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<tr>
<td><strong>Personal Authors</strong></td>
<td>Taylor, M and Williamson, G</td>
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<tr>
<td><strong>Corporate Author</strong></td>
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<td></td>
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<tr>
<td><strong>Email for Technical Details</strong></td>
<td><a href="mailto:grant.williamson@uel.com.au">grant.williamson@uel.com.au</a></td>
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EXECUTIVE SUMMARY

The West Arnhem Land region in the Northern Territory is well known for unconformity-related uranium mineralisation such as the Ranger and Jabiluka Deposits. The economic success of this mineralisation style has meant unconformity-related uranium has remained the focus of exploration in the region, however, the depths to the unconformity in some areas such as the Headwaters region have been too restrictive for this target model.

A review of the exploration potential of the Headwaters Project identified geological environments that hold similarities for significant near surface Westmoreland-style uranium and Coronation Hill-style gold-platinum-palladium-uranium mineralisation.

Exploration during the first year of tenure for EL24711, EL24712 and EL24713 consist predominately of regional targeting investigations. Desktop geochemical and structural analysis studies, mineral alteration and spectral interpretation of Landsat ETM+7 and ASTER satellite data to assist in prioritising targets and an airborne magnetic-radiometric survey of 8298.6 line km was completed in the south-eastern part of EL24713.

Exploration during the second year of tenure consisted predominately of regional targeting investigations looking for Westmoreland and Coronation Hill-style mineralisation. Desktop geochemical, radiometric and structural analysis studies, mineral alteration and spectral interpretation of Landsat ETM+7 and ASTER satellite data to assist in prioritising targets which were then field checked to determine priority drill targets.

Exploration in the third and final year of tenure consisted of a reverse circulation drilling program. A total of six drillholes (HRC001 – HRC006) were completed for 600m.

Following a strategic internal company review and the likelihood that little effective exploration work would be completed in subsequent years, the Company has surrendered EL24711, EL24712 and EL24713 on their third anniversary.
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1 INTRODUCTION

This combined Annual Technical and Final Surrender Report details all exploration work conducted by Uranium Equities Limited within EL24711, EL24712 and EL24713 during the three years of the company’s tenure.

1.1 Location and Tenure

The Headwaters Project is located within the prospective West Arnhem Land region, approximately 300km east of Darwin (Figure 1). EL24711, EL24712 and EL24713 cover an area of 2,679km². The region is well known for economic-grade uranium mineralisation such as the Ranger, Jabiluka and Nabarlek Deposits. The tenements are situated along the southeast margin of Kakadu National Park.

![Headwaters Location Map](image)

Figure 1: Headwaters Location Map

The exploration licences were initially granted to GE Resources Pty Ltd, a wholly owned subsidiary of Uranium Equities Limited, on 26/02/2010.

The Headwaters Project was subject to a joint venture agreement between Uranium Equities and Vale Exploration Pty Ltd, a wholly owned Australian subsidiary of Vale S.A. whereby Vale can earn up to 80% equity in the Headwaters Project area. Vale participated in the Joint Venture from 2010 until they withdrew from the JV during 2012.
There was a partial relinquishment of EL24711 and EL24712 on their second anniversary (Reed, 2012a). EL24711, EL24712 and EL24713 were entirely surrendered on their third anniversary.

1.2 Access

EL24711, EL24712 and EL24713 are located 60km east of the township of Katherine. Access to the tenements is via the sealed Stuart Highway and Central Arnhem Road then along the unsealed Manyallaluk Road. The Mann River Track (known as Bat Guyangguyang to the Traditional Owners) turns off just before Manyallaluk Community and extends north through the tenements to the banks of the Mann River and the northern part of EL24711.

1.3 Heritage

The Headwaters tenements are located on Aboriginal Freehold land and require access approval from the traditional owners. Exploration agreements have been signed with the Northern Land Council who represents the traditional owners in this area and Work Program Meetings were held with the Traditional Owners, Northern Land Council and Jawoyn Association Aboriginal Corporation. In the third year of tenure a Work Program Meeting was not held as the work had been discussed an approved in the previous year.

Current NT legislation requires that all sacred, cultural and heritage sites are initially documented by the Traditional Owners and NLC Anthropologists prior to exploration commencing. Consultant group Earth Sea Heritage Surveys undertook a ground survey over the areas proposed for drilling, clearing the areas of any cultural sensitivity (Appendix I).

UEL has undertaken an Aboriginal Areas Protection Authority register inspection to determine if there are any registered sacred sites with the area. These have also been marked as "No-Go areas“ within the Company’s GIS database.

2 Geology

2.1 Regional Geology

The regional geology is characterised by intensely deformed and metamorphosed sedimentary successions of the Pine Creek Basin, notably the Palaeoproterozoic aged Nimbuwah Metamorphic Complex and the Myra Falls Metamorphics. These basement rocks are host to the major unconformity related uranium deposits of the Alligator Rivers region. Peak deformation and metamorphism is attributed to the Barramundi Orogeny (~1880 – 1850Ma).

Undeformed fluvial sediments and intraformational volcanics of the Kombolgie Subgroup (~1822 – 1720Ma) unconformably overlie the basement rocks and represent the basal portion of the McArthur Basin. The platform sediment thickness is poorly known, but progressively thickens to the southeast, probably reaching depths in excess of 1000 metres in the southeast of the project area.
2.2 Project Geology

The tenements lie on the Arnhem Land Plateau which forms the western margin of the Palaeoproterozoic McArthur Basin and comprises undeformed sediments of the Katherine River Group. The lower part of this sequence was previously known as the Kombolgie Sandstone and has been renamed the Kombolgie Subgroup.

This subgroup has been further subdivided into three main sandstone units, the lowermost Mamadawerre Sandstone, the middle Gumarrirnbang Sandstone and the upper Marlgowa Sandstone. The sandstone sequences are separated by thin basaltic/volcanic horizons with the lower Nungbalgarri Volcanics and the upper Gilruth Volcanic Member. The lowermost unit, the Mamadawerre Sandstone and the overlying Nungbalgarri Volcanics do not outcrop within the project area but are present immediately to the north.

The lowermost unit exposed on the project is the Gumarrirnbang Sandstone, consisting of a fine to very coarse grained, medium to thickly bedded quartz arenite. Deposition of the Gumarrirnbang Sandstone is interpreted to have been in a braided fluvial system with an overall upwards fining and better-sorting of the sands within the upper portions of the formation.

The Gilruth Volcanic Member is a thin mafic volcanic horizon which conformably overlies the Gumarrirnbang Sandstone. The Gilruth Volcanics are generally recessive in outcrop, forming lateritised terraces of ferruginous debris that are clearly recognisable in the radiometric imagery.

Conformably overlying the Gilruth Volcanics is the Marlgowa Sandstone, a fine grained to granular, thickly bedded quartz arenite deposited in a braided fluvial to shallow marine, tidal environment.

While not exposed on the licence area, dolerite dykes and sills of the Oenpelli Dolerite are visible in the magnetic imagery. It has been suggested that the Oenpelli Dolerite could be the feeder dykes to the Nungbalgarri or Gilruth Volcanics basaltic units.

2.3 Mineralisation

Uranium mineralisation is well known in the region, with the Ranger, Jabiluka, Koongarra, Coronation Hill and Nabarlek Deposits being the most significant. These deposits are typically associated with the unconformity at the base of the McArthur Basin sediments.

Various mechanisms have been proposed to explain the source, transport, and formation of these deposits, with it widely noted that there is a lack of extensive mineralisation in the cover (Kombolgie Subgroup) rocks.

There are several known uranium occurrences within EL24711, EL24712 and EL24713, as defined by previous explorers from radiometric anomalies and surface geochemistry, as indicated in Figure 2. The most significant of these is the Flying Ghost Prospect.
Figure 2: Regional Geology and Uranium Deposits and Occurrences
3 PREVIOUS EXPLORATION

A collation of data from previous exploration conducted in the Headwaters region concluded that previous exploration in the area has been conducted since 1969 with very little success. Normandy Exploration focussed on commodities such as diamonds, copper, lead, zinc and silver with no significant results.

 Cameco Australia held the Headwaters (formerly Deaf Adder) tenements (as EL5061 and EL5062) until relinquishment in 2002. Cameco searched for uranium deposits similar to those found in the Athabasca Basin in Saskatchewan, Canada and the Alligator Rivers Region in the Northern Territory. Their 1997 exploration program consisted of an airborne magnetic spectrometric survey, radiometric prospecting, PIMA analysis of sandstone samples and lithogeochemical studies.

Several areas of interest were found and were followed up with diamond drilling the following year, and airborne geophysics and air photography were undertaken to aid in geological mapping in 1998. Cameco (Drever et al., 1999) noted that in most of the 1998 drill holes, radioactivity and alteration occurred at the contacts between the Gilruth and Nungbalgarri Volcanic members and the Kombolgie Sandstone.

In 1999, exploration consisted of a gravity survey, sampling of anomalous areas and further diamond drilling in the southern Spectre prospect. Drilling results showed elevated uranium located at contacts between the Kombolgie Sandstone and the volcanic units. In 2000 an Airborne Multispectral Scanner (AMS) survey was conducted and diamond drilling continued. In 2001, sampling of fracture, quartz vein, breccia and follow-up of anomalous zones was undertaken.

In chasing unconformity-related uranium mineralisation as seen at nearby deposits such as Ranger, Jabiluka and Nabarlek, Cameco determined the depth to unconformity prohibitive and the licences were surrendered in June 2002.

Cameco concluded that the highest uranium geochemistry values are associated with the Gilruth Volcanic Member, which downgraded their significance with respect to unconformity related deposits. Furthermore, the geophysics was unable to identify any targets underneath the Kombolgie Subgroup, and thus the ground was relinquished.

4 EXPLORATION CONCEPT

In contrast to previous explorers, Uranium Equities Limited has been targeting Westmoreland-style and Coronation Hill-style mineralisation in Arnhem Land.

4.1 Westmoreland-style Exploration Target

While the unconformity-style target may still be valid, it is more appropriate to target Westmoreland-style mineralisation within the platform cover sequences. Currently known anomalism should be reviewed in the search for Westmoreland-style targets associated with the volcanic horizons and/or dolerite. Mobilisation of uranium in the sequence may be precipitated within or adjoining the slightly reducing volcanic sequences.
These deposits occur within conglomerate, sandstone and mafic volcanic rocks within the McArthur Basin succession more than one kilometre above the unconformity as well as in the basement (Wall, 2006).

They have some features in common with sandstone–hosted, vein-type and unconformity-related deposits and are associated with redox boundaries near the contacts between different lithologies, in a variety of geological settings (Lally and Bajwah, 2006).

Uranium and primary gold – PGE mineralisation at Westmoreland is associated with brecciation, faulting and silica/clay alteration zones within the McArthur Basin sediments above the unconformity. Higher grade mineralisation is spatially associated with north-east trending mafic dykes emplaced along steep trending fault systems. Extensive, shallow dipping, stratabound mineralised zones are also associated with the fault interaction zones. Figure 3 shows the comparison between the geological setting between the two areas.

A significant feature of this style of mineralisation is that the target footprint is relatively large, with the vertical dykes likely to be in the order of 10 – 20m thick, and stratabound mineralisation possibly up to 600m away.

![Figure 3: Schematic cross-section of Westmoreland-style mineralisation](image)

4.2 **Coronation Hill-style Exploration Target**

Several of the deposits in the vicinity of the Headwaters Project not only contain economic concentrations of uranium, but include significant gold mineralisation (Jabiluka 2, Koongarra and Coronation Hill) and platinum – palladium
mineralisation (Coronation Hill). They are related to fracture, fault and breccia zones, close to the unconformable Pine Creek Basin/Katherine River Group contact and are believed to be controlled primarily by the basement lithologies (Lally and Bajwah, 2004).

The southern part of Headwaters contains a large-scale regional northwest trending Spectre Fault that has similarities to the South Alligator Valley Mineral Field, host to the El Sherana, Coronation Hill and Sleisbeck Deposits.

5 EXPLORATION BY URANIUM EQUITIES LIMITED

5.1 WORK COMPLETED IN THE FIRST YEAR

Exploration during the first year of tenure consisted predominantly of desktop studies and included;

- A full database compilation of the previous exploration from the region and target generation.
- A regional analysis of the previous exploration as part of a Masters Project sponsored by UEL.
- A desktop structural study of the Headwaters Project
- Collation and interpretation of Landsat and ASTER data.
- An airborne radiometric and magnetic survey over part of EL24713.
- Interpretation and processing of geophysical data.

Full details and additional discussion can be found in the Annual Technical Report by Bradley and Williamson (2011).

5.2 WORK COMPLETED IN THE SECOND YEAR

Exploration work conducted in the second year of tenure was aimed at furthering the geological understanding of the area and generate possible targets for drill testing.

- Interpretation and processing of geophysical data.
- A reconnaissance program to field check the priority targets, with rock chip and regolith samples collected.

Full details and additional discussion can be found in the Annual Technical Report by Reed (2012b).
6 EXPLORATION IN THE CURRENT YEAR

Exploration during the third year of tenure consisted predominantly of preparing and completing a reverse circulation drilling program.

Kalgoorlie based Kennedy Drilling were contracted to undertake six drill holes (HRC001 – HRC006) for 600m of RC drilling. These six holes were designed to test three distinct radiometric targets that had been field checked and returned anomalous assays.

6.1 Target 1A

This target is located on the Spectre Fault and is a distinct radiometric anomaly closely associated with both the Spectre Fault and the McCaw Formation.

Drillhole HRC001 was collared on the south side of the Spectre Fault within the McCaw Formation and was drilled to a depth of 100m. A distinct redox zone was encountered from 40 – 77 metres. The drillhole intersected anomalous barium from 8 – 48 metres with a peak of 16100ppm at 32 – 36 metres. HRC001 had moderate to strong quartz veining and brecciation from 68m to end of hole, this is interpreted to be related to the Spectre Fault zone.

Drillhole HRC002 was drilled to the north of the Spectre Fault and was designed to test the fault position for anomalism related to the fault. The drillhole intersected dolerite from 9 – 92 metres, with strong hematite alteration from 20 – 51 metres.

6.2 Target 12C

This target area was selected based on the geochemistry of sandstone samples collected as part of field reconnaissance over a distinct U2/Th anomaly.

HRC003 was collared within the Cottee Formation in the centre of a radiometric high. This drillhole predominantly encountered mudstone lithologies, except for a 12 metre interval of medium grained sandstone from 74 – 87 metres. There is strong to intense hematite alteration within the mudstone from 31 – 60 metres. This drillhole had no anomalous uranium however there was slightly elevated Au, As and Cr.

HRC004 was also collared within the Cottee Formation on the margin of the radiometric high and intersected lithologies similar to HRC003 with mudstone and interbedded sandstone. This drillhole failed to intersect significant uranium or evidence of faulting or fracturing.

6.3 Target 12D

This target is within the Cottee Formation and is a pronounced U2/Th high. Weakly anomalous rock chip samples collected from field reconnaissance gave weight to drilling of this anomaly.
HRC005 was collared in mudstone and also encountered dolerite lithologies from 21m to bottom of hole. The dolerite is medium grained with varying amounts of hematite alteration. There was no anomalous uranium encountered. It is unclear if the dolerite is a fault related dyke or potentially a sill intruding sandstone sequences.

HRC006 was mudstone with minor intervals of interbedded sandstone. Strong brick red hematite was prevalent within the mudstone with a redox zone encountered from 61m to end of hole. There were no anomalous results for uranium or the other elements analysed.

6.4 RC Drilling Details

A summary of completed drillholes is provided in Table 1 with data text files of collar details and geological logs can be found in Appendix II and Appendix III respectively. Downhole surveys were not done.

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Table 1: Drillhole Statistics

A total of 150 four-metre speared composite samples (X17726 – X17880) were collected during the program. These samples were submitted to NTEL in Darwin for laboratory analysis for a 20 element suite by G422 (four acid digest and an ICPMS finish) and Au, Pt and Pd using 50g fire assay. Summary results include:

- Only background values of uranium were reported with a peak assay of 24ppm U$_3$O$_8$ recorded in HRC006 (88 – 92m).
- Au, Pd and Pt results were generally below detection, with peak values of 29ppb, 9ppb and 7ppb respectively
- Some low-level base metal anomalism was recorded, with a peak value of 890ppm Cu and 650ppm Zn
- REE analysis reported peak values of 82ppm La, 148ppm Ce, 71ppm Nd and 48.2ppm Y.

The data file with NTEL assay results is found in Appendix IV.
Two drill chip samples were submitted to Pontifex and Associates Pty Ltd for petrography.

Both samples were described as altered quartz – dolerite, with well preserved primary crystalline textures. The shallower sample has extensive red earthy hematite alteration of ex-plagioclase together with K–feldspar – chlorite – anatase “hydrothermal” alteration (which occurs in both samples). The deeper sample contains minor pyrite as well as the K–feldspar – chlorite – sericite – carbonate – limonite alteration.

These samples seem likely to represent altered Oenpelli Dolerite. The petrography report is included as Appendix V.
7 CONCLUSION

There were no significant results from the limited reverse circulation drilling program completed within EL24713.

However using the exploration model for unconformity-related U ± Au ± PGE’s of Mernagh et al. (Figure 5) the results from the six hole RC program show that geochemical anomalism can be detected at surface from mineralisation at depth. The presence of slightly elevated PGE and REE results in the near surface environment, especially associated with the regional Spectre Fault Zone, indicates that the region has potential for economic mineralisation.

![Figure 5: Model for unconformity-related U ± Au ± PGE deposits (Mernagh et al.1998)](image)

In addition, the presence of the previously unmapped dolerite within this area (HRC002 and HRC005) related to the regional faulting, gives the potential for a Westmoreland-style uranium mineralisation target.

Following a strategic internal company review and the likelihood that little effective exploration work was planned for subsequent years, the decision to fully surrender EL24711, EL24712 and EL24713 was made.
8 REFERENCES


Reed B, 2012b. Headwaters Project – EL24711, EL24712 and EL24713 Annual Technical Report For the Period 26/02/11 – 25/02/12.

Appendix I

Archaeological and Heritage Assessment of Parts of EL24713
South West Arnhem Land, NT
2012

by

Richard Woolfe and Karen Martin-Stone
Archaeological and Heritage Assessment of Parts of EL24713 South West Arnhem Land, NT 2012

A Report for Uranium Equities Limited.

Richard Woolfe and Karen Martin-Stone
Earth Sea Heritage Surveys
June 2012
Archaeological and Heritage Assessment of parts of EL24712, South West Arnhem Land, Northern Territory.

A Draft Report for:
Uranium Equities Limited (UEL)

Copy to:
Northern Land Council and
NT Heritage Conservation Services, NRETAS


Draft Version 1.2 22 June 2012
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GLOSSARY

Definitions of terms referred to in this interim report are listed below:

Archaeological survey: An archaeological assessment of a defined survey area by qualified professionals (archaeologists), locating and recording places and objects as defined by the NT Heritage Conservation Act. The survey methods could be reconnaissance, stratified or comprehensive (see below).

Artefact Scatters: Consists of a cluster of stone artefacts, either located in the open or in a sandstone overhang.

Comprehensive survey: Often called 100% land survey. This type of survey will typically allow for a group of technical experts (i.e. archaeologists) and Traditional Owners to transect across an area of land on foot recording any and all located archaeological sites and artefacts. Typically the team will transect about 15-20 metres apart in a line abreast. Five people in a team would usually survey 0.6 to 1.0 square kilometres per day.

Grid Reference Datum: All grid references reported in this report are in GDA94.

Heritage Assessment: An archaeological and or heritage study of an area involving an assessment of the risk of locating sites that have not yet been mapped or added to a register. This process will often involve a desktop study of past surveys in the area or similar land units and reconnaissance surveys by foot, vehicle or helicopter.

HCA: Northern Territory of Australia Heritage Conservation Act 1991, providing protection for listed heritage places and Aboriginal and Macassan archaeological sites and artefacts.

Heritage clearance: ‘Heritage clearance’ is a term not often used by heritage practitioners. Instead they provide a report to the client that includes recommendations for mitigating the impact of the proposed works on archaeological places and objects. The recommendations are developed taking into account the type of ground disturbance in the project area. An archaeological assessment and report for a specific survey area does not confer clearance for future projects in the same area with a higher level of impact. This is because an archaeologist cannot be 100% sure that there are no sites under the ground, or difficult to identify due to low ground visibility.
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<td>An archaeological survey by foot, vehicle or helicopter. This type of survey is used to provide an assessment of the probability of locating sites within the survey area, within the resources of the survey project.</td>
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<td>Significance:</td>
<td>An assessment of the importance of an archaeological place or object according to established heritage significance criteria. Significance assessment is an essential tool in the decision making process for heritage sites. (Refer to Section 4.1)</td>
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<td>Stratified survey:</td>
<td>A systematic foot survey covering a representative sample of landscape features through transects. This type of survey aims to locate a representative sample of archaeological places and objects across defined landscape features in a broad survey area. Recommendations can then be made on the probability of finding sites through comprehensive survey.</td>
</tr>
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</table>
EXECUTIVE SUMMARY

Earthsea Heritage Surveys undertook an archaeological and heritage assessment of EL24713 on Friday, 1 June 2012. The assessment area was located near the headwaters of the Waterhouse River, and is currently leased for exploration activities to Uranium Equities Limited (UEL). The UEL 2012 Work Program is proposing a set of low impact exploration activities that will have limited impact on the ground surface. The archaeological and heritage assessment included a helicopter reconnaissance of the proposed area and four walking transects totalling 9 km. The ground survey was conducted by Karen Martin-Stone of Earthsea Heritage Surveys (Earthsea Pty Ltd). Karen was accompanied in the field by Simon Owen, of Jawoyn Helicopters. Traditional Owner, George Rrunyu, had wished to be involved in the survey but was unable to attend.

EL24713 consists of approximately 1051 square kilometres of plateau country in South West Arnhem Land. The survey area covered sand plain and lateritic gravel ridge land forms. Past surveys in the area have indicated that stone artefacts occur in low densities on similar land units. The helicopter reconnaissance results showed that there were no sandstone outcrops on the surface of the tenement, so the presence of rock art was not considered likely. At the time of the survey, surface visibility was low due to dense vegetation, however burning had increased visibility in parts of the northern survey area.

The Consultants did not locate any archaeological places or objects in the survey.

Karen Martin-Stone met with George Rrunyu on Saturday, 2 June 2012. George agreed that the proposed drill lines are unlikely to impact any cultural heritage, but also made clear that the sacred site area just south of the southern-most drill line is to remain untouched. George also requested advance notice of the dates of the drilling program, and expressed a willingness to be on site during the drilling. George’s son is also available to work on the drilling program.

The Consultants believe that there is a low risk of locating further archaeological sites or artefacts in the survey area and believe that a higher level of survey is not warranted given the low impact nature of the proposed work program. It is important to note that this assessment does not provide a heritage clearance for future work programs.
SUMMARY OF RECOMMENDATIONS

Recommendations arising from the survey include:

1. There is a low risk that the UEL 2012 work program activities will accidentally damage artefacts and sites protected under the NT Heritage Conservation Act 1991 in EL24713.

2. Further heritage survey is not required for this area unless greater levels of ground disturbance are planned (i.e. large scale vegetation clearing or mining operations).

3. It is recommended that the Traditional Owner group be kept informed of the work program, and that opportunity for employment and site visitation be made available wherever possible.

4. Route access tracks away from creek margins where possible.
1.0. INTRODUCTION

1.1. INTRODUCTION

Earth Sea Heritage Surveys was engaged by Uranium Equities Limited to conduct an archaeological/heritage survey of proposed drill locations and access tracks in an area of West Arnhem Land approx 20-30 km SSE of the confluence of Snowdrop Creek and the Katherine River. The survey was completed in one day (1st June 2012), and the report was completed and presented on 22nd June 2012. As noted in the Executive Summary no archaeological sites were located in the Project Area. Therefore there are no heritage issues with proceeding with the proposed work program.

1.2. THE UEL 2012 WORK PROGRAM

The Uranium Equities Limited ‘Headwaters’ 2012 Work Program consists of an exploration project of approx 23 drill holes and five access tracks in the West Arnhem Land Region. The total project area was approx 10 square kilometres, although the area to be disturbed by tracks and drilling is only a small part of the overall project area. Access to the Project Area in June 2012 was by helicopter from the Nitmuluk Gorge helipad using a Robinson 44 machine owned by Jawoyn Aviation. Simon Owen piloted the consultant, Karen Martin-Stone to the area. The Mann River track will be cleared as used for the drill program starting in July 2012.
FIGURE 1: PROJECT AREA MAP, UEL HEADWATERS WORK PROGRAM 2012
1.3. SCOPE OF THE STUDY

The West Arnhem region contains a suite of highly significant Indigenous cultural heritage places that span from the Pleistocene through to the early historic period of European settlement in the Northern Territory. The most highly visible component of this archaeological record is the incredibly diverse and abundant rock art which owes its longevity to the Mamadewerre Formation within the Kombolgie Sandstone sub-group. It is within this archaeological environment that some of the exploration activities are located. Therefore mineral exploration work programs are assessed on a specific exploration project basis for potential impacts on the valuable and significant Indigenous archaeological record of West Arnhem Land.

The archaeological survey for the Uranium Equities Limited Headwaters Work Program 2012 was conducted by Karen Martin-Stone on June 1, 2012. Aboriginal Traditional Owner George Rrunyu was due to accompany the consultant in the field, however illness prevented George attending on the nominated day. As noted in the Executive Summary, George was consulted on the results of the survey (no sites found, or expected) on 2nd June 2012.

The report was prepared by Richard Woolfe and Karen Martin-Stone with background information provided by Daryl Wesley (Guse). Site mapping for this report was prepared by Richard Woolfe.

The archaeological study will:

- Identify archaeological material (prescribed archaeological places and objects, HCA) within EL24713 by means of a survey. Archaeological sites are to be recorded in such detail as to permit independent assessment of their significance. Location of archaeological places and objects were recorded using a Trimble Nomad (WGA94 datum);

- Test previous archaeological site location models and evidence from previous archaeological surveys;

- Assess the cultural heritage significance of archaeological places and objects located during the survey;

- Provide advice on management strategies to protect archaeological and cultural heritage places; and,

- Where practical, provide mitigation advice to exploration staff in the field.
In addition, the report will:

- Research and report background geographic, vegetation and outcropping geology in the Project Area;

- Outline a survey methodology including definitions of sites, background scatters of artefacts and isolated artefacts;

- Present the transect methodology (how much ground was inspected and why);

- Outline the recording methodology for sites, features and artefacts;

- Present an risk assessment methodology based on bio-geographic land information (land systems, units, patterns and elements); and,

- Describe the methodology used to assess the significance of sites and artefacts.
1.4. THE EL24713 AREA: PHYSICAL ENVIRONMENT

EL24713 consists of approximately 1051 square kilometres of sand plain and rock outcrop located in the Arnhem Land Aboriginal Land Trust north east of Katherine. The land surface of the Project Area comprises undulating sand plains dissected by small semi-permanent watercourses. Past surveys in West Arnhem Land have indicated that stone artefacts occur in very low densities on similar land units within the same land units, however rock art sites are likely where sandstone outcrops and forms rock shelters. Additional archaeological features, such as grinding hollows are also common within the Arnhem Land Plateau and surrounding areas.

The greater West Arnhem region has a diversity of environmental zones including coastal and estuarine areas, alluvial floodplains, major river systems, dissected sandy plains, steep foothills and ridges, and finally the plateau area itself. The landscape has been affected by significant environmental change since the Pleistocene sea level rise and subsequent evolution of the major tidal river systems. Geologically, the project area is within the McArthur Basin geological region and the Kombolgie sandstone subgroup, which includes the Mamadawerre Sandstone member\(^1\). The Pine Creek Geosyncline abuts the area to the south west. The Pine Creek Geosyncline is characterised by numerous intrusions and folds giving rise to the presence of other geological formations that crop out at the ground surface. Large rivers, including the Katherine and Edith rise in the Plateau near the project area.

Vegetation in the Project Areas is dominated by *Eucalyptus tetradonta* (Darwin Stringybark), *Eucalyptus miniata* (Darwin Woolly Butt) and *Eucalyptus Bleeseri* (Smooth Stemmed Bloodwood) on an understory of tussock grasses principally *Sarga spp* (Classified Mapping Unit 9, Wilson et.al.,1990)

1.5. BACKGROUND ARCHAEOLOGICAL RESEARCH IN THE WEST ARNHEM LAND REGION

Most archaeological research in the region has tended to focus on the abundant rock art sites, primarily due to their chronology (from Pleistocene to near present), their aesthetic appeal and their cultural significance to Aboriginal people and the wider Australian community. The advent of heritage management surveys for mining and infrastructure development from the early 1990s has added another dimension to our understanding of the region’s archaeology, where stone artefact sites, quarries and culturally modified trees began to be recorded along with the rock art.

BACKGROUND ROCK ART RESEARCH

According to Chippendale and Tacon (1998:90) there is a strong framework provided for identifying and dating the long tradition of rock art in Western Arnhem Land. Chaloupka (1984; 1993) has defined various rock art styles and grouped them into art periods and phases for the West Arnhem region. By relating the known climatological, geomorphological, archaeological, historical, zoological and botanical data, Chaloupka (1985) developed a chronology for the rock art. Evidence of weathering, chemical changes in the rock surfaces and pigments, and the order in which paintings are apparently superimposed at particular sites also contributed to this process. According to Chaloupka (1984) the key to major stylistic changes lies in significant environmental changes, particularly sea level fluctuations experienced in the region during the late Pleistocene and Holocene. On this basis he proposed four main chronological periods for the classification of rock art in the West Arnhem region. This is further expanded by Chippendale and Tacon (1998:107) who present a chronology of western Arnhem Land rock art based on Chaloupka’s research, their own and others (Figure 2). Chippendale and Tacon (1998) provide a useful chronology for identification of rock art that is utilised in this study.

Pre-estuarine Period (before 8000 BP) The pre-estuarine period may be as old as 20000 BP and up to 50000BP. Chaloupka (1984) inferred that the hunting weapons depicted in the art such as boomerangs which could have been effectively used only in the grasslands and low woodlands that predominated in Kakadu at that time. Extinct faunal species from the late Pleistocene are also used as evidence for this time frame. The pre-estuarine period contained a number of different rock art styles. The earliest of these consisted of prints of hand, grass and other objects. These were followed by paintings of naturalistic figures including macropod and extinct fauna, dynamic figures, post-dynamic figures and yam figures. Weapons such as spears are clearly illustrated in the art. Chaloupka
considers the main body of art from this time period to be dated between 20000 BP to 8000 BP. Chaloupka argued that the changing art of the late Pre-estuarine Period reflected changing times for the Aboriginal people.

Estuarine Period (8000BP to 1500BP) Chaloupka (1984) defined the estuarine period by relating stylist changes in art, to the changes occurring in floodplain conditions from 8000 years ago and the subsequent changes in the nature of the resource base. Styles of the estuarine period are characterised by the appearance of animals, notably fish and a decline in the representations of emu and macropod. Depictions of hunters with a range of weapons documented the change in technology, which took place in response to the changing environment and resource availability. The x-ray style of art developed and was continued in use up until the present.

**Freshwater Period** (from 1500BP): the freshwater period is defined from 1500 years ago with the appearance of large freshwater swamps and floodplains. Freshwater faunal and floral species were depicted such as Jabiru, water lilies and magpie geese. Different material culture was again developed and depicted to utilise the emerging resources.

**Contact Period** (since Macassan and European contact 300 years ago): The final phase of the Contact period from about 300 years ago differed only in the choice of the subject matter. According to Chippendale and Tacon (1998:95) European people and European objects have been known in Arnhem Land since early settlements on the Coburg Peninsula some 160 years ago. Therefore depictions of items such as guns, ships, European persons and items, and introduced animals are datable from that period onwards.
Changes in Australian rock art research methodologies followed the introduction of ‘post-processualism’ in Australian archaeology. The emphasis in rock art research shifted to attempting to understand:

- The integrating function of art in Aboriginal society,
- How a range of social and economic information is encoded in art and its distributional characteristics.
- How it may reflect fundamental changes in social organisation, group interaction and land use.

These types of investigations required information on the cultural and natural contexts of rock art production whereas previous studies had tended to be more focused on rock art in isolation. Important steps in the development of current perspectives on the study of Indigenous rock art were taken by Maynard (1977) and Clegg (1983). These archaeologists developed a more analytical approach to the study of rock art. Maynard (1977) contended that meaning is always highly specific and usually

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3 Processualism is widely regarded as a school of anthropological/archaeological thought originating in the US with Lewis Binford. Archaeological theory in the present is often a modification or rejection of processual thought, and is therefore defined as ‘post-processual’.
esoteric and as such is probably completely intractable. Clegg (1983) extended this position to argue against attempting to reconstruct the meaning of motifs on the grounds that it is impossible to securely ascertain either the subject or motivation of the artist.

Another influence in the study of rock art came from the study of semiotics, the study of signs. This is where style became re-conceptualized as a means of communicating information. This development in rock art research was partly attributable to the increasing influence of anthropological studies of cultural material which demonstrated the communicative capacity of style. The increased emphasis on social explanations in archaeology emerged in rock art studies in information exchange theories. The main functions of style are related to cultural processes such as group integration and differentiation and boundary maintenance. The concept of information exchange as an explicit theoretical tool has been used to interpret a wide range of rock art. The general approach is based on the notion that the functional interdependence between art and other cultural components which is so evident in ethnographic studies that art and changes in art can tell much about the complexity of pre-contact cultural systems. This same functional interdependence indicates that archaeological studies of art need to be undertaken in the light of all available evidence for systemic context, one basic component of which is resource utilisation. Fundamental to this approach is the notion of style as information. The main point about the use of information exchange theory in Australian rock art studies is that it moves beyond a simple correlation between stylistic similarity and social interaction to consideration of the causes underlying these interactions.

There are generally two main types of rock art (Clegg 1983):

1. Engravings and poundings where the pattern depicted is one of relief and pictures were apparently produced by removing material from the rock surface.

2. Drawings, stencils and paintings where the material was added to the rock surface.

Common rock art terms used in describing rock art sites include:

- Anthropomorph: A figure of a human form.
- Figurative Art: Art motifs which resemble objects familiar to the observer, representational or naturalistic art.
- Motif: A very common word used in describing rock art. This is usually defined as a recurrent visual image which has a particular arrangement (Maynard 1977). A mark or combination of
marks of human origin, which can reasonably be interpreted to have formed an individual or separate picture, or design or a recurrent type of figure.

- Petroglyph: A mark or picture made on rock through the process of pecking, pounding, abrading or scratching the rock surface.

- X-ray Art: A style of rock art in which the internal skeleton and internal organs of humans or animals are depicted.

- Zoomorph: A figure of animal form.

- Stencils: Where paint has been applied over an object placed against the shelter wall. Most commonly found in the form of hand stencils, however many examples of items of material culture have been documented.

- Bees Wax Figures: Where bees wax has been modified and placed on shelter walls to form an image.

- Superimposition: When multiple motifs are executed over one another at different times in the past.
2.0 THE LEGISLATIVE AND SOCIAL BASIS FOR CULTURAL HERITAGE PROTECTION.

2.1 CULTURAL HERITAGE IN THE NORTHERN TERRITORY

The Northern Territory has a rich cultural heritage environment which includes a long history of Aboriginal occupation (at least 50,000 years to the present), Macassan trade with the North Australian coast from the 17th century to 1906, contact with European explorers from 1606 onwards and a history of Chinese and European mining from 1872 onwards. Table 2 below outlines site and place types, a description of the places and the legislation that protects these sites in the NT.

**TABLE 1: HERITAGE LEGISLATION IN THE NORTHERN TERRITORY.**

<table>
<thead>
<tr>
<th>Type of Cultural Heritage Place</th>
<th>Examples</th>
<th>Commonwealth Legislation</th>
<th>Territory Legislation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Sites of significance in the Aboriginal Tradition (Sacred Sites)</td>
<td>Dreaming places, story places, camp sites, areas of special bush tucker resources, birthing places, rock art sites and stone artifact quarries that are of significance in the Aboriginal Tradition.</td>
<td>Aboriginal Land Rights (Northern Territory) Act 1976</td>
<td>Northern Territory Aboriginal Sacred Sites Act 1989</td>
</tr>
</tbody>
</table>

³ Archaeological places are defined as places of Aboriginal origin that are not considered to be Sacred Sites in the Aboriginal Tradition. Despite this, these places often do have significance to Aboriginal people.
2.2 LEGISLATION IN THE NORTHERN TERRITORY.

NT SACRED SITES ACT 1989

The NT Sacred Sites Act 1989 protects sites that are ‘sacred and otherwise of significance in the Aboriginal Tradition’. Sacred Sites are protected whether the location of the sites are known or not by any person or company seeking to do work on lands. The Act is administered by the Aboriginal Areas Protection Authority. The Authority can issue a Certificate indemnifying any proponent for an area upon application and payment of a fee. The Certificate will contain conditions limiting or preventing works in and around registered and recorded Sacred Sites. The Authority Certificate will contain maps outlining any restricted work areas in the area of application.

See http://www.aapant.org.au/ for a fuller understanding of the provisions of the Sacred Sites Act. Note that the provisions of the Sacred Sites Act override Section 39 of the Heritage Conservation Act. This report recommends that Vista Gold obtain Authority Certificates for areas of proposed works.

THE NT HERITAGE CONSERVATION ACT 1991

This Act has two parts that apply in this Project Area. Part two of the Act allows for the establishment of the NT Heritage Register.

Members of the community can nominate areas, places, sites, buildings, shipwrecks and heritage objects to the register. If the Minister agrees that these features are of special significance to the heritage of the NT, the place is added to the register. The place will then be protected from accidental and deliberate damage or harm. The Act allows for processes to approve works and maintenance for a heritage place. There are no nominated or declared heritage places in the Project Area.

Section 39 of the Heritage Conservation Act, and it regulations, provide a ‘blanket’ or ‘presumptive’ protection for Aboriginal and Macassan archaeological places and objects until a decision by the Minister to either permanently protect these places or permit their disturbance or destruction. This decision making process is triggered by an application to disturb these places. There are penalties for accidental or deliberate destruction of these sites. There are large numbers of protected Aboriginal archaeological places in the Project Area.
THE NT HERITAGE ACT 2012

In October 2011, the NT Assembly passed a new bill for the protection of heritage in the Northern Territory. This bill will come into force during 2012 following drafting of regulations to the Act and receiving the Administrators assent. The new Act will protect the same classes of places as the current Act, with some changes. The new Act includes a provision for the declaration of classes of places or objects that are known to be of significance in the NT but where not all locations are currently mapped and recorded\(^4\). ‘Blanket’ protection may be extended to:

- Relics of the Overland Telegraph Line (there are numbers of these places in the Project Area);
- WWII aircraft crash sites;
- Lone graves (i.e. graves that are not in regular cemeteries); and,
- Shipwrecks.

Under the new Act, Aboriginal archaeological places will all automatically become heritage places, and will be protected until a permit is approved by the Minister, the Heritage Council or the Department administering the Act, to disturb or destroy such sites. Some sites may become permanently protected by adding them to the NT Heritage Register. Permits to disturb sites may involve conditions as part of a permit, such as site salvage and analysis.

\(^4\) At time of drafting this report, the new Act has not been promulgated, awaiting appointment of a new Heritage Council.
1.6. REGISTER SEARCHES (NORTHERN TERRITORY ARCHAEOLOGY DATABASE)

A search of the Northern Territory Archaeological Site Database (NRETAS, dated to October 2009) shows that there are 77 previously recorded archaeological sites in the within map sheet 5570 Snowdrop (1:100,000 scale). Figure 3 illustrates the distribution of previously recorded archaeological sites in the region.

The majority of the past and contemporary archaeological research in the West Arnhem Land area has concentrated on documenting rock art sites in sandstone rock shelters and overhangs. The most recent sites recorded in the area are the result of archaeological investigations for mineral exploration activities. Table 1 provides a breakdown of the types of archaeological site features that have been recorded within the Snowdrop 5570 Map Sheet, which broadly reflects the research focus on rock art rather than the more recent heritage management approach.

**TABLE 2: OCCURRENCE OF ARCHAEOLOGICAL SITE FEATURES AT THE 77 PREVIOUSLYRecorded ARCHAEOLOGICAL SITES IN THE 5570 SNOWDROP (NRETAS DATABASE ONLY, DOES NOT INCLUDE NLCRecorded SITES)**

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<th>Archaeological Site Features</th>
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<td>Cultural Deposit</td>
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<td>Grinding Hollows</td>
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<td>Human Skeletal Remains</td>
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<td>Wax Designs</td>
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<td>Stone Quarry</td>
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### TABLE 3: NRETAS DATABASE, MAP SHEET 5570 SNOWDROP

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Figure 3: NRETAS Site Database, Snowdrop 5570 Mapsheet
3.0. METHODOLOGY

The methodology for locating, recording and assessing sites and artefacts is presented here to relate the consultants approach to acceptable archaeological practice. This is a necessary part of reporting despite the absence of recorded sites in this study. Standard methodologies for this type of survey include:

1. Identifying Archaeological materials and heritage sites;
2. Defining ‘sites’, ‘background scatter’, ‘isolated artefacts’ and ‘historical features’;
3. Defining sampling methodology;
4. Recording data;
5. Assessing site distribution against land unit/ pattern/ element (predictive modelling of site data to form a risk assessment of the likelihood of finding more sites);
6. A methodology for assessing the significance of recorded sites as archaeological places and their significance to Aboriginal people.

3.1 DEFINING SITE TYPES

There are a variety of archaeological site types previously recorded as occurring in the region that are documented in the Northern Territory Archaeological Site Register. According to Burke and Smith (2004:63) the two broadest categories of archaeological site types can be defined as Indigenous archaeological sites and non-Indigenous archaeological sites (more commonly referred to as European or historical sites). Many of the previously recorded sites have been recorded over several decades and the recorders have most likely used different definitions for each site type. For this reason the authors have described these site definitions in the broadest sense. The following site definitions can also occur in conjunction with other types. Indigenous site types that are known to occur in the West Arnhem region are as follows:

- **Artefact scatters** may contain flaked or ground artefacts and hearthstones. Artefact scatters may occur as surface scatters of material or as stratified deposits where there have been repeated
occupations. These scatters do not necessarily imply that prehistoric people actually camped on the site; rather, they may only indicate that some type of activity was performed there.

- **Stone Quarry.** A site where stone for flaked or edge-ground artefacts have been extracted from an outcropping source of stone. This is a broad definition a stone quarry and there are further subdivisions of this site type (Hiscock and Mitchell 1993). According to Hiscock and Mitchell (1993) most surface hard stone quarries have associated reduction sites.

- **Knapping locations**, consisting of one or more knapping floors, are discrete scatters of artefacts, anywhere in the landscape, resulting from stone being worked or reduced at that spot. The criteria for a knapping floor are that the original block of stone can be at least partially reconstructed from scattered flaked stone pieces (Hiscock and Mitchell 1993). A knapping floor can exist as a feature within the context of an open site or archaeological deposit. However there are certain methodological problems in identifying such features arising from post-depositional processes.

- **Shell middens**, which are deposits containing shells occurring somewhere in the open, near a beach or estuary or rocky shoreline, or an inland lake or river (see Meehan 1977). These shells have been accumulated in these deposits by humans exploiting marine resources. Middens may take the form of a thin veneer of shell over the land surface or a thick mound of shell. A subsurface midden layer or horizon (from 1cm in thickness) may occur within mounds or chenier ridges in the Project Area.

- **Stone Arrangements** can range from simple cairns to more elaborate arrangements. Some stone arrangements were used in ceremonial activities and represent sacred or totemic sites. Other stone features were constructed by Aboriginal people as route markers, territory markers, and walls of huts, animal traps, hides, or seed traps.

- **Rock Art sites**, include two main types of rock art, engravings and pounding’s where the pattern is one of relief and the pictures were apparently produced by removing material from the rock surface and drawings, stencils and paintings where the material was added to the rock surface (Clegg: 1983). Bees wax designs are also common in the Project Area.

- **Rock shelter occupation sites**, which contains a deposit of cultural material that has built up over time containing flaked or ground stone artefacts, faunal material and other various items of Aboriginal material culture including ancestral human skeletal remains, wax designs, rock art, grinding hollows, and caches of material culture objects.
• *Contact sites* contain foreign materials, such as glass, ceramics or metal that exhibit modification by Aboriginal people. Alternatively a contact site may be identified by the presence of Macassan or European objects which may be unmodified but are the result of transportation to that locality by Aboriginal people. A contact site may also include rock art depictions of Macassan or European objects or people. Contact sites represent the interface between Aboriginal, Macassan and European peoples during the early forays Northern Territory.

Earthsea consultants use a standard artefact identification methodology informed by a number of sources, including Andrefsky (1998) and Holdaway and Stern (2004) for stone artefacts and Chaloupka (1999) for rock art.

### 3.2. SAMPLING METHODOLOGY

This survey used two sampling strategies in conjunction during the field day:

1. A random stratified sampling strategy to attempt to inspect all land patterns and elements in the Project Areas. All land patterns and elements were inspected to approx 20%, and data collected used to inform the risk assessment process (described below).

2. Purposive sampling to cover as many actual drill hole locations and proposed tracks within the time frame for the field visit. Approx 30% of the total track and drill locations were visited during the field visit.
Earthsea use the following methodology in recording environmental and site data:

1. All proposed drill and track data are projected on a GIS (MapInfo 11.0) along with geo-referenced base topographic mapping, satellite images, vegetation mapping and outcropping rock layers.

2. This project is loaded to a Trimble Nomad data recording GPS along with a set of standard recording forms (using GBM Mobile 6.5, recording forms based on Burke and Smith, 2004). Recording forms include:
   
   2.1. Open site (stone artefact) recording form using polygon and point data.
   
   2.2. Culturally Modified Trees recording basic information including type of scar, type of tree, orientation of scar, height above ground of scar or scars.
   
   2.3. Rock Art recording form
   
   2.4. Isolated Aboriginal artefact recording form;
   
   2.5. Historical site and feature recording form;
   
   2.6. Transect data recording form, including a GPS track of the transect, the visibility, the type of survey and the mode of travel and environmental information
   
   2.7. Area Assessment form, to allow land form elements to be mapped in polygon form along with geographic, geological, geomorphological and vegetation data. This form also records ground visibility and the likelihood of finding sites that were not recorded in the transect process.

3. Images of sites, selected artefacts and environmental views are recorded and cross referenced in the field

4. GBM data is uploaded to the original GIS to enable mapping and assessment of sites for reporting purposes.
3.4. AREA ASSESSMENT AND RISK ANALYSIS PROCESS

Earthsea use a risk analysis approach to analysing the likelihood of undiscovered archaeological sites existing within a project area. This methodology is built on the following assumptions:

1. Archaeological sites are not evenly distributed across the landscape, but are patterned as a result of cultural choices within an environmental framework;

2. Similar environments often contain similar site features. For example, the Mamadewerre Sandstone Formation often erodes to form rock shelters. Rock art is common in these rock shelters across western Arnhem Land. Therefore, project areas with Mamadewerre sandstone are likely to contain rock art sites;

3. It is not practical within the scope of a heritage management survey to inspect every square metre of ground;

4. Whilst all care is taken to locate and record archaeological sites, it is not possible to guarantee that there are no sites within a given area. For example, sites may be below the ground surface, so it is not possible to check for them without breaching various heritage acts.

These assumptions inform the basis for a predictive modelling approach based on past experience by the consultants and on the experience of other consultants and researchers in the NT. For example, a number of past surveys (i.e. Martin-Stone 2005, Cameco King River Archaeological) have shown that there are low numbers of stone artefact sites in northern Arnhem Land coastal sand plain. Therefore, a risk assessment based on this information would involve a random sampling strategy in a project area and then the assessment that there is a low risk of accidental damage to sites where few are likely to exist. The methodology for a survey in such areas would necessarily minimise the transecting of large areas of sand plain, whilst concentrating effort on areas more likely to hold archaeological sites.

The risk assessment and area assessment methodology process is included in the results section below.
4.0. RESULTS

No archaeological sites were located in the Project Area during the field visit. The field consultant found that there were:

1. No rock shelters, precluding the location of rock art sites;

2. Few low sandstone outcrops, minimising the risk of damage to grinding hollows; and,

3. No outcropping stone tool raw materials, such as quartzite, quartz, cherts, greywacke or tuff.
## FIGURE 4: SURVEY AREA AND TRANSECT INFORMATION

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### TABLE 4: EXPLANATION OF FIELDS IN AREA ASSESSMENT PROCESS.

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<td><strong>Land Information</strong></td>
<td>Records information on Land System, Unit, Pattern and Element following Speight, 2009.</td>
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<tr>
<td><strong>Survey Type</strong></td>
<td>Records information on whether the survey was by foot, slow moving vehicle, all terrain vehicle, and aircraft or by assessment (see Methodology Section for explanation). This field also records whether the survey was a reconnaissance, an intensive survey and how much of the area was sampled.</td>
</tr>
<tr>
<td><strong>Boundaries</strong></td>
<td>This field records the geographic accuracy of the observations. GPS means the observer walked around and through the area recording the extent of the area to a GPS track. Estimated means that the observer walked into the area and estimated the extent of the area based on visual estimates of distance and the information available on a hand held field GPS. Map means that the observer identified the area from a map or satellite image after the survey.</td>
</tr>
<tr>
<td><strong>Av Visibility</strong></td>
<td>Means an estimate of the visibility of the ground surface in any particular area. The four values used are high, medium, low and zero. These are usually estimates based on the vegetation in any area. For example, an area with a dense understory so that no part of the ground surface is visible is either a zero or low.</td>
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<tr>
<td><strong>Rock Art</strong></td>
<td>This field records the estimated risk of locating rock art sites in a particular area. Fields can be low, medium, high. An area without rock outcrops would be classified as low. An area where there are numbers of rock outcrops forming rock shelters and overhangs, plus a number of rock art sites have already been recorded would be classified as high risk.</td>
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<tr>
<td><strong>Open Sites</strong></td>
<td>As per rock art, but measuring the risk of locating open site stone artefact sites.</td>
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<td><strong>Sub surface</strong></td>
<td>This field records the risk of sub-surface archaeological materials. This means the likelihood of otherwise undiscovered sub-surface deposits containing archaeological materials. For example, rock shelters with deep sandy/silt deposits are highly likely to have artefactual material in the deposit.</td>
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<tr>
<td><strong>CMT</strong></td>
<td>This field records the risk or likelihood of otherwise undiscovered culturally modified trees existing in an area. For example, some areas of Western Cape York may be classified as high risk for CMTs because there are over 3000 CMTs recorded near Weipa alone.</td>
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<tr>
<td><strong>Cleared low impact</strong></td>
<td>This field records the opinion of the consultant that the risk of finding undiscovered sites in an area is low enough to justify continuing with a low impact mining exploration program without further archaeological survey. Fields are yes or no. Low impact means exploration programs that are based on minimal disturbance of the land surface and vegetation. For example, a rock sampling program based on quad bikes would be considered low impact. RC drill programs based on existing tracks or ‘blade up’ track making would also be considered low impact. High impact would be extensive track making and benching slope to allow for deeper drill rigs.</td>
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<tr>
<td><strong>Cleared mining</strong></td>
<td>This is the same as cleared low impact, but for open cut mining, wide area strip mining or high impact exploration activities. It records that, in the opinion of the consultant, the level of archaeological survey and assessment has been adequate to recommend that no further heritage assessment is required for high levels of land surface disturbance.</td>
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</tbody>
</table>
4.0. ARCHAEOLOGICAL DISCUSSION

The results of this survey are consistent with the surveys conducted in previous years in similar land units (for example, see Guse 2007, 2008, 2009, Martin Stone 200, Collis 2004). These surveys concluded that it is highly unlikely to find sites on sand plain in the Arnhem Land Plateau or in the Arnhem Land coastal plain area (Guse 1999).

5.0. RECOMMENDATIONS

Recommendations arising from the survey include:

1. There is a low risk that the UEL 2012 work program activities will accidentally damage artefacts and sites protected under the NT *Heritage Conservation Act* 1991 in EL24713.

2. Further heritage survey is not required for this area unless greater levels of ground disturbance are planned (i.e. large scale vegetation clearing or mining operations).

3. It is recommended that the Traditional Owner group be kept informed of the work program, and that opportunity for employment and site visitation be made available wherever possible.

4. Route access tracks away from creek margins where possible.
REFERENCE LIST


Collis, A. 2004 Archaeology survey King River Project. An unpublished report to the Northern Land Council by ERM.


Appendix II

Drilling Collars (Text File)

HW_NTLS4_COLL2013S.txt
Appendix III

Drill Logs (Text File)
and UEL Logging Codes

HW_NTDL4_GEO2013S.txt
### Porphyritic Gabbro (SCP) Lava polymictic zone

**Porphyritic**

- **Abbreviation:** SCP (Scoria-Porphyry)
- **Location:** Lavas
- **Description:** Polymictic zone

### Breccia

- **Type:** Breccia
- **Description:** Breccia, polymictic zone
- **Abbreviation:** BRC

### Other Rocks

- **Skarns, undifferentiated**
- **Metamorphic Rocks:**
  - **Gneiss, undifferentiated**
  - **Talc-Dolomite rock**
- **Alteration:**
  - **Carbonatite**
  - **Kimberlite**

### Other Minerals

- **Calcite**
- **Dolomite**
- **Pyrite**
- **Pentlandite**
- **Goethite**

### Other Characteristics

- **Vein:**
  - **Quartz:**
  - **Sulphide:**
- **Vein and selvedge:**

### Logbook Codes

- **LOGGING CODES**
- **MASTER**
- **Specific**

### Other Information

- **Sub-metre scale interbedded sand/silt**
- **Evaporitic rocks, undifferentiated**
- **Fossiliferous sediments**

### Other Uses

- **Calcite Bearing Shale**
- **Calcite Bearing Silt**
- **Calcite Bearing Sand**
- **Sulphidic Shale**
- **Calcite Bearing Siltstone**
- **Calcite Bearing Sandstone**

### Overall Comment

- **Use the COMMENTS column to note actual percentage of veining and mineralisation, note anything unusual, excessive water flows, drilling problems.**
- **Add suffix "&" to denote that extra comments are recorded in the COMMENTS column. You then must use COMMENTS to describe the unusual features of the rock.**

### Rock Description

- **Porphyritic Gabbro (SCP) Lava polymictic zone**
  - **Abbreviation:** SCP (Scoria-Porphyry)
  - **Location:** Lavas
  - **Description:** Polymictic zone
  - **Porphyritic**

### Petrographic Rocks

- **Porphyritic Gabbro (SCP) Lava polymictic zone**
  - **Abbreviation:** SCP (Scoria-Porphyry)
  - **Location:** Lavas
  - **Description:** Polymictic zone

### Petrographic Characteristics

- **Porphyritic Gabbro (SCP) Lava polymictic zone**
  - **Abbreviation:** SCP (Scoria-Porphyry)
  - **Location:** Lavas
  - **Description:** Polymictic zone

### Petrographic Features

- **Porphyritic Gabbro (SCP) Lava polymictic zone**
  - **Abbreviation:** SCP (Scoria-Porphyry)
  - **Location:** Lavas
  - **Description:** Polymictic zone

### Petrographic Analysis

- **Porphyritic Gabbro (SCP) Lava polymictic zone**
  - **Abbreviation:** SCP (Scoria-Porphyry)
  - **Location:** Lavas
  - **Description:** Polymictic zone

### Petrographic Summary

- **Porphyritic Gabbro (SCP) Lava polymictic zone**
  - **Abbreviation:** SCP (Scoria-Porphyry)
  - **Location:** Lavas
  - **Description:** Polymictic zone

### Petrographic Notes

- **Porphyritic Gabbro (SCP) Lava polymictic zone**
  - **Abbreviation:** SCP (Scoria-Porphyry)
  - **Location:** Lavas
  - **Description:** Polymictic zone

### Petrographic Observations

- **Porphyritic Gabbro (SCP) Lava polymictic zone**
  - **Abbreviation:** SCP (Scoria-Porphyry)
  - **Location:** Lavas
  - **Description:** Polymictic zone

### Petrographic Evaluation

- **Porphyritic Gabbro (SCP) Lava polymictic zone**
  - **Abbreviation:** SCP (Scoria-Porphyry)
  - **Location:** Lavas
  - **Description:** Polymictic zone

### Petrographic Interpretation

- **Porphyritic Gabbro (SCP) Lava polymictic zone**
  - **Abbreviation:** SCP (Scoria-Porphyry)
  - **Location:** Lavas
  - **Description:** Polymictic zone

### Petrographic Results

- **Porphyritic Gabbro (SCP) Lava polymictic zone**
  - **Abbreviation:** SCP (Scoria-Porphyry)
  - **Location:** Lavas
  - **Description:** Polymictic zone

### Petrographic Findings

- **Porphyritic Gabbro (SCP) Lava polymictic zone**
  - **Abbreviation:** SCP (Scoria-Porphyry)
  - **Location:** Lavas
  - **Description:** Polymictic zone

### Petrographic Analysis

- **Porphyritic Gabbro (SCP) Lava polymictic zone**
  - **Abbreviation:** SCP (Scoria-Porphyry)
  - **Location:** Lavas
  - **Description:** Polymictic zone

### Petrographic Attributes

- **Porphyritic Gabbro (SCP) Lava polymictic zone**
  - **Abbreviation:** SCP (Scoria-Porphyry)
  - **Location:** Lavas
  - **Description:** Polymictic zone

### Petrographic Characteristics

- **Porphyritic Gabbro (SCP) Lava polymictic zone**
  - **Abbreviation:** SCP (Scoria-Porphyry)
  - **Location:** Lavas
  - **Description:** Polymictic zone

### Petrographic Features

- **Porphyritic Gabbro (SCP) Lava polymictic zone**
  - **Abbreviation:** SCP (Scoria-Porphyry)
  - **Location:** Lavas
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### Petrographic Observations

- **Porphyritic Gabbro (SCP) Lava polymictic zone**
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  - **Location:** Lavas
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### Petrographic Evaluation

- **Porphyritic Gabbro (SCP) Lava polymictic zone**
  - **Abbreviation:** SCP (Scoria-Porphyry)
  - **Location:** Lavas
  - **Description:** Polymictic zone

### Petrographic Results

- **Porphyritic Gabbro (SCP) Lava polymictic zone**
  - **Abbreviation:** SCP (Scoria-Porphyry)
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  - **Description:** Polymictic zone

### Petrographic Findings

- **Porphyritic Gabbro (SCP) Lava polymictic zone**
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### Petrographic Analysis

- **Porphyritic Gabbro (SCP) Lava polymictic zone**
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  - **Location:** Lavas
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### Petrographic Attributes

- **Porphyritic Gabbro (SCP) Lava polymictic zone**
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### Petrographic Characteristics

- **Porphyritic Gabbro (SCP) Lava polymictic zone**
  - **Abbreviation:** SCP (Scoria-Porphyry)
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  - **Description:** Polymictic zone

### Petrographic Features

- **Porphyritic Gabbro (SCP) Lava polymictic zone**
  - **Abbreviation:** SCP (Scoria-Porphyry)
  - **Location:** Lavas
  - **Description:** Polymictic zone
Appendix IV

NTEL Assay Report (Text File)

HW_NTDG4_ASS2013S.txt
Appendix V

Petrology Report
MINERALOGICAL REPORT No. 10183
by Alan C. Purvis, PhD

September 13th, 2012

TO: Brendan Reed
    Senior Geologist
    Uranium Equities Ltd
    Level 5, 29 King William Street
    ADELAIDE SA 5000

YOUR REFERENCE: Order No. TBA

MATERIAL: RC Rock chips (Arnhem Land Plateau, NT)

IDENTIFICATION: HRC-002, 23-50m
                HRC-002, 50-75m

WORK REQUESTED: Section preparation, description and report.

SAMPLES & SECTIONS: Returned to you with hard copy of this report.

DIGITAL COPY: Emailed 13/9/12 to:
               <brendan.reed@uel.com.au>

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PONTIFEX & ASSOCIATES PTY. LTD.
SUMMARY COMMENTS

This report describes two RC chip samples from the Katherine River Group, Arnhem Land Plateau, Northern Territory. These are labelled HRC-002, 23-50m and HRC-002, 50-75m and were examined in polished thin sections embedded in epoxy, to identify the minor opaque minerals as well as the host rocks. The offcuts were stained with HF and sodium cobaltinitrite which revealed abundant K-feldspar with a yellow stain.

The petrography identifies chips in both samples as altered quartz-dolerite, with well preserved primary crystalline textures, (rather than amphibolites, as questioned in your notes, which may have a similar mineralogy, but which would have metamorphic textures and in this area would be expected to occur in basement. The shallower sample has extensive red earthy hematite alteration of ex-plagioclase together with K-feldspar-chlorite-anatase “hydrothermal” alteration (which occurs in both samples). The deeper sample contains minor pyrite as well as the K-spar-chlorite-sericite-carbonate-limonite alteration.

In this area, these samples seem likely to represent altered Oenpelli Dolerite. (Red K-spar alteration is also known in altered basalts within the Katherine River Group in Arnhem Land, but is less common in dolerites.)
### INDIVIDUAL DESCRIPTIONS

| HRC-002, 23-50m | Primary quartz-dolerite, with (hydrothermal) altered/replacement by K-feldspar > chlorite-hematite and local anatase. |

**Field Note:** *Hematite-altered possible para-amphibolite*

**Hand Specimen**

This sample has three chips with abundant K-feldspar as seen on the stained offcut.

**Thin Section**

These chips have a well preserved, classic primary (micro)-doleritic texture, dominated by random interlocking former feldspar laths (50-55%) to 3mm long, altered variously to K-spar and red earthy hematite ± chlorite. Abundant chlorite also replace former ophitic pyroxene, typically between plagioclase laths of uncertain grainsize, possibly 5mm in diameter. About 7-8% interstitial late magmatic quartz is scattered, to 1,5mm long, (indicating quartz-dolerite) also diagnostic associated crystals of apatite in quartz and in chlorite. The quartz rarely forms graphic intergrowths with K-feldspar. About 5% Fe-Ti opaque oxide crystals are typically scattered and partly altered to anatase.

This sample represents former quartz dolerite, with K-spar-chlorite-hematite-anatase alteration representing oxidised K-rich fluids.
Figs 1 & 2

HRC-002, 23-50m

Thin section (TS), Fig 1: Plane polarised light (PPL) and Fig 2: Crossed nicols (Xnic). Magnification (x20). Altered dolerite showing random hematite-stained K-spar ex-plagioclase laths, chloritised mafic grains (with subophitic texture), clear quartz, black Fe-Ti opaque oxide crystals and a white needle of apatite (lower right) cutting oxide.
Figs 3 & 4  

HRC-002, 23-50m

TS. Fig 3: PPL. Fig 4: Xnic. (x20). Another area of altered dolerite with primary random plagioclase laths altered to secondary k-spar, lesser hematite and minor chlorite. Abundant green chlorite replacing ex-pyroxene, black opaque oxide, quartz and sparse apatite.
HRC-002, 50-75m  Quartz-dolerite, with rare preserved primary hornblende and more extensive alteration to secondary K-spar-chlorite-sericite-carbonate-pyrite-limonite.

Field Note:  *Amphibolite with moderate chlorite alteration*

Hand Specimen

These chips contain chlorite and K-feldspar, (which is emphasised on the stained offcut), but lacks the reddish hematite alteration seen in the above 23-50m sample.

Thin Section

This sample also has a classic primary ophitic/doleritic texture, with abundant (50-55%) former random plagioclase to 2.5mm long altered to K-spar, with sericite-clouded cores, locally with weak limonite staining, and minor chlorite. Abundant chlorite and sparse carbonate replace ex-pyroxene between the feldspars, rarely accompanied by fine primary brown hornblende to 0.3mm in grainsize. Quartz is again scattered interstitially, to 2mm in grainsize (7-8%) and 4-5% Fe-Ti opaque oxide crystals to 0.5mm in size. Accessory apatite needles are locally more than 1mm long. One chip has a patch 4mm x 3mm of secondary interstitial pyrite.

This sample represents quartz dolerite with K-spar-chlorite-sericite alteration.
Figs 5 & 6  

HRC-002, 50-75m

TS, Fig 5: PPL.  Fig 6: Xnic.  (x20) Less oxidised/ altered dolerite with pale pink limonite-sericite-stained K-spar replacing plagioclase, green chlorite ex-mafic grains, black opaque oxide and minor quartz. A needle of apatite is in SW quadrant. Scattered Fe-Ti opaque crystals.
**Fig 7**  
**HRC-002, 50-75m**  

**Fig 8**  
**HRC-002, 50-75m**  
PTS. RPL. (x50). Part of an aggregate of low temperature pyrite, with fractured ilmenite (upper right).