



## PALADIN ENERGY LTD

Titleholder	Paladin NT Pty Ltd
Operator	Paladin Energy Ltd
Tenement Manager/Operator	Paladin Energy Ltd
Titles/Tenements	EL 25758
Mine/Project Name	Angela Uranium Project
Report Title	Annual Report for period 3 October 2012 to 2 October 2013
Personal Authors	Cathy Paxton, David Holmes & Ian Loftus
Corporate Author	Paladin Energy Ltd
Company Reference Number	
Target Commodity	Uranium
Date of Report	November 2013
Datum/Zone	GDA94 (Zone 53)
250 000 K mapsheet	Alice Springs (SF5314)
100 000 K mapsheet	
Contact Details	Paladin Energy Ltd PO Box 201 Subiaco WA 6904 Tel 08 9381 4366 Fax 08 9381 4978
Email for further technical details	Gillian.mcbain@paladinenergy.com.au
Email for Expenditure	Gillian.mcbain@paladinenergy.com.au

---

## CONTENTS

<b>1</b>	<b>SUMMARY .....</b>	<b>4</b>
<b>2</b>	<b>INTRODUCTION .....</b>	<b>5</b>
	Location.....	5
	Tenure.....	7
<b>3</b>	<b>GEOLOGICAL SETTING .....</b>	<b>7</b>
	Regional Geology .....	7
	Project Geology .....	8
<b>4</b>	<b>PREVIOUS EXPLORATION .....</b>	<b>8</b>
	Historical Exploration.....	8
	Previous Exploration.....	9
<b>5</b>	<b>2012/2013 PROGRAM .....</b>	<b>10</b>
<b>6</b>	<b>REHABILITATION .....</b>	<b>10</b>
<b>7</b>	<b>ENVIRONMENTAL MONITORING .....</b>	<b>10</b>
<b>8</b>	<b>COMMUNITY RELATIONS .....</b>	<b>11</b>
<b>9</b>	<b>EXPENDITURE .....</b>	<b>11</b>
<b>10</b>	<b>2013 - 2014 PROPOSED WORK PROGRAM AND BUDGET .....</b>	<b>11</b>
	<b>BIBLIOGRAPHY .....</b>	<b>12</b>

## FIGURES

**FIGURE 1      Location of EL25758**

---

## **COPYRIGHT STATEMENT**

This document, the data it contains and its attachments are submitted under the *NT Mineral Titles Act 2010*. As such, the copyright normally reserved by Paladin Energy Ltd is controlled by that Act as well as the Commonwealth Copyright Act, as may be applicable. This statement authorises the NT Department of Mines and Energy to copy, store and distribute this document, data and attachments subject to the confidentiality restrictions of the relevant NT Acts.

---

## 1 SUMMARY

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

Exploration Licence 25758 was granted over an area of 21 blocks on 3 October 2008. The licence is currently registered to Paladin NT Pty Ltd (100%).

Cameco Australia Pty Ltd operated and managed the Project to August 2011 when Paladin NT Pty Ltd took over management of the Project.

The Northern Territory Government made an announcement on 28 September 2010 that it would not support the development of a mine at Angela, therefore a substantially reduced program has been undertaken during the current and previous reporting periods.

During the 2012 – 2013 reporting period work was limited to completion of the proposed rehabilitation program.

---

## 2 INTRODUCTION

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

Cameco Australia Pty Ltd (Cameco) and Paladin Energy Minerals NL (Paladin), the “Angela Project Joint Venture” were 50:50 partners in the Angela-Pamela Project over 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.

The Angela Project Joint Venture was dissolved during 2013 and Cameco’s 50% interest was transferred to Paladin NT Pty Ltd, a wholly owned subsidiary of Paladin Energy Ltd.

### Location

EL25758 is located approximately 25km south of Alice Springs, and straddles the Old South Road, the historic Ghan Railway Line, the Old Telegraph Line and the Central Australian Railway (see **Figure 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 the abovementioned, 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.

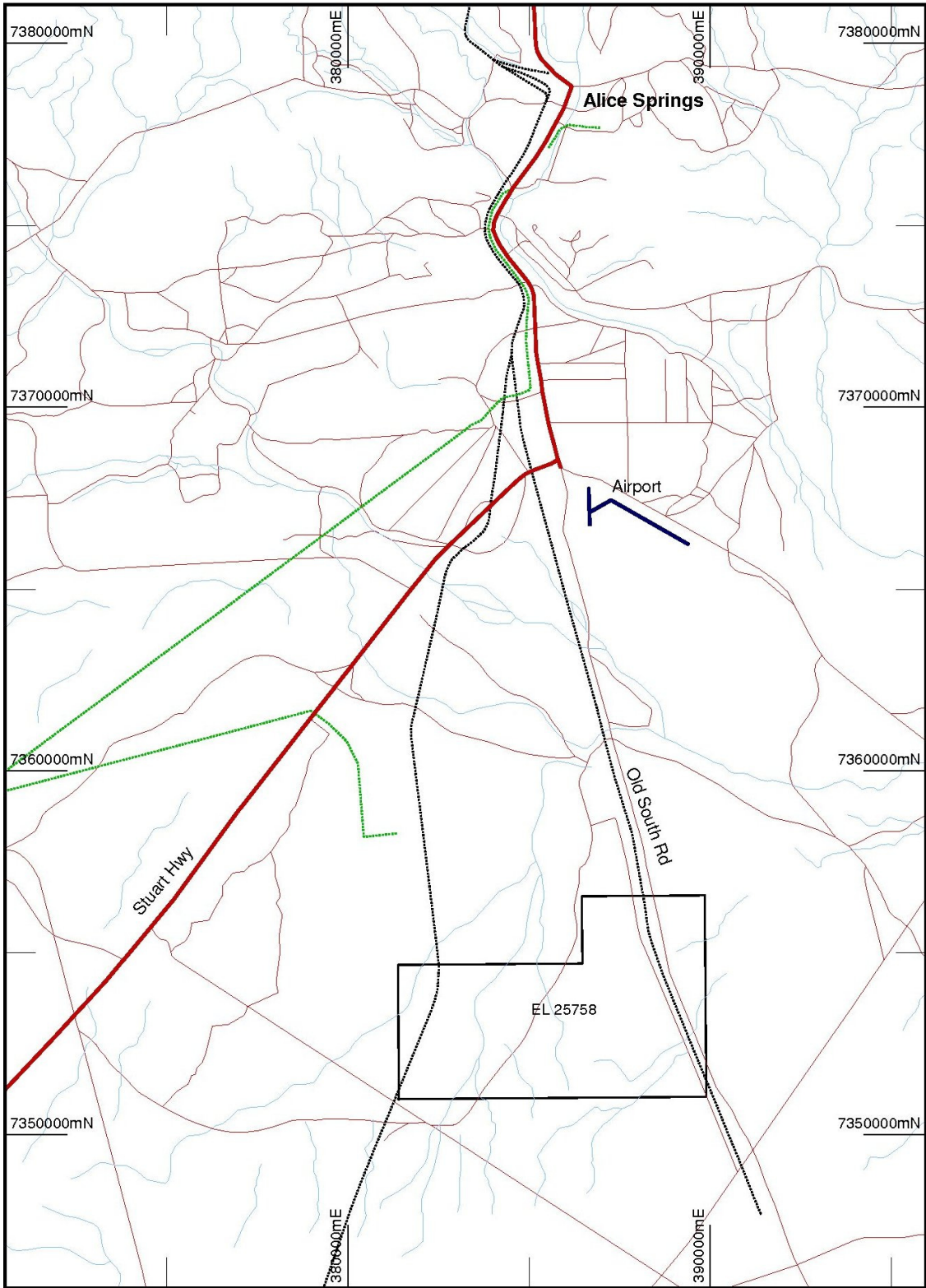


Figure 1 - Location of EL25758

---

## 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 37.67km<sup>2</sup>. On 3 October 2008, EL25758 was granted to the Cameco Australia Pty Ltd (50%) / Paladin Energy Minerals NL (50%) Joint Venture over an area of 21 blocks for a period of six years (expiring on 2 October 2014).

Following grant of EL 25758, Paladin Energy Minerals NL transferred its 50% interest to Paladin NT Pty Ltd, a wholly owned subsidiary of Paladin Energy Ltd.

Paladin assumed the role of operator and manager of the Project in August 2011 and Cameco's 50% interest in EL25758 was transferred to Paladin NT Pty Ltd during 2013.

## 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, 15km 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.

### **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**

### **Historical 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 U<sub>3</sub>O<sub>8</sub>. 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 recalculation of ore resources based on results of the latest investigations confirmed a resource of 1,500t U<sub>3</sub>O<sub>8</sub> 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 eU<sub>3</sub>O<sub>8</sub> 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.

### **Previous Exploration**

Work conducted on EL 25758 during year ended **2009** included a drilling program comprising 103 diamond holes for 10,333 with 16,684 metres of RC pre-collars and 8 geotechnical holes. All holes were probed for gamma and resistivity. A total of 1,924 samples were sent for assay.

---

During the **2010** reporting year a total of 59 percussion pre-collared diamond holes were drilled for 5,683 metres with downhole gamma and resistivity probing conducted on all holes. Geochemical analysis was conducted on a total of 1,948 samples.

Activities on the project were scaled back during the **2010-2011** reporting period following NT Government's announcement that it would not support the development of a mine at Angela. Work included drilling of 3 rotary mud holes for 690 metres and baseline environmental studies.

Work conducted during the **2011 – 2012** reporting period was restricted to completion of the baseline studies, environmental management and rehabilitation monitoring.

## **5 2012/2013 PROGRAM**

Work completed during the year ended October 2013 was limited to completion of the proposed rehabilitation program.

## **6 REHABILITATION**

During the first half of 2013 two site visits were made to assess the status of site rehabilitation and to rehabilitate outstanding areas. The aim of this rehabilitation was to satisfy the rehabilitation requirements of the existing Mining Management Plans (MMPs) and to retire the rehabilitation bond attached to those MMPs.

All holes from the 2009, 2010 and 2011 programs have now been rehabilitated and a report was submitted to the Department of Minerals and Energy in October 2013.

Some infrastructure (water monitoring bores and an enclosure that formerly housed the meteorology station) remains on site, and the status of this infrastructure has been discussed with the Department. These discussions are ongoing and may result in a new MMP and bond being put in place to cover the residual infrastructure following the retirement of the existing bonds.

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 Mines and Energy.

## **7 ENVIRONMENTAL MONITORING**

The licence conditions 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 the tenement and in the immediate region for background uranium and related isotopes be undertaken.

The baseline monitoring requirements have been met and the results provided in previously submitted Annual Reports. The monitoring program has therefore ceased.

---

## **8 COMMUNITY RELATIONS**

No community consultation activity occurred in the period from October 2012 to October 2013, 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.

## **9 EXPENDITURE**

Eligible expenditure for the reporting period on EL25758 totalled \$72,918 and is detailed in the Mineral Exploration and Mining Expenditure Form (Form 17 under the *Mineral Titles Act 2010*).

## **10 2013 - 2014 PROPOSED WORK PROGRAM AND BUDGET**

The work program for the Angela Project for 2013-2014 reporting period will be very limited and may include an MMI orientation survey and/or an IP resistivity survey. Details of the potential work are included on the Mineral Exploration and Mining Expenditure Form.

---

## BIBLIOGRAPHY

- Alice Springs. 1983. SF53-14 1:250K Raster Geology Data. Northern Territory Geological Survey, Minerals and Energy Division, Department of Regional Development, Primary Industry, Fisheries and Resources.
- Aquaterra Consulting Pty Ltd (2011). *Angela Uranium Project – Surface Water and Groundwater Baseline Monitoring – Final Report*.
- Batthey G. 1984. Summary of Discussion with Uranerz Australia Pty Ltd on Methods Used to Process Borehole Gamma Ray Logs From the Angela Deposit (NT)
- Borshoff J. & Faris I. 1990. Angela and Pamela uranium deposits. In: Geology of the Mineral deposits of Australia and Papua New Guinea (editor Hughes F.E.). The Australasian Institute of Mining & Metallurgy, Melbourne; p1139.1142.
- Chea Y. Chew W., Zhang G. 1998. A Novel Array Laterolog Method, The Log Analyst.
- Ferguson, K.M. 1975. UAL report 54: Exploration 1975 on the Ewaninga Prospect surrounding areas. Alice Springs, NT. Uranerz (Australia) Pty Ltd internal Report. NTGS Open File Report 9112-EXP-0003-V1.
- Kellogg Brown & Root Pty Ltd (KBR) (2011). *Summary of Baseline Data Acquisition – 2010. Radiation and meteorology at the Angela Deposit* (2011). Prepared for Cameco Australia Pty Ltd
- Morete S. 1983. Supplementary Information for the Bureau of Mineral Resources on the Angela I Deposit and Angela II-V Prospects, Alice Springs, Northern Territory, UEL Report TR230-29.
- Paladin, 2012; Inaugural Annual Water Report Angela Project, Circa 2008 to June 2012, October 2012
- Scott. 1980. Pitfalls in Determining the Dead Time of Nuclear Well-Logging Probes, SLWLA Twenty-First Annual Logging Symposium, July 8-11.
- UAL Report No. 62. Exploration 1976 on the Ewaninga Prospect and surrounding areas, Alice Springs, N.T. Compiled by Dr. G. Ott. Edited by D.O. Zimmerman and S. Morete. March, 1977.