulated in the letter of grant require that, prior to the undertaking of any activity that causes a substantial disturbance and triggers the requirement of the Mining Management Act, that baseline:

1. Dust monitoring be undertaken; and,

2. Water monitoring of existing bores on tenement and in the immediate region for background uranium and related isotopes be undertaken.

The information provided in this report and the previous annual report demonstrates that these requirements have now been met. Additional environmental baseline studies have also been undertaken across the Exploration Licence area to provide information to enable an environmental impact assessment to be prepared should the Project proceed to a mining stage. The environmental baseline studies undertaken to date include:

- Water (groundwater and surface water);
- Air quality (dust) and radiation;
- Meteorology;
- Fauna and flora; and
- Heritage (ethnography and archaeology).

Water Monitoring

Surface water and groundwater samples have been collected from selected locations on a quarterly to bi-annual basis since February 2009. One of the primary aims of the program has been to provide baseline data as required by the Exploration Licence conditions.

This Licence requirement has now been met, with six sampling events carried out at groundwater bores and the results presented in a baseline monitoring report prepared by consultants RPS Aquaterra.

**Groundwater Monitoring**

Groundwater samples have been collected across six sampling periods. The initial plan was to undertake quarterly monitoring, and this was successful for the first three quarters however, as previously reported, the fourth quarter monitoring had to be delayed due to logistical issues.

The results of the fourth round of monitoring, which was carried out in February 2010, plus two additional sampling rounds, carried out in July 2010 and May 2011 are now available and included in the baseline monitoring report.

As previously reported, the methods applied to the groundwater sampling were consistent with standard sampling protocols where possible.

Where bores where particularly slow to recover from purging and the recovery time was lengthy (many days to weeks in some cases) the standard sampling protocol was not adhered to.

Collected groundwater samples were submitted for laboratory analysis of:

- pH, and Total Dissolved Solids (TDS);
- Alkalinity as CaCO$_3$;
- Major cations (calcium, magnesium, potassium, sodium) and anions (bicarbonate, carbonate chloride, sulphate and sulphur as S);
- Nutrients (total nitrogen, ammonia, total phosphorous, reactive phosphorous);
- Dissolved heavy metals (aluminium, arsenic, barium, beryllium, boron, cadmium, chromium, cobalt, copper, iron, lead, mercury manganese, molybdenum, nickel, selenium, silicon, uranium, vanadium and zinc); and
- Total alpha and beta radiation – where readings exceeded 0.5Bq/L, speciation for radium, uranium, lead, polonium and thorium was undertaken.

All samples were contained in laboratory-supplied bottles, placed on ice and transferred to ALS Environmental (Melbourne) under standard RPS Aquaterra chain of custody documentation. For radiological testing, all groundwater samples were sent to Western Radiation Services (Perth). Field duplicate samples were collected in accordance with RPS Aquaterra standard quality assurance/quality control (QA/QC) procedures.

**pH and TDS**

Laboratory tested pH of the groundwater samples ranged from 6.85 to 8.14 pH units. All values were reported below the Australian Drinking Water Guidelines (ADWG) health and aesthetic guideline value of 8.5 pH units, and showed broad consistency across seasons.

Laboratory tested TDS ranged generally from more than 3,000 to 31,500mg/L TDS, with the exception of two bores noted below. There was broad consistency in quality across seasons, and the groundwater can be characterised as suitable for stockwater at best, as the samples collected from all bores exceeded the ANZECC stock water Guideline for TDS of 3,000mg/L. The exceptions are two bores located in the north-east corner of the EL (RN018706 and RN018710) which have TDS values generally in the range 1000 to 1700mg/L.
**Major Anions and Cations**

Values at several bores exceeded the Australia and New Zealand Environment Conservation Council (ANZECC) Guidelines (2000) for sulphate (1,000mg/L) in stock water. Other concentrations were reported below the guideline, indicating that groundwater is at best at the marginal limit of stockwater (noting that several metals concentrations typically exceed the guidelines – see below).

ADWG guideline criteria for major ions exist for chloride (250mg/L) and sodium (180mg/L) only. All groundwater samples submitted for analysis exceed these guidelines with a few minor exceptions. No significant increasing or decreasing trends were identified in major ion groundwater concentrations.

**Heavy Metals**

Typically, bores sampled showed one or more metals concentrations that exceeded the ANZECC 80% or 99% criteria and the ADWG criteria. With some exceptions, other heavy metal concentrations were generally below the ANZECC stock water criteria, and showed little variation with time.

**Nutrients**

With the exception of ammonia as N, guidelines do not exist for nutrients. In May 2011, as distinct to the previous monitoring periods, the concentration of ammonia as N exceeded the ADWG aesthetic guidelines of 0.5mg/L only at bores RN018702 and RN018704.

The ammonia as N concentration at RN018704 shows a general decreasing trend with time. Otherwise, the nutrient concentrations are consistent across historical results.

**Radionuclides**

Groundwater samples collected from the Angela site bores were submitted for laboratory analysis of gross alpha and beta radionuclides. Values for alpha nuclides ranged from <5mBq/L at several bores, and up to 3,259mBq/L at RN018712 over the baseline program. With the exception of RN018703, beta values ranged from <10mBq/L at several bores, and up to 12,730mBq/L at RN018705 over the baseline program.

Bore RN018703 had the highest value of beta radionuclides with a value of 40,871mBq/L for September 2009, however this shows a downwards trend over time with a reading at May 2011 of 989mBq/L, indicating that initial sampling may not have been representative of the groundwater system, with ongoing campaigns of purging and sampling possibly providing more representative samples.

For comparison purposes with the Australian Drinking Water Guidelines (ADWG), where values exceed 500mBq/L, speciation is undertaken for radium, lead, uranium, polonium and thorium. This was undertaken at various times on all groundwater monitoring bores except RN018707 and RN018713.

The detailed groundwater radiological speciation results indicate that:

- Uranium-234 activity was below the detection limit of 5µg/L;
- All bores except RN018703, RN018709 and RN018710 showed activity levels higher than the detection limits of 100mBq/L for Thorium; and
- The other elements showed activity levels higher than their detection limits of 100mBq/L for all bores.
Summary of Groundwater Quality

In summary, the groundwater at the Angela site can be characterised as being non-potable, saline (greater than 1,000mg/L TDS), neutral, with elevated concentrations of dissolved heavy metals (including uranium) and alpha and beta radionuclides, but with generally low nutrients (except ammonia as N). There are no substantial changes with time.

The highest value use status of the Angela groundwater is industrial (ie. mining), or stock water in some cases.

Surface Water Monitoring

Surface water sampling was undertaken at two sites, Dam No. 3, located just outside the south-west corner of the Exploration Licence area, and Railway Dam, a small soak at the north-west of EL25758, adjacent the Adelaide-Darwin railway.

Dam No.3 is the only known permanent surface water feature close to EL25758 and despite attempts to take opportunistic water samples from Railway Dam, it was often dry and sampling was not possible.

Eight samples were collected from Dam No. 3 from March 2009 to May 2011, whilst only two samples were collected from Railway Dam.

Collected surface water samples were submitted for laboratory analysis of:

- pH;
- Total dissolved solids (TDS);
- Colour;
- Turbidity;
- Alkalinity as CaCO$_3$;
- Major cations and anions;
- Total metals (aluminium, arsenic, barium, beryllium, boron, cadmium, chromium, cobalt, copper, iron, lead, mercury, manganese, molybdenum, nickel, selenium, uranium, vanadium and zinc); and
- Total alpha and beta radiation – while total alpha/beta was undertaken, speciation for radium, radon, uranium and thorium was not undertaken as the total alpha and beta gamma radiation values did not exceed 1,000mBq/L.

All samples were collected in laboratory supplied bottles, placed on ice and transferred to ALS Environmental (Melbourne) under standard RPS Aquaterra chain of custody (COC) documentation.

Field measurement of pH and electrical conductivity (EC) prior to sample collection was undertaken as a rule, except that it was not possible in May 2011 due to unit malfunction.

The surface water (as characterised mostly by water from Dam No.3) is of low salinity, turbid, slightly basic and often exceeds the ANZECC 99% protection guidelines for several metals. The highest value use status of this water is interpreted to be stock water (non-potable).

Surface water results indicate that although not saline, the water available for use in Dam No. 3 does not comply with ADWG aesthetic values for colour and turbidity, and at times aluminium and manganese, but it does comply generally with ANZECC stock water criteria.
Historically, this water has been used for stock watering purposes. Interestingly, the July 2010 analytical results for surface water collected from the Railway Dam indicates reasonable quality and complies with the ANZECC stock water guidelines.

Site exploration works are not likely to impact the water quality at Dam No. 3 and/or Railway Dam because they are fed by catchments located up-gradient of the Angela site.

**Ongoing Water Monitoring Program**

The volume of information that has been collected to date is considered to provide an appropriate amount of baseline data currently.

The Aquaterra RPS (2010) notes that, given the stability in the results and the practical constraints to site access, an annual to bi-annual program is considered appropriate while exploration is ongoing. In consideration of the data collected to date and the planned reduction in ground disturbing site activities in the coming year, it is planned to carry out only one or two water sampling program.

**Air (Dust) and Radiation**

Kellogg Brown & Root Pty Ltd (KBR) was engaged by to undertake baseline data acquisition for the Angela Project.

This included monitoring of:

- Dust in air concentrations (gravimetric, and long-lived alpha-emitting radionuclides);
- Passive average radon concentrations in air;
- Continuous radon decay product concentrations in air (potential alpha energy concentration, PAEC); and
- Dust deposition

Information provided below is excerpts taken from the Kellogg Brown & Root Pty Ltd (KBR) report, *Summary of Baseline Data Acquisition – 2010. Radiation and meteorology at the Angela Deposit (2011)* which is provided in Appendix 7.

**Gravimetric Dust Analysis and Long-lived Alpha Emitter Concentration in Air**

Two medium-volume air samplers were used to collect dust on 47mm filter media. Dry gas meters were used to record the total volume of air sampled. Filters were pre-conditioned by being placed in a desiccator cabinet before being weighed.

Following the sampling period, the filters were again conditioned before being weighed on a micro-balance. The dust program began in May 2009 and continued through to December 2010.

As noted in the previous annual report, the programme was modified to overcome the problems of 2009, when most of the air samplers failed due to either overloaded filters, high temperatures, or both. The samplers were pre-programme to operate for four hours, then sleep for four hours, then start again, etc. This seems to allow them to cool between sample runs and overcome the problems previously experienced.

Filters used to determine dust concentration are also placed into an alpha counter after a period during which the short-lived decay products of radon decay to insignificant concentrations. This leaves the long-lived alpha emitting radionuclides on the filter.
There is no great difference between the concentration of dust in air in Alice Springs and Angela, although there is a slightly higher concentration of long-lived alpha-emitting radionuclides in the dust collected at the Angela site.

**Radon Concentration in Air**

At twenty locations, track-etch devices were placed to record the average radon concentration in air. The devices were deployed for three-month periods to allow sufficient sensitivity and statistical robustness. The devices were deployed from May 2009 to September 2010.

The concentration of radon gas in un-confined atmospheres is driven by continental-scale climate factors. At the local level, radon emanation rates from soils are influenced by soil moisture, barometric pressure and uranium/radium concentrations in soils and rocks.

In confined atmospheres, the concentration of radon gas can build up, and in sealed spaces this concentration can reach levels at which ventilation is indicated if the space is to be occupied for long periods.

The results show relatively low and consistent concentrations of radon gas in un-confined atmospheres, and relatively high and stable concentrations in confined spaces (i.e. the ISO Shipping container in which core is stored. Although the container is equipped with vents in its ceiling, this is the closest location there is to a confined atmosphere).

Radon gas alone is of little health consequence. It is the decay products of radon that are associated with radiation exposure, principally due to the alpha emissions of radon decay products in the lungs.

**Radon Decay Product Concentration in Air**

Two continuous radon decay product monitors were deployed from May 2009 to December 2010. This allows for measurement of the concentration of radon decay products in air, expressed in terms of the potential alpha energy concentration (PAEC in units of µJ/m³). The radon decay product concentrations in air varied greatly from day to day and season to season. It is interesting to note a slight but consistent difference in hourly PAEC between the meteorological station monitor and the West station monitor.

The West station shows slightly higher concentrations throughout the 24-hour period than the meteorological station. This is almost certainly due to a difference in topography between the two sites, with the West station being situated at a lower height and in open low woodland, while the meteorological station is elevated by comparison. Under atmospheric inversion conditions, lower-lying areas are likely to have higher concentrations, and this can be seen in the figure for the hours before dawn, when inversions are more common.

**Dust Deposition Rate**

Ten standard dust deposition gauges were deployed. The method for dust deposition determination is that of AS/NZS 3580.10.1:2003 - *Method for sampling and analysis of ambient air. Method 10.1: Determination of particulate matter—Deposited matter—Gravimetric method.*

Samplers were deployed for one-month periods from March 2009 to November 2010, with new sample containers replacing used sample containers during the change-over. Sample containers were sent to an external, NATA-certified, laboratory for analysis. The analyses reported were:
• insoluble matter (g/m²/month);
• combustible matter (g/m²/month);
• ash (g/m²/month);
• soluble matter (g/m²/month);
• total deposited matter (g/m²/month);
• Uranium-Total (µg/month); and
• Thorium-Total (µg/month).

Dust deposition rate appears to be higher in summer (November to March) which can be partially explained by the long-term average weather conditions.

Data from Alice Springs Airport, going back to 1941, shows that higher maximum and minimum temperatures occur in summer. It might seem counter-intuitive that rainfall is also higher in summer, when dust deposition rate is higher, however this is partially explained by the action of rain ‘washing’ dust out of the atmosphere into the gauges.

Very few samples of deposited dust contained concentration of uranium or thorium. Of the 110 samples, 10 uranium and 16 thorium results were at or above the detection limit. Of these samples, the maximum uranium result was 0.1 µg/filter and the maximum thorium result was 0.9 µg/filter.

**Meteorology**

A fully-automated meteorological station was erected at the Angela site in May 2009. The parameters measured are:

- Wind speed and direction;
- Temperature (at 2m and 10m. Giving delta temperature);
- Albedo;
- Barometric pressure;
- Evaporation;
- Rainfall and rainfall intensity and
- Relative humidity.

The meteorological station has been in continuous operation for some time now and overall, data recovery has been good, and there are sufficient data now for future modelling and dispersion studies.

There are some anomalies in the records which appear to be due either to the power having been switched off at some time, or data being over-written on the computer hard disk when down-loading the data logger.

A summary of the meteorological data for 2010 is shown in Table 2 below.

Whilst there is only a limited amount of work scheduled for the Project, the meteorological station will be decommissioned. The station requires a certain level of maintenance and calibration that it will not be feasible to carry out in the next reporting period.
Table 2 - Summary of meteorological data for 2010

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average daily wind speed at 10m</td>
<td>3.47</td>
<td>m/s</td>
</tr>
<tr>
<td>Maximum wind speed at 10m</td>
<td>9.51</td>
<td>m/s</td>
</tr>
<tr>
<td>Most frequent wind direction from</td>
<td>143</td>
<td>deg</td>
</tr>
<tr>
<td>Average temperature at 10m</td>
<td>14.21</td>
<td>°C</td>
</tr>
<tr>
<td>Maximum temperature at 10m</td>
<td>31.73</td>
<td>°C</td>
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<tr>
<td>Average temperature at 2m</td>
<td>14.12</td>
<td>°C</td>
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<tr>
<td>Maximum temperature at 2m</td>
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<tr>
<td>Average relative humidity</td>
<td>58.44</td>
<td>%</td>
</tr>
<tr>
<td>Maximum relative humidity</td>
<td>92.20</td>
<td>%</td>
</tr>
<tr>
<td>Average barometric pressure</td>
<td>954.20</td>
<td>mBar</td>
</tr>
<tr>
<td>Maximum barometric pressure</td>
<td>966.00</td>
<td>mBar</td>
</tr>
<tr>
<td>Maximum rainfall (24 hour period)</td>
<td>18.4</td>
<td>mm</td>
</tr>
</tbody>
</table>

Flora and Fauna

As previously reported, a comprehensive baseline fauna and flora was conducted by Low Ecological Services in 2009 and submitted with the 2010 Annual Report. No further baseline fauna or flora surveys were carried during the current reporting period.

Heritage

As previously reported, a Stage 1 archaeological survey was undertaken across the Exploration Licence area by Earth Sea Heritage Surveys in 2008. No further heritage surveys were carried during the current reporting period.

10 COMMUNITY RELATIONS

The level of Community Consultation in the period from October 2010 to October 2011 was less than in previous years, due in significant part to the Northern Territory Chief Minister’s announcement on 28 September 2010 that the Government would not support the development of the Angela mine. The Joint Venture subsequently closed its office in the Alice Springs CBD.

One meeting of the Community Reference Group was held, on 26 October 2010.

11 EXPENDITURE

Eligible expenditure for the reporting period on EL25758 was $306,920 and is detailed in the Mineral Exploration and Mining Expenditure Form (Form 17 under the Mineral Titles Act 2010).

12 2011 - 2012 PROPOSED WORK PROGRAM AND BUDGET

Because of the NT Government’s announcement in late 2010 that it would not support the development of a mine at Angela, it is proposed that the work program for 2011-12 is smaller than programs conducted in previous years.
MMI Survey

It is proposed that an orientation Mobile Metal Ion (MMI) survey be carried out, based on two lines of 10 sample pits. The pit will be dug at each location using a backhoe to depth of 0.5m. Four samples of 300g will be extracted at varying depths from each pit with duplicate samples to be collected from two pits. The pits will be back-filled and rehabilitated immediately after sampling. The samples will be dispatched to SGS in Perth for MMI analysis.

It is proposed that this program will occur in the dry season/winter.

Rehabilitation Monitoring

This proposed work will be undertaken to fulfil a commitment made in previous Mining Management Plans. The proposal will involve visiting each rehabilitated site to assess the performance of the rehabilitation and obtain a photographic record. The current state will be compared with the pre-disturbance state of the site; where there is sufficient resemblance the site will be recorded as requiring no further work.

Water Monitoring

Potential impacts to groundwater have been identified as one of the key concerns of stakeholders; as such it is proposed to continue the monitoring programme at the reduced frequency of bi-annual. The groundwater monitoring programme will include level monitoring at 21 bores and water quality sampling at 11 bores. Where possible, opportunistic surface water samples will also be collected.

The analysis suites will be kept consistent with those previously undertaken (chemistry and total alpha/beta screening with speciation where the threshold is exceeded).

Proposed Expenditure

It is expected that expenditure of $138,000 will be undertaken on these activities during the period from 3 October 2011 to 2 October 2012, as shown in Table 3 below.

<table>
<thead>
<tr>
<th>Activity</th>
<th>Proposed Expenditure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mobile Metal Ion Survey</td>
<td>$10,000</td>
</tr>
<tr>
<td>Rehabilitation Monitoring</td>
<td>$10,000</td>
</tr>
<tr>
<td>Water Monitoring</td>
<td>$100,000</td>
</tr>
<tr>
<td>Office Overheads etc (based on 15%)</td>
<td>$18,000</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>$138,000</strong></td>
</tr>
</tbody>
</table>

REFERENCES


Battey G.1984. Summary of Discussion with Uranerz Australia Pty Ltd on Methods Used to Process Borehole Gamma Ray Logs From the Angela Deposit (NT)


